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DETECTION OF DECEPTION IN THE LABORATORY AS A FUNCTION OF MOTIVATION AND SET SIZE

by

Daniel Mark Tuckett

A Thesis Submitted to the Faculty of The Graduate College in partial fulfillment of the requirements for the Degree of Master of Arts Department of Psychology

Western Michigan University Kalamazoo, Michigan December 1986
The purpose of this study was to determine the validity of the polygraph in a controlled laboratory setting. The Guilty Knowledge Test (GKT) was the procedure employed in conjunction with the galvanic skin response (GSR) monitor. The experimenter tested 40 subjects over two trial each. Overall the polygrapher was correct 44 times, out of 80 trials. This number of detections exceeded chance \((p<.001)\) levels. The manipulation of subject motivation with a monetary reward increased detection rates significantly \((p<.05)\) in comparison to those not offered money. With each subject being tested over two trials, there appears to be a habituation effect as indicated by a decrease in detection from trial one to trial two. The relationship fell slightly short of significance at the \((p<.05)\) level. In general the level of subject motivation may play a major role in the detection of subjects who attempt deceit.
ACKNOWLEDGEMENTS

Immense gratitude goes to Dr. Jack Asher who as chairman of my committee guided me through both the development and refinement of this study; to Dr. Brad Huitema and Dr. Dale Brethower for their interest and feedback at critical times; and to my assistant, Vance Boyer, who gave both valuable input and time. I am truly grateful to Dr. Fred Gault who aided me in both the building of the polygraph apparatus and teaching me how to operate it. I would also like to express my appreciation to my family and the undergraduate faculty for their support and encouragement to pursue this goal.

Daniel Mark Tuckett
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INTRODUCTION

The physiological detection of deception (lie detection) field is one of the most controversial subjects in the social sciences. The widespread use of the field lie detector, accompanied with the potential severity of the implications, has brought the field of polygraphy to the forefront of many controversies. The United States judicial system epitomizes the uncertainty towards the field of polygraphy through the continuous shifting of positions as to the admissibility of polygraph evidence in court (Lykken, 1984). As recently as 1975 the high courts of 24 states had implemented a stipulation rule, thus allowing the trial judge to decide on admissibility of polygraphic evidence in criminal cases. The current position of many courts is to exclude polygraph results unless both parties agree to have these presented or allow the trial judge to decide the issue. In the latter case, the party seeking the admission of polygraph results as evidence must lay the proper foundation to gain admissibility of such measures (Lykken, 1984).

A Brief History of Polygraphy

To appreciate the controversy that surrounds the
field of lie detection, one need not look only at the
differences in current court admissibility but also at
the similarities of the issues surrounding the polygraph
now and over 60 years ago. In the case of Frye V. United
States, a federal appellate court ruled that:

while courts will go a long way in admitting expert
testimony deduced from a well-recognized scientific
principle or discovery, the thing from which the
deduction is made must be sufficiently established
to have gained general acceptance in the particular
field to which it belongs. We think the systolic
blood pressure deception test has not yet gained
such standing and scientific recognition among
physiological and psychological authorities as would
justify the courts in admitting expert testimony
deduced from the discovery, development and
experiments thus far made. (Lykken, 1984, p. 75).

While we may have further clarified the issues of
reliability and validity may have been clarified, it is
obvious from both a research perspective as well as
public opinion that our current methods in the detection
of deception are far from perfect (Waid & Orne, 1982).

The Polygraph in Industry

Ferguson (1971) declared the following:

The preemployment polygraph test offers for the
employer (1) verification of the applicant's
background, (2) detection of chronic alcoholics, job
jumpers, and accident prone persons, (3) revelation
of maladjusted people that shouldn't be employed,
(4) a reduction in turnover by helping management
put the right person on the right job, (5) a
constant deterrent to employee dishonesty, and (6) a
reduction in inventory and case shortages. (p. 6)
The view of the potential uses of the polygraph such as those described above were not uncommon during the late 1960s. Several studies (Arther, 1967; Holmes, 1968; Stephens, 1967) proclaimed the benefits of polygraphy in private industry with claims similar to those made above. While statements of this nature were common, public skepticism had not yet begun to flourish as it does today.

When is the polygraph test used in industry? The polygraph test is used in industry for investigative purposes and preemployment screening. It is used both periodically and routinely by some organizations. Ferguson, and Gugas (1984) reported a survey conducted by the Research Department of the National Association of Chain Drug Stores, Inc. (NACDS), in 1978, which indicated that 81% of the companies that responded to the survey use the polygraph. It should also be noted that 60% of the polygraph users felt their losses decreased when they initiated use of the polygraph and 97% of the companies felt it was essential for their company to continue use of polygraph screening procedures.

Where is the polygraph industry now? The field of polygraphy has expanded from the research laboratory to the applied setting where it is now used not only in
criminal investigations but as an employment screening device as well. A survey conducted in 1978 found that about 20% of the Fortune 500 companies, and 50% of major retail chains, made some use of polygraph testing (Belt & Holden, 1978). The usage of the polygraph in business has changed from that of a tool to investigate acts of theft and sabotage, to that of a preemployment screening device as well (Lykken, 1984).

According to the ideas proposed by Mills (1972), the polygraph test could be used in conjunction with numerous other selection and evaluation tests as part of a psychological evaluation of incoming police officers. The current job applications for numerous governmental agencies such as special agent, drug enforcement agent, language specialist, etc. require polygraph examinations in the preemployment stages. The record of polygraph usage in the business setting may be a gross understatement of the actual number, largely due to the lack of sophistication in record-keeping by many organizations.

Qualifications of a Polygrapher

In 1984 there were 35 American Polygraph Association (APA) approved schools and approximately 10,000 alumni (Lykken, 1984). This number does not take into account the unapproved schools such as those in Florida which out-
number the approved schools by a margin of seven to one (Lykken, 1984). Many of the unapproved schools offer a six-week course in mastering the polygraph apparatus while most APA schools offer a six-month course (Reid, 1966). This suggests that training methods may be inconsistent across schools and may affect the polygrapher's ability to use the apparatus effectively. With the possible inconsistency across schools and the potential thousands of polygraphers in the field conducting tests, it is understandable how such inconsistencies in reliability and validity have surfaced.

The Meaning of a Response

To assess the validity of the polygraph apparatus, as a tool of the polygrapher in detecting deception, involves numerous issues. There is a common myth that polygraph machines are able to detect "lies." In actuality, current polygraph apparatus measure only physiological response to certain psychological stimuli. According to Patterson (1979) this stimulus refers to an auditory stimulation which is cause for the interaction among the autonomic sensory organs. The graph interpreter merely infers that a certain behavior has occurred, which has in turn caused a physiological response of a detectable magnitude. The behavior that the polygrapher is trying to infer is a "deception" or
"concealment of information" on the part of the suspect. This procedure of response and inference, known to the public as "lie detection," continues to garner criticism and skepticism, largely due to the erroneous conclusions of such a procedure. According to Lykken (1981), "there will never be a truth verifier (lie detector) until a specific lie response can be identified" (p. 18).

There are two definite drawbacks to the currently employed procedures in the field of lie detection. The first problem is that a physiological response of a discernible magnitude can occur in a person without a lie being told or communicated. The second major problem in this area is merely the inverse of the first, in that a lie can be communicated, perhaps verbally, while no marked physiological change takes place. These are the two fundamental drawbacks to the "lie detectors" that are currently in use. Most other arguments against the procedures and theories of lie detection stem from these two major areas. The current outcry of the public against the misclassification of innocent people as guilty (false positives) as well as the potential use of counter-measures to "beat" the polygraph, are both simply extensions of the two major problems. The area of false positives will be expanded upon in a later part of this introduction.

Which physiological response should the polygraph
examiner measure? The first method to be described is the Psychological Stress Evaluation (PSE), which measures tremors in the vocal muscles from 8 to 14 Hz. This is the claim of Decktor Counterintelligence and Security of Springfield, Virginia which promotes the PSE. The PSE supposedly measures deception-induced stress in the voice according to research by Podlesney and Raskin (1977). The recorded patterns of that activity measured by the PSE are inversely related to psychological stress (patterns decrease during attempted deception). The exact measures used in PSE voice analysis are not entirely clear, as stated by Podlesney and Raskin (1977).

An overview of current research tends to classify the PSE as having very limited value as a discrimination technique in the field of lie detection. Kubis (1974) found the accuracy (hit rate) of the PSE to be similar to chance levels in the detection of deception. In comparing the PSE to what is currently considered a polygraph apparatus (respiration, galvanic skin response and pulmonary measures), Barland (1975) found that with a large sample of subjects, the PSE could not significantly discriminate between the truthful and deceptive criminal suspects, while the polygraph produced accuracy rates above chance levels. Later research by Podlesny and Raskin (1977) has indicated that the Psychological Stress Evaluator is a poor discriminator of deceptive and
truthful participants, yielding results which in general do not exceed levels of chance.

Current Polygraph Apparati

The second measure of physiological response records any combination of one to four channels of information. This is the field lie detector or polygraph which in general monitors three channels of physiological response simultaneously. The first channel is the "cardio" cycle change which measures changes in relative blood pressure (Posey, Geddes, Williams, & Moore, 1969). Studies by Kugelmass, Lieblich, Ben-Ishai, Opatowski & Kaplan (1968) and Barland and Raskin (1975) found increases in the diastolic level of the cardio tracing to be associated with deception.

The rate of respiration of a subject is also monitored with current field polygraphs. This is measured from an expandable belt around the chest region. When respiration amplitude is used as the criterion for scoring "deception," numerous studies (Cutrow, Parks, Lucas & Thomas, 1972; Ellson, Davis, Saltzman & Burke, 1952; Kubis, 1973; and Thackray & Orne, 1968a) have indicated a relationship between deception and a decrease in the amplitude of respiration. Other researchers have focused on respiration cycle time (Barland & Raskin, 1975; Kubis, 1973) as well as the respiration-expiration
ratio (Burtt, 1921) although this index is troubled by conflicting research.

The field polygraph also measures a third channel of physiological response known as electrodermal change. The "electrodermal" channel records the conductivity or resistance responses of the surface of the skin. When a person is psychologically stimulated, he tends to perspire, which is a reaction of the sympathetic nervous system. Detection of a person's level of perspiration is then taken as an indication of a heightened state of arousal. These changes in palmer skin resistance or galvanic skin resistance (GSR) are generally considered to be the most valid measures in the detection of deception (Barland & Raskin, 1975; Cutrow et al., 1972; Gustafson & Orne, 1964, 1965; Kubis, 1973, 1974; Kugelmass et al., 1968; Lykken, 1959; Thackray & Orne, 1968a, 1968b).

While different combinations of the above three channels can be utilized, the electrodermal channel is considered the "base" of the field polygraph. This statement is made based upon the large number of laboratory studies of the validity of the GSR monitor as the "most efficient" indicator of attempted deceit (Balloun & Holmes, 1979; Bradley & Janisse, 1981; Davidson, 1968; Gustafson, & Orne, 1965; Horvath, 1978; Lieblich, Orne, Cook & Orne, 1970; Podlesny & Raskin,

In the study by Raskin and Hare (1978), an overall comparison of GSR, respiration, and cardiovascular measures by use of a Newman-Keuls test indicated the skin conductance measure produced a better discrimination between "guilty" and "innocent" subjects than did respiration and cardiovascular measures. A comparison of skin resistance, pupil size and heart rate by Bradley and Janisse (1981), looking at physiological response across two different polygraph tests (Guilty Knowledge Test (GKT) vs. Control Question Test (CQT), indicated the GSR to be superior to both pupil size and heart rate in the detection of deception.

In an experiment by Balloun and Holmes (1979), involving a real crime in which subjects were found cheating, the GSR monitor proved to be the most efficient indicator in the detection of deception. The electrodermal response was again shown to be the most effective indicator in the detection of deception. The authors of this study go so far as to state, "only skin resistance was effective for detecting guilt, thus suggesting that other physiological measures employed by examiners may introduce errors" (p. 316).

In reviewing the research related to the field of lie detection, it becomes apparent that electrodermal response is the best indicator of deception currently
available. While various combinations of measures can be ascertained through the polygraph, i.e., blood pressure, respiration, skin resistance, pupil dilation, the electrodermal response appears to be the most valid indication of a subject's attempted deceit.

Current Testing Methods

There are two principle testing methods of administering a polygraph test. These two methods are the Guilty Person Test (GPT) and the Guilty Knowledge Test (GKT). A field lie detector, utilizing respiration, galvanic skin response and cardiovascular measures, is generally used with the GPT. The GPT is also know as the Critical Question Technique (CQT).

Guilty Person Test

The questions asked in the Guilty Person Test fall into three categories. The first category of question is the "irrelevant" questions which should elicit very little or no physiological response change on the part of the subject. An example of this question would be, "Are you sitting down?" The second category of question that is asked is the control question, which should elicit some response change on the part of the subject. An example of this question might be, "Did you ever cheat while in high school?" The third and final category of
questions asked are the relevant or critical questions. These questions pertain directly to the situation under investigation and may be similar to the question, "Did you steal the diamond ring from the vault?" If the subject is guilty and claims to be innocent, the rationale behind this questioning states that the guilty subject should respond physiologically to a greater extent to the critical questions than to either the control or irrelevant questions. The innocent subject, on the other hand, should show a greater response to the control questions than to either of the other two types of questions. The exact method of the interrogation may vary from polygrapher to polygrapher and the order of the questions may be systematically altered over the three trials. The scoring of this testing method involves comparing autonomic response to critical questions and the nearest control or irrelevant question. Lykken (1974) claims the method and criteria of scoring the graphs may vary across polygraphers. The GPT is the test most often used in the field, due to its speed of administration, pertinent questions to a real crime, and presence of "true" anxiety in the suspect over the results. This anxiety is understandable when one considers that a job may be lost or jail sentence incurred, based on the polygrapher's judgment.
Guilty Knowledge Test

The second method of interrogation is known as the Guilty Knowledge Test. This test is designed to determine if the suspect is aware of certain information. An example of the GKT is as follows:

Item 1. The man we are looking for robbed a jewelry store in this vicinity. If you are the guilty person, you will recognize the name of the store in question. I am going to name a few jewelry stores that are located in this area. Please repeat the name of each jewelry store after me. Was it Baker's Jewelers? ... Was it Friendly Jewelers? ... Was it Cribb's Jeweler? ... Was it Franklin Jewelers? If the suspect under questioning shows a marked physiological response to the identified item then guilt is inferred. With five alternatives being given, chances are .2 that a suspect will react significantly to the identified question. This procedure is continued in stage 2 with the variables being the possible weapon used in the perpetration of the crime. Again, five possible alternatives will be made available. The chances of the suspect reacting to both identified alternatives in stages 1 and 2 are now .04. This procedure can be continued over a couple more stages to increase discrimination.

The assumption behind the Guilty Knowledge Test is that there will be the presence or absence of
differential responsivity to items of information that only the guilty suspect should recognize as being relevant (Lykken, 1974). While a hyperactive or hyporeactive suspect may show an abnormal response to the various alternatives, the polygrapher must compare the subject's responses across certain incorrect alternatives, as well as to later stage responding. In general, the guilty suspect will show a greater physiological response to the identified alternative as compared to the control items. The innocent suspect will not respond with any consistency or heightened arousal to the critical alternatives. An increase in the number of stages in this test should allow the suspect to further classify himself as innocent or guilty.

The GKT is designed to protect the innocent subject from being falsely classified as guilty. This is termed false positive classification. Lykken (1974) states, "the Guilty Knowledge Test is designed such that false positives will be minimized, unlike other psychophysiological detection of deception (PDD) procedures" (p. 728). It does appear though that while the GKT may decrease the number of false positives it does also tend to increase the number of false negatives (guilty subjects classified as innocent) as indicated in the study by Lykken (1959).

One of the problems with the Guilty Knowledge Test
is the guilty subject's recollection of certain details. It is not unusual in mock crime studies for subjects to report after the interrogation that they "hadn't noticed" some vital aspects of the crime, i.e., the color of a suspect's hair. At the same time, when the GKT is used in real life situations which involve less control on extraneous variables, the chances for an innocent suspect to gain knowledge of certain crimes through either the media or word of mouth increases drastically.

Some other problems with the Guilty Knowledge Test involve the short "truncated" answers on the part of the subject and the possibility that habituation may occur. This "tuning out of insignificant stimuli allows people to reduce their levels of stress while avoiding unnecessary cognitive interruptions (Timm, 1984). In a research article by Iacono and Lykken (1983) the study of repeated exposure by the subject to stimuli may cause the stimuli to lose their signal value (the extent to which they are considered relevant and may induce further processing) and result in a general "tuning out" on the part of the subject.

Laboratory Versus Field Testing

In a comparison of lie detection procedures in laboratory vs. real life conditions, both testing procedures are used in each condition. The Guilty Person
Test or Control Question Technique is more often found in real life situations. The Guilty Knowledge Test, on the other hand, is more common in the laboratory setting and as a consequence has resulted in more documented research being done on it. The two procedures are often compared in the laboratory setting (Bradley & Janisse, 1981; Podlesny & Raskin, 1978; Waid et al., 1981; Waid & Orne, 1980) using mock crimes, word tests or variations of a numbered card test.

Research in the laboratory has the advantage of control of factual information. Circumstances may be manipulated to the point that a purely objective appraisal of a subject's guilt or innocence can be obtained and in turn objectively verify the polygrapher's judgment. In real life situations, all of the facts may not be present and the judgment of the polygrapher may not be verified objectively. The experimenter can also manipulate more variables which can be studied with greater accuracy using the laboratory setting then in comparison to available field situations (Podlesny & Raskin, 1977).

Skeptics of laboratory research in general claim the "real life" anxiety is not present in the laboratory. In a study by Davidson (1968), the GKT was evaluated using simulated situations involving real crimes, while maintaining rigorous experimental control. The results
of this study did not show any significant difference in
detection rates for a real crime in which the level of
motivation was manipulated. This tends to lend support
for both the GKT as well as the laboratory setting in the
physiological detection of deception.

The Role of Potential Variables

The number of potential variables that one may study
in connection with the polygraph is relatively endless.
Some of the more common areas of interest include imagery
(Kubis, 1962), feedback (Barland, 1972; Bradley &
Janisse, 1979; Gustafson & Orne, 1963), countermeasures
(Hontes, Hodes, & Raskin, 1985; Raskin, 1978), ethnic
differences (Kugelmass & Lieblich, 1968; Waid & Orne,
1980), depth of processing (Timm, 1984; Waid et al.,
1981), to name a few. One of the more popular variables
to study in connection with the polygraph is motivation.
Numerous studies (Davidson, 1968; Gustafson & Orne, 1964,
1965; Gustafson & Orne, 1965; Horvath, 1979; Podlesny &
Raskin, 1978; Raskin & Hare, 1978) have attempted to
assess the effects of motivation in some aspect on
suspect's performance during a polygraph test.

Research by Raskin and Hare (1978) considered the
effects of psychopathy on the detection of deception.
This study looked at prison inmates who may have certain
qualities which make the detection of their deceit less
probable for the polygrapher. All subjects were offered $20 to attempt to convince a polygrapher that they had not committed a mock crime just prior to the polygraph test. The use of the money, it was thought, would accentuate the psychophysiological responding of all inmates involved. This study used money as a motivator in a different way than Davidson (1968), who through an elaborate charade of a mock killing, used money or the pursuit of a gift certificate which could be used to purchase items in a local store. In the Davidson (1968) study, one subject out of four possible subjects was highly motivated to deceive the polygrapher and in turn receive the reward that he had earned. The subjects classified in the "low motivation" group knew nothing about the crime or the victim and would not receive a voucher if he passed the polygraph test. The results of this study, while showing no significant difference, do show the highly motivated suspects as easier to detect than the nonmotivated suspects.

A study dealing with the effects of heightened motivation by Gustafson and Orne (1963) attempted to create this state of arousal by offering both one extra dollar as well as some verbal "encouragement." This encouragement came in the form of a tape recording that informed the subjects (prior to the test) that only persons who were of superior intelligence and great
emotional control would be able to deceive the polygrapher. Whether or not this procedure actually heightened the motivational state or merely raised the anxiety levels of the students is yet another issue in the lie detection paradigm.

Rational for Thesis

This thesis had as its purpose to help expand and perhaps clarify some issues surrounding the field of lie detection. This laboratory study involved five main areas. The first of these issues was the validity of skin resistance as a measure of the detection of deception. While the Guilty Knowledge Test was used, it was not a primary concern. The second issue this research addressed was the use of a monetary reward (high motivation) to increase the detectability of those subjects, as has been suggested in prior research. Two other areas, that may be of lesser importance to the field of polygraphy, were examined here as well. These issues were the administering of two tests per person and the use of blank cards along with numbered cards in a numbered card test. The final area this study dealt with was the use of an objective scoring system similar to that used in the study by Gustafson and Orne (1963).
METHOD

Description of Subjects

The subjects were undergraduate students enrolled in a psychology of work class of approximately 280 students. The subjects were told they could earn two extra credit points towards their course total for their participation in a lie detection experiment. In general, the subjects were freshmen or sophomore business majors interested in seeing if they could "beat the machine" or increase their total number of points in the class. The subjects were selected on a first come, first serve basis. The subjects were placed in one of four possible conditions by the polygrapher's assistant who controlled the random assignment of subjects to each condition.

Apparatus

Skin resistance recordings were obtained for each subject through a Grass Model 7 Polygraph with a 7P-1A Low Level ED.C. Pre-Amplifier. The pre-amplifier was set in the P.G.R. mode. The pre-gelled Ag/AgCl electrodes were attached to the palmar surface of the distal phalange of the first and third fingers of the right hand.

The "target" numbers were drawn on 3 x 5 inch index

20
cards. One set of cards included the numbers 1 through 6 omitting the number 4. The second set of cards was similar to the previous set but included two blank cards as well. The numbered cards also had the number written on the bottom to avoid any possible confusion. The subject's chosen card was placed in a cardboard box in the interrogation room.

The interrogation room was a sparsely furnished laboratory room with moderate lighting. During the question process the suspect sat in a cushioned chair facing a black wall. The polygraph apparatus and polygrapher remained in the same room as the suspect during the administration of the test.

Design and Procedure

The experiment conducted was a 2 x 2 design. Both variables were manipulated between subjects. The first independent variable was the level of motivation on the part of the subject. The opportunity to gain a cash reward distinguished "motivated" group from the "non-motivated" group. The second independent variable in this study was the number of cards the subject selects from. Half the subjects selected a number card from the numbers 1 to 6 (with the number 4 omitted). The other 20 subjects selected a card from seven possible cards (five numbered and two blank cards). Each subject was tested
over two trials.

The dependent variable in this study was the number of "correct hits" by the polygrapher. A correct hit is determined when the polygrapher scores the suspect's GSR charts and writes down the number that he believed the suspect was concealing. The suspect then revealed his number and a comparison was made by the assistant, who informed both parties as to the outcome. With each subject being tested two separate times with "potentially" two different cards, the polygrapher could score a maximum of two correct hits per suspect.

There were two stages in this experiment. In stage 1 the subjects were randomly assigned to one of the four possible groups. This was done by the polygrapher's assistant for the purpose of keeping the polygrapher blind to which condition any subject may be in. After the preliminary signing of the extra credit sheet and the human subjects protection form, the subject was read a list of instructions by the assistant. The polygrapher remained in another room throughout this preliminary phase. There were two sets of instructions used during the experiment. Each subject would receive one set of instructions that were consistent with the condition of "motivation" the subject was in. Subjects in the "motivation" group who successfully deceived the polygrapher were paid by the assistant. The money paid
came from a fund set up by the polygrapher. A list of the instructions read to each subject can be found in Appendix A or Appendix B, depending on the condition.

After the initial instructions were read by the assistant to the subject, the subject was asked to draw a card from a deck the assistant was holding. The subject then chose a card and was asked by the assistant to say what was on the card. This was done to verify that the subject was aware of the card's content. In the study by Gustafson and Orne (1965), the subject was asked to write down the number selected. One of the goals of this study and similar studies in this area is to ensure that the subject is aware of the information on the card. After selecting a card and stating its contents to the assistant, the subject was led to an adjoining room where the card was placed in a cardboard box. The subject was then hooked up to the skin response monitor and read some general instructions by the polygrapher. The instructions read to the subject by the interrogator can be seen in Appendix C. These instructions were read after the electrodes were in place, to give the interrogator a chance to derive a baseline response for the subject.

The subject was informed to respond "no" to all questions by the interrogator. The questions were asked roughly every 15 seconds. The questions were only in
regard to the subject's hidden card. The number asked by
the interrogator were in a random order with the number 4
being the first question asked of all subjects. The
asking of the number 4 (which was omitted from the deck)
allowed the interrogator to throw out the inordinately
large GSR response which usually appears on the first
stimulus presentation. All potential numbers were
stated, as well as a blank card question. This was done
three times in succession. When the questioning
procedure was over, the interrogator removed the graph
and went to a nearby room to score the responses. The
assistant then detached the electrodes and kept the
subject busy for a couple of minutes. The polygrapher
then returned and wrote the response that he thought the
subject was trying to conceal. The assistant then
verified this decision by removing the card from the
cardboard box. The subject was then informed of his
success or failure at deceiving the polygrapher and lead
out to the adjoining room for stage 2.

Stage 2 of the experiment consisted of an
abbreviated set of instructions by the assistant to the
subject. The subject then selected a card again and the
procedure was replicated as trial number 2. The entire
two-stage procedure lasted between 30-45 minutes for each
subject.
The Polygrapher's Scoring Method

The difference in skin resistance between the level immediately prior to the stimulus and the highest level reached within 6 seconds was used as the response measure for each stimulus. The three largest responses (one per stimulus number) in each set were ranked according to height. A set was determined by the questioning of each possible number and blank card only once. There were three sets of questions per detection trial. The polygrapher then had one response ranked as the highest response per set for three sets. Should the subject's physiological response to one number be greatest in all three sets, then that number was identified as the subject's "hidden number." If a number came first in the ranking in two out of three sets, then again it was identified by the graph interpreter (polygrapher) as the concealed number. What if all three sets show a different number as the highest ranking? The graph interpreter then chose the largest response of the three top ranking, and the accompanying stimulus number. When the graph interpreter was done scoring the responses, he then wrote the identified number on the back of the chart and gave it to the assistant who then verified the polygrapher's judgment. This signaled the end of the trial.
Polygrapher Training

The experimenter who conducted this study also acted as the polygrapher. While the polygrapher in this study was not a trained professional, the method of testing (GKT) lends itself to be replicated quite easily by a non-professional. The use of an objective scoring method served two purposes: (1) it can be performed quickly and (2) it decreases the subjective element and in turn allows for direct replication. The polygrapher also tested five subjects prior to the experiment to clarify procedural inconsistencies and become acquainted with the apparatus. The polygrapher had also performed a similar experiment at the undergraduate level using a Galvanic Skin Response monitor.
RESULTS

The principal concern of this study was to evaluate the effects of heightened subject motivation on the detection of deception. Each of the 40 subjects was tested over two trials. The total number of tests run was 80. As can be seen in Tables 1 and 2, a two way repeated measures analysis of variance was used to calculate differences in subject detection rates of motivated and non-motivated subjects over two trials. The number of correct hits by the polygrapher was significantly larger for the highly motivated subjects than those less motivated $F(1,39) = 5.556, p< .05$. The conventional level of significance of .05 was chosen to interpret the results; however, few studies involving polygraph apparatus go to this extreme. The data are traditionally presented in the literature in the form of a percent correct. While data put in the form of percent may be more easily understood by the general public, research performed by the scientific community tends to be presented in a more complex form (i.e., analysis of variance). Further, analysis of Table 1 indicates a disproportion of detections across subjects, from trial 1 to trial 2. While the number of detections by the polygrapher decreased from 26 to 18, this discrepancy was
not significant in that \( F(1,40) = 3.220, p = .076 \). The possibility of an interaction between levels of motivation and trials did not transpire as indicated by the repeated measures analysis of variance.

### Table 1
Repeate Measures Analysis of Variance

<table>
<thead>
<tr>
<th>Source</th>
<th>SS</th>
<th>DF</th>
<th>MS</th>
<th>F</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Subjects</td>
<td>9.80</td>
<td>39</td>
<td>.2513</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A (level of motivation)</td>
<td>1.25</td>
<td>1</td>
<td>1.2500</td>
<td>5.556</td>
<td>.024</td>
</tr>
<tr>
<td>Subjects within groups</td>
<td>8.55</td>
<td>38</td>
<td>.2250</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Within Subjects</td>
<td>10.00</td>
<td>40</td>
<td>.2500</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B (Trials)</td>
<td>.80</td>
<td>1</td>
<td>.8000</td>
<td>3.220</td>
<td>.076</td>
</tr>
<tr>
<td>A x B (level of motivation)</td>
<td>.05</td>
<td>1</td>
<td>0.500</td>
<td>.208</td>
<td>.651</td>
</tr>
<tr>
<td>groups x trials</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>19.80</td>
<td>79</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 2
Mean Number of Correct Identifications

<table>
<thead>
<tr>
<th>Motivation</th>
<th>Non Motivation</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>5 Card</td>
<td>15</td>
<td>7</td>
</tr>
<tr>
<td>7 Card</td>
<td>12</td>
<td>10</td>
</tr>
<tr>
<td>Total</td>
<td>27</td>
<td>17</td>
</tr>
</tbody>
</table>

Another of the initial concerns of this study was the detection rates of the polygrapher when blank cards were introduced into the subjects' selection. The analysis of these data showed that the polygrapher detected the same number of subjects in each condition, that is, the rate of detection was the same with and without a blank card in the set. A review of Table 2 indicates identical detection rates of 22 in both the 5 and 7 card conditions. The total number of blank cards drawn was 7 with the polygraphers correctly identifying 4 of the subjects.

Overall, the polygrapher detected 44 cards out of 80 possible trials. As indicated on Table 3, this is a success rate of 55%. The polygrapher in this experiment was forced to make a judgement as to the subject's
potential card. The number of false positives, 36 out of 80, may be attributed to the forced choice of the polygraphers among other variables. The overall success rate of the polygrapher exceeded chance levels as indicated by a chi-square test in that \( x^2 (1) = 10.8, p < .001 \). While the polygrapher exceeded chance levels of detection, a more important aspect of the study is the actual number of detections in each category. The breakdown of detections and misses can be seen in Table 3.

Table 3

<table>
<thead>
<tr>
<th>Group</th>
<th>Detected</th>
<th>Non-Detected</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>#</td>
<td>%</td>
<td>#</td>
</tr>
<tr>
<td>Motivated</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(20 subjects x 2 trials)</td>
<td>27</td>
<td>67.5</td>
<td>13</td>
</tr>
<tr>
<td>Non-motivated</td>
<td>17</td>
<td>42.5</td>
<td>23</td>
</tr>
<tr>
<td>Trial 1</td>
<td>26</td>
<td>65</td>
<td>14</td>
</tr>
<tr>
<td>Trial 2</td>
<td>18</td>
<td>45</td>
<td>22</td>
</tr>
<tr>
<td>5 Cards</td>
<td>22</td>
<td>55</td>
<td>18</td>
</tr>
<tr>
<td>7 Cards</td>
<td>22</td>
<td>55</td>
<td>18</td>
</tr>
<tr>
<td>Blank Cards</td>
<td>4</td>
<td>57.1</td>
<td>3</td>
</tr>
</tbody>
</table>
DISCUSSION

A significant difference between the number of detections in the motivation vs. non-motivation groups was predicted by prior research (Gustafson and Orne, 1963). The study by Gustafson and Orne (1963) posed a similar question of the effects of motivation on subject detectability and found that subjects who were motivated to deceive more frequently produce disproportionately large skin resistance responses to certain critical items. This increase in responsivity due to the increase in motivation can help improve the detection ratio for the polygrapher from a chance level to a level of statistical significance. This means that the subject's level of motivation may play a major role in the overall effectiveness of a polygraph test attempting to discriminate guilty from innocent subjects. With the level of motivation of a subject being such a dominant variable in the detection of deception, the question concerning the optimal level of motivation of a suspect, must be examined further.

The psychophysiological arousal of a person may inadvertently lead a polygrapher to misclassify that person. The reaction of person uninterested in obtaining a job is invariably different from that of the person who

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is highly motivated to pass the same polygraph test and, in turn, get the job. The person who is applying for a job and is highly motivated stands a greater chance of being found guilty on a polygraph test versus another person who is perhaps going through the motions. While both applicants may be guilty of some prior violation (i.e., stealing from a previous employer), the motivational theory expanded upon in this study indicates that the less motivated applicant will be more difficult to detect through a polygraph test.

The logic behind this paradigm is that the less motivated subject will perhaps go undetected and proceed to the next stage of the preemployment testing. Related to this area directly is the current fear of classifying innocent subjects as guilty. This is known as a false positive classification. According to Lykken (1984), this misclassification of innocent subjects may occur as much as 50% in real life situations. Quite often the polygrapher is aware that a crime was committed by one person and perhaps seven are interrogated. The usual procedure involves the post-testing selection of the poorest scoring suspect as the guilty party. In dealing strictly with the subject of motivation, the levels of each possible suspect must differ in many respects. If someone's job is in jeopardy or someone was just hired, this person's level of motivation and anxiety may be
quite different from the suspect who is friends with management and has a spotless record over five years.

The blank cards were used in this study as an added variable to both increase the size of the set of numbers and to determine the detectability of a subject who had not chosen a numbered card. The use of blank cards in this study proved to be less of a factor then was expected.

The study by Gustafson and Orne (1965), which also used blank cards, was the initiating force to include these cards again. The difference between this study and that of Gustafson and Orne (1965) is that the current experiment attempted to assess the detectability of a subject with a blank card while the previous study used the blank card to manipulate guilt or innocence on a "dummy" trial. While Gustafson and Orne (1965) used the blank card to manipulate perceived success, this experiment used the blank card to assess detectability without the selection of a "guilty" number. To heighten the response of the subjects who drew blank cards, the polygrapher's question concerning the blank card was topographically different from the numbered questions (i.e., is your number 5? . . . Is your number 2? . . . Is your card blank?). It was also hoped that this change of topography would help increase the physiological response making the subjects with blank cards easier to detect. This did not occur in this study as seven subjects drew blank cards and only four were detected. The fact
that all subjects were asked to try to "beat" the polygrapher could have accounted for the lack of subject reactivity to the blank card question. While the blank cards were used in the manner just described, they were also used to differentiate sets of numbers. This comparison of the five card group to the seven card group indicated there was no difference in group detection rates. The fact that so few blank cards were picked from the seven card group may also have been a factor.

The comparison of the number of detections across trials one and two, though not significant, does bear further scrutiny. The difference in the detection of the subject's chosen number decreased from trial one (26 detections) to trial two (18 detections). This is in agreement with the research of Timm (1984) which indicated a possible physiological fatigue on a second trial. Notes taken by the current researchers were similar to those of Gustafson and Orne (1965) in terms of the general decrease in overall amplitude of GSR across trials. The ramifications of this decrease in physiological response may be that subjects who have been tested on a polygraph at a previous time may increase their chances at deceiving a polygrapher. Further long term research on this aspect of the polygraph procedure should be evaluated.

The use of an objective scoring method in this study
allowed the polygrapher to score the subject's responses quickly and without bias. While the polygrapher may have had "thoughts" as to what the subject's number was (based on the physiological response observed to various questions), the use of this method of scoring lends itself to be replicated in some form in future research. One of the problems with this scoring method was the flat GSR recording found periodically on the second trial for some subjects. This then forced the polygrapher to manipulate the polygraph apparatus between sets of numbers in order to obtain some graph movement. This was only done on a few trials (second trials only) and after the first or second set of questions. This altering of the scoring procedure and apparatus for a few subjects maintained the objectivity that was desired for this study.

Suggestions for Future Research

The results of this study are both mixed and indicative of some of the problems currently plaguing the field of lie detection. The issue of subject motivational level is a major far reaching component in the detection paradigm. At which point does motivation approach anxiety? Questions such as this must be answered through research in the laboratory long before this instrument and procedure are used to take jobs away
or convict suspects. The laboratory performance of a polygrapher can be objectively verified thus decreasing the often inflated accuracy rates that are found so often in the field.

This study has attempted to replicate and expand upon certain aspects of a lie detection test. The variables in this study were the level of motivation of the subjects as well as set size. This study has not solved any or all of the problems associated with a polygraph test, yet has added support for controlling the level of motivation of subjects to better discriminate guilty subjects from innocent. The study has also approached the topics of set size, habituation of response across trials and the scoring of the GSR charts objectively. Further research can quite easily take any one of these variables and compare different levels or procedures. Overall, the GSR monitor accompanied by the GKT proved to be effective in discriminating the physiological responses of subjects to critical and non-critical questions.
Appendix A

General Instructions
General Instructions Given to all Subjects

Stage 1  You are now in stage 1 of a two-stage experiment. This is a 'lie detection' study in which your job will be to attempt to conceal a 'selected number' from the polygraph operator (polygrapher). The polygraph operator will be monitoring your skin conductivity. While you may have heard of other polygraph studies that utilized other measures (i.e., respiration, heart rate, voice fluctuations, etc.), we have chosen to monitor skin resistance. Skin resistance or Galvanic Skin Response has consistently shown to be the best indicator in the detection of deceit, in the laboratory. The task in stage 1 will be for you to pick a card out of the deck and repeat the contents of this card to the assistant. This is "your card". The assistant will then show you to the interrogation room where you will deposit your card into a cardboard box for verification at the end of stage 1. Do you have any questions?

The polygrapher will attach the monitor to your hand and the questioning process will begin. During the questioning process, please refrain from any sudden movements if possible. You are instructed to respond with the answer "no" to each question. The polygrapher will ask, "is your number three?" The polygrapher will also ask about a blank card (i.e., is your card blank?)
which you may have selected from the group of numbered cards. Please respond with the answer "no" to this question as well. There may or may not be a blank card in the deck from which you will be selecting 'your card'. The polygrapher will not have knowledge as to which deck the assistant is presenting to you. The questions will be asked 'randomly', with one being asked every 15 seconds. When this procedure is over, the polygrapher will turn off the monitor and take the graph to an adjacent room to evaluate the physiological responses. The polygrapher will then write down the number he feels you were trying to conceal and the assistant will compare his 'choice' to your actual card. Do you have any questions? I will now offer a deck of cards to choose from (the assistant shuffles the cards so the subject can see that not all cards have the same number). The assistant then turns the deck over so the subject cannot pick a specific number deliberately. What card have you selected?

Stage 2

In this stage you will choose a card again. We will go through the same procedure. The deck is the same as the one used for the first trial. Please select a card. What is your card? Do you have any questions?
Appendix B

Motivational Instructions
Stage 1  Through a process of random assignment of subjects you have been placed in the 'high motivation' condition. Should you successfully conceal the identity of your card from the polygrapher, you will be paid $3 as well as obtaining your two extra credit points. Should you be successful in deceiving the polygrapher, you will be paid by the assistant after the completion of stage 1. Do you fully understand the potential consequences of a successful concealment? Do you know what your card is?

Stage 2

In this stage you will choose a card again. We will go through the same procedure. The deck of cards is the same as the one used for the first trial. If you are successful at concealing the identity of your card, I will pay you $3 at the completion of this trial. Please select a card. What is your card? Do you have any questions?
Appendix C

Polygrapher's Instructions
Polygrapher's Instructions

The experiment you are in is exactly as my assistant has presented it. During the questioning process please refrain from any sudden movements if possible. Please let your hands hang freely off the end of the arms of the chair. Keep both feet on the floor and look straight ahead at the wall. Like my assistant discussed with you, please respond with the answer "no" to each question. I will ask the numbers in a random fashion. Do you have any questions? Please take a deep breath and exhale. I will begin the questioning process now. Is your number four?
BIBLIOGRAPHY


