THE EFFECTS OF INFORMATION AND PRACTICE ON THE ACCURACY OF PHYSIOLOGICAL DETECTION OF DECEPTION

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THE EFFECTS OF INFORMATION AND PRACTICE ON THE ACCURACY OF PHYSIOLOGICAL DETECTION OF DECEPTION

by

Louis Irving Rovner

A dissertation submitted to the faculty of The University of Utah in partial fulfillment of the requirements for the degree of

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DEPARTMENT OF JUSTICE

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ABSTRACT

The effects of detailed information and practice on the effectiveness of the control question (CQ) technique for physiological detection of deception (PDD) were studied in a mock theft situation. A mock theft was committed by 36 of the subjects, and 36 subjects were simply informed about the theft. All subjects were instructed to deny having committed the theft when they were administered a CQ polygraph examination which utilized measures of skin conductance, blood pressure, respiration and digital vasomotor activity. All subjects were offered a $10 bonus for producing an innocent outcome on the polygraph test. Prior to that test, guilty and innocent subjects received either no information (STD), or detailed information about the CQ test and suggestions about methods to appear innocent (INFO) or the detailed information and suggestions plus two practice polygraph tests (INFO+PRAC). Each subject was then given a CQ polygraph test by an examiner who was blind regarding the subject's guilt or innocence or the treatment administered. The polygraph charts were numerically evaluated blindly by a third experimenter whose scores provided the basis for decisions concerning guilt or innocence. Accuracy of decisions was 95% for the STD group, 95% for the INFO group, and 71% for the INFO+PRAC group. There was significant discrimination between guilty and innocent subjects, but the innocent subjects in the INFO+PRAC group were less easily identified. Further analyses showed significant discrimination between guilty and

innocent subjects with measures of skin conductance, respiration, blood pressure and vasomotor activity. Objective quantitative analyses of the physiological measures generally confirmed the numerical scoring. The results indicated a high degree of effectiveness of the CQ technique even when subjects were given detailed information about the test and ways to defeat it. However, the combination of information and practice significantly weakened the effectiveness of the CQ technique with innocent subjects. It is important that field examiners realize that sophisticated, trained subjects may be more likely than others to produce erroneous outcomes on their tests. Examiners might wish to attempt to determine whether their subjects have received training in PDD techniques.

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INTRODUCTION

The physiological detection of deception (PDD) has proven to be a highly valid and reliable method of inferring a person's truthfulness or deception with regard to specific past events or acts (Podlesny & Raskin, 1977). Although several different questioning techniques have been developed and used over the years the control-question (CQ) technique has been shown to be one of the most efficacious (Raskin, Barland, & Podlesny, 1978). The CQ test contains several questions which pertain to the subject's involvement in the issue under investigation (relevant questions) and several questions which are similar in nature to the relevant issue, but do not deal specifically with that issue (control questions). For example, a murder suspect might be asked relevant questions such as "Did you shoot John Doe on the night of September 27?", and control questions such as "Between the ages of 18 and 27 did you ever hurt anyone?" The control questions are constructed during a pretest interview in such a way that the subject is likely to be deceptive when answering them or very concerned about the truthfulness of his answer.

Inferences about truthfulness or deception are based on the relative strengths of the subject's physiological responses to the relevant and control questions. According to the theory of the CQ test (Raskin, 1978a) the subject who truthfully answers the relevant

questions will be more concerned about the control questions and will produce greater responses to them. On the other hand, the subject who gives deceptive answers to the relevant questions will show stronger responses to them than to the control questions.

The CQ test is best evaluated by a numerical scoring system (Raskin et al., 1978). Each of the physiological measures for each control-relevant pair of questions is assigned a numerical value. That value is determined by the relative difference in the strengths of the responses to the control and relevant questions. (A detailed description of this scoring technique is presented in the method section.) In order to reach a decision of truthfulness or deception, the subject's total score for all physiological measures on all of the polygraph charts must exceed specified values. It has been demonstrated that numerical scoring leads to greater accuracy of decisions than less objective methods of evaluation (Raskin et al., 1978).

Recent studies which employed the CQ technique have attained accuracy rates for decisions which approach or exceed 90%. These include laboratory studies using subjects recruited from the community by means of newspaper ads (Podlesny & Raskin, 1978) and prison inmates and diagnosed psychopaths (Raskin & Hare, 1978). Similarly high accuracy rates have been demonstrated in field studies (Bersh, 1969; Raskin et al., 1978). Other studies in which confirmed polygraph charts from criminal suspects were blindly evaluated also yield accuracy rates of about 90% (Horvath & Reid, 1971; Hunter & Ash, 1973; Slowik & Buckley, 1975; Wicklander & Hunter, 1975). However, a recent

study (Horvath, 1977) obtained a mean accuracy rate of only 63.1% when confirmed and unconfirmed polygraph charts of criminal suspects were blindly evaluated by ten polygraph examiners. The doctoral dissertation from which the above datum was drawn (Horvath, 1974) reveals that the evaluators were trained at a polygraph school[1] which emphasizes the evaluation of subjects' overt behavior symptoms (Raskin, 1978c) and respiration measures (Raskin, 1978b) as their chief criteria, rather than relying upon systematic chart interpretation. Thus, attacks on the efficacy of the CQ technique which are based on the results of the Horvath study (Lykken, 1978, 1979) are not well-founded. Rather, the Horvath study indirectly highlights the importance of objective and systematic chart interpretation.

The interrater reliability of the CQ test is also quite high, particularly when numerical scoring procedures are used to evaluate polygraph charts (Raskin et al., 1978). In that study 16 cases with criminal suspects which were confirmed by confession were blindly evaluated by 25 polygraph examiners. Those examiners who employed numerical scoring procedures achieved 99% accuracy of decisions, which was significantly higher than the 88% accuracy achieved by examiners who did not use numerical scoring. In a recent laboratory study, decisions of truthfulness or deception made by the polygraph examiner and an independent blind evaluator using numerical scoring were in 100% agreement, and there was a .97 correlation between their numerical scores (Podlesny & Raskin, 1978).

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[1]The National Training Center of Lie Detection, New York, New York.

Perhaps the most important issue regarding laboratory research in the PDD is its generalizability to the field. In order for techniques and data developed in the laboratory to be confidently applied in a field setting, experimental paradigms must approximate "real" conditions. Although this has been achieved to some extent (see below), some authors feel that the dissimilarities between laboratory and field situations preclude generalization (Lykken, 1978). However, the convergence of data from recent field and laboratory studies lends credence to the notion of generalizability. Bersh (1969) and Raskin et al. (1978) reported accuracy rates of 92.4% and 88%, respectively, in field studies. These rates compare favorably with those found in recent laboratory experiments (Podlesny & Raskin, 1978; Raskin & Hare, 1978).

Differences do exist between laboratory subjects and criminal suspects. Barland and Raskin (1973) summarized these differences in terms of the subjects' levels of affect and motivation, the experiences of subjects prior to polygraph tests, their educational background and socio-economic status. In order to equalize these factors in laboratory and field settings, experimental paradigms have been developed which attempt to closely approximate "real" conditions. The mock-crime paradigm appears to be the best approach to maximize the generalizability of laboratory data (Podlesny & Raskin, 1977). In such studies, some of the subjects are instructed to commit a crime, such as a mock theft, and then are given a polygraph examination concerning that crime (Davidson, 1968; Podlesny & Raskin, 1978; Raskin & Hare, 1978). Among the features of this paradigm which

parallel those in the field are the involvement of the subjects in the commission of a wrongful act, motivation to appear truthful on the polygraph test (laboratory subjects are usually motivated with a cash bonus), similarity of physiological measures and evaluation techniques, and the use of similar questioning techniques. In addition to these factors, the laboratory situation permits absolute knowledge of ground truth, a feature which cannot be achieved in either a field study or in the testing of suspects or witnesses. In a properly designed study, equal numbers of innocent and guilty subjects are tested. In this way estimates are provided regarding the rates of accurate decisions for both truthful and deceptive subjects and the rates of false positive and false negative errors.

It can be reasonably anticipated that the results of recent PDD research will provide additional justification and impetus for increased confidence and continued use of polygraph examinations in law enforcement investigations and legal proceedings (Raskin et al., 1978). Some members of the legal community strongly advocate the use of the results of polygraph examinations as evidence and feel that this evidence is often more appropriate and valid than other traditional forms of evidence (Ennis & Litwack, 1974; Tarlow, 1975), and there is recent scientific evidence which supports this view (Buckhout, 1974; Widaski & Horvath, 1978). Although this view is not without its detractors (Abbell, 1977) there is a recent trend toward utilization of polygraph evidence in the courts (British Columbia, 1976; New Mexico vs. Dorsey, 1975; U.S. vs. DeBetham, 1972; U.S. vs. Ridling, 1972; U.S. vs. Zeiger, 1972).

In addition to reports and articles in scientific and professional publications, the popular press has recently focused a good deal of attention on "lie detection" in its various forms (e.g., Borger, 1978; Rice, 1978). As polygraph examinations become more commonplace in investigations and legal proceedings and public interest in the detection of deception continues to grow, it is likely that criminal suspects will have greater access to information and materials concerning the details of PDD techniques. That situation increases the importance of obtaining data concerning the effects that the possession of such information will have on the outcome of polygraph examinations.

There is only one published study (Lykken, 1960) concerning the accuracy of PDD techniques with subjects who had been given detailed knowledge of several aspects of PDD. In that study, subjects were given a 15-minute lecture on the nature of the physiological response being monitored (the skin resistance response), the polygraph, the principles underlying the test structure, and possible countermeasures. As an incentive each subject was offered a prize of $10 if he could "manage to defeat the objective scoring system being used." Under these conditions, Lykken's detection accuracy was 100%. However, the question structure used in that study was the guilty knowledge test, a test which is dependent on the assumption that an innocent suspect would not have knowledge of specific details about the matter under investigation. The theoretical assumptions, question structure, and evaluation techniques of the guilty knowledge test are quite different from those of the CQ technique (Podlesny & Raskin,

1978). Moreover, the guilty knowledge test is of limited value in the field due to certain pragmatic considerations (Lykken, 1974; Podlesny & Raskin, 1978). For example, the polygraph examiner might lack sufficient information about the matter under investigation to construct a proper question set, or as a result of police questioning or newspaper accounts prior to the polygraph examination the suspect may have gained information about the crime which would violate the necessary conditions and assumptions of the technique. Furthermore, many cases are not suitable for a guilty knowledge test due to complete knowledge of the details by the accused (e.g., self defense or accidental shooting).

The experimental literature dealing with the effects of countermeasures on examiner accuracy is small. Kubis (1962) found that modified yoga, a form of mental dissociation, was not an effective countermeasure. However, in the same study Kubis found that the use of stimulating thoughts to produce responses to questions other than relevant questions (exciting imagery) led to significantly decreased examiner accuracy. Kubis also noted that when subjects pressed their toes against the floor, detection rates were reduced to chance levels. However, Kubis used a peak-of-tension test and More (1966) failed to replicate Kubis' results with regard to the exciting imagery and toe-pressing countermeasures. A more recent study claimed that biofeedback-conditioned suppression of skin resistance and hypnotic suppression of an arousal state produced a significant decrease in the accuracy of examiners' decisions (Corcoran, Lewis, & Garver, 1978). However, serious deficiencies in methodology, design, and analysis

make those results nearly impossible to interpret. Subjects were not randomly assigned to the experimental and control groups, and the design lacked proper counterbalancing. The experimental paradigm consisted of the subjects lying about a card they had chosen, a task which is an inherently weak test of the efficacy of PDD techniques in that there is very little involvement in the task on the part of the subject (Podlesny & Raskin, 1977). In addition, Corcoran et al. offered their subjects no incentive or motivation to "beat the test." Those factors are extremely important in establishing a basis for generalizing laboratory results to the field (Podlesny & Raskin, 1977).

There are no published data concerning the effects of knowledge and experience on the accuracy of the PDD utilizing the CQ technique. However, it is possible that subjects' knowledge of the CQ theory, test structure, and evaluation rules would result in lower numerical scores and a greater number of false negative errors and inconclusive results. Guilty subjects may attempt to produce responses to the control questions by using mental or physical countermeasures. Furthermore, that knowledge might reduce the psychological impact of the control questions for innocent subjects, resulting in diminished autonomic responsiveness to the control questions and more false positive errors and inconclusive results. It is likely that these effects will be enhanced if subjects are given practice polygraph examinations in addition to receiving information about PDD techniques. Thus, the main purpose of this study was to assess the effects of prior information and practice on the accuracy of CQ techniques.

The present study also sought to confirm previous findings regarding the nature of guilty and innocent subjects' physiological responses to relevant and control questions and to determine whether there are systematic differences between the responses of sophisticated and naive subjects. Previous research (Barland & Raskin, 1975; Podlesny & Raskin, 1978; Raskin & Hare, 1978) has shown that the skin conductance response (SCR) has generally been the best single indicator of truthfulness or deception. Guilty subjects typically responded to relevant questions with SCRs of greater amplitude, and innocent subjects produced greater SCRs to control questions.

Thoracic and abdominal respiration amplitude have been found to decrease when guilty subjects answered relevant questions and when innocent subjects responded to control questions (Barland & Raskin, 1975; Raskin & Hare, 1978). In addition, innocent subjects produced a slowing of respiration in response to control questions and a speeding of respiration rate in response to relevant questions (Raskin & Hare, 1978). Furthermore, Raskin and Hare (1978) demonstrated that guilty subjects showed a larger rise in abdominal respiration baseline in response to relevant as compared to control questions, whereas innocent subjects showed an increase in abdominal respiration baseline in response to control questions and a contrasting decrease in abdominal respiration baseline in response to relevant questions.

Using measures of heart rate, Raskin and Hare (1978) and Podlesny and Raskin (1978) found that guilty subjects produced a large, long-latency heart rate (HR) deceleration to relevant questions.

Innocent subjects did not have significantly different HR responses to control and relevant questions.

Measures of finger blood volume (FBV) and finger pulse amplitude (FPA) have been shown to reliably discriminate guilty and innocent subjects (Raskin & Hare, 1978). Podlesny and Raskin (1978) found that decreases in FBV were larger and of longer duration when guilty subjects answered relevant questions and when innocent subjects answered control questions. In addition, greater relative decreases in FPA were produced by guilty subjects in response to relevant questions and by innocent subjects in response to control questions.

Increases in relative blood pressure have been shown to significantly identify innocent, but not guilty, subjects using a cardio cuff inflated to a pressure of 50-60 mmHg (Podlesny & Raskin, 1978). Other investigators have reported discrimination of both guilty and innocent subjects using a higher pressure device (Barland & Raskin, 1975) and a low pressure device inflated to 70 mmHg (Raskin et al., 1978). The present study sought to assess the effectiveness of cardio measures at the relatively comfortable pressure of 70 mmHg.

Podlesny and Raskin (1978) found that the dry cardio activity monitor (CAM), a device which supposedly measures relative blood pressure was of little practical value in discriminating between truthful and deceptive subjects using the CQ technique. The present study sought to assess the effectiveness of the wet CAM in the PDD (Decker, Stein & Ansley, 1972), since no research employing a mock crime situation has yet been reported using that transducer.

METHOD

Subjects

Eighty-four male subjects were recruited from the local community by means of a classified newspaper advertisement (Appendix A) which offered $7.50 and a possible $10 bonus for participation in a psychophysiological experiment. This method of subject recruitment has been used previously in PDD research (Podlesny & Raskin, 1978) and seems to provide a representative cross-section of the population.

When a person responded by telephone to the advertisement, he was told by a secretary that the study was a lie detection experiment. He was then asked if he had ever taken a lie detector exam and if he had any knowledge of the present experiment. Callers who answered both of those questions negatively and chose to participate in the study were used as subjects. Twelve of these subjects either disqualified themselves or were unable to participate due to other factors. After hearing the instructions concerning the mock crime (see below) 4 subjects refused to participate in the study because they had moral objections to stealing, 2 subjects expressed anxiety about the mock crime and disqualified themsleves, 1 subject was concerned about "getting in trouble," 1 lacked confidence in his ability to deceive the examiner, and 1 subject confessed the mock crime to the polygraph examiner during the pretest interview. Three other subjects had to be eliminated from the study due to procedural errors:

in one case the examiner had become aware of the subject's participation in the mock theft, another subject failed to follow his instructions properly, and another was not able to locate the ring which was to be stolen. The age of the remaining 72 subjects ranged from 17 to 54 years, with a median age of 25. Education ranged from 9 to 20 years, with a median of 13 years.

Procedure

Subjects who responded to the newspaper advertisement and who met the necessary qualifications were told to report at a specified time to a room in the Behavioral Sciences Building at the University of Utah, where they would find an envelope with their name on it taped to the door. Inside the envelope was the subject's preliminary instructions (Appendix B) which directed him to another room in which there was a cassette tape recorder containing further instructions. The subject was instructed to operate the tape recorder and listen to his instructions (Appendix C) using headphones.

Half of the subjects were instructed to commit a mock crime (the theft of a ring), and the other half were innocent of that crime. These guilty and innocent subjects were subdivided into three treatment groups (see below). Subjects were assigned in order of their arrival to the next condition/treatment combination from a randomized running order. The taped instructions were inserted into the tape recorder by the only one of three experimenters who was aware of the subject's treatment combination. The other two experimenters did not know the guilt or innocence of the subject or his treatment group until all of his data had been obtained and a decision had been made

regarding his guilt or innocence.

Subjects in the guilty condition committed the mock theft according to their taped instructions. They went to a secretary's office on a different floor of the building and asked the secretary where they could find the office of Dr. Mitchell. The secretary had previously been informed that subjects would ask about a Dr. Mitchell, and she answered, "There is no Dr. Mitchell in this department." The subject then left her office and covertly watched until the secretary left about 3 min later. The subject then entered her office and searched the secretary's desk for a gray metal cashbox. From the cashbox he took an envelope and removed the ring from the envelope. He then concealed the ring on his person, destroyed the envelope, and returned to the room in which he had heard the taped instructions. Guilty subjects were also instructed to prepare an alibi to use if they were questioned during the theft and to return in exactly 15 min.

Innocent subjects heard a tape which contained a brief general description of the crime, without any of the details. They simply left the floor, waited 15 min and then returned. All subjects had been instructed that they would be given a "lie detector" test and that they should deny any involvement in the crime or any knowledge of its details. A $10 bonus was offered to both guilty and innocent subjects for appearing truthful on the polygraph test.

After the subject returned, an experimenter took him to another room. Subjects who had been randomly assigned to the Standard (STD) group simply waited in that room with the experimenter for a 40-min

period. Newspapers and magazines were available if the subject chose to read them. Some subjects in the STD group conversed with the experimenter, but the experimenter did not answer any questions pertaining to the study or PDD in general.

Subjects in the Information (INFO) group were given specific, detailed information about the CQ test (Appendix D). The information was prepared in a looseleaf notebook and explained the theory underlying the CQ test, types of physiological responses which the examiner would use to make his decisions (including photographic examples of those responses), and a variety of physical and mental countermeasures which might be utilized to produce physiological responses at a given time so as to produce a truthful outcome. In addition, this information was recorded on a cassette tape, and the tape was played while the subject read the booklet. The tape played for 10.75 minutes, and for the remainder of the 40-min period the subject was free to ask questions of the experimenter, have the tape replayed, or examine the information booklet.

Subjects in the Information and Practice (INFO + PRAC) group were given the same information as subjects in the INFO group. After receiving that information they were attached to a Lafayette Model 76163 portable polygraph which recorded respiration, skin resistance, relative blood pressure, and finger vasomotor activity, and they were given two practice polygraph tests. The question sequence of those tests was as follows:

1. Is your first name _____?
2. Are you in Salt Lake City?

3. Is today _____?
4. Before today have you ever stolen anything?
5. Were you involved in stealing a ring from the office at the University?
6. Are you sitting down?
7. Before you were 18, did you ever lie about something important to get out of trouble?
8. Did you steal a ring from an office at the University of Utah?

These practice tests gave the subject two opportunities to attempt to produce reactions using countermeasures if he desired, and provided him with feedback concerning the nature of his physiological responses. After each test the subject was allowed to examine the polygraph charts and to discuss them with the experimenter to get an assessment of how well he had performed on the practice test.

Following the treatment period the subject was escorted to another room where the formal polygraph examination took place. Present in that room were a second experimenter who acted as the polygraph examiner and a laboratory assistant whose job it was to operate the instrumentation and audio tape recorders. Subjects were directed into a shielded chamber and sat in an upholstered armchair. After collecting some background information about the subject (Appendix E), the test questions were reviewed. Subjects were told that each question must be answered either "Yes" or "no." The wording of the control questions was adjusted so that each control question elicited a "No" answer. A typical question sequence was as follows:

1. Is your last name _____?
2. Regarding whether you took that ring, do you intend to answer truthfully each question about that?
3. Do you understand that I will ask only questions that we have discussed?
4. During the first 18 years of your life did you ever take something which didn't belong to you?
5. Did you take that ring?
6. Between the ages of 18 and 23 did you ever take something which didn't belong to you?
7. Did you take that ring from the desk?
8. Were you born in the United States?
9. Other than what you told me, prior to 1975 did you ever deceive someone?
10. Do you have that ring with you now?

The relevant questions were at positions 5, 7, and 10, and the control questions were at positions 4, 6, and 9. Questions 1, 2, and 3 served primarily as buffers to habituate initial responding (Raskin, 1978c),and Question 8 was a neutral question.

The sensors were then attached to the subject, and he was given a brief explanation of the polygraph, the autonomic nervous system, and a ratione for lie detection. The subject was then given a number test in which he was instructed to choose a number between "3" and "6", to tell the examiner which number he chose, and then to answer "No" to all of a series of questions about numbers including the number that he chose, which was written on a piece of paper posted

in front of him. This procedure allowed the subject to become accustomed to the testing situation and helped to ensure adequate recordings. In order to increase guilty subjects' concern about relevant questions and innocent subjects' concern about control questions, at the completion of the number test all subjects were told that they had produced large physiological responses when they lied about the chosen number and comparatively small responses to the other numbers.

The CQ test was then administered. A minimum of three charts (three times through the questions) was given to each subject. After each chart the experimenter discussed with the subject any problems or concerns he might have expressed with regard to the questions. The experimenter also reviewed the control questions again in order to draw the subject's attention to them so as to increase their salience. That procedure seems to increase the accuracy of the test by reducing false positive errors (Raskin & Hare, 1978). If the examiner could not make a decision based on a numerical evaluation of those three charts (Raskin & Hare, 1978), additional charts were administered to a maximum total of five. However, only the first three charts were used for the statistical analyses of the numerical scores and the objective quantification.

When the testing procedure was completed and the experimenter had finished scoring the charts numerically, he removed the sensors from the subject. Before the experimenter informed him of his decision, the subject was asked to complete a short questionnaire (Appendix F). The purposes of this questionnaire were to obtain the subject's

impression regarding the outcome of the test, to ascertain that subjects in the INFO and INFO + PRAC groups had been able to identify control and relevant questions, and to determine which, if any, countermeasures had been used by the subject. This was also used to determine the extent to which subjects in the INFO and INFO + PRAC groups understood and remembered the information they received during the treatment period.

Upon completion of the questionnaire, subjects were informed of the examiner's decision and were released. The payment for their participation was mailed to their homes. Some time after the subjects' departure the charts were scored blind by a third experimenter.

Apparatus

The pretest interviews and polygraph examinations were conducted in an Industrial Accoustics Company shielded chamber with the door closed. Physiological recordings were made on a Beckman Type R Dynograph located outside the chamber. During pretest interviews the experimenter sat inside the chamber with the subject, but the experimenter left the chamber during the polygraph tests and communicated with the subjects by means of an intercom.

Skin conductance (SC) was recorded from Beckman 10mm Biopotential Ag-AgCl electrodes filled with .05m NaCl in a Unibase medium (Fowles & Schneider, 1978) placed on the palmar surface of the middle phalanx of the 4th and 5th fingers of the left hand, which had been cleaned with 70% ethanol. A Beckman 9844 skin conductance coupler applied a constant potential of .5V, and SC was recorded DC with an upper frequency cutoff of 6Hz.

Respiration recordings were obtained from two mercury strain gauge transducers and two Beckman 9875B Hg Gauge couplers recorded DC with an upper frequency cutoff of 30 Hz. One strain gauge was placed around the upper thorax and the other around the abdomen just below the rib cage and secured with Velcro fasteners.

Heart rate was recorded from EKG lead II using a Beckman 9857 Cardiotachometer coupler which provided beat-by-beat heart rate and a square-wave pulse for each R-wave.

The photoplethysmograph pickup was strapped with Velcro over the palmar surface of the distal phalanx of the left index finger. It consisted of a Clairex CL703L CdSe photoconductive cell and a General Electric 683 miniature tungsten lamp mounted in a block of black phenolic plastic. Kodak Wratten Gelatin infrared filter No. 87C was placed over the photocell, and the lamp was activated with a potential of 3V. A Beckman 9853A Voltage/Pulse/Pressure coupler contained the bridge circuitry and was used to record FPA with a time constant of .1 sec and an upper frequency cutoff of 30Hz on one channel. The unfiltered outpout of the bridge was also connected to a Beckman 9806A AC-DC coupler which was modified to record FBV with a time constant of 25 sec on a second channel with an upper frequency cutoff of 30Hz.

A Stoelting wet Cardio Activity Monitor (CAM) was strapped with Velcro over the radial artery of the left wrist. A Beckman 9853A Voltage/Pulse/Pressure coupler was used, and recordings were made DC with an upper frequency cutoff of 30Hz.

The outputs of the shaped pulse from the cardiotachometer, the

short- and long-time-constant plethysmograph, cardio, CAM, and SC channels and time marks were recorded on Scotch 211 magnetic tape using two Hewlett-Packard 3960 Instrumentation Tape Recorders. Analog-to-digital conversion and preliminary data reduction were accomplished with a Digital Equipment Corporation PDP-12 computer. Further data reduction and analyses were performed on a Univac 1108 computer.

Data Reduction

Numerical Evaluations

The polygraph charts were scored blind by an independent evaluator who had not been present during the tests. He had no information regarding the subjects' guilt or innocence or their treatment groups. The scoring criteria were those described by Raskin and Hare (1978) and Podlesny and Raskin (1978). The measures evaluated were SCR, respiration, cardio, and plethysmograph, and the following characteristics were utilized to assess the strength of the responses: SCR - amplitude; respiration - decrease in amplitude, slowing of respiration rate, and baseline increase; cardio - increase in systolic and diastolic levels; plethysmograph - decrease in amplitude (FPA) and decrease in diastolic level (FBV). Each control-relevant pair of questions was assigned a score from -3 to +3 for each of the four physiological components, depending on the magnitude of the difference between the responses. Positive scores were assigned when responses to control questions were stronger, and negative scores were assigned when responses to relevant questions were stronger. Total scores of +6 or higher were considered truthful outcomes, and scores of -6 or

lower were considered deceptive outcomes. Scores of less than 6 in either direction were considered inconclusive. If the score was less than 6 after the first three charts were numerically evaluated, a maximum of two additional charts was run, and the scores were accumulated in an attempt to obtain a decision.

When no inconclusive zone was used, accuracy was assessed by numerically evaluating only the first three charts for all subjects. Total scores in the negative direction were considered deceptive. The data were also analyzed using inconclusive zones ranging from zero to ±12.

Objective Quantification

Objective measurements were made by computer and by persons who had no knowledge of the field evaluations or treatments administered to the subjects. Measurements were made on the responses to each of the three control and three relevant questions on the first three charts for each subject. Analyses were based on mean values for control and relevant questions for each chart. The following measurements were obtained:

Skin conductance response (SCR) amplitude. Increase in SCR was measured in mm of chart deflection from the onset of the first upward change in slope at least .5 sec after the beginning of the question to the highest level reached within 5 sec following the subject's answer.

Thoracic respiration amplitude (TRA) response. The amplitude in mm of the last complete inspiration prior to the onset of the question was subtracted from the amplitude of each of the first five complete

inspirations following the question onset to yield a TRA difference response. The amplitudes of the poststimulus inspirations were also divided by the amplitude of the prestimulus inspiration to yield a proportional TRA response. The above comparisons were also made for the prestimulus inspiration and the first complete inspiration following a subject's answer.

Thoracic respiration baseline (TRB) response. The difference in mm between the lowest point of the last complete expiration prior to the onset of the question and the lowest points of each of the first five complete expirations following the question onset were calculated to yield a TRB difference response. The difference between the lowest point of the prestimulus expiration and the lowest point of the first complete expiration following the subject's answer was also calculated.

Thoracic respiration cycle time (TRCT) response. The time in seconds between the last two points of maximum inspiration prior to the onset of the question was subtracted from the time in seconds between the two points of maximum inspiration for each successive pair of the first five inspirations following the question onset to yield a TRCT difference response. The poststimulus times were also divided by the prestimulus time to yield a proportional TRCT response. The above comparisons were also made for the prestimulus time and the time in seconds between the two points of maximum inspiration following the subject's answer.

Abdominal respiration amplitude (ARA) response. The ARA response

was obtained in the same manner as the TRA response.

Abdominal respiration baseline (ARB) response. The ARB response was obtained in the same manner as the TRB response.

Abdominal respiration cycle time (ARCT) response. The ARCT response was obtained in the same manner as the TRCT response.

Heart rate (HR) response. Intervals between successive R waves in the EKG were converted to sec-by-sec HR in beats per minute. The value obtained for each second was the sum of weighted rates for all pairs of R waves which overlapped any portion of that second. The rates for pairs of R waves were multiplied by the proportion of the second covered by each pair and them summed. Values were obtained for 3 sec prior to the question and 19 sec following the question onset. Deviations from prestimulus rates were obtained by subtracting the mean of the three prestimulus seconds from the rates for each of the 19 poststimulus seconds.

Finger blood volume (FBV) response. The decrease in the diastolic level of the recording obtained from the photoplethysmograph channel with the 25-sec time-constant was analyzed on a sec-by-sec basis. Values for diastolic levels were obtained for the period beginning 3 sec before question onset and ending 18 sec after the question onset. A mean was obtained for each successive pair of diastolic levels which overlapped any portion of the second. Each mean was multiplied by the proportion of the second covered by that pair. The resulting diastolic levels were summed for each second. The values

for each of the 18 poststimulus sec were subtracted from the mean level of the 3 prestimulus sec to yield an FBV response. The values obtained were corrected to a common gain because of the wide range of gain settings among the subjects.

Finger pulse amplitude (FPA) response. The .1-sec time-constant photoplethysmograph recordings were analyzed on a sec-by-sec basis. Each systolic and diastolic point was characterized by a relative level and a time of occurrence with respect to question onset. Sec-by-sec values for systolic and diastolic levels were obtained for the period beginning 3 sec prior to question onset and ending 18 sec after question onset. A mean was obtained for each successive pair of systolic or diastolic levels which overlapped any portion of the second. Each mean was multiplied by the proportion of the second covered by that pair. The resulting systolic and diastolic levels were summed separately for each second. The difference between systolic and disatolic levels was obtained for each second, and the FPA response was expressed as a proportion of the 3-sec prestimulus mean.

Cardio pulse amplitude (CPA) response. The cardio recordings were measured in the same manner employed for FPA.

Cardio systolic (CS) response. The systolic second-by-second levels were obtained as described for FPA. CS responses were expressed as deviations from the mean of the 3-sec prestimulus level.

Cardio diastolic (CD) response. The CD response was obtained in the same manner as the CS response using the diastolic levels.

CAM pulse amplitude (CMPA) response. The CMPA response was obtained from the CAM recordings in the same manner used for FPA response.

CAM systolic (CMS) response. The CMS response was measured in the same manner used for the CS response.

CAM diastolic (CMD) response. The CMD response was measured in the same manner used for the CD response.

Objective quantitative analyses were performed for all 72 subjects for the SCR and respiration measures. However, due to a malfunction in the recording apparatus the cardiovascular measures were not recorded for the last 16 subjects who were run. In order to equalize the number of subjects in each cell for the objective analyses, the records of 2 additional subjects were randomly chosen and discarded. Thus, the objective quantitative analyses for cardiocascular measures were performed for 54 subjects.

RESULTS[2]

Numerical Field Evaluations

Accuracy of Decisions

The results of field evaluations were based on the assigned scores and decisions by the independent blind evaluator who had no contact with the subjects. Rates of accurate decisions were computed for the first 3 charts without an inconclusive zone (Table 1). Under those conditions, decisions for the STD and INFO groups were 91.5% correct and 8.3% wrong. For the INFO + PRAC group those decisions were 70.8% correct and 29.2% wrong. An inconclusive zone of ±5 was also utilized when making those decisions, and the outcomes were assessed on the basis of the total score for all charts. Table 1 contains those evaluations. For the STD group and the INFO group the decisions were 87.5% correct, 4.2% wrong, and 8.3% inconclusive. For the INFO + PRAC group, 62.5% were correctly categorized, 25% were wrong, and 12.5% were inconclusive. Exclusing inconclusives, the accuracy rate was 95.5% for both the STD and INFO groups, and 71.4% for the INFO + PRAC group.

When the inconclusive zone of ±5 was utilized in making decisions, only one error was made in each of the STD and INFO groups, and both of those errors were false positives (e.g., innocent subjects who

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[2]All statistical tests employ a .05 rejection region, 2-tailed.

Table 1

Independent Rater Decisions Based on Numerical Evaluations
With and Without an Inconclusive Zone

Treatments	Rater Decisions							
	First Three Charts Without Inconclusive Zone			All Charts With Inconclusive Zone				
	% Correct	% False Positive	% False Negative	% Correct	% False Positive	% False Negative	% Incon-clusive	% Correct Decisions
STD	91.7	4.2	4.2	87.5	4.2	0	8.3	95.5
INFO	91.7	4.2	4.2	87.5	4.2	0	8.3	95.5
INFO + PRAC	70.8	12.5	16.7	62.5	12.5	12.5	12.5	71.4

appeared deceptive). It should be noted that no guilty subject in either of those groups was able to produce a truthful outcome. In the INFO + PRAC group six errors occurred, three false positives and three false negatives.

Using the total score for the first three charts, the percentages of accurate decisions and inconclusives were calculated for each treatment group for inconclusive regions ranging from zero to ±12. The results of this post facto manipulation are shown in Figure 1. When the inconclusive zone was limited to scores of zero, 91.7% of the subjects in the STD and INFO group, and 70.8% of the INFO + PRAC group were correctly categorized. As the inconclusive boundaries were extended, there was a slight increase in the degree of accuracy of decisions. Inconclusive regions of ±7 and greater led to 100% accuracy in the STD group and accuracy rates of 83% to 89% in the INFO + PRAC group. The accuracy rates for the INFO group remained relatively stable throughout the various inconclusive zones. Predictably, the rate of inconclusives rose as the size of the inconclusive region increased. However, there was very little difference between the accuracy rates between inconclusive zones of zero and ±5, the region that was used in the field evaluations. Because of the concurrent increase in inconclusive outcomes between the boundaries of zero and ±5, fewer subjects were correctly identified at the wider zone.

Evaluator Agreement

The decisions based on the numerical evaluations by the polygraph examiner and the independent evaluator were compared. The examiner

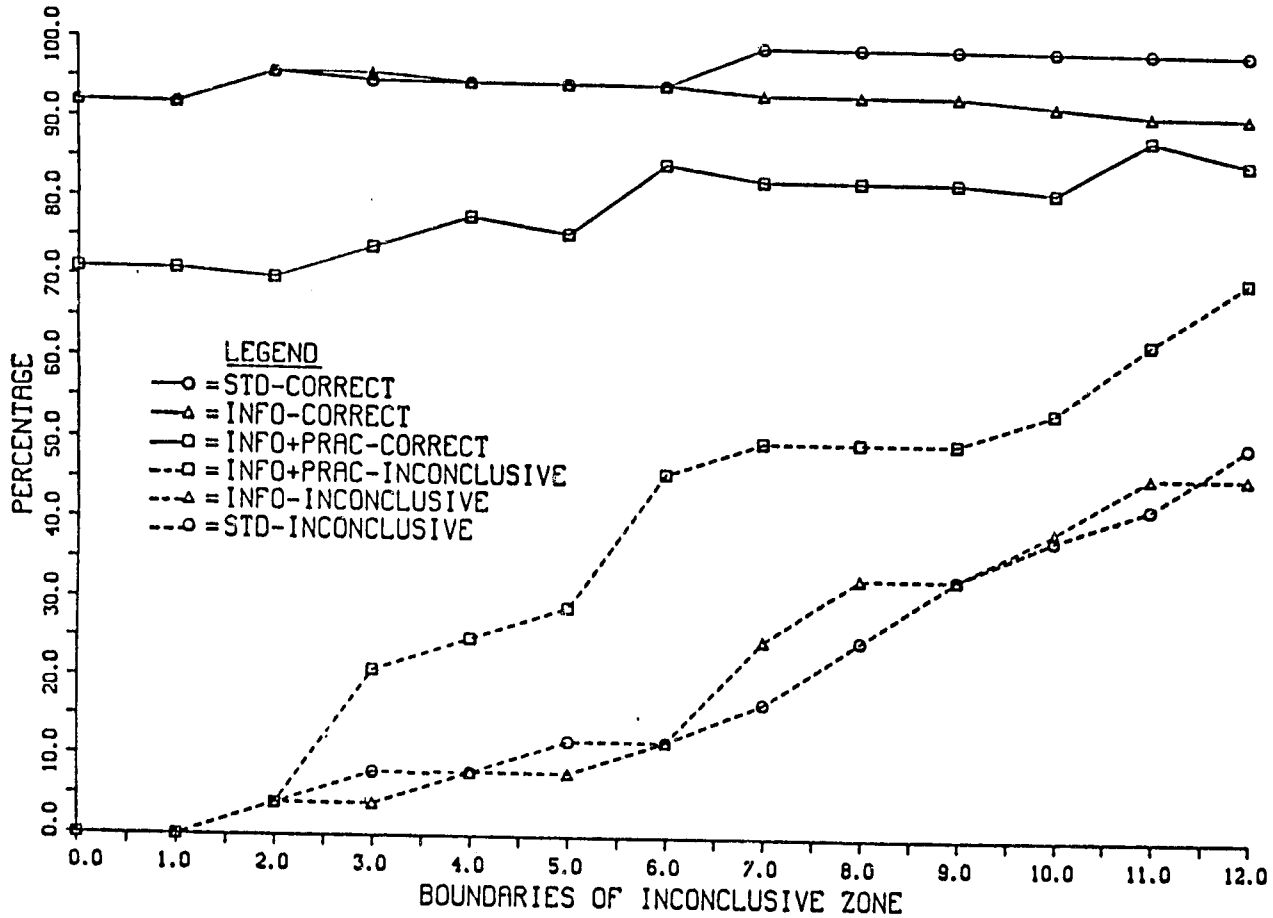

Figure 1. Accuracy of Decisions and Percent Inconclusives for Different Inconclusive Regions.

and the independent evaluator made definite decisions (e.g., truthful or deceptive) in 93% and 90% of the cases, respectively. When both made definite decisions on the same subjects, they were in agreement in 95% of those cases. In the three cases where they disagreed, the blind evaluator, who was the more experienced of the two, made the correct decisions. As a further test of interrater reliability, the numerical scores assigned by the examiner and the independent evaluator on the first three charts for all subjects were compared. The correlation between the two sets of scores was extremely high, $r(70) = +.97$.

Effectiveness of Numerical Scores

The total score for each subject's first three charts was compared for guilty and innocent subjects in the three treatment groups. The mean 3-chart totals are presented in Table 2. Analysis of variance revealed a significant difference between the scores of guilty and innocent subjects, F (1/66) = 72.25, MSe = 128.0, but no significant differences among the three treatments ($F < 1$). There was a significant Guilt X Treatment interaction, F (2/66) = 4.83, MSe = 128.0. A Newman-Keuls test showed that the scores of innocent subjects in the INFO + PRAC group were significantly lower than those of the other two innocent groups, but there was no significant difference among the three treatments when the scores of guilty subjects were compared. Additional comparisons revealed a significant discrimination between guilty and innocent subjects in the STD group, t (22) = 6.22, in the INFO group, $t(22) = 5.43$, and in the INFO + PRAC group $t(22) = 2.76$.

Table 2

Mean Numerical Field Scores for Each Component and Total Scores for the First Three Charts

Treatments		Mean Numerical Component Scores				
		Skin Conductance	Plethysmograph	Cardio	Respiration	Total
STD	Guilty	-6.6[a]	-2.9[f]	-1.8	-1.3	-12.6
	Innocent	+6.0[b]	+2.0	+6.3[g]	+3.8[j]	+18.1
INFO	Guilty	-5.6[c]	-1.9	-2.1	-1.3	-10.9
	Innocent	+5.4[d]	+2.1	+5.0[h]	+2.7[k]	+15.2
INFO + PRAC	Guilty	-5.5[e]	-0.5	-0.1	+0.4	- 5.7
	Innocent	+0.6	+1.2	+2.3[i]	+1.5	+ 5.6

[a] $t(11) = 4.87$, SE = 1.36

[b] $t(11) = 3.17$, SE = 1.90

[c] $t(11) = 3.87$, SE = 1.45

[d] $t(11) = 2.66$, SE = 2.04

[e] $t(11) = 3.27$, SE = 1.69

[f] $t(11) = 5.12$, SE = 0.58

[g] $t(11) = 5.74$, SE = 1.11

[h] $t(11) = 3.69$, SE = 1.39

[i] $t(11) = 3.84$, SE = 0.61

[j] $t(11) = 3.61$, SE = 1.04

[k] $t(11) = 5.36$, SE = 0.50

In order to determine whether there was a difference in the magnitude of scores for guilty and innocent subjects, an analysis of variance was performed with the signs reversed for the scores of the guilty subjects. There was no significant difference between the magnitude of mean scores for guilty and innocent subjects, $F(1/66) = 1.46$, $MSe - 128.0$, nor was there a significant Guilt X Treatment interaction, $F < 1$. However, there was a significant treatment effect, $F(2/66) = 4.83$, $MSe = 128.0$. A Newman-Keuls test revealed that the magnitude of subjects' scores in the INFO + PRAC group was significantly lower than for the other two groups.

Effectiveness of Physiological Components

In order to assess the effectiveness of each of the four components which were evaluated by numerical field scoring, the mean 3-chart total was calculated for each component separately. Those means are presented in Table 2. When all four of the measures were considered simultaneously in a multivariate analysis of variance, a significant discrimination was revealed between guilty and innocent subjects, $F(4/63) = 17.81$. There was no significant difference among the treatments, $F(8/126) = 0.78$, nor was there a significant interaction, $F(8/126) = 1.23$.

Analyses of variance were performed on each of the four physiological measures separately. All of the measures discriminated significantly between guilty and innocent subjects: plethysmograph, $F(1/66) = 22.09$; respiration, $F(1/66) = 21.79$; skin conductance, $F(1/66) = 54.47$; cardio, $F(1/66) = 44.98$. There was no significant difference among the treatments for any of the components. There

was a significant Guilt X Treatment interaction for the cardio measure, $F(2/66) = 3.99$, $MSe = 13.75$. A Newman-Keuls test of the cardio scores indicated that cardio scores were significantly lower for innocent subjects in the INFO + PRAC treatment than in the STD group, and there was not a significant difference between guilty and innocent subjects in the INFO + PRAC group, $t(22) = 1.99$. No significant Guilt X Treatment interactions were found for the other three measures.

Additional tests of the means against zero for each of the components were performed for guilty and innocent subjects in each treatment group (Table 2). The results of these tests indicated that the plethysmograph scores did not significantly identify guilty subjects, and they significantly identified innocent subjects only in the STD group. The respiration scores significantly identified only innocent subjects in the STD and INFO groups. The skin conductance scores significantly discriminated subjects in all of the groups except for innocent subjects in the INFO + PRAC treatment. Cardio scores significantly identified innocent subjects in all three groups, but not guilty subjects.

Questionnaire Data

The majority of the subjects (64%) felt that they would be correctly identified as being innocent or guilty, 14% of the subjects felt that they would be incorrectly identified, and 22% thought that the examiner would fail to reach a conclusive decision. None of the subjects in the STD group thought that they would be incorrectly identified. Three guilty subjects in the INFO group and four guilty

subjects in the INFO + PRAC group thought that they would be considered innocent by the examiner, but only one of those subjects (INFO + PRAC group) was scored as truthful. Two innocent subjects in the INFO group and one in the INFO + PRAC group thought that they would be found deceptive. In both of those groups, one of those subjects was incorrectly identified.

Only 2 subjects in the STD group were able to identify the control and relevant questions. In the INFO group 16 subjects made the correct identification of control and relevant questions, and 15 subjects in the INFO + PRAC group correctly identified the two types of questions.

The use of countermeasures was reported almost exclusively by guilty subjects (Table 3). The most common attempted countermeasures were controlled breathing, rationalization, and relaxation. Of the guilty subjects who used countermeasures, 6 were in the STD group, 8 were in the INFO group, and 11 were in the INFO + PRAC group. Only 5 innocent subjects used countermeasures, 2 in each of the STD and INFO groups, and one in the INFO + PRAC group. Of the 3 guilty subjects in the INFO + PRAC group who produced truthful outcomes on the polygraph test, one reported the use of breathing and rationalization countermeasures, one employed controlled breathing and relaxation, and the third used relaxation, rationalization, and deliberately lied to the control questions. These countermeasures were among the most common employed by subjects, and were ineffective for all but the three subjects described above. Only one of the innocent subjects who used countermeasures produced a deceptive outcome. That subject was in the

Table 3

Number of Subjects Who Reported Employing

Various Countermeasures

	STD		INFO		INFO + PRAC	
Countermeasures	G	I	G	I	G	I
Controlled Breathing	1	0	5	0	6	1
Rationalization	1	0	2	1	5	0
Relaxation	2	2	1	0	5	0
Muscular	1	0	1	0	1	0
Concentration	1	0	2	0	1	0
Deliberately Lied to Control Questions	0	0	0	1	1	0
Total Subjects Who Used Countermeasures	6	2	8	2	11	1

STD group and used relaxation as a countermeasure.

Objective Quantitative Analyses

Skin Conductance Response (SCR) Amplitude

Mean SCR amplitudes of guilty and innocent subjects to control and relevant questions are presented in Table 4. The Guilt X Question Type interaction was significant, $F(1/66) = 40.76$, $MSe = 2227.57$. Guilty subjects responded with relatively greater amplitude to relevant questions, and innocent subjects responded with relatively greater amplitude to control questions. The Guilt X Question Type X Treatment interaction was not significant, $F(2/66) = 1.78$, indicating no difference among the three treatments in terms of the SCR amplitude to control and relevant questions.

Heart Rate (HR) Response

Mean HR deviations from prestimulus HR are presented in Figure 2. Although this measure did not significantly differentiate guilty and innocent subjects, (the Guilt X Question Type X Seconds interaction was not significant, $F(18/864) = 1.49$, $p < .10$), the results were very much like those obtained in two previous experiments (Podlesny & Raskin, 1978; Raskin & Hare, 1978). Inspection of Figure 2 reveals that subjects responded to control and relevant questions with an increase in HR for the first four poststimulus seconds and then HR began to decrease toward baseline levels. However, the magnitude of HR decrease was greatest for guilty subjects in response to relevant questions and was the only instance in which HR decreased below prestimulus baseline. The HR response did not significantly discriminate

Table 4

Mean Skin Conductance Response Amplitude (mm)

for Guilty and Innocent Subjects

	Control	Relevant
Guilty	5.9	8.9
Innocent	8.6	5.8

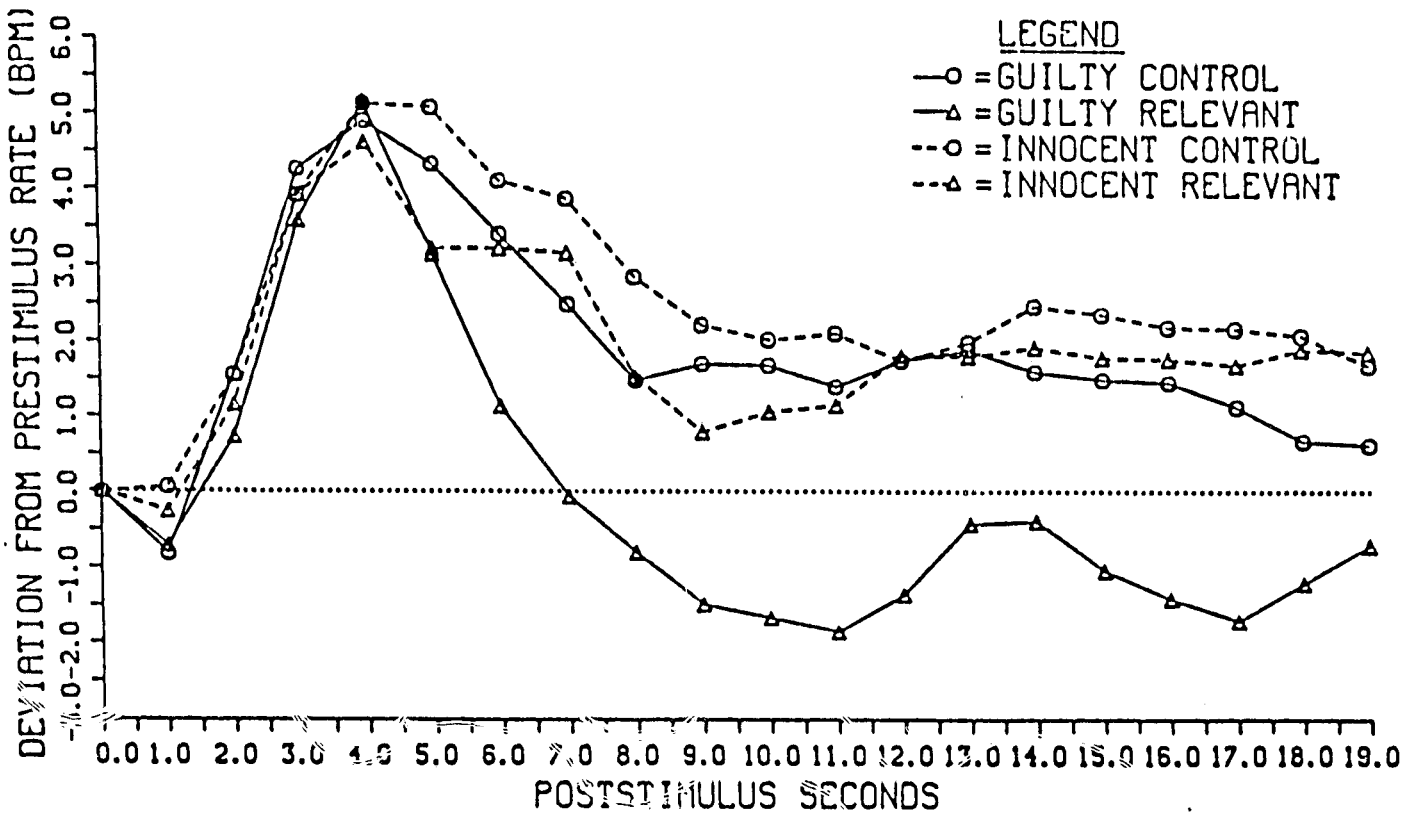

Figure 2. Mean Heart Rate Responses of Guilty and Innocent Subjects to Control and Relevant Questions.

among the three treatment groups.

Since the pattern of the subjects' HR responses was very similar to previous findings, further analyses were performed individually on guilty and innocent subjects in order to determine whether subjects had produced differential responses to control and relevant questions. The difference in HR between Seconds 4 and 11 was compared for control and relevant questions for guilty and innocent subjects. The HR of guilty subjects decreased significantly more in response to relevant questions than to control questions between seconds 4 and 11, $t(26) = 2.65$, SE = 34.85, but there was no significant difference in the degree of HR decrease of innocent subjects to control and relevant questions, $t(26) = 0.55$, SE = 21.82. Thus, guilty subjects responded to relevant questions with a late decrease in HR, but innocent subjects did not respond differentially to the two types of questions.

Cardio Systolic (CS) and Diastolic (CD) Responses

Since the results of the CS and CD analyses were essentially the same, and past cardio results have been reported in terms of CD (Podlesny & Raskin, 1978), only the CD responses are reported here. The Guilt X Question Type interaction was significant, $F(1/48) = 13.17$, $MSe = 29829.58$, and the Guilt X Question Type X Seconds interaction was also significant, $F(17/816) = 3.24$, $MSe = 1134.69$. Innocent subjects showed greater CD increases to control questions and guilty subjects showed larger increases to relevant questions. Since the Guilt X Question Type X Seconds X Treatment interaction was significant, $F(34/816) = 1.56$, $MSe = 1134.69$, further analyses were

performed on each of the three treatment groups. The mean CD responses of the STD, INFO, and INFO + PRAC groups are presented in Figure 3, 4, and 5, respectively. In the STD group the Guilt X Question Type interaction was significant, $F(1/16) = 11.65$, $MSe = 33741.97$, and the Guilt X Question Type X Seconds interaction was also significant, $F(17/272) = 3.86$, $MSe = 1116.14$, In the INFO group the Guilt X Question Type interaction was significant, $F(1/16) = 5.49$, $MSe = 32996.36$, but the Guilt X Question Type X Seconds interaction was not significant, $F(17/272) = 1.61$, $p < .10$. In both the STD and INFO groups innocent subjects produced larger responses to control questions and guilty subjects responded more strongly to relevant questions. Although Figure 5 indicates that in the INFO + PRAC group the responses of innocent subjects to control questions were somewhat stronger than their responses to relevant questions, the CD response did not significantly discriminate between guilty and innocent subjects $F(1/16) = 0.03$.

Cardio Pulse Amplitude (CPA) Response

Mean CPA responses of guilty and innocent subjects to control and relevant questions are presented in Figure 6. The Guilt X Question Type X SEconds interaction was significant, $F(17/816) = 5.35$, $MSe = 0.007$. For innocent subjects the mean decrease in CPA was greater in response to control questions than it was to relevant questions. The mean decrease in CPA for guilty subjects was about the same to control and relevant questions, but their subsequent increase in CPA was greater in response to relevant questions. The CPA response did not significantly differentiate the three treatment

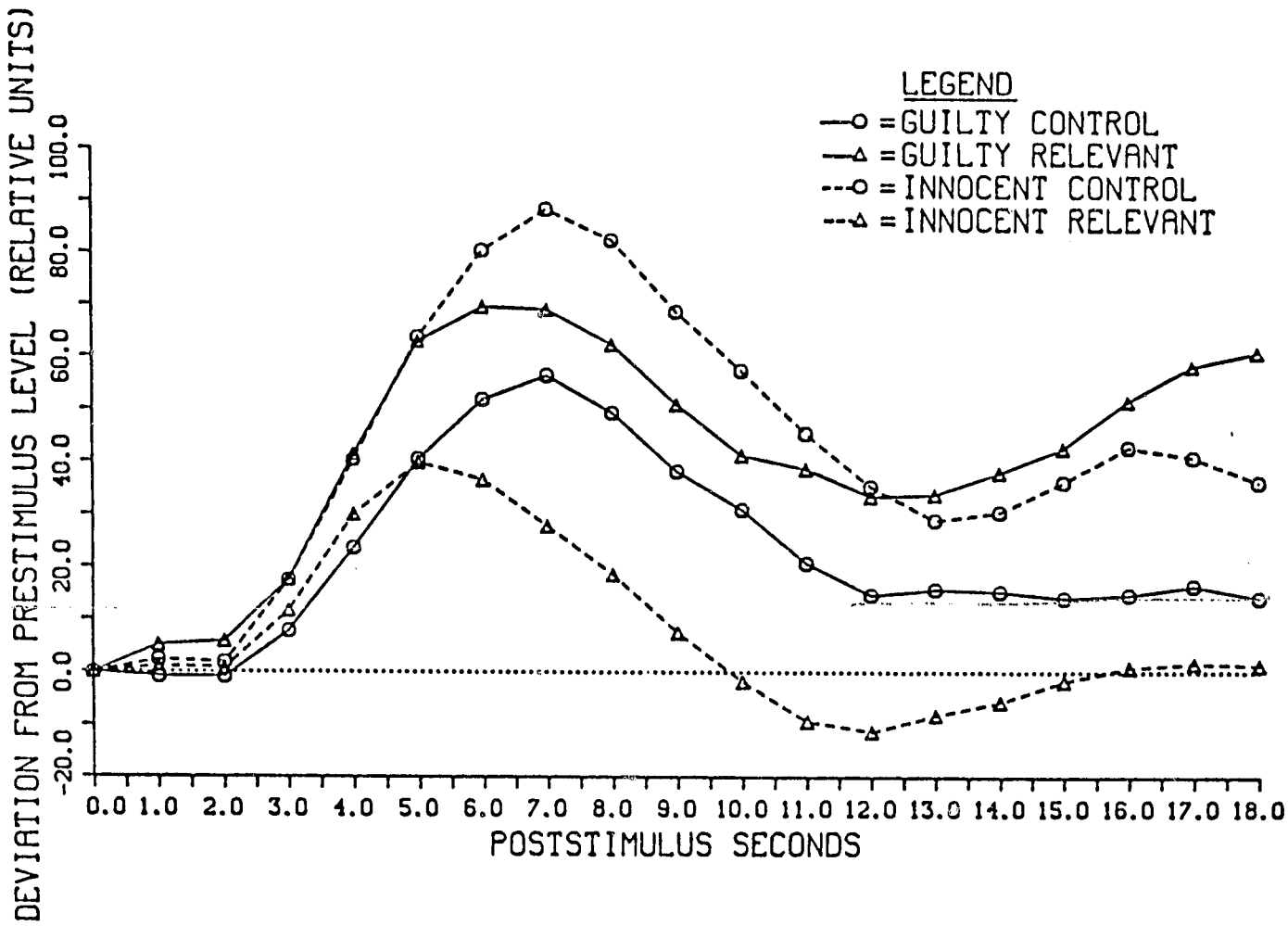

Figure 3. Mean Cardio Diastolic Responses of Guilty and Innocent Subjects to Control and Relevant Questions - STD Group.

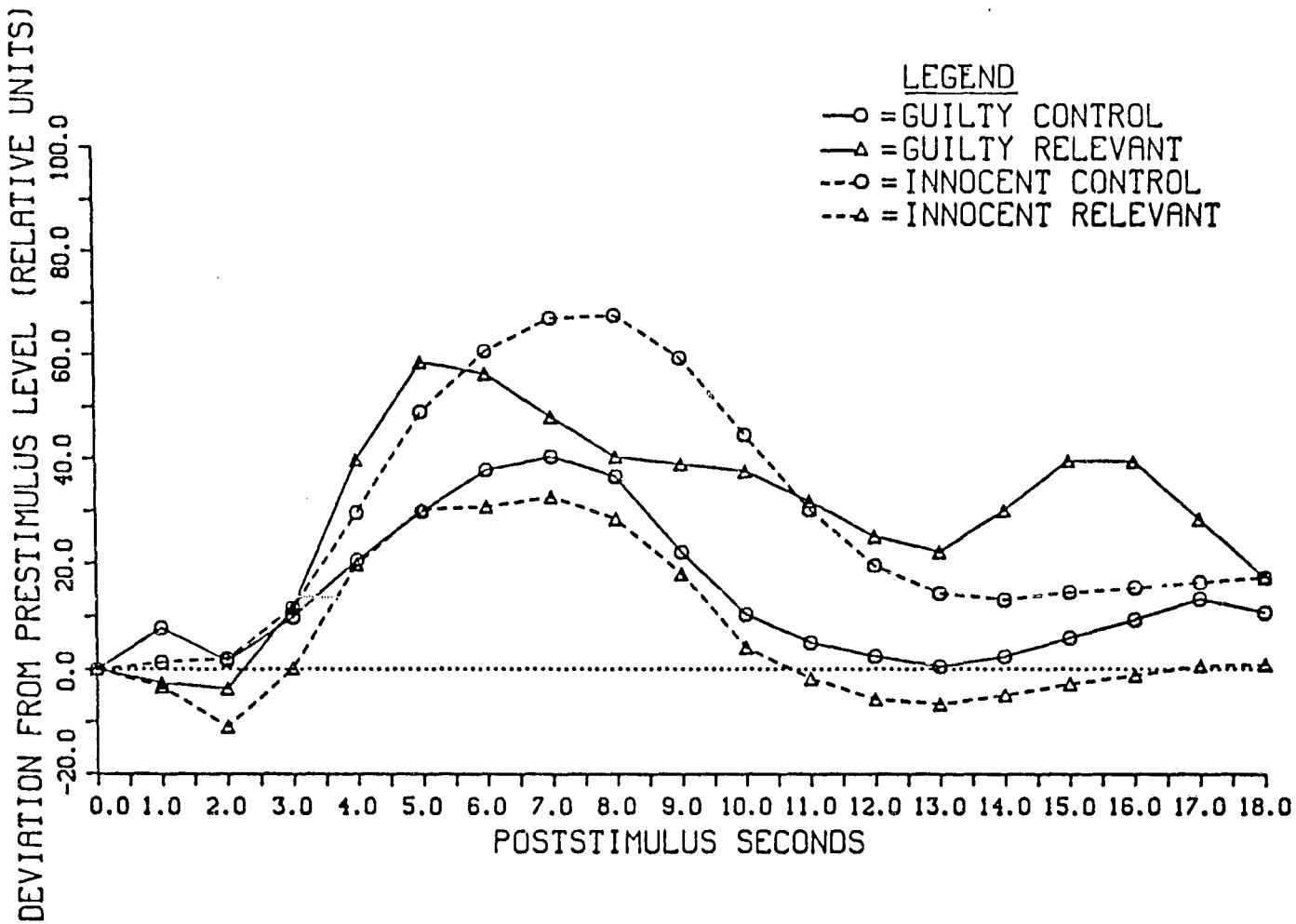

Figure 4. Mean Cardio Diastolic Responses of Guilty and Innocent Subjects to Control and Relevant Questions - INFO Group.

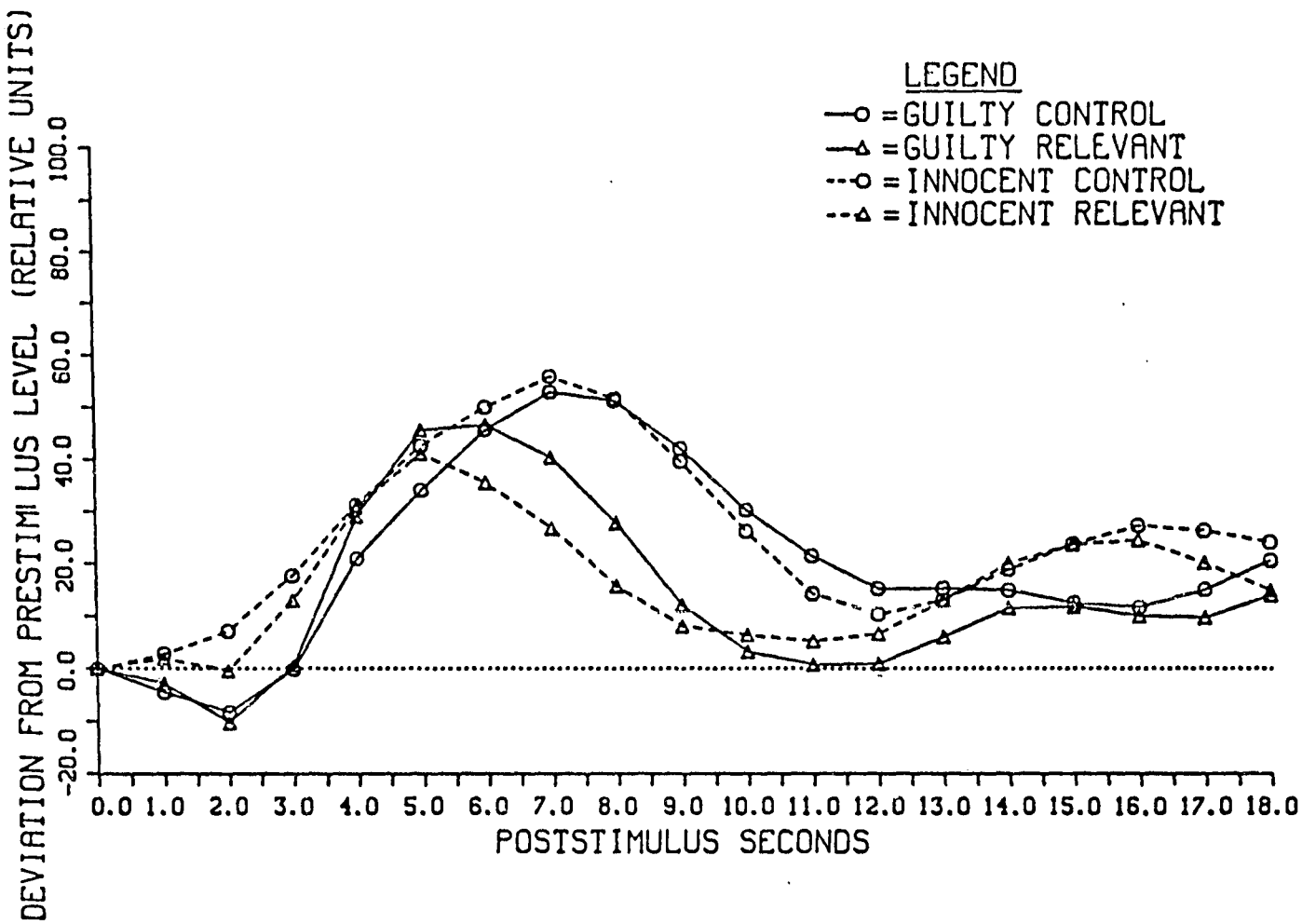

Figure 5. Mean Cardio Diastolic Responses of Guilty and Innocent Subjects to Control and Relevant Questions - INFO + PRAC Group.

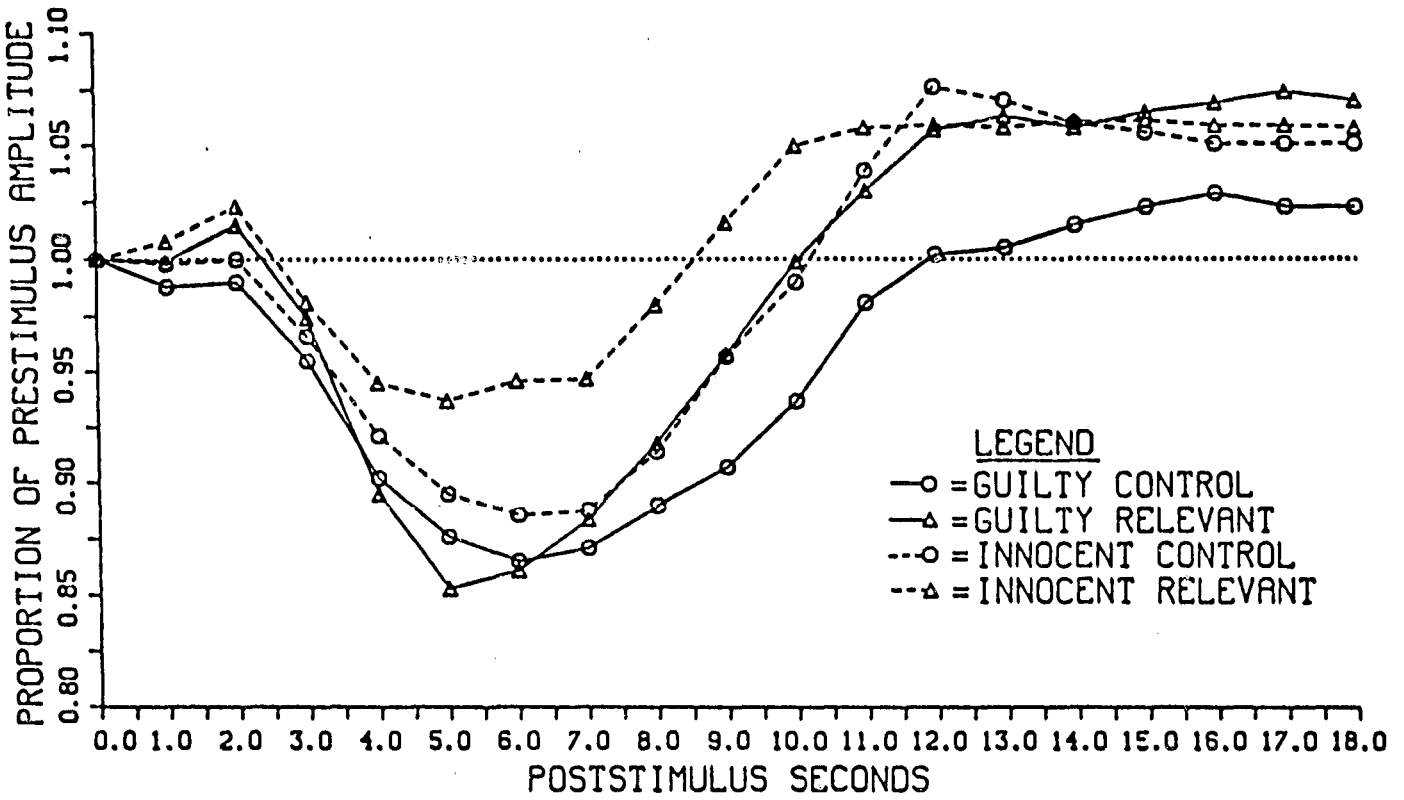

Figure 6. Mean Cardio Pulse Amplitude Responses of Guilty and Innocent Subjects to Control and Relevant Questions.

groups.

Finger Pulse Amplitude (FPA) Response

Mean FPA responses of guilty and innocent subjects to control and relevant questions are presented in Figure 7. The Guilt X Question Type X Seconds interaction was significant, $F(17/816) = 2.30$, $MSe = 0.006$. Inspection of Figure 7 reveals that innocent subjects had more prolonged decreases in FPA in response to control questions than to relevant questions. Although the FPA measure did not significantly discriminate the three treatment groups, additional analyses were performed on each of the three treatments to determine whether any of these hroups replicated the results of previous studies (Podlesny & Raskin, 1978; Raskin & Hare, 1978), which found that the FPA measure was more effective in identifying guilty subjects than innocent subjects. For the STD group the Guilt X Question Type X Seconds interaction was significant, $F(17/272) = 2.17$, $MSe = 0.006$. Guilty subjects produced greater decreases in FPA in response to relevant questions and innocent subjects produced decreases of longer duration to control questions. For the INFO group the Guilt X Question Type X Seconds interaction was significant, $F(17/272) = 1.82$, $MSe = 0.006$, indicating that innocent subjects produced decreases in FPA of longer duration to control than to relevant questions. The FPA measure did not significantly differentiate guilty and innocent subjects in the INFO + PRAC group.

Finger Blood Volume (FBV) Diastolic Response

The mean FBV responses of guilty and innocent subjects to control

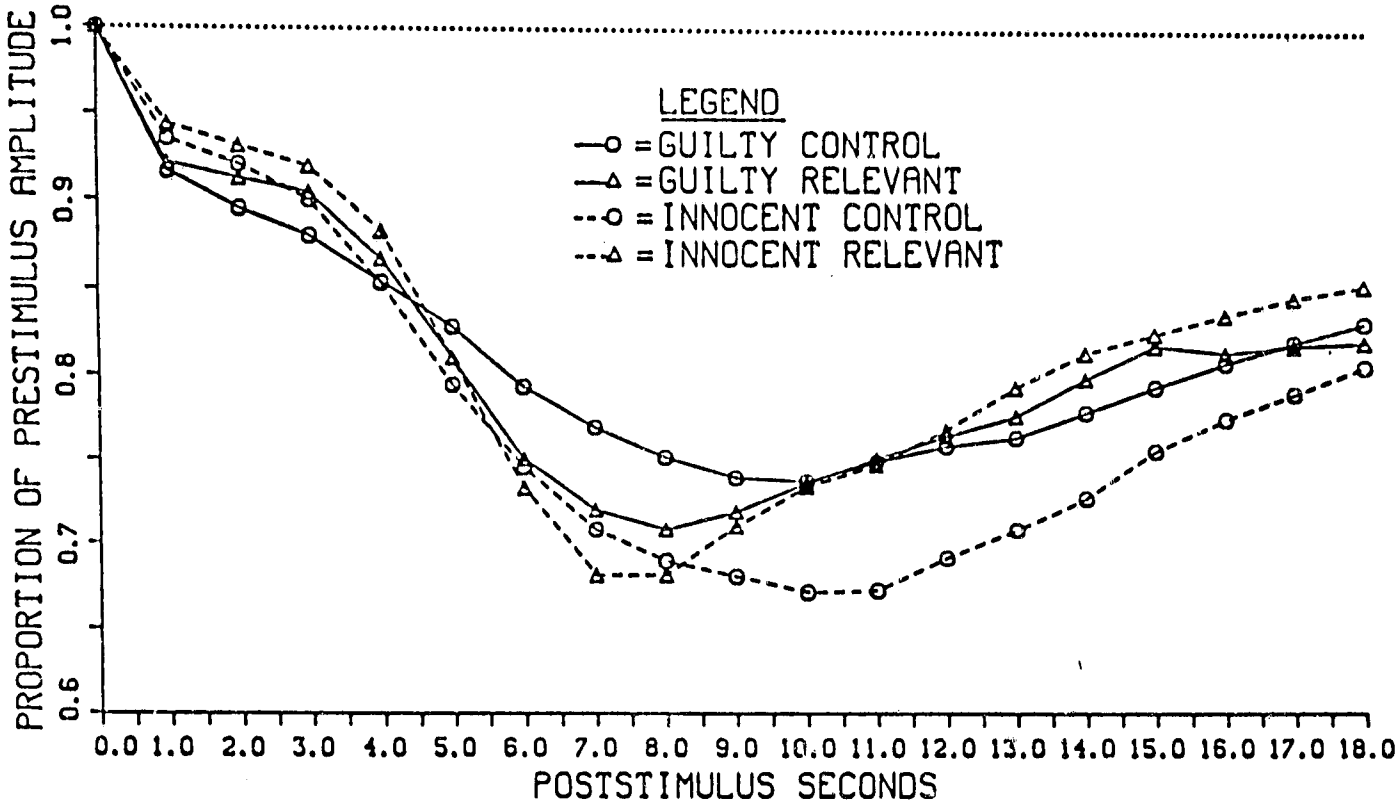

Figure 7. Mean Finger Pulse Amplitude Responses of Guilty and Innocent Subjects to Control and Relevant Questions.

and relevant questions are presented in Figure 8. The Guilt X Question Type X Seconds interaction was significant, $F(17/816) = 4.45$, $MSe = 247.55$. This interaction was due to differential responses of innocent subjects to control and relevant questions. Innocent subjects responded to control questions with a greater decrease in FBV than they did to relevant questions. The FBV response did not significantly discriminate among the three treatment groups.

Thoracic Respiration Amplitude (TRA) and Abdominal Respiration Amplitude (ARA) Responses

Mean difference and mean proportional TRA and ARA responses did not significantly differentiate between guilty and innocent subjects. This was true for the analyses which considered the first five post-stimulus cycles and for the analyses which considered the first post-stimulus cycle following the subjects' answers. There were no significant differences between the three treatment groups for either the TRA or ARA measures.

Thoracic Respiration Cycle Time (TRCT) and Abdominal Respiration Cycle Time (ARCT) Responses

Mean difference and mean proportional TRCT and ARCT responses did not significantly differentiate between guilty and innocent subjects for either method of analysis. There were not significant differences between the three treatment groups for either of these measures.

Thoracic Respiration Baseline (TRB) and Abdominal Respiration Baseline (ARB) Responses

Mean TRB respones of guilty and innocent subjects to control

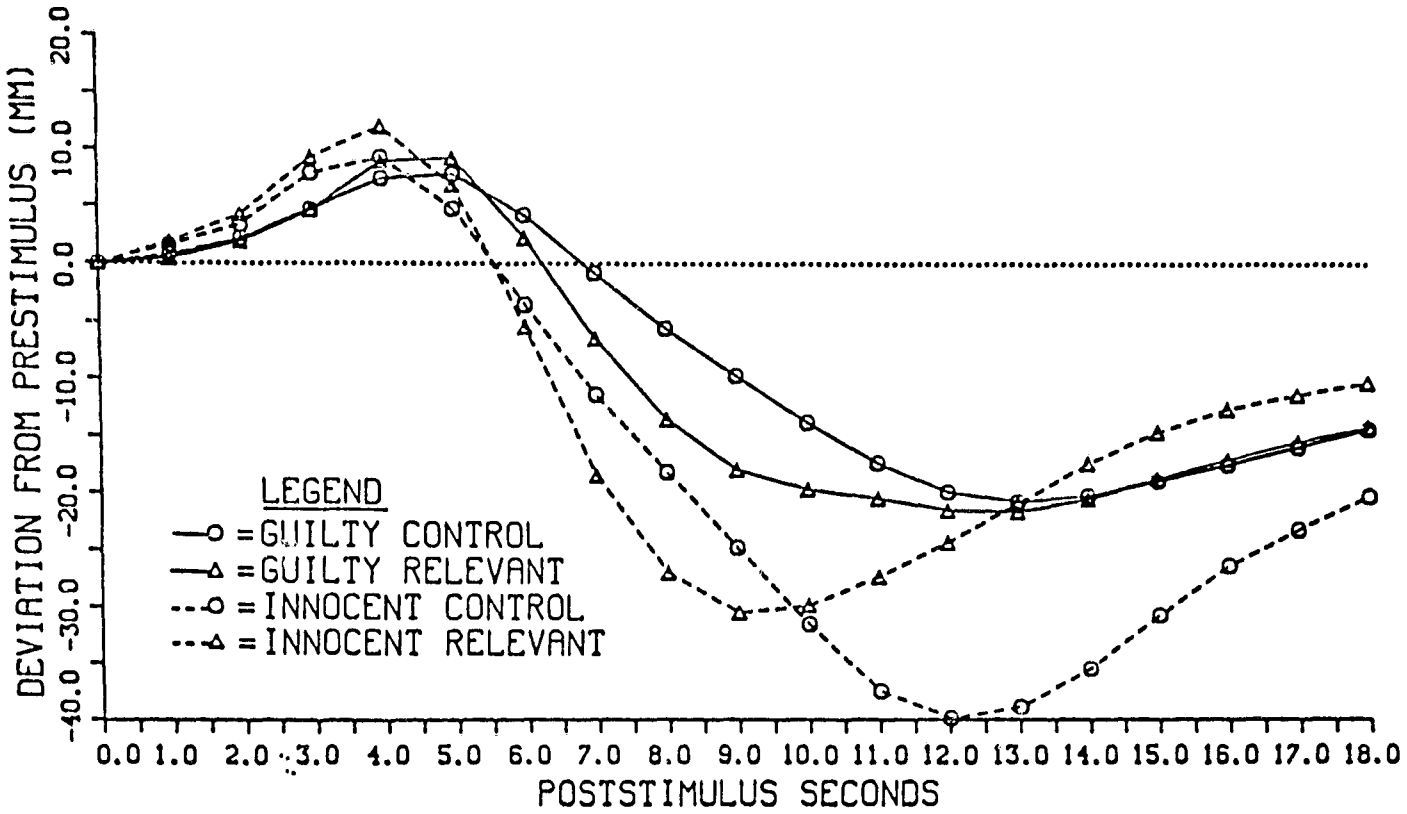

Figure 8. Mean Finger Blood Volume Responses of Guilty and Innocent Subjects to Control and Relevant Questions.

and relevant questions are presented in Figure 9. For the analysis which was performed on the first five poststimulus respiration cycles, the Guilt X Question Type interaction was significant, $F(1/66) = 4.75$, $MS3 = 856.23$. When the prestimulus TRB level was compared to the level of the first complete expiration following the subjects' answer (Barland & Raskin, 1975; Raskin & Hare, 1978) there was also a significant Guilt X Question Type interaction, $F(1/66) = 5.54$, $MSe = 257.94$. In both analyses the TRB increased when innocent subjects responded to control questions and decreased when they responded to relevant questions. The TRBs of guilty subjects increased to both relevant and control questions; the mean increase was greater in response to relevant than to control questions.

Mean ARB responses of guilty and innocent subjects to control and relevant questions are presented in Table 5. The analysis involving the first five poststimulus respiration cycles failed to significantly discriminate between guilty and innocent subjects. However, when the mean baseline levels of the prestimulus cycle and the first poststimulus expiration following the subjects' answers were compared (Barland & Raskin, 1975; Raskin & Hare, 1978) the Guilt X Question Type interaction was significant, $F(1/66) = 4.83$, $MSe = 345.89$. Innocent subjects produced an increase in ARB in response to control questions, and a decrease in response to relevant questions. The ARB of guilty subjects decreased below the prestimulus level in response to both relevant and control questions. There were no significant differences among the three treatment groups for either the TRB or ARB measures.

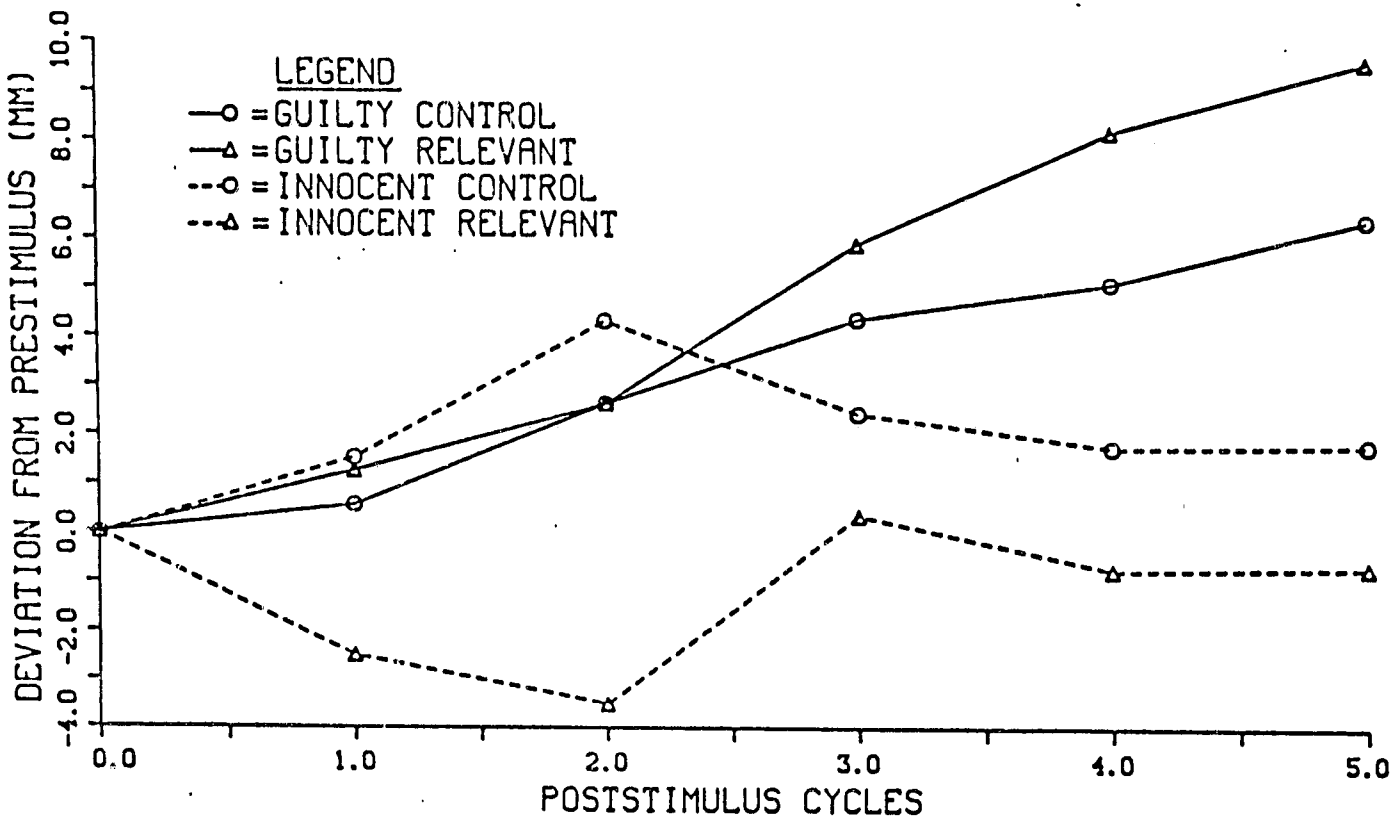

Figure 9. Mean Thoracic Respiration Baseline Responses of Guilty and Innocent Subjects to Control and Relevant Questions.

Table 5

Mean Abdominal Respiration Baseline Response (mm)

for Guilty and Innocent Subjects

	5 Poststimulus Cycles		Cycle Following Answer	
	Control	Relevant	Control	Relevant
Guilty	-0.7	-2.0	-2.6	-1.9
Innocent	3.8	-1.2	4.3	-2.8

CAM Systolic (CMS) and Diastolic (CMD) Responses

Mean CMS responses of guilty and innocent subjects to control and relevant questions are shown in Figure 10. The Guilt X Question Type X Seconds interaction was significant, $F(17/816) = 3.83$, $MSe = 1184.61$. Inspection of Figure 10 reveals that this interaction was due to the differential responses of innocent subjects. Those subjects produced a greater decrease in CMS levels to control questions than they did to relevant questions. The CMS measure did not significantly discriminate between the three treatment groups.

Mean CMD responses of guilty and innocent subjects to control and relevant questions are shown in Figure 11. The Guilt X Question Type X Seconds interaction was significant, $F(17/816) = 3.98$, $MSe = 917.51$. This was due to the differential responses of innocent subjects to control and relevant questions. The decrease in CMD levels for innocent subjects was more rapid in response to relevant than control questions, and the return toward baseline levels began earlier for relevant questions. The Guilt X Question Type X Seconds X Treatment interaction was significant, $F(34/816) = 1.60$, $MSe = 917.51$. Further analyses revealed that the Guilt X Question Type X Seconds interaction was significant for the STD group, $F(17/272) = 2.33$, $MSe = 971.53$, and the INFO group, $F(17/272) = 4.12$, $MSe = 881.25$. The CMD pattern of response for innocent subjects in both the STD and INFO groups was similar to the mean response for all innocent subjects i. e., a more rapid decrease and recovery in response to relevant questions. Guilty subjects in the STD and INFO groups produced a more rapid decrease and recovery of CMD levels to control questions

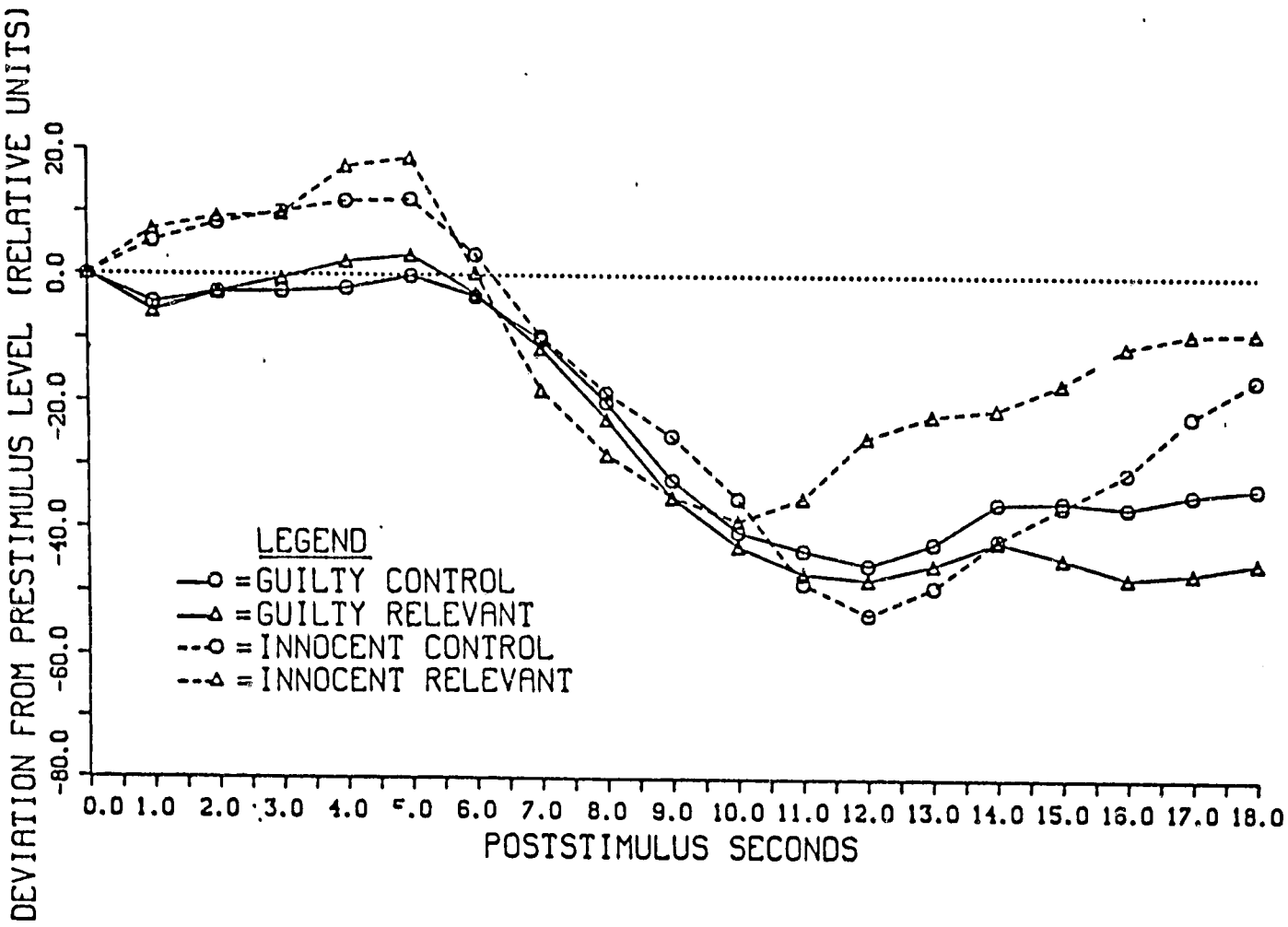

Figure 10. Mean CAM Systolic Responses of Guilty and Innocent Subjects to Control and Relevant Questions.

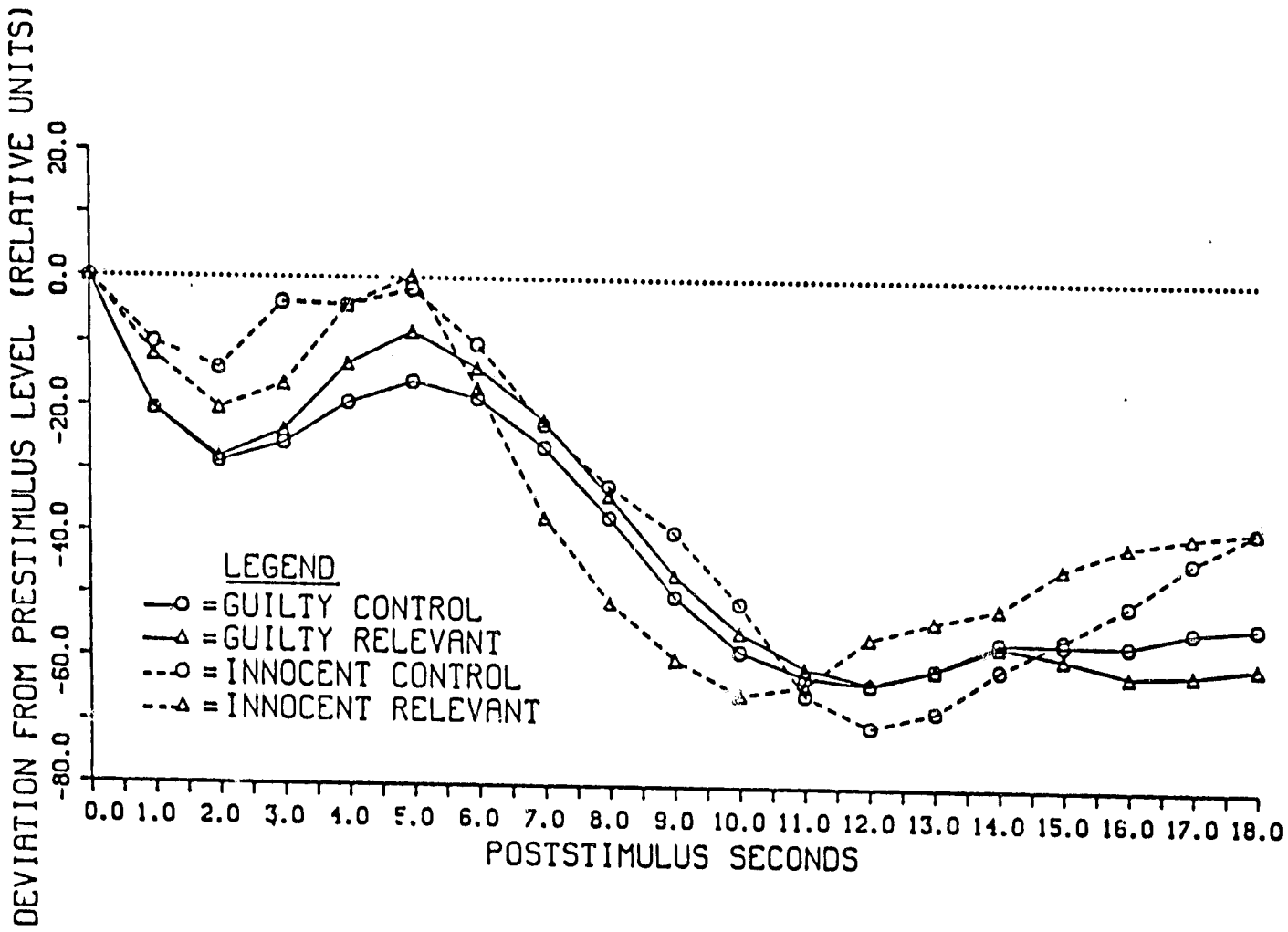

Figure 11. Mean CAM Diastolic Responses of Guilty and Innocent Subjects to Control and Relevant Questions.

than they did to relevant questions. The CMD measure did not significantly discriminate guilty and innocent subjects in the INFO + PRAC group.

It should be noted that the CMD and CMS responses consisted of decreases relative to the prestimulus levels. It would seem that the CAM did not measure relative blood pressure, since increases in relative blood pressure generally occur when innocent subjects answer control questions and when guilty subjects respond to relevant questions.

CAM Pulse Amplitude (CMPA) Response

Mean CMPA responses of guilty and innocent subjects to control and relevant questions are shown in Figure 12. Although this measure did not significantly differentiate guilty and innocent subjects for the entire sample, the Guilt X Question Type X Seconds X Treatment interaction was significant, $F(34/816) = 2.75$, $MSe = 0.013$. Further analyses revealed significant discrimination between innocent and guilty subjects in the STD and INFO + PRAC groups. For the STD group the Guilt X Question Type X Seconds interaction was significant, $F(17/272) = 3.17$, $MSe = 0.01$. For guilty subjects increases in CMPA were greater in response to control questions, and for innocent subjects increases in CMPA were greater in response to relevant questions. The Guilt X Question Type X Seconds interaction was significant for the INFO + PRAC group, $F(17/272) = 1.90$, $MSe = 0.02$. Innocent subjects responded to relevant questions with a greater increase in CMPA, but there was no discrimination between guilty subjects.

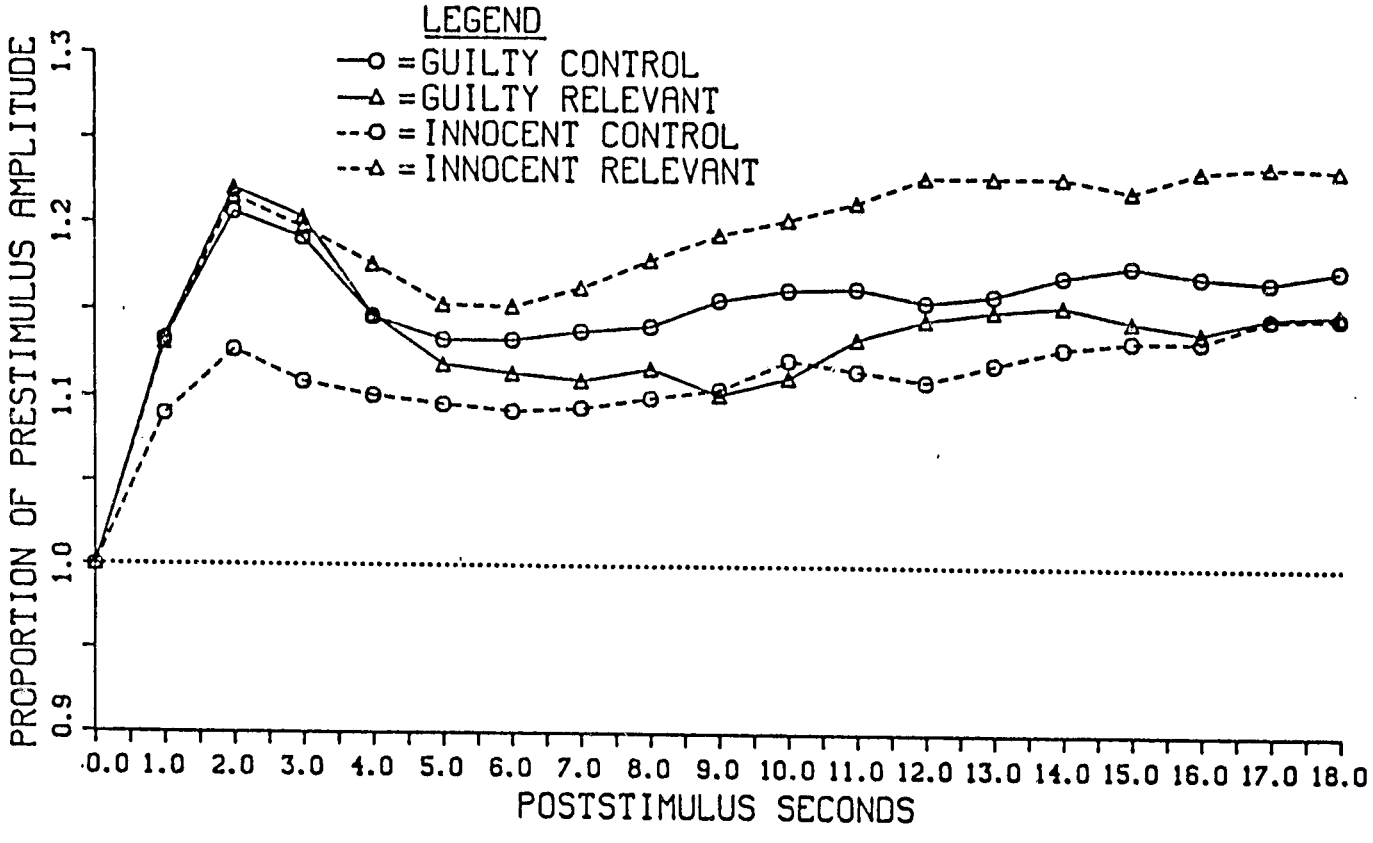

Figure 12. Mean CAM Pulse Amplitude Responses of Guilty and Innocent Subjects to Control and Relevant Questions.

DISCUSSION

The results of this study indicate a high degree of effectiveness of the CQ technique for the detection of deception in a mock crime situation. Blind numerical field scoring with an inconclusive zone resulted in significant identification of guilty and innocent subjects. When the subjects were naive with regard to specific knowledge about the test (STD group), 95.5% were correctly identified as being truthful or deceptive. Even when subjects received detailed information about the CQ test and possible countermeasures (INFO group), the accuracy of decisions was 95.5%. However, when subjects were given two practice polygraph tests with feedback from the experimenter after having received information about the test (INFO + PRAC group), the accuracy of decisions fell to 71%. That manipulation diminished the effectiveness of the CQ technique, although the differentiation of guilty and innocent subjects was still better than chance.

The results of the STD group confirm previous findings that naive subjects in a mock crime situation are highly detectable using the CQ technique (Podlesny & Raskin, 1978; Raskin & Hare, 1978). The present study extends those findings to subjects who are somewhat sophisticated in the CQ technique. Subjects in the INFO group who were given detailed information about the technique and suggestions for countermeasures were detected with the same degree of accuracy

as naive subjects. Although the mean numerical scores of subjects in the INFO group were slightly lower than those of the naive subjects, the difference was not significant.

The 71% accuracy of decisions for the INFO + PRAC treatment group was the most striking effect of the study. Although accuracy of decisions was lower than for the other two groups and the mean numerical scores were the lowest of all three groups, it should be noted that the INFO + PRAC treatment was designed to maximize the effects of information and practice. That is, subjects were tested immediately after receiving their training and practice, and the practice test was almost identical to the subsequent test. It would be expected that a longer time lapse between the treatment and testing would reduce the effect of the treatment, especially in light of the relationship between time lapse and memory decay (Lipton, 1977). Also, any reduction in similarity between the practice and subsequent tests would be expected to reduce the effects. Certainly in a field situation there would be such a period of time between training and testing and such close similarity between the two tests would be very unlikely. However, the existence of such a time function and similarity difference are questions for further research.

In order to generalize the results of a PDD study using a mock crime paradigm, several conditions must be met which approximate factors which are present in the field situation (Podlesny & Raskin, 1977). It is of upmost importance that the mock crime be as realistic as possible so as to involve the subject in the task. The fact that eight potential subjects refused to participate in the study for moral

or ethical reasons may be attributed in part to the religious and social climate in the Salt Lake City community. However, it is also plausible that the paradigm was so realistic that participating in the theft might have conflicted with the moral codes of many individuals.

Threat of punishment and motivation to produce a truthful outcome on the polygraph test are additional features which must be present in a laboratory study in order to enhance its generalizability (Podlesny & Raskin, 1977). The present study used a cash bonus of $10.00 to meet this requirement; the bonus was awarded to subjects who produced a truthful outcome and withheld from those who appeared deceptive. Although motivation to produce a truthful outcome is undoubtedly higher for a subject being tested in an actual criminal investigation, this method of motivating subjects has been used in previous laboratory studies (Davidson, 1968; Podlesny & Raskin, 1978; Raskin & Hare, 1978) and it seems to provide a sufficient impetus for guilty subjects to attempt to alter their physiological reactions in order to "beat the test." Since all subjects in the three treatment groups were offered the bonus it is not likely that the diminished rate of accurate decisions for the INFO + PRAC group was due to a differential level of motivation of the subjects in that group. However, the exceedingly more serious nature of the consequences of being detected in deception concerning a real crime committed by a criminal suspect might be expected to mitigate any benefits of the treatment administered to the INFO + PRAC subjects in this experiment. The results of this experiment probably represent an upper limit of

the effectiveness of such procedures, and effects of such procedures in the real-life criminal situation would be expected to be lower.

A further factor involved in the decrease in accuracy regarding the INFO + PRAC group was feedback during the training session. After each of the two practice polygraph exams subjects were given the opportunity to examine their charts and to ask questions of the examiner. It was this feedback which allowed them to gauge the effects of countermeasures that they were using. Since it has been shown that merely having undergone previous polygraph tests does not significantly affect an examiner's accuracy (Barland, 1975), it is not likely that simply having experienced the practice tests led to decreased accuracy in this study. Since detailed information about PDD techniques and countermeasures was ineffective in decreasing the accuracy of decisions in the INFO group, it seems likely that the combination of detailed information and feedback in a structured practice situation was responsible for the performance of subjects in the INFO + PRAC group.

Although all three of the guilty subjects who produced truthful outcomes reported using countermeasures, it is unlikely that these techniques alone were responsible for the false negatives, or that any single countermeasure or particular combination of countermeasures increased these subjects' probabilities of producing a truthful outcome. Two of those subjects employed two countermeasures and one used three techniques, but there was no common countermeasure employed by all of them. Furthermore, the countermeasures used by these subjects were among the most common techniques reported by other subjects

in the study, and the other 22 guilty subjects who used countermeasures were unable to produce truthful outcomes.

In a field situation it is conceivable that false positives or false negatives may be more likely to occur in subjects who have undergone training and practice procedures similar to those in the present study. However, there are practical considerations which might preclude a subject from receiving that training. First, the innocent subject is not likely to seek information on how to beat the test. Furthermore, innocent subjects are more likely to experience false positive outcomes as the result of training and thus it would be counter to their best interests to engage in that training. Second, although the guilty subject's probability of producing a false negative outcome may be increased by structured training and practice, that training would require the participation of a competent polygraph examiner and perhaps the subject's attorney. Since such activities would clearly violate the codes of ethics of both the American Polygraph Association (British Columbia, 1976) and the American Bar Association (Pirsig & Kirwin, 1976, p. 640) and might lead to criminal prosecution of those parties, it is unlikely that the participation of examiners and attorneys would be readily available. Nevertheless, it may be advisable for field examiners to include questions in pretest interviews and the polygraph examination to attempt to determine whether a subject has had special training and practice in PDD techniques and countermeasures.

The finding that an inconclusive zone of zero led to the correct identification of more subjects than an inconclusive zone of ±5

should not necessarily indicate that inclusive zones are not useful in the field. Many factors which influence subjects in a PDD situation differ between the laboratory and the field (Barland & Raskin, 1973). Among those factors is the degree of severity of the consequences of producing a deceptive outcome. Although the withholding of a monetary bonus may be important to laboratory subjects, a deceptive outcome during a criminal investigation could lead to prosecution of that subject. For an innocent subject, the threat of the potential consequences (among various other factors) might sometimes lead to a negative score on his polygraph test. Elimination of the inconclusive zone in a field situation could increase the risk of producing a greater number of false positive outcomes. Thus, it would be prudent to continue using an inconclusive zone and to adopt stringent criteria when making decisions based on polygraph examinations.

Continued theoretical attacks on the efficacy of the CQ technique (Lykken, 1974, 1978) were not substantiated. The present results confirm previous findings that innocent subjects respond more strongly to control questions and that guilty subjects respond more strongly to relevant questions (Podlesny & Raskin, 1978, 1979; Raskin, 1978c; Raskin & Hare, 1978). In fact, blind scoring procedures in this study resulted in numerical scores for innocent subjects which were approximately 50% greater in magnitude than the scores of guilty subjects. Objective measurement and analysis of the individual physiological measures generally confirmed these numerical scores. Thus, it would appear that in this experiment control questions were

more effective in identifying innocent subjects than relevant questions were in identifying guilty subjects. Guilty and innocent subjects have also been significantly differentiated in field studies (Bersh, 1969; Raskin et al., 1978) but the scores of innocent subjects in criminal investigations are usually less extreme than those in the present study (Raskin, 1978b).

The extremely high rate of agreement between the decisions and numerical scores of the polygraph examiner and the blind scorer is similar to those found in previous studies (Podlesny & Raskin, 1978; Raskin et al., 1977). It is of interest to note that the polygraph examiner in this study had scored only 25 polygraph charts and had administered only 8 complete hypothetical polygraph examinations prior to this study. Thus, in addition to demonstrating the high degree of reliability of the CQ and numerical scoring techniques, the results indicate that for a person with extensive psychophysiological training these techniques may be learned rather quickly with careful and proper instruction and some supervised practice.

The results with specific physiological measures generally confirmed previous findings. The STD group in the present study provided the best basis for comparison with the results of previous studies. The positive findings with SCR amplitude confirmed previous findings (Podlesny & Raskin, 1978; Raskin & Hare, 1978). Insofar as SCR significantly discriminated between guilty and innocent subjects in all three treatment groups, it was the most valid measure of those employed. However, SCR was not particularly effective in identifying innocent subjects in the INFO + PRAC group.

The HR results, although not statistically significant overall, tended to confirm previous findings (Podlesny & Raskin, 1978; Raskin & Hare, 1978). It appears that the HR measure is useful only in identifying guilty subjects using the CQ technique. As such, it has limited utility.

The results of the cardio measures generally confirmed the only previous study employing a sec-by-sec analysis (Podlesny & Raskin, 1978). Although the cardio measures significantly discriminated between guilty and innocent subjects, they were particularly useful in identifying innocent subjects.

The positive results with FPA confirmed previous findings that naive, guilty subjects can be identified using this measure (Podlesny & Raskin, 1978; Raskin & Hare, 1978). The present study extended those findings by demonstrating that naive innocent subjects may also be identified with the FPA measure. However, when subjects were knowledgeable about the CQ technique (INFO group), the FPA measure was useful only in identifying innocent subjects. The FBV measure was mainly useful in identifying innocent subjects. However, other investigators have found FBV to be useful in identifying guilty subjects as well (Kubis, 1973; Podlesny & Raskin, 1978; Raskin & Hare, 1978).

The results of the respiration measures are particularly interesting. The field evaluations of respiration yielded a significant differentiation between guilty and innocent subjects and were especially useful in identifying innocent subjects. However, the objective quantification of these measures resulted in significant

discrimination of innocent and guilty subjects only with measures of baseline changes. The analyses of respiration amplitudes and cycle times did not yield significant discrimination. These findings are generally consistent with those of Podlesny and Raskin (1978), although they did not employ a respiration baseline measure. Podlesny and Raskin felt that their lack of positive results with those measures may have been due to the generally poor signal quality of their transducer, and that its size and construction made it relatively obtrusive to subjects, thus raising the possibility that those subjects attended more to their breathing than they might have under different circumstances. In the present study the signal quality of the respiration measures was excellent, and the mercury strain gauge transducers were less obtrusive than the pneumatic bellows used in other studies and those which are typically used in the field. It should be noted that previous studies which employed pneumatic tubes as respiration transducers yielded positive results for respiration amplitude and cycle time (Barland & Raskin, 1975; Raskin & Hare, 1978). It may be that that type of respiration transducer is superior to those used in the present study. Using the mercury strain gauge transducer, it may be that the methods of objective quantification employed in this study are not as sensitive to changes in those tracings as field evaluation procedures. Another possible explanation of the various findings is the position of the subject in the chair. The two studies which yielded positive results with respiration amplitude and cycle time (Barland & Raskin, 1975; Raskin & Hare, 1978) employed chairs in which the subjects sat upright without

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1 OF 2

slouching. However, the present study employed a comfortable, upholstered armchair in which many subjects slouched down and leaned their heads back. That body position may have interfered with the respiration responses observed in the earlier studies.

The positive results of the CAM measures in this study may be somewhat misleading. The wet CAM transducer presented many problems to the examiner. Proper placement of the transducer is extremely important, and the examiner often had to reposition the CAM several times in order to obtain acceptable recording. The water in the transducer often leaked, sometimes in the middle of an examination. These difficulties made it impossible to use several records in the analyses. In addition to these physical problems, the CAM recordings resemble those of a vasomotor response rather than a change in blood pressure. Since the CAM was designed as an alternative to the cardio cuff for measuring changes in blood pressure, it would seem not to be a proper substitute. Because of these shortcomings, the wet CAM has limited usefulness in the PDD.

In summary, the CQ technique was again shown to discriminate reliably between innocent and guilty naive subjects with a variety of measures. The same level of accuracy was obtained when subjects were sophisticated with regard to the CQ technique and countermeasures. Similar results have been obtained using the guilty knowledge technique (Lykken, 1960). However, accuracy of decisions decreased somewhat when sophisticated subjects had the opportunity to engage in practice on a polygraph and obtain feedback from an examiner prior to

their examinations. The finding that the use of countermeasures was relatively ineffective in decreasing the rate of accurate decisions contradicts some previous findings (Kubis, 1962). However, those studies were either not replicable (More, 1966) or had serious problems of design and analysis (Corcoran et al., 1978). Although problems of generalizing these results to field situations remain, the results from this laboratory study would seem to justify some cautious generalization to the field situation. It is important that field examiners realize that sophisticated, trained subjects may be more likely than others to produce erroneous outcomes on their tests. Examiners might wish to attempt to determine whether their subjects have received training in PDD techniques.

APPENDIX A

NEWSPAPER ADVERTISEMENT

Men wanted to participate in a psychophysiological experiment at the University of Utah Psychology Department. Earn $7.50 plus a possible $10.00 bonus for 2 hours participation. 581-7590.

APPENDIX B

PRELIMINARY INSTRUCTIONS

Go to Room 703. In that room there is a tape recorder sitting on the desk. Your instructions are on the tape. You must put on the earphones to hear the instructions. It is important that nobody can overhear any of your instructions, so be sure to put on the earphones before pushing the "play" lever. Once you have found the tape recorder <u>you must destroy this paper before listening to your instructions</u>.

APPENDIX C

TAPE RECORDED INSTRUCTIONS

Here is what you are to do. Go to room number 601 in this building. You will find a secretary there. Ask the secretary, "Where is Dr. Mitchell's office?" She will tell you that there is no Dr. Mitchell in this department. Thank her and leave immediately. After you leave, keep watch on Room 601 until the secretary goes out. Don't act suspiciously, and don't let her see you. When she is gone, go into her room. In one of her desk drawers there is a grey metal cash box. Find that cash box as quickly as possible. Inside the cash box is an envelope containing a ring. Take the ring out of the envelope and conceal it on your person. You can hide it in your wallet, in a pocket, in your shoe, or anywhere else on your person. If you are found innocent on the lie detector test you will be paid a bonus of $10. You must return the ring when the lie detector test is over. Be careful not to leave any fingerprints and be sore to dispose of the envelope where it will not be found. Since anyone may walk into Room 601 while you are there, be sure to have an alibi ready in case someone does catch you. You are not, and I repeat <u>not</u>, to tell anyone that you are participating in an experiment. If the secretary returns, and your alibi does not satisfy her, you will be disqualified from taking the lie detector test, and you will not be paid anything.

Before you leave this room, check the time. You have 15 minutes to complete your theft once you leave. Do not return early. If you finish early wait until the full 15 minutes are up. Then return to Room 703, the room you are not in, and wait until an experimenter comes for you.

You will be given a lie detector test by a lie detector expert. He will not know if you are innocent or guilty because half of the subjects in the experiment are control subjects who have not committed the theft. This means that he will have to make his decision entirely on the basis of the lie detector test. You will receive the bonus only if the examiner finds you innocent, so you must actually convince the examiner that you are innocent. If he decides when the test is over that you are guilty, or if he can't decide whether you are guilty or innocent, you will not receive the bonus.

Also, you must not make him suspicious when he is interviewing you during the initial portion of the test. The innocent subjects in this experiment simply leave this floor for 15 minutes. They do not know any details of the theft, such as the room number of what desk drawer the ring was in. They know only that the guilty subjects have gone to a room, taken a ring from an envelope in a cash box after searching a desk, and have concealed it on their person. They don't know anything else. You could easily give yourself away by revealing any other details. So when the lie detector expert asks you questions about any other details of the theft, you must not only deny knowing anything other than that, but you must do so sincerely so that he doesn't become suspicious. If at some point during the

test you think you blew it, don't give up! You may still be able to beat the test, but if you confess you will not even be eligible to receive the $7.50 which is paid for participating in the experiment.

Those are your instructions. You must follow those instructions exactly if you are to be eligle for the $7.50 pay and for the $10 bonus. If you do not wish to participate in this experiment, please inform anyone in Room 706. If you are not entirely sure of what you are to do, push the "stop" lever and rewind the tape by pushing the "rewind" lever. Then push the "play" lever to hear the instructions again. When you are done, push the "stop" lever and close the drawer. Destroy any notes you made before leaving this room. Once you leave this room, you should return in exactly 15 minutes, not sooner and not later. That is all.

Innocent Subjects

Please listen to these instructions carefully and make sure that you understand exactly what you are to do. Replay this tape if necessary. You may make a few notes to help you remember what to do as you carry out these instructions. There are writing materials next to this recorder. However, any notes that you make must be destroyed before you leave this room.

This is a lie detection experiment. Half of the subjects in the experiment are instructed to commit a theft. They are told to go to a room and search a desk until they find a cash box. From that cash box they take an envelope containing a ring. They are instructed to take the ring out of the envelope and conceal it on their person. Then they report back for a lie detector test. If they are found

innocent on the test they are paid a bonus of $10, in addition to the $7.50 which they are paid for participating in the experiment.

You are not one of those subjects. You are not to steal anything. You are an innocent suspect. But you will also receive a $10 bonus, in addition to the $7.50, if you are found innocent on the lie detector test. Therefore, it is in your best interest to be truthful during the test and deny having anything to do with the theft of the ring.

Before you leave this room, check the time. You are to leave this floor for exactly 15 minutes and then return for the lie detector test. Be sure to leave the floor completely. Do not wait around here. Do not return early. Wait until exactly 15 minutes have passed and then return to Room 703, the room you are not in, and wait until an experimenter comes for you.

You will be given a lie detector test by a lie detector expert. He will not know if you are innocent or guilty. This means that he will have to make his decision entirely on the basis of the lie detector test. You will receive the bonus only if the examiner finds you innocent. If he decides when the test is over that you are guilty, or if he tells you that he can't decide whether you are guilty or innocent, you will not be eligible for the bonus.

Those are your instructions. You must follow those instructions exactly if you are to be eligible for the $7.50 pay and for the $10 bonus. If you do not wish to participate in this experiment, please inform anyone in Room 706. Ifyou are not entirely sure of what you are to do, push the "stop" lever and rewind the tape by pushing the

"rewind" lever. Then push the "play" lever to hear the instructions again. When you are done, push the "stop" lever and close the drawer. Destroy any notes you make before leaving this room. Once you leave this room, you should return in exactly 15 minutes, not sooner and not later. That is all.

APPENDIX D

EXPLANATION OF POLYGRAPH TECHNIQUES AND COUNTERMEASURES

You are about to be given a test to determine whether you were involved in the theft of a ring from an office in the Behavioral Sciences Building. In this test you will be asked a number of questions while attached to an instrument called a polygraph, which monitores several physiological systems. The test is commonly known as a "lie detector test" and is based on a number of physiological and psychological principles.

The test itself consists of a series of ten questions, and you will be asked that series of questions at least three times, with a rest between each series. The questions will be the same each time, although they may not be asked in the same order. Of these ten questions, the examiner is really interested in only six. These six questions are arranged in three pairs, and are placed in the series as questions 4 & 5, 6 & 7, and 9 & 10. In each case, the first question of the pair is called a "control question" (questions 4, 6, and 9) and the second is called a "relevant question" (questions 5, 7, and 10).

Relevant questions are specific questions about a given issue. For example, a person suspected of murder might be asked "Did you shoot John Doe on the night of September 27?" These questions pertain

only to matters that are directly related to the crime about which a person is being questioned.

Control questions, on the other hand, are concerned with issues similar in nature to the crime, but which have nothing to do with the crime itself. A control question that might be asked of a murder suspect would be "Before the age of 18 did you ever hurt anyone?"

A person's physiological responses to these pairs of control and relevant questions provide the basis for the examiner's decision. The theory behind this technique is quite simple: a person who is guilty of the crime in question is likely to be far more concerned about the relevant questions, since they deal with the crime of which he is accused. Being caught at a lie about that crime is obviously a more clear and present danger than having the examiner find out about something that may have happened years ago. Besides, the person is not being accused of anything else but the crime in question. Thus, a deceptive answer to a relevant question should bring about a greater physiological response to that question than to its control question pair.

An innocent suspect is not going to lie about the crime. His answers to the relevant questions will be truthful. This person will be more concerned about the control questions for two reasons. First, the person is never really certain that his answer is completely truthful, since the question is not very specific and concerns events that may have happened years ago. Secondly, his character is being called into question; being innocent about the crime in question, he is probably more concerned about others knowing of events in his past

that he would rather keep secret. Thus, an innocent person should have larger physiological responses to the control questions than to the relevant questions.

The person's physiological responses to the questions are recorded on the polygraph. By means of several devices, the responses are monitored and converted into electronic signals which are recorded by pens on a special polygraph paper.

Three major physiological systems are monitored during the test, and the nature of the changes in these systems provides a basis for the examiner's decision. The first of these systems is breathing. When a person lies, his breathing becomes shallower, slower, and less rythmic. A truthful answer is accompanied by either normal breathing or deeper breathing for a short period of time.

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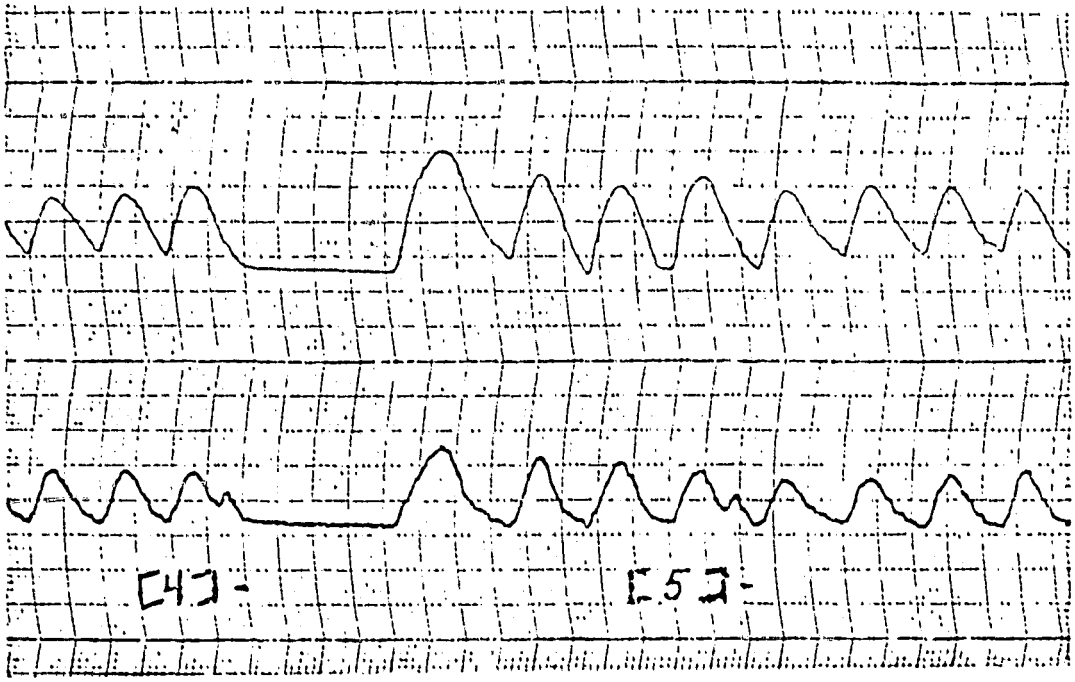

Figure 1 is an example of breathing responses to a control question (4) and a relevant question (5). In this case the subject was lying about the control question or was very concerned about it. As you can see, after he answered that question he actually stopped breathing for several seconds. However, he then answered the relevant question truthfully and his breathing became quite regular. Take a few moments to study Figure 1.

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The second physiological measure is the amount of sweat on the palms and fingers. This measure is generally known as the GSR, or Galvanic Skin Response. When a person lies or is greatly concerned about a question, the sweat glands in his hands become more active, nad this extra activity shows up on the polygraph. A person who is answering a question truthfully, or who is not particularly concerned about the question, will have little or no extra sweat gland activity.

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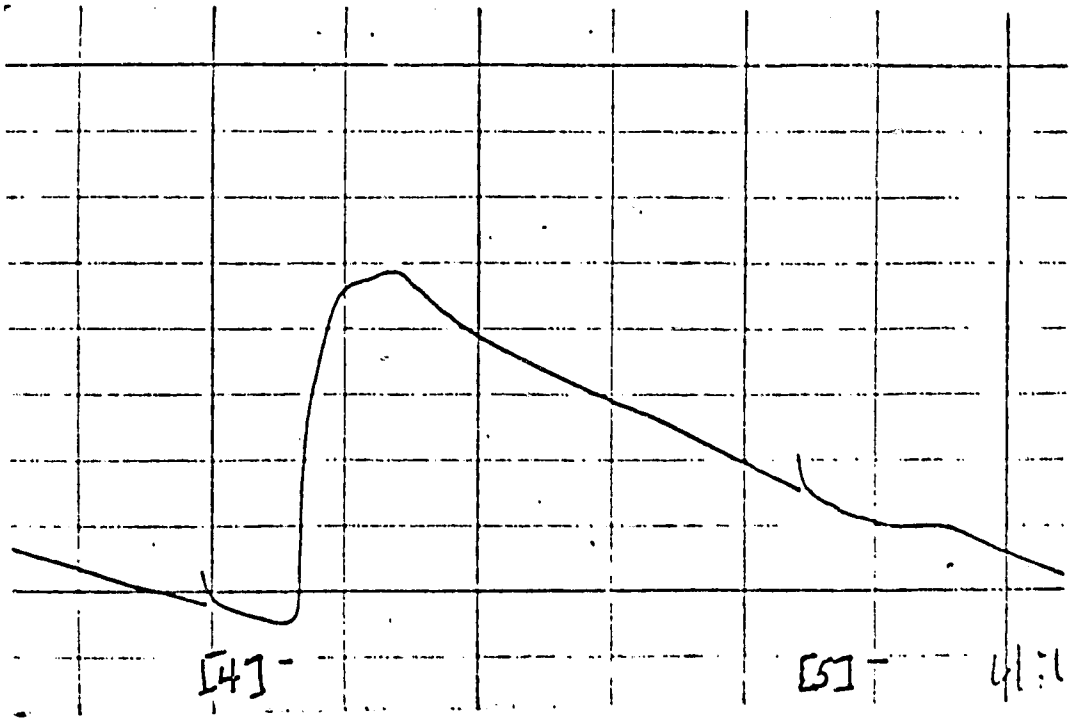

Figure 2 is an example of a GSR. The subject was deceptive about the control question (4) and gave a truthful answer to the relevant question (5). There was a large response when he deceptively answered question (4) but hardly any response to his truthful answer to question (5) the relevant question. Take a few moments to study Figure 2.

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The third physiological response system is the cardiovascular system. Measurement involve the activity of the heart and blood vessels. When a person lies, his heart rate increases for a short time and then decreases far below what it was before the question was asked. It is this sharp slowing of heart rate that differentiates deceptive answers from those which are truthful. An increase in blood pressure is also an indicator of a deceptive response. The final measurement recorded is finger blood volume, or the amount of blood in the vessels of a fingertip. When a person lies, blood vessels near the skin surface constrict, thereby not allowing the normal amount of blood to flow through.

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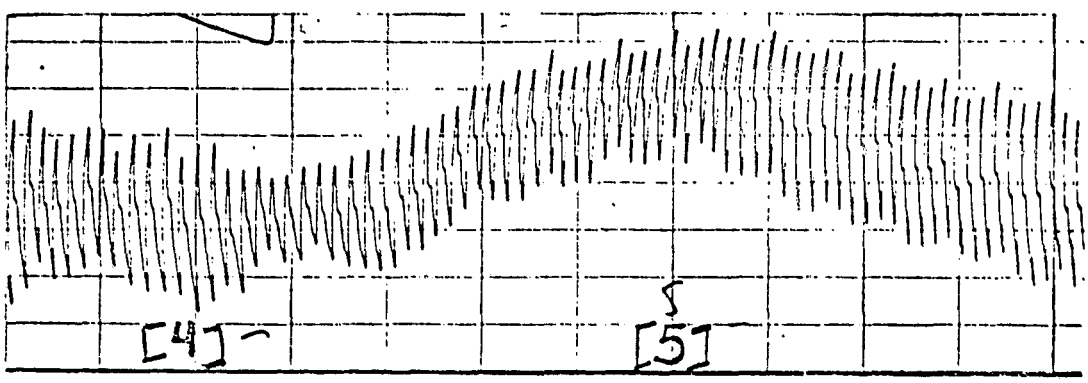

Figure 3 is an example of blood pressure responses. When the person deceptively answered the control question (4), there was a large rise in his blood pressure. But after he truthfully answered the relevant question (5), his blood pressure began to return to normal. Take a few moments to study Figure 3.

Turn to the next page.....

Once again, all of these measures are compared for each pair of control and relevant questions, and each pair is assigned a numerical score. If a person's physiological responses are generally greater to the control questions, the examiner assumes that he is answering the relevant questions truthfully. On the other hand, if his responses are greater to the relevant questions, it is assumed that he has been lying about the crime.

Thus, in order to appear truthful on the test (e.g., innocent of the crime) your physiological responses to the control questions should be relatively large, and there should be no unusually large responses to the relevant questions.

Various methods of attempting to "beat the test" have been used by subjects in the past. These techniques are called "countermeasures." Although no countermeasure is likely to be successfully employed most of the time, it is quite possible that any of them might confuse the examiner and lead to a mistaken decision.

Three of the countermeasures which have been used are mental in nature. The first of these is called "mental dissociation." In this technique the subject ignore the content of the questions and answers them automatically. He may focus his attention on some irrelevant task, like counting the bricks in a wall or the pattern on a carpet.

The second mental countermeasure, known as "rationalization," involves the subject telling himself that the question does not apply to him. For instance, a subject who stole $10 might tell himself that he didn't really steal $10, he took 2 $5 bills.

The third mental countermeasure is the use of stimulating thoughts to produce responses to certain questions. When using this technique, called "exciting imagery," the subject concentrates on thoughts which are erotic, embarrassing, or painful, or otherwise emotionally arousing.

Several countermeasures involve physical activity. Responses may be produced by tensing muscles in some part of the body, but this must be done in such a manner that the examiner cannot see it. Muscular countermeasures include tensing the arm on which the cardio cuff is located, pressing toes against the floor or thighs against the chair, looking cross-eyed, gritting teeth, pressing the tongue against the roof of the mouth, or tensing the anal muscles.

Other physical countermeasures are based on the use of pain to produce responses. Among the pain techniques that have been used are biting one's tongue or lips.

Other subjects have attempted to control their breathing. If this is done properly it can also affect cardiovascular responses. Two of these techniques are 1) breathing very regularly and 2) occasionally taking a deep breath.

Once again, it is important to remember that on a control-question test you will only look truthful (innocent of the crime) if your physiological responses are larger on the control questions than they are on the relevant questions. Thus, if you use countermeasures to produce large responses, they should only occur on the control questions.

Countermeasures are probably used only by guilty subjects who

want to "beat the test." However, they are often very noticeable to the polygraph expert, as they are sometimes easy to distinguish from real responses. If the polygraph expert sees such obvious attempts to beat the test, he is likely to become very suspicious. It would be unwise for an innocent subject to use countermeasures, since it is not to his advantage to try to confuse the examiner. The innocent subject who uses countermeasures runs the risk of producing responses that the examiner may interpret incorrectly, leading to a decision that the subject is being deceptive.

Be sure that you do not, repeat, do not let the polygraph examiner know thatyou have received any of this information.

APPENDIX E

POLYGRAPH EXAMINATION INFORMATION SHEET

Name Date File No.

Address Phone

Requestor: Issue Tested:

Social Security #:

Age: Birthdate: Marital: Children

General Health:

Hospitalization:

Heart and Blood Pressure:

Psychiatric Treatment & Hospitalization:

Medication last 24 hours:

Hours Slept Last Night:

Previous Polygraph Tests:

Education:

Specialized Training:

Employment:

Miscellaneous:

APPENDIX F

QUESTIONNAIRE

1. What do you think the polygraph examiner's decision will be regarding this test?

   Guilty

   Innocent

   He can't tell

2. Did you notice that there were different types of questions in the test?

   Yes

   No

3. Were there control questions and relevant questions in the test?

   Yes

   No

   I don't know

4. If there were control and relevant questions in the test, please list them to the best of your memory.

5. Did you use any particular method(s) to help you come out innocent on the test?

   Yes

   No

6. If you used any method(s) to come out innocent what were they?

7. If you used any methods to come out innocent at which point(s) in the test did you use them?

8. If you used any methods to come out innocent, describe any you think helped to make the examiner think that you were innocent.

9. If you used any methods to come out innocent, describe any you think didn't help to make the examiner think that you were innocent.

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