Polygraph

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THE POLYGRAPH IN THE COURTS

by

Clarence H. A. Romig, B.A., M.S.

Associate Professor
Police Training Institute
University of Illinois
Champaign, Illinois 61820

For over forty years polygraph examiners and a sprinkling of legal scholars have sought to gain court acceptance of the polygraph in criminal cases. For the most part, however, their efforts have been futile. To the layman this may seem incredible, especially in light of the reputation the polygraph has gained with the general public as a device for the detection of deception. In fact, many people consider the refusal to submit to a polygraph examination is prima facie evidence of guilty knowledge.[1]

In spite of general public acceptance, however, the courts have remained steadfast in refusing to utilize the results of polygraph examination as evidence in criminal actions. Although this inflexible attitude has waivered on several occasions, United States courts have generally excluded such evidence on the grounds that it has not received general scientific recognition and that the margin of error possible in interpreting test results is too great for general courtroom use. So strictly have the courts adhered to this viewpoint that even the mention of an accused's desire or refusal to take a polygraph examination has led to reversal in appellate courts.

In an article entitled, "The Fourth Degree," Jack Streeter and Melvin M. Belli summarize court attitudes toward the polygraph in the following manner. The most broadly accepted attitude is a refusal to admit the results of polygraph examinations on the grounds that the techniques employed by examiners have not achieved sufficient scientific recognition. Some courts have recognized that there might be some validity to polygraph tests and will probably admit them as evidence with sufficient showing of proof of their validity. So far the most enlightened viewpoint in respect to the polygraph is that the results of such tests will be admitted upon stipulation of the parties involved.[2]

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One expert in the use of this instrument has hypothesized that there are three major reasons for the courts having taken such a stand: (1) Unfounded objections resulting from either a misunderstanding of the instrument, or its proposed place in the trial. (2) Objections, both sound and unsound, which, although directed at the polygraph, apply equally to all expert testimony based upon scientific investigation. (3) Valid objections arising from the unusual nature of the polygraph itself.[3] Although we have discussed briefly the attitudes held by the courts in regard to the polygraph as well as a hypothesis concerning their rationale, a discussion of some of the most important case law is necessary if one is to understand the true position of the polygraph within our court system.

The first court decision concerning the use of the polygraph for evidential purposes was Frye vs. United States in 1923.[4] In this case the defendant appealed his murder conviction on the grounds that the trial court did not permit expert testimony on the results of a systolic blood pressure deception test which he had been given. In affirming the conviction, the Court of Appeals of the District of Columbia established the standard of admissibility by which the polygraph has subsequently been judged. Concisely stated the court made the following decision:

> ". . . the thing from which the deduction is made must be sufficiently established to have gained general scientific acceptance in the particular field in which it belongs."
>
> "We think the systolic blood pressure deception test has not yet gained such standing and scientific recognition among physiological and psychological authorities as would justify the courts in admitting expert testimony deduced from the discovery, development, and experiments thus far made."[5]

Ten years later, in 1933, a Wisconsin trial court rejected the results of a Keeler polygraph test on the basis that it was still in the experimental stage of development. Using the Frye decision as their authority in this case, State vs. Bohner,[6] the court held that:

> "The present necessity for elaborate exposition of its theory and demonstration of its practical

> working, in order to convince the jury of its probative tendencies, together with the possibility of attacks upon the soundness of its underlying theory and its practical usefulness, may easily result in a trial of the lie detector rather than the issues in the cause."[7]

A similar attitude was expressed by the New York Court of Appeals in People vs. Forte.[8] In this case Vincent Forte was convicted of first degree murder on the basis of strong circumstantial evidence. After the evidence was presented, the defense counsel moved to reopen the case and allow the defendent to undergo a lie detector examination. His motion was denied by the trial court and he appealed his subsequent conviction on the basis of this denial. In affirming the conviction, the Court of Appeals stated that:

> "We cannot take judicial notice that this instrument is or is not effective for the purpose of determining the truth. Can it be depended upon to operate with complete success on persons of varying emotional stability? The record is devoid of evidence tending to show general scientific recognition that the pathometer possesses efficacy."[9]

It is interesting to note that in these first three appellate cases dealing with the polygraph, all were criminal proceedings that were decided by a jury. In each case the defense, rather than the prosecution, offered the evidence and each time a different instrument was used. Without exception the courts involved failed to admit as expert testimony the statements of a polygraph examiner.[10] According to Adria G. Kaplan, courts have continued to reject polygraph evidence by merely citing the older cases without further discussion of the problem.[11] Besides rejecting the evidence of test results, it has been held to be a reversible error to even mention that a defendant or witness took a polygraph test,[12] was willing to take such a test,[13] or refused to take a test.[14]

In the Forte case it was noted that the court failed to take judicial notice of the polygraph when asked to do so by the defense counsel. This point is important in understanding court attitudes toward the instrument, for their failure to take judicial notice is inextricably wound up in the question of fallibility and general scientific acceptance of the polygraph.

In criminal cases not everything alleged during the trial must be proven. This is especially true in situations where the matter alleged is so well established that it is not worthwhile to offer evidence of its veracity. The legally accepted means of accomplishing this are judicial admissions, judicial presumptions, and judicial notice.[15]

Judicial notice is used by the courts to clarify issues and to shorten the duration of trials. The matters presented for judicial notice, however, must be a matter of general knowledge to any judge who might try the case, and not just to a specific judge who might have private knowledge of the matter. It is not necessary that the judge know the fact personally as long as he can determine its unchallenged existence by personal examination or by referring to pertinent data provided him by counsel. Basically, it is sufficient if the judge can satisfy himself that the fact presented is one of common knowledge.[16]

In scientific matters a court will take judicial notice of well documented scientific procedures that are well known to all. If any doubt exists, however, it will require proof of the degree of acceptance the procedure has received in the scientific profession concerned.[17]

While other facets of the forensic sciences such as fingerprint and firearms identification have become accepted topics for judicial notice, the polygraph has failed to be accorded such recognition. This fact has been a thorn in the sides of polygraph exponents for over two generations. Most of them feel that when polygraph examination procedures are accepted by psychologists, the instrument will qualify for judicial notice.

In this respect, Charles T. McCormick, Professor of Law at the University of Texas, feels that too many polygraph examiners are preoccupied with gaining judicial notice of their instruments and techniques. He points out that while general scientific acceptance is a proper condition for the court's taking judicial notice of scientific facts, it is not a criterion for the admissibility of scientific evidence.[18] On this basis, he contends, the results of polygraph tests should be subjected to the same rules of admissibility as other scientific evidence. Therefore, "any relevant conclusions which are supported by a qualified expert witness should be received unless there are other reasons for their exclusion."[19]

In answer to Professor McCormick's statement it would seem that the courts have found other reasons for excluding polygraphic evidence. Concisely stated their reasons hinge upon the fear that the use of such evidence amounts to heresay, impairs the right of cross-examination, and might lead to the abolition of the jury system. If in fact the abolition of juries did not come to pass, they contend that it certainly would preempt the fact-finding province of the jury. Most important, however, there is lack of a real judicial precedent for admitting such evidence.[20]

Regardless of arguments to the contrary, however, it suffices to state that the unquestioned weight of authority holds " . . . that the results of a lie detector are universally held inadmissible in evidence."[21] Such an emphatic statement does not end the question of the polygraph in the courts for there are several other important aspects of case law that should be considered.

Modern Scientific Evidence, by James R. Richardson, contains a lengthy and valuable chapter concerning the polygraph and its position in American jurisprudence. Particularly significant is his discussion of court attitudes in respect to use of the polygraph in criminal investigations in general and in obtaining confessions in particular.

As of 1953 over 200,000 persons in the United States has taken polygraph examinations and over 100 police departments and 55 personnel consultants employed them in connection with criminal investigations and personnel examinations.[22] In the words of Paul V. Trovillo, " . . . the murders of thousands of men, women, and children whose violent and ignominious deaths remained mysterious, have been solved through the review by experts of polygraph charts."

In the years subsequent to Mr. Trovillo's statements the use of the polygraph in conducting investigations, both criminal and administrative in nature, has gained even wider acceptance by police departments, governmental agencies, and personnel consultants. So much so, in fact, that noted authors such as Alan Barth, Vance Packard and Myron Brenton have published books branding the use of such devices as flagrant invasions of the privacy guaranteed by the United States Constitution. While these viewpoints are indicative of concern over possible misuse of the polygraph, especially by business firms and personnel consultants,

they failed to alter the fact that the courts have in no way condemned its use as a means of interrogation and investigation. In Davis vs. State the Texas Criminal Court of Appeals held that, "Nothing herein should be construed as condemning the use of the polygraph as a means of interrogation."[24] Although they reversed the murder conviction of the appellant on other grounds, they adhered to the traditional attitude in such cases that " . . . upon another trial, the testimony which in effect revealed the results of the polygraph tests should be excluded from the jury."[25]

Another case which held that the polygraph constituted a proper investigative device was McCain vs. Sheridan.[26] In this case the action involved a petition for writ of mandate to compel plaintiff's reinstatement as a member of a police department. After a shortage occurred in the records section of the police department, the plaintiff made a written request that a polygraph test be given him. After failing the initial screening the plaintiff refused to take another test even after being ordered to do so by the chief of police. He was thereafter dismissed for insubordination, disobedience and conduct unbecoming a police officer.[27]

The petitioner appealed after his writ of mandate was denied by the trial court. McCain contended that the order requiring him to take a polygraph test was invalid because the results of the test could not be admissible in evidence for or against him. In affirming the judgement the District Court of Appeals stated:

> "By his written request that the test be administered to him, appellant evinced desire to obtain whatever benefit such apparent willingness might yield in diverting the investigation to others. The order that he complete the test he had himself requested seems in no way an unreasonable departmental regulation. Such tests are recognized as having some value in investigation, even though they are not yet sufficiently reliable to be admitted in evidence. . . . Appellant's refusal to obey that order impeded the investigation of a criminal offense and amounted to insubordination and unofficerlike conduct, thus warranting his discharge."[28]

In essence, then, while the courts refuse to admit polygraph test results in evidence they have also consistently

recognized its legality and value as an aid in conducting criminal and administrative investigations. Statistics indicate that as high as 75-80 percent of those suspects who are confronted with the polygraph confess either without volunteering to take a test, or subsequent to an indication of deception in a test they voluntarily took. These figures themselves, however, have lead to criticism that the device is used to coerce confessions from innocent suspects.

Traditionally the rules governing the admissibility of confessions is that they must be voluntary and trustworthy. This simply means that a confession that is obtained by physical or psychological duress or by methods that shock the conscience as being innately coercive in nature are not useable in court. Generally speaking, the courts will not invalidate a confession simply because it was obtained through the use of the polygraph. In this respect it is important to note that if a test is administered it must be with the suspect's willing permission if a subsequent confession is to be considered "voluntary and trustworthy." Two significant cases regarding the voluntariness of confessions in respect to the polygraph are State vs. Dehart and Hinson vs. State.

In a Wisconsin case, State vs. Dehart, the Supreme Court of the State upheld a murder conviction in which the defendant confessed after willingly undergoinga polygraph examination. Following his conviction, Dehart appealed on the grounds that his confession was not voluntary. In writing the opinion of the court, Justice Wickhem said:

> "There is an intimation in defendant's brief that the sequence of events was such as to leave the impression that the lie detector test had demonstrated defendant's guilt and that this circumstance actuated his confession. The record does not warrant this intimation, but if it did, the point would not be material since it would not bear upon the voluntary character of the confession. Such an impression would not be prejudicial to defendant. The thing that was prejudicial to defendant was the confession which is many times more conclusive than any implication that could be drawn from the fact of the lie detector test. The jury was entitled to conclude that the confession was trustworthy and believable."[29]

Along these same lines, in Hinson vs. State, the Texas Court of Criminal Appeals upheld a conviction of night time burglary of a residence in spite of the fact that truth serum and polygraph tests had been made. Basically the court said that where the results of such tests were not used to bring about the making of a confession, the fact that such tests were made did not require that defendant's confession be rejected as involuntary.[30]

Generally speaking, the courts have rejected the theory that even the voluntary use of the polygraph constitutes psychological coercion within the privilege against self-incrimination. This, in turn, suggests that the courts are still adhering to the general rule that a confession procured by a trick or artifice, not calculated to produce untruth, is valid in court.

In spite of the court's apparent inflexible attitude regarding the use of polygraph evidence it would be inaccurate to state that the results of polygraph examinations have never been admitted as evidence in a criminal trial for in the case of People vs. Kenny such evidence was so admitted. This unique decision to permit the introduction of polygraph test results into evidence was made in 1938 by Judge Colden of the Queens County Court in New York State. He permitted such evidence to be admitted in behalf of the accused over the strong objection of the prosecutor who relied on the Frye and Bohner decisions to sustain his contention.[32]

The objection of the prosecutor not withstanding, the evidence was admitted in the form of expert testimony by Reverend Walter G. Summers who was at that time head of the Department of Psychology of the Graduate School of Fordham University. During preliminary examination Father Summers stated that his "pathometer" or "psychogalvanometer" had been tested upon more than 6,000 individuals and that the device was 100 percent effective when used upon persons accused of crimes.[33] In short, this decision held that the results of an accused's interrogation under the pathometer may be admitted as evidence on his behalf if a proper foundation as to its accuracy is laid by an expert examiner. This case, however, represents a radical departure from the traditional court viewpoint concerning polygraph evidence. In no way should the Kenny case be construed to be the law, especially in view of the fact that the defendant was acquitted and no appeal was made that would enable an appellate court to rule on the legality of the lower court's

decision to admit such evidence.

Since the Kenny decision the only real breakthrough in the court's inflexible attitude has come in the area of stipulations. Although there are records of other similar unreported cases,[34] the most recent and significant case in this respect is State vs. Valdez.[35]

In Valdez, the Arizona Supreme Court recognized that an exception exists to the well established rule of excluding reference to the polygraph in the courtroom. This exception is where parties have stipulated that the results of a polygraph test should be admissible in evidence during the trial.

In this case Valdez was charged with the possession of narcotics. Prior to trial the parties involved signed a stipulation that the results of the defendant's polygraph test would be admissible by either party in the subsequent trial. Since the results of the examination were unfavorable to Valdez, he objected to the examiner's testimony at the trial. The objection was overruled and the case allowed to go to the jury and the defendant was subsequently found guilty as charged. The defendant appealed his conviction to the Arizona Supreme Court.[36]

It is important to note that in affirming the conviction the high court did not overrule their traditional attitude that polygraph evidence is not admissible in a criminal trial. They simply held that polygraphs and expert testimony relating to them are admissible upon stipulation entered into by both parties prior to the trial.

Similar decisions were made by California and Iowa courts in the cases of People vs. Houser[37] and State vs. McNamara.[38] In both cases stipulations were signed, the evidence proved to be unfavorable to the defendants and was admitted over their objections by the trial courts. On appeal both states held that the convictions should be affirmed on the basis that the defendants could not complain merely because the results were unfavorable to them.

In discussing this case, G. L. Ouellette points out that the stipulation was regarded by the Arizona Supreme Court, as a satisfactory substitute for a lack of recognized scientific reliability. Concerning the use of the polygraph the usual stipulation is an agreement, not only as to the admissibility of the results, but also to the subject

matter, time, place and examiner. To a certain degree such an agreement offers certain safeguards against abuse in the use of the polygraph that might ordinarily arise in obtaining evidential results. In addition to this a stipulation can waive statutory and constitutional rights as well as provide for the admission of facts proved by evidence otherwise inadmissible.[39]

FOOTNOTES

[1]John S. Boyle, "A Bar Association's Viewpoint Regarding the Lie Detector," Journal of Criminal Law, Vol. 50 (May-June, 1959), p.99

[2]Jack Streeter and Melvin M. Belli, "The Fourth Degree: The Lie Detector," Vanderbilt Law Review, Vol. 5 (April, 1952), p. 553

[3]Charlotte L. Smallwood, "Evidence: Lie Detectors: Discussion and Proposals," Cornell Law Quarterly, Vol. 29 (June, 1944), pp. 540-541

[4]Frye v. United States, 293 Fed. 1013 (1923)

[5]Ibid., p. 1014

[6]State v. Bohner, 246 N.W. 2d 314 (1933)

[7]Ibid., pp. 317-318

[8]People v. Forte, 18 N.E. 2d 31 (1937)

[9]Ibid., p. 32

[10]Adria G. Kaplan, "The Lie Detector: An Analysis of Its Place in the Law of Evidence," Wayne Law Review, Vol. 10 (Winter, 1964), p. 383

[11]Ibid., p. 384

[12]Leeks v. States, 245 P. 2d 764 (1952)

[13]People v. Carter, 312 P. 2d 665 (1957)

[14]State v. Chang, 374 P. 2d 5 (1962)

[15]John E. Tracy, Handbook of the Law of Evidence (Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1960), p.44

[16]Ibid., pp. 44-46

[17]Ibid., p. 151

[18]Charles T. McCormick, Handbook of the Law of Evidence (St. Paul: West Publishing Co., 1954), p. 363

[19]Ibid.

[20]James R. Richardson, Modern Scientific Evidence (Cincinnati: The W. H. Anderson Company, 1961), p. 290

[21]Marable v. State, 313 S.W. 2d 45 (1958)

[22]Paul V. Trovillo, "Scientific Proof of Credibility," Tennessee Law Review, Vol. 22 (February, 1953), p. 743

[23]Ibid.

[24]Davis v. State, 308 S.W. 2d 880 (1957)

[25]Ibid.

[26]McCain v. Sheridan, 324 P. 2d 923 (1958)

[27]Ibid., p. 925

[28]Ibid., p.296

[29]State v. Dehart, 8 N.W. 2d 360 (1943)

[30]Henson v. State, 266 S.W. 2d 864 (1953)

[31]Richardson, op. cit., pp. 295-296

[32]People v. Kenny, 3 N.Y.S. 2d 348 (1938)

[33]Ibid.

[34]State v. Rowe (1936) and State v. Conn (1941). Both of these cases were noted in 1943 Wisconsin Law Review, pp. 430, 435.

[35]State v. Valdez, 371 P. 2d 894 (1962)

[36]G. L. Ouellette, "Admitting Lie Detector Results by Stipulation," Washington and Lee Law Review, Vol. 20 (Spring, 1963), p. 174

[37]People v. Houser, 193 P. 2d 937 (1948)

[38]State v. McNamara, 104 N.W. 2d 568 (1960)

[39]Ouellette, op. cit., p. 176

ABDOMINAL AND THORACIC RESPIRATION RECORDINGS IN THE DETECTION OF DECEPTION

by

Stanley M. Slowik, Joseph P. Buckley,
Leonard Kroeker, Ph.D., and Philip Ash, Ph.D.[1]

Since 1935 when Leonarde Keeler first combined the three test parameters of respiration, blood pressure/pulse and Galvanic Skin Reflex (GSR) into a single simultaneously recording instrument, polygraph examiners have been content to obtain respiratory recordings by using only one pneumographic tracing, most often placed across the subject's abdomen. In fact, most of the existing data conerning the identification and classification of deceptive respiratory responses is based upon tests conducted with a single respiratory recording. More recently, examiners have incorporated dual-pneumographic recordings as a standardized procedure. This implimentation allows for the simultaneous recording of thoracic and abdominal respiratory responses. However, most examiners still rely primarily upon the abdominal recording in making judgments of respiratory deceptive responses.

The purpose of this paper is to answer the most significant questions regarding the two respiratory measures:

(1) Is there a significant difference between simultaneously recorded abdominal and thoracic respiratory responses?

If so, what are these differences and what is their importance to the test analysis?

(2) Noting in the control question technique that the examiner is concerned with the relationship between the respiratory responses to the relevant questions as compared with the respiratory responses to the control questions, is there a

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[1]Mr. Slowik and Mr. Buckley are with John E. Reid & Associates. Dr. Kroeker and Dr. Ash are with the University of Illinois.

significant difference between the thoracic relevant/control respiratory responses and the abdominal relevant/control respiratory responses?

(3) Which measures of difference, if any, best separate innocent from guilty subjects in respiratory recordings?

In our experiment, the polygraph records of 47 subjects (25 verified guilty and 22 verified innocent) were analyzed to note differences between abdominal and thoracic respiratory responses along five items of measure; deception indicated, two functions of the amplitude of the response, the duration of response, and the respiratory rate (Slowik, 1971). In the normal Reid procedure, each subject is asked four or five relevant questions, two control questions and four irrelevant questions on each test (Reid, 1966). Although the subject normally undergoes four or five individual tests, the recordings of the relevant and control questions responses of only the first and the third tests were analyzed, (Reid, 1966). Since both the thoracic respiratory responses and abdominal respiratory responses were measured, this data represents 28 measured responses for each subject, and 1,316 responses for the group of 47 subjects.

The first variable the authors evaluated on the 28 critical subject responses was the Deception Indicated Response (DIR), i.e., was there observed a deceptive respiratory response? If the findings were negative, the subsequent four variables were omitted. If respiratory deception was in fact indicated, the investigator would note the point on the tracing where deception began and where it ended. The amplitudes of the shortest inspiration/expiration cycle and that of the tallest inspiration/expiration cycle were measured perpendicularly from the peak of the cycle to a baseline constructed between the two bordering valleys (See Figure 1). Measurements were made to the nearest 1/16th of an inch. In the typical case of a staircase suppression deceptive respiratory response, the amplitude and particularly the change of amplitude is characterized by a sudden restriction in breathing, with shallow breaths (small amplitude) gradually growing deeper. To translate the amplitude measurements into a manipulable form, two sub-variables were defined; Summated Amplitude (SUMAM) in which the lowest

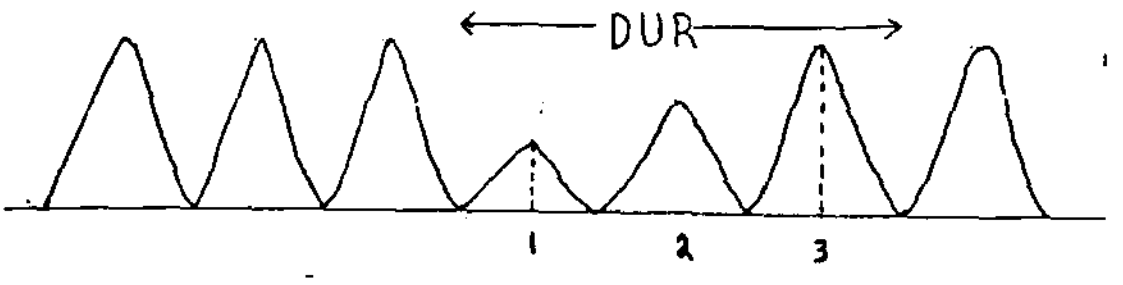

FIGURE 1

DUR - Length of the subject's deceptive response measured horizontally from the beginning of inspiration of the 1st breath within the response to the completion of expiration of the last breath within the response.

SUMAM - Height of the shortest breath (1) within the deceptive response added to the height of tallest breath (3) within the response.

DIFFAM - Height of the shortest breath (1) within the deceptive response subtracted from the height of the tallest breath (3) within the response.

RER - Respiratory rate, the total of complete respiratory cycles (breaths) with the deceptive response (3 cycles).

DIR - Deception indicated response - the examiners interpretation of the presence of a deceptive respiratory response to the question (relevant or control) under observation.

amplitude peak in a respiration response is added to the highest amplitude peak in that response, and Difference of Amplitude (DIFFAM) in which the lowest amplitude in a deceptive respiratory response is subtracted from the highest amplitude in that response.

In atypical staircase deception response, the highest amplitude returns to a near normal level and the lowest is depressed. The sum, therefore, should be smaller in a deceptive response than a non-deceptive response. The difference function should be greatest for a deception response and smallest for a non-deception response. The potential of 1,316 responses for the 47 subjects compared along five variables therefore represented a possible body of 6,580 items which were used in the statistical analysis of the experiment.

As described by other authors, care was taken to standardize such variables as bellows sensitivity, and attachment pressure, and location to ensure equal data gathering procedures for all subjects. (Wakamatsu, 1968).

RESULTS

Abdominal - Thoracic Differences. The measures listed above averaged over the two tests, were computed for both the abdominal and thoracic recordings. These data were subjected to a multi-variate analysis of variance designed to determine whether significant differences existed over all cases between the information provided in the two tracings.

A significant difference was found for only one variable, SUMAM (See Figure 2). The sum of the lowest and highest amplitudes for the abdominal recording was consistently larger than the sum for the thoracic recording. It appears that amplitude of respiration as measured thoracically by the polygraph is restricted by the relatively limited travel of the rib cage and sternum (breast bone) while abdominal respiration, as a function of the diaphragm, does not have such severe skeletal restriction (Slonim, 1967). Since no other differences and particularly the DIFFAM differences, even approached significance, the SUMMAM difference can be safely ignored; it simply reflects a difference in scale (See Table 1). The degree to which the variables of measure were inter-correlated was also studied. These inter-correlations are given in Table 2. Most of the correlations

are not significantly different from zero. The correlation of .70 between the difference in amplitude (DIFFAM) and the sum of the (extreme) amplitudes (SUMAM) is to be expected, since both are based on the combination of the same numbers.

The correlation between duration of response and respiration rate, more precisely the number of respirations within the response, is also measureable. In many cases, the longer a deception reaction takes, the more frequently is the subject to breath.

In simplistic terms, the statistical evaluation indicates there is little difference between abdominal and thoracic respiratory responses except in terms of amplitude. In other words, if deception is noted abdominally it usually appears simultaneously thoracically, the duration of the response is about the same and the number of breaths within the response is also about equal (See Figure 3). Table 2 represents a test of the variables used to detect differences between the abdominal and thoracic responses, i.e., are these variables really detecting distinct and different points of comparison or do they all measure the same thing? The data analysis supports the hypothesis that the measures used to determine if differences do exist between abdominal and thoracic responses are differentiating between valid points of difference and therefore the results of the analysis, i.e., that there are no statistically significant differences between the two, with the exception of the sum of the amplitude variable, which is in turn, a valid conclusion.

The remainder of this experiment dealt with issues that outwardly may appear to the polygraph examiner to be fundamental. We needed to know if there is a difference between the way innocent subjects respond, abdominally and thoracically, as compared to the manner in which guilty subjects respond, abdominally and thoracically. Also, within this context, is there a difference between abdominal control question vs. relevant question responses and thoracic control questions vs. relevant question responses? (See Table 3).

The results of this analysis indicates quite clearly that significant differences do exist between guilty and innocent subjects in terms of respiratory responses. It appears that the best measures of difference were the Deception-Indicated Relevant Questions, Deception-Indicated Control Questions and the Duration of the Control Questions.

These results were nearly identical between abdominal and thoracic responses. In other words, if an evaluation of guilt or innocence is based upon the variables cited, a high degree of predictive accuracy can be obtained from either abdominal or thoracic indicators.

It is stated, in the Reid technique, that an innocent subject will exhibit a greater deceptive reaction on the control questions than the relevant questions, and that a guilty subject will exhibit a greater deceptive reaction on relevant questions than control questions. In other words a response pattern difference should distinguish the guilty from the innocent (See Figure 4 and Table 4).

The multivariate analysis of variance indicated that not only is this hypothesis true, but can be supported to an extremely high degree of probability. The variables that contribute most to this separation are: (1) the difference between abdominal relevant and control deception-indicated response, (2) the difference between abdominal relevant and control respiration rate, and (3) the difference between abdominal relevant and control duration. This analysis, combined with the analysis that preceded, strongly lead to the conclusion: For maximum discrimination between innocent and guilty subjects, the abdominal tracing is more sensitive and a combination of the three variables, Deception Indicated Response, Duration of Response, and Respiration Rate will give the most dependable discrimination between the innocent and the guilty.

Summary & Conclusion - This study was designed to answer three principal questions:

(1) Is there a significant difference between simultaneously recorded abdominal respiratory and thoracic respiratory responses? If so, on which measures?

Overall, there is not a significant statistical difference but on the SUMMAM variable (sum of lowest and highest amplitude in a question cycle) there is a significant difference, attributable largely to mechanical physiological differences. This result may be considered in two important ways. First of all, if for some reason, the examiner is unable to obtain both respiratory recordings, either one may be considered statistically similar enough to be used independently.

Secondly, although the statistical differences between abdominal and thoracic recording appears too insignificant as far as their use as measures of deception, this is not to say there is never any important differences between the two. It is perhaps these exceptional cases that necessitates the use of both abdominal and thoracic respiratory recordings (See Figure 5). Other polygraph researchers have confirmed a suspicion noted by the authors(Wakamatsu, 1968), as yet statistically unverified, that when gross response pattern differences exist between abdominal and thoracic responses, these differences usually occur when the subject is engaging in some form of intentional, voluntary or controlled respiration as opposed to the involuntary autonomic responses observed in deception (See Figures 6 and 7).

(2) Is there a significant difference in pattern of response (relevant versus control questions) as between abdominal and thoracic recordings? The data indicate that this difference is not significant. In both recordings, approximately the same relevant control pattern occurs as between innocent and guilty subjects.

(3) Which measures best differentiate innocent and guilty subjects?

The best indicators are pattern differences on Deception, Indicated Responses, (abdominal or thoracic), Duration of Response, (abdominal or thoracic); and Respiration Rate (abdominal).

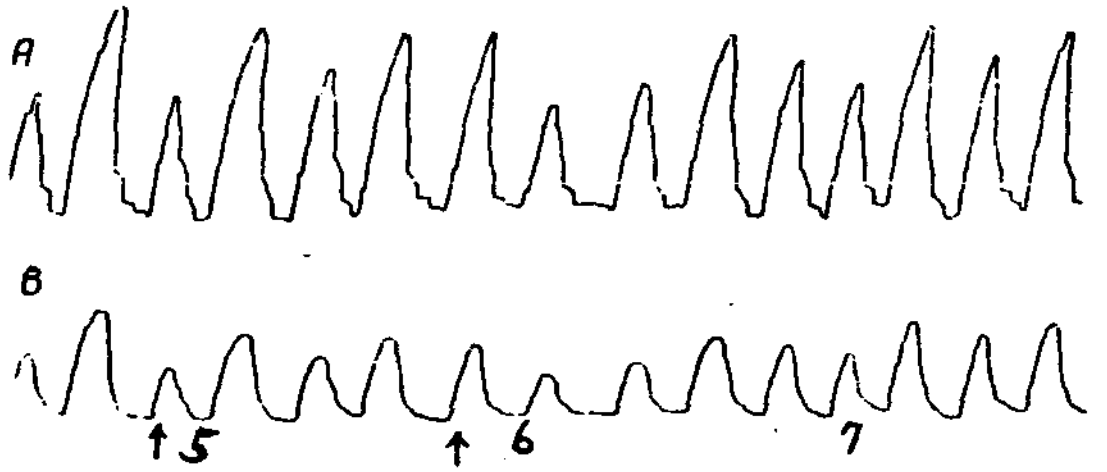

FIGURE 2

Portion of the Silent Answer Test record of a law enforcement official suspected of theft. The Silent Answer Test is one in which the subject is instructed by the examiner to refrain during the test from giving any audible answers to the questions that are to be asked of him. In the Silent Answer Test the subject is told to listen to each test question and to answer only to himself silently. In other words, the subject is instructed that he is to "subvocalize" his answers, just as a person might do when he reads to himself.

Observe the change in respiration in both the abdominal (A) and thoracic (B) patterns at control question 6. The greater amplitude in the abdominal respiratory pattern makes the deception response more evident in this tracing than in the thoracic tracing. This type of amplitude difference (i.e., greater in the abdominal than thoracic tracing) is one of the most frequently occurring differences in our comparison of the two respiratory measures.

Question 5 is a relevant question and question 7 is an irrelevant question. The arrows preceding the question numbers indicate the point at which the examiner began asking the question.

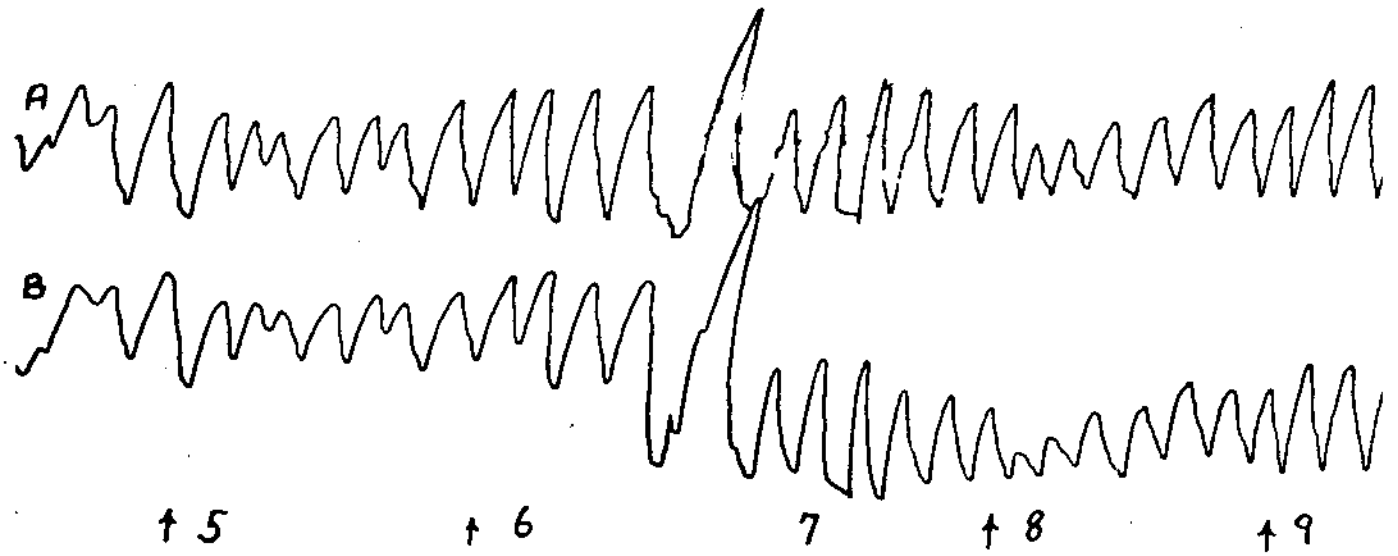

FIGURE 3

Portion of the Silent Answer Test records of a subject suspected of theft. Observe at relevant questions 5 and 8 the change in both the abdominal (A) and thoracic (B) respiration tracings, clearly indicative of guilt. Of particular note is the similarity of the subject's respiratory recordings in terms of amplitude, rate of respiration, duration of response and response pattern. This example is consistent with our studies of abdominal and thoracic respiratory tracings with the exception of the lack of a greater amplitude in the abdominal pattern.

Question 6 is the control question "Besides what you told me, did you ever steal anything else?" Question 7 is an irrelevant question.

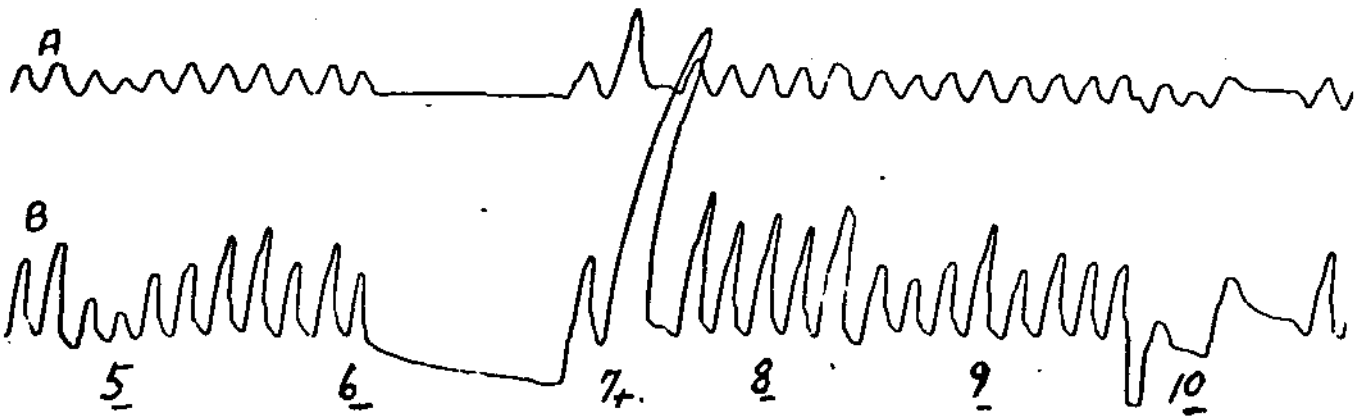

FIGURE 4

Records of a woman suspected of infidelity. Questions 5, 8 & 9 are relevant to the issue under investigation. Question 7 is an irrelevant question. Observe the respiratory blocks in both the abdominal (A) and thoracic (B) patterns at control question 6 and 10 clearly indicating the subject's innocence. This record demonstrates the inverse of our studies statistical finding in that the amplitude of the thoracic recording is greater than that of the abdominal recording. Note however, the similarity of the respiratory rate, duration and pattern of the responses in all other measurements within the tracings.

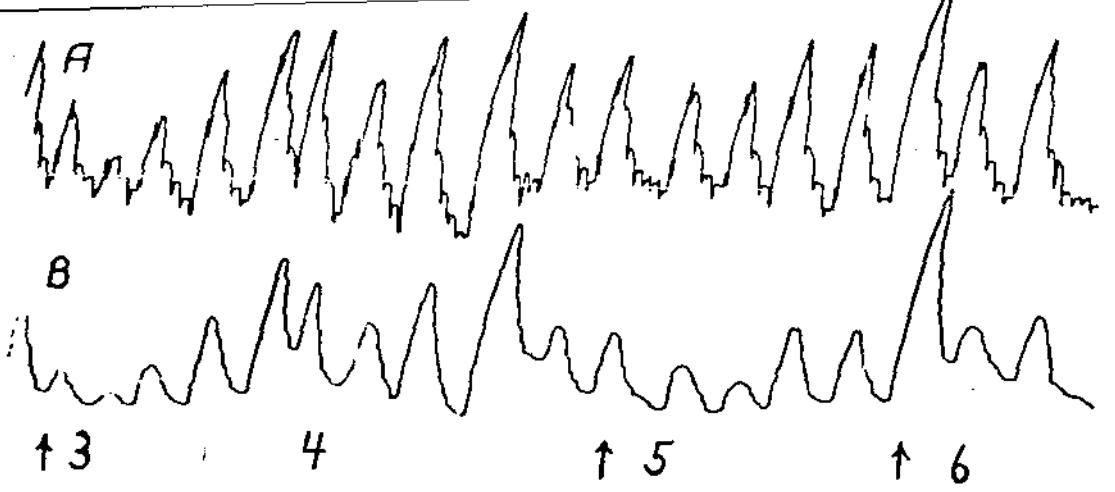

FIGURE 5

Portion of the Silent Answer Test record of an untruthful, nervous subject. Although the subject's deceptive responses to relevant question 3 and 5 are similar in both the abdominal (A) and thoracic (B) respiration patterns, the subject's nervousness is revealed in the serrated respiratory pattern of the abdominal tracing only. Question 4 is an irrelevant question and question 6 is a control question.

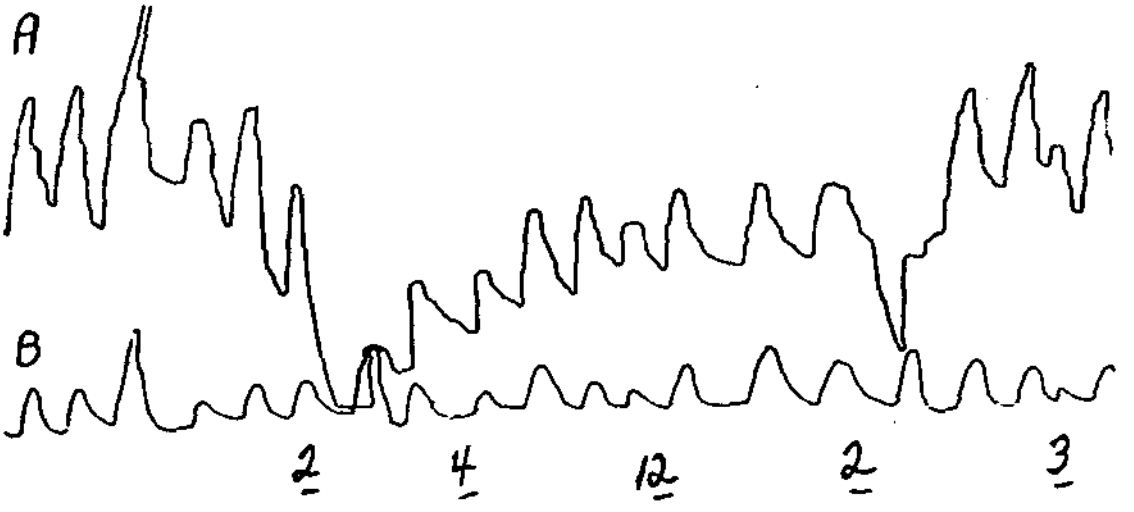

FIGURE 6

Card test record of a suspect in the theft of $2,000.00. Observe the subject's attempt to distort his respiration pattern in the abdominal tracing (A) at the point the examiner called his chosen card #(2). No evidence of purposeful distortion is indicated in the thoracic respiration pattern (B). If the examiner had recorded the subject's respiration from only the thoracic area, he would not have detected the subject's attempt to distort his records.

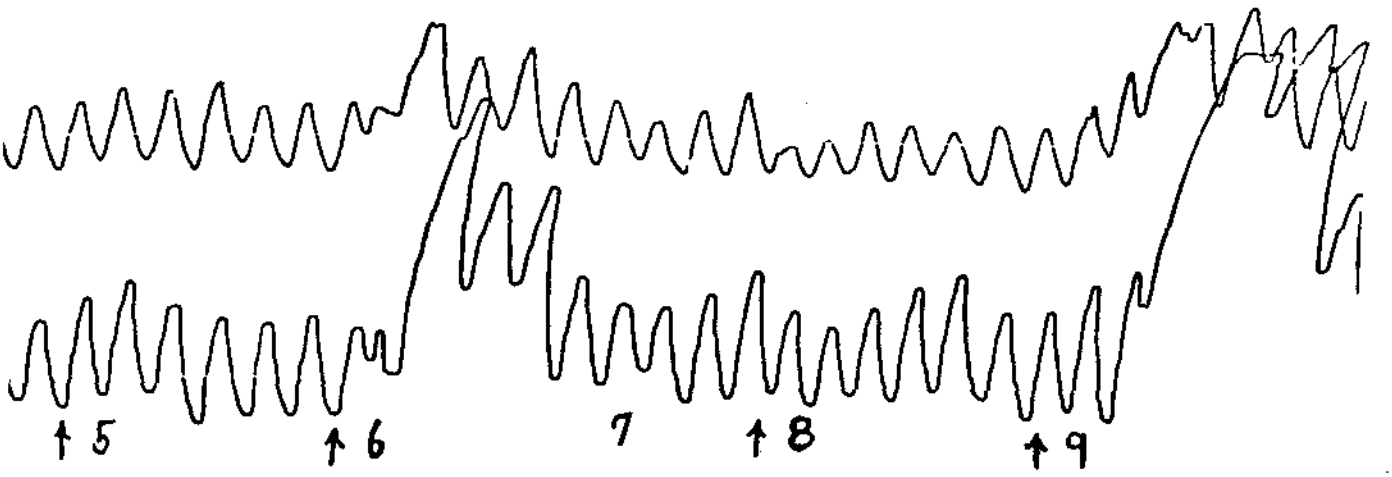

FIGURE 7

Portion of the Silent Answer Test record of a subject who alleged that a law enforcement officer solicited a bribe from him. Questions 5 and 8 are relevant questions, question 7 is an irrelevant question, and questions 6 and 9 are control questions. Observe at control questions 6 and 9 the subject's attempt to purposefully distort his respiration responses in the thoracic tracing (B) in an effort to prohibit the examiner from determining his status regarding the veracity of his answers. The subject's concern with his responses on the control questions indicated his probable truthfulness to the issues under investigation. Of particular note is the fact that without the thoracic recording the subject's obvious attempts to distort his respiratory patterns would not have been so clearly indicated.

TABLE 1

Multivariate Analysis of Variance
Comparing Abdominal and Thoracic Respiration Variables
For 47 Polygraph Records

Variable (Abdominal vs. Thoracic)	Hypothesis Mean Square	Mean Error Square	F
1. Deception-Indicated Response (DIR)	0.0126	0.0098	1.29
2. Duration of Response (DUR)	0.0343	1.4349	0.02
3. Amplitude Sum (SUMAM)	655.3962	33.3244	19.67*
4. Amplitude Difference (DIFFAM)	2.8976	2.7783	1.04
5. Respiration Rate (RER)	0.0301	0.0673	.45

* $p < .0001$. All other F-ratios insignificant.

TABLE 2

Intercorrelations Among Five Basic
Respiration Cycle Variables

	Variables			
	DIR	DUR	SUMAM	DIFFAM
Deception-Indicated Response (DIR)	-			
Duration of Response (DUR)	-.00	-		
Amplitude Sum (SUMAM)	.10	-.01	-	
Amplitude Difference (DIFFAM)	.17	-.03	.70	-
Respiration Rate (RER)	-.08	.72	-.01	.01

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Differentiation of Innocence Or Guilt On Abdominal And Thoracic Respiration Measures

	Abdominal Measures			Thoracic Measures		
	Hypothesis Mean Square	Error Square	F	Hypothesis Mean Square	Error Square	F
Relevant Questions			****			***
DIR	.4975	.0249	20.00	.4128	.0304	13.56
DUR	.2223	8.7107	.03	1.2701	7.7717	.16
SUMAM	31.1688	50.0317	.62	9.7486	36.8320	.26
DIFFAM	2.5253	5.2291	.48	2.6921	7.2334	.37
RER	1.5428	.3632	4.25	.7453	.5859	1.27
Control Questions						
			**			**
DIR	.4479	.0672	6.66	.5730	.0733	7.81
			***			*
DUR	99.3280	8.7004	11.42	42.9749	7.0809	6.07
SUMAM	27.1994	74.6548	.36	7.6121	32.3362	.24
DIFFAM	.1650	6.1789	.02	.0910	3.7793	.02
RER	.8416	.5508	1.53	.0004	.6520	.00

* $p < .02$ ** $p < .01$

*** $p < .001$ **** $p < .0001$

TABLE 4

Differentiation Of Innocence And Guilt
By Response Pattern Difference
(Behavior On Relevant Questions Against
Behavior On Control Questions)

	Hypothesis Mean Square	Error Square	F
Abdominal Responses			
(DIR Relevant) - (DIR Control)	.9232	.0451	20.48 ****
(DUR Relevant) - (DUR Control)	54.5621	4.0308	13.54 **
(SUMMAM Relevant) - (SUMMAM Control)	.0651	6.9176	.01
(DIFFAM Relevant) - (DIFFAM Control)	.7098	1.3979	.51
(RER Relevant) - (RER Control)	2.3247	.1154	15.36 ***
Thoracic Responses			
(DIR Relevant) - (DIR Control)	.9596	.0494	19.42 ****
(DUR Relevant) - (DUR Control)	29.4994	5.6018	5.26 *
(SUMMAM Relevant) - (SUMMAM Control)	.0656	7.8407	.01
(DIFFAM Relevant) - (DIFFAM Control)	.9012	2.8350	.32
(RER Relevant) - (RER Control)	.3874	.1763	2.20

* $p < .05$

** $p < .001$

*** $p < .0005$

**** $p < .0001$

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AN INVESTIGATION OF MUTUAL RELATIONSHIPS BETWEEN "SIGHS" AND "CARDIO" TRACINGS IN CHART INTERPRETATION

by

William J. Yankee, Ph.D. and Donald L. Laughner

Introduction

Considerable emphasis has been directed toward the cardio-sphygmograph pattern in chart interpretation. Keelers, as well as other schools and professions, have typically enumerated on the variety of reaction possibilities. These have been divided, in some instances, into two categories: (1) changes indicative of deception, and (2) changes not necessarily indicative of deception.

A number of patterns, not necessarily indicative of deception, are listed in the Keeler Training Guide. The general headings in this section includes one entitled "Subject's Respiratory Activities." This is described by the listing of three major variables: (1) sign, (2) clearing of the throat or cough, and (3) talking by subject. Of these variables, the one of special concern is the "sigh." According to the Keeler method of interpretation the sigh "will generally be reflected by a rise and fall in the subject's cardio tracing."[1]

It is apparent from the previous paragraphs that the Keeler technique, as far as cardio-sphygmograph interpretaion is concerned, does not consider the sign and its supposed rise and fall effect on the cardio tracing as deceptive criteria.

In the pneumograph patterns, however, interpretations of sighs are made in both the deceptive as well as the non-deceptive categories. The only pattern listed as indicative of deception is "labored breathing." This pattern is described as follows:

> The pen may swing from one mechanical stop to the other. This may be an attempt by the subject to beat the test. This type of breathing

[1] Harrelson, Leonard. Keeler Polygraph Institute Training Guide. Copyright 1964. 160 E. Grand Ave., Chicago, Ill. 60611.

should produce the same effect on the cardio tracing as a sigh.

In the non-deceptive pneumograph pattern, the only criterion listed is the "audible sigh." Although the Keeler technique and guide does not specifically instruct, it implies that the reactions in the sphygomanometer tracing at and subsequent to an "audible sigh" are similar to those associated with the "sigh" and "labored breathing."

Some examiners have reported observing rather smooth, sympathetic like, rise and fall patterns at and following a sigh. It was their speculation that this phenomena was often effected by the blood pressure cuff coming into contact with the rib cage of the subject as the chest expanded. The Keeler Guide mentions this possibility under "subject movement" but makes no further explanations. The implication is that any kind of change from movement would be abrupt and noticeably different from normal or deceptive cardio tracings.

The possibility that externally applied cuff-chest pressure may or may not be a reason for rise and fall patterns in cardio tracings in relation to sighs led to a pilot investigation.

In the pilot study, five subjects were used to obtain normal polygraphic recordings. Two recordings were taken on each subject. The first recording was taken with the arm and cuff close to the rib cage (in physical contact but with no pressure). The second recording was taken with the arm and cuff definitely out of contact with one another and so that even an extreme sigh would not bring them together.

The results of this pilot work supported the observation that the "close contact" sigh could produce smooth rise and fall cardio tracings. The "non-contact" recordings produced a variety of patterns, thus led to this more extended study.

In summary it appears that the Keeler position is one that ascribes a non-deceptive role to all "sighs" except the "labored breathing" pattern. But, in all instances, it maintains the theoretical position that the sigh will "generally be reflected by a rise and fall in the subject's cardio tracing."

Upon close inspection it appears that the theory of chart interpretation associated with the sigh, whether in the cardiograph or pneumograph sections, as indications of deception or non-deception, is rather general and vague, and in need of extensive research and development.

Purpose

This is an exploratory study for the purpose of attempting to determine the mutual relationships between sighs and cardio tracings by:

1. Verifying the Keeler theory that a sigh "will generally be reflected by a rise and fall in the subject's cardio tracing."

2. Produce and define meaningful major classification of sighs.

3. Describe the patterns of cardio tracings related to each classification.

4. Observe the frequency these cardio patterns appear in each classification.

Procedure

Subjects and Instructions.

The subjects were 120 students in psychology class at Western Michigan University of Kalamazoo, Michigan. All subjects were volunteers. However, only 89 subjects met enough of the experimental conditions to finish and be included in this study. Of the 89 subjects, 47 were male and 42 were female. The average age of the females was 21 years, of the males 20.8.

The subjects, for the purposes of this study, served as their own controls. Each subject was subjected to the same conditions and instructions. The only difference experienced was in the cuff pressure. The range of pressure, however, was equally distributed.

The instructions, in addition to general explanations and description of the equipment, directed the subjects to "take a deep breath when you are told" and to "hold your breath until told to breathe again." The implication for

the deep breath instructions led subjects to take what could be described as a good sigh. The holding of the breath was initiated at various stages of the breathing cycle and was held for 10 seconds.

Apparatus

The experiment was conducted in an 8' X 10' semi-sound proof, windowless room. A Keeler Model 6303 polygraph, installed in a desk, was used. The subject's chair was stuffed, leather-covered, with wide arms. Other than the examiner's chair there was no apparatus or equipment in the room. All physical conditions and equipment resembled usual commercial polygraph settings as nearly as possible.

Results

The results of this study are based on the following operational definition of a sigh and its operationally-defined sub-classifications.

1. Sigh.

   A Sigh will be defined as a breathing cycle of magnitude and duration that is observably greater than the normal breathing cycles preceding it and following it. It may or may not be accompanied by audible vocal or respiratory sounds in either the inhalation, exhalation, or both portions of the cycle. It is not a pre-talking inhalation.

   A. Elicited sigh.

      An elicited sigh is operationally defined as a breathing cycle of magnitude and duration that is observably greater than than the normal breathing cycles preceding it and following it. It may or may not be accompanied by audible vocal or respiratory sounds in either the inhalation, exhalation, or both portions of the cycle. It is not a pre-talking breath. It is brought forth by a conscious, voluntary effort on the part of the organism.

B. Emitted sigh.

> An emitted sigh is operationally defined as a breathing cycle of magnitude and duration that is observably greater than the restrained breathing cycles preceding it and the normal or restrained cycles following it. It may or may not be accompanied by audible vocal or respiratory sounds in either the inhalation, exhalation, or both portions of the cycle. It is brought forth by unconscious, shallow, superficial breathing and/or conscious or unconscious suspension of breathing immediately preceding it.

The data is summarized in Table I. It should be noted that no descriptive attempts were made with cardio amplitude or heart rate. The relative blood pressure tracings and the direction of this tracing surrounding each classification of a sigh is the concern of this study.

Table I

A Summary of the Types of Relative Blood Pressure Changes and the Frequency of Occurrence in Elicited and Emitted Sighs.

Relative Blood Pressure Tracings	Elicited Sigh						Emitted Sigh					
	Male		Female		Total		Male		Female		Total	
	N	%	N	%	N	%	N	%	N	%	N	%
Rise Only	0	0	0	0	0	0	26	55	16	38	42	47
Fall Only	35	74	29	69	64	72	1	2	4	9	5	6
Rise & Fall	2	4	4	10	6	7	13	28	7	17	20	23
Fall & Rise	4	9	3	7	7	8	1	2	2	5	3	3
No Fall or Rise	6	13	6	14	12	13	6	13	13	31	19	21
Totals	47	100	42	100	89	100	47	100	42	100	89	100

Discussion and Analysis

The most notable feature of the data presented is the absence of support for the position that a sigh "will generally be reflected by a rise and fall in the subject's cardio tracing." This is especially true in reference to the elicited type of sigh since only 7 % of the subjects demonstrated the expected rise and fall phenomena. In the emitted sigh, however, 23% demonstrated a rise and fall pattern, with a higher percent of males (28%) than females (17%) showing this.

If one speculated as to the applied implications of the operational differences in these two sighs, some rather pertinent information could be gleaned. For example, suppression is one of the first listed criterion, in the Keeler Training Guide, for deception reaction patterns in the pneumo recording. Although the Keeler Guide does not define "suppression" it has commonly been noted as a breathing pattern characterized by observable differences in breathing cycles as compared with cycles preceding and following it. These differences appear in the recording as a "restrained," "stifled," or "partially withheld" manner with less magnitude but not necessarily less duration. They are not voluntarily or consciously produced by the organism.

If this definition of suppression is what Keeler's mean by the work, then the resemblance between this behavior and the "emitted sigh" as experimentally induced and operationally defined in this study are obvious.

Other important differences appear in the data. Note that in no instance was there a "rise only" pattern in the "elicited sigh" yet 47% of the subjects produced a "rise only" pattern as a result of the "emitted sigh." In the "fall only" tracing the opposite occurs: 72% of the elicited sighs produced a fall only pattern, whereas only 6% showed a similar result for the emitted sigh.

Some subjects - 13% - do not show any changes at all in elicited, and only 21% in the emitted, sigh categories.

Although sex differences are reasonably small in the elicited category, some are worth noting in the emitted. The largest percentage - 55% of male responses to emitted sighs - result in a "rise only" pattern, whereas only 38%

of the females show this trend. The female on the other hand is higher - 31% - in the "no rise or fall" category.

The two commonly found patterns resulting from emitted sighs are first, "rise only," and secondly, "rise and fall." The two commonly found patterns resulting from elicited sighs are first, "fall only," and secondly, "no rise or fall." Fall and rise patterns are rare in both classed of sighs.

If suppression in the breathing cycle can be claimed to be a reliable criterion of deception, then compensatory breathing subsequent to the suppression would be similar to our operationally defined "emitted sigh." If this appears reasonable then it is strongly suggestive of an emitted sigh, in the majority of cases, of also being a criterion of deception. On the other hand, elicited sighs would show no observable traces of suppression and the fall in the cardio tracing would assist in interpreting that the sigh was a conscious voluntary pattern.

Conclusions and Recommendations

This study suggests and provides support for the following conclusions:

1. That the position, a sigh "will generally be reflected by a rise and fall in the subject's cardio tracing," is not tenable.

2. That sighs can be classified into two main categories, elicited and emitted, and these categories can be described in terms of cardio responses.

3. That voluntary or consciously forced sighs, operationally defined as elicited sighs, will generally produce a fall or no rise or fall at all, in the cardio tracing.

4. That involuntary and unconscious sighs, subsequent to a suppression in breathing, operationally defined as emitted sighs, will generally produce a rise or a rise and fall in the cardio tracing.

5. Extreme care should be taken to avoid cuff and rib cage contact.

Recommendations

The data support and suggest the following recommendations:

1. A cross-validation should be made and if similar results ensue, then the results of these studies become the support for the theoretical position of chart interpretation regarding sighs.

2. That the present Keeler position regarding sighs be suspended.

3. That further studies regarding emitted sighs and their inclusion as a deceptive criteria be undertaken.

4. That additionally defined and described sub-categories of sighs be experimentally pursued.

5. That similar, but reversed procedure studies, be made by utilizing charts already obtained in applied settings.

This study was presented at the Keeler Alumni Association Meeting in Chicago, Illinois, 1964.

THE POLYGRAPH IN JAPAN

by

Stanley Abrams, Ph.D.

The literature on the polygraph in this country and in others indicates little utilization of this approach except in the United States, Israel, and Japan. Undoubtedly, this instrument is employed in Russia, but obviously, such information is difficult to obtain. Much of the European literature on the polygraph consists of only a description of the use and research findings from the United States. In some countries, such as Germany, this technique has been declared illegal for use by both the courts and the law enforcement agencies because it is seen as an encroachment upon the freedom of the individual (Kaginiec 1956). Swanson (1957) stated that, "This regard for the dignity and freedom of decision of the human being as a moral person does not leave any room for the use of devices which explore his inner life." In Holland, Meyjes (1961) reported that investigators cannot attempt to obtain a statement other than in accordance with the free will of the subject. Since the individual is required neither to render any assistance nor to answer any questions, polygraph approaches cannot be used. In their thinking, it is inconsistent with the individual's right against self-incrimination.

In Japan, however, the polygraph technique is an acceptable investigative procedure and is admissible into the courts. Since 1959, there have been many instances in which polygraph results have been received as evidence in the lower courts. In a 1966 publication in the International Criminal Police Review it was stated that, "... it is expected in the near future the Supreme Court will pass a judgment on the question of its admission as evidence." Its accuracy at that time was coming to be generally approved by judges and they had even then been issuing orders for polygraph testing of the accused. Makoto Shimizu, M.D., Director of the Polygraph Program in Japan, has indicated in a personal communication that polygraph evidence at this time is being accepted by the Japanese Supreme Court. The decision regarding its admissibility, however, is dependent upon the judge in each case.

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In a publication by the Police Science Laboratory in Tokyo, two cases were presented in which the polygraph was reported to be of definite value in assisting the jurists in determining innocence or guilt. The statement presented by the higher courts was that with able and experienced examiners employing adequate instruments, the polygraph approach can be quite accurate. They further indicated that there are instances when the court cannot make a determination of guilt, while the polygraph can accomplish this with accuracy.

This approach was first used by the Japanese prefectural police in 1956, and its use has steadily increased. In 1956, only fifty-one subjects were examined while at the present time there are approximately five thousand examinations a year (Suzuki 1973). Unlike the United States, polygraph examinations are administered only by law enforcement examiners. There are no private polygraphers working in the areas of business or industry, and all tests are conducted at the request of the courts or in criminal investigations.

The polygraph technique is approached quite rigidly in Japan. Akihiro Suzuki reported that no one is examined who has recently consumed an alcoholic beverage or who has taken drugs. Individuals who are retarded or psychiatrically ill are not examined nor are those tested who have medical conditions such as hypertension. A polygraph examination is not administered unless a peak of tension test can be employed. It is not felt that a general series test alone results in sufficiently valid results.

A polygraph training institute is associated with the Police Science Laboratory in Tokyo. Students are admitted into the school through competitive examinations. The candidate must be either a college graduate who majored in psychology or a graduate from one of the technical areas, who has shown an aptitude for polygraphy. Those accepted for training undergo a highly intensive course which includes advanced work in psychology and physiology. In the same setting, research is carried out in a wide range of polygraph related areas. Their entire approach, whether it be in training, testing, or research is done in a rigidly scientific, well-controlled, and cautious manner.

The research which has been done on actual criminal investigations suffers from the same weakness as does the

experimentation carried out in the United States: it is impossible to obtain complete verification of the guilt or innocence of all suspects in studies of actual crimes. A report in the Interpol Journal indicated that in the year 1962, 35.9% of the suspects were diagnosed as guilty, 57.9% as innocent, and 5.2% as inconclusive. In 1963, similar findings were obtained with 34.8% judged to be guilty, 61.6% truthful, and 3.6% inconclusive. Although no other statistics were reported, it was stated that, "Most subjects diagnosed as 'positive' confess their crime to investigators, yielding to the accuracy of the finding of the test; and even in cases of denial, verdicts of guilty are obtained in many cases where the test results are submitted as expert reports. . . ." In a later study by Hikita on the examination of 1,889 criminal suspects, 56.3% were judged to be guilty, 39.6% as innocent, and 4.1% as inconclusive. Of those diagnosed as guilty, 87.7% were verified as accurate through either confession or other evidence. Of those reported to be innocent, the findings were proved to be accurate in 34.1% of the cases.

Several companies in Japan manufacture polygraphs with the retail cost being somewhat higher than the cost for a comparable instrument in this country. Takei and Company* produces a variety of instruments, including one in which all verbal communications between the examiner and subject are taped on the chart. A cursory examination of the equipment showed it to be well made and quite sensitive.

The acceptance of the polygraph in Japan and its demonstrated effectiveness add more evidence for the validity of this approach and for its value in law enforcement and as an aid to the courts. Its utilization by the Japanese judicial system should provide further impetus to the polygraph's admission into the courts in the United States. In spite of the limited research, there is a growing body of proof demonstrating the ability of the polygraph technique in detecting deception, and it is rapidly approaching the time when jurists here, as in Japan, should admit this approach into the courts as evidence.

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*Address: No. 18, 6-1 chome, Hatanodai, Shinagawa-Ku, Tokyo, Japan

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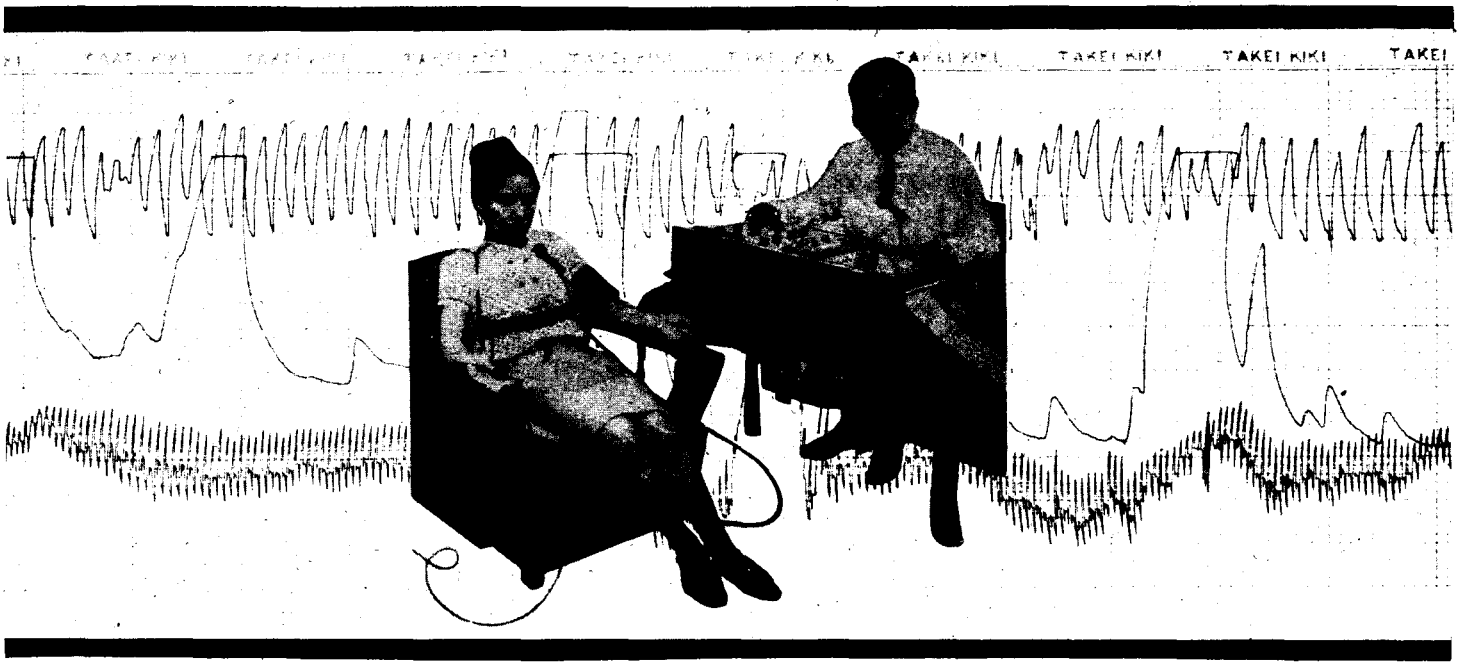


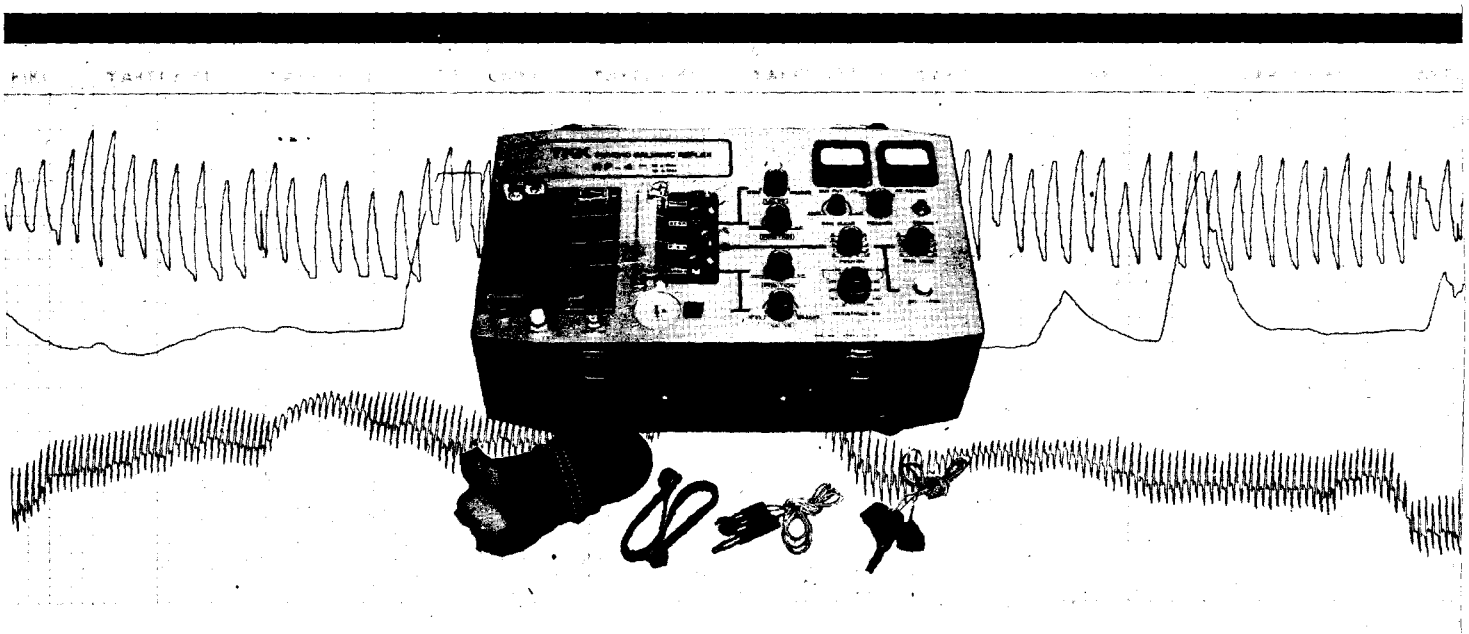
T.K.K. POLYGRAPH (RP–4)

Polygraph Model (RP-4) is applied to the use in many fields such as psychological research, physical study, speech theraph, aptitude testing industrial security, bonding investigation, advertising study, employment (personal screening) etc. This model (RP-4) is used by universities, laboratories, hospitals, courts and many industrial organizations and facilities.

The model (RP-4) employs the improved pneumograph, cardiogarph and galvanographic sections as described for Model (TRP-1). Also check marker for stimulus is attached to this instrument which can easily record the subject's response on the chart paper. The distinctive characteristic in the galvanographic section is that both the basic skin resistance (measurement of subject's normal condition) and the skin resistance in his reaction against stimulus (measurement of lie detection) are obtained by using change over switch. For measurement of the basic skin resistance, bridge circuit is used in this instrument.

Characteristics :

1. It takes a form of direct recording with ink, (1) galvanic skin resistance (2) respiration and (3) blood pressure change and pulse rate can be all recorded simultaneously.
2. The amplitude of each recording pen is 60 mm at maximum. These pens are kept from touching each other, even though the sensitivity may be increased to the full.
3. The recorder is not affected by the voltage drop by means of synchronous motor which works at a uniform rate of speed.
   Speed-2.5 mm/sec. or 5 mm/sec.



4. For recording blood pressure changes it enables clear record by the air pressure of approx. 50 – 60 Hg. in the blood pressure cuff.
5. For recording G.S.R. its changes can be exactly recorded and read up to 0-500 KΩ, G.S.R. gain control can be numerically read and converted in an exact and easy manner by changing-over switch.
6. Check marker pen (for stimulus) is arranged.

Attachments :

1.	Recording paper	2 rolls	
2.	Pneumograph chest assembly	1 pc.	
3.	Finger electrodes	1 pc.	
4.	Recording ink	2 bottles (red & green)	
5.	Hand pump bulb	1 pc.	
6.	Recording pen	4 pcs.	
7.	Blood pressure cuff	1 pc.	
8.	Power source cord	1 pc.	
9.	Vinyl cover for instrument	1 pc.	

Size : 50 cm width × 28 cm depth × 16.5 cm height
Weight : 20 kg.
paper size : 14.5 cm (wide) × 50 m (long)

T.K.K. PHONO-CHART TYPE POLYGRAPH (PC-1)

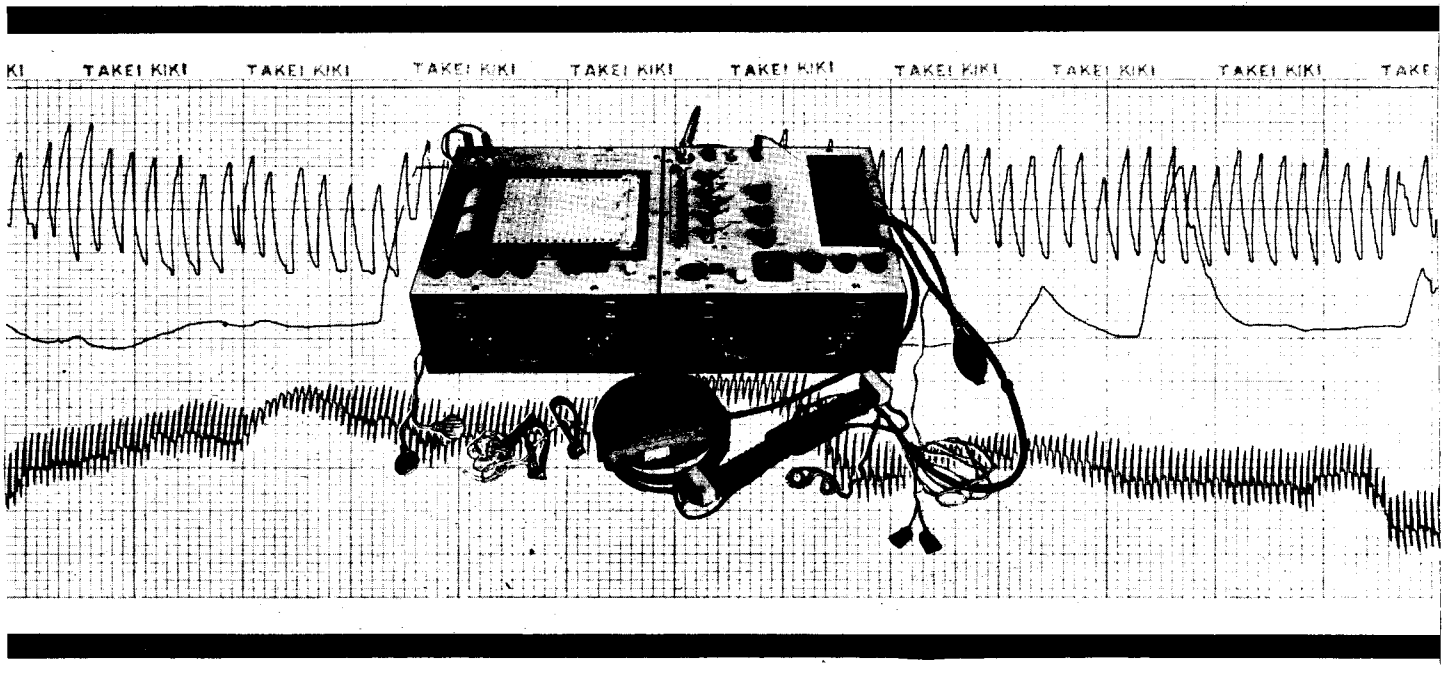
This equipment is so designed that the recording of response phenomena, question and answer and other stimuli or atmosphere etc, i.e. the whole procedures of measurement, is perfectly synchronized, because on the surface of chart the recordings of G.S.R., respiration, blood pressure and pulse rate and the location of question and answer by two elements of voice key are perrormed by ink-writing method, whereas on the backside of the chart, the question by testor, the answer by subject the circumstances of above and other stimuli can be sound-recorded simultaneously. By this combined recording, the accurate estimation of response phenomena by recorded wave form and play-back of process of measurement after the completion of measurement, can be performed easily, so that the degree of analysis of measurement become highly accurate.

For easier transportation this equipment is divided into two parts of recorder unit and measuring unit.

This equipment is designed and developed under the guidance of Psychological Laboratory of Scientific Police Reseach Institute, National Police Bureau of Japan.

Construction :

1. Measuring Unit :
   1. G.S.R. measuring unit
   2. Blood pressure and pulse rate measuring unit
   3. Respiration measuring unit
2. Recorder Unit :
   1. Sound recording and reproducing operation unit
   2. Voice key unit
   3. Recording paper feeding unit



Specifications :

1. Power source : AC Line Voltage, 50 or 60 Hz as indicated.
2. Sensitivity of respiration : The length of pneumograph tube is 30 cm ± 2 cm. Amplitude of pen : 20 mm ± 5 mm for the 5 mm elongation of pneumograph tube.
3. Galvanometer : Moving preuemograph coil type, sensitivity : more than 10 mm/A.
4. Time constant for G.S.R. circuit : In case of 500 K Ω series for the variation of 1 K Ω.....time constant, : 2.5 sec ± 0.5 sec.
5. Sensitivity of G.S.R. measuring circuit : The amplitude of pen, more than 6 mm for the variation of 1 K Ω, in case of 500 K Ω input.
6. Maximum amplitude : ± 30 mm
7. Method of sound recording : New type A.C. bias system, two heads alternative recording type.
8. Indication of sound recording level : Using level meter.
9. Microphone : Label type crystal microphone, 2.
10. Recording paper : effective width, 140 mm, length of one roll, 20 m.
11. Motor for sound recording : Induction motor, 1,500 r.p.m.
12. Speaker : Dynamic oval type.
13. Frequency characteristics : abt. 300—3,000 Hz
14. Output : more than 300 mW.
15. Voice key unit : Two circuits, four stage amplification.

Attachments :

1. Recording paper : one roll
2. Recording pen : 5
3. Pneumograph for respiration recording : 1
4. Blood pressure cuff for pulse recording : 1
5. Hand pump bulb : 1
6. Electrodes for G.S.R. measurement : for finger-tip : 1
   for palm pressure : 1
7. Power source cord : 1
8. Microphone for sound recording : 2
9. Recording inks : two colors
10. Hand eraser : 1

ANALYSIS OF POLYGRAPHIC DATA

Dependent and Independent Situations

by

Joseph F. Kubis, Ph.D.
Department of Psychology
Fordham University

ABSTRACT

To evaluate the feasibility of adapting rapid processing techniques to the present art of polygraph interpretation, it was necessary to evaluate and study the various factors affecting the processes of interpretation of polygraphic data. This report covers factors affecting the decision process and the accuracy of measured responses.

Two types of decision situations are characteristic of lie detection investigations: the dependent judgment case in which the examiner, selects the guilty individual, and possibly accomplices, from among a group of suspects known to include the culprit(s); and, the independent judgment case, in which a decision of innocence or guilt is made independently for each suspect on the basis of his record alone. In the latter situation the suspects are usually apprehended one at a time and at irregular intervals.

The results indicate that neither accuracy of decisions nor confidence in them was diminished under independent judgment conditions. However, the one rater who served in both experimental situations showed less accuracy and less confidence in his decisions in the independent judgment situation. Furthermore, the more "serious" errors of misclassification

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This study was conducted under contract for Rome Air Development Center, Air Force Systems Command, and reported in RADC-TDR-64-101. It is reprinted with permission of Dr. J. F. Kubis and The Department of the Air Force.

were more numerous in the independent judgment situation. Greatest accuracy was achieved with the psychogalvanic index of deception, and this index tended to determine the direction of the final decision in the analysis of the total polygraph chart.

Precise standards were established for measuring responses. The measured characteristics of the physiological response systems were found to be as accurate as the ratings of the lie detector operators in discriminating between culprit, collaborator, and innocent suspect.

Factors Affecting the Decision Process in Lie Detection

Two types of decision situations confront the polygraph expert. In the one, he is called upon to examine a relatively small and fixed group of suspects. His objective is to determine the culprit among them. He is assured that these are the only suspects who could be associated with the crime. As an example, bank loses very often can be confined to a small area and to a small group of employees who could have had access to a particular safe or vault. In identifying the culprit, the expert is influenced by and dependent upon the mutual comparison of the polygraph charts of all suspects. This will be called a Dependent Judgment situation.

By contrast, the second type of case involves the examination of a single suspect. If there are more, they are brought in at irregular intervals, usually one at a time. A decision is rendered after the examination of each suspect. Guilt or innocence is determined independently for each suspect on the basis of his records alone. Naturally enough, this will be called the Independent Judgment situation.

In a previous research (Kubis, 1962) several aspects of the decision process in lie detection were studied. A Simulated Theft provided a situation in which a Thief (T), a Lookout (L), or confederate, and an Innocent Suspect (I) were involved. An examiner, playing the role of a lie detector expert, tested the three members of the Simulated Theft group immediately after the theft was committed. He knew that one of the three individuals to be examined was a Thief, one a Lookout, and one an Innocent Suspect. It was his job to identify the role of each suspect. After he

tested the group of three, the examiner rated the physiological reactions to those questions that were directly related to the theft. The instrument he used recorded respiratory changes (Resp), a plethysmographic finger volume pattern (Pleth), and the psychogalvanic reaction (PGR). The examiner studied the physiological responses and made a decision as to the role each suspect assumed in the experiment. In other words, he tried to identify the Thief, the Lookout, and the Innocent Suspect on the basis of all the chart recordings he had just obtained. Having made his decision, the examiner then indicated the degree of his confidence in them.

Statement of Problem

In actual circumstances the lie detector expert is not usually confronted with a small group of suspects among whom the guilty one is certain to be found. Often he examines a single individual and is asked for his decision after the examination. Furthermore, there are groups of suspects brought in for examination that do not have a culprit among them. Fundamentally, the expert must be prepared to make a decision of guilt or innocence (more accurately, of lying or truth-telling) in single cases, without having the opportunity of comparing the records of several suspects.

An important question, however, needs to be answered. How does the accuracy of the lie detector expert compare (a) in cases where there is but one suspect, (b) in cases where there are several suspects, one of whom being definitely guilty? One would intuitively expect greater accuracy in the latter situation. In terms of the Simulated Theft Experiment the question becomes: Would a rater, making a decision on each polygraph record singly and independently of other records, be as accurate as the raters in the Simulated Theft Experiment. The latter worked with and compared the records of all three suspects before arriving at their decisions. The problem is one of determining the relative accuracies of lie detection decisions in the Independent Judgment and Dependent Judgment situations.

Procedure

Since all records from the Simulated Theft Experiment were available, it was a simple task to recode them after eliminating any markings that would identify the suspect or

the examiner who did the testing. In this form the records could be reassembled and presented singly to a rater for a decision as to the role the subject played in the experiment. The accuracy of such ratings could be compared with the accuracy already reported in the Simulated Theft Experiment.

Of the five examiners who conducted the tests in the Simulated Theft Experiment and who also served as raters only one, Rater E, remained. For the present experiment one graduate student, Rater H, was carefully trained to interpret the polygraph charts, to operate the polygraph, and to administer the lie detection test. Two other graduate students, Raters Y and Z, were trained only up to the level of chart interpretation. As yet these two had no practical experience; they were not trained in the use of the polygraph; they had not served as examiners in a lie detection experiment. There were, then, four raters two of whom were at a lower level of experience, namely, the level of chart interpretation.

Of the 336 records in the Simulated Theft Experiment, 100 were selected for the present experiment. To compare how accurately the same person would rate a set of records under both Dependent Judgment and Independent Judgment conditions, all 100 records were those in which Rater E, either as examiner or as rater, had been involved in the Simulated Theft Experiment. At no time was he aware that any specific record was one he had rated before. All he knew was that 100 of 336 records from the old experiment were included in this decision task. Recognition of specific peculiarities or clues was not highly probably since he had not seen his old records in over a year. Neither was it likely that he had lost his skills. Since the completion of the Simulated Theft Experiment he had been involved in numerous rating and training tasks related to lie detection.

To continue with the description of the 100 records. These included 10 complete groups (each with a Thief, a Lookout, and an Innocent Suspect) for which Rater E had served as examiner, i.e., the person who tested the subjects by means of the polygraph. An additional 23 complete groups (69 subjects tested by other examiners) were included because Rater E had rated them. One subject was randomly selected to round off the number to 100. The 100 records were placed into 10 large folders, each of which served to contain a convenient unit of work. No folder contained more than seven subjects with the same role. Each folder represented

all three roles.

A random assignment of records to each folder was stressed in the directions to the raters. The purpose was to prevent an expectation of equal division of roles among the 100 records. At no time were the raters aware of the fact that entire groups (Thief, Lookout, Innocent Suspect) were selected from the Simulated Theft data.

The four raters for this experiment, Raters E, H, Y, and Z, were instructed to work independently and to evaluate one record at a time. The first task was to rate the respiratory response alone. This was accomplished by blocking out the plethysmgraphic and psychogalvanic tracings. After completing his ratings on a particular record, the rater had to decide whether the person was a Thief, a Lookout, or an Innocent Suspect. He continued in this fashion until all 100 records were rated. The entire process was repeated for the Plethysmographic tracings; and again, for the psychogalvanic response. Finally, the decision procedure was completed with the total record exposed for analysis and available for interpretation. In all, each rater made 400 decisions, four for each record.

Only one decision was required in the original Simulated Theft Experiment, and this was based on an overall evaluation of the polygraph chart which included respiratory, plethysmographic and psychogalvanic tracings. In the present experiment, four independent decisions were required, one each for the separate physiological indices and a final one on the overall aspects of the total record. Consequently, only the overall evaluations in both experiments could be compared to assess the relative accuracies of decisions under Independent Judgment and Dependent Judgment conditions.

The comparative analyses discussed in the next section are based on 99 subjects, since the Dependent Judgment decisions can only come from an entire group involving a Thief, a Lookout, and an Innocent Suspect.

Results

The purpose of this experiment was to compare diagnostic accuracy of judges under two decision conditions. In the Dependent Judgment situation, typified by the Simulated Theft Experiment, judges had before them records of a complete

group consisting of a Thief, a Lookout, and an Innocent Suspect. After an evaluation of each record and a comparison of all, they had to identify which record belonged to the Thief, which to the Lookout, and which to the Innocent Suspect. Under Independent Judgment conditions raters examined and decided the status of one record at a time. The order in which the records were examined was random. These raters, then, seemed to operate with less information than that available to the raters in the Dependent Judgment situation.

An allied objective was to evaluate several factors that might possibly differentiate between two types of decision situations. There was the matter of confidence in one's decisions, the nature of the errors made, and the factor of experience.

Accuracy

Rater accuracy under Dependent and Independent Judgment conditions is presented in Table i. Decisions were based on the total polygraph chart including all three indices -- respiratory, plethysmographic, and psychogalvanic. The accuracy scores were obtained from the records of the same sample of 99 subjects, as they were evaluated under Dependent Judgment conditions (Simulated Theft Experiment) and under Independent Judgment conditions.

TABLE I
PERCENTAGE OF CORRECT DECISIONS BASED ON EVALUATION OF TOTAL RECORD

DEPENDENT JUDGMENT (Simulated Theft Experiment)*			INDEPENDENT JUDGMENT (Present Experiment)**	
Judge	As Examiner	As Rater	Judge	As Rater
B	70	67	H	67
C	(33)	64	Y	71
D	77	--	Z	72
E	84	73	E	68
F	(100)	(100)		
Average	75	69		69

* Percentages in parantheses are based on fewer than 7 records; all others on 30 or more. ** Percentages based on 99 records.

In the Dependent Judgment situation most of the judges had two roles: as examiners they evaluated the records of suspects they themselves had tested; as raters they evaluated the records of other examiners. Thus, Judge E had an accuracy score of 84 when he made decisions on subjects he himself tested. His score dropped to 73 when he evaluated the records obtained by other examiners. Accuracy was further reduced to 68 when, more than a year later in the Independent Judgment Experiment, he reevaluated the same records. Judges H, Y, and Z served as raters only, since they were not involved in the Simulated Theft Experiment. Judge E was considered as a rater in the Independent Judgment situation; he did not know whose records were being used for this experiment, and he could not be expected to remember any details of the ratings or decisions he made more than a year ago.

It is apparent from Table 1 that there is no difference between the average accuracy of raters in the Dependent and Independent Judgment situations. The averages of the four raters in each experiment were identical, 69 percent. Assuming that the raters in both experiments were equivalent in overall ability, it may be concluded that the added information and the opportunity to compare records in the Dependent Judgment situation did not increase decision accuracy -- an unexpected conclusion. One explanation may be greater exposure to the records in the Independent Judgment situation. Each judge made four separate and independent evaluations of the records, first using the respiratory pattern alone, then the plethysmographic, then the psychogalvanic, and finally the total record with all its tracings. On the other hand, the judges in the Dependent Judgment situation arrived at their decisions after a careful examination and rating of the total record, but without intermediary decisions for each of the three physiological components. Although no time measurements were taken, it is safe to conclude that the decision time (per record) was shorter for the Dependent Judgment situation.

The "greater exposure" explanation, though seemingly reasonable, fails for Rater E who was involved in both experiments. In the Dependent Judgment Experiment his accuracy scores were 84 percent as examiner and 73 percent as rater. In rerating the same records one year later his accuracy score dropped to 68 percent, contrary to expectation. A possible explanation may be obtained from a study of Rater E's decisions in both experiments. Of the 99 decisions in

the Dependent Judgment situation, Rater E changed 29 of them under Independent Judgment conditions. This would seem to point to the existence of a large number of records (above 30%) which do not possess clear cut indications of diagnostic deception and which therefore do not "coerce" the same interpretation when reexamined after an appreciable time interval. With this explanation, emphasizing as it does a relatively large error variance, Rater E's poorer performance in the Dependent Judgment situation can be ascribed, in part, to a general regression effect. In addition, one may emphasize the loss of comparative clues to which Rate E may have become particularly sensitive in the Dependent Judgment experiment. Without these he became a more or less average rater in the Independent Judgment situation. He had been the best rater in the Simulated Theft Experiment.

Although Table I indicates that the examiners seem to be more accurate than either set of raters, the difference is not statistically significant. The table, however, suggests that amount of predecision knowledge available to raters may have an effect on variability of accuracy. A rough index for this conclusion may be found in the range of accuracy scores for each group. The group with most predecision knowledge--the examiners who based their decisions on polygraph records, observations of suspects' behavior in the testing situation, comparison of three records--had the largest range, 14 percentage points. The group intermediate in predecision knowledge--the raters in the Dependent Judgment situation--had the next largest range, 9 percentage points. The group with the least amount of predecision knowledge--the raters in the Independent Judgment situation--had the smallest range, 5 percentage points.

In summary, one definite conclusion is apparent. With sufficient time provided for evaluation (cf, exposure hypothesis) the accuracy of raters in the Independent Judgment situation is probably not much difference from that of raters in a Dependent Judgment procedure.

Confidence in Decisions

It was hypothesized that a polygraph examiner in Independent Judgment situations would have less confidence in his decisions than if he worked under Dependent Judgment

conditions. In the latter case he would always have an opportunity to compare records of all suspects involved in a particular crime. Such comparisons were considered to generate more confidence in the resulting decisions than in others where this was not possible. Data from the present experiment were analyzed for possible evidence to test the hypothesis.

TABLE 2

AVERAGE CONFIDENCE RATINGS FOR CORRECT AND INCORRECT DECISIONS IN THE DEPENDENT AND INDEPENDENT JUDGMENT SITUATIONS

SCALE OF 0 - 6

	DEPENDENT JUDGMENT		INDEPENDENT JUDGMENT	
ROLE	Correct	Incorrect	Correct	Incorrect
T	3.85	3.07	3.78	3.61
L	3.62	3.35	3.87	3.79
I	3.94	3.40	4.17	3.03
Average	3.80	3.27	3.94	3.48

Table 2 presents the average confidence ratings in the two experimental situations. The confidence rating scale was the same as that used in the Simulated Theft Experiment. The results would seem to indicate that the hypothesis is not verified. On the average, the raters under Independent Judgment conditions gave higher ratings of confidence both for correct and incorrect decisions.

A further analysis was made of the confidence ratings of Rater E who was involved in both experiments. His confidence ratings for each record were compared with those of the other raters. Table 3 presents the results in terms of the percentage of times E's ratings were greater than, equal to, or less than the mean rating of his colleagues. The results were treated separately for the Dependent and Independent Judgment situations. It is apparent that E showed greater than average confidence in the decisions he made as

a rater in the Dependent Judgment situation. A Chi-square test indicates that this is a statistically significant result (beyond the 0.01 level). Contrariwise, E manifested significantly lower than average confidence in the Independent Judgment situation. In fact, he was the most confident rater in the first situation, the least confident in the second.

TABLE 3

CONFIDENCE RATINGS OF RATER E (RELATIVE TO MEAN OF OTHER RATERS) IN THE DEPENDENT AND INDEPENDENT JUDGMENT SITUATIONS

COMPARISON (E vs. Mean Others)	JUDGMENT SITUATION Dependent	Independent
Greater	67	34
Equal	16	9
Smaller	17	57
	100%	100%

As would be expected, E's confidence ratings dropped in absolute value from the first to the second experimental condition. In the Dependent Judgment situation the averages of his confidence ratings were 4.00 and 3.64 for correct and incorrect decisions respectively. The corresponding averages for the Independent Judgment situation were 3.72 and 3.41.

Why, then, would the other raters in the Independent Judgment situation have more confidence in their decisions than the raters in the Dependent Judgment situation? The most likely explanation concerns the notion of personal involvement. The raters in the Independent Judgment experiment were not personally involved in the records they were evaluating. They were not in the Simulated Theft Experiment; they did not know its weaknesses; they did not experience the wide range of response variability present in a highly motivated and emotionally charged experiment. On the other hand, the raters in the Dependent Judgment situation were personally involved in the conduct and execution of the Simulated Theft Experiment. It was their experiment, their subjects, their records. They knew the difficulties involved and their rating attitudes were

cautious and conservative. Because of this basic difference in attitude, there was a marked difference in the confidence they expressed in their ratings.

Experience and Accuracy

As noted before two of the raters (E and H) in the Independent Judgment experiment were well trained both in polygraph testing and in interpreting polygraph charts. The other two raters (Y and Z) had no testing experience in lie detection experiments. They had, however, been trained to rate and interpret polygraph charts. But even in this, they had less experience than raters E and H.

TABLE 4

PERCENT ACCURACY SCORES OF RATERS (INDEPENDENT JUDGMENT SITUATION

RATER	INDEX			
	Resp	Pleth	PGR	Total
E	45	59	69	68
H	47	65	68	67
Y	39*	39*	69	71
Z	35*	50	73	72

*Not significantly better than chance.

Table 4 presents the accuracy scores of the four raters for each of the physiological indices and for the total record. Thus, of the 99 records rated, E was correct in 45 percent of his decisions on the basis of the respiratory response alone. His accuracy increased to 59 percent when he based his decisions on the plethysmographic tracings. The highest accuracy was obtained with the psychogalvanic response (69%), better even than that for the total record where rater E had all three physiological tracings for evaluation.

The same pattern prevails for the entire table. Accuracy

in detecting deception is least for the respiration pattern. The best accuracy is obtained with the psychogalvainc response. Even when the total polygraph chart is examined, accuracy is slightly below that obtained for the psychogalvanic response alone.

As for the relation of accuracy and experience, the table shows that the more experienced raters (E and H) have higher scores for the respiration and plethysmographic indices. In fact, three of the four scores obtained by raters Y and Z on these indices are no better than chance. However, experience seems to have no influence on the accuracy with which the psychogalvanic response or the total record are evaluated. In fact, the less experienced raters have slightly better scores in these rating situations, but the difference is not statistically significant.

The results are not unexpected. Since the psychogalvanic tracing is less complicated than the plethysmographic and respiratory patterns, it lends itself to the development of more objective criteria in evaluating deception. Because of this, accuracy is no greater among more experienced raters than among less experienced, though well-trained, raters. Experience is of value in interpreting the more complicated respiratory and plethysmographic patterns as attested by the better accuracy scores of raters E and H. Finally, insofar as this experiment in concerned, use of the psychogalvanic response alone would have yielded results as accurate as those obtained from evaluating the entire polygraph chart with all three physiological tracings.

Errors of Misclassification

Independent vs. Dependent Judgment. Three types of misclassification are possible: Thief and Lookout, Thief and Innocent, and Lookout and Innocent. In each, the misclassification is reversible, as for example, either mistaking the Thief for the Lookout (Thief-Lookout) or the Lookout for the Thief (Lookout-Thief). Table 5 presents the relative frequency of the six possible errors raters made in the Independent and Dependent Judgment situations. It may be observed that 11 percent of theerrors in the Independent Judgment situation were the mistakes of calling an Innocent Suspect a Lookout. This type of error comprised 15 percent of the total for the Dependent Judgment situation. The reverse misclassification (Lookout judged as Innocent) occurred in 16 percent of the errors in the Independent Judgment experiment and in

15 percent of the errors in the Dependent Judgment experiment.

TABLE 5

RELATIVE FREQUENCY (AS PERCENTAGES) OF MISCLASSIFICATION ERRORS FOR INDEPENDENT AND DEPENDENT JUDGMENT SITUATIONS

	DECISIONS (INCORRECT)					
ROLE	INNOCENT		LOOKOUT		THIEF	
	Ind	Dep	Ind	Dep	Ind	Dep
INNOCENT	--	--	11	15	13	5
LOOKOUT	16	15	--	--	26	34
THIEF	13	5	21	27	--	--

An overview of the table reveals that the most frequent errors were the Lookout-Thief misclassifications (26%, 34%) for both Independent and Dependent Judgment situations. Next in frequency were the Thief-Lookout errors (21%, 27%). In both misclassifications these errors were greater for the Dependent Judgment situation. The lowest frequency of misclassification occurred in the Innocent-Thief (5%) and Thief-Innocent (5%) decisions for the Dependent Judgment situation.

A relatively greater homogeneity of error is observed for the Independent Judgment situation. The error percentage ranges from 11 to 26, a range half as great as that found among the Dependent Judgment percentages (5 to 34).

Probably the most critical result emerging from these comparisons is the relatively large number of Innocent-Thief and Thief-Innocent errors in the Independent Judgment situation. Furthermore, in this decision situation it is as easy to commit an Innocent-Thief error (13%) as an Innocent-Lookout error (11%), and almost as easy for the Thief-Innocent error (13%) as for a Lookout-Innocent error (16%). In contrast, the Thief-Innocent errors (5%) in the Dependent Judgment situation are much less frequent than the Lookout-Innocent or Innocent-Lookout errors (both 15%). The differentiation among the three roles seems to be an easier task in the Dependent Judgment experiment.

Among Physiological Indices. An informative comparison may be made of the six misclassification errors among the individual physiological indices. This will serve to point up the interaction of the various physiological indices with the six specific types of error. Table 6 presents the total frequencies of error found in the ratings of the three indices and in the ratings made on the total record, i.e., on the polygraph chart as a whole. Since there were no appreciable differences among the raters, the errors for each index were totalled and these sums comprise the data of the table. Thus, for the respiratory index there were 12 Innocent-Lookout errors while there were 85 of the Lookout-Innocent type.

TABLE 6

TOTAL FREQUENCIES OF EACH ERROR OF MISCLASSIFICATION FOR THE THREE PHYSIOLOGICAL INDICES AND FOR THE TOTAL RECORD IN THE INDEPENDENT JUDGMENT SITUATION

ROLE	INDEX	DECISION (INCORRECT)		
		INNOCENT	LOOKOUT	THIEF
INNOCENT	Resp	--	12	22
	Pleth	--	8	16
	PGR	--	13	16
	Total	--	13	16
LOOKOUT	Resp	85	--	31
	Pleth	55	--	34
	PGR	22	--	31
	Total	20	--	32
THIEF	Resp	76	11	--
	Pleth	65	11	--
	PGR	16	24	--
	Total	16	25	--

The most striking feature of Table 6 is the magnitude of errors in the first column among the respiratory and plethysmographic indices. These errors involve the Lookout-Innocent and the Thief-Innocent misclassifications. These two misclassifications (of a total of six) account for 68 percent (161/237) of the total number of errors made with the respiratory

index. The corresponding value is 63 percent (120/189) with the plethysmographic index. These errors are from three to four times as numerous as the corresponding errors involving the psychogalvanic response. In other words, when forced to use an index that yielded complex and vague criteria of deception (respiratory and plethysmographic), the rater would tend to judge a suspect as Innocent rather than incriminate him. And yet when a relatively more objective index (PGR) was introduced into the decision process, as can be observed in the "Total" Lookout-Innocent and Thief-Innocent errors, the misclassification was correspondingly reduced from 85 (Resp) to 20 (Total) and from 76 (Resp) to 16 (Total). A similar result is found for the Lookout-Innocent and Thief-Innocent errors with the plethysmographic index. The more easily rated and the more readily interpreted psychogalvanic index seems to have determined the final "Total" rating and thus dominated the decision process. The result was that the former Innocent ratings given on the basis of respiratory or plethysmographic tracings were now changed in the direction indicated by the psychogalvanic response.

Influence of PGR on Ratings

One of the conclusions in the previous paragraph emphasizes the importance of the psychogalvanic response on the decisions of raters in their evaluation of the total polygraph chart. Table 4 indicates that the accuracy scores of raters using the phychogalvanic response alone do not differ more than two percentage points from the accuracy scores based on the total polygraph chart. Table 6 also indicates almost identical error frequencies for the psychogalvanic response and for the total polygraph chart. Table 7 presents the percentage of identical ratings (correct and incorrect) obtained by pairing the ratings made in each of the physiological indices with the ratings made on the total polygraph chart. Specifically, 97 percent of E's ratings based on the psychogalvanic response alone agreed with the ratings he made when he evaluated the total polygraph record. On the average, the percentage agreement between psychogalvanic reflex and total record ratings was 95 for the four raters. The average percentage of such agreement between plethysmographic and total record ratings was only 58; that between respiratory and total record ratings still lower, 50. The more experienced raters (E and H) tended to get higher agreement scores for all three indices.

TABLE 7

PERCENTAGE OF IDENTICAL RATINGS WHEN TOTAL POLYGRAPH CHART DECISIONS ARE PAIRED WITH DECISIONS ON EACH PHYSIOLOGICAL INDEX

RATER	PAIRED DECISIONS		
	Total-PGR	Total-Pleth	Total-Resp
E	97	66	57
H	97	74	56
Y	93	39	49
Z	94	53	39
Average	95	58	50

To conclude, the high degree of correspondence between accuracy scores for the psychogalvanic response and total record (Table 4) can be accounted for by the data in Table 7. Further evidence (Table 6) seems to indicate that the rating of the total polygraph record was relatively uninfluenced by the respiratory and plethysmographic evidence that may have been present in the chart. Reliance was placed almost entirely on the psychogalvanic index which influenced the final decision.

Conclusions

1. Decision accuracy in the Dependent Judgment situation was no greater than that attained under Independent Judgment conditions. Greater exposure to the records in the Independent Judgment situation probably counterbalanced the inherent advantages assumed to be present in the Dependent Judgment case.

2. The hypotheses that confidence in decisions would be consistently greater for the Dependent Judgment situation was not verified for the group data.

3. In the case of the one rater who served in both experiments, accuracy and confidence in decisions decreased

from the Dependent to the Independent Judgment situation.

4. Experienced raters were more accurate than the less experienced raters in analyzing respiratory and plethysmographic indices for evidence of deception. No difference in accuracy between the two groups of raters was noted in the evaluation of the psychogalvanic response or of the total polygraph chart.

5. The more "serious" errors of misclassification (Thief-Innocent and Innocent-Thief) were more frequent in the Independent Judgment situation.

6. In using the less objective indices (respiratory and plethysmographic), raters tended to judge Thief and Lookout as Innocent approximately 3-4 times more frequently than with the psychogalvanic index.

7. The psychogalvanic response determined the final decision in the analysis of the total polygraph chart. Furthermore, greatest accuracy was attained when the psychogalvanic response alone was used in the lie detection decision.

PART TWO WILL APPEAR IN THE JUNE ISSUE.

JUDICIAL ORDER ADMITS POLYGRAPH IN FLORIDA

Circuit Court, 11th Judicial Circuit, Dade County

Case No. 70-5585

ORDER

STATE OF FLORIDA,)
Plaintiff,)
-VS)

GEORGE CURTIS,)
Defendant.)

The Defendant is charged by Information with having committed an aggravated assault. A Defense Motion for a Pre-Trial Evidentiary Hearing on the admissibility of a polygraph examination was granted after sufficient notice to, and without objection from the State. Both parties had an opportunity to present any and all expert testimony either side desired bearing on the reliability and acceptance of the polygraph examination. The Defendant had submitted to one test voluntarily by an expert of his own selection, and was subsequently examined by a Court-appointed expert. Neither of these tests were made with the approval or consent of the State.

The rule for determining the admissibility of polygraph results has been "General Acceptance in the Particular Field to which it Belongs." FRYE v. UNITED STATES, 293 F. 1013 (D.C. Cir. 1923).

> "Just when a scientific principle or discovery crosses the line between the experimental and demonstrable stages is difficult to define. Somewhere in this twilight zone the evidential force of the principle must be recognized, and while courts will go a long way in admitting expert testimony deduced from a well-recognized principle or discovery, the thing from which the deduction is made must be sufficiently established to have gained general scientific

> acceptance in the field in which it belongs. We think the Systolic Blood Pressure Deception Test has not gained such standing and scientific recognition among physiological and psychological authorities as would justify the courts in admitting expert testimony deduced from the discovery, development, and experiments, thus far made." FRYE v. UNITED STATES, 293 F. 1013, 1014.

A study of the overwhelming majority of decisions indicates that polygraph test results would be admissible upon a showing of scientific acceptability. FRYE v. UNITED STATES, 293 F. 1013(1923); STATE v. BOHNER, 210 Wis. 651, 246 N.W. 314 (1933); PEOPLE v. BECKER, 300 Mich. 562, 2 N.W. 2d 503 (1942); PEOPLE v. FORTE, 279 N.Y. 204 2d 503 (1942); STATE v. COLE, 354 Mo. 181, 188 S.W. 2d 43 (1945); STATE v. LOWRY, 163 Kans. 622, 185 P. 2d 147 (1947); PEOPLE v. WOCHNICK, 98 Cal. App. 2d 124, 219 P. 2d 70 (1950); HENDERSON v. STATE, (Okla. Crim. Ct. App. 1951) 230 P. 2d 495; STATE v. KOLANDER, (Minn. 1952) 52 N.W. 2d 458; BOECHE v. STATE, 151 Neb. 358, 37 N.W. 2d 593 (1949); PEOPLE v. LEONE, 307 N.Y.S. 2d 430 (1969).

The Florida Courts have never been presented squarely with the issue of admissibility of specific polygraph results. The cases dealt with collateral points: Rehabilitaion on redirect examination by asking if witness consented to taking polygraph, KAMINSKI v. STATE, 63 So. 2d 339 (Sp. Ct. 1952); confession to a polygraph operator, JOHNSON v. STATE, 166 So. 2d 798 (2d Dist. 1964); adverse presumption from failure to submit to lie detector test, CITY OF MIAMI v. JERVIS, 139 So. 2d 513 (3rd Dist. 1962); trial court's discretion in granting new trial on stipulated polygraph, STATE v. BROWN, 177 So. 2d 532 (2d Dist. 1965); production of test results under Brady Rule, ANDERSON v. STATE, 241 So. 2d 390 (Sp. Ct. 1970). None of these decisions dealt with the admissibility of specific test results, coupled with expert testimony, on its scientific validity and reliability.

An increasing number of trial courts throughout the country have held that the polygraph has met the test of scientific acceptability: UNITED STATES OF AMERICA v. BRUCE DE BETHAM, Crim. Nos. 12929, 12527, USDC Southern District of California, September 8, 1972; UNITED STATES OF AMERICA v. RICHARD RIDLING, Crim. Case No. 46732, USDC Eastern District

of Michigan, October 6, 1972; UNITED STATES OF AMERICA v. ERROL ZEIGER, Crim. Case Nos. 1831-70, USDC District of Columbia, October 10, 1972 (reversed without opinion); PEOPLE v. MILLER, Criminal Action No. 506, Circuit Court, Iosco County, Michigan, October 25, 1972; PEOPLE v. CUTTER, No. A-176, 965, Superior Court, Los Angeles, November 6, 1972.

It is well settled in Florida that the trial court has wide discretion in admitting scientific evidence. MUTUAL LIFE INS. CO. OF NEW YORK v. BELL, 3 So. 2d 487 (Sp. Ct. 1941); COPPOLINO v. STATE, 223 So. 2d 68 (2d Dist. 1968), Cert. denied, 399 U.S. 927 (1970). In COPPOLINO, a prosecution toxicologist testified he had developed testing procedures to determine the toxic level for succinic acid, a component of succinylcholine chloride, in body tissue. Prior to this trial, medical science deemed it impossible to detect this substance in a corpse. On review the admission of this testimony was not disturbed, the Court holding the trial Court had discretion to accord recognition to a novel, yet scientifically reliable principle.

The Court has heard evidence from experts in the use of the polygraph to establish the validity and reliability of the results of tests. Applying the principles of FRYE and its prodigy, and implementing the discretion invested in the Florida trial courts, this Court makes the following findings of fact:

1. Human beings possess an autonomic nervous system which has two divisions; the sympathetic and parasympathetic nervous systems. The sympathetic nervous system responds involuntarily to stressful conditions. It is well-established in medical science that among the physiological responses stimulated by the autonomic nervous system, which are involuntary and uncontrollable, are certain definite and consistent responses: the pulse beat, blood pressure, respiratory pattern and electric conductivity of the skin.

2. The act of knowingly making a false assertion of fact by an individual causes stress and stimulates the autonomic nervous system to react and cause, among others, the physiological changes mentioned above of such a magnitude they can be measured.

3. The polygraph is an instrument which measures and records these physiological phenomena with substantial precision.

4. While attached to the subject's body during questioning, the polygraph measures and records these physiological responses and relates them to the combined stimulus of the question and the attempt, if any, at a deceptive answer.

5. The absence of responses to the stimuli indicates that the subject has answered truthfully; the presence of responses indicates that the subject is withholding information.

6. In order to obtain a competent result, the subject must cooperate with the examiner; well-recognized interrogation techniques must be utilized; the subject understand the polygraph technique and the questions asked; the polygraph instrument be in good working order, and that a competent examiner interpret the test results.

7. The accuracy of a polygraph test depends on the skill of the operator. A competent examiner will make an erroneous diagnosis in less than two (2) - three (3) percent of his examinations.

8. Neither nervousness, pathologic or psychopathic liars, rationalization or drugs will cause erroneous results since the operators and their techniques are equipped to combat these factors.

9. Polygraph examiners have organized into national and state organizations; there exist several accredited polygraph schools with standardized curriculum.

10. Police departments, various governmental departments including the armed forces, and commercial industry successfully utilize polygraph test results in their every-day operations.

11. Warren Holmes and Leonard Bierman are highly qualified polygraph examiners. Mr. Holmes was retained by the defendant, while Mr. Bierman was appointed by the Court.

After considering the testimony presented, as well as the argument of counsel, the Court concludes that a sufficient foundation has been established for permitting the expert testimony on the results of the Defendant's polygraph examinations at trial; therefore, both polygraph examiners will

be allowed to testify during the trial of this case.

In future cases polygraph opinion should be admitted subject to the following terms and conditions:

1. The Defendant, through his counsel, shall request the State to stipulate to a polygraph test and its results.

2. If the State rejects this stipulation, the Defendant may then apply to the Court, who will appoint one or more qualified experts to conduct a polygraph examination subject to the following conditions:

a. There must be a signed waiver by the defendant of his constitutional rights against self-incrimination, i.e., the right to remain silent.

b. That as a predicate for his testimony as an expert the polygraph examiner establish his qualifications, including proof that he has graduated from a qualified polygraph institute, that he has administered a substantial number of polygraph tests, and established a degree of accuracy in such tests.

c. If the expert or experts conclude either that the defendant was telling the truth or that he was not telling the truth on the issues involved in the case, he shall be permitted to be called upon by either party to testify and shall be subject to cross-examination.

d. If the Defendant proposes to present the opinion of the polygraph examiner he must first testify at the trial.

3. The instrument, machine or device commonly known as the polygraph machine must not measure the systolic blood pressure alone; or, what is commonly called, "The lie detector test" must not be the Marston Systolic Blood Pressure Deception Test.

4. This Order applies only to the instrument, device or machine about which there was testimony and the technique applicable thereto. In the event an attempt is made to offer the results of a polygraph test where some other instrument, machine or device has been or may be used by the polygraph

examiner, the Court will, and should require a new predicate to be proven establishing the scientific reliability and accuracy of the polygraph test as administered by means of the new or different instrument, device or machine.

DONE and ORDERED at Miami, Dade County, Florida, in Open Court this 31 day of Jan., 1973.

S/ALFONSO C. SEPE
Circuit Judge

VASOMOTOR BEHAVIOR DURING SEMANTIC CONDITIONING

by

Ralph F. Darr, Ph.D.
Associate Professor
University of Akron

ABSTRACT

Vasomotor reactivity was studied with 88 undergraduates. The component of the vasomotor response were analyzed under four different conditions: adaptation, habituation, semantic conditioning, and extinction. Generally, vasomotor reactivity during adaptation and habituation was negatively correlated with the number of trials to semantic conditioning and positively correlated with the number of trials to extinction. A photoelectric plethysmograph was used to record digital blood volume. (Ed.)

Pavlov (1928) reported that responsive subjects tend to condition more rapidly and extinguish more slowly than less responsive subjects. It was hypothesized that the high degree of responsiveness, rapid conditioning and resistance to extinction, found in certain subjects, is a function to their high degree of cortical excitation, while unresponsiveness, slow conditioning, and rapid extinction was hypothesized to be a function of other subjects' high cortical inhibition.

Soviet psychophysiologists have worked with vasomotor behavior as a criterion measure in semantic conditioning studies (Luria & Vinogradova, 1959; Schvarts, 1964; Sokolov, 1963). Luria & Vinogradova (1959) reported that some subjects remained labile throughout the course of their two hour experimental sessions and that some subjects took longer than others to adapt, habituate, condition, and extinguish the vasoreflex. Reports are frequently non-detailed.

Unger (1964) found little apparent consistency between subjects' vasomotor behavior during adaptation to the experimental setting, habituation to serial presentation of numbers, and habituation to serial presentations of numbers interrupted by numbers out of order. Maltzman and Raskin (1965) found amplitude of the vasomotor component of the orienting reflex (OR) to be highly correlated with speed of

semantic conditioning, paired associates learning, and "attention." Raskin (1969) found that the vasomotor component of the OR was not a reliable predictor of semantic conditioning, but GSR did reliably correlate with speed of semantic conditioning.

The present study was designed specifically to investigate patterns of human vasomotor behavior during the four phases of the typical Soviet semantic conditioning study: (a) adaptation to the laboratory setting, (b) habituation to a series of unrelated, unreinforced verbal stimuli, and (c) conditioning and extinction of the vasoreflex to a key or conditioned word.

Method

Subjects

Eighty-eight students, 28 men and 60 women, recruited from two sections of introductory educational psychology served as subjects. All subjects were undergraduates ranging in age from 19 to 25 years.

Selection and recording of verbal stimuli. Two lists of verbal stimuli were recorded on audiotape at 20 second intervals prior to the experiment. Words were chosen from lists of unrelated words that had been used in previous semantic conditioning studies (Luria & Vinogradova, 1959; Mednick, 1957). To insure their unrelatedness, the experimenter submitted the two lists to a group of undergraduates, who were asked to pair the words they thought to be related. Word pairs that received nominations by more than 20% of the students were rejected.

The list presented during the Habituation phase contained 30 unrelated words. The second list contained 135 words; 90% of which were different and unrelated, and 45 presentations of the key word violin randomly distributed among the 90 unrelated, neutral words -- for use during the Conditioning/Extinction phase. All words were nouns which contained no more than seven letters nor less than three.

Experimental setting and apparatus. All students were studied individually in an acoustically controlled room at a time selected by them. Instructions and stimuli were tape recorded and presented via overhead speaker at fixed

20 second intervals.

Changes in digital blood volume were detected photoelectrically with an adjustable fingertip unit which contained its own light source and photocell. Variations in the amount of light passing through the finger, due to changes in the size of blood vessels were reflected on E & M Physiograph 6. Input from the photocells was run through an E & M preamplifier in order to reduce the rolling amplitude variations usually found with unintegrated measures.

A taped white noise background of 50db was used throughout to reduce startle effect of stimuli and to mask equipment noise. Room temperature was maintained at 25°C (77°F) to insure full vasodilation in subjects.

Procedures. Prior to the experimental session itself, students were informed that the study involved physiological measures and that no aversive stimuli would be administered during the course of the study.

The subject was seated in a reclining chair, with both arms at heart level. The investigator showed the subject the photocell unit and explained its function prior to attaching the unit to the subject's left index finger with a Velcro strip.

The subject was then shown the doorbell which he was to use to make his instrumental response to the key word, violin, during the Conditioning/Extinction phase. The subject was asked to press firmly with his right index finger the button located on the right arm of the chair. After several trial presses, the subject was told he would receive further instructions about the doorbell later. It was emphasized that the subject was simply to remain relaxed, awake, and to listen carefully without moving.

After the one minute allowed for equipment warm up and bodily changes by the subject, the Adaptation phase was begun with the instructions, "For the next few minutes, you are to sit quietly and relax." No stimuli were presented during this phase, which lasted for five minutes.

The Adaptation phase was terminated by instructions for the Habituation phase: "Now I am going to present a list of words. You are simply to sit quietly and listen to each

word." The tape containing the 30 nonreinforced, unrelated words, presented at 20 second intervals, was then begun. The Habituation phase was terminated when the subject showed no measurable vascular reaction to three successive words or when all 30 words had been presented.

Twenty seconds after the Habituation phase was terminated, the Conditioning/Extinction was begun with the instruction, "Now you will be presented another list of words. Every time that you hear the word violin you are to press the button on the right arm of your chair. Press firmly each time that you hear the word violin. Do not press for any other word."

All subjects received the entire list of 135 stimuli during the Conditioning/Extinction phase at 20 second intervals even though they may have become stabile or their vasoreflex to the key word extinguished early in the phase. There were 45 presentations of the word violin and 90 unrelated words. Twenty seconds after presentation of the 135th stimuli, the experiment was terminated.

Vasomotor reactivity was divided into 4 categories. Four response categories were operationally defined: (1) Spontaneous vasomotor reaction (SVR): which consisted of all vasoconstructions during the Adaptation phase and any vasoconstrictions occurring between 6 and 14 seconds after a stimulus presentation; (2) Anticipatory vasomotor reaction (AVR) was a vasoconstriction which occurred more than 14 seconds after the last stimulus presentation (Gale, 1969; Gale & Ax, 1968); (3) Unconditioned vasomotor reaction (UVR) was a vasoconstriction that occurred within 6 seconds after presentation of nonreinforced stimulus (unrelated words) during the Habituation or Conditioning/Extinction phase; (4) Conditioned vasomotor reaction (CVR) was a constriction which occurred within 6 seconds after presentation of the key word violin and to which the subject pressed the doorbell as instructed at the beginning of the Conditioning/Extinction phase.

RESULTS

The relationship of vasomotor reactivity during adaptation and habituation was assessed by Pearson correlation coefficients.

Spontaneous reactivity during adaptation correlated .72 with the same measure during habituation. A similar relationship was found between spontaneous and anticipatory reactivity (r=.74) and spontaneous and unconditioned reactivity (r=.59).

Correlations were also computed between the various reactivity measures obtained during the conditioning phase and the activity observed in habituation and adaptation. Table 1 presents the correlations for these computations. In order to assess response decremant with time the Conditioning/Extinction phase was divided into three equal intervals and correlations were obtained across intervals. These data are also included in Table 2.

Table 1 shows that vasomotor responsivity during adaptation is significantly correlated with number of conditioned vasomotor responses in the first and second interval, but not in the third.

Higher correlations were found between number of SVRs, AVRs, and UVRs during the habituation phase and number of CVRs during all three conditioning intervals. The correlations between habituation measures and conditioning are lowest in the third interval.

Lower correlations were obtained between the number of trials to extinction and reactivity during adaptation and habituation. The CVR was defined as extinguished when a significant vasoconstriction did not accompany the motor act in three successive presentations of the key word.

Significant negative correlations were obtained between all reactivity measures and the number of conditioning trials. The CVR was considered when a significant vasoconstruction followed the motor act within 6 seconds after presentation of the key word (CS), in three successive occasions.

Correlations between reactivity during the Conditioning/Extinction phase and two earlier phases indicated that there was a significant relationship between all measures throughout the three conditioning intervals. Decrement in reactivity was again observed in interval three and was reflected in the lower correlation coefficient.

Discussion

Results of the present study suggest that human vasomotor behavior is relatively consistent across the three phases of the semantic conditioning paradigm (Luria & Vinogradova, 1959; Sokolov, 1963; and Vinogradova, 1965). Highly responsive subjects were found to emit a vasoreflex to a key word after fewer presentations and to extinguish the CVR more slowly than less responsive subjects.

The number of anticipatory reactions increased as the study progressed for some subjects but not others. Subjects who demonstrated anticipatory responses (AVR) tended to do so consistently during both the Habituation and the Conditioning/Extinction phases. The number of AVRs was significantly related to the number of spontaneous vascular reactions (SVRs) throughout the study. These data are similar to the findings of Gale & Ax (1968).

TABLE 1

CONDITIONING

Adaptation	Conditioned Response Interval			Trials to Criterion
	I	II	III	
Spontaneous Responses	.30	.26	.10	-.30
Habituation				
Spontaneous Responses	47	44	26	-.43
Anticipatory Responses	39	35	19	-.37
Unconditioned Responses	63	59	39	-.57

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TABLE 2

Correlations Between the Number of Vasomotor Reactivity Responses During Adaptation and Habituation and in Vasoreflex Conditioning and Extinction

Pre-Conditioning Phase		Conditioning/Extinction Phase				
		Conditioning				Extinction
	Type of Vasomotor Response	No. of Conditioned Vasoreflexes			No. of CSs to Conditioning	No. Trials to Extinction
		C/EI	C/EII	C/EIII		
	Adaptation No. of SVRs	* .30	** .26	.10	* -.30	.16
Habituation	No. of SVRs	* .47	* .44	** .26	* -.43	* .35
	No. of AVRs	* .39	* .35	.19	* -.37	*** .25
	No. of UVRs	* .63	* .59	* .39	* -.57	* .58

* $r \geq .29$, $p < .01$ ** $r \geq .26$, $p < .02$ *** $r \geq .21$, $p < .05$

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