The Effects of Simple Physical Countermeasures on the Physiological Detection of Deception

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INTRODUCTION

The recording of physiological responses in order to make inferences about the veracity of a person's statements is known as the physiological detection of deception (PDD). PDD, while originally based on the work of research scientists, was developed and put into general use by field practitioners who were, for the most part, members of police or intelligence agencies (Barland & Raskin, 1973; Lykken, 1981). At present the use of PDD techniques has spread to at least 12 countries (Barland & Raskin, 1973) and is an industry of growing social and finanical import in the United States with the number of domestic tests being estimated in the millions (Lykken, 1981). As president of the Society for Psychophysiological Research, Lykken (Note 1) recently described PDD " . . . as by far the most important application of psychophysiology in the real world".

With the continued growth of the PDD industry, scientists have again taken an interest in PDD. Over the past decade a number of review articles, book chapters, and a book have been published considering the social, moral, ethical, legal, and scientific questions raised by the use of PDD (Barland & Raskin, 1973; Grings & Dawson, 1978; Lykken

1974,1979,1981; Orne, Thackray, & Paskewitz, 1972; Podlesny & Raskin, 1977; and Raskin, 1981). The questions regarding the reliability, validity, and utility of the PDD techniques can clearly and easily be assessed by psychophysiological research.

The remainder of this introduction will be concerned with a description of a specific PDD technique, the control question test (CQT), and a review of the scientific literature regarding its reliability and validity. The CQT is a psychophysiological test designed to make inferences about a person's veracity regarding a single issue based on that individual's differential physiological reactivity to certain questions as is described in the next section. The CQT is the PDD technique that is by far the most commonly used field technique and is the technique that is most likely to have an impact on the legal system in this country (Lykken, 1981; and Raskin 1981). The present review will present the case that the reliability and validity questions regarding the CQT have been substantially resolved (at least in the laboratory situation). Questions regarding the generalization of data from the laboratory to the field will be discussed and finally questions regarding challenges to the validity of the CQT will be addressed. Interest will be specifically centered on the challenge to the validity of

the CQT posed by the use of countermeasures by guilty individuals. If guilty individuals can use countermeasures to lower the validity of the CQT then most of the probative utility of the CQT for the court system of this country is lost. A research project will be described that attempts to resolve this serious challenge to the utility of the CQT.

1.1 THE CONTROL QUESTION TEST

The broad term PDD encompasses a wide range of techniques which have found application in a number of situations. However, the majority of these techniques can be broken down into two basic types. One type tests the individual for guilty information, that is the individual is questioned regarding some information that only the guilty person should have (e.g., that a diamond ring was taken from the body of a murder victim). This technique is usually referred to as the guilty knowledge test (GKT) (Raskin, 1981). The second type of PDD technique tests the individual with direct questions regarding his/her involvement in some act (e.g., Did you stab John Doe?). The most popular form of this type of PDD test in use in the field today is the CQT (Raskin, 1981). Both of these techniques have been subjected to laboratory and field study and both have been reported as being of approximately equal power in separating

deceptive from truthful subjects (Bradley & Janisse, 1981; Podlesny & Raskin, 1978). The CQT has become the technique of choice among field practitioners, and is the technique most likely to be introduced as evidence in a court of law (Abrams, 1977; Lykken, 1981; Raskin, 1981). The overwhelming popularity of the CQT over the GKT in the field can be explained by the fact that the prerequisite conditions for the use of the GKT almost never exist in the field, i. e. it is almost impossible to have enough protected information to formulate a GKT that will be effective in separating guilty from innocent.

The CQT leads to inferences regarding an individual's truth or deception based on a comparison of the individual's physiological reactions while answering relevant and control questions. Traditionally measures are taken of the individual's respiration, electrodermal activity, and cardiovascular functions, although several other measures of autonomic function have been suggested as being potentially productive measures. (Podlesny & Raskin, 1977; 1978). Relevant questions are direct nonambigous questions dealing with the specific issue of concern (e.g., Did you steal the missing test?). The control questions deal with an issue related to the specific issue of concern but are removed in time from the target issue (e.g., During the first 18 years of your life did you ever steal anything of any real value?). An

answer of "No" to the control questions is elicited from the subject by the structure of the pretest interview (Detail regarding the formulation and elicitation of "No" answers to control questions is discussed in Appendix L.). It is assumed that the subject is lying or is at least uncertain about the veracity of his/her denial to the control questions. It is unfortunate that the originator of the CQT, John Reid (1947), referred to this type of question with the term control, as this gives the erroneous impression of the scientific meaning of the term control. The control question is clearly not a control item in the scientific sense, rather it is intended as an active stimulus in the technique and as the most salient stimulus for the innocent individual as is described below.

The expected pattern of responding to the relevant and control questions is one of differential reactivity dependent upon truth telling or attempted deception toward the issue of concern. The guilty individual who is attempting deception with regard to the issue of concern is expected to react with stronger physiological responses to the relevant questions while the innocent individual is expected to react with stronger physiological responses to the control questions. These expectations are based on the following assumptions. Guilty individuals will find the relevant

questions to be stimuli of greater signal strength, that is more threatening to their well being because they know that they are being deceptive regarding the issue of concern and they have something to lose if they are discovered in their deception. For guilty individuals the control questions present little or no threat to their well being and are thus of low signal strength producing either small or no physiological responses. Innocent individuals, on the other hand, will find the control questions to be of greater signal strength, and more threatening to their well being because they know they are being truthful to the relevant questions but they are at least uncertain about the veracity of their answers to the control questions. During the pretest interview all subjects are led to believe that detection of deception to the control questions is at least as serious as deception to the relevant questions (Podlesny & Raskin, 1977; Raskin 1979).

In considering any psychological measurement technique two basic issues must be addressed. These are the issues of reliability and validity. The next two sections will address these two issues with a review of the relevant literature on the CQT.

1.2 THE RELIABILITY OF MEASUREMENT WITH THE CQT

The inter- and intra-rater reliability of examiner decisions has been considered in several laboratory and field studies over the past decade. Table 1, presents the reported inter-rater Pearson product-moment correlations where numerical scoring was used to evaluate CQT charts. (The numerical scoring procedure used in these studies is a semi-objective evaluation technique where scores on a 7 point scale are assigned according to evaulators' judgments of the relative strengths of reaction in each of the dependent measures as they are read from the polygraph chart at each of the relevant/control question pairs. These scores are collapsed across dependent measures and trials and the resultant total score is evaluated against some predetermined criterion in order to determine the outcome of the examination, see Appendix M for detail.) These correlation coefficients represent correlations among the original examiner's total scores and the total scores of one or more blind evaluators who rescored the charts without access to any of the case information except the question pattern.

Table 2, presents reported intra-rater Pearson product-moment correlations. These correlations represent the correlation between the original examiner's semi-objective scoring and a blind rescoring by the same examiner after 6

Table 1

Inter-Rater Correlations Reported in PDD Studies Using Semi-Objective Scoring Procedures

Study	# of Raters	$\underline{r}$
Barland & Raskin (1975)	6	mean $\underline{r}$ = .86 range (.78 - .95)
Barland & Raskin (Note 2)	2	.91
Podlesny & Raskin (1978)	2	.97
Dawson (1980)	2	.94

Table 2

Intra-Rater Correlations Reported in PDD Studies Using Semi-Objective Scoring Procedures

Study	*r*
Barland & Raskin (Note 2)	.92
Dawson (1980)	.97

months (Barland & Raskin, 1975) and after 18 months (Dawson, 1980). As can be seen the evaluation of CQT charts with field numerical scoring techniques yeild results that are quite reliable both between and within raters.

1.3 THE VALIDITY OF THE CONTROL QUESTION TEST

The validity of the CQT has been a topic of heated debate in the scientific literature during the past several years. One major problem in this debate is the lack of clear definition of the data base upon which to make estimates of validity. Field PDD research presents the as yet unresolved problem of verifying ground truth independent of the PDD examination. That is, in the field there is no conclusive way of determining ground truth as to who is actually truthful or deceptive. Of the field studies reported to date all are open to serious criticisms regarding case selection and or the objective criteria chosen as ground truth (Lykken, 1981; Raskin, 1981; Raskin & Podlesny, 1979).

Laboratory research offers a clean solution to the problem of ground truth, but suffers from a potential lack of generalizability to the real world (Lykken, 1979). Lykken (1978, 1979, 1981) has argued that laboratory studies of PDD techniques do not provide an adequate analog of the field PDD situation and are thus practically worthless in assess-

ing the validity of PDD techniques in the real world. Raskin has countered Lykken's arguments by proposing that laboratory studies which provide subjects with a realistic deception situation and some motivation to be successful in beating the test do provide a good analog to the field PDD situation and have good generalizability to the field (Podlesny & Raskin, 1978; Raskin & Podlesny, 1979; Raskin 1981). Podlesny & Raskin (1977) have proposed specific guidelines for laboratory PDD studies which they believe will maximize the potential for generalizability. (For detail of these guidelines see the Method section of this thesis.)

Table 3 presents the results of 5 studies that have utilized the CQT in the laboratory paradigm outlined by Podlesny & Raskin (1978). As can be seen from the data the CQT as used in these laboratory studies provides highly accurate decisions in separating truthful from deceptive subjects, with a tendency to make more false positive errors than false negative errors. Thus, it would seem that the CQT has considerable validity at least in this laboratory paradigm.

The question of the generalizability of these data to the real world situation is still unresolved. One of Lykken's major criticisms of laboratory PDD research concerns the fact that it is not possible in the laboratory to create motivational states that are equivalent to those found in

Table 3

Percent Accuracy of Decisions in Laboratory PDD Studies Using Semi-Objective Scoring Procedures

Study	n	Correct[a]	Incorrect[a]		Inconclusive
			False		
			Positive	Negative	
Barland & Raskin (1975)	72	81	13	6	35
Raskin & Hare (1978)	48	96	5	0	8
Podlesny & Raskin (1978)	60	89	2	9	10
Rovner, Raskin, & Kircher (1979)	24[b]	95	5	0	8
Dawson (1980)	24	91	9	0	4

[a]Calculated excluding inconclusives.

[b]Data represent only criterion innocent and guilty groups, countermeasure treatment groups will be considered later.

the field situation (Lykken, 1981). There is one aspect of laboratory research that tends to provide support for the notion that laboratory data may be generalizable to the field situation. The finding that the high validity of PDD techniques in the laboratory is maintained across a wide range of motivational levels and types would suggest that the change in motivation from the laboratory to the field might not be a critical difference. Evidence can be found in the validity research on both the CQT and GKT concerning the effects of motivational levels and types.

Gustafson & Orne (1963) reported that a complete lack of motivational factors sharply reduced detection rates in GKT examinations, implying that some minimal level of motivation is required for the technique to function. In a parametric study Davidson (1968) has demonstrated that once this minimal level of motivation is crossed adding additional increments of motivation does not improve detection rates in the GKT. Davidson offered as rewards for successfully defeating a GKT (regarding a mock murder) money in varying amounts from $0.50 to $50.00. He reported no differences in the detection frequency of any of his experimental groups. A more recent study reported by Balloun & Holmes (1979) has used a GKT in a laboratory study with a real crime. Subjects in the Balloun & Holmes study were lured into cheating

by two confederates. Subsequent to the cheating episode these subjects were told that there had been reports of cheating on the examination and that this was regarded as a severe honor code violation. All subjects were asked to take a lie detector test and were told that failing the test was grounds for immediate dismissal from the university. Balloun & Holmes reported high detection rates in their study with no tendency for higher false positives rates than in other laboratory PDD studies.

No one as yet has conducted a study of the effects of various levels of motivation on the CQT. Most of the reported CQT studies have used monetary rewards as the motivating factor (Barland & Raskin, 1975; Dawson, 1980; Podlesny & Raskin, 1978; Raskin & Hare, 1978; Rovner, Raskin & Kircher, 1979). Lykken (1979; 1981) has particularly criticized the generalizability of these studies noting that the motivating factor in the real world is more likely to be an escape from punishment than a working for reward. Lykken also notes that the motivational levels encountered in the field are likely to be much higher than those induced in the laboratory. While the effects of heightened motivation on the detection of deception with the CQT are not known there are two possible effects with potentially very different results. First it is possible that heightened motivational

factors would simply serve to raise the general level of arousal of the subject. This increase in general arousal level would effect the signal strength of both the relevant and control questions and should enhance detectability of both truthtellers and deceivers. The second possibility is that the heightened motivation would effect only the relevant questions as they are the ones that deal with the real crime. The result of this effect would be to produce an increase in the number of false positive errors made by CQT examinations. Lykken (1981) clearly believes that the second case is the actual effect of heightened motivation on the CQT.

A recent study by Bradley & Janisse (1981) brings Lykken's (1979; 1981) position into doubt. Threat of severe electric shock was used as the motivating factor for some subjects with no change in the detection or false positive error frequency from those subjects not so threatened. These data, while certainly not conclusive, do suggest that the phenomena being tapped by PDD procedures might not be as sensitive to motivational factors as Lykken (1979; 1981) has suggested. While we cannot yet state with certainty that laboratory studies of the CQT offer good generalizability to the field, let us note Raskin's recent comments on the subject and for now simply accept the point that the CQT is a

valid discriminator of truth and deception in the laboratory.

> It is a generally accepted axiom in science, and in psychology in particular, that our understanding of complex natural phenomena is best attained by subjecting those phenomena to carefully controlled experimentation in the laboratory setting. (Raskin, 1981, p. 15)

1.4 CHALLENGES TO THE VALIDITY AND UTILITY OF THE CQT

Raskin has repeatedly argued that the state of the art in PDD has reached the point where truthful results in a PDD examination merit introduction and strong consideration in providing the reasonable doubt of innocence our courts of law search for (Raskin, 1979, 1981; Podlesny & Raskin, 1977, 1978). However, even assuming generalizability of the high accuracy rates found in laboratory research, the CQT faces one major challenge to the usage prescribed by Raskin. That challenge lies in the possibility that guilty individuals can use countermeasures to beat the test and produce false negative results. The probative value of the CQT is completely lost if such guilty individuals can consistently appear innocent. Lykken (1979) claims that through training in simple physical countermeasures guilty subjects should be able to produce false negative rates in excess of 50%. Anecdotally Lykken reports that an individual with whom he has corresponded has trained inmates in a penitentiary to

beat lie detector tests given in the penitentiary 23 out of 27 times (Lykken, Note 3). While these claims by Lykken are without objective verification they must be considered in evaluating the utility of the CQT in our courts of law. If Lykken is correct in his assertions that the CQT is easily defeated by guilty individuals armed with relatively simple physical countermeasures and some readily available knowledge about the workings of the PDD techniques then the utility of the CQT as a defense tool in our courts of law is practically nil. This issue has been investigated by the scientific community but before reviewing the work that has been done I would like to first describe explicitly the task that must be accomplished by a guilty individual if he/she is to beat the CQT.

As was noted earlier a decision of either truthful or deceptive requires differential responsivity by the subject to the relevant and control questions. That is, the subject must show consistent physiological responses to either the relevant or the control questions but not to both or a lack of response to both. A consistent pattern of responses to both the relevant and control questions or a lack of responses to both relevant and control questions will result in a decision of inconclusive. Thus for the quilty person to appear innocent on a CQT he/she must produce responses to

control questions that are clearly larger than responses to the relevant questions. Simple hyper- or hypo-reactivity will not be sufficient to produce a false negative outcome although either might be sufficient to produce an inconclusive outcome.

At this point it seems reasonable to ask if an inconclusive outcome is a success for the individual who is trying to beat the CQT. In a stipulated court situation where the results of the PDD examination are to be presented regardless of the outcome an inconclusive result is clearly an improvement over a deceptive result for the guilty individual but still he has not gained the benefits of a truthful result. In this situation the guilty individual has gained little and little damage has been done to our legal system. It is just as if the examination had never been conducted. In other applications of the CQT an inconclusive result gains the guilty individual even less. In police and private investigations an inconclusive result means that the investigation continues as before with attention directed toward the subject of the test unaltered by the examination results. If other individuals in the investigation have been cleared by PDD examinations or by other means more attention may be given to the individual who produces an inconclusive result. In summary then it can be seen that at

best an inconclusive result acts as a neutralizer and may in fact direct more attention toward the subject, therefore the real challenge to the probative utility of the CQT lies in the potential for guilty subjects to produce false negative rather than inconclusive results. The next two sections will review the literature from the PDD industry and from the scientific community regarding the use of countermeasures and their effectiveness in beating the CQT.

1.5 POLYGRAPHERS' OPINIONS REGARDING THE EFFECTIVENESS OF COUNTERMEASURES

John Reid, originator of the CQT, head of a major PDD examiner training center, and co-author of a major text on PDD has been quoted as saying that self-induced reactions " . . . are so obvious and unnatural that they are a clear indication of guilt" (quoted in Lykken, 1981, p. 239). Cleve Backster, another prominent polygrapher and head of a major PDD examiner training center, gave a similar opinion but conceded that anyone can produce an inconclusive result by simply failing to sit still during the test. Such behavior would undoubtedly direct suspicion toward the subject but in Backster's system the decision of the examination is based only on the data present in the physiological charts, a result of deceptive is not permitted based on the subject's overt behavior as is allowed in the Reid system

(Backster, Note 4; Reid & Inbau, 1977). Stanley Abrams, a psychologist-polygrapher has commented, "The vast majority of countermeasures ... tend to be quite obvious and easily detected and at most cause only an inconclusive diagnosis." (Abrams, 1977, p. 147).

Another polygrapher, Magiera, (1975) conducted an informal post hoc review of 100 deceptive cases from his case files to determine the frequency of countermeasure usage in the field. He reported that 90% of the subjects in specific issue examinations (the type of PDD technique used was not specified) attempted some form of countermeasure. Magiera goes on to claim that purposeful distortions only helped the polygrapher to evaluate the records. For Magiera an assumption of guilt is clearly associated with any detectable attempt to distort the charts.

In summary, it seems that there is a widely held belief among polygraphers that the following points are true about countermeasures. One, at best (or worst) the use of countermeasures results in an inconclusive result. Two, countermeasures are easily detected by the examiner, both from an observation of the subject's overt behavior and from the physiological charts. Finally, the use of countermeasures, because they are so easily detected are usually counter productive for the guilty individual in that if he/she is

caught using a countermeasure many PDD examiners assume attempted deception regardless of the quality of the physiological data.

1.6 REVIEW OF THE SCIENTIFIC LITERATURE ON COUNTERMEASURES

Barland & Raskin (1973) provide a detailed discussion and review of the scientific literature on countermeasures to that date. The applicability of the pre-1970 research to the CQT is however severely limited by the fact that all the studies to that date used the GKT as their PDD technique rather than the CQT. The general nature of the GKT would seem to make it particularly susceptible to countermeasures; since it does not require differential reactivity to the component questions, a subject who reacts to every item or to no items is likely to be judged truthful. However, despite the limitations of this research it can be of some interest to briefly review some of the pre-1970 findings if for nothing else to provide continuity to the research area.

Kubis (as cited in Barland & Raskin, 1973; and quoted in More, 1966) conducted a countermeasure study where subjects were instructed to tense their feet in a way so as to mislead the examiner as to which number was picked in a numbers test. (The numbers test is a staged version of the GKT where the subject is asked to choose a number, usually between 1

and 10, the subject is then to keep his choice hidden from the examiner and is to deny all foils in the GKT question series presented to determine the number picked.) Kubis' subjects were also instructed to use this physical countermeasure in a way that would not be readily observed by the examiner. Kubis reported a highly significant drop in the correct detection rates for subjects in this muscle tension countermeasure group (10-20% correct) as compared to a no countermeasure control group (75%). These data are, however, brought into question by an exact replication by More (1966) who reported no effect for the same muscle tension countermeasure with identical 95% correct detection rates for the countermeasure and no countermeasure control groups.

A study reported by Lykken also deals with this issue. Lykken (1960) reported a study within which sophisticated subjects (departmental secretaries, medical students, staff psychologists, and psychiatrists) were used as subjects in a study regarding the use of countermeasures against a GKT. Subjects were given detailed instructions about the nature of the GKT and about producing GSR responses (the GSR was the only dependent measure). The subjects in the Lykken study were also allowed to practice producing GSR responses while receiving biofeedback from the instrument they were going to be tested with. Subjects were motivated to beat

the test by being offered a $10.00 reward if they were successful. Despite the facts that subjects had explicit knowledge about the nature of the test, had training and biofeedback in how to produce relevant responses, and were motivated to beat the test by the offer of a monetary reward, Lykken reported 100% correct detection rates in the administered GKT. Unfortunately no post-test manipulation check was reported and so we do not know what countermeasures the subjects used and how consistently they used them.

Since 1972 there have been three countermeaure studies reported that are of interest. One of these studies used biofeedback and hypnosis as countermeasures against a GKT examination. The other two studies are of particular interest as they are concerned with countermeasures directed against CQT examinations. The first of these studies was reported by Corcoran, Lewis, & Garver (1978). Corcoran et al. reported significant effects for the use of biofeedback and auto-hypnosis as countermeasures against a GKT. The Corcoran et al. data are however brought into serious question by a number of conceptual and methodological flaws in his experimental design. Conceptually, Corcoran et al. failed to create a deceptive context as the basis the study. Their subjects were not motivated to deceive in any way and the issues of the GKTs that were conducted were trivial.

Methodologically, the Corcoran et al. study suffers from subject assignment problems. Subjects in the biofeedback condition were assigned to that condition on the basis of being most readily detected in a pretest examination. The finding that these subjects were less easily detected on later GKTs may simply reflect a regression to the mean as a result of chance detection on the pretest. Thus although the thesis of the Corcoran et al. study is interesting the study is so fraught with conceptual and methodological errors that the results must be considered unreliable and invalid.

Two studies have employed countermeasures directed at CQT examinations. Dawson (1980) utilized individuals who had been trained in the Stanislavsky method of acting as subjects. This method of acting requires the individual to use "personal memories of sensory experience in order to recreate emotional states" (Dawson, 1980, p. 9). Dawson instructed his subjects to use their method of acting in an effort to beat a CQT examination. Subjects were motivated to beat the test by being offered a $5.00 bonus if they were successful in producing a false negative outcome. The subjects chosen to be guilty acted out a mock crime fitting the requirements suggested in Podlesny & Raskin (1977) and were then tested by a field PDD examiner using the Backster ver-

sion of the CQT. Excluding inconclusives Dawson reported 100% accuracy of detection of guilty subjects but did report a 9% false positive rate. Dawson commented

> No guilty subject was incorrectly classified as innocent with any of the measures despite the fact that all subjects were motivated to appear innocent and were trained in a technique which theoretically could have helped them appear innocent. (Dawson, 1980, p. 12)

Dawson's study, while interesting does have some weaknesses. First, Dawson does not provide any baseline data to indicate the effectiveness of the Stanislavsky method of acting in producing the physiological changes associated with reaction in PDD examinations. Second, since Dawson does not report a post-test manipulation check, we are unable to determine either when or how consistently the subjects applied their countermeasures. The third and final weakness in the Dawson study amplifies the second, Dawson did not provide any information to his subjects about the structure of the CQT. Without the post-test manipulation check we cannot know if the subjects in this experiment applied the countermeasures to the proper reaction zones and it seems likely that many of them probably did not apply their countermeasure in a way that would maximize their potential for beating the test.

The only other study to address the use of countermeasures against a CQT was reported by Rovner, Raskin, &

Kircher (1979). In this laboratory mock crime study the effects of information and information plus practice using physical countermeasures with feedback were explored. Guilty subjects in the information group were given detailed information about the nature of the CQT and the theory underlying its analysis. Subjects in the information plus practice group were given the same information plus suggestions about how to beat the CQT and two practice PDD examinations during which they received feedback about their performance at beating the CQT

The results of the Rovner et al. study are presented in Table 4. From these data it seems that the simple possession of information has little effect on the accuracy of the CQT. This is an important concern as the public becomes more knowledgable of PDD techniques. The information plus practice manipulation while increasing the error rate was reported as statistically not different from the other two conditions. The importance of these errors of classification is decreased even more when you consider the fact that half of the errors involve innocent individuals. It would seem likely that innocent individuals would rarely if ever attempt the use of countermeasures and from the results of the Rovner et al. study it seems clear that it would be counter-productive for them to do so.

Table 4

Percent Accuracy of Decisions in Rovner, Raskin, & Kircher (1979)

Group	n	Correct[a]	Incorrect[a]		Inconclusive
			False Positive	False Negative	
Standard	24	95	5	0	8
Information	24	95	5	0	8
Information plus Practice	24	71	14.5	14.5	12.5

[a]Calculated excluding inconclusives.

The Rovner et al. study makes a fairly strong statement for the robustness of the CQT in the face of information and information plus practice as defined above. There are however two serious shortcomings to the Rovner et al. study. First, while subjects were given suggestions as to possibly effective physical countermeasures (Raskin, 1981) we do not know which if any of the suggested countermeasures were practiced and the level of proficiency obtained in their use. The second shortcoming lies in the fact that no post-test manipulation check was reported. There is no way to know what countermeasures the subjects in the information plus practice group used or how consistently they used them. It is possible that some subjects in the information plus practice group did nothing other than sit there. Thus it is also possible that the three false negative errors reported for this group might represent the only members of that group who used the countermeasures that were suggested to them.

In summary then, it seems that some evidence suggests the CQT's validity to be robust in the face of countermeasures, both mental and physical. The case for this robustness of the CQT must however remain open as the studies reviewed leave the possibility that their manipulations were not properly applied. The next sections will address evidence

from outside the specific area of PDD research to see if it is at all reasonable to expect the most commonly reported physical countermeasures to produce responses that might be mistaken for responses on a PDD examination. Following this review a research project will be described which attempts to bring resolution to the ambiguity left regarding the effects of the use of physical countermeasures on the validity of the CQT.

1.7 A PSYCHOPHYSIOLOGICAL BASIS FOR PHYSICAL COUNTERMEASURES

The physical countermeasures that have most often been discussed as possibly effective against the CQT (Lykken, 1981; Raskin, 1981) can be dichotomized into two broad categories, those which involve self-induced pain (biting the tongue, a tack in the shoe, or digging the fingernails into the palm of the hand) and those which involve the periodic tensing of major muscle groups (pressing the toes against the floor, the thighs against the chair or contracting the anal sphincter). Is there good reason to expect these maneuvers to produce responses that could be mistaken for those associated with lying during a CQT examination (lowering of skin resistance, heart rate change, loss of respiration and pulse amplitude and/or an increase in relative blood pressure)? As described below there is considerable

evidence in the psychophysiological literature that the noted physical countermeasures might produce the very types of reaction expected in a PDD examination.

Research into the physiological reactions to acute pain has shown that acute pain can be expected to produce skin resistance responses (SRR), elevations in blood pressure, peripheral vasoconstriction, (Hardy, Wolff, & Goodell, 1967) increases in heart rate (HR), and loss of respiration amplitude (Velden & Schumaker, 1979; Wolff, 1978). These are the very responses associated with reaction in the scoring of PDD charts, so it does seem reasonable to expect that acute self induced pain might be effective in producing responses that would be effective countermeasures against a CQT examination.

Obrist's (1981) description of the exercise response would lead one to expect the following physiological reactions to acute muscle contraction: an increase in cardiac output (an increase in HR and/or stroke volume), an initial peripheral vasoconstriction , and an increase in blood pressure. In addition, electrodermal responses in the hands and fingers can be expected in response to muscle tension in the ipsilateral foot (Culp & Edelberg, 1966; Edelberg, 1973). Again, we have some indication that the muscular countermeasure maneuvers suggested might be expected to produce

responses that could be mistaken for indices of reaction in the analysis of CQT charts.

These data must serve to increase concern over the results reported by Rovner et al. Without a post-test manipulation check to verify the type and frequency of the countermeasures used one might well conclude that the individuals who succeeded in beating the test were in fact the only ones who applied the countermeasures. This is a very important issue facing PDD and requires empirical resolution. The following chapter describes a research project designed to correct the weaknesses of the Rovner et al. study and to bring some resolution to this issue of the use of physical countermeausres and the validity of the CQT.

Chapter II

A RESEARCH PROJECT

In an effort to provide resolution to the ambiguities of the Rovner et al. (1979) results the following research project was conducted. A population of criterion innocent and guilty individuals was established by having subjects randomly assigned to either participate or not participate in a mock crime following the suggestions for standardization of laboratory PDD research given by Podlesny & Raskin (1977). A four groups between subjects design was implemented with the following group conditions: a criterion innocent group, a criterion guilty group, a criterion guilty group trained in a pain countermeasure, and a criterion guilty group trained in a muscle tension countermeasure. Members of all four groups were motivated to produce truthful results by being offered additional credit points toward their final grades in an Introductory Psychology class. These four equal N groups are described in detail below.

The innocent group consisted of subjects who remained naive to the details of the mock crime. They were given pretest instructions to the effect that if they were completely honest with the examiner they would be reported as truthful.

The guilty control group consisted of subjects who participated in the mock crime and were told that it might be possible for them to beat the lie detector if they tried. These subject were neither provided with information about the nature of the test nor with suggestions about possible countermeasures.

The pain countermeasures group consisted of subjects who participated in the mock crime and who were subsequently given training in the use of a self-inflicted pain countermeasure, biting the tongue. In addition these subjects were given detailed information about the nature of the CQT and were instructed as to when and where to attempt to augment reactions for the greatest possibility of defeating the test. The subjects were also instructed to attempt to relax during the relevant question zones in a effort to minimize reaction there.

The muscle countermeasure group was like the pain countermeasure group except that these subjects were instructed to press their toes against the floor and to tense the muscles in the legs during the control question zones.

This research project was designed to avoid the problems previously discussed in relation to the Rovner et al. (1978) study and to specifically answer the following five questions with the associated statistical analyses of the noted dependent measures.

Question # 1. Can a trained PDD examiner readily detect the use of physical countermeasures by the direct observation of the subject's overt muscular movements, behavior, and appearance coupled with a brief (< five minutes) scanning of the charts? The answer to this question was obtained by requiring the examiner in this study to make a forced yes/no (subjective) decision on the use of countermeasures by each subject within 5 minutes of the termination of the examination. Evaluation of the examiner's performance was made by comparing the examiner's classifications against the chance probability of classifing a subject as using countermeasures. (In this study chance = .46 if the evaluator called all subjects as having used a countermeasure.)

Question # 2. Can the original examiner and/or another trained PDD examiner detect the use of countermeasures from a unlimited analysis of the physiological charts? The answer to this question was obtained by requiring the original examiner to reevaluate the charts two weeks after the completion of the study as to the use of countermeasures on the part of each subject. Again the examiner was required to render a forced choice yes/no decision regarding countermeasure usage, based on the recognition of patterns of response that the examiner would subjectively associate with

deliberate distortions of the charts. In addition, an independent blind evaluator was required to render a purely subjective forced choice yes/no decision regarding the use of countermeasures based solely on the information contained in the physiological data.

Question # 3. Can the high inter-rater reliability scores reported in Table 1 be replicated? The answer to this question was obtained by having the physiological data rescored by an independent evaluator who was completely blind to the study's design and the a priori odds of group assignment. A Pearson product moment correlation was calculated between the total numerical scores obtained by the original examiner and those obtained by the blind reevaluator.

Question # 4. Can the high validity rates for the CQT examination reported in Table 3 be replicated? The answer to this question was obtained by an examination of the accuracy of detection within the various groups and by significance tests of the pairwise comparisons between the innocent and the guilty control group and between the innocent and the combined guilty groups with the individual total semi-objective scores from the PDD analysis serving as the dependent measure. Further resolution of this question was provided by similar pairwise comparisons between groups on each of the objectively reduced physiological measures.

Question # 5. Does the use of physical countermeasures reduce the validity of the CQT? The answer to this question is provided by a comparison of the false negative rates between the guilty control group and the two countermeaures groups. An increase in the inconclusive rate of either of the two countermeasure groups as compared to the guilty control group would also be indicative of some effectiveness of the countermeasures. Statistically the effectiveness of the countermeasures was tested by the pairwise contrasts between the total numerical semi-objective scores of the members of the guilty control group with the total numerical semi-objective scores of the members of the two countermeasures groups and by the same pairwise comparisons of the group by question type interactions in each of the analyses of the objectively reduced physiological measures.

Chapter III

METHOD

3.1 SUBJECTS

The subjects in this experiment were 52 volunteers, 27 female and 25 male, (mean age = 18.8 years) from the spring quarter, 1981, Introductory Psychology classes at Virginia Polytechnic Institute and State University. Subjects received extra credit points toward their final grade as compensation for their participation in this experiment.

Nine of these subjects were eliminated (except as noted) from the statistical analyses for the following reasons: instrument failure resulting in unacceptable tracings during one or more charts (3), confession during the pretest interview (1), and failure to comply with the requirements regarding the use of instructed countermeasures in the countermeasures groups (5) (Members of this subgroup are included in some of the analyses, when this is the case it will be explicitly noted in the captions and/or text.)

3.2 APPARATUS

Subjects' physiological responses were recorded on a four channel Lafayette Datagraph, Model 76102. The instrument was located (concealed from the subject) in an adjacent lab-

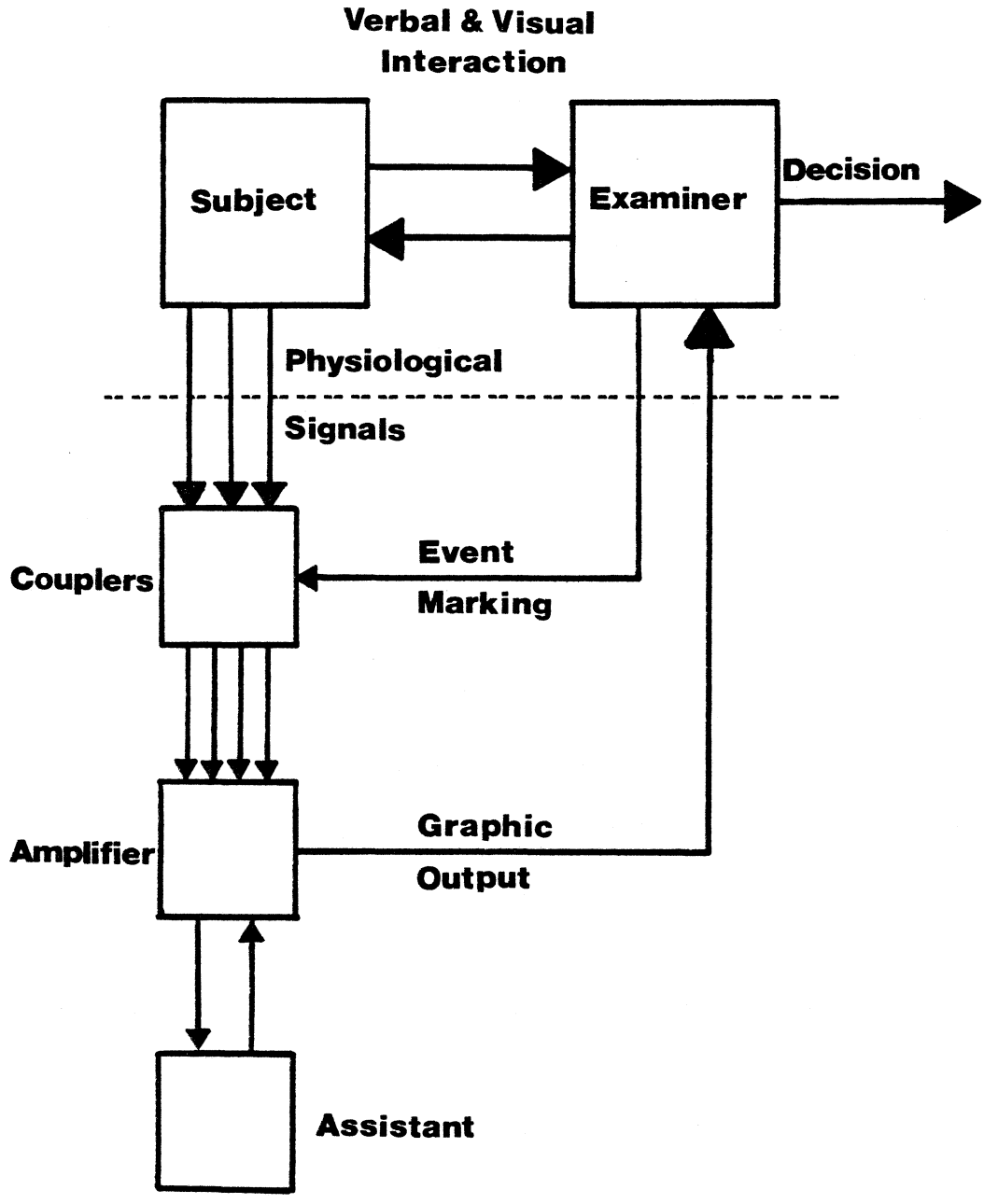

Figure 1. A block diagram of the flow and control of data in this experiment.

oratory and was controlled by an assistant during recording periods. A block diagram of the flow of data in this experiment is presented in Figure 1.

Each subject's respiration was recorded by means of a pneumatic tube placed around the thoracic or abdominal areas, dependent upon which location produced the more acceptable tracing. Respiratory responses were transduced through a Lafayette respiration coupler Model 76607 and were amplified through a Lafayette Model 76405 amplifier set in the AUX mode. No frequency filtering was imposed on the respiratory signal.

Each subject's skin resistance responses (SRR) were recorded by the use of two field quality stainless steel electrodes placed on the distal phalanx of the index and third fingers of the right hand. In accordance with standard field practice no electrolyte medium was used. The SRR coupler/amplifier, a Lafayette Model 76405 employed a constant current (10 microamp) circuit for measuring skin resistance and was run in the BSR mode which does not introduce any time constant filtering, allowing low frequency waves to appear in the writeout. Tracing centering was maintained manually.

Each subject's cardiovasular activity was monitored by the use of a Lafayette reflectance photoplethysmograph

attached to the palmar surface of the right thumb by a velcro band. The output of the plethysmograph was sent to and amplified by a Lafayette Model 76400 coupler/amplifier set in the AUX mode. This amplifier imposed a short time constant on the physiological signal in order to reduce slow wave drift (effectively all waves slower than .2 Hz were filtered from the signal). All physiological signals were recorded on the datagraph's strip chart which was set at a paper speed of 2.5mm/second.

Subjects were seated in a 10' X 10' room in a comfortable chair with arm rests. During the pretest interview the examiner was seated facing the subject as in Figure 2 A. During the collection of the physiological data the examiner was seated out of the direct line of sight of the subject as in Figure 2 B.

All quesions were presented verbally by the examiner in a low monotone voice. The examiner marked question onset, offset and the point of the subject's answer through the use of a remote event marker. The assistant noted any unusal events (e. g. noises, subject talking, sneezing etc.) and all centering and sensitivity changes directly on the chart paper. The examiner maintained question timing with an electronic Texas Instruments chronograph.

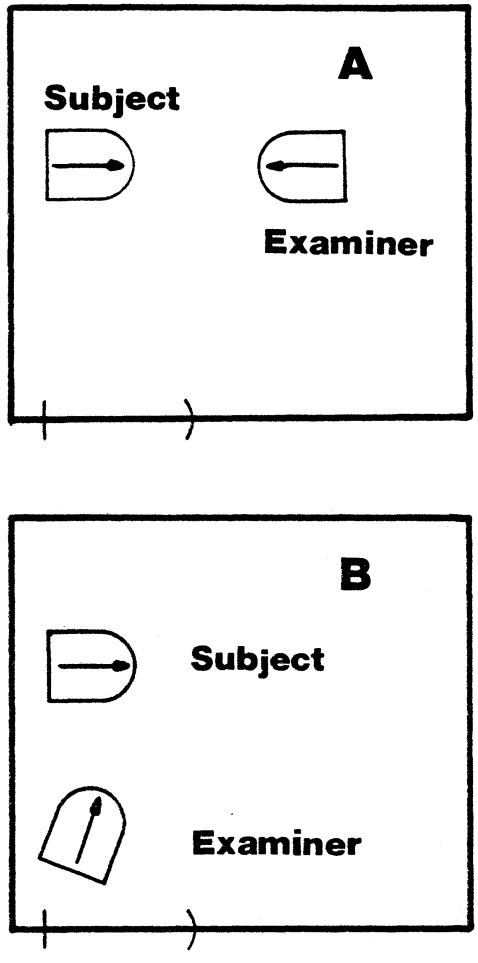

Figure 2. Seating of the subject and examiner during the PDD examination. In A the examiner and subject faced one another during the pretest interview. In B the examiner moved out of the subject's view during question presentation.

3.3 PROCEDURE

This experiment was conducted in two sessions separated by about one week as described below. During the first session, group assignment was accomplished and all training took place. During the second session, the actual PDD examination was conducted.

3.3.1 Session One

Subjects volunteered for this experiment by making an appointment on a signup sheet made available to all Introductory Psychology students at Virginia Tech during the spring quarter of 1981. Upon arriving for Session One, subjects were greeted and were asked to read and sign Consent Form A (Appendix A) by an assistant. Consent Form A served to inform subjects as to their rights to terminate the experiment and gave a brief description of the subject's role in the experiment. Following this the assistant interviewed the subject regarding any relevant health problems using a checklist (Appendix B) as a guide. No subjects were eliminated for health related reasons.

Random assignment of subjects to groups was acheived by having subjects choose an envelope from a shuffled stack of envelopes containing equal numbers of four forms that defined the four experimental groups. As noted in the "Sub-

jects" section, 4 subjects were eliminated from the experiment because of instrument failure and confession. An assistant involved in the experiment in no other way replaced envelopes for these subjects so that a group size balance was maintained at 12 subjects per group.

Once the subject had chosen an envelope from the stack the assistant asked the subject to read and to carry out the instructions contained therein. After carrying out the instructions (which are described in detail below) the subject returned the envelope and the instructions letter to the assistant who checked the group assignment code and assigned an appropriately coded subject number. If the subject was a member of a countermeasures group, training was then given (also described below). Subjects were then assigned an appointment for the PDD examination. All examinations were conducted within at least one week of Session One. Just prior to leaving Session One, all subjects were instructed to not use drugs or alcohol during the 24 hours preceding the PDD examination appointment and to refrain form any vigorous physical activity during the 1 hour immediately preceding the examination appointment.

3.3.2 Group Assignment Instructions From Session One

The one quarter of the subjects assigned to the innocent group received the instruction reproduced as Appendix C. These instructions simply informed the subjects that they were innocent of the crime and instructed them to maintain their innocence during the PDD examination. Innocent subjects were informed of the general nature of the crime but were given no details.

The remaining 36 subjects received the instructions reproduced as Appendix D. These subjects were required to carryout a mock crime, stealing an examination from an office in the Psychology Department. The subjects were instructed to enter this closed office, locate a desk, and then to search this desk for a stack of examinations. When the examinations were located the subject was instructed to hide one copy on his/her person and to then return to the interview room. The subject was cautioned to remain undiscovered througout the crime. When the subject returned to the interview room, he/she was instructed to return the instruction form to the assistant.

The instruction forms that required the subjects to carry out the mock crime were coded in order to provide equal assignment to the three guilty groups, the guilty control group, the pain countermeasures group, and the muscle coun-

termeasures group. When the assistant received a guilty instructions form coded for the guilty control group the subject was simply assigned a number and an appointment time for the PDD examination and was allowed to leave. The assistant responded to any questions the subjects posed but offered no additional information to the members of the guilty control group except to encourage them to try to appear innocent in order to receive the bonus points.

When the assistant received a guilty instructions form coded for the muscle countermeasures group he/she asked the subject to read and sign Consent Form B (Appendix E). Consent Form B again informed the subjects as to their rights regarding participation in the experiment, it also introduced the subjects to the notion of countermeasures and outlined the requirements of their group assignment. When the subject had agreed to continue with the experiment and had signed Consent Form B the assistant then read to the subject the muscle contermeasure instructions (Appendix F). The assistant then demonstrated the proper implementation of the countermeasure and required the subject to demonstrate its use. The assistant coached the subject until the assistant was satisfied the subject knew what was required of him/her and was performing the countermeasure properly. The subject was cautioned not to be discovered using the countermeasure

as discovery would result in an automatic decision of deception and a loss of the extra credit bonus points.

The muscle countermeasure instructions also informed the subjects as to the nature of the CQT. The subjects were specifically instructed to use the countermeasure only on the control questions (which were described to the subject as questions dealing with events earlier in his/her life). The subjects were further instructed to try to remain as calm as possible during the relevant questions in an effort to minimize reaction to them. The assistant emphasized the proper use of the countermeasure instructing the subject to apply muscular tension both during the presentation of the question and following his/her answer. The assistant answered any questions the subject might have had in detail and when the assistant was sure the subject knew when and how to use the countermeasure the subject was assigned a number and was given a PDD examination time.

When the assistant received a guilty instructions form coded for the pain countermeasure group the assistant asked the subject to read and sign Consent Form C (Appendix G). Consent Form C served the same function for the pain countermeasure group as Consent Form B did for the muscle countermeasure group. The countermeasure for this group consisted of biting the tongue during the presentation of the

control questions and following the answer to the control questions. The sequence of events and the information regarding the CQT was exactly the same for the pain countermeasure group as it was for the muscle countermeasure group, except that extra emphasis was placed on the notion that subjects should not inflict enough pain so as to cause injury. The actual instructions read to the pain countermeasures group subjects are reproduced as Appendix H.

All subjects were motivated to produce truthful examination outcomes by being offered two additional extra credit points for such outcomes. These subjects were allowed to obtain up to ten extra credit points toward their final grade in the Introductory Psychology class so the two bonus points offered in this experiment represented one fifth of the possible points they could potentially collect.

3.3.3 Session Two, The PDD Examination

A single examiner[1] conducted all of the PDD examinations in this experiment. This examiner was trained in field PDD techniques at the Backster School of Lie Detection, San Diego, California. The examiner held a current Polygraph Examiner's license in the Commonwealth of Virginia and had five years of field experience having conducted in excess of

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[1]Charles Honts served as the examiner.

3000 examinations. The examiner remained blind to each subject's group assignment throughout the experiment. The examiner was however aware of the proportional number of innocent and guilty subjects he would be testing and was also aware that some subjects would be attempting to beat the test with muscular and self-inflicted pain countermeasures.

When the subject arrived at the appointment for the PDD examination, he/she was greeted by the examiner and was seated in the examination room. The subject's appointment was verified and biographical data from each subject were recorded on the Subject Record Form (Appendix I). Subjects were informed that this experiment was designed to verify the validity of popular, field, lie detection techniques. The examiner then conducted a pretest interview with the subject. This pretest interview was designed to impress upon the subject the power of the PDD technique and the expertise of the administering examiner. The subject was shown the examiner's license and was informed that the examiner was a field PDD examiner of considerable experience in criminal testing. The subject was told that all questions would be reviewed in advance and was also encouraged to ask questions at any time. The relevant questions were reviewed first, followed by a review of the irrelevant questions.

Next the control questions were formulated in an interaction with the subject and an effort was made to impress upon the subject the importance of the control questions. Toward that end the subject was led to believe that detection of deception to the control questions is as harmful to the outcome of the test as detection of deception to the relevants (See Appendix J for a stylizied version of the formulation of control questions and comments on control question formulation in the Backster CQT system.). Finally the symptomatic questions were reviewed with the subject and the final version of all questions was recorded on a Backster YOU Phase test form (Appendix K).

Next the instrument and the various transducers were described to the subject and, with his/her permission, they were placed on his/her person. At this point the examiner asked the subject to sit quietly and left the room to supervise the establishment of the physiological tracings. Transducers were repositioned at this time if acceptable tracings were not obtainable. Initial instrument settings were then recorded on the Subject Record Form (Appendix I). When the examiner was satisfied with the quality of the physiological tracings he returned to the examination room and positionsed himself out of the direct visual range of the subject. The subject was instructed to sit as quietly as

possible and to answer all questions with a simple yes or no answer.

The examiner warned the subject that the questions were about to begin, marked the chart, and then presented a question. The examiner marked the chart with the use of a remote event marker and indicated the point of question onset, the point of question offset and the point of answer to the question by the subject. Questions were presented every 30 seconds until the question pattern was completed. The examiner attempted to present each question in a monotone voice of equal intensity.

The question pattern presented to each subject during the first presentation of the PDD question is shown in Figure 3. An additional question, # 15, Are you 21 years of age?, was also reviewed with the subject but was not used unless the charts were disrupted in some way. Disruptions could take the form of major overt body movements or unusual respiratory events (coughs, sneezes, yawns, etc.) on the part of the subject. If the examiner observed an event he believed would disrupt the tracings he inserted question # 15 and resumed the question pattern 30 seconds later. This procedure was used only once each with three subjects in the course of this experiment.

For subject, John Doe, age 21.

Question #13:	Do people call you John?	(Irrelevant)
Question #14:	Are you a student at Virginia Tech?	(Irrelevant)
Question #25:	Do you believe me when I promise you I won't ask a question we haven't gone over?	(Symptomatic)
Question #39	Regarding whether or not you stole the missing test: Do you intend to answer all my questions truthfully?	(Pseudo-Relevant)
Question #46:	During the first 20 years of your life do you ever remember stealing anything of any real value?	(Control)
Question #33:	Did you steal the missing test?	(Relevant)
Question #47:	While you were in high school did you ever cheat on a test?	(Control)
Question #35:	Regarding the test that was reported missing: Did you steal that test?	(Relevant)
Question #26:	Even though I have promised you I would not, are you afraid I'll ask a question we haven't gone over?	(Symptomatic)

Figure 3. The PDD question pattern. This question pattern represents the application of the standard Backster (Note 4) Zone of Comparison (ZOC) examination to the specific issue in this experiment.

Thirty seconds following the presentation of question #26 the examiner marked the chart and told the subject that this portion of the examination was over. The instrument was allowed to record the subject's physiology for at least an additional 30 seconds without the subject's knowledge. At this point the examiner left the subject and briefly inspected the charts to assure they were of acceptable quality. The examiner returned to the examination room and the above procedure was repeated three times so that the subject was exposed to four presentations of the question pattern. The order of the questions was varied systematically in the following manner in an effort to minimize order effects and to prevent the subject from having specific expectations about the presentation of the various questions. The following questions orders were used on the subsequent presentations of the questions:

Presentation # 2: 14,25,39,46,35,47,33,26.

Presentation # 3: 13,25,39,47,33,46,35,26.

Presentation # 4: 14,25,39,47,35,46,33,26.

When the final question pattern had been presented the examiner thanked the subject for his/her participation in the experiment and told him/her that the assistant would be in to inform him/her of the outcome of the examination. The examiner then made a brief scanning (< 5 minutes) of the

charts and formed an initial opinion regarding the subject's truth telling or deception. The examiner also made a forced choice yes/no decision regarding the subject's use of countermeasures based on his observation of the subject's overt behavior during the examination and on the brief scanning of the charts. Both of these examiner decisions were recorded on the Subject Record Form (Appendix I).

The assistant then debriefed the subject using the Subject Debriefing Form (Appendix L) as a guide and recorded the subject's responses. The assistant retrieved stolen examinations, informed the subject as to the outcome of the examination, and assigned experimental credit points at this time as was appropriate. Any questions the subject had regarding the experiment were answered and the subject was allowed to leave.

Subject's charts were coded only with the subject numbers and were filed. The charts were then subjected to a standard field semi-objective scoring analysis by the original examiner the two weeks after the last subject was tested. During this period the original examiner remained blind to individual subjects' group assignments and was not allowed access to his previous decisions. At this time the examiner also made a second forced choice yes/no decision regarding countermeasure usage based only on the information present in the physiological data.

The relevant and control question zones of comparison were photocopied and were sent to a recognized field lie detection expert[2] for a blind evaluation.

3.4 DATA-QUANTIFICATION

3.4.1 Subjective Analyses

The examiner in this experiment was required to make three subjective judgments. First, he was required to make a time limited judgment regarding the truth or deception of each subject with only limited access (< 5 minutes) to the physiological data. These decisions represent a composite subjective judgment on the part of the examiner based on his observation of the subject's overt behavior and on the more salient features of the physiological charts. Second, the examiner was forced to make a subjective judgment regarding each subject's use of countermeasures based on his observation of the subject and on his limited access to the physiological data. This judgment was based on the recognition of overt body movements on the part of the subjects and on the recognition of patterns of response in the physiological data that through experience an examiner comes to associate with deliberate distortions. Third and finally, the examiner made a second subjective judgment regarding the use of

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[2]Cleve Backster of the Backster Research Foundation, San Diego, California served as the blind evaluator.

countermasures based on a unlimited access to the physiological data but without access to previous decisions. The blind evaluator was also required to make this third decision.

3.4.2 Semi-Objective Analyses

The charts in this experiment were scored by two experienced raters using the Backster Spot Analysis Techinque (BSAT) (Note 4), a semi-objective numerical PDD analysis technique. The first rater was the original examiner who conducted the examinations and who remained blind to individual subject's group assignments throughout the scoring process. The second rater was not involved in this project in any other way and was blind to the experimental design as well as to individual subject's group assignments.

The BSAT assigns a numerical score in the range of -3 to +3 inclusive based on the relative strength of reaction to the respective relevant or control questions at each relevant/control locus of comparison for each of the three dependent measures, respiration, SRR, and cardiovascular function. A score of -3 would indicate maximal reaction to the relevant question and no reaction to the control question at that locus of comparsion in that dependent measure. A score of +3 would indicate maximal reaction to the control

question and no reaction to the relevant question at that locus of comparison in that dependent measure. Scores intermediate in this range reflect the examiner's judgments of the relative increments between these two extremes. (Note a detailed description of the BSAT scoring algorithms is provided in Appendix M.) Scores are assigned for each dependent measure independent of the assignment of scores in the other two dependent measures resulting in 24 independent score assignments form the four charts. Following scoring, all scores are summed to arrive at a total score in the range of +/- 48 for each subject. (A total score of +/- 72 is possible for each subject but under the rules of the BSAT scores at 1/3 of the loci of comparison are eliminated before collapsing to obtain the total score. Please see Appendix M for details of the BSAT tabulation procedures.) This total score is used as the decision criterion for the outcome of the examination and is evaluated against an inconclusive region of -16 to +16 inclusive. (The BSAT allows the elimination of 1 chart if it is nonproductive or inconsistent, if only three charts are considered a decision is made against an inconclusive region of -12 to +12 inclusive. Please see Appendix M for details.) Subjects who receive a total score below -16 are reported as deceptive, while subjects with total scores above +16 are reported as

truthful. Subjects with scores between -16 and +16 are reported as inconclusive.

The specific algorithms by which the BSAT assigns numerical scores at each locus of comparison and by which scores are summed are extended and somewhat complicated and are presented in detail in Appendix M. Basically the decision to assign a specific score at a particular locus of comparison is a judgment made on a continuum of the relative strength of reactions to the relevant and control questions at that locus. The location of specific responses on this continuum of relative strength of reaction results from a more or less subjective judgment on the part of the examiner regarding the following dimensions of the dependent measures.

Respiration. The assignment of scores to respiratory responses is based on the recognition of patterns in the breathing cycles of the subject during question presentation and immediately following the point of answer. Response patterns that began more than 5 seconds past the point of answer were not considered. In general decreases in respiration amplitude are considered as indicants of reaction while increases in respiration amplitude are considered relief (reactions classified as relief are considered as indicative of truthtelling to the question that elicited

them, Backster, Note 4). Lack of response is interpreted as lack of reaction in most cases (but see Appendix M for an exception). Judgments of the magnitude of responses in respiration in the BSAT are made by visual inspection rather than by objective measurement. Strength of reaction decisions are based on the relative magnitudes of change and on the number of cycles involved. No specific rules are provided for a comparison across reaction patterns (for example a sustained suppression of respiration amplitude VS a loss of baseline); rather the examiner is required to make a subjective judgment as to the "dramatic nature" of the respective responses (Backster, Note 4).

Electrodermal Activity. The assignment of numerical scores to loci of comparison between skin resistance responses (SRR) is based on the ratio of the measured amplitude of the responses to the relevant and control questions at each locus. Response amplitude is taken as that distance between the largest response that begins after the point of question onset but no later than 5 seconds after the point of answer and an imaginary baseline drawn in to extend the tonic baseline along the path it probably would have taken had the phasic response not occurred (see Figure 22). A ratio of 2 to 1 results in the assignment of a score of +/- 1 (negative scores indicate that the response to the relevant question

was larger). A ratio of 3 to 1 results in a score of +/- 2, a ratio of 4 to 1 results in a score of +/- 3, and ratios of less that 2 to 1 result in a score of 0.

Cardiovascular Measures. Assignment of scores to the loci of comparison in the cardiovascular measures are based on visual judgments of changes in the following parameters of the cardiovascular measure. Decreases in pulse amplitude, slowing of heart rate, changes of the position of the dicrotic notch, and baseline elevations in blood volume are interpreted as indicants of reaction. Lack of change in the above parameters is interpreted as lack of reaction (except as noted in Appendix M). Increases in pulse amplitude, heart rate accelerations and decreases in the tonic blood volume baseline are all interpreted as indicants of relief. (It is important to note that the slow wave changes in blood volume were attenuated by the time constant present in the amplifier of the photoplethysmograph and were thus not available for use in the evaluation of the cardiovascular measure in this experiment). No specific rules are provided for the weighting of these parameters of cardiovascular response, rather the examiner makes a subjective judgment as to their relative strengths.

3.4.3 Objective Analyses

The second analysis consisted of an objective quantification of the various physiological measures. Measures of physiological response were made at each presentation of a relevant and control question across the four charts. The following scores were reduced from the raw charts at each of these 16 points of observation.

Percentage change in respiration amplitude (RA). A difference change in RA was calculated by taking the amplitude, in mm of pen deflection, of the last complete respiratory cycle before the point of question onset and subtracting the amplitude, in mm of pen deflection, of the first complete respiratory cycle following the point of answer. The resultant difference score was then divided by the amplitude, in mm of pen deflection, of the last complete cycle before the point of question onset and multiplied by 100. The product of these calculations is a percentage change score corrected for the wide range of initial amplifier gain settings used in this study. The percentage change score provides an index of each subject's reaction in RA with negative percentage change scores indicating an increase in RA between the period before question onset and the period following the point of answer.

Skin resistance response. The amplitude of the SRR was calculated by measuring the amplitude, in mm of pen deflection, of the largest SRR beginning after the point question onset but before 5 seconds after the point of answer. Amplitude was measured by the standard psychophysiological procedure described by Venables & Christie (1980).

Percentage change in finger pulse amplitude (FPA). A difference score was calculated at each point of observation by taking the average amplitude, in mm of pen deflection, of the complete cycles occurring in a time window of the 5 seconds immediately before the point of question onset and subtracting the average amplitude, in mm of pen deflection, of the complete cycles occuring in a time window consisting of the 10 seconds following the point of answer. The resultant difference score was then divided by the first average amplitude described and the result was multiplied by 100. The product of these calculations is a percentage change score for FPA corrected for the wide range of amplifier gain settings used in this experiment. This percentage change score provides an indication of the change in FPA between the time before the question and after the point of answer, with negative percentage change scores indicating an increase in FPA.

Heart rate (HR). Two objective measures of HR change were calculated as there is some indication in the literature that reaction in HR may consist of a biphasic response consisting of an initial brief deceleration of HR followed by a more extended acceleration of HR (Podlesny & Raskin, 1978). It was felt that the first HR measure described might capture only the acceleratory portion of this biphasic response indicating a greater magnitude of change than might be seen if the entire reaction zone was included as in measure two. The first measure of HR change was a difference score obtained by calculating the average HR for the 4 seconds preceding the point of question onset and subtracting the the average HR from an 8 second window begining 4 seconds after the point of question onset. The second measure of HR change was a difference score obtained by calculating average HR from the four seconds preceding the point of question onset and subtracting the average HR from the 12 seconds following the point of question onset. Positive differences in both HR measures indicate HR decelerations.

Chapter IV

RESULTS

4.1 EVALUATION OF THE SUBJECTIVE JUDGMENTS

4.1.1 Decisions Regarding Countermeasure Useage

Decisions based on an observation of the subject's overt behavior and on a brief (< 5 minute) scan of the charts. Table 5 presents the percentage accuracy of the original examiner's decisions regarding countermeasure usage. These decisions were given immediately following each examination and were subjective judgments based on an observation of the subjects and on limited access to the physiological data. Examiner decisions were judged as correct if they agreed with a subject's debriefing report regarding his/her use of countermeasures during the examination. Those five subjects who failed to employ the countermeasure in which they were trained are included in Table 5, since these five countermeasure subjects did not attempt to use a countermeasure an examiner opinion of "no" regarding countermeasure usage was scored as correct. The post examination debriefing also revealed that three subjects in the guilty control group attempted to use a physical countermeasure (two bit their tongues, the third reported that she tried to 'react' to the control questions) to defeat the test event though they were

Table 5

Correct[a] Subjective Decisions[b] Regarding Countermeasure Usage

Group	n	Original Evaluator		Blind Evaluator
		Observation & Scan	Charts Only	Charts Only
Innocent	12	8/67%	9/75%	11/92%
Guilty	12	11/92%	8/67%	10/83%
Pain Countermeasure	12	4/33%	4/33%	2/17%
Muscle Countermeasure	12	5/42%	5/42%	4/33%
Total	48	28/58%	26/54%	27/56%

[a]Decisions were scored as correct if they agreed with subject's post-examination reports regarding countermeasure usage.

[b]Decisions were based on either an observation of the subject's overt behavior and a brief (<5 minute) scan of the charts or on an analysis of the charts only.

not instructed to do so. For these three subjects an examiner opinion of "yes" regarding countermeasure usage was scored as correct.

The examiner obtained an overall accuracy of 58% correct in his judgments of countermeasure usage as compared to a chance accuracy of 46%, had he said that all subjects were using countermeasures. However, a closer examination of his decision accuracy reveals that his accuracy rate in actually detecting subjects who used a countermeasure is below the chance level of 46% at 41% (9 of 22). It is of further interest to note that all three of the spontaneous countermeasure users were correctly reported as having used countermeasures. If these three subjects are excluded and we look only at the detection of subjects who were trained in and did use a countermeasure we find the examiner's accuracy drops to 32% (6 of 19).

Countermeasure decisions based on an analysis of the charts alone. Table 5 also presents the accuracy of examiner decisions based on a blind evaluation of the charts alone. Decisions regarding the subjects who performed outside the parameters of their assigned groups are scored as in the previous section.

Overall the examiner was able to correctly classify subjects as to countermeasure usage only 54% of the time as

compared to a chance accuracy of 46%. Considering only those subjects who actually attempted the use of a countermeasure the examiner correctly detected countermeasure usage only 36% of the time (8 of 22). Again all three of the spontaneous countermeasure users were correctly classified. Excluding these three subjects and considering only those subjects trained in, and who actually used a countermeasure 26% (5 of 19) were correctly classified.

These results indicate that this examiner was not able to detect countermeasure usage at above chance levels using either observation of the subject's overt behaviors or the physiological charts, or both.

The results of the countermeasure decisions made by the blind rescorer also appear in Table 5. Overall the rescorer was able to correctly classify subjects as to countermeasure usage only 50% of the time as compared to a chance rate of 46%. Considering only those subjects who actually used a countermeasure this rater was correct 14% of the time (3 of 22). None of the spontaneous countermeasure users were correctly classified by the blind rater. Excluding those three subjects and considering only those subjects trained in and who used a countermeasure the blind rescorer was correct 16% of the time.

4.1.2 Subjective Decisions Regarding Subject Veracity

The original examiner's decisions regarding subject veracity based on an observation of the subject's overt behavior and on a brief (< 5 minute) scanning of the charts are presented in Table 6. Overall the examiner was correct 60% of the time, was incorrect 15% of the time and reported 25% of the subjects as inconclusive. Excluding inconclusives, the examiner was correct 81% of the time.

Lykken (1981) has noted that a description of an examiner's performance in this way can be misleading, particularly if the base frequencies of guilty and innocent subjects are not equal. For example, it could be argued that since the examiner knew that 3 out of 4 subjects were deceptive on an a priori basis then he could achieve an accuracy rate of 75% merely by calling all subjects deceptive. To correct for this problem Lykken (1981) has suggested the following procedure for evaluating an examiner's decision accuracy.

> Instead of using total agreement between test and criterion, which may be influenced by factors unrelated to test accuracy, we simply compute the test's performance with the criterion-truthful and the criterion-deceptive subjects separately and then average these two percentages. (Lykken, 1981, pp.76-77)

Applying this procedure to the data in Table 6 we arrive at a Lykken estimate of decision validity of 74% for examiner decisions as compared to a chance estimate of 50%.

Table 6

Subjective Decisions[a] Regarding Subject Veracity

Group	n	Decision		
		Deceptive	Truthful	Inconclusive
Innocent	12	4	6	2
Guilty[b]	12	5(1)	1	3(2)
Pain Countermeasure[b]	12	5(3)	1	3
Muscle Countermeasure[b]	12	7(2)	1	2

[a]Decision based on an observation of the subject's overt behavior during the examination and on a brief (<5 minute) scanning of the physiological charts by the original examiner.

[b]Numbers in parentheses indicate those subjects who did not comply with their group's countermeasure instructions.

The errors made by the examiner in this decision process fall with approximately equal frequency into false positive (4) and false negative errors (3). An examination of the false negative and inconclusive decision frequencies across the three guilty groups failed to reveal any effects of the use of physical countermeasures on the production of false negative or inconclusive outcomes.

4.2 EVALUATION OF THE SEMI-OBJECTIVE MEASURES

4.2.1 Reliability of the Semi-Objective Scoring Procedures

The Pearson product moment correlation calculated between the total semi-objective scores of the original examiner and the total semi-objective scores of the blind evaluator yielded a highly significant inter-rater reliability correlation coefficient, $r = .88$, $p < 0.00001$. In cases where both examiners reached a decision of truthful or deceptive there was a 100% agreement of decisions.

4.2.2 Accuracy of Decisions Based on the Semi-Objective Scores

The total numerical score obtained from each subject's three most productive charts was classified as truthful or deceptive using an inconclusive range of +/- 12 inclusive (see Appendix M for detail). The resultant classification of subjects based on their total scores is presented as

Table 7

Semi-Objective Decisions[a] Regarding Subject Veracity

Group	n	Decision		
		Deceptive	Truthful	Inconclusive
Innocent	12	2	4	6
Guilty[b]	12	6(1)	0	3(2)
Pain Countermeasure	12	5(3)	1	3
Muscle Countermeasure[b]	12	6	0	4(2)

[a]Decisions made using the Backster Spot Analysis Technique (BSAT) (Note 4) and are based on each subject's three most productive charts (see Appendix M).

[b]Numbers in parentheses indicate those subjects who did not comply with their group's countermeasure instructions.

Table 7. Overall, the examiner classified 52% of the subjects correctly, 6% incorrectly and 42% as inconclusive. Excluding inconclusives, the examiner was correct 82% of the time.

Applying the conservative estimate of examiner decision validity described in the previous section we arrive at a Lykken (1981) estimate of examiner decision validity of 81% as compared to a chance expectation of 50%. The errors made consisted of two false positives and one false negative. An examination of the results across the guilty groups failed to reveal any dramatic increase in either the false negative or the inconclusive frequencies in the countermeasure groups. While it is interesting that the one false negative error was in the pain countermeasure group an examination of all individual's total scores shows this subject to be an outlier with respect to the other members of this group.

4.2.3 Statistical Analyses of the Total Numerical Scores

The group mean total numerical scores obtained from all four of each subject's charts are presented in Figure 4. These scores were subjected to a oneway between groups analysis of variance (ANOVA). The overall F ratio between groups was significant F (3, 39) = 3.526, $p < 0.03$. (For the purpose of this and all subsequent statistical analyses

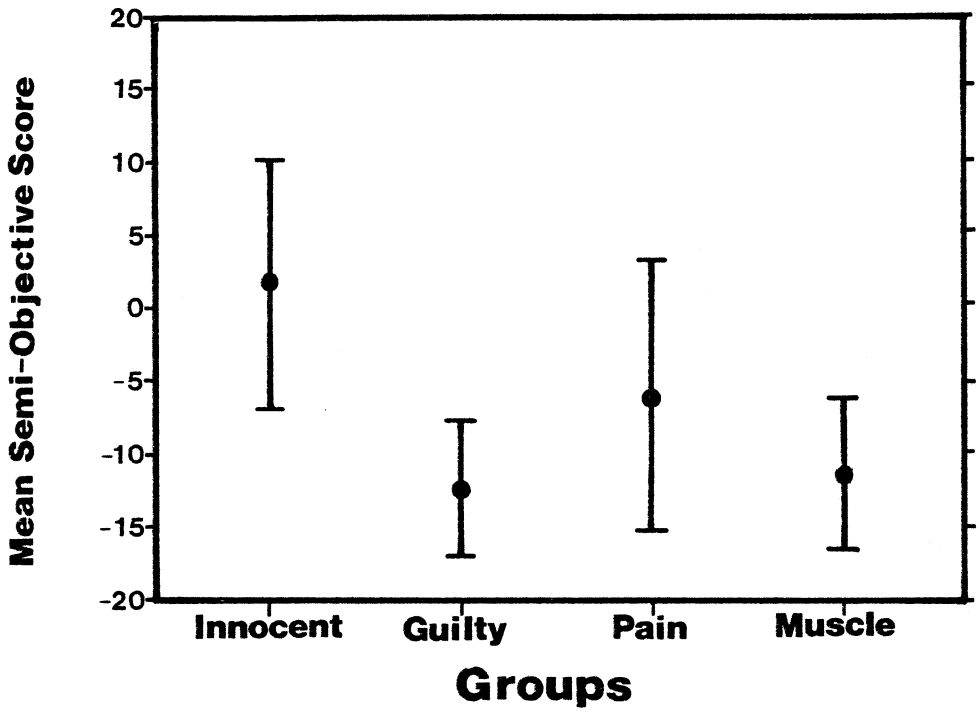

Figure 4. Mean semi-objective scores and 95% confidence intervals across groups.

the five noncompliant countermeasure subjects are excluded unless explicitly noted otherwise.) Pairwise contrasts revealed a significant difference between the innocent and the combined guilty groups t (39) = 2.915, $p < 0.006$ but failed to show any differences between the guilty control group and the countermeasures groups.

Statistical evaluation of the separate dependent measures. Semi-objective score group means for each of the dependent measures are presented in Table 8. A series of Discriminant Analyses (DA) was conducted on these data in order to see if there was sufficient information in the data to separate the four groups, and to see if a more efficient weighting of the dependent measures would produce a more accurate classification of subjects into groups. The initial DA failed to find enough information in the data to produce significant classification into four groups. A subsequent DA between the innocent and the combined guilty groups did produce a significant discriminant function (Wilks' Lambda after the discriminant function = 0.783, Chi squared = 9.663 (3) $p < 0.02$) with the following standardized discriminant function coefficients for each of the respective dependent measures: respiration = 0.30165, SRR = 0.91673, and cardiovascular = (-)0.07269. A third DA conducted between the innocent and the combined guilty groups

Table 8

Group Mean Semi-Objective Scores for Each Dependent Measure

Group	n	Mean Score		
		Respiration	SRR	Cardiovascular
Innocent	12	1.83	0.25	-0.42
Guilty	12	-1.08	-6.42	-4.92
Pain Countermeasure	9	-0.33	-4.00	-1.78
Muscle Countermeasure	10	-1.30	-7.40	-2.80

including the five noncompliant countermeasure subjects also produced a significant discriminant function (Wilks' Lambda after the discriminant function = 0.7768, Chi squared (3) = 11.238, $p < 0.01$) with the following standardized discriminant function coefficients for each of the respective dependent measures: respiration = 0.21846, SRR = 0.89583, cardiovascular = 0.3228. The interpretation of these standarized discriminant function coefficients is equivalent to the interpretation of Beta weights in a regression analysis when the DA is between two groups (Klecka,1975)

The third DA resulted in the classification table presented as Table 9. Overall the DA classified 83.33% of the subjects correctly. The errors made consisted of 7 false positive errors and 1 false negative error. It should be noted that the DA procedure does not use an inconclusive region, it is likely that the error rate would drop dramatically if a narrow inconclusive range was allowed.

Separate between groups ANOVAs were also conducted on the semi-objective scores in each dependent measure. The only measure to show a significant F ratio was the SRR, F (3, 39) = 4.048,, $p < 0.0134$. Likewise the pairwise contrasts revealed that only the SRR showed a significant difference between the innocent and combined guilty groups, t (39) = 3.169, $p < 0.003$. However the respiratory measure

Table 9

Classification Table Generated by the Discriminant Analysis of the Semi-Objective Data

Group	n	Classification	
		Truthful	Deceptive
Innocent	12	5	7
Combined Guilty	36[a]	1	35

[a]Data entered into the discriminant analysis included the 5 non-compliant countermeasure subjects.

approached significance on this contrast, t (39) = 1.897, p < 0.07.

4.3 EVALUATION OF THE OBJECTIVE MEASURES

The physiological data from each of the subject's four charts were quantified using the procedures previously described. An average response was then calculated between the two relevant and control questions on each chart. The data from the four groups were then subjected to a 4 X 2 X 4 repeated measures ANOVA with group membership (4) entered as a between subjects factor and with question type (2) and charts (4) as repeated measures factors.

The differential responding required for the separation of innocent from guilty subjects in the CQT is indicated by significant group X question type interactions. As this is the point of primary interest in this thesis only the tests of this interaction will be reported in this results section (Complete ANOVA tables for each of the separate statistical analyses are reproduced in Appendix N).

To ascertain the specific nature of the potential differences between groups three pairwise contrasts were conducted for each of the objective measures. These contrasts were, innocent VS guilty control, guilty control VS pain countermeasure, and guilty control VS muscle countermeasure. The

results of the overall ANOVAs and the pairwise contrasts are reported in separate sections for each measure.

4.3.1 Respiration Amplitude

The mean percentage change scores in respiration amplitude (RA) to relevant and control questions for each of the four groups are plotted in Figure 5. The overall ANOVA revealed a significant group X question type interaction F (3, 39) = 2.90, $p < .05$. The pairwise contrasts indicated a significant group X question type interaction between the innocent and the guilty control group, F (1, 39) = 8.153, $p < 0.01$. Subjects in the innocent group reacted to the control questions with a loss of RA and to the relevant questions with an increase in RA. Subjects in the guilty control group reacted to the control questions with an increase in RA and to the relevant questions with a loss in RA.

Subjects in the two countermeasures groups reacted to both relevant and control questions with losses in RA. The pairwise contrasts failed to show a significant group X question type interaction effect between the guilty control group and either of the countermeasures groups, although both approached significance (pain countermeasure, F (1, 39) = 3.69, $p < 0.10$, and muscle countermeasure, F (1, 39) = 3.20, $p < 0.10$). An examination of the plotted means in

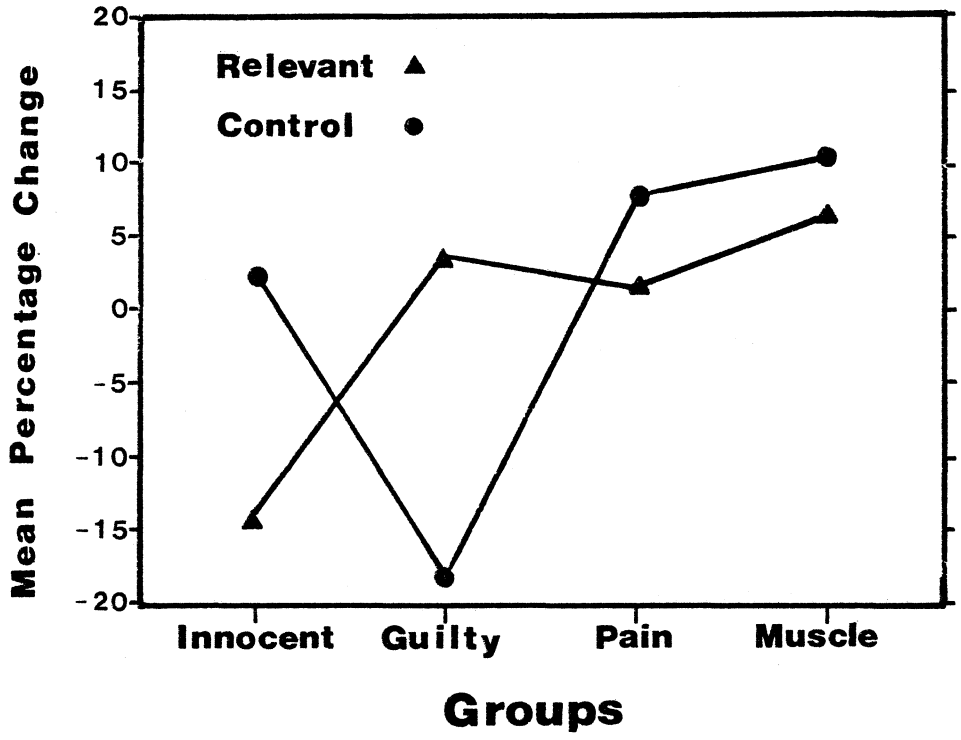

Figure 5. Mean percentage change from baseline in respiration amplitude (RA). Responses to relevant and control questions. Positive change scores indicate a loss of RA.

conjunction with the reported statistics indicates that subjects in the countermeasure groups were able to produce responses to the control questions but were unable to inhibit responses to the relevant questions.

4.3.2 Skin Resistance Response

The mean amplitude of the skin resistance responses (SRR) to control and relevant questions for the subjects in the four groups are plotted in Figure 6. The overall ANOVA revealed a significant group X question type interaction, F (3, 39) = 4.38, $p < .01$. The pairwise contrasts indicated a significant group X question type interaction between the innocent and the guilty control groups, F (1, 39) = 7.616, $p < .01$. Subjects in the innocent group reacted to control questions with larger amplitude SRRs while subjects in the guilty control group reacted to the relevant questions with larger amplitude SRRs.

The pairwise contrasts between the guilty control group and the two countermeasure groups failed to reveal any significant group X question type interaction effects. An inspection of the SRR means indicates that subjects in the countermeasure groups were unable to augment their SRRs to control questions and in fact the mean SRR to control questions by members of the muscle countermeasure groups is of a

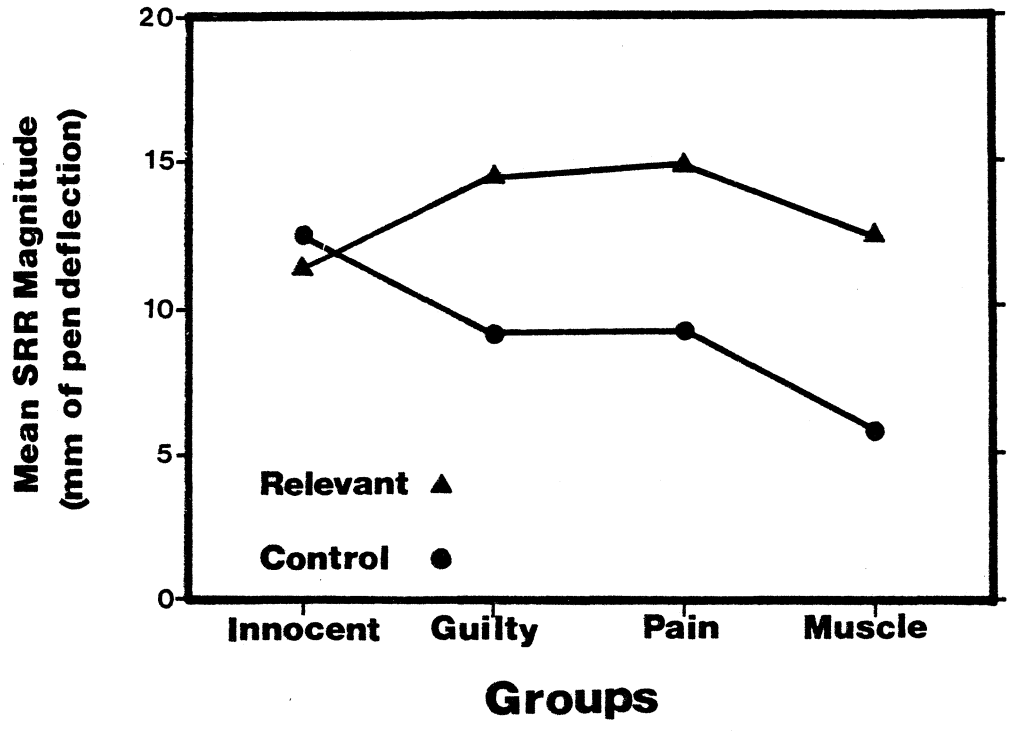

Figure 6. Mean skin resistance responses (SRR) to relevant and control questions across groups.

lower amplitude than for members of the guilty control group.

4.3.3 Finger Pulse Amplitude

The mean percentage change scores in finger pulse amplitude (FPA) to relevant and control questions across the four groups are plotted in Figure 7. The overall ANOVA revealed a significant group X question type interaction, F (3, 39) = 3.40, $p < .027$. The pairwise contrasts indicated a significant group X question type interaction between the innocent and the guilty control group, F (1, 39) = 8.16, $p < 0.01$. Subjects in the innocent group reacted to relevant and control questions with approximately equal mean losses in FPA. Subjects in the guilty control group also reacted to both relevant and control questions with mean losses in FPA but showed a larger magnitude of loss to the relevant questions.

The pairwise contrasts also revealed significant group by question type interaction effects between the guilty control group and the pain countermeasure group, F (1, 39) = 5.239, $p < .04$, and the muscle countermeasure group, F (1, 39) = 5.804, $p < .03$. Members of both countermeasure groups reacted to both relevant and control questions with approximately equal mean losses in FPA.

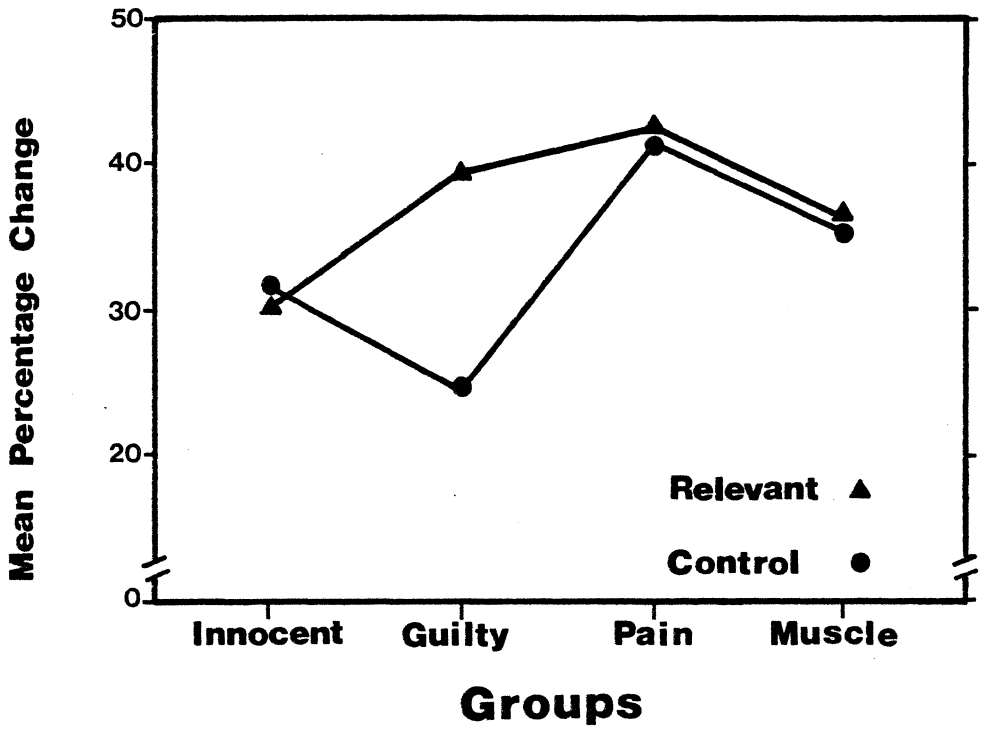

Figure 7. Mean percentage change from baseline in finger pulse amplitude (FPA). Responses to relevant and control questions across groups. Positive change scores indicate a loss of FPA.

4.3.4 Heart Rate

The heart rate difference scores calculated between the base rate and the average HR during the answer only are plotted in Figure 8. The HR difference scores calculated between the base HR and the average HR during question presentation and answer are plotted in Figure 9. The overall ANOVA and the pairwise contrasts failed to reveal any significant group X question type interaction effects for either HR measure.

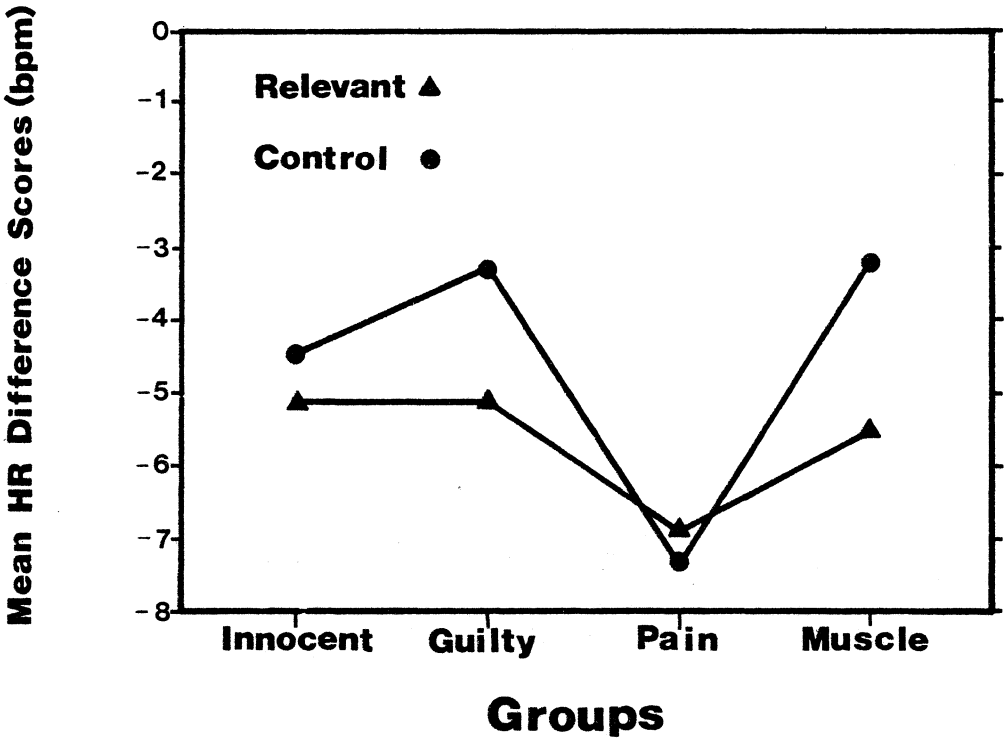

Figure 8. Mean difference scores in heart rate (HR) to relevant and control questions across groups. Difference score calculated between basal HR and the average HR during answer.

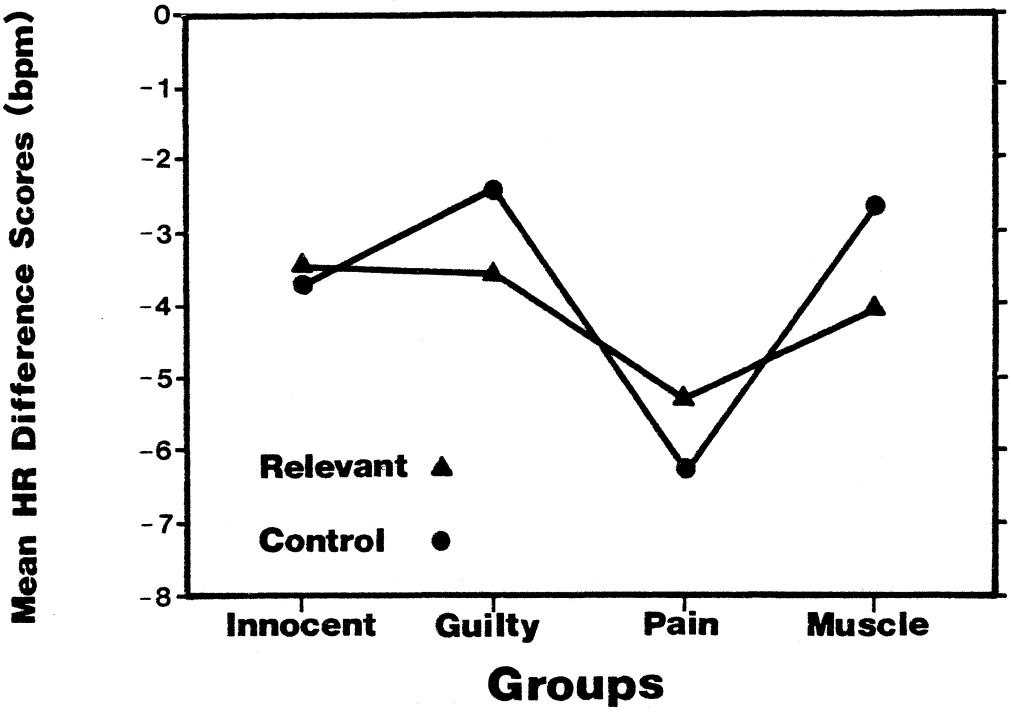

Figure 9. Mean difference scores in heart rate (HR) to relevant and control questions across groups. Difference score calculated between basal HR and the average HR during question presentation and answer.

Chapter V

DISCUSSION

5.1 A SPECIFIC DISCUSSION OF THE POSED QUESTIONS

Five questions were posed in the introduction of this thesis. Evidence was found to support the notions that the CQT is a reliable and valid technique. Little support was provided for polygraphers' claims that countermeasure usage was readily detectable either from an observation of a subject's overt behavior or from a detailed analysis of the physiological data. Some support was found for the robustness of the CQT in the face of countermeasure challenges. The use of physical countermeasures failed to produce any differences in either the error or inconclusive rates across the guilty groups, and also failed to produce any statistically significant effects in the analyses of the semi-objective scores. However, the analyses of the objectively reduced measures indicated the robustness of the technique to lie primarily in one measure, the SRR. Statistically significant effects in one measure, FPA, and nearly significant results in another measure, RA, leaves open the question of potentially effective countermeasure usage. The following sections will consider each of the posed questions in detail followed by a general discussion of the importance

of these results on the development and utilization of PDD techniques.

5.1.1 Countermeasure Detection From an Observation of the Subject

The results of this study clearly fail to support polygraphers' claims that the use of physical countermeasures is readily detectable from an observation of subjects' overt behavior. The experienced field examiner in this study operated at level of detection of countermeasure usage that was clearly at or below chance. This is a finding of considerable importance for field PDD examiners as they have the impression that physical countermeasures are readily detectable (Abrams, 1977; Backster, Note 3; Magiera 1975; Reid & Inbau 1977). This misconception on the part of field examiners may arise in part from the fact that many field subjects who do attempt some physical countermeasure do so on the spur of the moment without a knowledge or consideration of the factors involved. It is not surprising that such things as moving the arm under the cardio cuff and gross hyperventilation are readily detected. However, any assumption of ignorance and lack of preparedness on the part of the general public and the criminal element can no longer be accepted. Lykken's claims about the ways in which the CQT can be beaten are well disseminated to the public by his

book, publications in the popular press, and by his appearances on popular TV talk shows. Complete detail about the workings of the CQT are available to anyone with access to a good public library.

If Magiera (1975) is correct in his estimation that 90% of all guilty subjects in specific issue examinations attempt the use of some countermeasure and if, as it seems likely, these attempts are becoming more sophisticated, then it is imperative that field examiners not be lulled into a false sense of security by the misconception that physical countermeasures can be readily detected from a close observation of the subject and a scanning of the charts. Additional work is required to clarify this area, it is possible that physical countermeasures could be detected by observation if such observations could be made under ideal conditions, say perhaps on slow motion videotape. In the field, however, it is often the case that the examiner's attention is drawn away from a continuous observation of the subject's behavior by a need to adjust the instrument and/or prepare for the next question. These factors, however, were minimized in this study since the examiner did not have to split his attention by controlling the instrument. In addition, the odds were stacked in the examiner's favor since he was aware of the a priori odds and the typography of the coun-

termeasures he would encounter in this study. It seems likely then that under normal field conditions even more countermeasure usage would go undetected.

5.1.2 Countermeasure Detection Based on the Physiological Data Only

The data also failed to support the assertion of field polygraphers that self-induced physiological reactions are obvious and unnatural in appearance. Again the original examiner clearly operated at or below a chance level in the detection of persons using physical countermeasures when his judgments were based on an unlimited analysis of the physiological data. The experimentally blind evaluator who has had many thousands of hours devoted to chart evaluation also operated at below chance levels in the detection of countermeasure usage from the physiological data. These data are important for the same reasons discussed above in relation to the detection of countermeasure usage from an observation of the subject's overt behavior. A PDD examiner should have little confidence in his ability to either observe countermeasure usage in the overt behavior of the subject or in his ability to deduce their usage from an analysis of the physiological data. (It should be noted that a partial inflation cardio cuff was not used to transduce the cardiovascular signal in this experiment. Some field polygraphers feel

that this measure is particularly sensitive to the physical maneuvers used as countermeasures (Backster, Note 5), and would significantly increase the detection of countermeasure usage over that found here. Research currently in progress at Virginia Tech is employing this transducer in an effort to explore this possibility.)

It is of interest to note that the overall accuracy rate of the detection of countermeasure usage varies little between the condition where the examiner observed the subject and scanned the charts and the condition where he had access only to the physiological data. It seems likely that countermeasure classification in the observation plus scanning condition is based primarily on the scanning of the charts, providing a further indictment of polygraphers who claim physical countermeasures are readily detectable from an observation of the subject's overt behavior.

5.1.3 The Reliability and Validity of the CQT

The high interrater correlation obtained between the total numerical scores of original examiner and the blind rescorer and the 100% agreement between the original examiner and the blind evaluator where decisions were reached are impressive and fit well with the data reported in other laboratory PDD studies (see Table 1). These data then

clearly provide support to Raskin's assertion, " . . . that the PDD numerical evaluation procedure is an extremely reliable procedure, at least as reliable as any psychological test we know." (Raskin, 1981, p. 23).

The evaluation of the results of the PDD decision process also provides support for the validity of the CQT procedure used. The high accuracy rate and the tendency for a higher false positive rate also fits well with the reported PDD research data (see Table 3). The ability of the CQT to separate truthful subjects from all deceptive subjects was strongly supported by the statistical analyses. The results of the significance tests and the significant discriminant equation resulting from an analysis of the semi-objective scores of the members of the innocent and the combined guilty groups are all completely consistent with the hypotheses underlying the CQT. In a like manner the significance tests of the objectively reduced measures, with the exception of the HR data, which fell in the proper direction but were not significant, are all also in accord with the differential reactivity expected in the CQT.

These data do, however, vary from the recently reported data from laboratory PDD studies in one important aspect, the relatively high inconclusive rate (see Table 3). In a personal discussion of these data with Raskin (Note 6) he

suggested several points regarding this study that might have contributed to this high inconclusive rate. Of principle importance in his comments, Raskin expressed the opinion that the BSAT contains a number of factors which critically bias the BSAT against the innocent subject and contribute to a high inconclusive rate in general. Unpublished data and a discussion concerning a comparison of the BSAT and the semi-objective scoring system used in the University of Utah studies were later obtained from Raskin (Note 7; 8). Interestingly the accuracy and inconclusive rates reported by Raskin for the BSAT in this data are almost identical with those reported here. A study within which a set of CQT charts was blindly evaluated with both of these scoring systems would possibly provide important data regarding the biases built into these techniques. Future research is being planned that will address this problem.

A second factor which Raskin noted as possibly contribuating to the high inconclusive rate was the lack of a so-called stim test during the pretest interview. The stim test is a staged version of the GKT and is used during the pretest interview to impress upon the subject the power of the lie detector to detect lies. Backster at present does not teach a stim test as part of the standard PDD test procedure and one was not used in this study although, one has

consistantly been used in the laboratory PDD studies at the University of Utah. A recent study by Bradley & Janisse (1981) offers clear support to the notion that stim tests do improve detectability and reduce inconclusive rates. The University of Utah stim test has now been adopted and is currently being used in the PDD research presently being conducted at Va Tech.

A final factor that may have contributed to to the high inconclusive rate in this study relates to the absence of the incidental feedback provided to the subject by the presence of the polygraph instrument in the examination room. Stern & Ray (1977) have suggested that the auditory feedback from the movement of the polygraph's pens might serve as a source of biofeedback and might enhance detectability. Stern and his colleagues have reported two studies in which subjects either are or are not provided biofeedback during GKT examinations (Stern & Ray,1977; Stern, Breen, Watanabe, & Perry, 1981). Subjects who received auditory feedback of their SRRs were reported as more easily detected.

Golden (Note 9) reports a field PDD study in which biofeedback was manipulated in a within subjects design. Subjects were given one presentation of a series of PDD questions without any feedback and were then given a second presentation of the PDD question while receiving an analog

auditory feedback of their SRRs. Golden reported a 100 to 600% increase in the "responsiveness" (no dependent measure specified) of deceptive subjects but no changes in innocent subjects. The value of these results while suggestive is questionable because of a number of weaknesses in Golden's study and by a lack of information in the report. Many of the cases were never verified independently of the PDD examination, therefore it is impossible to know if Golden's categories of innocent and guilty are correct. Another problem with the Golden data lies in the fact that the cases used were were drawn from preemployment as well as specific issue examinations. The techniques used were not specified.

Despite the limitations of the Golden data, they in combination with the Stern et al. data do offer the suggestion that the naturally occuring auditory feedback provided to the subject by the incidental noises of the polygraph may enhance the reactivity and detectability of the subject in the PDD situation. This incidental feedback was not available to the subject in this study and thus may have contributed to the high inconclusive rate obtained. Current research at Va Tech is utilizing an instrument in the room with the subject.

Another factor that might have contributed to the inconclusive rate was the lack of the traditional partial occlu-

sion cuff measure of cardiovascualar activity. The relationship between the partial occlusion cuff and other noninvasive cardiovascular measures is not known in detail (Dawson, Note 10). Polygraphers traditionally place a great deal of confidence in the partial occlusion cuff measure (Backster, Note 5; Reid & Inbau, 1977). It is possible that this measure could provide a significant amount of information not present in the data transduced through the photoplethysmograph. Current research at Virgina Tech is employing a partial occlusion cuff and a photoplethysmograph in an effort to explore this possibility.

In summary then, despite a high inconclusive rate this study can be seen as having well replicated the reported reliability and validity of the CQT reported by other research laboratories.

5.1.4 The Effects of Simple Physcial Countermeasures

The analyses of the semi-objective scores in this study failed to reveal any effects for the use of physical countermeasures. Clinically a comparison of the accuracy rates and the inconclusive rates across the three guilty groups failed to show any notable differences between these groups. The one false negative in this study was in the pain countermeasure group but an examination of the individual total

scores reveals that this subject is an outlier in this group, with a total score removed from the other members of the pain countermeasures group. Statistically there were no differences between the three guilty groups in this study as a result of the analysis of the semi-objective total scores.

The results of the ANOVAs of the objectively reduced data fail to paint as clean a picture as the analyses of the semi-objective PDD scores. While all of the objectively reduced measures except one (HR) produced a statistically significant separation of the innocent and guilty control groups, a significant effect was found for countermeasure usage in one of the objectively reduced measures, finger pulse amplitude, and a second measure, respiration amplitude, approached significance for this effect. However, an examination of the means reveals the fact that these effects are of a relatively small magnitude and consisted primarily of an increase in responsivity to the control questions with no effect on response magnitude to relevant questions. As was noted earlier there were no differences between groups in the analyses of the semi-objective PDD scores and thus it is illustrated that these effects for countermeasures are clinically insignificant despite their statistical significance. Even if these trends could be intensified without a reduction in the amplitude of responses to relevant ques-

tions they could only result in inconclusive results not false negative outcomes. In this respect the CQT clearly has the advantage over the GKT; a consistent production of the trends shown in these indices should be sufficient to produce false negative outcomes on GKT examinations.

One aspect of the RA data is particularly noteworthy. Subjects in the Innocent and in the Guilty Control Groups showed relief responses (hyperventilation) to the non-critical items (relevant and control questions respectively), while subjects in the countermeasures groups failed to show relief responses to any items (see Figure 5). If this is a reliable finding it might prove to provide useful information classification of innocent subjects and also serve as an indicant of countermeasure usage. Research regarding relief responses is notably missig from the literature and is an area requiring further investigation.

The SRR data are perhaps more interesting. Despite the fact that there is considerable evidence suggesting the countermeasures used here should produce strong SRRs there was absolutely no support found for their effectiveness in producing misleading responses in CQT examinations. An examination of Figure 6 shows no positive change in the mean SRR to control questions across the guilty groups and if anything in the muscle countermeasures group there is a loss

in the mean SRR amplitude to the contol questions. These data are very important as all reported laboratory studies using the CQT have found the electrodermal measure to carry most of the discriminative variance (Balloun & Holmes, 1979; Barland & Raskin 1975; Bradley & Janisse, 1981; Dawson, 1980; Podlesny & Raskin, 1978; Raskin & Hare, 1978; Rovner et al., 1979). These data must be considered strongly supportive of the robustness of the SRR in the face of physical countermeasures, and should suggest stronger reliance on the SRR measure when countermeasure usage is suspected.

5.2 GENERAL DISCUSSION

The lack of any appreciable clinical effects and the finding of only a small, albeit statistically significant effect in one of the objective measures provides evidence for the robustness of the validity and utility of PDD techniques, and the CQT in particular, in the face of physical countermeasures used by individuals motivated to beat the procedure. This one study, while suggestive, clearly does not provide sufficient evidence to support the null hypothesis that countermeasures cannot be effective in defeating PDD examinations and is subject to several criticisms. One problem with this study is that subjects were trained in only one countermeasure. In the real world it would be

likely that individuals would use several countermeasures both separately and concurrently. It is possible that the small effects observed for the separate use of countermeasures in this study might be additive and clinically important if they had been used simultaneously. It is also possible that the training sessions were too brief. In the field a highly motivated guilty individual would no doubt practice potential countermeasures with some fervor. Again it is possible that with increased training the small effects might increase to clinically important levels. However, I believe an equally strong argument could be made that increased practice would result in habituation of the produced responses. Research is currently underway at Va Tech in a effort to explore these possibilities.

The low affect nature of this study, however, mitigates against these criticisms. If subjects were going to be able to inhibit responding to relevant questions and/or produce responses to control questions that would overshadow responses to relevant questions they should have had the maximal potential for doing so in this experiment. Intuitively the nature of the relevant questions in a real world situation must carry more weight (signal strength) that the relevant questions in this study. Thus in the real world responses to the relevant questions should be even stronger and harder

to inhibit or overshadow. Thus I suggest that considerable weight can be given to the data regarding countermeasures as generalizable to the field situation.

These data fit well with the countermeasure studies reported to date. In combination with them there seems to be little support for Lykken's (1979, 1981) assertions that individuals can be readily trained to beat CQT examinations. This study can be taken as support for Raskin's repeated assertions that PDD techniques can be used as a valuable aid to our legal system when used by defense to provide the reasonable doubt of innocence our court system searches for (Podlesny & Raskin, 1977; 1978; Raskin & Podlesny, 1979; Raskin, 1978; 1981).

These data also support Raskin's (Raskin, 1978; 1981) suggested caution in the application of deceptive results. A clear trend for the higher occurrence of false positive outcomes has emerged in the literature and is also found here, somewhat weakening the confidence we can have in deceptive outcomes. The finding of a consistant trend for false positive errors must be considered in any application of PDD that makes use of deceptive outcomes. Since it appears certain that some percentage of innocent subjects will be wrongly reported as deceptive, ethical questions regarding the tradeoff of false positives versus near 100%

detection of the guilty must be explicitly considered in each prospective use of the PDD techniques.

In conclusion, it can be stated that in general this study has replicated the findings of high reliability and validity reported in other laboratory studies of the CQT. However some questions regarding the utility of the CQT remain unanwsered. The finding of a relatively high false positive rate and a high inconclusive rate are problems that require resoultion in future research. Regarding the effects of simple physical countermeasures, the semi-objective analysis procedure used by field PDD examiners was found to be robust in the face of countermeasure usage. This finding, however, must be noted with caution as it is based almost completely on the resilience of only one dependent measure, the SRR. Additional research is required using multiple countermeasures and more training to determine the reliability of these findings. Within the limitations noted above, these data can be taken as empirical support for the continued and wider application of PDD in the real world and in particular in courts of law where the innocent individual accused by circumstantial evidence stands the most to gain.

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Appendix A

CONSENT FORM A

Form A .

Consent Form

The purpose of this study is to assess the accuracy of physiological detection of deception (lie detection) techniques. During the course of this study you may be asked to take part in a mock crime or you may remain innocent with regard to the mock crime in question. Assignment to guilty and innocent groups will be made on a random basis. If at any time for any reason you would like to withdraw from this study you may do so without penalty.

Following this initial session you will be asked to return for a second session during which a lie detection examination will take place. During the pretest interview the questions to be used will be reviewed with you verbatim, no suprise or embarassing questions will be asked. You are free to refuse to answer any question. The actual examination will involve the asking of a series of approximately nine questions, these questions will be repeated four times while your physiological responses are monitored. The physiological monitoring will involve placing several sensors on your person. These sensors will not harm you in any way nor should they be uncomfortable. If at anytime you should experience discomfort from the sensors you should inform the examiner and he will adjust the sensors accordingly. The actual sensors to be used are, two stainless steel plates placed on the index and third fingers of one hand to measure the galvanic skin responce, a blood pressure cuff placed around the upper arm to measure relative blood pressure, and a pneumatic tube placed around the torso to measure respiration.

Please understand that any information obtained from you will be used solely for research purposes. Your name will never be linked to the information in any way in any discussion or paper regarding this study. Also understand that any information provided will never be used against you in any way. There will be no direct benefit to you as as a result of participating in this study, except that you will receive 2 experimental credit points for taking part in the study and an additional 2 experimental credit points as a bonus if the examiner finds you to be truthful regarding the mock crime in question, regardless of your assignment to a guilty or innocent group. You should do everything you can to earn these bonus points without giving yourself away.

Remember you are free to withdraw from this study at any time without losing credit. If you have any questions at any time feel free to ask the experimenter, he/she will be glad to answer them the the best of his/her ability.

Signature of Participant: _____

Date: _____

Signature of Witness: _____

Appendix B

INTERVIEW CHECKLIST

SUBJECT CHECKLIST

1. Has the subject signed Consent Form A? Yes No

Explain to the subject that this experiment will be recording physiological measures and as such certain medical conditions will preclude participation.

2. Has the subject ever been in a physiological experiment before? Yes No

* 3. Does the subject have any history of heart disease? Yes No

* 4. Does the subject use any regular medication? Yes No
4a. If Yes what?

* 5. Is the subject under the care of a psychiatrist? Yes No

* 6. Does the subject suffer from any chronic illness? Yes No

*Yes answers to these questions may preclude involvement see Honts if in doubt!

Please ask the subject to refrain from the use of any drugs or alcohol for 24 hours before the start of the experiment. Done

Also please request the subject not take part in any vigorous activities for at least one hour before the experiment. Done

If the subject is a member of group P or M make sure they sign the secondary release forms. Done

Assign the subject number

Subject number _____

Appendix C

INSTRUCTIONS FOR INNOCENT SUBJECTS

Hello

You have randomly selected yourself to be in the innocent group in this experiment. To earn the 2 bonus credit points all you have to do is to convince the examiner you are innocent of the crime (stealing an examination) when you take the examination.

Evidence has indicated that the best way for an innocent person to show his innocence on a lie detector test is to simply be honest and tell the truth. Good Luck! We want you to earn the extra credit points.

The experimenter will return in about 10 minutes. When he/she does so simply tell him/her that you are a member of the innocent group. He/she will then set up the second appointment when you will take the lie detector test. The experimenter will also assign you a subject number. This number will be on the appointment card the experimenter gives you. It is very important that you keep this card and especially the number, we will not be able to give you the lie detection test if you don't have the number with you.

Thanks for taking part in this experiment, if you have any questions please ask the experimenter when he/she returns.

Appendix D

INSTRUCTIONS FOR GUILTY SUBJECTS

Hello -

You have randomly selected yourself to be a member of the guilty group in this experiment.

Please leave this room and go to room _____ here in Derring Hall. Open the door, it will not be locked, but try not to let anyone see you entering the room. Enter the room and look for a stack of examinations on or in the desk in the room. When you find the examinations take one, fold it up, and hide it on your person (e.g., in a pocket). Return to this office as quickly as you can. You will have only 10 minutes to complete this task.

Your role in this experiment is to allow for the assessment of the accuracy of the lie detector in detecting guilty persons. Some researchers have suggested that if a guilty person makes a genuine effort to appear honest he will fool the lie detector.

If you do fool the lie detector and the examiner reports you to be truthful in regard to stealing the examination you will earn an additional 2 credit points. Also bring the stolen examination with you to the test but keep it hidden from the person giving the test. When the test is over give the examination to the person who tells you the results so we will know if you have beaten the test and earned the bonus points.

The experimenter will return in about 10 minutes, complete the crime and return to this office as quickly as possible. When the experimenter returns please tell him/her that you are a member of the guilty group. He/she will then set up an appointment when you will take the lie detector test. The experimenter will also assign you a subject number. This number will be on an appointment card the experimenter will give you. It is very important that you keep this card and especially the number. We will not be able to give you the test if you don't have the number with you.

Thanks for taking part in this experiment, if you have any questions please ask the experimenter when he/she returns.

Appendix E

CONSENT FORM B

Form B

Consent Form

You have been randomly selected to be one of the guilty groups in this study. Within this assignment we want to assess the effectiveness of some physical countermeasures in beating the lie detector. The group to which you have been assigned is requested to use muscle tension to produce erroneous responses during the examination in an effeort to confuse the examiner and produce truthful charts even though you have participated in the mock crime. One of the experimenters will now show you the countermeasure we want you to use, this involves simply pressing your toes against the floor. When you press your toes against the floor you cause changes in your physiology that in many ways are like those which occur when a person lies. If you do succeed in producing a truthful result in the examination you will receive the 2 bonus points as noted in the original consent form. Try as hard as you can to obtain these points but do not overextend yourself or allow the examiner to discover you using countermeasures.

Remember if you do not wish to participate you can withdraw at any time without penality. If you have any questions about the countermeasure after the experimenter has demonstrated it please ask the experimenter at this time.

Signature of Participant: _____

Date: _____

Signature of Witness: _____

Appendix F

INSTRUCTIONS FOR MUSCLE COUNTERMEASURE SUBJECTS

Group M Countermeasure Instructions

Research has indicated that muscular tension such as that created by pressing your toes against the floor will produce physiological changes that can be mistaken for the physiological changes that occur when you tell a lie. In order for you to beat the test we want you to press your toes against the floor during the lie detection test. It is very important however that you use this countermeasure only at the proper time during the test.

The examiner will be asking you a variety of question types during the test but only two types are important. One type of question will deal with the theft of the examination, these are the questions that the guilty person is expected to react to. It is very important that you remain as calm as possible while answering these questions. More importantly for you in beating the test is another type of question. These questions will be general in nature and will deal with some period of time in the past. The innocent person is expected to react to these questions. Therefore for you to beat the test you should remain as calm as possible during the specific questions about the examination and use the countermeasure during the general questions to make it look as if you are reacting like an innocent person.

It is very important that you make every effort to hide the countermeasure when you are using it, if the examiner catches you trying to beat the test he will call you deceptive and you won't receive the bonus points. We want you to receive the bonus points so work as hard as you can to beat the test. I will now demonstrate the countermeasures for you, please ask me any questions you may have about the test or the countermeasure at this time.

Appendix G

CONSENT FORM C

Form C

Consent Form

You have been randomly assigned to be in one of the guilty groups in this study. Within this assignment we want to assess the effectiveness of some physical countermeasures in beating the lie detector. The members of the group to which you have been assigned are requested to lightly bite their tongues during the examination in order to confuse the examiner and produce a truthful outcome eventhough you have participated in the mock crime. When you lightly bite your tongue (pleasenote only a very light bite is required, do not injure yourself in any way) you produce a number of physiological changes that in many ways are like those that occur when a person lies. If you do succeed in producing a truthful result in the examination you will receive the 2 bonus points as noted in the original consent form. Try as hard as you can to obtain these points but do not overextend or injure yourself in any way and do not allow the examiner to discover you using the countermeasure.

Remember if you do not wish to participate you can withdraw at any time without penality. If you have any questions about the countermeasure after the experimenter demonstrates it please ask the experimenter at this time.

Signature of Participant: _____

Date: _____

Signature of Witness: _____

Appendix H

INSTRUCTIONS FOR PAIN COUNTERMEASURE SUBJECTS

Group P Countermeasure Instructions

Research has indicated that light self induced pain such as that created by lightly biting your tongue will produce physiological changes that can be mistaken for the physiological changes that occur when you tell a lie. In order for you to beat the test we want you to lightly bite your tongue just after you answer some of the questions on the test. It is very important that you use this countermeasure on only some of the questions on the test.

The examiner will be asking you a variety of question types during the test but only two types are important. One type of question will deal with the theft of the examination, these are the questions that the guilty person is expected to react to. It is very important that you remain as calm as possible while answering these questions. More importantly for you in beating the test is another type of question. These questions will be general in nature and will deal with some period of time in the past. The innocent person is expected to react to these questions. Therefore for you to beat the test you should remain as calm as possible during the specific questions about the examination and use the countermeasure during the general questions to make it look as if you are reacting like an innocent person.

It is very important that you make every effort to hide the countermeasure when you are using it, if the examiner catches you trying to beat the test he will call you deceptive and you won't receive the bonus points. We want you to receive the bonus points so work as hard as you can, without injuring yourself, to beat the test. I will now demonstrate the countermeasure for you. Please ask me any questions you may have about the test or the countermeasure at this time.

Appendix I

SUBJECT RECORD FORM

Subject Record Name_____

Subject Number_____ Date_____

Sex M F Age_____ Time_____

Weather_____ Temperature in examination room ____

INSTRUMENT SETTINGS

EDR Mode: BSR

Start Chart 1 _____OHMS Sensitivity_____

End Chart 1 _____OHMS Sensitivity_____

Start Chart 2 _____OHMS Sensitivity_____

End Chart 2 _____OHMS Sensitivity_____

Start Chart 3 _____OHMS Sensitivity_____

End Chart 3 _____OHMS Sensitivity_____

Start Chart 4 _____OHMS Sensitivity_____

End Chart 4 _____OHMS Sensitivity_____

Respiration Mode AUX

Chart 1 Sensitivity Start_____ Sensitivity End_____

Chart 2 Sensitivity Start_____ Sensitivity End_____

Chart 3 Sensitivity Start_____ Sensitivity End_____

Chart 4 Sensitivity Start_____ Sensitivity End_____

Blood Volume Mode AUX

Chart 1 Sensitivity Start_____ Sensitivity End_____

Chart 2 Sensitivity Start_____ Sensitivity End_____

Chart 3 Sensitivity Start_____ Sensitivity End_____

Chart 4 Sensitivity Start_____ Sensitivity End_____

Erlanger Blood Pressure Mode AUX

Chart 1 Pressure Start____ End____ Sensitivity Start____ End____

Chart 2 Pressure Start____ End____ Sensitivity Start____ End____

Chart 3 Pressure Start____ End____ Sensitivity Start____ End____

Chart 4 Pressure Start____ End____ Sensitivity Start____ End____

Examiners Field Decision T I D Countermeasures Y N

Quantative Score _____ on four charts resulting in T I D

Assistant _____

Appendix J

A STYLIZED EXAMPLE OF THE FORMULATION OF CONTROL QUESTIONS

The following is a stylized example of an examiner/subject interaction used in the formulation of control questions (adapted from the technique tought at the Backster School of Lie Detection, Backster, Note 4).

Examiner: John, there is another type of question that is just as important to the outcome of this examination as the ones that we have already gone over (The relevant and irrelevant questions to be used in the examination have already been reviewed with the subject.). These questions are somewhat more general and what they are designed to do is to get at your character. We want to show, if we can, that you are basically a good person. You know, for example, that the kind of person who would steal an examination from an office has probably stolen other things, right?

Subject: Yes, I suppose that is right.

Examiner: And I believe it would be safe to assume that, that kind of person has probably cheated on tests before, right?

Subject: Yes, right.

Examiner: So you can see that the person who stole that missing examination is basically a dishonest person, he or

she has a history of doing bad things. You're not that kind of person are you?

Subject: No, of course not!

Examiner: Well good, that is exactly what these next two questions are intended to show. These are very important questions for the outcome of the test so it is important that you be completely honest with me. So, if I were to ask you, During the first 18 years of your life, do you ever remember stealing anything? You could answer that "no" couldn't you?

Subject: Well, maybe.

Examiner: (Showing some dismay) Well I mean stealing, you know something of some real value.

Subject: Ok, let me think.

Examiner: (Pressing) Let me ask you this instead, During the first 18 years of your life did you ever steal anything of any real value? You haven't done that now have you?!

Subject: No.

If at this point the subject makes specific admissions, the examiner reacts with shock and replies, "Oh really, that's very serious, you've never stolen anything else have you?!". If no further admissions are made the examiner rephrases the question prefaced with "Other than what you told me about,". If the subject continues to make admis-

sions in the face of the examiner's dismay the nature of the question can be changed (for example to, Have you ever stolen from a close friend?), this tactic was, however, never needed in this experiment.

Examiner: Ok! Good, now along a similar line, let me ask you, While you were in high school did you ever cheat on a test? You've never done anything as bad as that have you?

Subject: No, of course not.

Note. The same types of modifications apply to this question as for the first control question if admissions are offered by the subject.

Appendix K

THE BACKSTER YOU PHASE TEST FORM

	HF HFC	"YOU" PHASE TEST					Used on chart no.	1	2	3	4	5		
Y/0	y	13	(name)	14	(birth)	15	(residence)							
1	b	25	Do you believe me when I promise you I won't ask a question we haven't gone over--word-for-word?											
2	y r	39	Re. Whether you:				Do you intend to answer truthfully each question about that?							
3	g	46												
4	r	33												
5	g	47												
6	r	35												
7	g	48												
8	r	37	(OPTIONAL)											
9	b	26	Even though I promised you I would not--are you afraid I'll ask a question we haven't gone over--word for word?											

BACKSTER ZONE COMPARISON TEST (September 1978) Pages 11 & 15

(From Backster, Note 4)

Appendix L

SUBJECT DEBRIEFING FORM

SUBJECT DEBRIEFING FORM

Name_____ Subject Number _____

1. Were you a member of the innocent or the guilty group? I G

2. If you were a member of a guilty group were you trained in a countermeasure? Yes or No If Yes what countermeasure were you trained in?

   _____

   Did you use this countermeasure? Yes No If yes when did you use it?

   _____

   _____

   Did you use any other method in an attempt to distort the charts? If so what?

   _____

   _____

   Do you think you were successful in beating the test? Yes No

3. If you were not trained in a countermeasure technique did you attempt to defeat of distort the test in any way? Yes No
   If Yes what did you do and when did you do it?

   _____

   _____

   _____

4. If you were a member of the innocent group did you attempt to distort the recordings in any way? Yes No If so what and when?

   _____

   _____

   Do you think you were successful in convincing the examiner you were truthful? Yes No

EXAMINERS FIELD DECISION T I D

Please inform the subject of the Examiner's field decision.

Retrieve the stolen examination from the guilty subjects.

Sign the subjects experimental credit sheet.

Answer any questions the subject may have.

Thank the subject for taking part in this experiment.

Ask the subject not to discuss the experiment with any other students in the intro classes until the end of the quarter.

Appendix M

THE BACKSTER SPOT ANALYSIS TECHNIQUE (BSAT)

The BSAT consists of a series of assumptions, rules and decision algorithms used in the numerical socring of lie detection charts where the Backster Zone of Comparison (ZOC) test (a CQT type PDD examination) has been used. This appendix is concerned with a detailed explication of these assumptions, rules and algorithms in order to provide a basis for the semi-objective scoring data reported in this thesis. (All material in this appendix is adapted from Backster, Note 4.)

M.1 ASSUMPTIONS

The BSAT is built on three assumptions. The first of these assumptions is that the guilty individual will find the relevant questions to be more threatening than the control questions. The relevant questions are thus expected to produce larger physiological responses in guilty individuals. The second assumption is that the control questions will be more threatening to the innocent individual than are the relevant questions. The innocent individual is expected to produce larger physiological responses to the control questions than to the relevant questions. The third assump-

tion is that the relevant questions always perform at an optimal level but that the control questions may perform at a less than optimal level.

The third assumption is critical to an understanding of the BSAT approach to chart interpretation and to an understanding of the application of the ZOC test. Backster accepts this third assumption as valid if the relevant questions can meet two tests regarding their formualtion. The first requirement of the relevant questions is that it not be possible for the subject to be attempting deception to the relevant questions but be innocent regarding the specific issue of concern. The second requirement of the relevant questions is that it not be possible for the subject to answer the relevant questions truthfully but be guilty regarding the specific issue of concern. If these tests are met but the initial charts fail to show a clear differential in responding (that is, either responses to both the relevant and control questions or a lack of response to both) it is assumed that the control questions are at fault, and they are altered in some way (either made weaker or stronger, respectively). Thus from the BSAT viewpoint responses to the relevant questions enjoy a preferred status in that they are accepted a priori as being genuine responses while responses to control questions are potentially suspect as

artifact. Also under the BSAT scoring system whenever a relevant question is contiguous with two control question it is permissible to go to the control question with the smaller response in order to determine the numerical score at that locus of comparison (within the scoring rules discussed later in this appendix). The validity of this assumption has not been established and some believe that it biases the BSAT against innocent subjects (Raskin, Note 8). The BSAT is ,however, a widely accepted field PDD technique and the third assumption is critical to its implementation. For the purposes of the analyses conducted in this thesis the third assumption was accepted and implemented with the notation that it is an area that requires further validation at some point.

M.2 RULES

The BSAT contains a number of rules that are to be obeyed during the numerical scoring process. Many of these reles are general in nature and apply equally to the scoring of all the indices. These general rules will be discussed first. There are also rules that are specific to the scoring of the seperate indices, these rules will be discussed in the 'Decision Algorithm' section for those indices. The BSAT rules are very important as they define the parameters

for the application of the numerical scores with the use of the decision algorithms.

M.2.1 General Rules

The Either-Or Rule. This rule states that for the assignement of scores beyond +/- 1, a response must be shown to either the relevant of the control question being compared but not to both or a lack of response to both.

The Non-Reinforcement Rule. This rule states that the assignment of socres in a index at a locus of comparison shall be independent of the assignment of scores at other loci of comparison and of the assignment of scores to the other indices at that same locus of comparison.

The Green Zone Abuse Rule. This rule, based on the third assumption above, states that when a relevant is contiguous with two control questions it should be compared to the weaker control question response. Except in the case where one of the responses to a contiguous control question is three times larger than the response displayed to the relevant question, in which case the larger control question response must be used. (Note: In the cardiovascular and the respiratory measures the judgement of 'three times larger than' is a subjective judgement on the part of the examiner).

The Presence of Reaction Via Deduction Rule. This rule states that where a relief response begins between the point of of question onset and within 5 seconds past the point of answer and the preceeding question shows a lack of reaction, it is permissible to infer reaction to the preceeding question and to assign a score of +/- 1 as appropriate to that locus of comparison.

The Lack of Reaction Via Deduction Rule. This rule states that responses characterized as relief responses can be considered lack of reaction responses for compliance to the Either-Or Rule.

The Green Zone Yes Answer Penality Rule. This rule states that a 'yes' answer given inappropriately to a control question prohibits the use of responses to that question as indicants of reaction, however, these loci can be used as lack of reaction loci for scores of up to +/- 2 but not for scores of +/- 3.

M.2.2 Upgrading Rules

In order to be assigned a score of +/- 3 loci of comparison must also meet the requirements outlined in the following upgrading rules. These rules will be illustrated in each indices' Decision Algorithm section if such illustration is needed for clarity. There are also some index spe-

cific upgrading rules which are explicated in the specific Decision Algorithm sections.

Tracing Purity Upgrading Rule. This rule states that for a score of +/- 3 the relevant and chosen control question loci must show pure or clean tracings, that is they should show a clear uniformity of response.

Tracing Distortion Upgrading Rule. This rule states that a score of +/- 3 is disallowed if either the relevant or the chosen control question loci encompasses a tracing segment that could be categorized as a distortion.

Reaction Magnitude Upgrading Rule. This rule states that for a score of +/- 3 to be awarded the reaction must be of a significant and dramatic nature. In the electrodermal index this is objectively fixed at a ratio of reaction of 4 to 1. In the evaluation of the cardiovascular and the respiratory indices this rule becomes a subjective judgement on the part of the examiner.

The Red Zone Yes Answer Penality Rule. This rule states that when there is a permissable "yes" answer to a relevant question there can be no upgrading to scores of +/- 3.

M.3 DECISION ALGORITHMS AND INDEX SPECIFIC EVALUATION RULES

M.3.1 General Considerations

In assigning numerical scores the BSAT requires that responses be categorized into one of the following four types. (For a response to be considered it must begin within a measurement zone that begins at the point of question onset and ends 5 seconds after the point of answer.) Tracing Average. Tracing average zones are those zones which show no indication of reaction, these zones are considered lack of reaction zones. Reaction Tracings. Reaction tracings show physiological changes that are considered indicants of stress, these zones are considered presence of reaction zones. Relief Tracings. Releif tracings show physiological changes that indicate a return to the subjects basal level following reaction, often with over- compensation, these zones are considered lack of reaction zones (also see the Presence of Reaction Via Deduction Rule). Distortion Tracings. Distortion tracings show changes that are produced by stimuli other thatn those of the relevant and control questions, for example, gross motor movements, loud noises, and unusual respiratory events (coughs, sneezes, yawns, ect.). Distortion tracings are removed for consideration in the assignement of numerical scores. Algorithms for the assignement of a reaction zone at a locus of comparison are described below for each of the indices.

M.3.2 Decision Algorithms for the Respiratory Index

The criteria for the classification of respiratory tracing segments are based on the recognition of specific patterns in the subject's respiratory tracings. These patterns and their specific classifications are described in the following paragraphs.

Tracing Average Patterns. A tracing average pattern of respiratory response is illustrated in Figure 10. Tracing average patterns represent those times when the subject is not showing any reaction other than the general arousal of the testing situation. Reaction zone tracings which show tracing average segments are classified as lack of reaction zones.

Sustained Supression Patterns. A sustained suppression pattern consists of a series of cycles of a uniform amplitude that is less than the amplitude of the tracing average cycles for that chart. Figure 11 illustrates a sustained suppression patttern. Reaction zones which show sustained suppression patterns are classified as reaction zones.

Acending Suppression Patterns. An ascending suppression pattern consists of a series of cycles that are of an amplitude less than tracing average cycle amplitude but which show a gradual return to tracing average amplitude. Figure 12 illustrates an ascending suppression pattern. Reaction

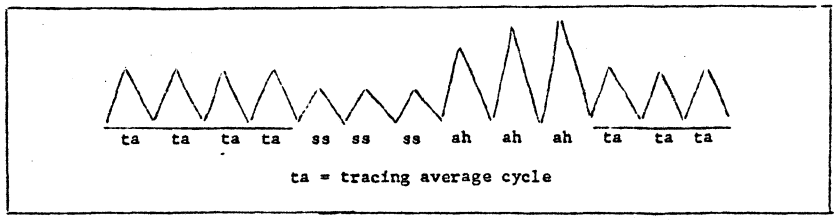
TRACING AVERAGE CYCLE

With Tri-Zone Polygraph test structure a tracing average cycle is ordinarily evidenced when there is no psychological change from the subject's basic emotional level within the general stress situation of the polygraph examination.

The subject has no immediate fear of detection regarding a then current question zone that does not provide the greater threat to his well-being. As there is no psychological change within the subject, there is no ensuing physiological change. The action of the diaphragm-inspiration muscular complex is not being inhibited and there is an average enlargement of the chest cavity. The subject consequently has tidal air intake. During expiration, relaxation of the diaphragm-inspiration muscular complex is not being inhibited, or the rib cage return unduly expedited, and there is an average diminution of the chest cavity. The subject consequently has average residual air volume.

Because the subject has tidal air intake, the amplitude of a tracing average cycle is tracing average amplitude. Because the subject has average residual air volume, a tracing average cycle is on a stable baseline.

Tri-Zone Polygraph Schematic of a Tracing Average Pattern



A series of consecutive tracing average cycles forms a tracing average pattern. A tracing average cycle is classified as a tracing average segment and constitues a part of a lack-of-reaction tracing trend.

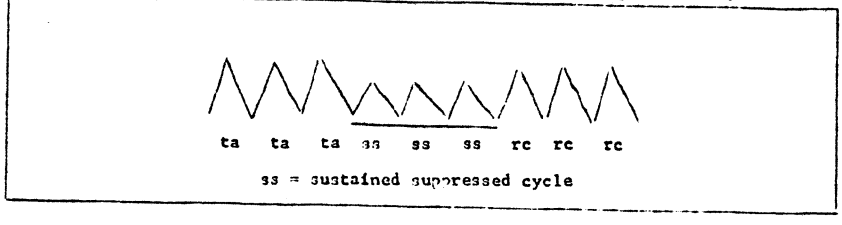
Figure 10. A tracing average pattern in respiration. (From Backster, Note 4.)

SUSTAINED SUPPRESSED CYCLE

Within Tri-Zone Polygraph test structures a sustained suppressed cycle is ordinarily evidenced when there is a psychological change from the subject's basic emotional level within the general stress situation of the polygraph examination.

The subject has immediate fear of detection regarding a then current question zone that provides the greater threat to his well-being. As there is psychological change, there is ensuring physiological change. During inspiration, the action of the diaphragm-inspiration muscular complex is being inhibited and there is less than average enlargement of the chest cavity. The subject consequently has less than tidal air intake. During expiration, relaxation of the diaphragm-inspiration muscular complex is not being inhibited, or the rib cage return unduly expedited, and there is an average diminution of the chest cavity. The subject consequently has average residual air volume. Because the subject has less than tidal air intake, the amplitude of a sustained suppressed cycle is less than tracing average amplitude. Because the subject has average residual air volume, a sustained suppressed cycle is on a stable baseline.

Tri-Zone Polygraph Schematic of a Sustained Suppressed Cycle



A series of consecutive sustained suppressed cycles forms a suppression pattern. A sustained suppressed cycle is classified as a reaction tracing segment and constitutes a part of a presence-of-reaction tracing trend.

Figure 11. A sustained suppression pattern in respiration. (From Backster, Note 4.)

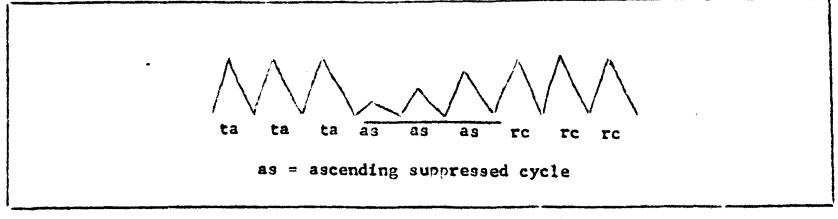
ASCENDING SUPPRESSED CYCLE

Within Tri-Zone Polygraph test structures an ascending suppressed cycle is ordinarily evidenced when there is a psychological change from the subject's basic emotional level within the general stress situation of the polygraph examination.

The subject has immediate fear of detection regarding a then current question zone that provides the greater threat to his well-being. As there is psychological change, there is ensuing physiological change. During inspiration, the action of the diaphragm-inspiration muscular complex is being inhibited and there is less than average enlargement of the chest cavity. The subject consequently has less than tidal air intake. During expiration, relaxation of the diaphragm-inspiration muscular complex is not being inhibited, or the rib cage return unduly expedited, and there is an average diminution of the chest cavity. The subject consequently has average residual air volume.

Because the subject has less than tidal air intake, the amplitude of an ascending suppressed cycle is less than tracing average amplitude. Because the subject has average residual air volume, an ascending suppressed cycle is on a stable baseline.

Tri-Zone Polygraph Schematic of an Ascending Suppressed Cycle



A series of ascending suppressed cycles of progressively increasing amplitude forms a staircase reaction pattern. An ascending suppressed cycle is classified as a reaction tracing segment and constitutes a part of a presence-of-reaction tracing trend.

Figure 12. An ascending suppression pattern in respiration. (From Backster, Note 4.)

zones which show ascending suppression patterns are classified as reaction zones.

Descending suppression patterns. A descinding suppersion pattern consists of a series of cycles that are of an amplitude less than tracing average cycle amplitude and also showing a progressive loss of amplitude away from tracing average cycle amplitude. Figure 13 illustrates a descending suppression pattern. Reaction zones which show descending suppression patterns are classified as reaction zones.

Baseline Arousal patterns. A baseline arousal pattern consists of a series of cycles displaying an elevation in baselie, indicating an increased residual volume in the lungs. In addition cycle amplitude is also decreased to a level below that of tracing averace cycle amplitude. Figure 14 illustrates a baseline arousal pattern. Reaction zones which display baseline arousal patterns are classified as reaction zones.

Sustained Hyperventilation Patterns. A sustained hyperventilation pattern consists of a series of cycles showing an amplitude uniformly greater than tracing average cycle amplitude. Figure 15 illustrates a sustained hyperventilation pattern. Reaction zones which show sustained hyperventilation patterns are classified as relief zones.

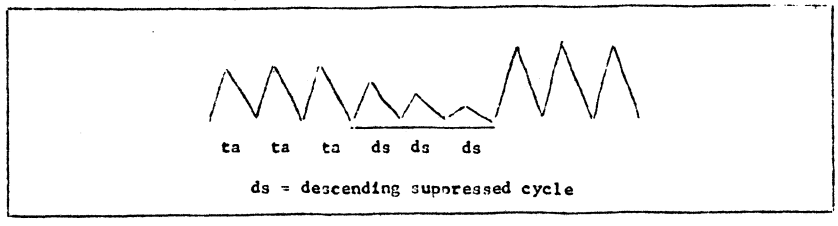
DESCENDING SUPPRESSED CYCLE

Within Tri-Zone Polygraph test structures a descending suppressed cycle is ordinarily evidenced when there is a psychological change from the subject's basic emotional level within the general stress situation of the polygraph examination.

The subject has immediate fear of detection regarding a then current question zone that provides the greater threat to his well-being. As there is psychological change, there is ensuing physiological change. During inspiration, the action of the diaphragm-inspiration muscular complex is being inhibited and there is less than tidal air intake. During expiration, relaxation of the diaphragm-inspiration muscular complex is not being inhibited, or the rib cage return unduly expedited, and there is an average diminution of the chest cavity. The subject consequently has average residual air volume.

Because the subject has less than tidal air intake, the amplitude of a descending suppressed cycle is less than tracing average amplitude. Because the subject has average residual air volume, a descending suppressed cycle is on a stable baseline.

Tri-Zone Polygraph Schematic of a Descending Suppressed Cycle



A series of descending suppressed cycles of progressively decreasing amplitude forms a reverse-staircase reaction pattern. A descending suppressed cycle is classified as a reaction tracing segment and constitutes a part of a presence-of-reaction tracing trend.

Figure 13. A descending suppression pattern in respiration. (From Backster, Note 4.)

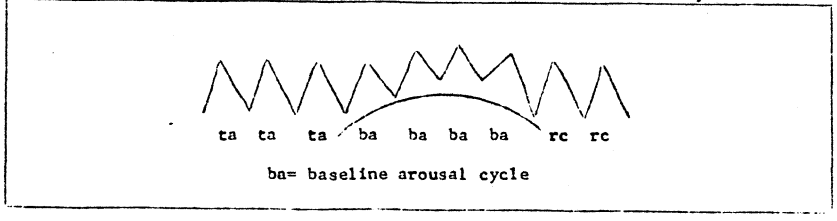
BASELINE AROUSAL CYCLE

Within Tri-Zone Polygraph test structures a baseline arousal cycle is ordinarily evidenced when there is a psychological change from the subject's basic emotional level within the general stress situation of the polygraph examination.

The subject has immediate fear of detection regarding a then current question zone that provides the greater threat to his well-being. As there is psychological change, there is ensuing physiological change. During inspiration, the action of the diaphragm-inspiration muscular complex is being inhibited and there is less than average enlargement of the chest cavity. The subject consequently has less than tidal air intake. During expiration, relaxation of the diaphragm-inspiration muscular complex is being inhibited, completion of the rib cage return is unduly impeded, and there is less than average diminution of the chest cavity. The subject consequently has greater than average residual air volume.

Because the subject has less than tidal air intake, the amplitude of a baseline arousal cycle is less than tracing average amplitude. Because the subject has above average residual air volume, a baseline arousal cycle is on an unstable baseline.

Tri-Zone Polygraph Schematic of a Baseline Arousal Cycle



A series of baseline arousal cycles forms a baseline arousal pattern. A baseline arousal cycle is classified as a reaction tracing segment and constitutes a part of a presence-of-reaction tracing trend.

Figure 14. A baseline arousal pattern in respiration. (From Backster, Note 4.)

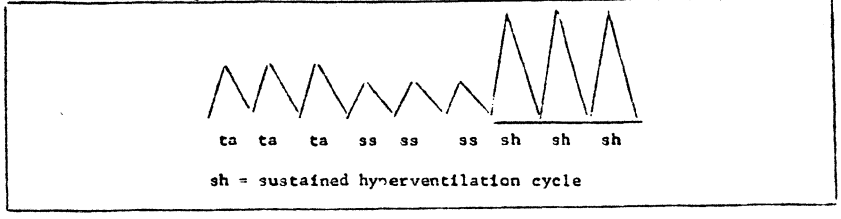
SUSTAINED HYPERVENTILATION CYCLE

Within Tri-Zone Polygraph test structures a sustained hyperventilation cycle is ordinarily evidenced when there is a psychological return to the subject's basic emotional level within the general stress situation of the polygraph examination.

The subject has just passed fear of detection regarding the prior or then current question zone that provides the greater threat to his well-being. As there is psychological change, there is physiological change. During inspiration, the action of the diaphragm-inspiration muscular complex provides for compensation due to the immediately preceding suppressed breathing and there is greater than average enlargement of the chest cavity. The subject consequently has greater than tidal air intake. During expiration, relaxation of the diaphragm -inspiration muscular complex is not being inhibited, or the rib cage return unduly expedited, and there is an average diminution of the chest cavity. The subject consequently has average residual air volume.

Because the subject has greater than tidal air intake, the amplitude of a sustained hyperventilation cycle is greater than tracing average amplitude. Because the subject has average residual air volume, a sustained hyperventilation cycle is on a stable baseline.

Tri-Zone Polygraph Schematic of a Sustained Hyperventilation Cycle



A series of consecutive sustained hyperventilation cycles forms a hyperventilation pattern. Sustained hyperventilation cycle is classified as a relief tracing segment and constitutes a part of a lack-of-reaction tracing trend.

Figure 15. A sustained hyperventilation pattern in respiration. (From Backster, Note 4.)

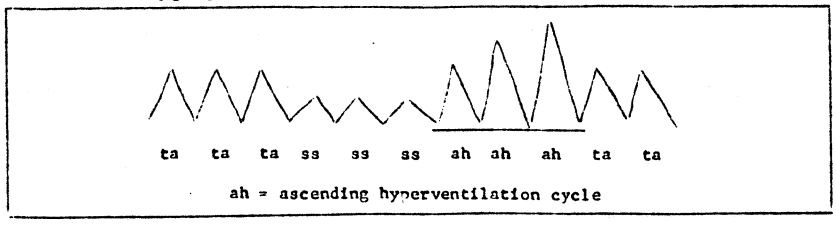
ASCENDING HYPERVENTILATION CYCLE

Within Tri-Zone Polygraph test structures an ascending hyperventilation cycle is ordinarily evidenced when there is a psychological return to the subject's basic emotional level within the general stress situation of the polygraph examination.

The subject has just passed fear of detection regarding the prior or then current question zone that provides the greater threat to his well-being. As there is psychological change, there is ensuing physiological change. During inspiration, the action of the diaphragm-inspiration muscular complex provides for compensation due to the immediately preceding suppressed breathing and there is greater than average enlargement of the chest cavity. The subject consequently has greater than tidal air intake. During expiration, relaxation of the diaphragm-inspiration muscular complex is not being inhibited, or the rib cage return unduly expedited, and there is an average diminution of the chest cavity. The subject consequently has average residual air volume.

Because the subject has greater than tidal air intake, the amplitude of an ascending hyperventilation cycle is greater than tracing average amplitude. Because the subject has average residual air volume, an ascending hyperventilation cycle is on a stable baseline.

Tri-Zone Polygraph Schematic of an Ascending Hyperventilation Cycle



A series of consecutive ascending hyperventilation cycles of progressively increasing amplitude forms a staircase relief pattern. An ascending hyperventilation cycle is classified as a relief tracing segment and constitues a part of a lack-of-reaction tracing trend.

Figure 16. An ascending hyperventilation pattern in respiration. (From Backster, Note 4.)

Ascending Hyperventilation Patterns. An ascending hyperventilation pattern consists of a series of cycles with an amplitude greater than tracing average cycle amplitude and also showing an incremental decrease toward tracing average cycle amplitude. Figure 16 illustrates an ascending hyperventilation pattern. Reaction zones which show ascending hyperventilation patterns are classified as relief zones.

Descending Hyperventilation Patterns. A descencing hyperventilation pattern consists of a series of cycles with an amplitude greater than tracng average cycle amplitude and also showing an incremental decrease toward tracing average cycle amplitude. Figure 17 illustrates a descending hyperventilation pattern. Reaction zones which show a descending hyperventilation pattern are classified as relief zones.

M.3.3 Specific Evaluation Rules for Respiration

Listening reaction VS listening distortion and answer reaction VS answer distortion rules. These rules state that any changes in the respiratory pattern that occur while the question is being asked, during the preparation to answer, or during the answer itself may be considered as scorable reactions if they occur to only one of the questions types at a locus of comparison but not to both.

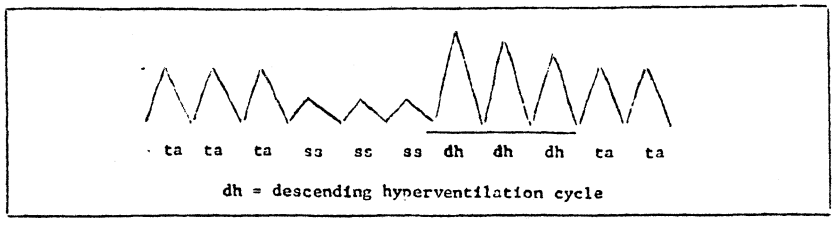
DESCENDING HYPERVENTILATION CYCLE

Within Tri-Zone Polygraph test structures a descending hyperventilation cycle is ordinarily evidenced when there is a psychological return to the subject's basic emotional level within the general stress situation of the polygraph examination.

The subject has just passed fear of detection regarding the prior or then current question zone that provides the greater threat to his well-being. As there is psychological change, there is ensuing physiological change. During inspiration, the action of the diaphragm-inspired muscular complex provides for compensation due to the immediately preceding suppressed breathing and there is greater than average enlargement of the chest cavity. The subject consequently has greater than tidal air intake. During expiration, relaxation of the diaphragm inspiration muscular complex is not being inhibited, or the rib cage return unduly expedited, and there is an average diminution of the chest cavity. The subject consequently has average residual air volume.

Because the subject has greater than tidal air intake, the amplitude of a descending hyperventilation cycle is greater than tracing average amplitude. Because the subject has average residual air volume, a descending hyperventilation cycle is on a stable baseline.

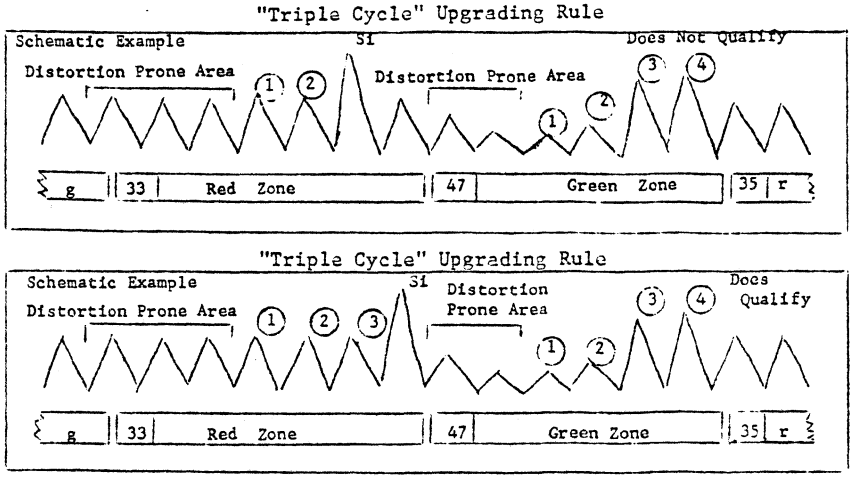
Tri-Zone Polygraph Schematic of a Descending Hyperventilation Cycle



A series of consecutive descending hyperventilation cycles of progressively decreasing amplitude forms a reverse-staircase relief pattern. A descending hyperventilation cycle is classified as a relief tracing segment and constitutes a part of a lack-of-reaction tracing trend.

Figure 17. A descending hyperventilation pattern in respiration. (From Backster, Note 4.)

BREATHING INTERPRETATION RULES



"TRIPLE CYCLE" UPGRADING RULE

In order for a "seven position scale" rating to qualify for upgrading from (t) to (tt) or from (d) to (dd), the red zone of influence and also the green zone of influence with which it is being compared must each embrace a minimum of three complete and consecutive undistorted cycles that fall outside of "typical areas of tracing distortion." Although not required--these three cycles may constitute a tracing trend.

Typical areas of tracing distortion are:

(a) listening cycle or cycles
(b) preparation to answer - answer cycle
(c) cycle following the answer cycle

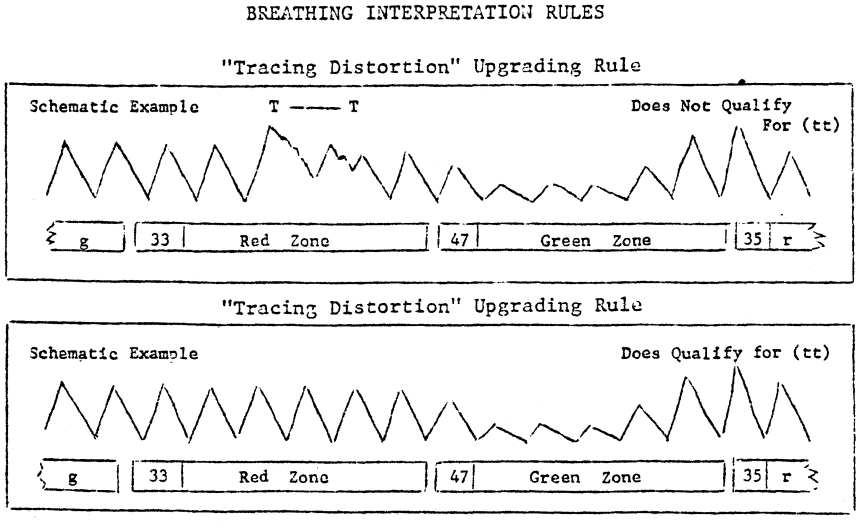
Figure 18. An illustration of the triple cycle upgrading rule. (From Backster, Note 4.)

Triple cycle upgrading rule. This rule states that for a score of +/- 3 to be assigned to a locus of comparison in the respiratory index both the relevant and the chosen control zones must encompass at least three complete, consecutive, and undistorted cycles beyond the distortion prone zone as is illustrated in Figure 18.

Illustrations of the tracing distortion, tracing purity, and reaction magnitude upgrading rules are provided in Figures 19, 20, and 21 respectively.

M.3.4 Decision Algorithms for the Electrodermal Index

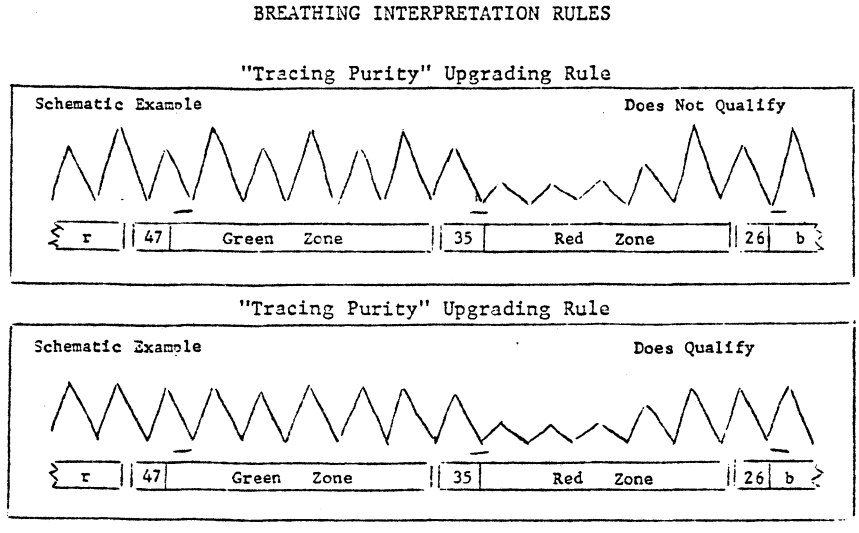
The criteria for the assignment of scores to loci of comparison in the electrodermal response (EDR) index are based on an objective measurement of EDR amplitudes. In the BSAT this amplitude is measured against an inferred extension of the tonic electrodermal baseline as is illustrated in Figure 22. The reported response amplitude consists the measured perpendicular distance from the inferred baseline to the peak of the highest response that begins within 5 seconds after the point of answer. The BSAT sets 1/8 of an inch as the smallest response to be considered. Ratios between relevant and control question EDR amplitudes are calculated and scores are assigned according to the following brakedown. Ratios of less than 2 to 1 are assigned the value of 0.



"TRACING DISTORTION" UPGRADING RULE

When inter-comparing zones during the spot analysis rating procedure, if tracing distortion exists within the red zone of influence or within the green zone of influence with which it is being compared--or in both of these zones--the rating cannot be upgraded from (d) to (dd) or (t) to (tt).

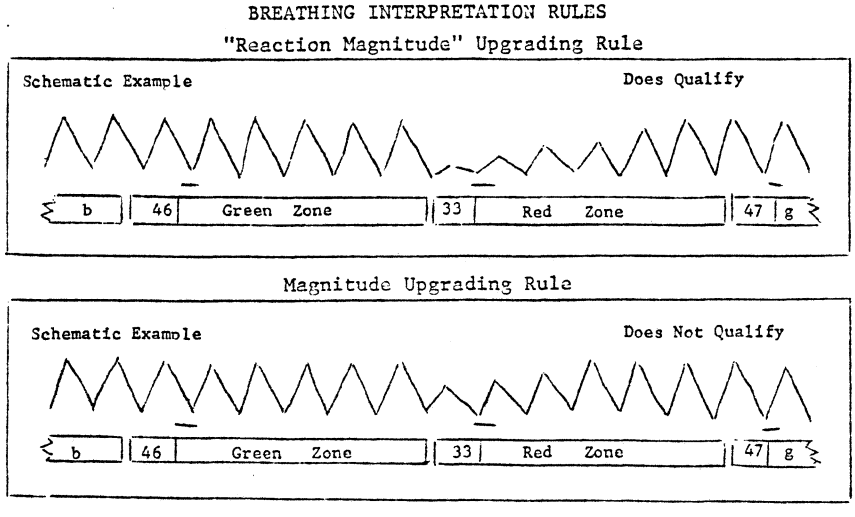
Figure 19. An illustration of the tracing distortion upgrading rule for respiration. (From Backster, Note 4.)



"TRACING PURITY" UPGRADING RULE

To upgrade a (t) or (d) interim spot rating to a (tt) or (dd) final spot rating, there must be purity (or cleanness) of the breathing tracing of those two zones of influence being inter-compared.

Figure 20. An illustration of the tracing purity upgrading rule for respiration. (From Backster, Note 4.)



"REACTION MAGNITUDE" UPGRADING RULE

To upgrade a (t) or (d) interim spot rating to a (tt) or (dd) final spot rating, there must be magnitude of the "presence of reaction" in one zone as opposed to comparative "lack of reaction" in the zone with which it is to be compared.

Figure 21. An illustration of the reaction magnitude upgrading rule for respiration. (From Backster, Note 4.)

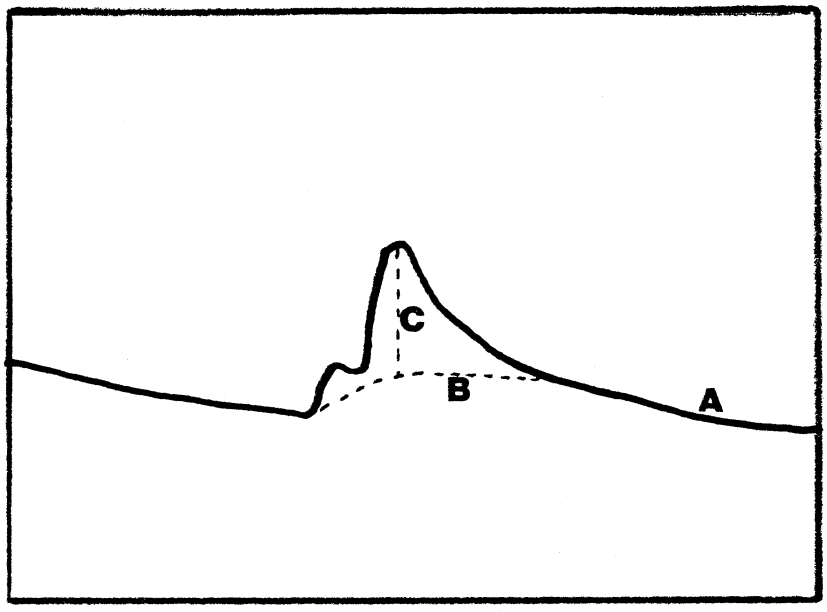


Figure 22. Measurement of electrodermal response (EDR) amplitude in the BSAT. In the above figure: A = EDR tracing, B = inferred electrodermal level, C = measured EDR amplitude. (Adapted from Backster, Note 4.)

Ratios of at least 2 to 1 are assigned a value of +/- 1. Ratios of at least 3 to 1 are assigned a value of +/- 2. Ratios of at least 4 to 1 or more are assigned a value of +/- 3, provided all the upgrading rules are met. There are no relief tracing segment classifications in the EDR index.

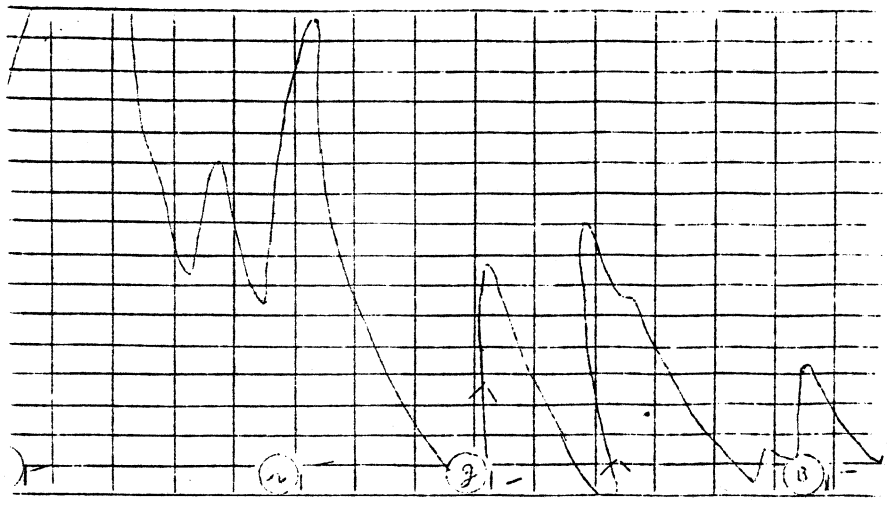
M.3.5 Specific Evlauation Rules for the Electrodermal Response Index

The minimum lack of reaction magnitude rule. This rule provides that for the calculation of the decision ratios those tracings showing no measurable responses will be assumed to display a response amplitude of 1/8 of an inch of pen deflection.

The plunging tracing rule. This rule states that scores of greater than +/- 1 are not allowed if the tracing consistantly fall on the chart at an angle of 45 degrees or greater as is illustrated in Figure 23.

Change in amplifier sensitivity rule. This rule states that scores greater than +/- 1 are not allowed if the sensitivity of the EDR amplifier is changed during either of the loci of comparison being considered.

P.G.R. INTERPRETATION RULES



"PLUNGING TRACING" RULE

The "seven position scale" rating of (t) (tt) or (d) (dd) are not permitted where a rapidly plunging tracing is evidenced during either or both of the question zones being inter-compared. This additional safety factor is warranted when experiencing plunging tracings because of the difficulty in distinguishing between authentic P.G.R. arousals and outright tracing distortion.

Figure 23. An illustration of the plunging tracing rule. (From Backster, Note 4.)

M.3.6 Decision Algorithms for the Cardiovascular Index

Reactions in the cardiovascular index are assigned numerical scores on the basis of subjective judgements made by the examiner regarding the magnitude of changes in blood volume, pulse amplitude, heart rate, and movement of the dichrotic notch. Changes showing an increase in blood volume and/or decreases in pulse amplitude and heart rate are considered reaction. Changes in the oppsite directions in these parameters are considered relief. Movements of the dichrotic notch in either direction, its disappearance and/or its appearance are all considered reaction.

M.3.7 Specific Evaluation Rules for the Cardiovascular Index

The stabilized cyclic blood pressure trend rule. This rule states that the disappearance of a prominent sinus arythmia during a measurement zone constitutes a reaction but only for a score of +/-1.

Extra-systole interpretation rule. This rule states that single or sporatic extra-systolic heart beats are not to be considered except that they constitute a violation of the tracing purity upgrading rule for this index. When an extended series of extra-systolic beats occurs in one zone but not the other the zone where the beats occur can be considered a relief zone.

M.4 TABULATION OF NUMERICAL SCORES AND THE DETERMINATION OF CUTOFFS

Following assignment, scores are intered in a table like that shown in Figure 24. These scores are then considered at each locus of comparison where one score is eliminated. The choice of which score is to be eliminated is made on the following bases. Zero scores are eliminated first, if there are no zero scores at a locus of comparison the score of least magnitude is eliminated regardless of sign. If all the scores at a locus of comparison are of equivalent magnitude but of different sign the folowing procedure is used: all scores from that chart are summed, (if the chart sum is 0, then all scores from all charts are summed) the sign of this sum is observed and the score of the least magnitude and of the oppsite sign as this sum is the one eliminated at the locus in question. The "X" marks at the respective loci of comparison in Figure 24 represent score eliminations based on these procedures.

After the elimination of one score per locus of comparison all remaining scores are summed providing a total score. This total socre is evaluated against a inconclusive zone of +/- 4 inclusive for a single chart. If more than one chart is considered then the inconclusive range is expanded by increments of +/- 4 per chart considered.

Chart Number 1

Respiration	+1	+1	
G. S. R.	+2	+2	
Cardio	-1 X	0 X	
Sub-Totals	+ 3	+ 3	+6 Chart Sub-Total

Chart Number 2

Respiration	-1 X	-1 X	
G. S. R.	+2	+1	
Cardio	+1	-1	
Sub-Totals	+3	0	+3 Chart Sub-Total

Chart Number 3

Respiration	+1	0	
G. S. R.	+1	+2	
Cardio	+1 X	0	
Sub-Total	+2	+2	+4 Chart Sub-Total

Chart Number 4

Respiration	-1	+1	
G. S. R.	+1	-1 X	
Cardio	-1 X	+1	
Sub-Total	0	+2	+2 Chart Sub-Total

— this chart eliminated as least productive

Total score +13 resulting in a decision of truthful

based on 3 of the above charts. If any chart was eliminated from consideration in the final decision please indicated chart number 4.

Do you believe the subject was using a countermeasure? No

If so what do you think the subject was doing? NA

Figure 24. A tabulation table illustrating score and chart elimination procedures from the BSAT. (Adapted from Backster, Note 4.)

In the BSAT a minimum of two charts (four loci of comparison) are required for a decision regarding a subjects truth or deception. If three or more charts are run it is permissible to eliminate charts which are non-productive as long as two complete charts are retained to base the final decision on. Non-productivity would refer to any condition which would fail to show differential reactivity, for example, a malfunction of the instrument, distortion of the tracings or hypo- or hyper-responsiveness on the part of the subject.

In this experiment the subject's least productive chart was eliminated and the total score was evaluated against an inconclusive region of +/- 12 inclusive. Subjects with a total score greater than 12 were classified as truthful while those with scores of less than -12 were classified as deceptive.

Appendix N

ANOVA TABLES FROM THE ANALYSES OF THE OBJECTIVELY REDUCED DATA

Table 10

ANOVA Table From the Analysis of the Respiration Amplitude Data

	SOURCE	SUM OF SQUARES	DEGREES OF FREEDOM	MEAN SQUARE	F	TAIL PROBABILITY
	MEAN	4.00000	1	4.00000	0.00	0.975
	G	16684.87500	3	5561.62500	1.42	0.252
1	ERROR	152861.68750	39	3919.53027		

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	C	5917.75000	3	1972.58325	0.81	0.488
	CG	13588.62500	9	1509.84717	0.62	0.775
2	ERROR	283404.75000	117	2422.26270		
	Q	166.75000	1	166.75000	0.08	0.782
	QG	18716.31250	3	6238.76953	2.90	0.047
3	ERROR	83851.43750	39	2150.03662		
	CQ	2955.06250	3	985.02075	0.41	0.746
	CQG	7437.75000	9	826.41650	0.34	0.959
4	ERROR	282957.93750	117	2418.44385		

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Q = Question

Table 11

ANOVA Table From the Analysis of the

Skin Resistance Response Data

	SOURCE	SUM OF SQUARES	DEGREES OF FREEDOM	MEAN SQUARE	F	TAIL PROBABILITY
	MEAN	42299.00000	1	42299.00000	111.36	0.000
	G	404.89453	3	134.96484	0.41	0.748
1	ERROR	14813.14453	39	379.82422		
	C	802.79297	3	267.59766	3.07	0.031
	CG	307.49609	9	34.16623	0.39	0.937
2	ERROR	10214.20313	117	87.30087		
	Q	1496.67647	1	1496.67647	22.77	0.000
	GQ	863.25269	3	287.75073	4.38	0.009
3	ERROR	2563.16821	39	65.72226		
	CQ	187.32710	3	62.50903	2.10	0.104
	CGQ	497.46729	9	55.27414	1.85	0.066
4	ERROR	3466.36110	117	29.61522		

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Table 12

ANOVA Table From the Analysis of the Finger Pulse Amplitude Data

	SOURCE	SUM OF SQUARES	DEGREES OF FREEDOM	MEAN SQUARE	F	TAIL PROBABILITY
	MEAN	421148.93750	1	421148.93750	177.51	0.000
	G	6177.25000	3	2059.08325	0.87	0.466
1	ERROR	92528.56250	39	2372.52710		
	C	6644.81250	3	2214.93750	4.82	0.003
	CG	4122.26953	9	458.02979	1.00	0.446

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2	ERROR	53719.74609	117	459.14307		
	Q	1183.60078	1	1183.60078	3.15	0.084
	QG	3827.13281	3	1275.71094	3.40	0.027
3	ERROR	14035.46094	39	375.26807		
	CQ	2470.47656	3	823.49219	2.81	0.042
	CQG	1547.27344	9	171.91927	0.59	0.805
4	ERROR	34234.71484	117	292.60425		

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Q = Question

Table 13

ANOVA Table From the Analysis of the

Heart Rate Data[a]

	SOURCE	SUM OF SQUARES	DEGREES OF FREEDOM	MEAN SQUARE	F	TAIL PROBABILITY
	MEAN	8983.17188	1	8983.17188	112.02	0.000
	G	415.00693	3	138.33564	1.73	0.177
1	ERROR	3127.56421	39	80.19394		
	C	24.07813	3	8.02604	0.18	0.906
	CG	494.64844	9	54.96094	1.27	0.262
2	ERROR	5076.28125	117	43.38701		
	Q	95.39014	1	95.39014	2.60	0.115
	QG	95.28296	3	31.76099	0.87	0.467
3	ERROR	1431.39185	39	36.70235		
	CQ	71.20313	3	23.73438	0.67	0.569
	CQG	561.73828	9	62.41536	1.77	0.080
4	ERROR	4115.73438	117	35.17722		

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G = Group

C = Chart

Q = Question

[a]Heart rate difference score calculated between basal heart rate and the average heart rate during the answer.

Table 14

ANOVA Table From the Analysis of the

Heart Rate Data[a]

	SOURCE	SUM OF SQUARES	DEGREES OF FREEDOM	MEAN SQUARE	F	TAIL PROBABILITY
	MEAN	5185.85547	1	5185.85547	96.36	0.000
	G	367.06665	3	122.35555	2.27	0.095
1	ERROR	2098.85986	39	53.81691		
	C	283.32613	3	94.44270	3.07	0.031
	CG	386.26709	9	42.91856	1.40	0.198
2	ERROR	3596.19800	117	30.73672		
	Q	9.79785	1	9.79785	0.44	0.513
	QG	78.25562	3	26.08521	1.16	0.337
3	ERROR	877.04883	39	22.48842		
	CQ	173.49609	3	57.83203	1.94	0.128
	CQG	319.74121	9	35.52679	1.19	0.309
4	ERROR	3496.66650	117	29.88603		

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G = Group

C = Chart

Q = Question

[a]Heart rate difference score calculated between basal heart rate and the average heart rate during question presentation and answer.

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THE EFFECTS OF SIMPLE PHYSICAL COUNTERMEASURES ON THE PHYSIOLOGICAL DETECTION OF DECEPTION

by

Charles Robert Honts

(ABSTRACT)

The effects of simple physical countermeasures on the validity of the control question test (CQT), a physiological detection of deception (PDD) technique, was investigated in a laboratory mock crime paradigm.

Forty-eight Introductory Psychology students served as subjects and were assigned to either an innocent group or to one of three guilty groups, who participated in a mock crime. Two of the guilty groups were trained in a countermeasure technique, either self-induced pain or muscle tension, and were coached as to when to produce responses in order to beat the test. All subjects were motivated to produce truthful responses by the offer of credit points toward their final grades if they were classified as truthful on a subsequent PDD examination. All subjects were given a field type CQT examination by an experienced field PDD examiner.

The examiner correctly classified 52% of the subjects, incorrectly classified 6%, and called 42% inconclusive.

Countermeasure usage did not produce changes in the frequency of either inconclusive of incorrect classifications. Statistically significant differences were found between the innocent and guilty groups in the semi-objective scores and in all of the objectively reduced measures (except heart rate). A significant but small difference was found between the guilty control and the countermeasures groups in finger pulse amplitude but in no other objective measure nor in the semi-objective scores.

These results suggest the validity of the CQT to be robust in the face of the countermeasures used. Implications for field use of the CQT were discussed.