Polygraph

VOLUME 30 2001 NUMBER 1

Contents

Published Quarterly

P.O. Box 8037, Chattanooga, Tennessee 37414-0037

Effects of Spontaneous Countermeasures Used Against the Comparison Question Test

Charles R. Honts[1], Susan L. Amato[2], Anne K. Gordon[3]

Abstract

The frequency and effects of spontaneous countermeasures attempted against a polygraph examination were examined in a mock-crime study of the comparison question test (CQT). Half of the 192 participants enacted a mock crime of theft, were subsequently given a CQT polygraph examination, and were then debriefed concerning their use of spontaneous countermeasures. Overall, 67.7% of the participants reported the use of at least one spontaneous countermeasure. Replicating a recently reported trend in this area, it was found that 45.8% of the innocent participants reported trying at least one countermeasure in an effort to make themselves look more truthful. The use of spontaneous countermeasures had no effect on the deception detection scores of guilty participants, but spontaneous countermeasure use significantly shifted innocent subjects' numerical scores in the negative direction.

Key words: CQT, countermeasures, forensic science, polygraph

Polygraph tests are widely applied in assessing the veracity of criminal suspects, witnesses and job applicants (Honts, 1991; Raskin, Honts, & Kircher, 1997). The results of polygraph tests are sometimes used as evidence in courts of law (Faigman, Kaye, Saks & Sanders, 1997; Honts & Quick, 1994). In all of those settings, errors of classification by a polygraph test can have serious consequences for both the individual and for society. One area of interest, research and debate regarding such errors concerns the effects of countermeasures on the validity of polygraph tests (Honts, 1987).

Countermeasures are anything that a subject does in a deliberate effort to defeat, distort or alter a polygraph test. Some commentators suggest that polygraph countermeasures are easy to apply and are highly effective. Psychologist David Lykken claims to have given information to an Ohio inmate that enabled a number of other inmates to easily beat polygraph examinations administered by prison officials (Lykken, 1998). There are also World Wide Web sites that claim to offer, for a price, effective methods for beating the polygraph (Williams, 2000). Effective countermeasures would pose a significant threat to the continued application of polygraph testing. However, scientific research has not consistently supported the claims made by the countermeasure proponents.

Before discussing the research on polygraph countermeasures it is important to note that there are several different types of polygraph tests, against which, counter-measures may be differentially effective.

[1] Boise State University.
[2] Michigan Technological University.
[3] Bowling Green State University.

Address correspondence to Charles R. Honts, Ph. D., Department of Psychology, Boise State University, 1910 University Drive, Boise, Idaho 83725, or e-mail to Honts@truth.boisestate.edu

The research reported here was supported by the Department of the Navy, Office of Naval Research, Grant # N00014-98-0725. The content of the information does not necessarily reflect the position or the policy of the U. S. Government, and no official endorsement should be inferred.

The test most commonly applied in the criminal justice system in the United States is the comparison question test (CQT; previously known as the control question test; Raskin et al., 1997). The CQT assesses credibility by asking direct accusatory questions known as relevant questions (e.g. Did you take the money from the safe?). The CQT also asks other questions known as comparison questions. Comparison questions are designed to evoke physiological responses from innocent subjects. Comparison questions take the form of either probable lies or known lies (Horowitz, Kircher, Honts, & Raskin, 1997). The rationale of the CQT predicts that guilty subjects will produce larger physiological responses to relevant questions than to comparison questions. Innocent subjects are expected to produce larger physiological responses to comparison questions than to the relevant questions to which they are answering truthfully. Recent research has consistently shown high accuracy rates for the CQT in both laboratory and field settings (Raskin et al., 1997). The two other primary polygraph techniques are the concealed knowledge test (also known as the guilty knowledge test) and the relevant-irrelevant test. Although these tests have important niche applications, their use in the criminal justice system is minimal and they will not be discussed further in this paper. Readers interested in the topics of countermeasures and the concealed knowledge test are referred to Honts, Devitt, Winbush, and Kircher (1996), and for the relevant-irrelevant test see Otter-Henderson, Honts, and Amato (2000).

In order to beat a CQT, a countermeasure must reverse the expected differential reactivity between the relevant and comparison questions. Countermeasures that succeed in either inhibiting all responding, or in creating large responses to all question types will not be effective in producing a false negative outcome with the CQT. Such maneuvers would, at worst, result in an inconclusive outcome.

There have been a number of studies that have examined the effects of countermeasures against the CQT. The scientific research on polygraph counter-measures has reported very different results for subjects who have received specific training in countermeasures versus those who have not. Studies reported by Honts and his colleagues examined the effects of providing subjects with expert training in the use of countermeasures specifically designed to defeat the CQT (Honts, Hodes, & Raskin, 1985; Honts, Raskin, & Kircher, 1987; Honts, Raskin, & Kircher, 1994) and the concealed knowledge test (Honts et al., 1996). In those mock-crime studies, guilty subjects were given expert training and coaching by a research assistant. The training in those studies was designed to model the efforts of hostile intelligence officers trying to beat polygraph tests in order to infiltrate our national security system. Those studies indicated that mental and physical countermeasures were effective in allowing about half of the subjects who received the expert training to beat the CQT or the concealed knowledge test in a laboratory setting. Although these findings have implications for the national security system, it is not clear how they impact the criminal justice system. Providing countermeasure training to a person who was intent on subverting the legal system would be unethical and probably illegal. Presumably, such training is not readily available to criminal defendants (Honts & Perry, 1992). Of much greater concern would seem to be the effects of readily available information and/or spontaneous (untrained) attempts to beat polygraph tests.

Rovner (1986) reported a study that examined the effects of giving subjects information similar to that provided in the Honts et al. studies, but without the expert training. Rovner found no effects of providing detailed information regarding the nature of the CQT and possible countermeasures.

There is only one published study examining the use of spontaneous countermeasures attempted against the CQT (Honts, Raskin, Kircher, & Hodes, 1988). Honts and his colleagues found that although 65% percent of their guilty subjects reported the use of spontaneous countermeasures, such countermeasures were ineffective. None of the deceptive subjects who used spontaneous countermeasures produced a truthful outcome, nor were the inconclusive rates increased. Honts et al. also reported that none of the innocent participants made

any attempt to utilize countermeasures during their examinations.

The use of spontaneous countermeasures by innocent subjects is an important topic. Although research has indicated that trained countermeasures are difficult to detect (Honts & Hodes, 1983), the polygraph profession has traditionally interpreted the judgment of countermeasure use as synonymous with deception (Jayne, 1981). The typical attitude of the polygraph profession is shown in the testimony given by Sgt. Brian D. Reigle of the Ohio State Highway Patrol in *State of Ohio v. Nichols* (1999). Regarding the reasons for countermeasure use Sgt. Reigle stated under sworn testimony:

> **Q**. Now, what does that tell you about he's controlling his breathing, the specific accusation test, but he's also controlling for the numbers test, what does that tell you?
>
> **A.** Tells me that the examinee that I'm testing is employing a countermeasure, which is trying to defeat the results of the polygraph, which is only done for one reason, and that's to cover deception. (p. 415).

However, recent research raises serious questions about a per se assumption that countermeasures are only done for one reason, to cover deception. Otter-Henderson and her colleagues have recently reported that a substantial number (30%) of the innocent subjects in a mock-employment study of the relevant-irrelevant test attempted a spontaneous countermeasure (Otter-Henderson, Honts, & Amato, 2000). That finding is in sharp contrast to the earlier finding by Honts and his colleagues (1988) who reported no spontaneous countermeasure use by their innocent subjects. It is not known whether the Otter-Henderson et al. results represent a new trend in subject behavior or whether their results are limited to the relevant-irrelevant test and/or screening settings. The present study examined the effects of spontaneous countermeasures against the CQT in an effort to replicate the earlier work by Honts and his colleagues and to examine the frequency and effects of the use of spontaneous countermeasures by innocent subjects of CQT polygraph examinations. The data for the present report were collected from subjects who participated in a larger study that was conducted for other purposes (Honts, Amato, & Gordon, 2000).

Method

Participants

One hundred and ninety two individuals (111 female, 81 male) were recruited via help-wanted ads run in the local newspaper. The ad specified an hourly wage of $15 for approximately 2 1/2 hours of participation in a polygraph research study. Individuals who were currently taking prescription medication for high blood pressure, a heart condition, or to treat a psychological disorder or had previously taken a polygraph examination were deemed ineligible for participation in the study. Those who met the selection criteria were randomly assigned to one of eight experimental conditions of equal size. Participants ranged in age from 18 to 65 (M = 30, SD = 10.5).

Examiners

An experienced (22 years in practice) polygraph examiner used reference materials provided by the Department of Defense Polygraph Institute (DoDPI) to train three women, none of whom was a practicing polygraph examiner, to conduct polygraph examinations. Two of the examiners held the Ph. D. degree in Psychology, the third was an undergraduate research assistant. The goal of the training was that the examinations should follow field procedures as closely as possible. As a quality control procedure, all polygraph examinations were videotaped. Throughout the experiment, sample examinations were randomly reviewed by the supervising examiner to make sure that the examinations were being conducted properly. The polygraph examiner and the assistants who greeted the participants were unaware, at all times, of the participants' assignment to conditions.

Apparatus

Physiological data were collected with a CPSLab unit (Raskin & Kircher, 1989). The following physiological responses were monitored: Thoracic and abdominal respiration were monitored with strain gauges; electrodermal response was measured from

Ag/AgCl electrodes placed on the distal surface of the subjects' ring and index fingers of the right hand; relative blood pressure was monitored from a cuff placed on the subjects' upper left arm; and peripheral blood flow was monitored with a photoelectric plethysmograph placed on the distal surface of the subject's right thumb. Instrumentation filtering and sampling was modeled after field instrumentation procedures as closely as possible given the constraints of the equipment.

Design

The design of the parent study (Honts et al., 2000) was a 2 (Guilty, Innocent) X 2 (Outside Issue Present, Absent) X 2 (Outside Issue Question Present, Absent) between-subjects factorial. Subjects were randomly assigned to eight conditions with the constraint that each condition would be considered to be complete when 24 subjects had been run in that condition. Initial statistical analyses were conducted with Countermeasure Use included as a grouping variable in the parent design. There were no significant interactions involving Outside Issue or Outside Issue Question. Moreover, only the Guilt/Innocence manipulation is of interest for the present analysis and discussion. In the remainder of this paper, only the Guilty/Innocence manipulation is described.

Procedure

The design was implemented using a variation of the mock-crime paradigm developed at the University of Utah (e.g., Podlesny & Raskin, 1978). Upon arriving at the Applied Cognition Research Institute, participants were directed to a room where they privately watched a video and followed along with a written script. This script/video stated that their participation in the study might involve stealing some money. However, regardless of their assigned condition, they would take a polygraph examination during which they were to try to convince a polygraph examiner that they were responding truthfully to the questions. If they agreed to the described conditions of the study, participants signed an informed consent. After their consent was obtained, participants received a sealed envelope that contained instructions for watching another video that would describe their condition assignment and instructions for carrying out their task. At the beginning of the study, 192 envelopes were prepared containing descriptions of the eight conditions in the parent study. Those unmarked envelopes were sealed and were then shuffled. The research assistant picked an envelope at random for each subject and thus achieved random assignment to conditions for the participants of the study.

Some participants (Innocent) were shown a video informing them of their assignment to the innocent condition where they would not steal any money during the study. These participants were told that they would be paid a $1 bonus if they successfully convinced the polygraph examiner that they were innocent of stealing $1 from the Education Building. Innocent participants were instructed to leave the laboratory building and go to the Education Building (that houses the Psychology Department), where they were to deliver an envelope to Dr. Honts' office door and then return to the laboratory 20 minutes later to take a polygraph examination. The remainder of the subjects (Guilty) were shown a video that instructed them to go to the Education Building, go to Room 620 and to remove an envelope addressed to Sam Stone from the door. They were told to return to the laboratory 20 minutes later to take a polygraph examination about the theft of the envelope. Guilty subjects were told that if they passed their polygraph examination they would be paid a $1 bonus. Half of the innocent and half of the guilty subjects committed a second theft (the outside issue) about which they were never questioned or tested.

Upon returning to the laboratory, an assistant introduced the participants to the polygraph examiner. The examiner reminded participants that their polygraph examination would be videotaped and that the purpose of the examination was to identify the person who had stolen an envelope containing $1 from the door of Dr. Honts' office in the Education Building earlier that day. Examination sessions began with the examiner collecting some general information from the participant concerning things such as the participant's general health, how well he/she had slept the night before, whether he/she had ever taken a polygraph exam, etc.

Participants were then told that they were a suspect in the theft of $1 from the Education Building and were asked if they had stolen the envelope containing the money. After participants denied the accusation, the examiner asked them to explain where they had been and what they had been doing for approximately the last two hours.

After the subjects' statements, the examiner briefly discussed the nature of the autonomic nervous system (e.g., that although individuals are largely able to control their motor behavior, many functions of the body, such as temperature regulation, heart rate, and breathing are largely uncontrollable and vary automatically in response to physical and psychological stressors, such as lying). Next, the function of each sensor was described to participants, and participants were told to expect that, due to the pressure applied from the blood pressure cuff, they might experience a tingling sensation in and/or some discoloration of the arm on which the blood pressure cuff was placed. At this point, participants were asked to sign another informed consent form giving permission for the conduct of the polygraph examination.

Next, participants were told that a practice test would be conducted before the actual polygraph examination concerning the theft. The practice test was introduced as being necessary for establishing participants' unique physiological reactions to lying. Participants were told to pick a number between 2 and 6 and inform the examiner of the number that was chosen. It was explained that after the sensors were attached to the participant a series of questions would be posed, beginning with "Concerning the number that you chose, was it the number 1?" and continuing through to number 7. Participants were instructed to answer "no" to each of the seven questions, so that during the asking of the question regarding the number that was selected (and hence their deception was known) their unique physiological responses to lying could be identified. Although the information developed from the practice test (also referred to as a stimulation test) is not used in the assessment of credibility it has been associated with higher accuracy rates in some research (e. g., Bradley & Janisse, 1981).

Participants then were asked to wash their hands (so that the best possible recordings from the sensors could be obtained). At this point, the sensors were attached, and the practice test was conducted. All participants were told that the polygraph revealed a highly distinct change in their physiological responses on the question to which they lied. Hence, the participant was ideally suited for assessment with a polygraph examination.

Next, each of the test questions was reviewed with the participant. As the examiner read each question, the participant was instructed to answer with a "yes" or "no" just as they would during the actual examination. All participants were asked a CQT series containing 3 relevant questions, 3 comparison questions, and some filler questions. The question pattern was similar to the CQT used by the U. S. Government polygraph examiners. After all of the questions were reviewed and responded to by the participants, a comparison question test was conducted according to standard procedures used by the U. S. Federal polygraph examiners.

After the examination was completed, participants received a thorough debriefing by an assistant, during which they were told about the outcome of their examination (i.e., whether their responses were scored as truthful or deceptive) and the various conditions that were being compared as part of the study. During the debriefing, participants were asked to describe any countermeasures that they used during their polygraph examinations. Finally, participants were thanked and paid for their participation.

Countermeasure responses were coded into one of four classifications: None, Altered Breathing, Mental, Physical. The Mental classification included maneuvers such as rationalization (e.g., I did not steal the $1, I was told to take it as part of a study.) and disassociation (e.g. The subject imagined themselves as not being in the testing room.). Physical countermeasures were anything that involved a physical act, other than altered breathing. Although it is clearly a physical countermeasure, altered breathing was treated as a separate category, partly because of historical precedent (Honts, et al., 1988) and

partly because respiration is the one polygraph measure that is under some direct voluntary control, and should thus be a likely target for spontaneous attempts to control the physiology.

The physiological data from the examinations were printed on paper charts and were evaluated independently by three Department of Defense Polygraph Institute (DoDPI) instructors using the numerical scoring system taught at DoDPI (Swinford, 1999; Weaver, 1980). Those instructors also made an assessment on a 7-point scale (1=not likely at all) regarding the likelihood of countermeasure use.

Results

Frequency of Spontaneous Countermeasure Attempts

A breakdown of the frequency of countermeasure attempts is given in Table 1. The frequency of spontaneous countermeasure attempts was high, 67.7% (130 of 192) reported using one or more countermeasures during their CQT polygraph examinations. Among those subjects reporting countermeasure use, 55.4% (72 of 130) reported attempting more than one countermeasure. Among the guilty subjects 89.6% (86 of 96) reported the use of one or more spontaneous countermeasures. Among the innocent subjects, 45.8% (44 of 96) reported the use of one or more spontaneous countermeasures. Mental maneuvers were the most frequently reported spontaneous countermeasure while physical countermeasure attempts were rare.

Detection of Spontaneous Countermeasures

The DoDPI instructors were asked to make assessments of the likelihood (on a 7-point scale) that each of the subjects had engaged in countermeasure use at some time during the examination. Those scale values were correlated with a countermeasure use vector (coded: 0 = no countermeasures, 1 = countermeasures attempted) and with each other. Although significant, the inter-rater agreement between the DoDPI instructors about when countermeasures were used was very poor, average inter-rater correlation, $\underline{r}$ = .27, $\underline{p} < .001$. However, none of the DoDPI evaluators detected countermeasure use at better than chance levels. The average predictive correlation was $\underline{r} = -.01$, ns.

Table 1
Frequency and type of Spontaneous Countermeasure Attempts.

	Frequency		
Type of Countermeasure	Innocent	Guilty	All Subjects
None	44	10	54
Altered Breathing	24	37	61
Mental	49	97	146
Physical	10	10	20

Note: Many subjects (55.4%) reported using more than one countermeasure. Multiple countermeasure use occurred both within and across countermeasure categories. Thus, the totals in Table 1 can be larger than the total number of subjects in each category.

In order to explore the practical impact of making a countermeasure decision, the scalar scores generated by the DoDPI examiners were converted to decisions with the following rule. Scale values of 4 on the 7-point scale were considered to be inconclusive. Scale values less than 4 were considered as a decision of No Countermeasure Use. Scale values of more than 4 were considered as a decision of Countermeasures Used. Not surprisingly, none of the evaluators' decisions were significantly associated with actual countermeasure use. However, the three evaluators made a combined total of 44 decisions of countermeasures used. This indicates that most countermeasures were

undetected, as there would have been a possibility of 414 correct decisions by the three evaluators had every countermeasure been detected with no false positive errors. Breaking those decisions down by Innocence/Guilty reveals that 47.7% of the decisions that countermeasures had been used were made with Innocent subjects. Had decisions of countermeasure use been interpreted as indicative of attempted deception to the relevant questions of the examination, almost half of those decisions would have been false positive errors.

Effects of Spontaneous Countermeasures

The impact of spontaneous countermeasure use was initially examined by correlating the presence/absence of countermeasures use (coded 0 = No Countermeasures, 1 = Countermeasures Used) with the numerical scores generated by the DoDPI evaluators. To examine possible differential effects of countermeasures on Innocent and Guilty subjects, separate correlations were conducted for those two conditions. For Guilty subjects, none of the examiners showed a significant relationship between actual countermeasure use and total numerical score, average $\underline{r}$ = -.15, ns. For innocent subjects, all of the examiners showed a significant negative relationship between spontaneous countermeasure use and their numerical scores, average $\underline{r}$ = -.43, $\underline{p} < .01$. The numerical scores for Innocent subjects were further examined with a repeated measures ANOVA. The model for that analysis included Examiner (3 levels) as a within-subjects factor and Countermeasure Use as a between subjects factor. That analysis revealed several significant effects. The following analyses involving the within-subject factor, Examiner, were Greenhouse-Geisser adjusted for violations of the assumption of sphericity. There was a significant, but uninteresting, main effect for Examiner, $\underline{F}(1.84, 173.4) = 6.55$, $\underline{p} = .002$. There was also a difficult to interpret interaction of Examiner and Countermeasure Use, $\underline{F}(1.844, 173.4) = 5.00$, $\underline{p} = .009$. Of interest, was a significant and large main effect of Countermeasure Use, $\underline{F}(1, 94) = 24.21$, $\underline{p} < .001$. The main effect of Countermeasure Use indexed a significant difference in total numerical scores between innocent subjects who did not use countermeasures ($\underline{M}$ = 4.55) and those who did use countermeasures ($\underline{M}$ = -3.91). Thus the use of spontaneous countermeasures was detrimental to Innocent subjects, moving them significantly in the direction of a deceptive decision.

Demographic Variables

In an effort to see if spontaneous countermeasure use was related to any demographic variables, several analyses were conducted. Spontaneous countermeasure use was not related to, age of the participant ($\underline{r}$ = .001, ns), sex of the participant($\underline{r}$ = .042, ns), nor to the number of years of education reported by the participant ($\underline{r}$ = .082, ns.)

Discussion

The results of this study, along with those of Honts et al. (1988), and of Otter-Henderson et al. (2000) strongly suggest that the use of spontaneous countermeasures by deceptive participants does not affect polygraph examination outcomes. However, this study, unlike Honts et al., (1988) found that a substantial number of truthful subjects (45.8%) tried to "appear more innocent" through the use of spontaneous countermeasures. The finding that a substantial number of innocent subjects were engaging in spontaneous countermeasures replicates and extends Otter-Henderson et al.'s (2000) results with the relevant/irrelevant test to the comparison question test. However, unlike the results of Otter-Henderson et al., spontaneous countermeasures in this study did have a significant impact on the innocent subjects who used them. Unfortunately, for the Innocent subjects who attempted countermeasures, their maneuvers moved their numerical scores in the deceptive rather than in the truthful direction.

The present study also examined the ability of highly trained polygraph examiners to detect the use of countermeasures. The results of this study indicate that they cannot detect the use of spontaneous countermeasures. Their ratings of the likelihood of countermeasure use were generally unreliable and were not associated with actual countermeasure use at better than chance levels. Field polygraph examiners generally appear to operate under the notion that a

detection of countermeasure attempts is synonymous with attempted deception to the relevant questions of the examination (Jayne, 1981). Clearly, that notion is incorrect. The results of this study show that an examiner's decision of countermeasure use is unrelated to both countermeasure use, and to deception. Our analyses indicated that almost half of the subjects judged to be using countermeasures were in fact Innocent subjects. These results strongly suggest that the field practice of equating countermeasure attempts with deception to the relevant issues of an examination should be abandoned.

These results are supportive of the continued use of polygraph tests in applied settings. Despite the widespread availability of information concerning countermeasures, laypersons appear to be either unaware of such information or they are unable to make effective use of it. To date, the only demonstrated threat posed by countermeasures occurs when subjects receive hands-on training from an expert (Honts, 1987). End users of polygraph examinations should weigh the probability that any given subject had access to, and did benefit him- or herself of expert training in the use of countermeasures. If the probability of access or acquisition is low, then the likelihood of countermeasure impacts on guilty subjects appears minimal. Innocent persons considering the use of countermeasures in an effort to enhance their chances of passing should be cautioned that their efforts are likely to be counterproductive.

References

Bradley, M. T, & Janisse, M. P. (1981). Accuracy demonstrations, threat, and the detection of deception: Cardiovascular, electrodermal, and pupillary measures. *Psychophysiology*, 18, 307-315.

Faigman, D. L., Kaye, D. H., Saks, M. J., & Sanders, J. (1997). Legal issues. In, D. L. Faigman, D. Kaye, M. J. Saks, & J. Sanders (Eds.) *Modern scientific evidence: The law and science of expert testimony* (pp. 554-564).

Honts, C. R. (1987). Interpreting research on countermeasures and the physiological detection of deception. *Journal of Police Science and Administration*, 15, 204-209.

Honts, C. R., (1991). The emperor's new clothes: Application of polygraph tests in the American workplace. *Forensic Reports*, 4, 91-116.

Honts, C. R., Amato, S., Gordon, A. (2000). Validity of outside-issue questions in the control question test: Final report on grant no. N00014-98-1-0725. Applied Cognition Research Institute, Boise State University.

Honts, C. R., Devitt, M. K., Winbush, M., & Kircher, J. C. (1996). Mental and physical countermeasures reduce the accuracy of the concealed knowledge test. *Psychophysiology*, 33, 84-92.

Honts C. R., Hodes R. L. (1983). The detection of physical countermeasures. *Polygraph*, 12, 7-17.

Honts, C. R., Hodes, R. L., & Raskin, D. C. (1985). Effects of physical countermeasures on the physiological detection of deception. *Journal of Applied Psychology*, 70, 177-187.

Honts, C. R. & Quick, B. D., (1995). The polygraph in 1995: Progress in science and the law. *North Dakota Law Review*, 71, 987-1020.

Honts, C. R., & Perry, M. V. (1992). Polygraph admissibility: Changes and challenges. *Law and Human Behavior*, 16, 357-379.

Honts, C. R., Raskin, D. C., & Kircher, J. C. (1987). Effects of physical countermeasures and their electromyographic detection during polygraph tests for deception. *Journal of Psychophysiology*, 1, 241-247.

Honts, C. R., Raskin, D. C., & Kircher, J. C. (1994). Mental and physical countermeasures reduce the accuracy of polygraph tests. *Journal of Applied Psychology*, 79, 252-259.

Honts C. R., Raskin D. C., Kircher J. C., & Hodes R. L. (1988). Effects of spontaneous countermeasures on the physiological detection of deception. *Journal of Police Science and Administration*, 16, 91-94.

Horowitz, S. W., Kircher, J. C., Honts, C. R., & Raskin, D. C. (1997). The role of comparison questions in physiological detection of deception. *Psychophysiology*, 34, 108-115.

Jayne B. (1981). Purposeful non-cooperation: A diagnostic opinion of deception. *Polygraph*, 10, 156-174.

Kircher, J. C., Raskin, D. C. (1989). *Computerized Polygraph System-Laboratory.* Salt Lake City: Scientific Assessment Technologies.

Lykken, D. T. (1998). *A tremor in the blood: Uses and abuses of the lie detector.* New York: Plenum Trade.

Otter-Henderson, K., Honts, C. R., & Amato, S. L. (2000). Spontaneous countermeasures during polygraph examinations: An apparent exercise in futility. Manuscript accepted for publication pending revision.

Podlesny, J. A., & Raskin, D. C. (1978). Effectiveness of techniques and physiological measures in the detection of deception. *Psychophysiology*, 15, 344-358.

Raskin, D. C., Honts, C. R., & Kircher, J. C. (1997). The scientific status of research on polygraph techniques: The case for polygraph tests. Chapter in, D. L. Faigman, D. Kaye, M. J. Saks, & J. Sanders (Eds.) *Modern scientific evidence: The law and science of expert testimony* (pp. 565-582).

Rovner, L. I. (1986). The accuracy of physiological detection of deception for subjects with prior knowledge. *Polygraph*, 15, 1-39.

State of Ohio v. Arnold Nichols (1999). Sworn testimony of Sgt. Brian D. Reigle in, Case No. 95-CR-07-4299. Official transcript of trial testimony, Columbus, Ohio, August 23.

Swinford, J. (1999). Manually scoring polygraph charts utilizing the seven-position numerical analysis scale at the Department of Defense Polygraph Institute. *Polygraph*, 28, 10-27.

Weaver, R. S. (1980). The numerical evaluation of polygraph charts: Evolution and comparison of three major systems. *Polygraph*, 9, 94-108.

Williams, D. *How to sting the polygraph.* Available online: http://www.polygraph.com/stin1.html.

Polygraph Examination Issues in New Jersey Prisons

Trinidad Pena & Jeffrey Poling

Key words: informants, inmates, prison

Investigators in traditional law enforcement are given the task of solving multitudes of crimes. They do jobs such as collecting evidence and interviewing suspects and witnesses. Often they rely on informants or witnesses whose identity cannot be revealed until such time as a suspect is put in custody. Otherwise, the suspect may prey on those giving information to the investigators.

Imagine that when you went to collect a piece of evidence and everyone in town knew you had gone to the crime scene and took something away. Imagine you need to talk to an informant or witness and the only way to meet the subject is to call for him over loud speakers where everybody knows he is being summoned. Better yet, imagine being stopped at the town limit and having your polygraph checked at a gate before you can bring it in to town. These are some of the obstacles that investigators in a prison have to overcome.

In the State of New Jersey, the job of investigating crimes within the state prison system is handled by the New Jersey Department of Corrections' Special Investigations Division. New Jersey has 14 state prisons with a combined inmate population of over 30,000. The Special Investigations Division is also responsible for conducting internal investigations on a correctional staff that numbers over 6,000.

One can certainly draw some similarities between cities or towns and prisons. Both cities and prisons have populations. Cities have streets and neighborhoods; prisons have housing wings and tiers. Policeman in cities patrol their neighborhoods, corrections officers patrol their housing units. Cities have an administrative leader called a mayor, in prisons there are administrators or wardens. Both cities and prisons have hospitals, libraries, churches, and a place to buy goods. And of course, both have crime and need investigators to help solve these crimes. The main difference, and probably most obvious, is that cities are not surrounded by thirty-foot cement walls topped with razor wire. Also, a city's number of criminals is usually a small percentage of the population. In prison everybody who lives there is a criminal.

As one can imagine, everything that comes in and out of a prison is scrutinized. This is a security necessity to ensure that drugs and weapons do not get in and that inmates do not get out. Movements within a prison are controlled, and there is no unfettered access to any area. As mentioned in the beginning of the article, these are some of the restrictions that traditional law enforcement does not face. Investigators with the Special Investigations Division are not exempt from these restrictions and must find ways to achieve investigative success by working within the system.

The public has the misconception that prisons are crime free environments. People believe that criminals are sent to prison to subdue their anti-social behavior. Once a criminal goes to jail, it does not mean that he has stopped committing crimes. He has to adapt to a new environment, and then pick up where he left off on the streets. Accordingly,

This student paper was submitted as a partial requirement for graduation from the Maryland Institute of Criminal Justice. For reprints, contact the authors at: East Jersey State Prison, Special Investigations Division, Lock Bag R, Rahway, NJ 07065.

any crime that occurs on the street can occur in a prison environment. It is important to point out that in addition to state and federal criminal violations, there is also a disciplinary code that all inmates must adhere to. Violations of the disciplinary code are investigated the same as state or federal criminal violations. Inmates who are found guilty of any of these infractions are subject to punitive action by the Department.

The use of the polygraph by the Special Investigations Division has proven to be invaluable in helping to solve a multitude of these crimes and infractions. The NJ Department of Corrections for over 17 years has utilized polygraph. Its use is authorized by statute through New Jersey Administrative Code 10A. There are also written polices and procedures used within the Special Investigations Division.

Any request for a polygraph examination must be requested through the chief executive officer (Administrator) of a given prison and submitted to the Special Investigations Division. Polygraph examinations can be requested when there are issues of credibility regarding serious incidents or allegations which may result in disciplinary action or as part of a reinvestigation of a disciplinary charge where new evidence is being presented or additional allegations of credibility arise.

The polygraph is not used in place of a thorough investigation but is used to assist in an investigation when appropriate. Agreement by an inmate to take a polygraph examination is not a pre-condition for ordering a reinvestigation. Also, an inmate's request for a polygraph examination is not sufficient cause for granting the request.

Polygraph examiners in the Special Investigations Division are faced with a number of problems when preparing for and conducting an examination. First, there are certain issues or crimes that occur in a prison which traditional law enforcement does not face. Escapes and riots are not street-level crimes that occur regularly on the outside. Weapons possession and special-issue tests are especially prevalent in prison. Dealing with individuals who have lengthy criminal histories and a skewed sense of right and wrong requires special considerations in all phases of a polygraph examination.

In the pretest interview the investigator has the opportunity to view an inmate's history from a "classification" folder. This contains the subject's criminal history, family history and prison history. The investigator is also able to access an inmate's medical and psychological history. This aids in collecting and verifying biographical information.

Question formulation has to be developed carefully, especially when non-traditional crimes such as escape and rioting are the relevant issues. The relevant questions use lying as the basis for formulation. An examiner will ask an inmate "Did you lie about whether you made plans to escape?" or "Did you lie about planning a riot?" The structure of these questions, using lying as the relevant issue, is crucial when it comes to formulating the probable-lie comparison questions.

An investigator cannot ask an inmate comparison questions with subject content that is similar in nature to offenses, like escape and rioting. There is just nothing that coincides. That is why using "lie" relevant questions are the key. Principal Investigator Michael Mancuso, head of the Special Investigations Division Polygraph Unit, states that using a comparison question such as "Prior to the year 2000, have you ever told a lie to get another inmate in trouble?" is an excellent comparison question used often. Few inmates would never admit that they "ratted" or "snitched" on another inmate. In actuality, inmates get each other in trouble all the time, which makes this comparison question a good known lie. Another excellent example of comparison questions given by Investigator Mancuso is "Prior to the year 2000, have you ever lied to a corrections officer or investigator?" Mancuso indicated that very few inmates would admit to lying to a staff member. Lying to a staff member is a violation of the disciplinary code and can result in punitive active. Anyone who works in a prison is well aware that inmates lie to everyone about everything. Again, this allows the question to be a known lie and similar in nature to the relevant issue.

Principal Investigator Mancuso indicated that the Special Investigations Division uses primarily Modified General Question Technique (MGQT) and Modified Zone Comparison Technique (MZCT) testing formats. Peak of Tension tests are certainly applicable, given favorable circumstances. Examiners are required to have another Senior Investigator/Examiner review a set of charts for quality control.

The next, and probably most important issues that prison investigators face when conducting polygraph examinations are testing environments and confidentiality. In a prison environment these two elements are invariably linked. When an investigator walks into a prison with his instrument he must go through a number of security checkpoints. There are no designated polygraph examination rooms. An empty office or room is all an examiner can hope for in terms of a testing environment. Officers will know what the investigator is coming into the prison for, and where he is going. There is no way to "sneak" a polygraph into a prison.

Confidentiality of the test is always a concern when the examination is given in a prison. Again, the investigator cannot get into the prison with his instrument without being noticed and checked. When the investigator arrives at his designated testing location, the inmate who is taking the test has to be brought to that area. Obviously, inmates are not allowed to move about the prison unannounced. Inmates go through a series of security check-points where they are questioned by staff as to where they are going and who sent for them. More importantly, other inmates may begin to wonder where that inmate is headed to, and why. If an investigator with an instrument arrives at a location in the prison, and five minutes later an inmate arrives at the same location, inmates and staff will begin to put the pieces together. The first question that comes to most inmates' minds, and possibly staff, is "Who is that inmate telling on, and is he telling on me?"

It is in these scenarios where investigators must use ingenuity and experience to maintain confidentiality. An inmate may be transported out of the prison under false pretenses to a location where an examination can be performed in secret. This is often utilized in cases where information received from an informant needs to be verified. This may be information that could be used against inmates planning a disturbance or crime. It may also be information on an alleged perpetrator of a previously committed offense. This perpetrator could be an inmate or a staff member. The informant's identity needs to remain confidential, and his well-being must be protected.

Prison Informants and The Polygraph

An informant is any person who possesses confidential information belonging exclusively to a certain person or a group of people and divulges that confidential information to an outside party for various reasons.

Informants have had a vital role throughout history. Their contributions have had both positive and negative consequences. The historical roots of the informant can be traced as far back as Biblical times. Informants are also seen as playing an important role in American history. One of the most famous occurrences in U.S. presidential history, known as Watergate (Stencel, 1997), involved an informant known as "Deep Throat". The information that he provided to Washington Post reporter, Bob Woodward, helped bring down President Nixon and many White House officials. He also helped bring about political reform.

Informants come in many shapes and sizes. In the law enforcement field the variety of informants are, but not limited to, the anonymous informant, the citizen informant, the agent informant, the unwitting informant, the paid informant, the criminal informant, and for purposes of this report, the unique prison confidential informant. Unlike the aforementioned list of informants, the prison informant is a seasoned criminal living in an enclosed criminal society. The purpose of cultivating and maintaining prison informants is to maintain a safe and orderly prison environment for the inmates and staff alike. The prison setting is not immune to gambling,

sex, fighting, drugs, and gang activity. Having informants in the inner circle of these prohibited activities is a great asset to the administration and prison custodial staff alike (Fox, 1972). The use of prison informants in maintaining the safe and orderly running of an institution has its proponents and opponents. Many correctional administrators indicate that a prison could not be operated without informants. Other correctional administrators contend that if informants are used, the administrator abdicates his responsibilities. The arguments for using inmate informants are that:

(1) More effective control is available when the inmates do not trust each other and the "inmate code" is broken.

(2) Fewer officers are needed to maintain the same discipline.

(3) A group of administrative-minded inmates can be developed for the informal self-government of the institution.

The arguments against using inmates as informants are that:

(1) The administration becomes dependent upon inmates in a matter of their own responsibility.

(2) It builds up an artificial hierarchy of prestige (status) or lack of it between the informers and the rest of the inmate body.

It is apparent that better all around custodial control can be maintained by attending to matters that come to official attention rather than by running down leads given by inmates with dubious motivation. However, as stated in the proponent's point of view, the New Jersey Department of Corrections (NJDOC) believes in the concept of using informants to maintain a more effective control of its prisons. Unlike the conventional informants living outside in the free society, the prison informant is housed on a constant basis with his associates, and their conducts is observed on a daily basis by the informant. Having law enforcement personnel conduct undercover work and surveillance against criminal activity are not practical in a prison setting. It is apparent that the informant within the prison system is a valuable investigative tool.

Confidentiality of the informant is top priority and is handled with the utmost care. Information is provided in various communication forms such as telephone contacts, letters, and one on one interview whenever the opportunity arises. The informant, once cultivated, is kept under strict guidelines by the department. Communication is established in order to build a rapport between the investigator and the informant. The informant is assigned minimal tasks at first in order to establish their credibility. Oftentimes they are utilized to gain historical and current information about a certain prison group or gang, and the scope of ongoing criminal activity. Other situations may arise where periodic contact is maintained between the investigator and the informant where superficial information is given in order to maintain accountability with the informant and his actions.

Prison informants inform for a variety of reasons. Their main motivation is driven by their desire to have their prison sentencing time reduced whenever applicable. The informant is also driven for the simple fact that the prison is his home and he will do whatever he can do make it a safer and more comfortable place to live in. Unfortunately, the informant cannot be trusted 100% of the time. As stated earlier in this report, custodial staff and department investigators do not have the time to run down leads given by inmates with dubious motivations. As reported by Blum and Osterloh (1968):

> The high potential value of good information is offset by the high risk of its being false either in its entirety or in crucial details. Given both the value and the risk associated with informant stories and given the cost in time and effort in running down leads presented, it would be desirable to have a means for assessing the truth or falsehood of the stories told. The polygraph immediately presents itself as a possible assessment device.

The NJDOC employs polygraph examinations on its informants, and this practice has been ongoing for the past 15 years with a high success rate. Criminal activity is ongoing within the prisons and the inmate informant is a valuable asset in passing on the information concerning these prohibited activities. Along with the custody staff, the office of the NJDOC Special Investigations Division works in conjunction in maintaining a safe and orderly prison environment throughout the state. A combination of investigative tools is used to deter prohibited activity within the prison system. The polygraph is a tool of great assistance in this area.

Many situations occur within the prisons when the only evidence available is the informant's word. Some examples are escape plans, gang and drug activity, and assault and riot schemes. When attempting to assess the accuracy of the informant's information, all investigative techniques are used. When these methods are exhausted and confirmation of the informant's information pertaining to the specific issue is needed, the polygraph is implemented.

Unlike the criminal judicial system outside of the prison, the polygraph is used as evidence in administrative disciplinary hearings against those inmates who commit such infractions. A finding of guilt at an administrative hearing is based upon substantial evidence that the inmate has committed a prohibited act. A concise summary of the facts on which the Disciplinary Hearing Officer concluded that the informant was credible or his information reliable is based upon the informant's personal knowledge of the matters being factual rather than conclusive. The Disciplinary Hearing Officer is not permitted to disclose the identity of the informant.

Based on actual case facts, for purposes of this report several inmates' accounts which involved informants and polygraph examinations are described as follows:

Case 1. On 8/17/98 information was received from a confidential informant in regard to an inmate making plans to place a "contract" out on two Special Investigations Division (SID) investigators. The informant stated that the inmate was making plans to place a contract on the investigators either by way of a street contract or in-house prison contract.

The suspect inmate initiated his plans due to his belief that the investigators had wrongfully accused him of drug and gang activity, for which the inmate was disciplined. Based on the information received, a polygraph examination was given to the informant. The relevant questions asked of the informant proved him to be nondeceptive. The suspect inmate was also given a polygraph in order to prove his innocence. The relevant test questions asked of the inmate indicated that he was deceptive. A confession was gained by the polygraphist, and it was determined that the inmate was in fact making plans to physically assault the investigators. The inmate was administratively charged and was found guilty. He received one year of administrative segregation time.

Case 2. On 10/21/98, two anonymous notes were found displayed on an inmate housing unit. The notes were inflammatory in nature and indicated that the inmate population should display a job action/commissary boycott. The notes also encouraged the inmates to assault custodial staff members. Confidential information was received that three specific inmates were responsible for the notes and contents. The informant also provided information that he had overheard the inmates discussing these actions as a response to departmental policy changes regarding their clothing, commissary, and visitation privileges. Polygraph examinations were given to the informant and the three inmates in question. The relevant test questions asked of the informant proved him to be nondeceptive. The relevant test questions asked of the inmates proved them to be deceptive. No confession was gained. However, they were administratively charged and were found guilty of creating a disturbance within the prison.

Case 3. On 12/16/99, an inmate alleged that he was subjected to racial harassment by a custodial staff member. Arrangements were made by the inmate to file a lawsuit against the NJDOC and the custody staff member.

Confidential information was received by two different informants who indicated that the racial harassment story was fabricated by the suspect inmate in order for the inmate to receive a monetary gain for himself. Polygraph examinations were given to the two informants. The relevant test questions asked of the informants proved them to be nondeceptive. The suspect inmate refused to take a polygraph examination to substantiate his allegations. Based on the polygraph results, the inmate was administratively charged.

Conclusion

Polygraph use during informant operations has proven to be highly successful within the investigative field of the NJDOC. As indicated in this report, the polygraph aids in solving many cases within the NJDOC. Often, the polygraph is the only corroborating piece of evidence that proves to be crucial in attaining confirmation of the informant's statements.

References

Blum, R.H., Osterloh, W. (1968). The polygraph examination as a means for detecting truth and falsehood in stories presented by police informants. *Journal of Criminal Law, Criminology and Police Science*, 59, 133-137.

Fox, V. (1972). *Introduction to Correction.* Prentice Hall, pp.163-164.

Stencel, M. (June 13, 1997). Watergate 25. *Washingtonpost.com.*

A Comparative Study of Polygraph Tests and Other Forensic Methods

Eitan Elaad

Abstract

An attempt was made to compare the accuracy of two major polygraph methods, used in criminal investigations by the Israeli police, with other common criminal identification methods such as: fingerprint identification; voice identification; handwriting identification and eyewitness identification. Results indicated that three methods were free of false positive errors; fingerprint identification, the guilty knowledge polygraph test (GKT) and natural handwriting identification. While the more subjective handwriting identification task seemed to be rather easy, fingerprint identification and the GKT are standard and relatively objective procedures that require more expertise. Furthermore, they differ from the handwriting identification procedure by providing control over the probability of false positive errors.

Criminal investigations conducted by the Israeli Police often use polygraph as an aid for pointing at the guilty suspect or eliminating innocent suspects, thus directing the investigation. The polygraph itself is no more than a device to record physiological changes. Each polygraph records changes in respiration, electrodermal responses and cardiovascular activity. Respiration is recorded by two pneumatic rubber tubes positioned around the thoracic area and abdomen. The electrodermal recording is made with stainless steel electrodes attached to the volar side of the index and fourth fingers of the examinee's left hand. Cardiovascular activity is recorded with a pneumatic pressure cuff positioned around the upper portion of the examinee's right arm. The polygraph examination is conducted in a quiet, plainly furnished, soundproof comfortable room where the examiner is alone with the examinee. While operating the instrument, questions are presented to the examinees to which they are instructed to answer yes or no. According to the recorded physiological responses the assessment of truthfulness is made.

Several methods of psychophysiological detection have been developed and used in field practice (see, Lykken, 1981; Raskin, 1989; Reid and Inbau, 1977; Saxe, Dougherty and Cross, 1985). These methods are based on a comparison between physiological responses to relevant questions (i.e., questions that focus on the issue under investigation) and some form of control questions. Two common methods are the focus of the present study: one, which is called the Control Question Technique (CQT), should have been called the comparison question technique. The other, which is known as the Guilty Knowledge Test (GKT) should have been referred to as the concealed knowledge test (Honts, Devitt, Winbush and Kircher, 1996).

Eitan Elaad has been with the National Police of Israel since 1976. He received his Ph.D. in psychology from the Hebrew University of Jerusalem in 1988. He is a member of the Society for Psychophysiological Research (SPR) and for many years lectured in the Department of Criminology at Bar-Llan University. His research has focused on psychophysiological detection of deception and concealed knowledge. He also studied social factors which have influence on deception and its detection, forensic methods and decision making processes.

This article is a book chapter in *Offender Profiling Series: I - Interviewing and Deception*, Edited by D. Canter and L. Alison.

The Control Question Technique

The CQT is the most commonly used method in field practice. It emphasizes the interaction between the polygraph examiner and the examinee as the basis for the elicitation of appropriate physiological recordings (Raskin, 1982). For this purpose the examiner's consent has to follow knowledge of the suspicion against him or her, and the examinee must be of sound mental and physical health.

Briefly, the CQT consists of several stages. First the examiner becomes familiar with the facts of the crime by reading the case file and by speaking directly to the investigating officer. Information such as previous criminal records, the basis for suspicion, motives, the desired questions to be asked, etc. are useful to confirm that the examinee understand the charges, to resolve any discrepancies, and construct the appropriate questions.

During the next stage the examiner conducts an extensive pre-test interview. The pre-test interview may last up to one hour, during which the examiner establishes a degree of rapport with the examinee. The examinee is given the opportunity to present his or her version of the crime and the examiner makes sure that the facts reported by the examinee correspond to those presented by the investigator. Then, the questions are formulated so that the examinee can give a direct "yes" or "no" answer to each question. If there is a need for clarification, the examiner does so and, if necessary, questions may be reformulated. Finally, the examiner explains the testing procedure and ensures that the examinee understands all the questions.

The next stage is the actual examination stage during which the examinee is attached to the polygraph and asked the questions. Essentially, the questions are of the following three types: (a) relevant questions which bear on the issue under investigation in the "Did you do it?" form (e.g., "Did you take $100 from the drawer last Monday?"). Relevant questions are specific with regard to time and place and are typically answered "no". This indicates that the examinee denies involvement with the crime; (b) control questions which deal with undesirable acts committed by the suspect in the past which are of the same kind as those covered by the relevant questions (e.g., "Before 1995, did you ever take something that didn't belong to you without permission?").

Control questions focus on general, non-specific misconducts and are expected to be answered "no". In other words, the examinee denies any involvement with the indicated act; (c) irrelevant questions which correspond to a neutral issue to which the affirmative answer is a known truth (e.g., "Are you sitting on a chair?"). The irrelevant questions are intended to absorb the initial orienting response evoked by any opening question and to enable rest periods between the more loaded questions. Typically, the whole question series consists of 10-12 questions which are repeated three or four times.

It is assumed that the relevant questions will generate more concern and arousal in the guilty examinee while an innocent examinee will attend and respond more to the control questions. The pre-test interview is used to produce concern about the control questions. The innocent examinee who is truthful with regard to the relevant questions and either deceptive, or at least unsure of being truthful in answering the control questions, is expected to react with greater strength to the control questions. The guilty examinee, who is more concerned about the relevant issue, will not be able to divert attention from the relevant questions, and therefore is expected to react more to these questions.

Finally, the examinee is released from the transducers and is accompanied to a waiting room. The examiner analyzes the records and reaches a decision by comparing the physiological responses given to the relevant questions with those given to the adjacent control questions. Each chart is quantitatively scored.

In cases where a deceptive outcome is reached the examiner may return for a post-test interrogation. An attempt to elicit an admission is made. Here the examiner may use the rapport he has developed during the examination which may help him get a

confession. Confessions, either by the polygraph examiner or later on by the interrogator are achieved in about 5% of the cases of the Israeli police.

The assumptions underlying the CQT and its inference rule have been criticized as implausible (e.g., Ben-Shakhar and Furedy, 1990; Furedy and Heslegrave, 1991; Lykken, 1974, 1981). It was argued that in terms of eliciting arousal, the specific relevant question is not equivalent to the more general control question from the point of view of either innocent or guilty examinee. Therefore, the CQT should yield a very high false positive error rate. According to Podlesny and Raskin (1977), the control question technique attempts to set up a situation in which the innocent examinee will be more concerned about the control questions despite the knowledge that the relevant questions pertain to the crime under investigation and therefore have substantial arousal value. This can be done by a proper pretest interview. The debate continues but ultimately, the effectiveness of the CQT is an empirical question.

Ben-Shakhar and Furedy (1990), argued that the CQT is not a psychological test in its normal sense because it does not provide an objective and standardized procedure. The CQT is highly dependent on the operator in the formulation of the control questions and in how these questions are presented to the examinees. It is also likely that information other than that which emerges in the polygraph charts may influence the examiner's decisions. Podlesny and Raskin (1977) argued, that it is important that field polygraph examiners be well trained and base their decisions on the physiological recordings in order to avoid as much as possible the danger that in arriving at a decision the examiner would subtly affect the outcome or be influenced by factors other than the physiological recordings.

The Guilty Knowledge Test

Lykken (1959, 1960), the most determined opponent of the CQT, suggested another method, developed earlier, which he called the Guilty Knowledge Test (GKT). The GKT is less controversial than the CQT and is considered to be objective and scientific. The GKT is used in applied settings to detect information that an individual cannot or does not wish to reveal. The GKT is based on a series of multiple-choice questions (items), each having one relevant alternative (e.g., a feature of the crime that would be known to the perpetrator but not to innocent suspects) and several control alternatives. For example, the suspect might be asked, "Do you know that the color of the stolen car was?" (1) grey, (2) white, (3) yellow, (4) blue, or (5) red. It is assumed that only a guilty suspect will be able to single out and respond differentially to the true color of the stolen car, while innocent examinees, who have no guilty knowledge, are unable to distinguish crime-related information from other alternatives.

Inferences are made on the basis of the GKT by comparing the responses elicited by the relevant item with the responses to irrelevant items. Only if the responses to the relevant item are consistently larger, guilty knowledge is inferred. This provides a proper control against false positive outcomes, inasmuch as the likelihood that an innocent examinee might show consistently greater responsiveness to the correct alternative just by chance can be reduced to a low level by using many irrelevant items, by utilizing several GKT questions and by repeating each series of questions.

The rate of correct detection of guilty and innocent examinees reported in simulated experiments is quite impressive. Lykken (1959) and Davidson (1968) used a mock-crime procedure in which participants simulating the guilty condition tried to prevent six crime-related details from being detected by the polygraph. Lykken (1959) used a global score for each examinee, computed over the six GKT questions, and decided, according to a pre-defined decision rule, whether the examinee possessed the guilty knowledge or not. Lykken found that 44 of the 50 interrogations of perpetrators yielded correct detections, and that the classification of innocent examinees was perfect. Davidson (1968) replicated this study and reported a detection rate of 92% for guilty examinees and 100% for innocent participants. It seems, therefore, that the GKT is potentially a highly accurate method of detecting guilty knowledge.

Ben-Shakhar and Furedy (1990), selected ten GKT laboratory studies and summarized their results. All ten studies used the electrodermal measure, most of them as the sole measure. Results indicated a range of correct detections among the guilty examinees from 61% to 100%, but in only two out of the ten studies was the rate less than 85%. In the innocent condition the correct detection rate ranged between 81 % and 100%.

It should be noted that seven of the ten studies indicated perfect detection. Ben-Shakhar and Furedy (1990), concluded that the GKT assumptions are compatible with psychological theory and are supported by extensive research. Furthermore, the GKT can be designed very much like a standardized and objective test.

However, recent field studies (Elaad, 1990; Elaad, Ginton & Jungman, 1992) revealed that detection rates of guilty examinees in true examination conditions are much smaller.

To assess the applied value of the polygraph tests, a comparative approach, which compares the accuracy of the polygraph techniques with other commonly used forensic methods, under similar conditions, may be useful.

The Widacki and Horvath Study

The first attempt to compare the validity and utility of the CQT with three other methods of criminal identification, was made by Widacki and Horvath (1978). In this study, the participating students were assigned to 20 groups of four students each. Within each group one student was randomly selected to perform the role of the perpetrator and the remaining three students were assigned to the role of the innocent suspects. The task of the perpetrator was to collect a parcel from a doorkeeper in return for an envelope and the instruction sheet. The perpetrator was asked by the doorkeeper to complete a receipt form by signing "I acknowledge the receipt" and a signature of a fictitious name. The perpetrator was advised to try to deform the handwriting which was to be used as a means of identification. All the participating students underwent a CQT polygraph examination. Perpetrators were promised a reward of small value if found innocent in the polygraph test. Innocent examinees received no reward. In addition, Widacki and Horvath (1978) employed three other criminal identification methods. (a) Fingerprints were lifted from the envelope and instruction sheet using ninhydrin. The fingerprint expert was aware of the four students assigned to each perpetrated event, and his task was to decide which of the four prints matched those on the evidence. (b) The handwriting expert matched the handwriting on the receipt with the proper exemplar in each case. He was also aware of the four students assigned to each case. (c) Two doorkeepers served as eyewitnesses. Two days after the perpetrated crime the appropriate eyewitness was shown photographs of the four suspects in each case, and was asked to identify the perpetrator.

Results indicated that with the polygraph 18 cases were correctly resolved (correctly resolved cases are events in which the perpetrator and the three innocent suspects were correctly identified). The handwriting expert was successful in resolving 17 cases, the eyewitness succeeded in 7, and the fingerprint identification expert in only 4. However, when incorrect decisions were considered, the polygraph examiner yielded 1 incorrect decision, the handwriting expert 1, and the eyewitnesses 4. The fingerprint expert could not make any decision in 16 cases.

The shortcomings of the Widacki and Horvath (1978) study are considerable. The comparison between the forensic methods was flawed by the disadvantageous nature of the setting. Hence, identifiable fingerprints were found only in four cases. The CQT polygraph technique suffered from the low motivation of the students to yield truthful outcomes and from the fact that the polygraph examination was administered immediately after the completion of the assigned task. The analysis of the handwriting evidence was flawed by the short sentence of only four words and by the advice to the perpetrators to try and deform their handwriting.

On the other hand, the fact that the polygraph examiner and the handwriting expert were aware of the prior probabilities of guilt and innocence, may have led to an

overestimation of the polygraph and handwriting identification rate.

The results of Widacki and Horvath cannot be generalized to the real life situation because of the laboratory-based character of the study (the use of students with no incentive to produce truthful outcomes, the location in the university campus), and because of the closed trial method which indicated that one of every four suspects must be the perpetrator.

Therefore, a constructive replication of the Widacki and Horvath study is necessary. The replication must take into account the many flaws of the study in order to be more informative about the proper place of polygraph tests among other common forensic methods.

The Purpose of the Present Study

The purpose of the present study is threefold: first, to assess the accuracy of the CQT and GKT polygraph tests in comparison to other common conditions for identification. To this end, the identification experts were asked to define their demands and the experiment tried to meet them under the limitations of a mock-crime experiment.

Second, the present study was designed to resemble field conditions more than the study of Widacki and Horvath. Thus an open trial method was employed, the number of suspects in each case changed from 2 to 6 and the number of perpetrators were either none, one or two. This prevented the experts from estimating the prior probabilities of guilt and innocence. In addition, standard field equipment and measurement procedures were utilized. The promised reward for guilty examinees, in the case of truthful outcomes, was high and innocent examinees were punished if found deceptive. The setting was designed to impress the participants and to make them believe that their task is to cope with highly professional forensic experts. The participants were recruited from outside the Israel Police Headquarters, but the test was conducted in the headquarters building where many policemen in uniform were present. The participants enacted the crime several days before they were assigned to the polygraph tests as is usual in actual interrogations. Finally, they went through a standard procedure of interrogation, gave their fingerprints, were photographed, and were submitted to other forensic examinations such as handwriting analysis and voice identification.

Finally, the present study considers additional criminal identification tests such as the GKT and voice identification, which makes the comparison more informative.

Method

Participants

The participants were 81 males, with an age range from 19 to 51 years (M=25.0, SD=5.34). All participants reported good health. Participants were recruited either from the local community by the local employment services, or by the student employment agency of the Hebrew University of Jerusalem. Participants were offered 100 NIS (about $40) for participation in a forensic science experiment. It was noted that there might be a possible bonus for successful performance. Participants responded by telephone and were given general information about the experiment. They were told that the experiment was a two-session project. Those who agreed to participate were assigned an appointment for the first session.

The Mock Crime Procedure

Participants arrived at the forensic laboratories individually at a predetermined time. On arriving for the first session they met the experimenter who informed them of the nature of the experiment and requested their cooperation. Participants were then asked to complete a form requesting background information and signed a consent agreement to be interrogated with forensic tests about a mock crime in which they might be involved. Twenty-five participants were assigned to the role of the perpetrator in 20 perpetrated events. They received written instructions that informed them to enact a mock crime which consisted of entering a closed room, opening a box located on a desk and stealing money from an envelope which was placed inside that box. While entering the room they were observed by either one or two eyewitnesses recruited beforehand from the staff of the Israeli police. Perpetrators were instructed to take the money

and put it in their pocket. To avoid disclosure, they were asked to falsify a receipt indicating that a certain person, whose name was indicated in the instructions, received the money in return for delivering equipment to the Israeli police. Of the 25 perpetrators, 13 were advised to try and change their handwriting. In one case the perpetrator was asked to leave two receipts, one with his natural handwriting and one in which he deliberately deformed his handwriting.

Guilty participants were further instructed to make a phone call to a certain number, notifying a partner that the theft was accomplished and that they should meet at a certain street, indicated in the instructions, where they would deliver the money to the accomplice. The phone call was recorded. Thirteen perpetrators were instructed to try to disguise their voices whereas the other 12 did not receive such instructions.

After enacting the crime, 13 of the guilty participants were instructed to go to a nearby room, take a parcel addressed to a certain person and bring it to the experimenter who waited downstairs. The other 12 guilty participants were instructed to take another envelope with a different amount of money in it and deliver it to the experimenter. Four guilty knowledge items were produced; the stolen sum of money, the color of the envelope, the street in which the suspect would meet his partner, and the falsified name on the receipt. Finally, to ensure that participants were aware of the four GKT items, the experimenter asked the perpetrator to repeat them.

Fifty-six innocent participants received instructions that informed them to enter the nearby room, take the parcel (or envelope), and bring it to the experimenter. After receiving the parcel (or envelope), the experimenter informed all participants that they would receive 100 NIS (about $40) for participating in the experiment. Guilty participants were further informed that in addition to the 100 NIS, they were entitled to the money they stole, if found innocent. The stolen sum ranged from 40 to 480 NIS (from a $16 to $190). If found deceptive, guilty participants would not get the stolen money, and would be punished with a reduction of 25 NIS of their participation fee. To enhance the motivation of the innocent participants they were told that if they would yield deceptive outcomes, they would also be punished with a reduction of 25 NIS of their participation fee.

The experimenter informed the participants that they were under suspicion of stealing the money and therefore, they were to be interrogated. He cautioned the suspects not to confess the mock crime to the interrogator or to anyone else. In the case of confession, the suspect could expect to lose all the money. Suspects were then individually interrogated by a police interrogator as to their involvement in the crime. They were told that they would have the opportunity to clear themselves from suspicion through forensic examinations. They gave their written consent for the polygraph examination which was scheduled to take place several days later, and signed their testimony. Next, suspects were asked to give their fingerprints and were photographed in three positions. All participants were then assigned an appointment for the continuation of the examinations.

Several days (range from 1 to 7) after executing the mock crime, each suspect returned for additional identification tests. Upon arrival, the experimenter reminded the suspect about the suspicion against him. The suspect was further reminded of the incentive conditions and of the importance of yielding an innocent outcome. Guilty suspects were not, however, reminded of the relevant GKT items. Participants were then sent to give handwriting specimens in the Israel Police Document and Handwriting Identification Laboratory, and voice samples in the Israel Police Voice Identification Laboratory. Finally, they were polygraphed. Following field practice, the CQT preceded the GKT. The GKT was conducted by a different examiner who was unaware of the previous CQT result.

Data Acquisition and Analysis

The Control Question Test

The polygraph tests were conducted by eight polygraphers of the Israel police, all experienced in operating the polygraph. All examiners were uninformed of the base rates of guilt and innocence. The CQT examiner scored the polygraph records according to the

numerical scoring procedure which was proposed originally by Backster (1963). According to this scoring procedure, two or three pairs of relevant control questions are identified in each polygraph chart, and numbers (-3, -2, -1, 0, 1, 2, 3) are assigned to each pair for each physiological measure. The absolute value of the assigned number reflects the magnitude of the difference between the responses evoked by the two questions within the pair (e.g., -3 or +3 reflect a very large difference, -1 or +1 reflect a small difference, and 0 reflects no difference), and the sign of the assigned number reflects the direction of the difference, such that positive numbers are associated with a pattern of larger physiological reactivity to the control question, and negative numbers reflect the opposite pattern. These numbers are then summed up across question pairs, across physiological measures and across polygraph charts to yield a total score.

Using this scoring procedure, each examiner scored his own records. In addition, the records were given to another experienced examiner for a blind scoring. The blind scorers were unaware of the outcome of the test and of the content of the questions presented to the examinee. They identified the relevant and control questions according to their corresponding number. The correlation coefficient between the total scores assigned by the original examiners and those of the blind examiners was .88.

The two total scores were averaged. If the averaged score exceeded +5 the examinee was classified as truthful; if the score was less than –5, the examinee was classified deceptive; and if the averaged total score ranged between -5 and +5, inclusive, the record was classified as inconclusive. The relative frequencies of the three decisions made for innocent and guilty examinees are presented in Table 1. Note that two innocent examinees were examined only with the GKT. This reduced the total number of CQT examinees to 79.

The Guilty Knowledge Test

Examinees were presented with four series of GKT questions: the stolen sum of money, the color of the envelope from which the money was taken, the name of the street in which the culprit was going to meet his partner, and the name the culprit falsified on the receipt. The four GKT series were constructed by the experimenter. To each relevant item the experimenter added six neutral items, one of which was introduced at the beginning of each series to serve as a buffer. In two GKT series a target item, which the examinee could discriminate from the other items, was included instead of one neutral item, and in two GKT series the polygraph examiner was informed about the relevant item - the knowledge and target effects are discussed in Elaad, (in press). The order of questions was counterbalanced across cases. Each series was repeated three times. The position of the relevant items were randomly determined in each repetition. The seven GKT items in each series were presented with a 15-20 second inter-stimulus interval between them.

Skin resistance response amplitude (SRR) was used to measure the responses to each item in the GKT. This indice is considered a highly reliable and accurate measure for detecting concealed knowledge in laboratory settings (Balloun & Holmes, 1979; Thackray & Orne, 1968). Cardiovascular and respiration tracings were monitored but not scored.

Acquisition of the SRR responses was carried out by measuring the maximal difference between SRR onset and peak (SRR amplitude) within ten seconds starting immediately after the presentation of the item. The response to the first item in each set of items was excluded from measurement because it served as a buffer to dissipate the examinee's tendency to react strongly to the initial item. In cases where some kind of external disturbance (movements, deep breath, noise, etc.) occurred, the item was excluded from the analysis. The whole set was excluded when the disturbance occurred during presentation of the relevant item.

Excluding the buffer, the SRR amplitudes in each repetition were ranked from 1 (the largest) to 6 (the smallest). The mean ranking across the three repetitions was computed for each alternative item. If the mean rank of the relevant alternative was the smallest, the question was assigned the score of 2. If the mean rank of the relevant

Table 10.1 Decision Frequencies Made for Perpetrators and Innocent Participants According to the Various Forensic Methods

	Perpetrators			Innocent Participants		
Decisions	ID Guilty	Inconclusive	ID Innocent	ID Guilty	Inconclusive	ID Innocent
Polygraph						
CQT	10	7	8	2	13	39
GKT	19	3	3	0	9	46
Fingerprints						
	19	6 **	-*	0	56**	-*
Voice						
Natural	11	0	1	1	0	39
Deformed	10	2	1	1	8	33
Handwriting						
Natural	13	0	0	0	0	40
Deformed	9	3	1	2	6	35
Eyewitness						
Lineup	17	0	8	2	0	59
Photo Archive	6	0	8	1	0	40

*** The absence of fingerprints do not imply innocence**
**** Including two cases in which fingerprints were not developed**

alternative was the second smallest, the question was scored 1. For any larger mean rank of the relevant alternative the question was scored 0. The question scores were summed up for each examinee. The following decision rule was employed to classify examinees: the examinee was classified as guilty if S > Q, where S stands for the computed sum and Q stands for the number of questions presented to the examinee. Thus, a score of at least 5 is needed to classify an examinee presented with four questions as guilty. An inconclusive decision was reached if S=Q, and an innocent decision was made whenever the score computed for the examinee was less than the number of questions presented.

The correct detection rates computed for guilty and innocent examinees are displayed in Table 10.1. In one case an innocent examinee was examined only with the CQT. Thus, the total number of GKT examinees is 80.

Fingerprint Identification

The fingerprint pattern is unique and individual for a given finger. It is unique because of ridge characteristics such as ridge ending, bifurcation or a dot which are known as "points of identification". Given that the frequency of each type of ridge characteristic in large populations is known, it is possible to compute the probability of obtaining a certain combination of identification points in two fingers. The "12 point" rule has been adopted for identification in many countries because for any combination of 12 points the probability is low enough to confirm

identification. However, in reality, circumstances such as time and locality may limit the potential suspects to a small group. Identity can therefore be confirmed with only 8 points. The USA and Canada do not require a minimum number of identification points and leave the decision to the expert but it is rare that identification is made with less than 7 or 8 points (Margot and Lennard, 1994).

Three types of fingerprints may be found: (a) Indented fingerprints which are caused by the contact of the finger with a malleable substance which retains a three dimensional image of the print. (b) Visible fingerprints which may be found on dust, blood or paint. (c) Latent fingerprints which are invisible. To make the fingerprint visible the print must be treated physically (powdering) or chemically (ninhydrin). Such fingerprint development requires detailed knowledge about where the prints have been stored and what are the optimum techniques for development.

In the present study the fingerprints were all latent and were developed from hard surfaces such as the desk surface and the box. For this, black powder, aluminum powder and magnetic flake powder were used. The prints were lifted using lifting tape which was pressed evenly and smoothly over the powdered image and a near perfect powder reproduction of the ridges was obtained. The prints on the receipt were developed using ninhydrin. The lifts were then transferred to the identification experts for identification. In two perpetrated events the experts failed to develop prints. The results of the fingerprint identification are presented in Table 10.1.

Voice Identification

Participants were sent to give voice samples in the Israel Police Voice Identification Laboratory. The expert who recorded the voices used established procedures that ensured the obtained speech samples were reasonably representative of the perpetrator's voice. She attempted to duplicate the wordings of the original text verbatim and maintain the same physical and acoustic conditions associated with the original recording (e.g., using the telephone, eliminating noises, etc.).

Three experienced voice identification experts compared the voice of the perpetrator ("unknown voice") with the voices of the suspects using auditory recognition and visual spectrographic examination of the data. Features that could be unique, variations within the voice of the same speaker and similarities and differences between the unknown voice and the suspects' voices, were considered when the expert reached a decision. The results appear in Table 10.1.

Handwriting Identification

Participants were also sent to give handwriting specimens in the Israeli Police Document and Handwriting Identification Laboratory. Similar to the voice identification, the handwriting expert attempted to duplicate the wordings of the original text and ensure that the writing specimens were representative of the perpetrator's writing.

Three experienced handwriting identification experts compared the questioned writing on the falsified receipt and the specimens written by the suspects. The similarities between the two samples of writings need not be identical in the sense that the two sets can be matched bit by bit. However, the differences between the disputed writing and the handwriting specimens should not exceed the variations usually found in such writings. Furthermore, individual features should appear in both, to establish a decision that the two sets of writing must have been the work of the same person. Table 10.1 presents the decisions reached by the handwriting experts for guilty and innocent participants.

Eyewitness Identification

Descriptions of a person can be elicited in a number of ways. First, a free description invites the witness to provide a description of the person. Then, the witness is required to respond to a series of specific questions such as, "How old was the person." Finally, the witness is offered a range of alternatives from which he is asked to choose the most appropriate one. This can be done by a police artist or by a composite system. The latter is a kit of facial components such as the American Identikit or the British photo-fit. The witness describes the person he saw and accordingly the appropriate components of the face are selected. The face is shown to the witness for

comments, and amendments can then be made. The aim is to produce a schematic drawing of the culprit's type. Guilty participants in the present study were observed by either one or two eyewitnesses while they entered the office in which the mock crime took place. Each eyewitness made a composite picture of the person they saw.

After the composite had been compiled, the witness was presented with several lineups of pictures according to the number of suspects in the perpetrated event. Each lineup contained the picture of one suspect (either guilty or innocent) and seven pictures of other people. The correct identification frequencies of the lineups are displayed in Table 10.1.

In cases where two witnesses watched the culprit, the second witness was asked to search a crime archive of photos. The picture of the culprit and of all innocent suspects of the relevant event were put in that archive. Identification frequencies are presented in Table 10. 1.

A legal system that is designed to protect the innocent should base its decisions on methods that are relatively free of false positive errors (e.g., classifying an innocent suspect as guilty). The results point at three methods that comply with this demand, fingerprint identification, the GKT and the identification of natural handwriting. The natural handwriting yielded perfect classification of perpetrators and innocent participants. It seems, however, that this was an easy task. To examine this further, the questioned writing and the specimens written by the suspects were handed to 10 students, without any training in handwriting identification, for identification. The students classified correctly 9 (69%) perpetrators and all innocent participants.

In contrast to the natural handwriting identification, fingerprint identification and the GKT require some expertise. Both employ standard and objective procedures and may not be contaminated by examiner or examinee factors. Furthermore, both enable control over the probability of false positive errors. However, effort invested to minimize false positive errors may elicit an increase of false negative error rate (e.g., a failure to detect guilty suspects). The desired exchange rate between the two types of errors can be determined according to the purpose of the test and the social context.

It should be noted that the two methods differ in the identification of innocent people. Fingerprint identification is not designed to identify innocents and the fact that prints were not detected does not imply that a person is innocent. The GKT detects innocent as well as guilty examinees. This has its advantages but the GKT is also susceptible to errors of classifying a guilty examinee as innocent.

The CQT results showed a considerable false negative error rate (32%), and a much smaller false positive error rate (3.7%). This contradicts claims made by many critics of CQT polygraphy (e.g., Ben-Shakhar, Lieblich & Bar-Hillel, 1982; Lykken, 1974, 1978) according to which the CQT is biased against the innocent, because the obvious differences between the control and the relevant questions should produce a pattern of relatively larger responses to relevant questions in both guilty and innocent examinees.

On the other hand, the participants in the present experiment knew perfectly well that they were participating in an experiment, and that no harm would be inflicted upon them as a consequence of the forensic results. Hence, they were not exposed to the real threats confronting suspects undergoing real CQT examinations. This may lead to the neglect of relevant questions which are related to unreal crimes and to increased concern about control questions which deal with real problems of the examinee. However, many other CQT mock-crime studies produced relatively accurate detection rates for both guilty and innocent examinees (e.g., Dawson, 1980; Honts, Raskin & Kircher, 1987; Kircher & Raskin, 1988; Raskin & Hare, 1978).

The explanation lies in the training of the polygraphers. These polygraphers, with psychological background and with knowledge of the bias against the innocent in the CQT, were trained to emphasize the control questions in the pretest interview and in the test itself. In actual CQT examinations this

approach seems to be beneficial since it balances the relevant questions that may introduce the biggest threat.

The examiners in this study knew that their ability as professional polygraphers was being tested. Thus, they adopted the approach they usually employ in typical CQT examinations. The combination of enhanced emphasis on control questions and the fact that these questions deal with actual problems of the examinee whereas the relevant questions deal with a mock-crime, paved the way to the high false positive error rate. Hence, the present CQT is not typically analogous to the real-life situation and its results should not be generalized.

The CQT joins the spectrographic voice identification, the handwriting identification and the eyewitness identification in the sense that all these methods were influenced by the expert's or eyewitness' subjective impressions and, excluding the natural handwriting identification, yielded false positive errors. A variety of studies reviewed by Dawes (1979) demonstrated that experts in a field are good at selecting the right predictor variables and at coding them in such a way that they have a monotonic relationship with the criterion, but that these experts fail to integrate information from diverse sources.

Einhorn (1972), for example, asked expert physicians to examine biopsies of patients with Hodgkin's disease and make an overall rating of the severity of the process. The correlations of the experts' rating and actual survival time of the patients were all virtually zero. When the variables on which the physicians based their decisions were used in a multiple regression model, they predicted survival time with relative accuracy. This leads to the conclusion that standard methods should be preferred to methods based on experts' opinion.

The present study intended to provide a look at the efficiency of criminal identification methods operating under conditions that were nearly perfect for identification. Hence, spoken and written sentences were long and detailed. The area where fingerprints may have been stored was restricted and defined. Eyewitnesses were advised beforehand that they will have to identify the person they are going to see. Perpetrators were provided with the four relevant GKT items and the experimenter ensured that they were aware of them. Finally, the experimental setting was designed to resemble actual CQT procedures more than many other laboratory studies. This was expected to increase the concern of perpetrators about the test outcomes which is essential for the application of the CQT.

However, optimal conditions were only partly accomplished. The recordings of the unknown voices were in some cases not as clear as desired. The receipt the perpetrators left behind was sometimes not detailed enough. The removal of fingerprints from the boxes was not as easy as was planned. In some cases the two eyewitnesses talked while waiting for the culprit to appear and missed his arrival. Thus, they saw only the perpetrator's profile. Finally, on the second session five guilty participants forgot one GKT item, each. The effect on the identification rate is not known. However, this limits an effective comparison between the method's theoretical accuracy under optimal conditions.

Beside the recommendation that criminal identification methods should employ standard and objective procedures, no other applied conclusions should be drawn from this study. Future research should examine the actual utility of the various methods instead of their theoretical accuracy. This can be accomplished by using a random sample of criminal files and determine which of the various criminal identification methods could have been applied in each case.

References

Backster, C. (1963). Polygraph professionalization through technique standardization. *Law and Order*, 11, 63-64.

Balloun, K.D. and Holmes, D.S. (1979). Effects of repeated examinations' ability to detect guilt with a polygraphic examination: laboratory experiment with a real crime. *Journal of Applied Psychology*, 64, 316-322.

Ben-Shakhar, G. and Furedy J.J. (1990). *Theories and application in detection of deception.* New York: Springer-Verlag.

Ben-Shakhar, G., Lieblich, I. and Bar-Hillel, M. (1982). An evaluation of polygrapher's judgments: A review from a decision theoretic perspective. *Journal of Applied Psychology*, 67, 701-713.

Davidson, P.O. (1968). Validity of the guilty knowledge technique: The effects of motivation. *Journal of Applied Psychology*, 52, 62-65.

Dawes, R.M. (1979). The robust beauty of improper linear models in decision making. *American Psychologist*, 34, 571-582.

Dawson, M.E, (1980). Physiological detection of deception: Measurement of responses to questions and answers during countermeasure maneuvers. *Psychophysiology*, 17, 8-17.

Einhorn, H.J. (1972). Expert measurement and mechanical combination. *Organizational Behavior and Human Performance*, 13, 171-192.

Elaad, E. (1990). Detection of guilty knowledge in real-life criminal investigations. *Journal of Applied Psychology*, 75, 521-529.

Elaad, E. (in press). Polygraph examiner awareness of crime-relevant information and the guilty knowledge test. *Law and Human Behavior.*

Elaad, E., Ginton, A. and Jungman, N. (1992). Detection measures in real-life criminal guilty knowledge tests. *Journal of Applied Psychology*, 75, 521-529.

Furedy, J.J. and Heslegrave, R.J. (1991). The forensic use of the polygraph: A psychophysiological analysis of current trends and future prospects. In: J.R. Jennings, P.K. Ackles and M.G.H. Coles (eds.), *Advances in Psychophysiolgy*, 4, Greenwich, CT: JAI Press.

Honts, C.R., Raskin, D.C. and Kircher, J.C. (1987). Effects of physical countermeasures and their electromyographic detection during polygraph tests for deception. *Journal of Psychophysiology*, 1, 241-247.

Honts, C.R., Devitt, M.K., Winbush, M. and Kircher, J.C. (1996). Mental and physical countermeasures reduce the accuracy of the concealed knowledge test. *Psychophysiology*, 33, 84-92

Kircher, J.C. and Raskin, D.C. (1988). Human versus computerized evaluation of polygraph data in laboratory setting. *Journal of Applied Psychology*, 73, 291-302.

Lykken, D.T. (1959). The GSR in the detection of guilt. *Journal of Applied Psychology*, 43, 385-388.

Lykken, D.T. (1960). The validity of the guilty knowledge technique: The effects of faking. *Journal of Applied Psychology*, 44, 258-262.

Lykken, D.T. (1974). Psychology and the lie detector industry. *American Psychologist*, 29, 725-739.

Lykken, D.T. (1978). Uses and abuses of the polygraph. In: H.L. Pick (ed.) *Psychology: From Research to Practice.* New York: Plenum Press.

Lykken, D.T. (1981). *A tremor in the blood.* New York: McGraw-Hill.

Margot, P. and Lennard, C. (1994). *Fingerprint detection techniques* (Lausanne, 6th ed.).

Podlesny, J.A. and Raskin, D.C. (1977). Physiological measures and the detection of deception. *Psychological Bulletin*, 84, 782-799.

Raskin, D.C. (1982). The scientific basis of polygraph technique and their uses in the judicial process. In A. Trankell (Ed.), *Reconstructing the Past: The Role of Psychologists in the Criminal Trial.* Stockholm, Sweden: Norsted and Soners.

Raskin, D.C. (1989). Polygraph techniques for the detection of deception. In D.C. Raskin (ed.), *Psychological methods in criminal investigation and evidence* (pp. 247-296). New York: Springer.

Raskin, D.C. and Hare, R. (1978). Psychopathy and detection of deception in a prison population. *Psychophysiology*, 15, 126-136.

Reid, J.E. and Inbau, F.E. (1977). *Truth and deception: The polygraph ("lie detection") technique.* Baltimore: Williams and Wilkins.

Saxe, L., Dougherty, D. and Cross, T.P. (1985). The validity of polygraph testing: Scientific analysis and public controversy. *American Psychologist*, 40, 355-366.

Thackray, R.I. and Orne, M.T. (1968). A comparison of physiological indices in detection of deception. *Psychophysiology*, 4, 329-339.

Widacki, J. and Horvath, F. (1978). An experimental investigation of the relative validity and utility of the polygraph technique and three other common methods of criminal identification. *Journal of Forensic Sciences*, 23(3), 596-601.

Statistics and Other Lies

Stan Abrams

Abstract

This is the fourth, and for this writer, the last of a series of debates that have grown in intensity and deteriorated to the extent that they serve little of value to the reader. It began with Honts (1998) reporting his research on discussions between charts. By dealing only with this one issue, he implied that this was Abrams' only objection to the Utah directed lie (DL) test. He ended his paper with an attack on Abrams because he had testified against the DL test in *US v. Gilliard* (1996) and other cases. Honts stated that in doing this, "Abrams had done a disservice to the courts, polygraphy and society." In contrast to that, this writer feels that this test should not be admitted into evidence because of the frequent false negative errors that have been found (calling a deceptive person truthful). Many of these inaccuracies were in high profile cases which have resulted in bad press for polygraphy and places the validity of this procedure in question. This writer's response was to list his various arguments against the DL approach and offer evidence of their errors, through listing some of the instances in which their findings were in disagreement with the final outcome of the cases (Abrams, 1999). This writer did not critique Honts' research on discussion between charts because this was in process at that time by Matte, (1999) and Matte & Reuss, (2000). Honts et al. (2000) responded to Abrams' paper by claiming that he was misrepresenting the facts. They implied that those cases listed by this writer were not false negative findings because deception should not be confirmed by any method other than confessions. Essentially, they do not consider any of their truthful findings which end in a court finding of guilt, a plea, or *nolo contendere* as evidence of their being in error. Since this is quite harmful to polygraphy, Abrams has elected to testify against their approach. Because Honts et al.'s statements question Abrams' veracity, it is necessary to demonstrate the inaccuracy of many of their statements.

It should be recognized that polygraph validity is most difficult to determine and is highly dependent on the particular ground truth that is employed (Abrams et al., in press). The most accurate, although not necessarily perfect, is confession. However, this presents a biased sample because relatively few subjects make admissions, and those who are found deceptive and confess are undoubtedly different from those who do not make admissions. In fact, some of this population might be innocent. Moreover, evidence of truthfulness based on someone else's confession is particularly difficult to obtain. In Honts and Raskin (1988), they employed recantations and what they called "incontrovertible physical evidence" as ground truth. Yet, they do not accept courtroom findings, pleas, and *nolo contenderes*. They cannot have it both ways: one is not any more objective than the other. One reads in their trial transcripts, that when a defendant has pled or has been found guilty, the Utah DL test group does not accept this as indicative of an error in their findings. However, when one considers the number of cases in which they have reported truthful findings and the final decision was in opposition to this, one must question the validity of the DL procedure and their rejection of the court findings and pleas as ground truth.

For reprints, contact the author at: 1130 SW Morrison St. Ste. 411, Portland, Oregon 97205

Editors Note: This is the final article in the current debate. We appreciate those who have contributed. Readers are invited to consider all of the arguments, and come to their own conclusions.

A case in point is *US v. Gilliard* which Honts (1999) used to demonstrate Abrams' alleged wrongdoing in assisting to keep that DL polygraph test from being admitted into evidence. Gilliard was a former physician who had in the past been found guilty of Medicare fraud and lost his license to practice. He again was accused of the same offense in the above named case and found guilty of 102 charges. While it is recognized that conviction is not a perfect measure of ground truth, it is strongly believed that relatively few errors are made in our justice system. In fact, Matte & Reuss (1999) reported a study by Huff et al. (1986) who estimated that false convictions made up only about one-half of one percent (0.5%) of courtroom findings.

This is a second case in which they cite as indicative of Abrams' misrepresentation of the facts. They were aware that this writer had the transcripts from *New Mexico v. Mead* (1994), yet they made claims that cannot be documented in the records. During the cross examination of Raskin in *Mead*, the prosecutor went through a series of cases that Raskin had found truthful but where examinees had later confessed, were found guilty, or pled. One of those cases, which became a large issue, was *New Mexico v. Wilson* (1986). In the Honts et al (2000) paper, they reported that in *New Mexico v. Wilson*, "Raskin tested her and found her truthful in general, but inconclusive on the question regarding the specific criminal charge." The following is taken from the transcripts of Mead's trial in Farmington, New Mexico.

D.A.: Dr. Raskin, do you recall performing a polygraph here in Farmington back in 1986 on a Nora Wilson?

Raskin: Yes. I didn't perform the test in Farmington.

D.A.: Okay, but you did perform a polygraph on Nora Wilson? You remember that?

Raskin: That's correct.

D.A.: And she was a school teacher accused of, here in Farmington, of molesting 11 girls in McKinley Elementary School.

Raskin: I don't know about that. She was accused, as far as I recall my test, with regard to one.

D.A.: Okay

Raskin: But I'm not certain.

D.A.: Do you remember?

Raskin: It's a long time ago.

D.A.: I have a letter that you wrote on February 14th in which you found Ms. Wilson, who was accused of molesting, fondling breasts and the genital areas of these kids. You tested her and found her to be truthful. Do you remember that?

Raskin: On one girl as I remember.

D.A.: On one girl.

Raskin: Not eleven.

D. A.: In that you said the scientific evidence indicates that the confidence of your conclusions exceeded 95%. Why does your confidence then exceed what your confidence is now with 90%? (*NM v. Mead*)

Raskin: Well actually my confidence is 95%, I just stated it more simply. I would still stand by that. As I said before, the test is not perfect. And there will be errors.

D. A.: Do you recall one of the relevant questions in that case was, "Did you ever fondle the breasts or touch the genital area of any of those girls at the school?'

Raskin: That refreshes my memory, but I don't know that.

D.A.: And you administered this polygraph on February 9th 1986? And isn't it true that Nora Wilson pled guilty on February 18th, nine days later, to 5 counts of criminal sexual contact and later admitted to having a problem?

Raskin: That's correct. In fact, the test result is wrong and I had some concerns about it at the time and I referred her attorney to Dr. Esplin with whom I do a lot of work. Then Dr.

Esplin did an evaluation and he is the one who got her to admit it. There's no question the test was wrong. It was a close result, I had concerns about it and that's why I did the referral.

In Raskin's cross examination he stated that "it was a close result" but one in which he had 95% confidence, but that he "had some concerns about." In Honts et al, they say that he found her "inconclusive on the question regarding the specific criminal charge," but yet in court he testified that, "The test result is wrong ... there's no question the test was wrong."

When Honts et al. discussed *New Mexico v. Mead* in their article, they stated "Abrams (1999) implies that he (Mead) also admitted his guilt which is a gross misrepresentation. Mead's lawyer pressured him to enter a guilty plea to a lesser charge ... because the prosecution announced that they planned to present a witness from many years ago that would say negative things about Mead." That part actually was true. Mead's wife's brother informed her that his daughter had accused Mead of exposing himself to her. Ms. Mead admitted this in her tearful statement in court. According to Honts et al, "...the defendant in that case actually pled guilty to a lesser charge..." Honts et al. went on to say that "...Mead refused to admit guilt and never confessed, in spite of the judge's orders to do so. The judge then sentenced Mead to an additional four years in prison because he refused to admit that he committed any of the acts to which he pled guilty. This is certainly a far cry from Abrams' description that Mead confessed and described his acts in detail." In direct contrast to what Honts et al. reported, the judge said to Mead, that to assist him in his therapy, he wanted him to admit what he had done to his two victims. Mead responded to that by reading the charges that had been leveled against him. The court would not accept that and Mead then described exactly what he had done to the two children.

The following is part of the plea agreement, "The defendant agrees to plead guilty to the following offenses ... attempted criminal sexual penetration of a child under thirteen years of age, Penalty nine years; ... Criminal sexual contact with a child under thirteen years; Penalty, three years. Honts et al. would argue that a plea does not necessarily imply guilt. However, this writer strongly feels that in the vast majority of cases it is the guilty individual who is plea bargaining in order to obtain a lesser sentence. It would certainly be the case for Mead whose own niece accused him as well as the two little girls he admitted to abusing. Like most child sexual offenders, he left a trail of victims behind him.

In *Griffith v. Muscle Improvement Incorporated*, Raskin was examined by the defense attorney who asked him about his findings of truthfulness in a series of cases in which the defendants were not acquitted. The purpose undoubtedly was to defuse these issues before this could be done under cross examination. Only a few will be reported here. It should be noted that in *New Mexico v. Wilson*, Raskin indicated that he only asked about one child, not 11 and in *New Mexico v. Mead* the attorney "pressured Mead into plea bargaining." In *State v. Archibeque*, Raskin said "I concurred with his (another examiner) opinion of truthfulness and the jury did convict Mr. Archibeque, but he never confessed." In *US v. Freedman*, "He entered a plea to a much lesser offense to get the case over with because it impacted on his career." In *State v. Reno*, "I reviewed the examinations done by two other polygraphists. I testified that they indicated that Mr. Reno was being truthful. The jury convicted him and there was never any resolution in terms of a confession or other evidence." In *State v. Tanner*, "I found Ms. Tanner truthful when she denied having caused the injuries that resulted in her child's death; The judge found her innocent of that but found her guilty on another charge." *In State v. Falcone*, "(She) entered a plea to a lesser offense ... and there was other evidence that indicated that the polygraph was correct." Some of the following cases will be presented to demonstrate that Abrams was not fabricating as Honts et al claimed. In *Griffith v. Melgaard*, which revolved around child sexual abuse, they state, "In the end the judge allowed custody to remain with the mother. This is not an unusual outcome in a custody case." However, that was not quite what occurred. The judge's decision was, "Mr. Melgaard's

visitation with Joli is suspended until further order of the Court. Mr. Melgaard shall undergo psychological counseling and therapy..." In a civil case *Anderson v. Samrock and the Bernalillo Sheriff's Office*, Honts et al. stated that, "Raskin's polygraph test clearly showed Anderson to be truthful. However, the deputy's tape recording of the incident was unclear ... This in no way indicates that the polygraph result was incorrect, as Abrams claims." Apparently Raskin forgot that Abrams evaluated his test and did not find the examination of Anderson to be indicative of truthfulness and he testified accordingly.

Statements such as, The attorney pressured the defendant to plead; I tested the defendant on a different issue; He pled to a much lesser offense, could very well be rationalizations and projections used to deny an inaccurate finding.

While this writer feels that at this point, he is only beating the proverbial dead horse, he would be remiss if Abrams excluded *New Mexico v. House*. Raskin found him truthful when he stated that he had a migraine headache when he had a head-on collision while driving the wrong way on the freeway and killed a mother and her three daughters on Christmas Eve. Raskin stated that House admitted drinking "a number of beers." He actually admitted to drinking seven and a half beers, and that was possibly an underestimate. A blood alcohol test administered five hours after the wreck and after he had vomited twice still showed him to be legally intoxicated. He was found guilty, and the publicity on this case was wide spread emphasizing the inconsistency of the polygraph findings with the jury's decision.

The Honts et al. rules when one's tests are found to be inconsistent with the final decision in the case would seem to be that the only evidence that is acceptable proof that the findings are in error is a confession. Court decisions, jury findings, pleas, and *nolo contenderes* offer no evidence to them that the examiners misdiagnosed their subjects. Considering the fact that there are relatively few confessions and that these are typically obtained by law enforcement examiners, one would expect, based on their approach, that their accuracy rate would be close to 100%.

There is little value in arguing the findings in all of the other cases that this writer cited. Given the large number of these cases, most of which Abrams (1999) did not report, one only has to recognize the obvious. There are too many cases, whether it is an evaluation of someone else's examination, or whether they were tests conducted by this group in which their polygraph findings were inconsistent with the final decisions.

Another issue that has not been discussed relates to this group testifying to support another examiner's findings or establishing a foundation for the admission of another polygraphist's findings. One should never establish a foundation unless the charts are clearly indicative of truthfulness nor testify in their favor unless this is the case. There have been two recent cases of this nature, one in Alabama and the other in Idaho. Both were instances in which the charts were blatantly poor, but in spite of that, the examiner was willing to establish a foundation or testify to their validity. These cases were not necessarily deceptive, but so obviously poorly administered that they were unscorable. In the Alabama case, the FBI went on to test the defendant and found him deceptive and this writer was completely in agreement with the FBI's findings.

Honts et al. reported finding three instances in which Abrams conducted an examination "...that presented a picture of error and poor technique." Apparently, it was Raskin who dredged up a case from 1975 where he reported that this writer asked an inappropriate question of Patty Hearst and supposedly inaccurately scored it. F. Lee Bailey brought in four polygraphists to administer the tests, Barland, Raskin, Abrams, and Charles Zimmerman who had more polygraph experience than the three other examiners put together. Each night this group together developed the questions and the procedures to be used and the next day the three relatively new polygraphists simply administered the tests. Therefore, there is no way that Abrams varied from either the questions or the procedures that were developed by the group as a whole. As this writer recalls, the scoring was also a joint venture.

Regarding the second example given by Raskin, there was a case out of Seattle quite a few years ago in which this writer found a male teacher deceptive related to some sexual harassment charges and Raskin reportedly scored Abrams' charts and found the teacher truthful. However, in contrast to the woman admitting to a hoax, Abrams was informed by the attorney that she discontinued her legal action after Raskin's findings.

The remainder of this paper will be devoted to some of the other so called misrepresentations of Abrams.

They state, "Fortunately for the polygraph profession, Dr. Abrams' (1999) assessment of the frailty of the CQT is absolutely without support." Abrams has never criticized the CQT in writing, in court, or in a presentation. However, he has been a strong critic of the DL procedure which must be viewed separately from the probable lie technique.

Honts et al. indicated that Abrams never responded to Honts' study of discussion between charts. That is correct. Actually, Matte and Abrams were going to combine in their response to Honts, but it was decided that Matte would deal with discussion between test repetitions (Matte, 1999, Matte & Reuss 1999) and Abrams would deal with the other problems of the DL test. In their latter paper, Matte & Reuss very effectively demonstrated how the DL draws the subject away from his or her natural set in which the subject reacts to the greater threat, that is, the deceptive react to the relevants and the truthful to the comparison questions. However, when the DL is added and it is emphasized by indicating that this is how one can determine if deception is still being detected, it creates a new psychological set toward the DL. Matte stated (1999) that "This study also confirms that the discussion of the DLCQ between charts (tests) increases the guilty examinee's apprehension regarding the DLCQ, thus reorienting the guilty examinee's psychological set from the relevant question(s) to the directed-lie control question(s) creating a formula for false negative results."

Added to that, when the subjects are instructed prior to the examination and between each chart to think of a time when they committed that particular act to which they have been instructed to lie, it is creating cognitive arousal. This is the same type of increased reactivity that Raskin (1989) reported could be employed as an effective countermeasure. Therefore, as Barland (1999) pointed out, the examiners are in essence, creating a countermeasure for their subjects and assisting them in being found truthful in the test. This can be seen even more when the subject becomes somewhat unsure of his or her answer. When the subject is asked a DL such as "Did you ever tell even one lie in your life?" and he or she is supposed to lie and respond "no" the subject sometimes becomes confused and requires additional time to think or actually inadvertently answers "Yes". The confusion creates an even greater reaction. Recently this was seen in *Idaho v. Welch* (1999) where the defendant became confused during the DL questions, sometimes answering no and other times responding yes. This resulted in a test full of artifacts. During the test, the subject stated that she was confused. This test should never have been considered for admission into evidence which was demonstrated by her decision to plea bargain. Honts et al. state that Abrams in *US v. Gilliard* was asked if he were aware of any research showing that emphasis on one question over another resulted in swaying the results in that direction. Actually, prior to that in that hearing, this writer had discussed his pilot study (1991) on the DL. Abrams admitted that it was weak in some manners mainly because these were actual field tests and the writer did not want to risk contaminating the test results by including the DL questions within the examination. Therefore, the DL was only asked once in the last chart of each subject when the test was completed. The DL question was presented with exactly the same instructions that Raskin had used in some of his field tests. This procedure was used in many examinations, but was not included as part of the study unless an admission was obtained from the subject or some other individual who cleared the suspect. It was believed that administering the DL question had the same effect on Abrams' subjects as it did on the first chart on Raskin's DL test. However, it was only repeated one time as compared to the three repetitions in the typical DL used by the Honts-Raskin group. The

results were not expected to be an indication of the validity of this approach, but it was specifically aimed at determining what impact the emphasis had on confirmed truthful and deceptive subjects. It did demonstrate that both the truthful and deceptive subjects moved in the direction of truthfulness. While it certainly served to reduce the false positive rate, it was found that it could increase the false negative findings. Matte (1999) was in agreement with these assumptions. Moreover, in the Honts and Raskin (1988) field research of the validity of the DL, their only reported error was a false negative finding.

Honts et al. stated that "Abrams conveniently fails to mention that Fuse recommends the stimulation of the DL between repetitions." Unfortunately, they neglected to do their research. Fuse was the first government polygraphist to write about the use of the DL technique and he strongly recommended against discussing questions between charts let alone emphasizing one question, such as the DL more than the relevant. Honts et al. confused Stallsmith's paper which was an edited version of Fuse's, and he did recommend the stimulation of the DL questions between repetitions. This was confirmed by a phone conversation with Fuse who now lives and works in Maryland and still believes that there is a risk of false negative findings if one emphasizes the DL questions between charts.

The term hybrid approach was not created by this writer as implied by Honts et al., but by either the court or one of the attorneys in the *Gilliard* case. Since it was used during the discussion between the difference between the government's DL test and the Utah approach, it was assumed that whoever coined the term, used it to describe the Utah DL to keep it distinct from the government's procedure. Honts et al. have been trying for years to imply that the government employs this procedure in specific testing. They use it in employee screening and in terrorism and sabotage testing, but they do not emphasize DL questions between chart repetitions. Honts attempted to use a letter from Yankee in *US v. Gilliard* to indicate that many government agencies were employing the Utah approach. Honts wrote Yankee requesting a list of those agencies who were employing the DLCT and Yankee sent a list of those who were using the government's method, not the Utah approach. In fact, in preparation for the *Gilliard* case, some of these agencies were contacted and they denied any use of the Utah DL.

Honts et al. reported that in the Honts and Raskin DL validity study, only two of the six child victims recanted, therefore, Abrams' criticism of that research is invalid. While they only admit to two children of the six recanting, even that could distort the results of their study because it could mean that two of the alleged child sexual offenders who were evaluated as confirmed truthful, could well have been deceptive. In a small sample, that could certainly have influenced the overall results. Regardless of their claims, children who have been victimized tend to recant especially if it is their father or another relative who is the perpetrator. The child experiences guilt and perhaps fear in sending his or her father to prison and concern because the mother does not know how she alone can support the family. If Honts et al. are so objectively scientific that they do not accept courtroom decisions or plea bargaining as ground truth, one would wonder how they could possibly accept the recantations of a child. This is viewed as being every bit as subjective as plea bargaining and more so than courtroom decisions.

One final issue and then this will be more than enough. This relates to the notorious Hofmann case in which Honts et al. state that "Abrams also claimed that the Utah Polygraph Association evaluated the polygraph charts from the Hofmann examination, and that they all came up with inconclusive results, and the results of their evaluation were reported before the American Polygraph Association. This simply never happened. The Utah Polygraph Association never reviewed the Hofmann polygraph and thus could not have made a report to the American Polygraph Association." In direct contrast to their statements, Steve Bartlett attended a meeting in which Honts presented the Hofmann case and charts before about 25 members of the Utah Polygraph Association. Some of them found the charts deceptive and others inconclusive. Bartlett at some later time reported this before an APA Seminar.

The purpose of writing this paper was to deal with the many charges of Honts et al. that Abrams misrepresented the facts in his paper (1999). It was not possible for this writer to allow those accusations to remain unchallenged nor was it feasible to expend the time and effort to counter every accusation made. Hopefully, it will suffice to demonstrate that Honts et al. made several incorrect statements.

References

Abrams, S. (1991). The directed lie control question. *Polygraph*, 20(l), 26-31.

Abrams, S. (1999). A response to Honts on the issue of the discussion of questions between charts. *Polygraph*, 28(3), 223-228.

Abrams, S., Wygant, J. & Leutwyler, G. (2000). Polygraph validity in the new millennium. *Polygraph*, 29(4), 344-356.

Anderson v. Samrock (1995). 2nd Judicial District Court, CV 73 9898, Albuquerque, New Mexico.

Barland, G.H. (1999). Countermeasures. American Polygraph Association Seminar in Dallas Texas.

Bartlett, S.K. (October, 2000). Personal communication.

Dollins, A.B. (1998). A guide to Department of Defense Polygraph Institute research interests. *Polygraph*, 27(2), 89-95.

Fuse, L.S. (1982). The directed lie control question technique. Unpublished manuscript.

Fuse, L.S. (September, 2000). Personal communication.

Griffith v. Muscle Improvement Incorporated (1998). No. BC215080, Superior Court of the State of California of Los Angeles.*

*The 5 citations that follow can be found in *Griffith v. Muscle Improvement Incorporated*.

State v. Archibeque
U.S. v. Freedman
State v. Reno
State v. Tanner
State v. Falcone

Griffith v. Melgaard (1995). 4th Judicial District Court, case 23378 D, Boise Idaho.

Honts, C.R. & Raskin, D.C. (1988). A field study of the validity of the directed lie control question. *Journal of Police Science and Administration*, 16, 56-61.

Honts, C.R. (1999). The discussion of questions between list repetitions. *Polygraph*, 28(2), 117-123.

Honts, C.R., Raskin, D.C., Amato, S.L., Gordon, A., Devitt, M. (2000). The hybrid directed-lie test, the overemphasized comparison question, chimeras and other inventions: a rejoinder to Abrams. *Polygraph*, 29(2), 156-168.

Huff, C.R., Rattner, A. & Sagarin, E. (1986). Guilty until proved innocent: Wrongful conviction and public policy. *Crime and Delinquency,* 52(4), 518-544.

Matte, J.A, & Reuss, R.M. (1999). Validation of potential response elements in the directed-lie control question. *Polygraph,* 28(2), 124-142.

Matte, J.S. (2000). A critical analysis of Honts' study: the discussion (stimulation) of comparison questions. *Polygraph,* 29(2), 146-150.

Raskin, D.C. (1989). Polygraph techniques for the detection of deception. Chapter in D.C. Raskin (Ed.) *Psychological methods in criminal investigation and evidence.* (pp.246-296).

State v. Mead, (1993). 11th Judicial District Court, CR-92-502-3, Farmington, New Mexico.

State v. Norah Wilson.

State v. Welch, (1999). 7th Judicial District, CR-99-2362, Idaho Falls, Idaho.

U. S. v. Cordoba (1999). U.S. 9th Circuit Court of Appeals No. CR-95-0003 9-GLT.

U.S. v. Gilliard (1996). CR 196-6, Savannah, Georgia.

Is the Polygraph Allowed in Panama?

Geraldo Solis

Key words: admissibility, law, Panama

Before answering the title question, let us make a short review of the rules, both of the constitutional and legal order, that may have some incidence on this matter. In the first place, I would like to cite the Political Constitution of the Republic, that in its Article No. 40 establishes:

> "Every person is free to exercise any profession or trade subject to the regulations established by the Law in relation to capability, morality, prevision and social security, association, public health, unionism and binding quotations."

Immediately, in the second place, I cite Article No.18 of the Political Constitution, which established:

> "Private persons are only responsible before the authorities for the infringement of the Constitution or the Law. Public officials are responsible for these same causes and also for abuse of authority or by omission in the exercise of same."

Inasmuch as it is the law by constitutional mandate that governs the exercise of a profession and there is no legal rule prohibiting its exercise, we expeditiously arrive to the conclusion that the polygraph can be used in this country.

After having made the foregoing asseveration, it would be irresponsible to assume that its use may be carried out trivially. There are other norms, constitutional in nature which restrain the manner in which it must be used, which are not incompatible with the correct use demanded by the norms approved by the American Polygraph Association.

Article No. 22, also of the Political Constitution demands the assumption of innocence of every person accused of having committed a felony, whatever it may be. This provision, which has the highest rank in the hierarchy of the norms of living in society, requires from the examiner administering the polygraph exam, totally objective and fair conduct during the exercise of the discipline. Therefore, it should not be accusatory, nor even incline to suggest that the test has as its only objective, to detect deception, but that it has a double, well balanced mission: to verify the veracity or detect deception of the statements of the individual under examination.

The second part of Article No. 22 of the Political Constitution indicates that a detained person is entitled, as of this time, to the assistance of a lawyer during the police and judicial proceedings. This norm assumes, and it has been so expressed by the maximum corporation of justice in Panama, the existence of a person under arrest, and it is then, as of the time that someone is affected by a Detention order, that the person's right to be assisted by a lawyer in the judicial proceeding is recognized. Nevertheless, it should be well

This article is a portion of a paper presented at the annual meeting of the Association of Latin American Polygraphists, in Panama City, Panama, in October 2000 by Sr. Gerardo Solis. The author is the Electoral Attorney General of the Republic of Panama for the period 1999-2009, and a polygraph examiner trained at the International Polygraph Academy. He is a lecturer for two universities in Panama, and the author of three books. For reprints, write to: Gerardo Solis LL.M., PO Box 55-1063 Paitilla, Panama City, Republic of Panama.

established that this right to legal assistance does not mean in any way that the lawyer may interrupt the proceeding after being initiated. The participation of the juridical counselor is limited to letting the person under arrest know what his or her rights are, and to verify that these rights are not violated.

For example, the individual who has rendered a testimonial deposition at a criminal summary investigation is entitled to know Article 337, Numeral 2 of the Electoral Code, if it is a criminal electoral matter, or Article 355 of the Criminal Code if it is an ordinary criminal matter. Both norms warn of the penalties corresponding to those rendering false testimony, and the person to be questioned, as the presumed person connected to a possible felony, has the right not to incriminate himself or herself, and his or her declaration must be freely obtained and without pressure or oath[1].

Any person being questioned on criminal, police or correctional matters, whether as a mere witness or as perpetrator or participant in a sanctionable act, has the right to know the content of Article No. 25 of the Political Constitution which says:

> "No one is obliged to declare in a criminal, correctional or police matter, against himself or herself, his or her spouse or relatives within the fourth degree of consanguinity or second of affinity."

In a Civil or Commercial Procedure

Let us now examine which legal possibilities the polygraph has of being used at a civil or commercial lawsuit in Panama. The Judicial Code that governs the procedure of civil or commercial lawsuits says that documents, reports, scientific means and any other rational means may be used as evidence which serves to the formation of the judge's criterion. In the event it is deemed convenient for the same proof of what is sought to be demonstrated, the judge may order the obtainment of any other procedure of scientific verification[2].

When an expert of the polygraph science is a public official, the judge may request any "technical or scientific report from professionals or technicians, on facts and circumstances of interest to the process"[3]. The polygraph expert evidence may be heard by the judge, so that he or she may know, appreciate or evaluate any fact or deed influencing the process which has scientific, technical or practical character and which does not belong to common experience, nor to the specific formation required to the judge[4]. This expert opinion shall be considered by the judge, taking into consideration the scientific principles on which it is based, the relevance with the facts of the case, the competence of the experts and pursuant to the value system of sane criticism[5].

If, in order to make a philosophical juridical exercise, it is alleged that the judgment of the polygraph scientist is a mere act indicating the existence of another - to wit, the truthfulness or falseness of the statement- we would be in the presence of procedural evidence which should also be considered by the judge in accordance to sane criticism[6,7]. When the scientific knowledge is directly given by a testimonial statement, the judge shall also appraise it in accordance with the rules of sane criticism[8].

As shown herein until now, the general rule of the Panamanian Procedure Law is sane criticism, and it is categorically so expressed in Article no. 770:

[1] Article 2112 of the Judicial Code.
[2] Article 769 of the Judicial Code.
[3] Article 880 of the Judicial Code.
[4] Article 770 of the Judicial Code.
[5] Article 770 of the Judicial Code.
[6] Article 969 of the Judicial Code.
[7] Article 973 of the Judicial Code.
[8] Article 904 of the Judicial Code.

> "The evidences shall be appraised by the Judge pursuant to the rules of sane criticism, not excluding the documental solemnity established by the law for the existence or validity of certain acts or contracts. The judge shall reasonably express the examination of the probatory elements and the merits corresponding to them."

It is important to indicate that, even if the parties have not requested polygraphic evidence, the judge may so do it officially, as it is set forth in Article No. 782 of the Judicial Code which practically obliges the judge to perform those evidences which serve to "verify the statements of the parties."

The Supreme Court of Justice in court decisions of January 29, 1991, established as a doctrine that according to the immediately cited rule "it has been concluded that the legislator has conferred the judge the opportunity to produce evidence, within the process, to clarify, as completely as possible, all the aspects in relation to the controverted matter." This faculty of the judge of the first plea, whose duty is to obtain whatever it is necessary to arrive at the material truth should only be limited to "the performance of those evidences which are in order to verify the statements of the parties."

This jurisprudence reiterates the principle already expressed by the Court, by saying "[o]ur procedural law is leading toward new trends, seeking what is known as the search for material truth...Our code not only allows the official action of the judge in the contribution of evidence...but also establishes the principle of sane criticism which leads the judge to update his or her juridical knowledge to intent a better motivation of his or her judgments, it enhances his or her scope of action, making the process more dynamic, with the complement of probatory elements which may contribute to establish the veracity of the facts..." The judge of the first plea must order "...the practice of all those that he or she deems pertinent to verify the asseverations of the parties."

In a Criminal Court

Let us now examine the criminal process and the possibility of including the polygraph examination as evidence in the instruction summary for the investigation of the felonies and the right of the accused person. The instruction of the summary has the main purpose to verify that there is:

1. A punishable fact, and;

2. To discover their perpetrators, as well as any fact which allows to individualize him/her personally to know his life style and habits among others.

With this objective in mind, the instructing agent may carry out all the useful steps to discover the truth. As it may be observed, we have divided in two parts the purpose of the summary, to analyze now the use of the polygraph in each one of them.

During the Investigation of the Punishable Fact

In this phase the use of a polygraph is perfectly valid, because the violating fact of the criminal law which constitutes a felony may be verified with "scientific methods or any other rational mean which serves the formation of the judge's conviction[9]. In the event we are dealing with a felony which leaves no sign nor clue, the testimony of the polygraph scientist may be taken, in his or her capacity as a witness, if he or she arrives to the trustworthy knowledge that the felony was committed, or it may be included in the file of papers, the document containing the report of the polygraph examination which tends to demonstrate that the felony was really committed[10].

[9] Article 2073 of the Judicial Code.
[10] Article 2097 of the Judicial Code.

During the Investigation of the Offenders

Every person accused of a felony has the right, if so requested, to be examined for the verification of the truthfulness or detection of deception of his or her declarations, by the use of a polygraph. According to the Judicial Code, the accused has the right "to the performance of the proofs he or she deems favorable to his or her defense, which shall be obligatory."[11]

If a polygraph expert is cited to declare as a witness or expert, he must appear to carry out the duty demanded from him or her. The value of the statements shall be appraised by the judge pursuant to the rules of sane criticism[12]. To assure the best verification of the truthfulness of the events and the correct elucidation of the facts, the same judge shall be the person who shall examine the documents and other conviction pieces, which may be the reports of the polygraph test.

An interpretation "a contraria sensu" of the provisions of Articles 2261 and 2262 of the Judicial Code allows us the procedural opportunity to introduce any evidence requested by the judge, even up to the time of holding the hearing. Therefore, it may be possible that the judge may order the performance of a probatory pursuit, the summary investigation having been concluded.

The Polygraph Presence in the Electoral Jurisdiction

It must be considered and clearly understood that, in Panama, the electoral jurisdiction, by disposition of the Political Constitution, is totally autonomous and independent, and the decisions of the Electoral Court Judges are final, irrevocable and binding[13]. Both the Justices[14], as well as the Electoral Attorney General[15], have the same category as their homologous of the Supreme Court of Justice.

Thus, it is a very special jurisdiction to which all the foregoing references are supplementary applied to the common criminal and civil processes. Nevertheless, the interpretation and application of the laws in this jurisdiction is the exclusive competency of the Electoral Court.

Therefore, yes, the polygraph may serve democracy within an electoral procedure. Furthermore, according to the electoral law, all actions which are brought forward at the Electoral Court are obliged to submit all evidence which are in order to verify the assurances[16].

In order to obtain more evidences in the cases where it is deemed convenient, to demonstrate the realization or not of an investigated fact or the possible connection or not of a suspect, by means of a reasoned resolution, the Electoral Attorney General arranges, in the first place, to request the consent of the person who is to undergo the polygraphic examination, and if such person gives consent, arranges, in the second place, to perform the examination. Once the professional criterion has been formed, it serves as a scientifically based element for the formation of the conviction reflected in the juridical opinion which is delivered with the file of papers to the Electoral Court for its final classification.

Recently, a precedent was established in this jurisdiction, under the judgment of the Chief Judge Eduardo Valdes Escoffery, wherein the maximum corporation of electoral justice specifically ordered the polygraph test,

[11] Article 2123 of the Judicial Code.
[12] Article 2128 of the Judicial Code.
[13] Article 136 of the Political Constitution.
[14] Ibid.
[15] Article 498 of the Electoral Code.
[16] Article 443 of the Electoral Code.

with previous consent of the investigated person. And by means of judgment of September 28, 2000, the Electoral Court, by unanimous decision, resolved to release from responsibility, definitively dismissing the investigated person, among others, by virtue of the following reasoning that establishes jurisprudence.

> "The expansion of the summary was ordered, to request the accused one his/her consent to submit himself/ herself to the verification test of the truthfulness of his/her testimony indicating the questions to which he/she has to answer...by means of an agreement respectively subscribed, the ladies freely and spontaneously accepted to submit themselves to the polygraph technique, to verify the truthfulness of their testimonies or detect deception of their statements..."
>
> "From the reports of the procedure for scientific confirmation by means of the use of the polygraph, to which the ladies were submitted ... by the Electoral Attorney General's Office, it was concluded that the statements of the above referred ladies were true."
>
> "Taking this into consideration, the Electoral Attorney General has amended the previous request by the Deputy Electoral Attorney General ... and in default thereof, requested from the Judges of this court not to sanction...inasmuch as the veracity of the testimonies was verified, both, of the accused one as well as of the witness, after the usage of the scientific confirmation procedure of the veracity of their declarations by means of the use of the polygraph method..."
>
> "Nevertheless, taking same into consideration, it is in order to accept the request of the Attorney General, stating first that the technique to which said lady and the witness were submitted is accepted by our procedural legislation, specifically in article 769 of the Judicial Code wherein it states that the use of any scientific method which serves toward the formation of the conviction of the judge is allowed, and likewise it is wise to indicate that the above mentioned persons accepted to submit themselves to the examination and consented to the disclosure of same."

In another case, in October, 2000, the Electoral Court decided to sanction the accused person, taking into consideration a report of a procedure for scientific verification by means of the use of the polygraph. In this opportunity the Deputy Electoral Attorney General had requested to exempt the person under investigation; nevertheless the Justice who prepared the opinion, Dennis Allen Frias, ordered the expansion of the summary allowing to carry out "any other possible procedure, for the clarification of the facts".

Complying with this provision, the Electoral Attorney General, with the authority of the person under investigation, performed a polygraph test, detecting deception in the statements, and afterward, under examination, the person admitted having lied. The defense lawyer tried to justify the lie of the defendant, nevertheless, in another unanimous decision the Electoral Court resolved to sanction, clearly establishing that:

> "[w]e must not avoid mentioning, that the citizen in question, admitted having lied, after willingly submitting herself to the scientific verifying procedure of truthfulness of detection of deception of her statements, by means of the polygraph recorder of psychophysiological changes, wherein 'evidences and reactions which indicate deception were found.'"

The Judges assess the polygraph test according to the system of sane criticism[17].

Conclusion

Yes, the polygraph is allowed in Panama.

[17] Article 443 of the Electoral Code.

The use of the polygraph is rarely prohibited in any part of the world. Basically its use depends only on the free and spontaneous will of the subject under examination who has submitted to the test, so that a competent examiner performs it, and may determine if he or she is saying the truth or lying in his or her statements. The procedure of scientific verification by means of the use of the polygraph method may be used even in the judicial process to serve to the formation of the conviction of the judge, and it would be timely assessed, according to the sane criticism of the judge. In civil proceedings within the course of a commercial lawsuit, there is no impediment to its admission as scientific evidence which may serve to the formation of the conviction of the judge.

In the summary arraignment for a criminal investigation, the polygraph test may also be incorporated, as a test, if it is so deemed convenient by the instruction agent. It must be introduced in the file of papers with obligatory nature if it is a test requested by the defendant's attorney, because it serves to show the innocence of the accused.

The verification of veracity or detection of deception by means of a polygraph, a psychophysiological procedure, is a valid and trustworthy scientific method to find the material truth: and the material truth being the real objective of the judicial procedure. Therefore, the use of the polygraph is practically obligatory. The Supreme Court has said "[t]he judge of the first plea must order the performance of all those (evidences) which he deems fit in order to verify the statements of the parties." At the plenary phase, or during the hearing, the judge still has the possibility of requiring the use of the polygraph as evidence, if he so deems convenient.

References

American Polygraph Association, (1999). *Polygraph: Issues & Answers.* Revised October 1, 1999.

American Polygraph Association Newsletter, Vol. 33, May-June, 2000.

Electoral Code of Panama.

Judicial Code of Panama.

Matte, J.A. (1998). *Forensic Psychophysiology Using the Polygraph: Scientific Truth Verification - Lie Detection* (2nd Edition). JAM Publications: Williamsville, N.Y.

Political Constitution of the Republic of Panama.

Polygraph Course Handbook of the International Academy of Polygraph of Fort Lauderdale, Florida, United States.

A Polygraph Technique for Evidentiary Applications

Donald J. Krapohl and Yazmín Vélez

Key words: evidentiary examinations, Guilty Knowledge Test, objective scoring, polygraph

There are three principal testing formats used in polygraphy today. The most common method is the Comparison Question Technique (CQT), which takes on various forms and compositions: Reid, Arther, Backster, DoDPI, Marcy, Gordon, and others. The CQT is the method of choice almost everywhere the polygraph is used in criminal investigations, except in Japan and China. Its popularity stems from its wide range of applications, and the advent of scoring systems to which the CQT is amenable. To a lesser extent, the Relevant-Irrelevant (RI) technique is used, primarily in multiple-issue screening applications. For many years the RI was applied to criminal testing, but it began to decline with the spread of the CQT in the 1950s. The third format can be generically called the Concealed Information Technique (CIT). The family of CITs includes the Peak of Tension (POT) tests, stimulation tests, and the Guilty Knowledge Test (GKT). While most polygraph practitioners have used POT and stimulation tests, the GKT is less familiar, and it is the GKT that is the focus of this paper.

In 1959, Dr. David T. Lykken reported a testing and scoring system for the electrodermal channel that could be used in criminal investigations. Dr. Lykken's method, which he called the Guilty Knowledge Test, capitalized on the higher physiological arousal that occurs when a guilty subject recognized a crime-related test item placed on a test among several topically similar but unrelated items. Innocent subjects, those who do not know which of the items are relevant and which are neutral, are less likely to produce electrodermal responses (EDRs) to the crime-related test item.

A test for guilty knowledge was hardly new to the field of lie detection, and the earliest work on guilty knowledge for criminal applications can be traced back to the first part of the last century (Crane, 1915). Polygraph examiners may recognize the GKT as another form of POT, to which it is very closely related and has been used since at least the 1930s, but there are important differences. First, only the EDA channel need be used with the GKT. Examiners may record the other two traditional polygraph channels to comply with licensing, regulations or APA requirements when conducting a GKT, but they need not be interpreted. Second, the test items are in random order, except that the first item is always a buffer item. Third, the GKT is scored objectively, using a method described later in this paper.

Acknowledgments

We are grateful for the editorial review and technical information provided by Dr. Gordon Barland.

This paper originally appeared in Spanish on the Website of the Asociación Latinoamericana de Poligrafistas (ALP) at www.lafayetteinstrument.com /alp/entrada/alp.htm.

Donald J. Krapohl is a researcher at the US Department of Defense Polygraph Institute. Yazmín Vélez is a trained polygraph examiner, and Director of International Sales for the Lafayette Instrument Company. The opinions expressed do not necessarily represent the views of the Department of Defense, US Government, or Lafayette Instrument Company. For further information, contact Ms Vélez at: yvelez@licmef.com, or by telephone at 1-800-428-7545.

Before taking up a discussion of the GKT procedure, let us first address the natural question as to the reason that a trained field polygraph examiner, highly competent in conventional techniques, would consider using the GKT. One reason is that there is more general agreement in the scientific community regarding the defensibility of the theory underlying the GKT. While scientific agreement doesn't necessarily solve crimes, it does have bearing on whether a testing method meets evidentiary standards for courtroom admissibility. A polygraph examiner wishing to use the results of a polygraph examination as evidence in court would find more scientific support with the GKT than any other polygraph technique. This is not to imply that the other methods are less valid, only that many scientists have a preference, and that preference is the GKT.

The GKT is very simple to administer. Before the examination, the examiner constructs a series of test question lists where the items are taken from the case facts. The best way to explain the test construction process is to use an example. Let's say that the St. John Pharmacy was robbed by a man wearing a mask over his face and holding a screwdriver. He took $1,880 during the holdup. In addition, he stabbed the owner in the hand. The robber then ran down the street, and escaped by jumping on a bus that had pulled up to the corner.

We can assume that many of the details of that robbery would be remembered by the thief: the name of the business, the weapon, the disguise, the amount of money stolen, where the owner was injured, and the form of transportation used in the escape. Similarly, an innocent person would probably not know them unless there had been a leak of information to the public. Assuming that the police had properly withheld these details, a GKT could be administered using the crime information on any suspect brought in for testing.

Each case fact would have a separate test. Using the present example, the type of weapon would make a good GKT. The following items might be used: pistol, rifle, machete, knife, broken bottle, and of course, screwdriver. The screwdriver would be called the critical item, or sometimes the "key". All items in the list must be equally plausible: the innocent must not be able to guess which is the critical item in the list because of some characteristic of the item. In addition, there should not be any implausible items on the list, i.e., a cannon or a noose. It is also important that the critical item be something that the guilty person is very likely to remember. The robber may not recall the color of the shoes or hair of the victim because they were less important to the crime. One should also be mindful that crimes are often committed by intoxicated criminals, whose memories are compromised by drugs or alcohol. Care must be taken in selecting the critical items for the GKT that are very likely to be recognized by the guilty examinee.

Each GKT list should have 5 or 6 items, including the critical item, and there should be 3 or more lists, each with a different critical item. The placement of the critical item among the other items in a list should be done at random, using a random numbers table or some other means. However, the critical item must not be in the first position. That position is always reserved for a neutral item. The reason for having 3 or more lists of items will be discussed later in this paper.

Once the lists are made, the examinee can be tested. The sensors are placed in the usual manner, but as stated previously, only the EDA channel will be scored. The examiner then begins the test. A question series using the type of weapon could be presented like this:

> "If you are the robber of that pharmacy, you know what type of weapon was used. Just repeat the weapons I say after me. Was it a: pistol, rifle, machete, knife, screwdriver, broken bottle."

The examinee is instructed to repeat the items to ensure he is paying attention. Since only the EDA is used, question spacing can be closer than the 25 seconds recommended for CQT testing. The GKT is given only once per list, and then another list is used to conduct another GKT.

After 3 or more GKTs are given, the examiner can begin to score them. Scoring is very simple. The first item on the list is never scored, only the remaining items. Using only EDR amplitude, if the strongest EDR occurs on the critical item, it receives a score of 2. If the second highest is the critical item, the score is 1. No score is given if the EDR to the critical item is ranked third or lower. Therefore, the highest score possible for 3 GKTs is 6, and the lowest is 0. Decision rules vary, but Lykken (1959) reported success using a cutting score that was equal to the number of GKTs administered. In the present example, a score of greater than 3 would indicate the examinee had knowledge of details of the crime not expected of an innocent person.

The real beauty of the GKT, in addition to its simplicity, is that the test permits the user to calculate the precise probability of a false positive error. The capability to calculate the error of a test is a factor many jurisdictions find important in forensic testing. One method of error estimate for a version of the CQT has shown promise (Krapohl & McManus, 1999), however at this writing the GKT has the larger body of supporting data. Probability tables for GKT scores are found in Dr. Lykken's recent book (1998, pp 290, 292).

The reason that it becomes important to have 3 or more GKTs has to do with probabilities. The likelihood that an innocent person would react largest to the critical item is a function of the number of items. If there were 5 items on the test, excluding the first item, the probability that an innocent person would react greatest to the critical item is 20% (1 in 5). The likelihood of that same innocent person reacting to the critical item on the second GKT is also 20%, and so on through the number of GKTs. If the examinee reacted on the first and second GKT, the probability that this occurred solely by chance would be 4% (20% of 20%). Reacting also on the third GKT would be even more unlikely for the innocent person: 0.8% (20% times 20% times 20%). In other words, there is about one chance in 100 of an innocent person, unaware of the true crime details, would react most strongly to the critical items on all 3 GKTs. Reacting to the critical item on all subsequent GKTs further reduces the chance probabilities by 20% each.

One of the limiting factors for the GKT is the availability of critical test items. The success of the GKT depends on investigators having access to crime details that have not been released to the public or the examinee. In contrast, the CQT can be used in almost all circumstances, since the technique does not depend on the availability of restricted information. Podlesny (1993) conducted a file review of polygraph cases conducted by the Federal Bureau of Investigation (FBI) in order to determine to what extent the GKT could be used by the FBI in its crime investigation mission. His data indicated that only a small portion of the FBI polygraph caseload was amenable to the GKT methodology, a mere 13.1%. This percentage may or may not apply to other settings, where crime details are handled differently by the police and the news media. Podlesny suggests that the GKT might be introduced as an adjunct to the CQT testing, in order to reduce errors, but that it does not offer a strong alternative to the CQT in most field applications.

In summary, the GKT is an elegant and powerful testing technique, with many important advantages. Its only significant shortcoming is that it cannot be used in all cases, but only those where there are a sufficient number of critical items. Examiners are encouraged to try the GKT, to become familiar with it, so that they have yet another tool at their disposal.

References

Crane, H.W. (1915). A study in association reaction with an attempted application of results in determining the presence of guilty knowledge. *Psychological Monographs*, 18(4), 1-61.

Krapohl, D.J. & McManus, B. (1999). An objective method for manually scoring polygraph data. *Polygraph*, 28(3), 209-222.

Lykken, D.T. (1959). The GSR in the detection of guilt. *Journal of Applied Psychology*, 43, 385-388.

Lykken, D.T. (1998). *A tremor in the blood: Uses and abuses of the lie detector.* Plenum Trade: New York.

Podlesny, J.A. (1993). Is the guilty knowledge polygraph technique applicable in criminal investigations?: A review of FBI case records. *Crime Laboratory Digest*, 20(3), 57-61.

Industrial Espionage: What is it, Who's Involved and What Harm Can it Cause?

Randal F. Mueller

Abstract

Companies can spend tens of millions of dollars in research and development to deliver products to their customers, such as a new vaccine for cancer, a new weapons system to the battlefield or advances in computer technology. In a simple, yet reprehensible, criminal act called espionage, all of this research and development can be a bust. Trade secrets are the property of the companies developing the technology. Unauthorized disclosures of these trade secrets can devastate a business, and ultimately commerce in general. Threats of espionage can come from competitive industries within and outside a country by foreign competitors or even foreign governments. Industrial espionage is a threat that has been recognized and must be dealt with to ensure integrity within industry is maintained.

Profits from industrial espionage can be enormous; so, too, can the consequences. In a speech given to the Executive's Club in Chicago, Illinois, Louis J. Freeh (1995), Director of the Federal Bureau of Investigation (FBI), stated that, "(e)conomic espionage costs U.S. companies about $100 billion each year in lost market share, contracts, jobs, research and development. The stakes are too high for us to undervalue the threat and simply watch as our economic strength slips away."

A company named Intel Corporation, a semi-conductor manufacturer based in Sunnyvale, California, learned of the threat only after a rival company, Advanced Micro Devices, Inc. (AMD), also located in Sunnyvale, alerted Intel that a former employee had attempted to sell Intel's company secrets. As reported in the Los Angeles Times (October 20, 1995, p. D2), Guillermo (Bill) Gaede faces up to 14 years in prison and $500,000 in fines. Gaede is accused of giving Intel's proprietary information regarding advanced micro-processors to rival competitor, AMD. According to the FBI, the Silicon Valley, where Intel and AMD are headquartered in California, is a preferred target of the corporate spy (McDermott, 1994, p. 54).

Potential profits to be gained by individuals, rival companies and even foreign governments are immeasurable. Kahn (1978) highlighted the non-quantifiable aspect of economic impropriety, "In 1929 and 1930, Standard Oil Company (New Jersey) and I.G. Faren (a giant international chemical cartel based in Germany) entered into agreements between their firms to share development and divide exploitation of new products" (p. 85). One such product was isobutylene rubber. Standard Oil Company shared this discovery (secret) with I.G. Faren, who, in turn, promised to share company proprietary information regarding research into this synthetic rubber. I.G. Faren did not honor their promise to share information as agreed. "So the Germans got early information on the invention of a substance critical to motorized warfare without giving anything in return" (p. 86). Granted, this is not industrial espionage by definition, however, by adding, deleting or twisting certain aspects of the case facts presented, this could have been a prime

The author is a federal polygraph examiner with the Office of the Secretary of the Air Force. He is also a member of the American Polygraph Association (APA). The conclusions expressed in this paper do not necessarily represent the views of the US Government, or the APA. For reprints, write to Randal F. Mueller, P.O. Box 4110, Ft. Jackson, SC 29207.

example of spying. How long would the war have lasted for Germany without this technological advancement? More importantly, how many lives could have been saved if Standard Oil Company had not shared its "secret" with Nazi Germany?

Definition of Industrial Espionage

There is no simple definition of industrial espionage as it may take on many different forms of white-collar crime such as technology transfer, i.e. illegal export and diversion of technology. As noted in a U.S. Department of Defense Security Institute (DODSI) (n.d., p. 4) report on the foreign intelligence threat to U.S. defense industry, espionage is said to be, "...a betrayal of national and community loyalty for the sake of profit." In the same DODSI report, John Walker Sr., retired U.S. Navy and convicted spy, at his trial, speaking about the economics of espionage, is quoted as saying, "(e)spionage is a business ..." (p. 12).

Industrial espionage is an action that falls within the realm of white-collar crime. White-collar crime has been defined by Edelhertz as, "an illegal act or series of illegal acts committed by nonphysical means and by concealment or guile, to obtain money or property, to avoid payment or loss of money or property, or to obtain business or personal advantage" (quoted in Clinard, 1980, p. 18). Industrial espionage fits neatly into the definition of white-collar crime, as it comprises the theft of commercial trade secrets for ultimate illegal gain. A thorough search of the business and marketing literature uncovered only one definition of industrial espionage. That definition was simply spying.

Hunt (1992) defined a trade secret as generally, "...information that is used in business, gives its owner a competitive advantage, is not readily available to other persons, and has been protected by reasonable measures to maintain its secrecy." He further added, "(t)rade secret theft is industrial America's hidden crime." Trade secret theft is a hidden crime because industry will not openly admit they have been victimized for fear of being embarrassed. Dick Heffernan, member of the American Society for Industrial Security (ASIS), and chairman of the Committee on Safeguarding Proprietary Information, is quoted as saying, "(m)ost companies do not want to talk about their loss of information because people will think their competitive position has been damaged, and they don't want the value of their stock eroded" (quoted in Alexander, 1991).

During U.S. congressional hearings, Senator Arlen Spector, offered yet another reason why industry is faltering in reporting this crime, "...most companies are reluctant to prosecute cases under civil law out of fear that they will be forced to reveal proprietary information when the case gets to court" (quoted in Swoboda, 1996). Industry must grab the bull by the horns and report these illegal acts. Awareness is the key to protection.

Director Freeh, FBI, pointed out the importance of U.S. industry in the world's economy, "(t)he United States spends nearly $300 billion a year on basic research, making it the test lab for the world and a natural target of U.S. competitors" (quoted in Swoboda, 1996). With this in mind, Kenneth M. Geide (1995), Chief, FBI Economic Counterintelligence Unit, stated for the record, "(t)he FBI identifies economic espionage as a priority investigative area and has established a focused program to address the problem." This program has gotten a substantial boost from a law signed by U.S. President William J. Clinton on October 15, 1996.

Legal Insight

The law is known as the Economic Espionage Act of 1996, (H. R. 3723). One article summarized the intent of the new law, "(H. R. 3723) is intended to prevent and punish the theft of trade secrets by and for the benefit of foreign governments and private entities. Chapter 31 of Title 18 (U.S. Crimes and Criminal Procedure) was amended making it a criminal offense to 'wrongfully copy or otherwise control any proprietary economic information'" (Employee Security Connection, October-December 1996). President Clinton (1996) further related in a White House press release, "(t)his act will protect the trade secrets of all businesses operating in the United States, foreign and domestic alike, from economic espionage and trade secret theft..."

In the same White House press release, President Clinton (1996) remarked, "(u)ntil today, Federal law has not accorded appropriate or adequate protection to trade secrets, making it difficult to prosecute thefts involving this type of information. Law enforcement officials relied instead on antiquated laws that have not kept pace with the technological advances of modern society." Senator Spector during a U.S. Senate Intelligence Committee meeting was quoted as saying, "(a) Justice Department review has found a lack of specific criminal laws that would apply to many of the 800 ongoing economic espionage investigations involving 22 foreign countries" (NSI Advisory, March 1996, p. 3).

The Economic Espionage Act imposes criminal sanctions on anyone engaged in industrial espionage, including attempts and/or conspiracy to defy the new law. Sanctions include penalties to individuals of fines up to $500,000 and 25 years imprisonment. Corporations could be fined up to $10,000,000. Furthermore, the law requires forfeiture of property derived from economic spying. Import and export sanctions could be applicable. To protect company proprietary information, the new law would have to also address the fact that the courts must protect the confidentiality of this information (NSI Advisory, March 1996).

Former legal redress involved having U.S. courts hear civil lawsuits regarding the misappropriation of trade secrets. Criminal prosecution of those involved in industrial espionage revolved around laws involving simple theft and the Racketeer Influenced and Corrupt Organizations Act (RICO), dated October 15, 1970. As evidenced by the date alone, this act could not have anticipated recent technological advances that would necessitate changes in the laws. The statutory scheme of RICO as defined by reference material:

> It applies to a defendant who, through a pattern of racketeering activity, has indirectly or directly participated in an enterprise whose activities affect interstate commerce. The critical phrases "person," "enterprise," and "pattern of racketeering activity" are broadly defined in RICO, reflecting a congressional intent to provide for the widest application of the statute in combating organized crime. (Bessette, 1996)

A major problem with this legislation is that U.S. federal prosecutors have concentrated its targeting efforts against organized crime. Many times an individual committing an act of industrial espionage is not connected with organized crime, but rather is acting out for personal reasons.

Reasons for Spying

One of the main reasons for white-collar criminals to become involved in industrial espionage (also known as corporate spying) was identified through a U.S. Department of Justice (DOJ) white-collar crime survey, which indicated that "(m)ost white-collar criminals are found to engage in crime against their companies not out of greed, but rather to exact revenge" (NSI Advisory, June 1994).

Mr. Heffernan, ASIS, is cited as saying, "(a)n unhappy or disgruntled or greedy employee...plays an important role in getting information out of a company. Employees may attempt to hurt their employers before being laid off or to enhance their future employment prospects by misappropriating proprietary information. About 58 percent of all incidents of industrial espionage were undertaken by current or former employees" (quoted in Lee, 1993). Furthermore, a survey completed by the ASIS concluded that, "...the threat from insiders 'continues to be a major factor' in economic spying" (NSI Advisory, April 1996).

Greed was probably the motive involved in a recent case of industrial espionage involving former Kodak employees. Staff reporters for The Wall Street Journal reported that the FBI conducted a search of the home belonging to Harold C. Worden, Kodak retiree. The search, "...unearthed nearly 40,000 documents, many Kodak-related..." (Nelson & Narisetti, 1996). A lawsuit filed against Worden and another former Kodak employee was highlighted in a Kodak company newsletter entitled the *Kodakery*. In the newsletter it provided a brief synopsis of the on-going investigation.

"Harold Worden...set up a consulting firm...recruited approximately 60 former Kodak employees as associates. These employees had significant technical knowledge in areas related to manufacture of photographic films, acetate and photographic paper. Between 1993 and 1995, Worden Enterprises provided technical services to various clients, including companies that manufacture products similar to those sold by Kodak. Furthermore, Kodak confidential information was misappropriated by Worden, and one or more of his associates" (*Kodakery*, November 19, 1996).

Zeigler (1996) reported that Kodak is alleging that Worden and others, "...violated civil provisions of the RICO Act..." (p. 1). As mentioned previously, Kodak filed a civil lawsuit against Worden because of these violations. Zeigler also mentioned that Worden and his accomplices can be charged criminally under the RICO Act with interstate transportation of stolen property, sale of stolen property, wire fraud and mail fraud (p. 15A). Mr. Worden was not charged under the new Economic Espionage Act of 1996 because it had not yet been signed into law.

Orr and Patalon (1996) in their article, "Kodak: Secrets sale backfired," reported how Mr. Worden was identified through a FBI sting operation. Worden, "allegedly tried to peddle the core know-how of Kodak's immensely profitable film business to rivals Konica Corporation and Agfa, as well as to entities in China, India and Pakistan" (p. 1A). In the same article, Kodak, "accused him of leading what amounts to an industrial espionage ring made up of Kodak employees and retirees" (p. 1A). The FBI documented transactions totaling $117,550 in sales of stolen Kodak proprietary information and $500,000 in proposed sales. "Kodak officials concede...this is by far the worst industrial espionage case in which Kodak has been victimized" (p. 4A).

Spying, in regard to national defense, is also many times committed by an insider, as in the case of Ronald Craig Wolf. The Wolf case was highlighted in a U.S. DODSI publication (1992, p. 27) which cites recent espionage cases, it charges revenge and greed as reasons for this transgression:

> Wolf, a former pilot in the U.S. Air Force from 1974 to 1981, was arrested May 5, 1989 in Dallas, Texas, for selling classified information to a FBI undercover officer posing as a Soviet agent. During his career in the Air Force, Wolf was trained as a Russian voice-processing specialist and flew intelligence missions on reconnaissance aircraft in the Far East. He held a Top Secret clearance and was discharged from the military in 1981 because of his "unsuitability for service due to financial irresponsibility," ... The FBI's investigation began in March 1989 when information was obtained indicating Wolf's desire to sell sensitive information to the former Soviet Union. Wolf talked with FBI undercover agent "Sergei Kitin ..." During these conversations, Wolf talked about his military experience, and his desire to "defect" and provide Air Force secrets "for monetary gain and to get revenge for his treatment by the United States Government." Wolf passed along classified documents concerning Top Secret signal intelligence. In June 1989, Wolf was sentenced to ten years in prison without parole.

Mr. Wolf presumably collected the classified documents while commissioned in the U.S. Air Force, as he was unemployed at the time of contact with the FBI and had not worked for any defense contractor. It is interesting to note that in this case, Mr. Heffernan's previously cited quote seems to "hit the nail on the head" in that, "(e)mployees may attempt to hurt their employer before being laid off or to enhance their future employment prospects by misappropriating proprietary information" (quoted in Lee, 1993). It is also interesting to note that Mr. Wolf could have caused grave damage to not only national security, but also to the company who conducted the research and developed the devices used in signal intelligence.

Motivations and Contributing Factors Involved in Espionage

In a U.S. DODSI report (n.d.) on the foreign intelligence threat to U.S. defense industry, motivations and contributing factors were discussed in answering the question as

to why an individual might spy against his employer or his country. Thirty-two cases were analyzed over the period between 1980-1989. All cases reviewed pertained to U.S. citizens who were either recruited or volunteered their services for espionage. Primary motivations for espionage are noted in Table 1.

Table 1. Primary Motivation Associated with Reported Cases of Espionage, 1980-1989

Reported Motivation	Number of cases
Financial considerations	37
Financial difficulties	(8)
After "megabucks" (large amount of money)	(29)
Need for personal recognition or advancement	4
Psychological pressure or romantic involvement	4
Misplaced national loyalty	2
Desire for revenge	5

Note. From "The Foreign Intelligence Threat to U.S. Defense Industry," not dated, United States Department of Defense Security Institute, p. 14.

A summary of the previous table is included in the report cited above. The report acknowledges that money appears to be the principle motivating factor, however, it goes on to mention that this factor could be misleading because no one can say for sure what the underlying cause may be. The summary also addresses the need for further research. It should be noted that "revenge" is cited as a primary motivation factor in this report. This fact would lend credibility to the DOJ statement cited previously where revenge was mentioned as one of the major reasons for persons entering into corporate spying.

Table 2, taken from the same report just cited, indicated the complexity of motivations and contributing factors when combined in searching for a reason for espionage activities.

Foreign Intelligence and Industry

Citing the above mentioned U.S. DODSI report on the foreign intelligence threat to U.S. defense industry, foreign intelligence services (FIS) are unmistakably viewed as a threat to industry, "Every country maintains its own intelligence service or state security organization which has as its objective the acquisition of classified and sensitive defense information or high-technology for civilian industrial use" (p. 1). One would have to be naïve to believe that a FIS is only after national defense secrets. In an article describing foreign countries' involvement in espionage, the following technologies are listed as being targeted by foreign governments and their collection agencies: biotechnology; aerospace; telecommunications, including technology for the information superhighway; computer software/hardware; advanced transportation technology; stealth technology; energy research; defense and armaments technology; manufacturing processes; semiconductors; proprietary business information; and corporate financial and trade data (NSI Advisory, September 1995).

Espionage can impact any country as emphasized in a quote from a former KGB (Soviet Union Intelligence) officer, "We (Russia)

Table 2. Non-Financial Situational Factors and Motivations Attributed to U.S. Citizens Who Commit Espionage, 1980-1987

Drug use or dependency	5
Job dissatisfaction/desire for revenge	8
Sexual relationships/entrapment	3
Psychological disorder	3
Alcohol Abuse	3
For recognition or status	5
Contacts designated country citizens	2
Need for adventure, intrigue	1
Misplaced national loyalty	2
Sexual Deviance	3
Security Violations	2

Note. From "The Foreign Intelligence Threat to U.S. Defense Industry," not dated, United States Department of Defense Security Institute, p. 14.

are losing everything. We are losing our economic and military potential" (NSI Advisory, October 1994). This quote came during discussions with American authorities regarding U.S. intelligence gathering and private industry gathering information in a clandestine manner.

France and its intelligence service called the DGSE were identified recently engaging in industrial espionage. In an article labeling a French company as being the benefactor of raw intelligence in the on going economic war, the DGSE is suspected of orchestrating a highly complex espionage scheme. The following illustration can be made regarding the threat to industry by a FIS:

> The French glassmaker Saint Gobain and its U.S. subsidiary Norton Co., launched a series of 'intelligence attacks' against the U.S. abrasives manufacturer 3M in an effort to obtain trade secrets. 3M's problems began in the summer of 1990, several months after Saint Gobain made a purchase of the Norton Co., for $1.9 billion. The Worcester, Massachusetts company had been 3M's major competitor for nearly 80 years. The first attacks included telephone calls into 3M facilities seeking specific information on a 3M manufacturing process known as the Cubitron process. The manufacturing process was exclusive to 3M and it was not known if Norton had developed its own similar method. In some cases, the callers did not properly identify themselves. A second wave of attacks occurred when 3M was hit by three separate corporate intelligence firms. These firms appeared to be behind the effort to obtain 3M secrets. Targeted information included manufacturing technology, new equipment installations capacity, resident curing processes, number of manufacturers, radiation in ultraviolet curing, high voltage supply, labor contracts, number of employees, and data on 3M foreign and domestic plants and what 3M was doing in them. (NSI Advisory, January 1994)

It was noted in this article that 3M is the only American company left manufacturing coated abrasives. It is apparent that Saint Gobain and the DGSE would just as soon see 3M as a former U.S. manufacturer of coated abrasives.

The threat to global industry continues, and there is a vast number of countries (including the U.S.) in which companies engage in industrial espionage. In an article written by McDermott (1994), he cited the following countries which have been identified as being involved in industrial espionage possibly utilizing a FIS: Argentina, Canada, China, France, Great Britain, India, Israel, Japan and Russia. Blustein (1996) repeats and adds additional countries to the previous list: China, Russia, Iran, and Cuba. Sometime ago, during a filming of television news magazine *60 Minutes*, a French government official had much difficulty admitting that now that the "Iron Curtain" had fallen, France had directed its FIS to set its eyes on foreign business for corporate proprietary information (Alexander, 1991).

Alexander (1991) wrote that, "...France's General Director of Exterior Security tried to hire employees in the European offices of IBM, Texas Instruments, Inc. and other U.S. electronics companies to provide information for pay" (p. 64). In summary, the article goes on to say that a French company, (state owned/sponsored), was to receive any information collected from France's "information for pay" scheme. McDermott (1994, p. 53) places in prospective the amount of spying that goes on by foreign companies which may in fact be state affiliated, "...foreign involvement accounted for about 30% of all attempted thefts against U.S. companies in 1991 and 1992, up from 21% in the period 1985-1988."

"For the most part, foreign collectors do not distinguish between military technology, civilian technology, proprietary information, and trade secrets - they simply collect what they find to be of value" (see http://www.fas.org.irp/ops/ci/docs/fy98 on-line for Annual report to Congress on foreign collection and industrial espionage, p. 3).

Competitive Intelligence

In an effort to stay one step ahead of foreign and domestic business competition, companies must be able to collect competitor intelligence on their rivals. Competitor/ competitive intelligence is defined in an article written by Sharp-Paine (1991) as "information that helps managers understand their competitors" (p. 423). Bergstrom (1992) spoke about the importance of competitive intelligence, "(a)s competitive pressures in all U.S. industry segments increases, many organizations are finding significant value in keeping a closer eye on their competition. Keeping up with what the competition is doing is something the Japanese companies learned to do long ago and is largely responsible for their success in displacing U.S. firms in the electronics, computer and automobile industries. In Japan, competitor intelligence is an integral part of the overall strategic planning process" (p. 29).

Collection of this data must not take the form of an illegal act such as espionage, but rather by legitimate means, i.e. open sources. Open source intelligence is a valuable means in the strategic planning process. Governments, both local and federal, have a wealth of information available to the public, to include tax information. News articles are analyzed for information. Trade shows are visited. Even floor plans of businesses are a worthy piece of information to analyze as mentioned by Mutch (1996), "(a) pepperoni company was in a financial fix: A rival was selling sausages so cheap that it was taking a big bite out of profits. The company hired Fuld & Co. of Cambridge, Mass., a consulting firm specializing in competitive intelligence, to find out why the other firm could keep prices low." Members of Fuld & Co., "...visited the town hall in the home town of the target company... They got the building inspector to show them the building plans of the structure used by the target firm and found it was much smaller than the company whom hired Fuld & Co. Fuld's office discovered from the building plans that a certain company supplied commercial ovens to the target firm. Further investigation...turned up a little-known trick (but not a trade secret): Warm the product to a certain temperature early on and you can jump-start the curing process and save two weeks in production time." Larry Kahaner, a competitive intelligence expert, said that, "(w)e don't live in the age of information. We now live in the age of intelligence" (quoted in Mulch, 1996).

Discussion

Corporate secrets (those that are strictly civilian in nature and those that may

have military applications) are the lifeblood of the company conducting the research and development. Therefore, if corporate/government secrets are stolen and the information ends up in the hands of domestic/foreign competitors and/or foreign governments, it is considered an act of espionage.

Industrial and defense espionage are fundamentally one in the same, in that, ultimately industry may be charged with research and development and it is industry which will be preyed upon in an effort to obtain information illegally. Additionally, it is industry that will suffer due to a shortening of lead-time in technology. To illustrate this point the following excerpt from an article prepared for government and security executives is presented. "Certain things that Zacharski (Marian Zacharski, Polish Communist Spy who stole U.S. defense-related documents in the 1970's) brought with him to Poland could not be used in Polish military research institutes of the 1970's because the U.S. technology was too advanced to be applied in Poland" (NSI Advisory, October 1994). Of special interest is the fact that because of a lack of technical knowledge, Polish officials as of 1994 were beginning to review and understand secret papers stolen in the 1970's.

It would only stand to reason that in today's world where business contracts are awarded with a "winner take all" mentality, domestic companies and foreign corporations alike will go to any measure, including criminal activity, to ensure they are rewarded with the contract. The disgruntled employees cited in the previously mentioned report are the most sought after asset by a competitor because of the corporate knowledge they possess. Because today's marketplace is unstable and volatile due to restructuring and lay offs, among other reasons, many employees do not feel a real sense of loyalty to their employer that may lead to the phenomenon of industrial espionage. The strongest and weakest link in any corporation's security is the individual.

References

Alexander, M. (March 4, 1991). Industrial espionage with U.S. runs rampant. *Computerworld*, 64.

Annual Report to Congress on Foreign Collection and Industrial Espionage - 1998 [On-line]. Available: http://www.fas.org.irp/ops/ci/docs/fy98.htm.

Bergstrom, A. J. (October 1992). Business intelligence: a strategic advantage. *Bank Marketing*, 29-31.

Bessette, J. M. (Ed). (1996). *American Justice* (p. 656). Pasadena, CA: Salem Press.

Blustein, P. (August 16, 1996). France, Israel alleged to spy on U.S. firms. *The Washington Post*, p. A28.

Clinard, M. B., & Yeager, P. C. (1980). *Corporate Crime.* New York: The Free Press.

Clinton, W. J. (November 1996). President Clinton's statement on economic espionage act. *Security Awareness News*, p. 8.

Congress introduces new legislation to thwart foreign economic spying. (March 1996). NSI Advisory, pp. 2-3.

Former Intel employee pleads innocent. (October 20, 1995). *Los Angeles Times*, p. D2.

Freeh, L. J. (January 1995). Federal statute on trade secrets needed. *NSI Advisory*, p. 11.

French targeted U.S. manufacturer in economic intelligence scheme. (January 1994). *NSI Advisory*, pp. 6-7.

Geide, K. M. (February 1995). New FBI unit battles economic espionage. *NSI Advisory*, p. 11.

Hunt, P. B. (July 9, 1992). Preventing trade secret theft. *Machine Design*, p. 102.

Industry survey finds economic spying increased by over 300 percent. (April 1996). *NSI Advisory*, pp. 6-7.

Kahn, D. (1978). *Hitler's Spies*. New York: Macmillan Publishing Company.

Lawsuit attacks theft of confidential information. (November 19, 1996). *Kodakery*, pp. 1+.

Lee, M. (July 12, 1993). The rise of the company spy. *The Christian Science Monitor*, p. 7.

Legislation targets economic spying against U.S. (October-December 1996). *Employee Security Connection*, p. 3.

McDermott, M. J. (June 1994). Spies selling secrets. *Profiles*, pp. 53-54.

Mutch, D. (August 19, 1996). The pepperoni puzzle: corporate spies on rise. *The Christian Science Monitor*, p. 8.

Nelson, E. & Narisetti, R. (November 8, 1996). Kodak alleges theft of data by ex-staffers. *The Wall Street Journal*, pp. A3+.

Orr, S. & Patalon III, W. (December 1, 1996). Kodak: secrets sale backfired. *Democrat and Chronicle* [Rochester, New York], pp. 1A+.

Poland reviews U.S. secrets. (October 1994). *NSI Advisory*, p. 10.

Russia protests aggressive spying by U.S., FBI says former KGB is still active. (October 1994). *NSI Advisory*, p. 3.

Sharp-Paine, L. (1991). Corporate policy and the ethics of competitor intelligence gathering. *Journal of Business Ethics*, 10.6, 423-436.

Swoboda, F. (February 29, 1996). Economic espionage rising, FBI director tells Congress. *The Washington Post*, p. D11.

U.S. Department of Defense Security Institute. (n.d.). *The foreign intelligence threat to U.S. defense industry*. Washington, DC: U.S. Government Printing Office.

U.S. Department of Defense Security Institute. (August 1992). *Recent espionage cases*. Washington, DC: U.S. Government Printing Office.

White-collar crime survey. (June 1994). *NSI Advisory*, p. 10.

White house says industrial espionage by foreign countries is on the rise. (September 1995). *NSI Advisory*, p. 2.

Zeigler, M. (November 7, 1996). Kodak sues, says 2 men stole secrets. *Times Union* [Rochester, New York], pp. 1A+.

Respiration Line Length

Donald J. Krapohl & Donnie W. Dutton

Abstract

Line length of the respiration tracing has been found in polygraphy to be one of the reliable indicators of the act of deceiving. Despite its value, respiration line length (RLL) is a concept unfamiliar to most polygraph practitioners. RLL characterizes diagnostic information as a single value, and it may be useful for comparing phasic respiration responses that have different patterns. The present paper is intended as an introduction to respiration line length for those who may be less familiar with it.

Key words: respiration, respiration line length, scoring, test data analysis

It has long been known that the respiration[1] waveform contains information that permits a reliable inference of deception (Benussi, 1914; Burtt, 1921.) The respiration channel was one of the first to be included in field polygraphs in the 1920s (Larson, 1923), and has remained in all polygraphs used for the detection of deception since that time. Today respiration is recorded at not one, but two sites on the chest. Though there is not uniform agreement in the field regarding respiration's value relative to the other two polygraph data channels (Matte & Reuss, 1992; Bell, Raskin, Honts & Kircher, 1999), all would agree that respiration does make an important contribution to polygraph decision accuracy.

There is considerably less agreement among practitioners, however, on how to evaluate the respiration tracing. In most scoring systems there are many more individual deception criteria taught for respiration than the other two polygraph tracings, with only some overlap of criteria between the different scoring systems. Swinford (1999) identifies 11 respiration patterns that could be used to numerically score respiration tracings. Other systems contain in excess of 20 criteria. With so many criteria, it begs the question: is everything that happens in respiration an indication of deception?

The large lists of deception criteria may be a consequence of how respiration is ordinarily analyzed. For the entire history of the profession, field examiners have adopted a pattern-matching approach to the scoring of the respiration channel. Examiners are trained to recognize the signatures of phasic respiratory responses, such as suppression, inhalation/exhalation (I/E) ratio changes, apnea, bradypnea, and other terms. Though these patterns do correlate with the arousal associated with deceiving, field practice had no single concept that captured the shared diagnostic information that is manifested in these different visual forms. In other words, these patterns ostensibly have little in common, hence the need to create long lists of stereotypical patterns, instead of seeking a single feature that shows up in several shapes. In contrast, simple amplitude increases in the electrodermal and cardiograph channels are highly diagnostic. Amplitude is easy to interpret, and more or less of it is sufficient for assigning scores. The employment for several

[1] "Respiration," as commonly used in the polygraph literature, is called "ventilation" by physiologists. The former denotes the exchange of gases taking place in the tissues of the lungs, as opposed to the mechanical process of expansion and collapsing of the chest cavity, signifying the latter. Though the PDD discipline may, at a later time, choose to adopt the language of its sister science, "respiration" is used in the present paper to indicate the movement of the chest during breathing.

separate criteria for the pneumograph suggests at least some inefficiency, and may give rise to arbitrary rules on how to score the patterns (see the special edition on chart interpretation, *Polygraph* 1999, 28(1).)

Pattern matching is not without some validity, and the present writers want to reassure field examiners that we do not advocate its abandonment. Patterns are certainly easy to teach novices, and communicate with practitioners. This approach does not perform as well, however, when a scorer tries to judge the relative intensity of two different patterns. Pattern matching simply does not easily allow across-pattern assessment of reaction intensity. As an example, there is scarcely a uniform opinion regarding what to do when a scorer is faced with a suppression on a relevant question and an equally significant change in the inhalation (I/E) ratio on an adjacent comparison question. There is no single higher rule to apply regarding which pattern is more diagnostic of deception. Well, almost no rule. Research over the last 20 years indicates that something called respiration line length (RLL) could be a prevailing principle to apply across patterns, and even among similar patterns. Let us begin with a little history.

The Search for Parsimony

Dr. Howard Timm, as a doctoral student at Michigan State University, was the first to report the RLL concept. While Timm was conducting his graduate research on polygraphy (1979), Dr. Frank Horvath suggested that he measure electrodermal activity with a handheld device designed for measuring distances on maps, an instrument called a planimeter. One day, when a volunteer subject did not appear for his polygraph appointment, Timm used the time to experiment with the planimeter on other parts of the polygraph tracings collected from previous subjects (Timm, 2001). Before long he discovered a relationship between line length and veracity: the shorter the line for a given period of time, the more likely that the examinee had given a deceptive answer. Line length appeared to be the common thread among the different signature patterns of deception in the respiration channel. Timm later published his findings in the *Journal of Police Science in Administration* in 1982.

Meanwhile, masters candidate John Kircher of the University of Utah was testing the feasibility of a computerized scoring system for polygraph data. Because computers are much better at measuring things than they are at pattern recognition, Kircher was seeking a diagnostic measurement for phasic respiration responses instead of trying to teach the computer field scoring criteria. In 1981, when Kircher was conducting his masters research, Timm had not yet published his RLL paper, and Kircher experimented with several objective measurements, all of which performed significantly poorer than manual scoring (Kircher, 1981). In 1983, a year after the Timm paper was published, now-Ph.D. candidate John Kircher applied the RLL method, and he also found it to be very diagnostic (Kircher, 1983). RLL subsequently became the response measurement for the CPS algorithm, and is now either implicit or explicit in several polygraph scoring systems, including the Utah Scoring System (Bell, Raskin, Honts & Kircher, 1999), the Rank Order Scoring System (Honts & Driscoll, 1987), the Department of Defense Polygraph Institute Scoring System (DoDPI, 2001a, 2001b), and the Objective Scoring System (Krapohl & McManus, 1999).

What RLL Represents

RLL is nothing more than a measure of how much tracing activity occurs in a defined period of time. To help conceptualize RLL, imagine that the tracings were made of string, instead of ink. If one were to cut the string once at stimulus onset and again after 10 seconds had past, then stretched the string to remove the curves, the string would have a fixed length, something that could be measured with a ruler or other tool. In the respiration channel, almost all of the most diagnostic phasic patterns cause that string to shorten: suppression, I/E ratio changes, apnea, and bradypnea. As a rule, the shorter the RLL is, the more intense the reaction is. There is one notable exception, the upward shift of the respiration tracing from its baseline. This pattern may or may not show a shortening of the RLL.

Using RLL

RLL is an important feature, but is most useful under circumstances when comparisons between respiration responses are difficult. For example, if one category of question elicits a phasic response, and its comparative question does not, RLL does not reveal anything that is not already obvious. Conversely, if two questions are being compared against one another, and both have phasic responses, RLL can help determine which has more intensity, thereby allowing a better assignment of scores.

There are several options at the examiner's disposal for determining RLL. The easiest, and the most commonly used, is simply the visual assessment of the tracings. Examiners can estimate the RLL by "eyeballing" the line. Though less precise, this method is sufficiently reliable for most field applications. For better precision, a measuring device is needed. One such device is the planimeter, previously discussed. A scorer needs only trace the respiration waveform from stimulus onset to a subsequent timepoint. Kircher used 10 seconds as the time window, while Timm used 15 seconds. For field use, there may not be meaningful differences between these windows, but an examiner must use a constant window for all measurements of responses to be compared to one another. To do otherwise would affect the measurements, and the value of the RLL.

A better option for RLL measurement is to have the computer polygraph do the measuring. Some computer polygraph manufacturers already have or are considering software with this capability. The advantage of automated measurement of the RLL is the perfect reliability and high precision of the measurements. There is also a substantial savings of time, and a reduction in errors recording the RLL values.

Computerized instrumentation also affords other possible representations of the RLL. Non-traditional data displays are relatively easy to accomplish with software, and we hope polygraph manufacturers are investigating better ways of displaying the traditional tracings. One possibility is to produce an RLL tracing, a single EDA-like line created by a scrolling moving average of RLL across a chart. The occurrence of a shortening of the RLL would be represented by a drop in the RLL tracing. The RLL tracing could supplement the traditional respiration recording, adding objective information for examiners to use in their interpretation of the respiration data. There may be even better ways of displaying this information waiting for software developers to discover.

Summary

The limits imposed by the pattern-matching approach to respiration analysis can often be exceeded by the use of RLL. RLL provides a metric for comparing respiration responses that are manifested in different shapes. Moreover, with RLL, a degree of relative intensity of responses can be determined. RLL is not intended to replace the pattern-matching method, since the latter is highly effective most of the time, and is also important for the identification of certain types of countermeasures. However, RLL can be of added benefit when it is otherwise difficult to gauge differences in response intensities. Examiners are encouraged to experiment with this concept, to confirm for themselves that RLL is, indeed, a reliable diagnostic feature.

References

Bell, B.G., Raskin, D.C., Honts, C.R., Kircher, J.C. (1999). The Utah Numerical Scoring System. *Polygraph*, 28(1), 1-9.

Benussi, V. (1914). Die atmungssymptome der lüge [The respiratory symptoms of lying]. *Archiv fuer die Gesamte Psychologie*, 31, 244-273. (In German). English translation printed in *Polygraph*, 4(1), 52-76.

Burtt, H.E. (1921). The inspiration/expiration ratio during truth and falsehood. *Journal of Experimental Psychology*, 4(1), 1-23.

Department of Defense Polygraph Institute (2001a). Test Data Analysis (Manual Scoring Process) 7-Position Numerical Analysis Scale. Ft. Jackson, South Carolina.

Department of Defense Polygraph Institute (2001b). Test Data Analysis (Manual Scoring Process) 3-Position Numerical Analysis Scale. Ft, Jackson, South Carolina.

Honts, C.R., & Driscoll, L.N. (1987). An evaluation of the reliability and validity of rank order and standard numerical scoring of polygraph charts. *Polygraph*, 16(4), 241-257.

Kircher, J.C. (1981). Computerized chart evaluation in the detection of deception. Unpublished masters thesis.

Kircher, J.C. (1983). Computerized decision making and patterns of activation in the detection of deception. Doctoral dissertation, University of Utah, Salt Lake City. *Dissertation Abstracts International.* University Microfilm # AAD 83-13152.

Krapohl, D.J., & McManus, B. (1999). An objective method for manually scoring polygraph data. *Polygraph*, 28(3), 209-222.

Larson, J.A. (1923). The cardio-pneumo-psychogram and its use in the study of emotions, with practical applications. *Journal of Experimental Psychology*, 5(5), 323-328.

Matte, J.A., & Reuse, R.M. (1992). A study of the relative effectiveness of physiological data in field polygraph examinations. *Polygraph*, 21(1), 1-22.

Timm, H.W. (1979). The effect of placebos and feedback on the detection of deception. *Dissertation Abstracts International*, 40(12-B). University Microfilm No. AAD80-13808.

Timm, H.W. (1982). Analyzing deception from respiration patterns. *Journal of Police Science and Administration*, 10(1), 47-51.

Timm, H.W. (2001, Jan. 2). Personal communication with first author.

Bibliography of Respiration and Deception

Donald J. Krapohl

Ansley, N. (1999). Development of deception criteria prior to 1950. *Polygraph*, 28(1), 28-36.

Bradley, M.T., McLaren, V., & Carle, S.B. (1992). Deception and Non-Deception in Guilty Knowledge and Guilty Actions Polygraph Tests. University of New Brunswick. DTIC #ADA303184, contract #N00014-90-J-1298, #N00014-93-1-1242.

Bradley, M.T., & Cullen, M.C. (1993). Polygraph lie detection on real events in a laboratory setting. *Perceptual and Motor Skills*, 76, 1051-1058.

Crosland, H.R. (1927). Book review of *Changes of Blood Pressure and Respiration During Deception. Psychological Abstracts*, 1, 156-157.

Elaad, E., & Kleiner, M. (1990). Effects of polygraph chart interpreter experience on psychophysiological detection of deception. *Journal of Police Science and Administration*, 17(2), 115-123.

Honts, C.R., Kircher, J.C., & Raskin, D.C. (1988). *Patterns of activation and deception. Psychophysiology*, 25(4), p.455. (Abstract)

Kircher, J.C. (1983). Computerized decision making and patterns of activation in the detection of deception. Dissertation Abstracts International, 44(1B), 345. (University Microfilm # AAD 83-13152).

Klemm, O. (1929). Über die Atmungssymptomatik bei Untersuchungsgefangenen [The symptomatic breathing of prisoners being investigated]. *Neue Psychologische Studien*, 5, 111-132. [text in German].

Landis, C., & Wiley, L.E. (1926). Changes in blood pressure and respiration during deception. *Journal of Comparative Psychology*, 6(1), 1-19.

Nakayama, M., & Yamamura, T. (1990). Changes of respiration pattern to the critical question on guilty knowledge technique. *Polygraph*, 19(3), 188-198.

Reid, J.E. (1960). Controlled breathing as an indication of deception. *Polygraph*, 11, 12-13.

Reid, J. E. (1980). Interpretation of truth and deception in polygraph test records. *Polygraph*, 11, 46-61.

Slowik, S.M., Buckley, J.P., III, Kroeker, L., & Ash, P. (1973). Abdominal and thoracic respiration recordings in the detection of deception. *Polygraph*, 2(1), 12-28.

Slowik, S.M., Reid, J.E., Buckley, J.P., III, Kroeker, L., & Ash, P. (1975). Abdominal and thoracic respiration recordings in the detection of deception. In N. Ansley (Ed.), *Legal admissibility of the polygraph* (pp. 189-198). Springfield, IL: Charles C. Thomas.

Thackray, R.I., & Orne, M.T. (1968). A comparison of physiological indices in detection of deception. *Psychophysiology*, 4(3), 329-339.

Timm, H.W. (1982). Analyzing deception from respiration patterns. *Journal of Police Science and Administration,* 10(1), 47-51.

Timm, H.W. (1984). Significant findings attributable to electrodermal habituation effects: Artifact or essence in detection of deception research. *Journal of Police Science and Administration,* 12(3), 267-276.

Vance, E.B. (1976). An experimental investigation of the utility of some psychophysiological measures in the detection of deception. Dissertation Abstracts International, 37(2-B), 1017. (University Microfilms No. #76-17670).

Bibliography of ERP Detection Research

Updated October, 2000 by Vance MacLaren

Allen, J.J.B. & Iacono, W.G. (1997). A comparison of methods for the analysis of event-related potentials in deception detection. *Psychophysiology*, 34, 234-240.

Allen, J.J., Iacono, W.G. & Danielson, K.D. (1992). The identification of concealed memories using the event-related potential and implicit behavioral measures: A methodology for prediction in the face of individual differences. *Psychophysiology*, 29, 504-522.

Allen, J.J., Iacono, W.G., Lavaruso, J.J. & Dunn, L.A. (1995). An event-related potential investigation of posthypnotic recognition amnesia. *Journal of Abnormal Psychology*, 104, 421-430.

Allen, J.J.B & Movius, H.L. (2000). The objective assessment of amnesia in dissociative identity disorder using event-related potentials. *International Journal of Psychophysiology*, 38, 21-41.

Bashore, T.R. & Rapp, P.E. (1993). Are there alternatives to traditional polygraph procedures? *Psychological Bulletin*, 113, 3-22.

Berlad, I. & Pratt, H. (1995). P300 in response to the subject's own name. *Electroencephalography and Clinical Neurophysiology*, 96, 7-472-474.

Bessinger, G.T., Rosenfeld, J.P. & Hays, S. (1991). Feedback-evoked P3 responses as an indirect deception indicator. [abstract] *Psychophysiology*, S12.

Boaz, T.L., Perry, N.W., Raney, G., Fischler, I.S. & Shuman, D. (1991). Detection of guilty knowledge with event-related potentials. *Journal of Applied Psychology*, 76, 788-795.

Ellwanger, J., Rosenfeld, J.P., Sweet, J.J. & Bhatt, M. (1996). Detecting simulated amnesia for autobiographical and recently learned information using the P300 event-related potential. *International Journal of Psychophysiology*, 23, 9-23.

Farwell, L.A. & Donchin, E. (1986). The "brain detector": P300 in the detection of deception. [abstract]. *Psychophysiology*, 24, 434.

Farwell, L.A. & Donchin, E. (1988). Event-related potentials in interrogative polygraphy: Analysis using bootstrapping [abstract] *Psychophysiology*, 25, 445.

Farwell, L.A. & Donchin, E. (1989). Detection of guilty knowledge with ERPs. [abstract] *Psychophysiology*, 26, S8.

Farwell, L.A. & Donchin, E. (1991). The truth will out: Interrogative polygraphy ("lie detection") with event-related brain potentials. *Psychophysiology*, 28, 531-547.

Farwell L.A. (1992). Two new twists on the truth detector: brain-wave detection of occupational information. [abstract] *Psychophysiology*, 29, S3.

Farwell L.A. & Hernandez R. (1993). Brain-wave detection of concealed information. Office of Research and Development of the Central Intelligence Agency.

Farwell, L.A. & Richardson, D.C. (1993). Detection of FBI agents with the Farwell MERA system: A new paradigm for psychophysiological detection of concealed information. [unpublished report]. Washington DC: Human Brain Research Laboratory, Inc.

Farwell, L. A. and Smith, S. S. (in press). Using Brain MERMER Testing to Detect Knowledge Despite Efforts to Conceal. *Journal of Forensic Sciences* (preprint available at www.brainwavescience.com).

Fischler, I, Bloom, P.A., Childers, D.G., Roucos, S.E. & Perry, N.W. (1983). Brain potentials related to stages of sentence verification. *Psychophysiology*, 20, 400-409.

Fischler, I., Bloom, P.A., Childers, D.G., Arroyo, A.A. & Perry, N.W. (1984). Brain potentials during sentence verification: Late negativity and long-term memory strength. *Neuropsychologia*, 22, 559-568.

Fischler, I., Childers, D.G., Achariyapaopan, T. & Perry, N.W. (1985). Brain potentials during sentence verification: Automatic aspects of comprehension. *Biological Psychology*, 21, 83-105.

Florez, D.A & Rosenfeld, J.P. (1992). Single letter feedback-evoked P3 responses as a measure of deception detection. [abstract] *Psychophysiology*, S31.

Forth, A.E., Hart, S.D., Hare, R.D. & Harpur, T.J. (1988). Event-related brain potentials and detection of deception. [abstract] *Psychophysiology*, 25, 446.

Forth, A.E., Strachan, K.E., & Hare, R.D. (1989). The use of event-related brain potentials for the detection of guilty knowledge. [abstract] *Psychophysiology*, S26.

Hira, S., Nakata, M., Matsuka, T, & Kakigi, S. (1989). Event related potentials (Ps and CNV) as an index of detection of deception. [Japanese with English abstract] *Japanese Journal of Physiological Psychology and Psychophysiology*, 7, 11-17.

Ingram, E.M. (1995). Event-Related Potentials: The P300 and Self-Referent Stimuli. Ft. McClellan, AL: Department of Defense Polygraph Institute (DoDPI94-R-0006)

Johnson, M. M. & Rosenfeld, J.P. (1992). Oddball-evoked P300-based method of deception detection in the laboratory II: Utilization of non-selective activation of relevant knowledge. *International Journal of Psychophysiology*, 12, 289-306.

MacLaren, V.V. & Taukulis (in press). Forensic identification with event-related potentials. Polygraph, 29(4), 330-343.

Matsuda, T., Hira, S., Nakata, M. & Kakigi, S. (1990). The effect of one's own name upon event-related potentials-Event related potential (P3 and CNV) as an index of detection of deception. [Japanese with English abstract] *Japanese Journal of Physiological Psychology and Psychophysiology*, 8, 9-18.

Miller, A.R., Rosenfeld, J.P., Soskins, M. & Jhee, M. (1999). P300 amplitude and topography distinguish between honest performance and feigned amnesia in an autobiographical oddball task. [abstract] *Psychophysiology*, S93.

Parsons, T.E. (1996). Event-related potentials and the detection of guilty knowledge. Unpublished Doctoral Dissertation, University of Georgia.

Pollina, D.A. & Squires, N.K. (1998). Many-valued logic and event-related potentials. *Brain and Language*, 63, 321-345.

Radilova, J. (1982). Right and intentionally false statements concerning visual stimuli influence of late positive component of evoked potentials. *Activitas Nervosa Superior*, 23, 147-148.

Renault, B., Signoret, J.J., Debruille, B., Breton, F. & Bolgert, F. (1989). Brain potentials reveal covert facial recognition in prosopagnosia. *Neuropsychologia*, 27, 905-912.

Rosenfeld, J.P. (1995). Alternative views of Bashore & Rapp's (1993) alternatives to traditional polygraphy: A critique. *Psychological Bulletin*, 117, 159-166.

Rosenfeld, J.P. (in press). Event-related potentials in detection of deception. In M. Kleiner (ed.) *Handbook of polygraphy*. New York: Academic.

Rosenfeld, J.P., Angell, A., Johnson, M. & Ivanov, S. (1989). A P3-based, control question-like lie detector. [abstract] *Psychophysiology*, 26, S8.

Rosenfeld, J.P., Angell, A., Johnson, M. & Qian, J. (1991). An ERP-based, control-question lie detector analog: Algorithms for discriminating effects within individuals' average waveforms. *Psychophysiology*, 28, 319-335.

Rosenfeld, J.P. & Bessinger, T. (1990). Feedback-evoked P3 responses in lie detection. [abstract] *Psychophysiology*, 27, S60.

Rosenfeld, J.P., Cantwell, B., Nasman, V.T., Wodjac, V., Ivanov, S. & Mazzeri, L. (1988). A modified, event-related potential based guilty knowledge test. *International Journal of Neuroscience*, 42, 157-161.

Rosenfeld, J.P., Ellwanger, J.W., Nolan, K., Wu, S., Bermann, R.G. & Sweet, J. (1999). P300 scalp amplitude distribution as an index of deception in a simulated cognitive deficit model. *International journal of Psychophysiology*, 33, 3-19.

Rosenfeld, J.P., Ellwanger, J. & Sweet, J. (1995). Detecting simulated amnesia with event-related brain potentials. *International Journal of Psychophysiology*, 19, 1-11.

Rosenfeld, J.P., Nasman, V.T., Whalen, R., Cantwell, B. & Mazzeri, L. (1987). Late vertex positivity as a guilty knowledge indicator: A new method of lie detection. *International Journal of Neuroscience*, 34, 125-129.

Rosenfeld, J.P., Reinhart, A.M., Bhatt, M., Ellwanger, J., Gora, K., Sekera, M. & Sweet, J. (1998). P300 correlates of simulated malingered amnesia in a matching-to-sample task: Topographic analyses of deception versus truthtelling responses. *International Journal of Psychophysiology*, 233-247.

Rosenfeld, J.P., Rao, A., Soskins, M & Reinhart-Miller, A. (1999). Scaled P300 distributions specific for deception in an autobiographical oddball paradigm. [abstract] *Psychophysiology*, S97.

Rosenfeld, J.P., Wu, S. & Eftekhari, N. (1997). Specificity of scaled P300 scalp amplitude distribution associated with deception. [abstract] *Psychophysiology*, S76.

Stelmack, R.M., Houlihan, M., Doucet, C. & Belisle, M. (1994). Event-related potentials and the detection of deception: A two-stimulus paradigm. [abstract] *Psychophysiology*, S94.

Stelmack, R.M., Houlihan, M. & Doucet, C. (1994). Event-Related Potentials and the Detection of Deception: A Two-Stimulus Paradigm. Fort McClellan, AL: Department of Defense Polygraph Institute (N0001493-1-1002)

Tardif, H.P., Barry, R.J., Fox, A.M. & Johnstone, S.J. (2000). Detection of feigned recognition memory impairment using the old/new effect of the event-related potential. *International Journal of Psychophysiology*, 36, 1-9.

Van Hooff, J.C., Brunia, H.H. & Allen, J.J.B (1996). Event-related potentials as indirect measures of recognition memory. *International Journal of Psychophysiology*, 21, 15-31.

Wasserman, S. & Brockenholt, U. (1989). Bootstrapping: Applications to psychophysiology. *Psychophysiology*, 26, 208-221.

Zhou, L., Yang, W., Liao, S., & Zou, H. (1999). Experimental study of lie detection with P300 in simulated crime. (Chinese with English abstract) *Chinese Journal of Clinical Psychology*, 7, 31-33.