



EFFECTS OF COMPARISON QUESTION TYPE AND BETWEEN
TEST STIMULATION ON THE VALIDITY OF COMPARISON
QUESTION TEST
FINAL PROGRESS REPORT ON
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DEFENSE ACADEMY OF CREDIBILITY ASSESSMENT (DACA)

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13. ABSTRACT (Maximum 200 words) This study examined the validity of two approaches to the comparison question test. Probable-lie and directed-lie comparison questions were evaluated in a mock crime experiment with 250 participants. Review of questions between charts was also manipulated. Participants took a DACA style single issue polygraph examination. Resultant polygraph data were evaluated with the Objective Scoring System. Analyses found no evidence for significant differences between the validity of the probable-lie and directed-lie approaches. However, there was a significant effect of between repetition stimulation on decisions, reflecting an increased number of true positive outcomes when stimulation was employed and a higher number of false positive errors without stimulation. Although there were no significant effects of the approach to comparison questions, there is much to recommend the directed-lie approach: It is simpler and far more standardized. It is easy to teach and to use. A very small number of directed-lie questions can be used for essentially all examinations. These and other positive factors suggest that the directed-lie should be considered for wider application in field settings. The significant positive effect for between repetition stimulation recommends this practice for adoption in the field.				
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Executive Summary

This study examined the validity of two approaches to the comparison question test in a mock crime setting. To assess credibility the comparison question test contrasts subject responses to two types of critical questions. Relevant questions are syntactically simple questions that directly address the issue being assessed by the examination (Did you shoot John Doe?). It is expected that guilty persons attempting deception to the relevant questions will produce consistent physiological responses to the relevant questions as they provoke memory of the event and concerns about deception detection. However, innocent individuals who are being truthful to the relevant questions might also respond to them because they recognize their importance in the examination. Comparison questions are designed to provoke consistent responses from the innocent. In the probable-lie approach to comparison questions the subject is maneuvered by the examiner into an answer that is probably a lie (Prior to 2008, did you ever do anything that was dishonest or illegal? Answered No). In the probable-lie approach the subject is told that the comparison questions are important because they reveal information about the subject's character that would be useful in assessing their credibility about the issue being assessed. In the directed-lie approach questions similar to those used in the probable-lie approach are used, but the subject is instructed to lie to the questions. Subjects are told that the directed-lies are important for the outcome of the test because they provide an index that the subject is responding appropriately when he or she lies, and that without that index of continued appropriate responding, the test outcome will be inconclusive. The present study manipulated the use of the probable-lie and directed-lie approaches in a 2 (Guilty, Innocent) X Question Type (Probable-Lie, Directed-Lie) factorial experiment. This study also manipulated the stimulation of questions between question repetitions so that the full experiment was a 2 X 2 X 2 fully factorial design.

Two hundred and fifty persons were tested by an experienced polygraph examiner and three research assistants trained at the laboratory to run examinations for this study. Objective Scoring System scores were analyzed as were decisions based upon those scores. The analyses found no evidence for significant differences between the validity of the probable-lie and directed-lie approaches to comparison questions. However, there was a significant effect of between repetition stimulation of the questions on decisions. Analyses revealed that the effect of stimulation was due to an increased number of true positive outcomes when stimulation was employed and a higher number of false positive errors when stimulation was not employed.

Although there were no significant effects of the approach to comparison questions, there is much to recommend the directed-lie approach:

- The directed-lie approach is simpler and far more standardized than is the probable-lie approach. It is easy to teach and to use.

- A very small number of directed-lie questions can be used for essentially all examinations.
- Examiner judgments about which probable-lies balance the relevant issues are eliminated thus improving reliability in test administration.
- Examiner skill and experience required for properly presenting probable-lie comparison questions is not needed for presenting directed-lie which can be presented by script. This too should improve reliability in test administration.
- Assumptions and examiner judgments about what is and is not a probable-lie for individual subjects are eliminated. This should further improve the reliability of test administration.
- The directed-lie does not intrude into the subjects private life, nor does it go beyond the parameters of a forensic investigation. It should thus be perceived as less intrusive and objectionable, even by sensitive subjects.
- The directed-lie has face validity for subjects and for lay persons. It should be much easier to explain to subjects, policy makers, and legal professionals.

These positive factors suggest that the directed-lie should be considered for wider application in field settings. The significant positive effect for between repetition stimulation recommends this practice for adoption in the field.

Introduction

Comparison Question Tests (CQT) are the most commonly used type of psychophysiological deception detection (PDD) test in law enforcement, forensic practice, and national security screening settings (Honts, Raskin & Kircher, 2008; Raskin & Honts, 2002; Vrij, 2008). Such tests play an important role in the United States Government's national security and law enforcement programs. World-wide, the interest in and use of PDD is growing rapidly as was evidenced by the recent European Meeting on Polygraph Testing (Merckelbach & van Koppen, 2006). However, many aspects of the polygraph testing procedure, as it is used in practice, lack strong empirical validation and, in some cases lack any empirical validation. Two aspects of comparison test administration are currently the topic of controversy in polygraph literature. Those areas of controversy concern the type of comparison question used and between chart stimulation of questions.

Types Of Comparison Questions.

Comparison questions are designed to provide the innocent suspect an opportunity to become more concerned about questions other than the relevant questions, thereby causing the innocent suspect to react more strongly to the comparison questions than to the relevant questions. There are two types of comparison questions currently used in field practice. The more common and older form of the comparison question is the probable-lie. Probable-lie comparison questions deal with acts that are similar to the issue of the investigation. However, they are more general in nature, deliberately vague, and cover long periods of time in the life history of the subject. Virtually every subject has difficulty in unequivocally answering them with a simple and truthful "No." An example of a probable-lie question in an examination regarding a robbery is "Prior to 2008, did you ever take something that did not belong to you?" Probable-lie comparison questions are reviewed with the subject after the relevant questions are discussed and reviewed, and they are presented in a manner designed to encourage the subject to answer them with a denial.

A newer form of the comparison question is the directed-lie. With directed-lie comparison questions the subject is instructed to answer certain questions with an obvious lie. A typical directed-lie question is "Prior to 2008, did you ever tell even one lie?" All subjects are told that they must show appropriate responses when lying to the directed-lie questions, or the test will result in an inconclusive outcome. The rationale for using directed-lie comparison questions is similar to the rationale for probable-lie comparison questions. It is assumed that the subject's concern will be focused on the questions that pose the greatest risk of an undesirable test outcome. For guilty subjects, the focus will be on the relevant questions that are answered deceptively. Thus, guilty subjects should show stronger reactions to the relevant questions as compared to comparison questions. It is reasoned that innocent subjects will focus on showing they are suitable subjects, and on clearly demonstrating that their reactions when lying are dif-

ferent from when they are truthful. This focus of concern is designed to enhance the reactions of truthful subjects to the directed-lie questions, making them stronger than the relevant questions. Thus, subjects who are truthful in response to the relevant questions should be most concerned about their reactions to the directed-lie questions and should give larger physiological responses to the directed-lie comparison questions as a result.

The probable-lie version of the comparison question test (CQT) has several inherent problems, and some suggest that the directed-lie is a remedy for most of these problems (Fuse, 1982; Honts, 1994; Honts & Raskin, 1988; Honts et al., 2008; Horowitz, Kircher, Honts, & Raskin, 1997). Probable-lie comparison questions can be difficult to administer in field settings and require psychological sensitivity, sophistication, and skill on the part of the examiner to obtain an accurate outcome (see the review by Raskin & Honts, 2002). Unfortunately, many polygraph examiners lack adequate training in psychological methods and do not understand the basic concepts and requirements of using a standardized psychological test in a field setting. These problems are exacerbated when the examiner formulates and introduces probable-lie comparison questions to the subject, because it is difficult to standardize the wording and discussion of probable-lie comparison questions across different field settings. Clearly, the validity of a probable-lie comparison question test depends on how the subject perceives and responds to the probable-lie questions when they are introduced and discussed during the pretest interview.

The difficulties with probable-lie comparison questions may be compounded by problems related to the characteristics of examinees (Raskin & Honts, 2002). Examinees can be very anxious about the subject matter of the probable-lie questions, making it difficult for the examiner to establish effective comparison questions. These questions may be personally intrusive and offensive to some subjects. For others, the probable-lie questions may encompass prior criminal behavior of a serious nature that poses problems for the subjects, some of whom may refuse to answer the questions. If a person is administered more than one test or tested on multiple occasions, it may become difficult to formulate new probable-lie questions that continue to be effective for the subject. Moreover, it is difficult to explain the function of probable-lie questions and their role in interpreting the outcome of the test to those who use the results of polygraph tests (e.g., investigators, lawyers, judges, and juries) and to laypersons. They often do not understand the rationale of the probable-lie and may interpret strong physiological reactions to probable-lie questions as an indication that the subject is dishonest and guilty. For all of these reasons, the directed-lie test was developed, and, on its face, appears to be a preferable approach.

The stimulation of comparison questions between charts. In a typical CQT, the question series is repeated between three and five times. These repetitions are usually referred to as charts, in reference to the time when all polygraph data were collected on paper charts. One area of marked divergence in field practice concerns what is said to subjects between those question repetitions. The Department of Defense

approach is to not discuss (stimulate) any of the test questions between question repetitions. The University of Utah approach is to discuss both the relevant and comparison questions between charts. In the Utah system, after each presentation of the question sequence, the examiner asks the subject if there were any problems and discusses any concerns that the subject expressed. The examiner then reviews the relevant and comparison questions in order to ensure that the relevant questions are clear and straightforward and the comparison questions remain salient. If the subject makes an admission to a probable-lie question or provides additional information that changes the meaning of a relevant question, this is discussed and appropriate adjustments are made in the affected questions.

Both the type of comparison question and the stimulation of questions between repetitions represent important divergences in field practice. Questions about the effects of these practice differences represent problems that currently cannot be answered definitively with empirical evidence. The meta-analysis by Honts (1999) suggests that between chart stimulation offers a positive improvement in CQT accuracy. Moreover a recent study by Offe and Offe (2007) reported results that between chart discussion had a positive effect on accuracy, when there was minimal explanation of comparison question in the pretest. When there was a normal pretest discussion of the comparison questions between chart stimulation produced non-significantly higher accuracy. However, the Offe and Offe study had relatively few subjects and thus had relatively low statistical power to find small effects.

The literature contrasting the probable-lie and the directed-lie is more equivocal, but even if the accuracy rates associated with the probable-lie and the directed-lie are roughly equivalent, the directed-lie comparison question offers substantial advantages in standardization, face validity to lay audiences, and decreased intrusiveness. Resolution of these two questions through a well-conducted experiment would provide a substantial increase in our knowledge about the best practices to take in the field. Should the evidence support between chart stimulation and the directed-lie comparison question, those techniques could be added to field practice quickly and with minimal cost in retraining. Finally, it may be that the stimulation of questions between repetitions has differential effects on probable-lie and directed-lie comparison questions. Thus it makes the most sense to study these two variables in a factorial design where their possible interaction can be examined directly.

Relation To Personnel Security Issues

The research described here was designed to address two areas where current field practices diverge. The current U. S. Government standard is to use probable-lie comparison questions (except for certain screening tests, notably the Test for Espionage and Sabotage) and to not stimulate questions between charts. However, the current scientific literature provides some support for the notions that the stimulation of questions between repetitions and (to a lesser extent) the use of directed-lie comparison questions may increase CQT accuracy (for a summary see Raskin & Honts, 2002). If either of these inno-

vations offers even a modest improvement (of even 1 or 2 percent) in overall CQT accuracy this could have a major impact given the large number of individuals administered polygraph tests each year by law enforcement and in national security settings. The present study was designed to provide statistically powerful evidence regarding these potentially important variables.

Literature Review

The present first author has recently published two major co-authored reviews of CQT accuracy and practice (Honts et al., 2008; Raskin & Honts, 2002). Both publications provide extensive reviews of the scientific literature concerning the administration and validity of the two types of comparison questions, as well as the scientific literature concerning the stimulation of questions between repetitions. The following review closely follows Raskin & Honts (2002).

Validity Of The Probable-lie Approach

The validity of comparison question polygraph tests is the subject of intense debate among scientists (for example see the most recent exchange between: Honts et al., 2008; Iacono & Lykken, 2008). Although the majority of psychophysicists and psychologists who work in the area of Psychology and Law express generally positive attitudes concerning the usefulness of polygraph tests for assessment of credibility (Amato & Honts, 1994; Gallup, 1984; Honts, Thurber, Cvencek, & Alloway, 2002), the American Psychological Association expressed serious concerns about their scientific basis and some specific applications (see Raskin, 1986, p 73). In the last 30 years, there has been a great deal of research, development, and experience with various techniques that employ physiological measures for assessing credibility regarding specific facts, events, or knowledge (Honts et al., 2008).

The debate about the accuracy of comparison question centers on two general sources of data from which the accuracy of such tests are estimated. Data are obtained either from laboratory simulations or studies of actual cases that include testing of one or more suspects in a criminal investigation. There are advantages and disadvantages to each type of study, and both types are needed to provide an overall picture of test accuracy.

Laboratory Studies. Laboratory research is an attractive alternative because the scientist can control the environment. Moreover, with regard to credibility assessment studies, the scientist can know with certainty who is telling the truth and who is lying by randomly assigning subjects to conditions. Laboratory research on credibility assessment typically makes subjects deceivers by having them commit a mock crime (e.g. "steal" a watch from an office), and then instructing them to lie about it during a subsequent test. From a scientific viewpoint, random assignment to conditions is highly desirable because it controls the influence of extraneous variables that might confound the results of the experiment (Shadish, Cook &

Campbell, 2002). The most accepted type of laboratory study realistically simulates a crime in which some subjects commit an overt transgression, such as a theft (Kircher, Horowitz, & Raskin, 1988). While the guilty subjects enact a realistic crime, the innocent subjects are merely told about the nature of the crime but do not participate in it. All subjects are motivated to produce a truthful outcome, usually by a cash bonus for passing the test. For example, one such study used prison inmates who were offered a bonus equal to one month's wages if they could produce a truthful outcome (Raskin & Hare, 1978).

The advantages of careful laboratory simulations include total control over the issues that are investigated and the types of tests that are used, consistency in test administration and interpretation, specification of the subject populations that are studied, experimental control over the skill and training of the examiners, and absolute verification of the accuracy of test results. Carefully designed and conducted studies that closely approximate the methods and conditions characteristic of high quality practice by polygraph professionals and that use subjects similar to the target population, such as convicted felons or a cross-section of the general community, provide the most generalizable results (Kircher et al., 1988). Some laboratory research, including some credibility assessment studies, can be criticized for a lack of realism. This lack of realism may (but not necessarily) limit the ability of the scientist to apply the results of the laboratory to real-world settings. However, a recent study reported by Anderson, Lindsay, and Bushman (1999) examined a broad range of laboratory-based psychological research. They concluded the following, "Correspondence between lab- and field-based effect sizes of conceptually similar independent and dependent variables was considerable. In brief, the psychological laboratory has generally produced truths, rather than trivialities." (p. 3). It thus seems reasonable to conclude that high quality studies of the CQT are similar to other areas of psychological research and that those studies produce important information about the validity of such tests and not trivial information as some of the critics have claimed (e.g., Iacono & Lykken, 2008). Moreover, the majority of scientists in the Society for Psychophysiological Research and the American Psychology Law Society opine that judges and other policy makers should give weight to the results of laboratory studies of the polygraph (Honts et al., 2008.) A Committee of Concerned Social Scientists filed a Brief for Amicus Curiae (Honts & Peterson, 1997) with the Supreme Court of the United States in the case of *United States v. Scheffer* (1998). They found eight high quality laboratory studies of probable-lie versions of the CQT. Honts and Schweinle (2009) updated this work including three more recent studies that meet the criteria. The results of those laboratory studies are illustrated in Table 1. The high quality laboratory studies indicate that the CQT is a very accurate discriminator of truth tellers and deceivers. Over the studies, when inconclusive outcomes are ignored, the CQT correctly classified about 91% of the subjects and produced approximately equal numbers of false positive and false negative errors.

Table 1. Outcome For High Quality Laboratory Studies

Study	Guilty				Innocent			
	n	% Correct	% Wrong	% Inc	n	% Correct	% Wrong	% Inc
Driscoll et al. (1987) ^b	20	90	0	10	20	90	0	10
Ginton et al. (1984)	2	100	0	0	13	85	15	0
Honts et al. (1994) ^a	20	70	20	10	20	75	10	15
Honts et al. (2004) ^b	24	92	0	8	24	92	8	0
Horowitz et al. (1997) ^c	15	53	20	27	15	80	13	7
Kircher & Raskin (1988)	50	88	6	6	50	86	6	8
Offe & Offe (2007) ^d	18	89	11	0	15	93	7	0
Patrick & Iacono (1989)	24	92	8	0	24	64	36	0
Podlesny & Raskin (1978)	20	70	15	15	20	90	5	5
Podlesny & Truslow (1993)	72	69	13	18	24	75	4	21
Raskin & Hare (1978)	24	88	0	12	24	88	8	4
Rovner (1986) ^a	24	88	0	12	24	88	8	4
Means	26.08	82.42	7.75	9.83	22.75	83.83	10.00	6.17

^aCountermeasure subjects excluded.

^bConditions representing standard field practice.

^cTraditional comparison question subjects only.

^dStandard pretest subjects only.

Field studies. The major disadvantage of laboratory simulations is the difficulty of completely simulating the real-life situation in which a person suspected of a crime is administered a polygraph test. To verify test accuracy under field conditions, it is necessary to use tests conducted on actual criminal suspects. However, field studies of criminal suspects also have inherent problems. The major problem is obtaining verification of the accuracy of the test outcomes, which can be very difficult in real cases. Two

general methods have been used to develop a criterion of guilt and innocence against which to assess the accuracy of field polygraph tests (Raskin, 1986). The best and most common method utilizes confessions to verify the guilt and innocence of the examinees. Law enforcement cases that involve polygraph tests produce rates of confessions in the range of 30% to 80%, but it is not known how these cases compare to those that did not produce confessions (Raskin, 1986).

The other method of case verification relies on a panel of legal experts who review the case facts to provide judgments concerning the guilt or innocence of individual suspects. The use of panel decisions produces different problems than a criterion based on confessions (Raskin, 1986). Since the panel criterion for guilt and innocence is an educated guess, it is subject to unreliability and error. However, Honts (1996) examined the reliability of a panel decision as compared to the a confession criterion and found that such panel decisions could be reliable, and were not significantly different from cases confirmed by a confession criterion. Additional research is needed to refine the panel criterion approach. The other major problems with field studies concern the representativeness of the cases selected, the training and skill of the polygraph examiners who conducted the tests, and the adequacy of the test methods and diagnostic procedures employed. To estimate the accuracy of polygraph tests on criminal suspects, it is necessary to select cases in which the subjects were suspects, not victims or witnesses. Although it is generally recognized that polygraph tests are most likely to produce false positive errors on victims of serious crimes (Raskin, 1986), at least one major field study (Horvath, 1977) used a large number of tests in which verified innocent victims had been tested (see Raskin, 1986).

It is important that field studies select cases according to scientifically acceptable sampling procedures, using only cases in which properly trained polygraph examiners employed standard field methods for conducting the tests and interpreting their outcomes. Some of the frequently cited studies (e.g., Kleinmuntz & Szucko, 1984) failed to adhere to these principles. As a result, such studies provide limited information concerning the accuracy of properly conducted and interpreted polygraph tests. The Kleinmuntz and Szucko study stands out because it embodied all the serious methodological errors. They used only cases in which persons suspected of theft were ordered by their employers to take tests from a commercial polygraph firm, and they did not describe how they selected cases from the files of the commercial polygraph firm. In addition, they based the results on interpretations made by students in a commercial polygraph training course who were not trained in systematic methods of test interpretation, and they required the student examiners to make definite judgments of guilt or innocence on the basis of reactions to a single relevant question. It is not surprising that their study produced low rates of accuracy. Gross violations of acceptable scientific methodology and polygraph procedures render that study totally meaningless for estimating the accuracy of standard field polygraph examinations conducted by competent examiners under appropriate conditions.

In summary, it now seems to be generally agreed by persons doing field research in this area (Honts et al., 2008) that useful field studies of the psychophysiological credibility assessment tests should have all of the following characteristics:

- Subjects should be sampled from the actual population of subjects in which the researcher is interested. If the researcher wants to make inferences about tests conducted on criminal suspects, then criminal suspects should be the subjects who are studied.
- Subjects should be sampled by some random process. Cases must be accepted into the study without reference to either the accuracy of the original outcome or to the quality of the physiological recordings.
- The resulting physiological data must be evaluated by persons trained and experienced in the field scoring techniques about which inferential statements are to be made. Independent evaluations by persons who have access to only the physiological data are useful for evaluating the information content of those data. However, the decisions rendered by the original examiners probably provide a better estimate of the accuracy of polygraph techniques as they are actually employed in the field.
- The credibility of the subject must be determined by information that is independent of the specific test. Confessions documented by physical evidence are presently the best criterion available.

Unfortunately, there are few field studies from which we can estimate the accuracy of properly conducted comparison question tests. In 1983, the Office of Technology Assessment of the United States Congress selected 10 field studies that it felt had at least some degree of scientific merit. The overall accuracy of the polygraph decisions was 90% on criterion-guilty suspects and 80% on criterion-innocent suspects. In spite of the inclusion of many studies with serious methodological problems, accuracy in field cases was higher than is claimed by some of the most vocal critics (Iacono & Lykken, 2008).

A more recent survey of the available field studies was performed by the Committee of Concerned Social Scientists (Honts & Peterson, 1997). Four field studies were found that met the criteria, listed above, for meaningful field studies of psychophysiological credibility assessment tests. The results of the independent evaluations for those studies are illustrated in Table 2. Overall, the independent evaluations of the field studies produce results that are quite similar to the results of the high quality laboratory studies. The average accuracy of field decisions for the CQT was 90.5 percent. However, with the field studies nearly all of the errors made by the CQT were false positive errors.

Table 2. Outcomes Of High Quality Field Studies.

Study	Guilty				Innocent			
	n	% Correct	% Wrong	% Inc	n	% Correct	% Wrong	% Inc
Honts (1996) ^a	7	100	0	0	6	83	0	17
Honts & Raskin (1988) ^b	12	92	0	8	13	62	15	23
Mangan et al., (2008)	15	100	0	0	15	93	7	0
Patrick & Iacono (1991) ^c	52	92	2	6	37	30	24	46
Raskin et al. (1988) ^d	37	73	0	27	26	61	8	31
Means	24.6	91.4	0.4	8.2	19.4	65.8	10.8	23.4

^aSub-group of subjects confirmed by confession and evidence.

^bDecision based only on comparisons to traditional comparison questions.

^cResults from the mean blind rescoring of the cases "verified with maximum certainty" (p.235)

^dThese results are from an independent evaluation of the "pure verification" cases.

The scientific data concerning the validity of the polygraph can be summarized as follows: High quality scientific research from the laboratory and the field converge on the conclusion that, when properly conducted, the CQT is a highly accurate discriminator of truth tellers and deceivers. The research results converge on an accuracy estimate that exceeds 90 percent. Moreover, original examiners, who are most likely to offer testimony, produce even higher estimates of accuracy. There may be a tendency for the CQT to produce more false positive than false negative errors, but this trend in the current literature is not particularly strong. Moreover, no tendency toward false positive errors is seen in the decisions of the original examiners.

Validity Of The Directed-lie Approach

Since the directed-lie is relatively new, there are fewer studies of its validity. As with the probable-lie there are some laboratory validity (Department of Defense Polygraph Institute [DoDPI], 1995; 1997; 1998; Honts & Alloway, 2007; Horowitz et al., 1997; Reed, 1994) and one field validity (Honts & Raskin, 1988) studies. The Horowitz et al. study used a mock crime that closely approximated the field situation. Horowitz et al. compared the effectiveness of the directed-lie with the probable-lie and a relevant/irrelevant (RI) approach. Different groups received one of two types of directed-lies: the personally relevant

directed-lies using the procedures described, or simple directed-lies to three of the trivial neutral questions that were used in the RI. The results of the Horowitz et al. (1997) study indicate that compared to the other three conditions, the personal directed-lie produced the highest accuracy, except for the RI with guilty subjects. The outcomes for the four types of tests are presented in Table 3. Among all question structures, the personal directed-lie produced the highest number of correct decisions on innocent subjects and among the three tests that employed comparison questions, it produced the highest number of correct decisions on guilty subjects.

Table 3. Test Outcomes On The Horowitz Et Al. (1997) Study.

Experimental Groups	Test Outcomes (%)			
	Correct	Wrong	Inconclusive	% Correct Decisions
Guilty				
Relevant-irrelevant	100	0	0	100
Trivial Directed-Lie	53	20	27	73
Personal Directed-Lie	73	14	13	84
Probable-Lie Comparison	53	20	27	73
Innocent				
Relevant-irrelevant	20	73	7	22
Trivial Directed-Lie	67	13	20	84
Personal Directed-Lie	87	13	0	87
Probable-Lie Comparison	80	13	7	86

n = 15 for each of the experimental groups.

The percentage of correct decisions was calculated by excluding inconclusive outcomes.

The U. S. Department of Defense reported three sets of studies concerning the validity of the directed-lie comparison question in national security settings. Barland (1981) examined the validity of the Military Intelligence version of the directed-lie in a mock screening setting with 26 truthful subjects and 30 subjects who attempted deception. All subjects were tested with the directed-lie comparison; no other techniques were examined. Excluding inconclusive outcomes, Barland's evaluators correctly classified 79% of the subjects. Although this might be considered modest performance in comparison to that obtained in the University of Utah studies, it must be remembered that the Barland (1981) study was a screening study. When compared with other mock-screening studies, which have often produced near chance performance with probable-lie tests (e.g. Barland, Honts, & Barger, 1989; Honts, 1992), the performance of the directed-lie in Barland (1981) was actually quite strong. Abrams (1991) reported the only other laboratory

study of the directed-lie. Unfortunately that study was so poorly designed and methodologically flawed that the data it generated are meaningless, by the author's own admission (see the Abrams quotes in Honts & Gordon, 1998, p.248; and in Honts, Raskin, Amato, Gordon, & Devitt, 2000, p.158.) Abrams and Matte (Abrams, 1999; Matte, 1998; 2000; Matte & Reuss, 1999) are outspoken critics of the directed-lie approach, but their criticisms are easily shown to be without merit and essentially all of their attacks are baseless. Interested readers are referred to the research and commentary by Honts and his colleagues (Honts, 1999; 2000; Honts & Gordon, 1998; Honts et al., 2000).

The other studies on the directed-lie concern a newer test, the Test of Espionage and Sabotage (TES) developed by DODPI for use in national security screening tests. Reed (1994; also published as DODPI Research Staff, 1997), reported three laboratory mock screening studies. Following a series of studies that indicated that the national security screening tests of the time were making an unacceptably high number of false negative errors (Barland et al., 1989; Honts, 1991; 1992; 1994) the DODPI attempted to develop a more accurate screening test. It should be noted that the primary concern in conducting national security screening tests is a desire to avoid false negative errors. Following a series of studies that are not publicly available, Reed described the product of the DODPI's efforts. In the first study reported in Reed, the TES, a test format with only directed-lie comparison questions, was tested against two versions of the Counterintelligence Scope Polygraph (CSP) test. One version of the CSP used probable-lie comparison questions while the other used directed-lie comparison questions. The TES outperformed both of the CSP formats in terms of correctly identifying guilty subjects. The CSP with directed-lie comparisons was slightly, but not significantly, better at identifying guilty subjects than was the CSP with probable-lie comparisons. The second Reed study reported even higher accuracy for the TES, a directed-lie comparison test format. Little information is provided about the third study, but it also appears to show considerable accuracy for the directed-lie based TES.

DODPI Research Staff (1998) reported a mock espionage/sabotage study that involved 82 subjects. All subjects were tested with the TES. Excluding one inconclusive outcome, the examiners correctly identified 98% of the innocent subjects and 83.3% of the guilty subjects. This study also indicates that the directed-lie comparison-based TES is extremely successful in discriminating between innocent and guilty subjects. Honts and Alloway (2007) report a study of the susceptibility of the TES to information as a countermeasure. They failed to find any effects of exposing subjects to Masche and Scalabrini's (2000) online book about beating the lie detector. Honts and Alloway did not report a direct comparison of directed-lie to probable-lie. They reported 72.5% overall accuracy for their subject, but noted that the study was not designed to be an estimate of the field validity of the TES, rather it was designed as a test of the effectiveness of information as a countermeasure.

To date, Honts and Raskin (1988) have reported the only field study of the DLT. They conducted polygraph tests of criminal suspects over a four-year period and obtained 25 confirmed tests in which one personal directed-lie was included along with probable-lie comparison questions. Each of the investigators then performed blind interpretations of the charts obtained by the other investigator, scoring them with and without the use of the directed-lie question. The results of the Honts and Raskin study indicated that inclusion of the directed-lie question in the numerical evaluation of the charts had a noticeable effect on the confirmed innocent suspects, reducing the false positive rate from 20% to 0%. For the confirmed guilty suspects, it had the slight effect of changing one inconclusive outcome to a false negative. The effects of the directed-lie question on the numerical scores were more dramatic. Inclusion of the directed-lie comparisons almost doubled the size of the total numerical scores for the confirmed innocent suspects, raising the mean score from +4.7 to +9.0. It had a lesser effect on the scores of the confirmed guilty suspects, lowering them from -13.8 to -11.5. Thus, the directed-lie question had the effect of raising the mean score for innocent suspects from the inconclusive range into the definite truthful area, while leaving the mean score for guilty suspects clearly in the deceptive area. The main impact of the directed-lie question was a reduction in false positive errors.

Matte & Reuss (1999) and Matte (1998; 2000) have claimed that the directed-lie approach lacks construct validity. However, analyses by Honts and his colleagues (Honts, 2000; Honts & Alloway, 2007; Honts & Gordon, 1998; Honts et al., 2000) have clearly demonstrated that Matte's conceptual arguments are without merit. Moreover, the only empirical data to support their position was based on a simulation study where individuals were asked to imagine that they were taking a polygraph examination. Such data must clearly be questioned on the basis of external, face and construct validity, especially in the face of the positive validity data from subjects actually given polygraph examinations.

In summary, the results from the laboratory and the field are consistent with the proposition that the directed-lie test represents substantial conceptual and practical advantages over the probable-lie comparison question test. It is more standardized in its structure; it is easier to administer; it requires less manipulation of the subject and creates fewer problems for the subject; it is more readily explained to layperson, lawyers, judges, and juries. Most importantly, some evidence suggests that the directed-lie produces fewer errors as compared with probable-lie tests.

Between Repetition Stimulation Of Test Questions

As was noted above, one area of marked divergence in field practice concerns what is said to subjects between question repetitions (charts.) The Department of Defense approach is to not discuss (stimulate) any of the test questions between question repetitions. The University of Utah approach is to discuss both the relevant and comparison questions between charts. In the Utah system, after each presentation of the question sequence, the examiner asks the subject if there were any problems and discusses any concerns

that the subject expressed. The examiner then reviews the relevant and comparison questions in order to ensure that the relevant questions are clear and straightforward and the comparison questions remain salient. If the subject makes an admission to a probable-lie question or provides additional information that changes the meaning of a relevant question, this is discussed and appropriate adjustments are made in the affected questions.

Abrams (1999) and Matte (2000) claim that the between-charts discussion and review of questions places undue emphasis on the comparison questions and increases the risk of a false negative error. However, Honts (1999) analyzed data from 19 studies that involved 1092 polygraph tests. The results of the Honts analysis strongly suggest that between-charts discussion, even when limited only to the comparison questions, decreases the risk of error (see additional discussion of this issue in: Honts, 2000 and Honts et al., 2000.) However, none of the studies cited by Honts and his colleagues was designed to directly test the question of the effects of between repetition question stimulation. The present study directly addressed this issue in an experimental design.

Research Questioned Addressed in the Project

- Are there significant differences in accuracy between CQT tests conducted with probable-lie comparison questions or directed-lie comparison questions?
- Does a University of Utah style stimulation of questions between charts significantly effect CQT test accuracy?
- Does a University of Utah style stimulation of questions between charts interact with the type of comparison questions used in the CQT?

Method

Participants. Two hundred and fifty individuals (126 female, 124 male) were recruited via help-wanted ads on craigslist.com (see Appendix A), which stipulated an hourly wage of \$15 for approximately 2 1/2 hours of participation in a polygraph research study. Individuals who were currently pregnant, taking prescription medication for high blood pressure, a heart condition, or to treat a psychological disorder, or had previously taken a polygraph examination, were deemed ineligible for participation in the study (see Appendix B). Those who met the selection criteria were randomly assigned to one of eight experimental conditions. Participants ranged in age from 18 to 65 (Mode = 20, $M = 30$, $SD = 10.5$).

Examiners. An experienced polygraph examiner (the principal investigator, 32 years of field polygraph experience at project onset) used reference materials provided by the Department of Defense Polygraph Institute (now DACA) to train three individuals, none of whom was a practicing polygraph

examiner, to conduct polygraph examinations. Two of the examiners were undergraduate research assistants, the third was a recent graduate with a B.A. in psychology and who worked as the paid Research Assistant for the project. The latter examiner had run polygraph examinations as part of a previous research project in our laboratory. The goal of the training was that the examinations should follow field procedures as closely as possible. The polygraph examiner and the assistants who greeted the participants were unaware, at all times, of the participants' guilt or innocence. The experienced polygraph examiner conducted 92 examination in the project. The Research Assistant conducted 84 examination. The female undergraduate examiner conducted 38 examinations while the male undergraduate examiner conducted 35 examinations.

Apparatus. Physiological data were collected with CPSII field polygraph instruments. The following physiological responses were monitored: Thoracic and abdominal respiration were monitored with Pneumotrace strain sensors placed around the chest and abdomen; electrodermal response was measured from disposable Vermed GSR-13 electrodes placed on the palm in the area of the thenar and hypothenar eminences; relative blood pressure was monitored from a cuff placed on the subjects upper left arm; and peripheral blood flow was monitored with a photoelectric plethysmograph placed on the distal surface of the subject's right thumb. A Stoelting movement sensor was placed in the seat of the subject's chair. Instrumentation filtering and sampling was modeled after field instrumentation procedures as closely as possible.

Design. The design of the study was a 2 (Guilty, Innocent) X 2 (Probable-Lie, Directed-Lie) X 2 (Between Chart, Not) between subjects factorial. Subjects were randomly assigned to eight conditions with the constraint that each condition would be considered to be complete when 24 subjects had been run in that condition.

Procedures. The design was implemented using of a variation of the mock crime paradigm developed at the University of Utah (e.g., Podlesny & Raskin, 1978). Upon arriving at the Applied Cognition Research Institute, participants were directed to a room in which they privately watched a video (the script of which was also presented in typewritten form; see Appendix C). This script/video described that their participation in the study may involve stealing some money and that they, regardless of their assigned condition, would be taking a polygraph examination during which they were to try to convince a polygraph examiner that they were giving truthful responses to the questions. If they agreed to the described conditions of the study, participants signed an informed consent sheet (see Appendix D). After their consent was obtained, participants selected an unmarked sealed envelope from a box of unmarked envelopes. That envelope contained instructions for watching another video that would describe their condition assignment and instructions for carrying out their task(s).

Some participants (Innocent) were shown a video informing them that they were assigned to the innocent condition and thus they were not going to be stealing any money during the study. These participants were told that they would be paid a \$20 bonus if they successfully convinced the polygraph examiner that they were innocent of stealing \$20 from the Education Building (see Appendix E). These participants were instructed to leave the laboratory building and go to the Education Building (that houses the Psychology Department), where they were to deliver an envelope to the door of Dr. Anooshian's office and return to the laboratory 20 minutes later to take a polygraph examination.

Other participants watched a video informing them that they were assigned to the guilty condition and thus they were going to be stealing money during the study. These participants were also informed that if they were successful in passing the polygraph examination, by producing a truthful outcome concerning the theft of \$20 from the Education Building, they would be paid a \$20 bonus (see Appendix F). These participants were instructed to leave the laboratory building and go to the Education Building. They were asked to find Dr. Anooshian's office and steal an envelope addressed to Sam Stone that was taped to the door. They were then asked to open the envelope and hide its contents (a \$20 bill) on their person. They were asked to return to the laboratory 20 minutes later to take a polygraph examination.

Upon returning to the laboratory, an assistant introduced the participants to the polygraph examiner. Participants were reminded by the examiner that their polygraph examination would be videotaped and that the purpose of the examination was to identify the person who had stolen an envelope containing \$20 from the door of Dr. Anooshian's office in the Education Building earlier that day. Examination sessions began with the examiner collecting some general information from the participant concerning things such as the participant's general health, how well they had slept the night before, whether he/she had ever taken a polygraph exam. This was done using the built-in biographical forms in the CPS II software. Participants were then told that they were a suspect in the theft of \$20 from the Education Building and were asked if they had, in fact, stolen the envelope containing the money. After participants denied the accusation, the examiner asked them to explain where they had been and what they had been doing for approximately the last two hours.

At this point, the examiner briefly discussed the nature of the autonomic nervous system. In essence, that although individuals are largely able to control their motor behavior, many functions of the body, such as temperature regulation, heart rate, and breathing are largely uncontrollable and vary automatically in response to physical and psychological stressors, such as lying.

Next, the function of each sensor was described to participants, and participants were told to expect that, due to the pressure applied from the blood pressure cuff, they might experience a tingling sensation in and/or some discoloration of the arm on which the blood pressure cuff was placed. At this point, participants were asked to sign another informed consent sheet (see Appendix G). Next, participants were

told that a practice test was going to be conducted before the actual polygraph examination concerning the theft. The practice test was introduced under the guise of being necessary for establishing participants' unique physiological reactions to lying. Participants were told to pick a number between 2 and 6 and inform the examiner of the number that was chosen. It was explained that after the sensors were attached to the participant a series of questions would be posed, beginning with "Concerning the number that you chose, was it the number 1?" and continuing through to number 7. Participants were instructed to answer "no" to each of the seven questions, so that during the asking of the question regarding the number that was selected (and hence their deception was known) their unique physiological responses to lying could be identified.

Participants were asked to wash their hands (so that the best possible recordings from the sensors could be obtained). At this point, the sensors were attached, and the practice test was conducted. All participants were told that the polygraph revealed a highly distinct change in their physiological responses on the question to which they lied. Hence, the participant was a suitable subject for a polygraph examination. Next, each of the questions that would be asked during the polygraph examination concerning the theft of \$20 was reviewed with the participants. As the examiner read each question, the participant was instructed to answer with a "yes" or "no" just as they would during the actual examination. All participants were asked 3 relevant questions, 3 control questions, 2 neutral questions and three other questions (see Appendix H). After all the questions were reviewed and responded to by the participants, a comparison question test was conducted according to standard procedures used by the U. S. Federal polygraph examiners.

After the examination was completed, participants received a thorough debriefing by the examiner, during which they were told about the outcome of their examination (i.e., whether their responses were scored as truthful or deceptive) and the various conditions that were being compared as part of the study. Finally, participants were thanked and paid for their participation.

The resulting physiological data were edited independently by an experienced polygraph examiner who was not informed about subject assignment to conditions. Following editing, the data were analyzed with the Objective Scoring System module that is part of the CPSII software.

Results

OSS total scores were analyzed with a 2 (Guilty) X 2 (Test Type) X 2 (Stimulation) ANOVA. Means for all of the Cells of that ANOVA are shown in Table 3. The ANOVA revealed only one significant effect, a

Table 3. Cell Means For The 2 X 2 X 2 Design.

Test Type	Stimulation	Guilt	Mean	Std. Deviation	N
Probable-Lie	Yes	Guilty	-24.30	27.749	30
		Innocent	16.03	25.350	31
		Total	-3.80	33.269	61
	No	Guilty	-26.91	20.847	32
		Innocent	14.33	26.914	30
		Total	-6.95	31.574	62
	Total	Guilty	-25.65	24.262	62
		Innocent	15.20	25.926	61
		Total	-5.39	32.331	123
Directed-Lie	Yes	Guilty	-21.30	28.444	30
		Innocent	20.06	25.259	34
		Total	.67	33.754	64
	No	Guilty	-21.27	25.266	33
		Innocent	12.45	25.727	29
		Total	-5.50	30.438	62
	Total	Guilty	-21.29	26.607	63
		Innocent	16.56	25.556	63
		Total	-2.37	32.186	126
Total	Yes	Guilty	-22.80	27.900	60
		Innocent	18.14	25.185	65
		Total	-1.51	33.458	125
	No	Guilty	-24.05	23.190	65
		Innocent	13.41	26.127	59
		Total	-6.23	30.893	124
	Total	Guilty	-23.45	25.462	125
		Innocent	15.89	25.643	124
		Total	-3.86	32.228	249

large main effect for Guilt, $F(1, 241) = 143.82, p < .001$. The complete ANOVA table for the analysis is provided in Table 4. Review of the effect sizes and significance levels associated with the non-significant effects reveals that none of them approached significance or accounted for any appreciable amount of variance in the data. Virtually all the systematic variance in these data was accounted for by the Guilt variable.

Table 4. Complete ANOVA Table For The Primary Analysis.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	98021.527 ^a	7	14003.075	21.149	.000	.381
Intercept	3706.549	1	3706.549	5.598	.019	.023
Test Type	450.519	1	450.519	.680	.410	.003
Stimulation	548.437	1	548.437	.828	.364	.003
Guilt	95223.943	1	95223.943	143.821	.000	.374
Test Type X Stimulation	41.699	1	41.699	.063	.802	.000
Test Type X Guilt	163.544	1	163.544	.247	.620	.001
Stimulation X Guilt	175.780	1	175.780	.265	.607	.001
Test Type X Stimulation X Guilt	283.345	1	283.345	.428	.514	.002
Error	159566.553	241	662.102			
Total	261297.000	249				
Corrected Total	257588.080	248				

a. R Squared = .381 (Adjusted R Squared = .363)

To provide some prospective on the effect of the independent variables on decisions, the OSS scores were turned into decisions using the simple ± 6 rule. That is, examinations with OSS total scores of +6 or greater were classified as truthful. Examinations with OSS total scores of -6 or less were classified as deceptive and examinations with totals scores between -6 and +6 were classified as inconclusive. The resulting decisions were coded as deceptive = -1, inconclusive = 0 and truthful = 1. This coding scheme retains the ordinal characteristics of the underlying interval scaling of the OSS values. This data vector was submitted to a 2 (Guilt) X 2 (Test Type) X 2 (Stimulation) ANOVA. Although the scaling of these data may violate the assumptions of ANOVA they clearly are ordinal and one could argue that the coding method here is a simple transformation of the original interval scale that retains characteristics of an interval scale, albeit, a truncated one. In any event we wanted to provide the most powerful test possible of the effects of the independent variables and currently there is no non-parametric test of interactions. The resultant ANOVA table is provided here as Table 5. Similar to the ANOVA of the underlying OSS scores,

Table 5. ANOVA Table From The Analysis Of The Coded Decision Data.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	84.262 ^a	7	12.037	19.123	.000	.356
Intercept	10.711	1	10.711	17.015	.000	.066
Test Type	.406	1	.406	.644	.423	.003
Stimulation	2.592	1	2.592	4.117	.044	.017
Guilty	78.303	1	78.303	124.393	.000	.340
Test Type X Stimulation	.003	1	.003	.005	.942	.000
Test Type X Guilt	.513	1	.513	.814	.368	.003
Stimulation X Guilt	1.146	1	1.146	1.821	.178	.007
Test Type X Stimulation X Guilt	.059	1	.059	.093	.761	.000
Error	152.334	242	.629			
Total	247.000	250				
Corrected Total	236.596	249				

a. R Squared = .356 (Adjusted R Squared = .338)

this analysis revealed a large main effect of Guilt, $F(1, 242) = 124.39, p < .001$. However, this analysis also revealed a significant, but small effect of Stimulation between charts, $F(1, 242) = 4.12, p = .04$. Exploring this effect revealed that there were more cases were classified as deceptive when no between chart stimulation was employed. We explored that effect by creating cross-tabulations of Stimulation X Decision layered by Guilt. The resulting cross tabulation is presented here as Table 6. Examination of Table 6 reveals that the effect of stimulation is due to an increased number of true positive outcomes when stimulation was employed and a higher number of false positive errors when stimulation was not employed, *Kendal's tau-c* = $-.173, p = .038$, for the Innocent table, all tests with the Guilty table were not significant. These results indicate that between chart stimulation of the comparison questions produced a positive effect on decisions with Innocent subjects, but no effect on the accuracy of decisions with Guilty Subjects.

Table 6. Cross Tabulation Of OSS Decisions And Stimulation Between Charts Layered By Guilt.

Guilt				OSS Decision			
				Deceptive	Inconclusive	Truthful	Total
Guilty	Stimulation	Yes	Count	52 86.7%	0 .0%	8 13.3%	60 100.0%
		No	Count	58 89.2%	1 1.5%	6 9.2%	65 100.0%
	Total	Count	110 88.0%	1 .8%	14 11.2%	125 100.0%	
Innocent	Stimulation	Yes	Count	15 23.1%	1 1.5%	49 75.4%	65 100.0%
		No	Count	24 40.0%	1 1.7%	35 58.3%	60 100.0%
	Total	Count	39 31.2%	2 1.6%	84 67.2%	125 100.0%	

Examiners. To see if there was an effect of examiner experience on objective scores an Examiners (4) X Guilt (2) X Test Type (2) X Stimulation (2) ANOVA was conducted. That analysis failed to reveal any significant effects involving the Examiner variable. Moreover, none of the effects involving Examiners approached significance.

Countermeasures. After being tested subjects were debriefed concerning countermeasures use. Forty-eight percent of all subjects reported spontaneously attempting a countermeasure. One criticism often raised against the directed-lie approach is that because of its clear face validity it will invite more spontaneous countermeasures attempts from guilty subjects. Table 7 provides a breakdown of countermeasure attempts by Guilt and Test Type. Table 5 reveals no suggestion that the directed-lie approach invites more countermeasure attempts than the probable-lie. In fact, although not significant, *Chi-Square* (1) = 2.73, $p = .09$, the trend in the data is in the opposite direction. With probable-lie examinations 83.9% of the guilty subjects report countermeasure attempts while with the directed-lie approach 71.4% of the guilty subjects report countermeasure attempts.

Reported countermeasure use was then treated as an independent variable and was used to explore the effects of countermeasure use on the objective scores. A Countermeasure (2) X Guilty (2) X Test Type

(2) X Stimulation (2) ANOVA was performed on the objective scores. No effect involving Countermeasures reached significance.

Table 7. Frequency Of Countermeasure Attempts By Guilty And Test Type.

Test Type				Countermeasures		
				No	Yes	Total
Probable-lie	Guilt	Guilty	Count	10 16.1%	52 83.9%	62 100.0%
		Innocent	Count	51 83.6%	10 16.4%	61 100.0%
		Total	Count	61 49.6%	62 50.4%	123 100.0%
Directed-Lie	Guilt	Guilty	Count	18 28.6%	45 71.4%	63 100.0%
		Innocent	Count	51 79.7%	13 20.3%	64 100.0%
		Total	Count	69 54.3%	58 45.7%	127 100.0%

Discussion

Research Question 1: *Are There Significant Differences In Accuracy Between CQT Tests Conducted With Probable-lie Comparison Questions Or Directed-lie Comparison Questions?*

The research reported here failed to find any statistically significant differences between comparison question tests conducted with probable-lie and directed-lie comparison questions. Moreover, examination of Tables 4 and 5 indicate that the manipulation of comparison questions type (Test Type) not only was not statistically significant, it accounted for almost no systematic variability in either the objective scores or decisions based upon them. Given the large number of subjects and the statistical power of the tests used, this is a strong indication that there are, in fact, no differences in the results of comparison question tests based upon the type of comparison question used.

Research Question 2: *Does A University Of Utah Style Stimulation Of Questions Between Charts Significantly Effect CQT Test Accuracy?*

The research reported here failed to find any significant effects of between chart stimulation in the objective scores, see Table 4. Moreover the Stimulation independent variable accounted for little variance in the design. However, there was a statistically significant effect of stimulation in the decision data, see Table 5. Further analyses indicated that this effect was expressed as a positive effect of increased accuracy of decisions with Innocent subjects, but no effect on the accuracy of decisions with Guilty Subjects. It should be noted that this effect was of relatively small magnitude, *partial eta squared* = .017, indicating that approximately 2% of the variance in the decisions was due to the effects of the Stimulation independent variable.

Research Question 3: *Does A University Of Utah Style Stimulation Of Questions Between Charts Interact With The Type Of Comparison Questions Used In The CQT?*

The research reported here failed to find any significant interactions between Stimulation and Test Type in either the objective scores or the decision (see Tables 4 and 5). Not only were none of the interactions statistically significant, but the effect sizes associated with the interaction effects were all very small, the largest *partial eta squared* being .007. Given the large number of subjects and the high statistical power of the tests, these results strongly suggest that comparison question type and between chart stimulation do not interact.

General Discussion

As we noted in the introduction of this report, in the circumstance where the directed-lie and the probable-lie produce equivalent results there are important reasons to prefer the directed-lie.

- The directed-lie approach is simpler and far more standardized than is the probable-lie approach. It is easy to teach and to use.
- A very small number of directed-lie questions can be used for essentially all examinations.
- Examiner judgments about which probable-lies balance the relevant issues are eliminated thus improving reliability in test administration.
- Examiner skill and experience required for properly presenting probable-lie comparison questions is not needed for presenting directed-lie which can be presented by script. This too should improve reliability in test administration.
- Assumptions and examiner judgments about what is and is not a probable-lie for individual subjects are eliminated. This should improve the reliability of test administration.
- The directed-lie does not intrude into the subjects private life, nor does it go beyond the parameters of a forensic investigation. It should thus be perceived as less intrusive and objectionable, even by sensitive subjects.
- The directed-lie has face validity for subjects and for lay persons. It should be much easier to explain to subjects, policy makers, and legal professionals.

The combination of these factors with a determination of no differences in accuracy between the directed-lie and the probable-lie approaches makes an argument for widespread adoption of the directed-lie on the basis of practical reasons and because of likely gains in the reliability of test administration. In this highly controlled laboratory situation reliability of test administration was experimentally controlled for both techniques. However, in the field this is not the case. There appears to be a high degree of variability in field practice due to varying examiner skill, experience and training. Much of that unreliability could be ameliorated by the widespread adoption of a simpler and more standardized approach like that of the directed-lie.

Despite concerns by critics of the directed-lie approach, no evidence was found in this study that the directed-lie approach was either more inviting to countermeasure use or that it would be easier to beat with countermeasures than the probable-lie. Moreover, spontaneous countermeasure in this study were not effective in producing significant effects, despite their widespread use. This is particularly telling in that this was a sample of subjects recruited primarily from an online resource (Craig's List). A number of

subjects reported learning about countermeasures from public media sources, including the INTERNET. With regard to spontaneous countermeasures these results are completely consistent with a 20 year literature on spontaneous countermeasure use (see the review by Honts & Amato, 2002) that indicates that spontaneous attempts of countermeasures are ineffective in altering test scoring. However, one current finding does go against the trend of the reported spontaneous countermeasure data. In this study only 20% of the Innocent subjects reported countermeasure use while in the most recent study in the literature (Honts, Amato & Gordon, 2004) 45.8% of the Innocent subjects reported spontaneous countermeasure attempts. The lack of countermeasure effects associated with the directed-lie adds additional support for widespread adoption.

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Appendices

Appendix A. Recruitment Ad

Temporary Employment:

Temp employment as a participant in polygraph research. Pays \$15.00/hr for approximately 2 ½ hours, one day only. 426-3601, leave a message if no answer.

Appendix B. Eligibility Criteria

Criteria:	Response:	Answers Required to Participate:
Are you 18 years or older?	Y N	Yes
Do you have heart problems or take medication for high blood pressure?	Y N	No
Are you currently under the care of a psychiatrist?	Y N	No
Have you ever taken a polygraph before?	Y N	No
Is English your primary spoken and written language?	Y N	Yes
If female: Is there any chance you are pregnant right now.	Y N	No

Subject Does Not Meet Criteria:	Subject Meets Above Criteria:
I'm sorry; you do not meet the necessary requirements for the purpose of this study. Thanks for your time and interest.	You meet all of the criteria; we would like to schedule an appointment with you.

Appendix C. Video Script, Informed Consent

USERNAME: xxx
PASSWORD: yyy

Hello! I want to welcome you to the laboratory research study being conducted through the Psychology & Law laboratory at BSU.

The purpose of this video is to inform you about your role in this study, your rights as a participant, and to give you the opportunity to consent to participation in this study.

You have been given an INFORMED CONSENT FORM that we will ask you to read carefully and then sign if you agree to participate in this study. Please listen carefully to this video and then carefully read the form. If you are then willing to participate in this study please sign the form when the assistant returns.

When this video is completed, the assistant will return to the room. If you have any questions or concerns, please raise them with the assistant at that time.

The goal of this study is to determine if the computerized polygraph (lie detector) can detect deception. The results of this study will have important implications for future studies of credibility assessment.

Procedure: You will be asked to complete a simple task or series of tasks. The task or tasks that you will complete depend upon which condition of the study you are assigned to. All tasks will be explained to you on separate videos. It will be randomly determined which condition you are in, but please be aware that one of the conditions requires you to commit a mock theft of money. Upon completion of the tasks, you will be given a polygraph examination.

The polygraph examination will focus on your answers to the questions regarding the theft of money. The polygraph examiner will not know if your answers are true or false, and your goal during the examination will be to convince the polygraph examiner that you had nothing to do with the theft. **If you are successful in beating the polygraph, you will receive a bonus of \$20. To win the bonus, you must appear truthful to all of the questions on the polygraph tests regarding the theft of money.** After completing the polygraph examination, you will then be debriefed by a research assistant and awarded the bonus if earned.

After signing the consent form, you will be asked to watch another brief video. It will explain the condition to which you were randomly assigned. The task or tasks that you need to complete will be fully explained in the video. After you've watched the video, you may replay the video if you want. After you complete the tasks, the research assistant will show you where to go for the polygraph examination.

During the polygraph test portion of this experiment, several sensors will be attached to your left hand, a blood pressure cuff will be placed on your right arm, and two elastic straps will be attached around your chest and abdomen (on top of your clothes) to measure breathing. All sensors are attached with adhesive collars or Velcro.

None of these sensors will hurt you or harm you in any way, although the blood pressure cuff will squeeze your arm and **may** cause your arm to feel as if it has gone to sleep. Because of the way we measure blood pressure, the cuff pressure will be much less than that used by a physician. This is not harmful or dangerous in any way, and is a standard part of all polygraph tests. The cuff will be inflated for as little time as possible to conduct the test.

Prior to their placement on your body, the sensors will all be shown to you and their use will be explained. Please feel free to ask questions.

After the sensors are attached, the polygraph examiner will read the test questions while making the polygraph recordings. You will have to answer each question with just a "Yes" or "No", but please remember that your goal is to appear truthful and as though you were not involved in the theft.

Duration and Benefits:

The entire experiment can take up to 3 hours to complete. You will be compensated for your time, at \$15 per hour.

You will receive an additional bonus of \$20 if a standard computer analysis of your physiological responses during your polygraph tests reveals that you are truthful to all of the test questions about the theft of the money.

This determination of truthfulness is calculated by comparing your patterns of physiological responding to the individual polygraph test items. In theory, an individual displays different patterns of responding when being truthful or deceptive. The computer analysis will examine your patterns of responding and assign a value indicating the probability of your truthfulness. If the analysis determines that your patterns of physiological responding are similar to patterns displayed by a truthful individual, the probability of your being truthful will be higher than the probability of your being deceptive (greater than .50).

If this analysis determines you are truthful to all of the test questions, you will earn the bonus.

If you decide to withdraw from the study, you will receive compensation for the time you have given, but will not be eligible for the bonus.

Video recording:

The polygraph examinations in this study will be video recorded. When you sign the consent form, you are giving us permission to video record your polygraph examination. These videos are being made to document the procedures of this study and to be used in presentations, teaching and training in professional settings. By signing the consent form you will be giving us permission to use your image on the video for professional presentations. If you are uncomfortable with your image being recorded or being used for any of these purposes, you should decline to participate at this time. However, if we decide to use your image for such professional purposes, your name and any identifying information will be edited from the recording.

Confidentially:

A list of the names of participants will be maintained for 3 years after the study ends, at which time it will be destroyed.

A code number will be used to organize the physiological data but will not be associated with your name or any other personally identifying information.

Your name or any other personally identifying information will not be included in any publication or reports of this research or in any presentations on this study.

Risks:

There are no known risks to you physically or mentally for participating in this study. If anything about this study makes you feel bad or uncomfortable, we can arrange for a consultation for you at the Boise State counseling center on your request.

Withdrawal: Your participation in this study is voluntary. If at any time you wish to withdraw from the study you may do so and receive payment for the time you have spent to that point.

Concerns: If you have any concerns about how this study was conducted or about protection of your confidentiality you should contact the principal investigator, Dr. Charles Honts, (426-3695) in the Psychology Department at Boise State University.

Please wait for the return of the research assistant. Do not sign the Informed Consent Form until the assistant returns.

Thank you again for your interest and time in assisting the Department of Psychology in this research.

Appendix D. *Informed Consent*

INFORMED CONSENT FORM

The purpose of this document is to inform you about your role in this study, your rights as a participant, and to give you the opportunity to consent to participating in this study.

Purpose: The goal of this study is to determine if people can defeat the polygraph (lie detector), and to validate the accuracy of polygraph tests. This project is funded by the Department of Defense.

Procedure: During the first stage of the study, you will be assigned a condition (i.e., innocent/deceptive). You will then be asked to complete a simple task or series of tasks. Upon completion of the tasks, you will be given a polygraph examination. The polygraph examination will focus on your answers to the items regarding the task that you were asked to complete. The polygraph examiner will not know if your answers are true or false, and your objective during the examination will be to convince the polygraph examiner that your answers to all of the questions are true. If you are successful in beating the polygraph, you will be paid a bonus of \$20. To attain the bonus, you must appear truthful to all of the questions on the polygraph tests. After completing the polygraph examination, you will then be debriefed by a research assistant and awarded your earned compensation.

After completing the required tasks, you will be taken to another room and introduced to the polygraph examiner. The polygraph examiner will review each of the questions to be used on the tests and will describe the testing procedure to you. To monitor your physiological reactions to test questions, several sensors will be attached to your right hand, a blood pressure cuff will be placed on your left arm, and two elastic straps will be attached around your chest and abdomen (on top of your clothes) to measure breathing. All sensors are attached with adhesive collars or Velcro. None of these sensors will hurt you in any manner. Prior to their placement on your body, the sensors will all be shown to you and their use will be explained. In your polygraph test the polygraph examiner will read the test questions to you while making the polygraph recordings. Regardless of the testing format, you will answer each question with only a "Yes" or "No."

Duration and Benefits: You will be paid \$15 per hour for approximately three hours of your time. You will be paid an additional bonus of \$20 if a standard computer analysis of your physiological responses during your polygraph tests reveals that you are truthful to all of the test questions. This determination of truthfulness is calculated by comparing your patterns of physiological responding to the individual polygraph test items. In theory, an individual displays different patterns of responding when being truthful and deceptive. The computer analysis will examine your patterns of responding and assign a value indicating the probability of your truthfulness. If the analysis determines that your patterns of physiological responding are similar to patterns displayed by a truthful individual, the probability of your being truthful will be higher than the probability of your being deceptive (greater than .50). If this analysis determines you are truthful to all of the test questions, you will earn the bonus. No deception is involved in this study. But if for any reason you decide to withdraw from the study, you will be paid \$15 per hour of participation, but will not be eligible for the bonus.

Videotaping: Some of the polygraph examinations in this study will be videotaped. When you sign the consent form, you are giving us permission to videotape your polygraph examination. These videotapes are being made to document the procedures of this study and to be used in presentations, teaching and training in professional settings. By signing the consent form, you will be giving us permission to use your image on the videotape for professional presentations. However, if we decide to use your image for such professional purposes, your name and any identifying information will be edited from the tape.

Confidentially: A list of the names of participants will be maintained until three years after the end of the study, at which time it will be destroyed. A code number will be used to organize the physiological data but will not be associated with your name or any other personally identifying information. Your name or any other personally revealing information will not be included in any publication or reports of this research.

Risks: There are no known risks to you physically or mentally for participating in this study.

Withdrawal: Your participation in this study is voluntary. If at any time you wish to withdraw from the study you may do so and receive payment for the time you have spent to that point.

Concerns: If you have any concerns about how this study was conducted or about protection of your confidentiality you may contact the Project Director, Racheal Reavy (426-3601) in the Psychology Department at Boise State University.

Survey: Following the polygraph examination, you will be asked to fill out a very brief survey regarding your experiences during the appointment.

Consent: I, _____, have read the above description of this study and understand it. I also understand this study is funded by the Department of Defense. I have received a copy of this Informed Consent form. I agree to participate in this research.

_____/_____
(Signed) (Date)

_____/_____
Witness (Date)

This project has been reviewed and approved by the Boise State University Institutional Review Board for the protection of human subjects in research.

Appendix E. Video Script, Innocent Condition

By now you have agreed to be a participant in this study and have signed the Informed Consent.

As stated in the previous videotape, there are different conditions in this study. This video will tell you about your role in the experiment.

Your condition assignment was made on a random basis, and you actually chose it with the envelope you selected.

Neither the research assistant who had you choose the packet, nor the polygraph examiner, knows whether you will be telling the truth on the polygraph examination.

You have been selected to be in the innocent condition.

Please listen to these instructions carefully and make sure that you understand exactly what you are to do. Replay this video if necessary. You may make a few notes to help you remember what to do as you carry out these instructions.

There are writing materials on the desk for you, and a written (text) version of this entire process provided in the packet that you have been given. This is a polygraph, or lie detection, experiment. Half of the subjects in the experiment are instructed to commit a theft. They are instructed to go to a room and steal some money from an envelope. Then they report back for a polygraph examination. If they are found innocent on the test, they are paid a bonus in addition to the amount paid for participating in the experiment.

You are not one of those subjects. You are not to steal anything. Your mission, if you choose to accept it, will be to drop off an envelope (located in this packet) in a file folder outside the door of room E619 in the Education Building.

You are an innocent suspect. But you too can receive the bonus by being found innocent on the polygraph examination. The bonus, in addition to the amount you will be paid for your time participating in this experiment, is \$20.00. Therefore, it is in your best interest to be truthful during the test and deny having anything to do with the theft of the money.

Before you leave this room, check the time. You have 30 minutes to complete this task. Do not return early. If you finish early, wait until the 30 minutes are up, and then return to the room you are in now, and wait until an assistant comes for you.

You will then be given a test by a polygraph examiner. The examiner will not know if you are innocent or guilty of the theft, which is why you will be treated as though you are a suspect. This is so that the decision can be made entirely on the results of the polygraph test. Remember, you will be in the Education Building delivering an **envelope** to the office, but you won't see money or steal anything. You could easily give yourself away by accidentally revealing any other details, so please maintain your innocence wisely.

You will receive the bonus only if the examiner finds you innocent. So you must actually convince the examiner of your innocence. If the examiner decides that you are deceptive or cannot determine whether you are deceptive or innocent, you will not receive the bonus.

Those are your instructions. **You must follow those instructions exactly to be eligible for your payment.** If you do not wish to participate in this experiment, please inform anyone in the reception area (front of the building). If you are not entirely sure of what you are to

do, push the back button and start this video over. Then push the play button to hear the instructions again. When you are done, push the stop button.

Take the written script you got from the packet you chose and run it through the shredder before you leave this room.

Once you leave this room, you should return in exactly 30 minutes, not sooner, and not later. That is it. Good luck with the examination.

Appendix F. Video Script, Guilty Condition

By now you have agreed to be a participant in this study, and have signed the Informed Consent.

As stated in the previous videotape, there are different conditions in this study. This videotape will tell you about your role in the experiment.

Your condition assignment was made on a random basis, and you actually chose it with the envelope you selected.

Neither the research assistant who had you choose this packet, nor the polygraph examiner, knows whether you will be telling the truth on the polygraph examination.

You have been selected to be in the deceptive condition.

Please listen to these instructions carefully and make sure that you understand exactly what you are to do. Replay this video if necessary. You may make a few notes to help you remember what to do as you carry out these instructions.

There are writing materials on the desk for you, and a written (text) version of this entire process provided in the packet that you have been given. This is a polygraph, or lie detection, experiment. Because you are in the deceptive condition, you will steal an envelope containing money from the Education Building. You will then be given a polygraph examination. If you can beat the polygraph by appearing innocent on that test, you will be paid a bonus of \$20.00 in addition to the amount that you will be paid for participating in the experiment.

Your mission, if you choose to accept it, is as follows: You will go to room E619 of the Education Building and remove the envelope from the door. That envelope is addressed to Sam Stone. You will verify its contents. Take the contents out of the envelope and conceal it on your person. You can hide it in your wallet or in any of your pockets, but do not put it in your shoe or in your sock. Tear the envelope up and dispose of it in any trashcan. **If you are found innocent on the polygraph examination, you will be paid an amount equal to that which you stole.** However, you must return the money from the envelope when the polygraph examination is completed. Be careful not to leave any fingerprints, and be sure to dispose of the envelope where it will not be found. It is extremely important that you steal the money without alerting anyone to the theft. For example, since room E619 is a faculty office, be sure to have your alibi ready in case someone asks you what you are doing.

You are not, and I repeat, not to tell anyone that you are participating in an experiment. YOU DO NOT WANT TO GET CAUGHT COMMITTING THIS CRIME so be prepared to do this mission in a discrete fashion. If you do get caught please call Dr. Patt Alison Bowers at 426.4119

Before you leave this room, check the time. You have 30 minutes to complete your theft once you leave. Do not return early. If you finish early, wait until the 30 minutes are up, and then return to the room you are in now, and wait until an assistant comes for you.

You will then be given a test by a polygraph examiner. The examiner will be testing you about the theft of the missing money, and he or she will not know if you are innocent or guilty of the theft because half of the subjects in the experiment have not committed the theft. This is so that the decision can be made entirely on the results of the polygraph test.

Do not make the examiner suspicious when he or she is interviewing you during the initial portion of the test. Your alibi is to tell the examiner you were in the Education Building delivering an **envelope** to the office, but that you never saw money or stole anything. You could easily give yourself away by accidentally revealing any other details, so please maintain your innocence wisely.

So, when the polygraph examiner asks you questions about any other details about the theft, you must not only deny knowing anything other than that, but you must do so sincerely so that he or she does not become suspicious. If at some point during the test you think you blew it, do not give up.

You will receive the bonus only if the examiner finds you innocent. So you must actually convince the examiner that you are innocent. If the examiner decides that you are deceptive or cannot determine whether you are deceptive or innocent, you will not receive the bonus.

Those are your instructions. **You must follow those instructions exactly to be eligible for the bonus payment.** If you do not wish to participate in this experiment, please inform anyone in the reception area (front of the building). If you are not entirely sure of what you are to do, push the back button and start this video over. Then push the play button to hear the instructions again. When you are done, push the stop button.

Take the written script you got from the packet you chose and run it through the shredder before you leave this room

Once you leave this room, you should return in exactly 30 minutes, not sooner, and not later. That is it. Good luck with the examination.

Appendix G. Polygraph Examination Consent

POLYGRAPH EXAMINATION STATEMENT OF CONSENT

Place: Boise State University Date: _____ Time: _____

Statement of Consent of: _____

The polygraph examiner, _____, has explained the nature of the polygraph examination and told me that I cannot be required to take such examination without my consent. I was further advised that the examination room is equipped with a video camera and that the examination will be video-tape recorded. I have been advised that the results of this examination will be kept confidential. Understanding my unqualified right to refuse, I, _____, do hereby, this date, voluntarily and without duress, coercion, or unlawful inducement, consent to a polygraph examination concerning the theft of an envelope containing \$20 from an office in the Education Building.

Signature of Examinee _____

Signature of Examiner _____

Appendix H. Polygraph Examination Question List

Neutral Questions:

Are we in the State of Idaho?

Are the lights on in this room?

Comparison Questions:

Prior to 2008, did you ever lie to someone who trusted you?

Prior to 2008, did you ever do anything that was dishonest illegal?

Prior to 2008, did you ever lie to a person in a position of authority?

Relevant Questions:

Did you steal that missing envelope?

Did you steal the envelope from the door of Room 619 in the Education Building?

Do you know where the missing money is now?

Other Questions:

Regarding the envelope that was stolen from the Education Building, did you intend to truthfully answer each question about that?

Do you believe that I will only ask you the questions we reviewed?

Prior to 2008, did you ever lie to a person in a position of authority?