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THE INFLUENCE OF RACE AND GENDER ON SPECIFIC ISSUE POLYGRAPH EXAMINATIONS

By

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The polygraph technique is used extensively by government agencies and law enforcement agencies, both to screen job applicants and to investigate employee-related crimes. Because polygraph results affect hiring and firing decisions, there is a concern that the technique may discriminate against minorities. For example, in a law suit alleging that the technique was discriminatory, Johnson v. Georgia Highway Express, Inc., 488 F.2d 714 [5th Cir. 1972]), the court accepted the expert testimony of Dr. Martin Orne, who disclaimed any racial overtones or discriminatory characteristics in polygraph examinations. The court ruled that the employees were discharged, "for failure to clarify highly deceptive answers on polygraph examinations administered to them by the Defendant in a wholly non-discriminatory fashion."

The preceding case relied exclusively on a subjective evaluation of the procedures used and the probably discriminatory impact of such a procedure. As this issue arises more frequently, courts will look for a more objective criterion to evaluate the possibility of the adverse impact of polygraph examination results. The present research, therefore, is designed to investigate the possible influence of the subject's race and gender on the outcome of polygraph results, with respect to specific issue examinations. If one assumes that there is no inherent differences of truthfulness between races and genders, and that race and gender do not influence polygraph results, there should be no statistical differences in a random sample of different races and gender.

Review

In regard to race, minorities, ethnic origin, and gender, there is a significant body of literature discussing physiological differences. Some of the differences relate to physiological activities monitored by the polygraph instrument, such as electrodermal responsivity (i.e., Kugelmass, 1963; Kugelmass & Lieblich, 1966, 1968; Johnson & Corah, 1963; Johnson & Landon, 1965; Windel & Hogan, 1975), heart rate (Persky et.al., 1979), and blood pressure (Anderson, 1989; Anderson et.al., 1989, Durel et al., 1989). From a theoretical perspective, however, such differences should have no direct bearing on validity of polygraph tests because individual examinees serve as their own baselines (Reid & Inbau, 1977). The effects of cultural variations are difficult to assess with respect to polygraph accuracy because there is little literature on the topic (Doll & Law, 1990). We do know that specific issue and multiple issue polygraph tests work with a high degree of accuracy in many foreign countries when used by law enforcement

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The authors are members of the APA and prior contributors to this journal. This issue of Polygraph is devoted solely to their research.

personnel. The research represents subjects of different races, in a variety of cultures, and tests in diverse languages as represented by an extensive body of polygraph research literature in Israel (Ben-Shakhar & Furedy, 1990) and Japan (Yamamura & Miyata, 1990), and more limited research in other cultures, such as India (Lahri & Ganguly, 1978), Poland (Widacki, 1982), and Yugoslavia (Aleksic, 1972). In the United States we have a research project by Arellano (1984) in which 40 Spanish speaking subjects were administered polygraph examinations as suspects in theft cases, and all were tested successfully (verified). Those charts were read blind, with the same results. However, with only 40 subjects, the results must be considered tentative. We have no literature on how accurate polygraph tests are with other minorities, but there is a survey of 48 applicants for employment with the Richland County Sheriff's Department, in Columbia, South Carolina relating to subjects' attitudes toward the polygraph (Glymph, 1985). The examiner, who was Black, categorized the responses by Black and White, and by men and women. The questionnaires were administered after the polygraph test.

	White Male (n. 11)			Black Male (n. 14)			White Female (n. 8)			Black Female (n. 15)		
	Yes	No	No Opinion	Yes	No	No Opinion	Yes	No	No Opinion	Yes	No	Opinion
1. Were you in any manner embarrassed, humiliated, or degraded by any part of the polygraph examination?	0	100%	0	7%	85%	7%	0	100%	0	33%	60%	6%
2. In your opinion, was there any objectionable or unwarranted invasion of your privacy during the conduct of the polygraph examination?	0	100%	0	0	100%	0	0	100%	0	13%	87%	0
3. Should you be hired, do you believe you will be more secure in your work knowing the polygraph is used in personnel evaluations?	73%	18%	9%	86%	0	14%	75%	12%	12%	93%	0	7%

While the Glymph survey provides us with some opinions of those Blacks and Caucasians who have taken preemployment tests, it does not tell us about who was accepted and who was rejected.

In regard to women and men, the literature is sparse. As with minorities, there is literature about the physiological differences in processes that polygraph instruments record, such as blood pressure (McCubbin et al., 1991) and electrodermal activity (Russell, 1988), but this does not relate to the topic of accuracy or test outcome.

In regard to test outcome, in Arellano's (1984) study of real theft cases, the accuracy of the test, and subsequent blind analysis of charts was 100% correct for both Hispanic men and Hispanic women. There are a number of laboratory studies in which the results are separated by gender. There were researchers who found no difference in test results between men and women (Furedy, Davis & Gurevich, 1988; Gudjonsson, 1982; Hemsley, Heslegrave & Furedy, 1979; Horvath, 1978; MacKaay, 1967; Miyake, 1978; Timm, 1982; and Yankee & Grimsley, 1986), and others where the results were close (Beijk, 1980; Russell, 1988). Russell found women to be electrodermally less reactive than men. Differences in detection rates of men and women were found by Horvath (1979) in which women were detected at a greater rate than men. In that study Horvath used only the electrodermal measure. In the only research on screening which mentions the gender of the subjects (Correa & Adams, 1981), the detection rate was 100%, so no difference was observable. Like Arellano's study, the Correa & Adams research at University of Georgia study was limited by a small number of subjects, 20 of each sex.

In a Dutch experiment, Beijk (1980) conducted 74 Peak of Tension tests with women and 154 similar tests with men. With chance at 10%, the detection rate for men was 78% and for women was 84%, which is not a significant difference. The differentiation of the average response amplitude for the critical to non-critical numbers was 2.27 to 0.84 for men, and 2.62 to 0.74 for women. The differentiation of critical to non-critical items was significant for both men and women at $p < .001$, but the difference between men and women only approached significance at $p < .10$, with the differentiation between critical and non-critical items being greater for women. In another Dutch study vanDoornen (1985) measured the difference in stress levels of male and female college students on routine days and examination days. For each student he measured serum cholesterol level, plus ambulatory heart rate and ambulatory systolic blood pressure. The serum cholesterol level, systolic blood pressure level, and heart rate were higher on the examination day (and during the examination) than on a normal day for all participants, and the reactions did not differ between the sexes. However, ambulatory monitored heart rate during the examination was a good index of anxiety for females, but not the males. The rise in adrenaline was higher in males than females. In females, but not males, adrenaline base level correlated significantly with neuroticism ($r = .35$) and depression ($r = .38$). In males, but not females, achievement motivation correlated significantly with cholesterol base level ($r = .32$) and with stress induced cholesterol levels ($r = .52$).

To learn what race and gender differences exist outside of the laboratory, we needed to study a large number of subjects involved in real polygraph cases, conducted with standard techniques and field polygraph instruments.

Examination Procedures

The specific issue examination is designed to determine whether or not the subject is telling the truth regarding a specific alleged incident, e.g., theft, sexual harassment, sabotage, arson, etc. During the pretest interview the examiner discusses, in a non-accusatory manner, the issue under investigation and asks questions to develop investigative information

from the suspect such as his opportunity, access, motives, or propensity to commit the crime, as well as behavior provoking questions which provide insight to the subject's truthfulness by eliciting verbal and nonverbal "behavior symptoms" of truth or deception. The examiner also evaluates the subject's physical and emotional suitability for the examination and assesses the presence of underlying emotional states which are known to effect the examination results such as anger, guilt through negligence, or emotional defeat. During the pretest interview the examiner formulates and reviews with the subject all of the questions which will eventually be asked during the examination. In a specific issue examination this normally consists of 3 relevant questions, 2 control questions and 4 irrelevant questions. Of particular importance here, is the development of the control questions, the selection and formulation of which will be dictated by the examiner's ability to determine whether or not the subject, is uncertain in his answer to the control question and if the subject perceives the control question as a threat to their goal of the examination (Jayne, 1986).

Once all of the questions have been reviewed with the subject, and he is able to answer each of them with just a "yes" or "no" response, the chart recording phase of the examination begins. During a specific issue examination the examiner will conduct 3 to 5 separate polygraph tests, each containing the same questions. While the tests vary in purpose and design, the goal of the examiner is to select a test or stimulation statement (offered between tests) which will enhance the subject's discrimination between relevant and control questions.

When all tests have been completed, the final stage of the examination is the evaluation of the subject's polygraph charts. The examiner evaluates the consistency and degree of physiological arousal occurring to the relevant and control questions in making his determination of truth or deception. After reviewing the polygraph chart the examiner may decide that the charts clearly indicate truthfulness or deception. On the other hand, if the subject's responses to relevant and control questions are inconsistent or erratic, the examiner may render an inconclusive opinion, conduct further specialized tests, or withhold an opinion and schedule the subject for a reexamination.

Method

To develop a suitable sample, it was decided to evaluate the first 1000 subjects who were administered specific issue polygraph examinations during 1984. So as to not selectively eliminate any subjects, these subjects were selected on a per case basis, and, as it happened, the final case pulled included about 30 subjects which resulted in a total of 1022 subjects who were sequentially selected to form a sample. This sample included 567 (55%) Caucasians and 455 (45%) minorities, primarily Blacks and Hispanics. There were 480 (47%) men and 542 (53%) women.

Each of these subjects were administered specific issue polygraph examinations by staff examiners of John E. Reid and Associates. The clients for whom these examinations were conducted included private employers, insurance companies, police departments, and others. The polygraph examinations were conducted by experienced examiners who were licensed to conduct

polygraph examinations by the state of Illinois. The instruments used recorded respiratory, electrodermal, and cardiovascular activity.

Results

From the sample of 1022 specific issue examinations, 964 subjects (94%) were reported as either truthful or deceptive in their answers to the relevant questions (6% were reported inconclusive). Table 1 lists the results of the specific issue examinations by race and gender, excluding inconclusive opinions.

Table 1

Specific Issue Polygraph Results by Race and Gender

	Truthful	(%)	Deceptive	(%)
Caucasian	447	(84%)	85	(16%)
Minorities	342	(79%)	90	(21%)
Male	313	(71%)	129	(29%)
Female	476	(91%)	46	(9%)

Chi-squared tests indicated no significant difference between Caucasians and Minorities [$x^2 = 3.78$ (1) $p < .05$]. However, there was a significant difference in polygraph results between men and women [$x^2 = 68.86$ (1) $p < .05$]. To further isolate the influence of gender on specific issue polygraph results, the sample was subdivided into race and gender categories. These results are listed in Table 2.

Table 2

Specific Issue Polygraph Results by Race and Gender Subcategories

	Truthful	(%)	Deceptive	(%)
Caucasian male	164	(73%)	61	(27%)
Caucasian female	283	(92%)	24	(8%)
Minority male	149	(69%)	68	(31%)
Minority female	193	(90%)	22	(10%)

Chi-square tests indicated a significant difference between Caucasian males and females [$x^2 = 36$ (1)], as well as between Minority males and

females [x^2 = 29 (1)]. There was no significant difference between Caucasian and Minority males [x^2 = .95 (1) $P < .05$] or Caucasian and Minority females [x^2 = .92 (1) $p < .05$]. Thus, these differences were only due to gender, where both Caucasian and Minority females were statistically reported as truthful more often than males.

Discussion

The purpose for this study was to investigate whether or not a subject's race or gender influence their polygraph results in specific issue examinations. Because there was no ground truth criterion for these decisions, the findings do not reflect on the accuracy of the examiner's opinion, but merely the possible discriminatory impact the polygraph technique may have on minorities, e.g., Blacks, Hispanics, Orientals, and females.

It may be tempting to compare these results with national crime statistics in an effort to establish predicted outcomes. In the mid-1980's, Minorities represented 14% of the nation's population and yet, in 1985, the year this sample was collected, Blacks accounted for 27% of all arrests, 34% of the Uniform Crime Reports Index crime arrests, and 47% of all arrests for violent crimes. (Department of Justice Bureau of Criminal Statistics [BCS], 1988) In addition, in 1985, women represented only 5% of the prison population (BSC, 1988). While these national statistics would predict higher rates of deception for Minorities and males, this would only be so if this sample consisted of specific issue polygraph examinations primarily investigated single suspect crimes. This was not typically the case, especially with respect to truthful polygraph results. The reason for this is that this sample included many employee theft investigations in which in a given case possibly 24 to 36 suspects were administered polygraph examinations, only one of which was guilty of the offense. Because deception is the rare occurrence in such a situation, it would be predicted that a high number of males and Minorities would be reported as telling the truth to the issue under investigation.

The findings from this study indicate that a specific issue polygraph examination is more likely to find a male deceptive than a female, but equally likely to find a Caucasian deceptive as a Minority. There are two possible explanations for this result. The first is that the polygraph technique produces a higher incidence of false negative errors on females than males, or second, that males are more likely to engage in criminal behavior than females. Since females represent the protected class, the fact that they were reported as truthful more often than males indicates that specific issue examinations resulted in no adverse impact on females.

Conclusions

Because there are reported physiological differences between males and females as well as Blacks and Whites, and that polygraph results are based on analysis of physiological responses, it has been posited that these differences may cause polygraph results to adversely impact on Federally protected classes. This study investigated the polygraph results of 1022 subjects who were administered specific issue polygraph examinations. The

sample included a random selection of Whites and non-Whites, males and females.

After analyzing the frequency of truthful and deceptive opinions from specific issue examinations it was found that there were no statistical differences in polygraph results between Whites and Minorities. There was, however, a significant difference within gender where females were more likely to be reported as telling the truth during a specific issue polygraph examination.

Nonetheless, the fact that women were reported truthful more often than men is in line with the trend of statistics which show that women probably commit far less crimes than men and are convicted of crimes much less often than men.

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The Influence of Race and Gender on Preemployment Polygraph Examination Results

Joseph P. Buckley and Louis C. Senese

The object of this research was to compare the preemployment polygraph test outcomes of minorities with the test outcomes of Caucasians and to compare the preemployment polygraph test outcomes of women with the polygraph test outcomes of men.

Review

In regard to race, minorities, ethnic origin, and gender, there is a significant body of literature discussing physiological differences. Some of the differences relate to physiological activities monitored by the polygraph instrument, such as electrodermal responsivity (i.e., Kugelmass, 1963; Kugelmass & Lieblich, 1966, 1968; Johnson & Corah, 1963; Johnson & Landon, 1965; Windel & Hogan, 1975), heart rate (Persky et al., 1979), and blood pressure (Anderson, 1989; Anderson et al., 1989, Durel et al., 1989). From a theoretical perspective, however, such differences should have no direct bearing on validity of polygraph tests because individual examinees serve as their own baselines (Reid & Inbau, 1977). The effects of cultural variations are difficult to assess with respect to polygraph accuracy because there is little literature on the topic (Doll & Law, 1990). We do know that specific issue and multiple issue polygraph tests work with a high degree of accuracy in many foreign countries when used by law enforcement personnel. The research represents subjects of different races, in a variety of cultures, and tests in diverse languages as represented by an extensive body of polygraph research literature in Israel (Ben-Shakhar & Furedy, 1990) and Japan (Yamamura & Miyata, 1990), and more limited research in other cultures, such as India (Lahri & Ganguly, 1978), Poland (Widacki, 1982), and Yugoslavia (Aleksic, 1972). In the United States we have a research project by Arellano (1984) in which 40 Spanish speaking subjects were administered polygraph examinations as suspects in theft cases, and all were tested successfully (verified). Those charts were read blind, with the same results. However, with only 40 subjects, the results must be considered tentative. We have no literature on how accurate polygraph tests are with other minorities, but there is a survey of 48 applicants for employment with the Richland County Sheriff's Department, in Columbia, South Carolina relating to subject's attitudes toward the polygraph (Glymph, 1985). The examiner, who was Black, categorized the responses by Black and White, and by men and women. The questionnaires were administered after the polygraph test.

While the Glymph survey provides us with some opinions of those Blacks and Caucasians who have taken preemployment tests, it does not tell us about who was accepted and who was rejected.

	White Male (n. 11)			Black Male (n. 14)			White Female (n. 8)			Black Female (n. 15)		
	Yes	No	No Opinion	Yes	No	No Opinion	Yes	No	No Opinion	Yes	No	No Opinion
1. Were you in any manner embarrassed, humiliated, or degraded by any part of the polygraph examination?	0	100%	0	7%	85%	7%	0	100%	0	33%	60%	6%
2. In your opinion, was there any objectionable or unwarranted invasion of your privacy during the conduct of the polygraph examination?	0	100%	0	0	100%	0	0	100%	0	13%	87%	0
3. Should you be hired, do you believe you will be more secure in your work knowing the polygraph is used in personnel evaluations?	73%	18%	9%	86%	0	14%	75%	12%	12%	93%	0	7%

In regard to women and men, the literature is sparse. As with minorities, there is literature about the physiological differences in processes that polygraph instruments record, such as blood pressure (McCubbin et al., 1991) and electrodermal activity (Russell, 1988), but this does not relate to the topic of accuracy or test outcome.

In regard to test outcome, in Arellano's (1984) study of real theft cases, the accuracy of the test, and subsequent blind analysis of charts was 100% correct for both Hispanic men and Hispanic women. There are a number of laboratory studies in which the results are separated by gender. There were researchers who found no difference in test results between men and women (Furedy, Davis & Gurevich, 1988; Gudjonsson, 1982; Hemsley, Heslegrave & Furedy, 1979; Horvath, 1978; MacKaay, 1967; Miyake, 1978; Timm, 1982; and Yankee & Grimsley, 1986), and others where the results were close (Beijk, 1980; Russell, 1988). Russell found women to be electrodermally less reactive than men. Differences in detection rates of men and women were found by Horvath (1979) in which women were detected as a greater rate than men. In that study Horvath used only the electrodermal measure. In the only research on screening which mentions the gender of the subjects (Correa & Adams, 1981), the detection rate was 100%, so no difference was observable. Like Arellano's study, the Correa & Adams research at the University of Georgia study was limited by a small number of subjects, 20 of each sex.

In a Dutch experiment, Beijk (1980) conducted 74 Peak of Tension tests with women and 154 similar tests with men. With chance at 10%, the detection rate for men was 78% and for women was 84%, which is not a significant difference. The differentiation of the average response amplitude for the critical to non-critical numbers was 2.27 to 0.84 for men, and 2.62 to 0.74 for women. The differentiation of critical to non-critical items was significant for both men and women at $p < .001$, but the difference between men

and women only approached significance at $p < .10$, with the differentiation between critical and non-critical items being greater for women. In another Dutch study vanDoornen (1985) measured the difference in stress levels of male and female college students on routine days and examination days. For each student he measured serum cholesterol level, plus ambulatory heart rate and ambulatory systolic blood pressure. The serum cholesterol level, systolic blood pressure level, and heart rate were higher on the examination day (and during the examination) than on a normal day for all participants, and the reactions did not differ between the sexes. However, ambulatory monitored heart rate during the examination was a good index of anxiety for females, but not for males. The rise in adrenaline was higher in males than females. In females, but not males, adrenaline base level correlated significantly with neuroticism ($r = .35$) and depression ($r = .38$). In males, but not females, achievement motivation correlated significantly with cholesterol base level ($r = .32$) and with stress induced cholesterol levels ($r = .52$).

To learn what race and gender differences exist outside of the laboratory, we needed to study a large number of subjects involved in real preemployment polygraph cases, conducted with standard techniques and field polygraph instruments.

Examination Procedures

The primary goal of a preemployment polygraph examination is to determine whether or not a job applicant has engaged in significant past acts of dishonesty or misconduct which exceed pre-established standards of accepted behavior. In this regard, before John E. Reid and Associates conducts any preemployment screening for a client, maximum tolerance levels in such areas as thefts of money or merchandise from previous employers, illegal drug use during work hours, and commissions of crimes in the last 7 years are established with the client. For example, if a client decides that it will not hire any applicant who has stolen more than $5.00 worth of money from employers in the last five years, any applicant who admits stealing more than $5.00 in money during the time frame is reported as "not meeting standards". During the pretest interview, therefore, the examiner encourages the applicant to make admissions in these work related areas and will eventually formulate relevant questions which exclude the applicant's admissions. For example, if an applicant admitted stealing $50 in money from employers in the last 5 years, the examiner would ask, as a relevant polygraph question, "Did you steal more than $50 in money from employers in the last five years?"

Generally, four relevant questions are formulated for screening examinations as well as two control questions. The relevant questions are the same for all applicants and investigate thefts of money and merchandise from employers in the last 5 years, commission of crimes in the last 7 years and illegal drug use in the last 12 months. Following the review of each question the examiner conducts two or three polygraph tests, during which each relevant question is asked at least once. The chart interpretation phase of the examination is primarily designed to identify the question or questions to which the applicant is most emotionally focused (as evidenced

through physiological arousal) and, if it is a relevant question, the applicant will be so advised and given an opportunity to clarify the responses.

The results of preemployment screening examinations indicate whether or not the applicant's past behavior exceeded the client's preestablished standards.

Method

The sample of preemployment examinations collected for this study consisted of the first 1000 preemployment polygraph examinations administered in 1985 by staff examiners of John E. Reid and Associates. These examinations were conducted for a variety of clients including applicants for jobs with retail, financial, trucking, security, health care, and warehouse corporations. The polygraph examinations were conducted by experienced examiners who were licensed to conduct polygraph examinations in Illinois. The instruments used recorded respiratory, electrodermal, and cardiovascular activity.

Within the sample of 1000 applicants who were administered preemployment polygraph examinations, 619 (62%) were Caucasian and 381 (38%) were Minorities, primarily Blacks and Hispanics. There were 738 (74%) men and 262 (26%) women. Forty percent of the sample were reported as not meeting company standards, while the remaining 60% did not make admissions which exceeded company standards. Table 1 lists the number of applicants who were reported as meeting standards (recommended) and not meeting standards (not recommended) by race and gender.

Table 1

Preemployment Polygraph Results Listed by Race and Gender

	Recommended	(%)	Not Recommended	(%)
Caucasians	378	(61%)	241	(39%)
Minorities	157	(59%)	223	(41%)
Males	411	(56%)	327	(44%)
Females	191	(73%)	71	(27%)

Chi-square tests indicated a significant difference between Caucasians and Minorities [$x^2 = 36.93$ (1) $p < .05$] as well as Male and Female [$x^2 = 23.9$ (1) $p < .05$]. In an effort to isolate a primary effect causing these differences, the sample was subdivided into race and gender categories. These findings are listed in Table 2.

Table 2

Preemployment Polygraph Results by Race and Gender Subcategories

	Recommended	(%)	Not Recommended	(%)
Caucasian males	266	(57%)	202	(43%)
Minority males	145	(54%)	125	(46%)
Caucasian females	112	(74%)	39	(26%)
Minority females	79	(71%)	32	(29%)

Chi-square tests indicated no significant difference between Caucasian and Minority males [$x^2 = .68$ (1) $p < .05$], Caucasian and Minority females [$x^2 = .29$ (1) $p < .05$], or Minority males and Minority females [$x^2 = 14.43$ (1) $p < .05$]. This finding suggests that only the Caucasian female was reported as meeting standards at a rate significantly greater than any other subgroup.

Discussion

The purpose of this study was to investigate whether or not a subject's race or gender influence their polygraph results in preemployment polygraph examinations. Because there was no ground truth criterion for these decisions, the findings do not reflect on the accuracy of the examiner's opinion, but merely the possible discriminatory impact the polygraph technique may have on minorities, e.g., Blacks, Hispanics, Orientals, and females.

It may be tempting to compare these results with national crime statistics in an effort to establish predicted outcomes. In the mid-1980's, Minorities represented 14% of the nation's population and yet, in 1985, the year this sample was collected, Blacks accounted for 27% of all arrests, 34% of the Uniform Crime Reports Index crime arrests, and 47% of all arrests for violent crimes. (Department of Justice Bureau of Criminal Statistics [BCS], 1988) In addition, in 1985, women represented only 5% of the prison population (BSC, 1988).

With respect to preemployment screening examinations, those national statistics would predict a higher rate of Minorities and males who would be reported as not meeting standards. The sample of applicants who were administered preemployment polygraph examinations, however, were unlikely to be representative of the normal population. Individuals asked to take a preemployment polygraph examination have an established work history whereas many individuals who commit crimes are unemployed. In addition, many individuals who have engaged in criminal behavior will not agree to take a preemployment polygraph examination.

Consequently, there is no sound basis to make a prediction of how many Minorities or males in this study should have been reported as not meeting standards following a preemployment polygraph examination.

These results from the preemployment polygraph examinations indicate that only Caucasian females were reported as meeting integrity standards at a significantly higher rate than the other subgroups. This finding may be the result of a higher incidence of false negative polygraph errors with females, or that Caucasian females engage in fewer acts of dishonesty than other subgroups. If the latter case is true, this finding dovetails with the results from specific issue polygraph examinations (Buckley & Senese 1991) in that if females engage in fewer acts of dishonesty than men, one would predict that they would meet integrity standards at a higher rate than men, and also be more likely innocent when suspected of a crime. This research did not find any adverse impact on preemployment results from Minority females or Minority males.

Conclusions

Because there are reported physiological differences between males and females as well as Blacks and Whites, and that polygraph results are based on analysis of physiological responses, it has been posited that these differences may cause polygraph results to adversely impact on Federally protected classes. This study investigated the polygraph results of 1000 job applicants who were administered preemployment polygraph examinations. The sample included a random selection of Whites and non-Whites, males and females.

After analyzing the rates of meeting or not meeting standards as reported from preemployment examinations, it was found that there were no statistical differences in polygraph results between Whites and Minorities. There was, however, a significant difference within gender were females were more likely to be reported as meeting standards following a preemployment examination than men. Because these results were favorable to the female, again it was determined that the polygraph technique did not have an adverse impact on female subjects.

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THE INFLUENCE OF RACE AND GENDER ON BLIND POLYGRAPH CHART ANALYSES

By

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The polygraph technique represents a psychological procedure whereby a subject's truthfulness in inferred by recording and evaluating autonomic responsivity to relevant questions (related to the issue under investigation) and control questions (a question similar in nature to the issue under investigation, however, one to which the subject, in all probability, is lying to or has doubt about the complete accuracy of his answer((Reid and Inbau, 1977). Research which utilized field procedures and experienced examiners has consistently demonstrated that subjects who are telling the truth to relevant questions focus their emotional responses to control questions, whereas subjects who are lying to relevant questions focus their emotional responses away from the control questions and to the relevant questions (Capps, 1991). While this predicted response discrimination occurs well above chance levels, there are some subjects whose response discrimination is opposite to that which is predicted and who, consequently, produce misleading polygraph charts.

It is of interest to determine whether or not there are identifiable characteristics between different subjects which would predict a higher incidence of erroneous polygraph results. This this regard, the subject's race and gender have been cited as possible variables influencing the accuracy of the technique. As an example, in 1979 a Black defendant was administered a stipulated polygraph examination at the regional crime laboratory in Wisconsin and the defendant was reported as deceptive in his answers to relevant questions. David Lykken, a psychologist from the University of Minnesota, testified on behalf of the defense and persuaded the judge that the polygraph technique is prone to errors with Black subjects because of their innate physiological differences.

Unfortunately, many lay people, as well as educated Ph.D.'s perceive the polygraph as a lie detector. That is, they believe that the technique is designed to identify specific "lie responses" which are unique to the guilty subject. From this perspective, it would appear plausible that variations in an individual's biological constitution could predictably result in misleading responses during a polygraph examination in which case certain biological groups may be at higher risk for polygraph errors.

In truth, however, the polygraph does nothing more than record a subject's physiological arousal when asked a question during the examination. The control question polygraph technique relies on an evaluation as to which question type (between a relevant and control question) elicited the greatest amount of arousal. According to control question theory, the subject's relative responsivity, whether it be affected by a chemical agent, physiological conditioning, or biological differences, should not affect the

accuracy of the technique whatsoever. That is, as long as a subject is physiologically capable of exhibiting relative differences in arousal states between relevant and control questions, the technique should achieve accurate results. There are, of course, situations and conditions in which a subject fails to exhibit significant differences in arousal states between relevant and control questions, but this results in an inconclusive, not an erroneous finding.

Since there are documented differences between autonomic arousal states by gender and race, and that gender and race are easily identifiable characteristics within a polygraph subject, these two intrinsic differences emerge as obvious variables to research the effect such differences may have on the technique's validity. This present research, therefore, investigated the possible influence of the subject's race and gender on the validity of polygraph results.

Review

In the past fifteen years, numerous studies of a wide variety and type have been conducted in an effort to estimate the accuracy of the polygraph technique (Ansley, Horvath & Barland, 1983; Ansley, 1990). Some of these studies have considered a possible relationship of gender on the accuracy of the testing procedure or test outcome. No difference was found by Arellano (1984), Bradley (1988), Correa and Adams (1981), Cutrow et.al. (1972), or Yankee and Grimsley (1986). However, Yankee and Grimsley found a difference between guilty women and innocent women. Other differences were found by Horvath (1979) and Russell (1988). However, there does not appear to be any studies which have considered a relationship of race and accuracy. In a law suit alleging that polygraph was discriminatory Johnson v. Georgia Highway Express, Inc., 488 F.2d 714 [5th Cir. 1972]), the court accepted the expert testimony of Dr. Martin Orne, who disclaimed any racial overtones or discriminatory characteristics in polygraph tests. The court ruled that the employees were discharged "for failure to clarify highly deceptive answers on polygraph examinations administered to them by the Defendant in a wholly non-discriminatory fashion." Sex and race were particularly mentioned in the Office of Technology Assessment (OTA) report, "Scientific Validity of Polygraph Testing" (1983). The implication from the OTA report was that both gender and ethnic differences may adversely affect the accuracy of the polygraph test. Concerning gender, the report stated, "Males and females may have different patterns of autonomic arousal, and such differences may affect polygraph testing validity." As to ethnic differences, the report states, "Research conducted cross culturally indicates that there are ethnic differences in response to stress. Such differences may, in turn, affect detection of deception." These statements suggest that due to differences between males and females, as well as ethnic groups, the polygraph technique may be less accurate or more accurate with one group than another. Whether that result follows the mere existence of differences in response to stress is problematic. That there are racial and sexual differences in heart rate, blood pressure, respiration and other physiological measures is well documented (Anderson et.al., 1988; Anderson et.al., 1989; Cottington et.al., 1985; McCubbin et.al., 1991). Given that the theory of polygraph testing requires that phasic reactions are compared to other phasic reactions or the tonic levels of the subject being tested (Abrams, 1989; Reid & Inbau, 1977), differences in the average heart rate or average respiration rate between groups is meaningless.

The Influence of Race and Gender on Blind Polygraph Chart Analyses

In 1983 the Congressional Office of Technology Assessment (OTA), at the request of the Committee on Government Operations, U.S. House of Representatives, issued a technical report concerning evidence on the validity of polygraph testing. There was in inference in the OTA report that ethnic differences between the subject and the examiner may influence the accuracy of the testing procedure and test outcome. Typical of the poor scholarship evidence in the OTA report was the reference to Lazarus (1966), a book on stress and the coping process, which has nothing to do with the topic of ethnic differences. Further, a study by Kugelmass and Lieblich (1968) describes the differences in electrodermal responsivity of Israeli subjects of Western origin, Israeli subjects of Middle Eastern origin, and local Bedouin workers. The OTA failed to note that the equipment was so poor as to limit the value of the findings, and OTA neglected to mention there was nothing in the research about the effect of examiner/examinee interaction. Finally, OTA cited a work by Sternbach and Tursky (1965) in which the authors compared the ability of Yankee, Irish, Jewish and Italian housewives to withstand the pain of electric shocks, how fast and how complete their adaptation was, as represented by their diphasic palmer skin potential reactions, and their attitudes about shocks. This study found some differences, but it has nothing in it to support the OTA suggestion about ethnic aspects of examiner/examinee relationships.

Looking at other literature for interviewer/interview interaction where race or gender is different, a number of papers can be found on the topic, but none relevant to questions posed by the OTA (Binning et.al., 1988; Rosenthal, 1966; Sattler, 1970; Singhvi & Dixit, 1987; and Wade & Bernstein, 1991). The difference between sex and gender, and their relationships to emotion is set forth by Shields (1990). The distinction between the biologically based sexual aspects of male and female, and the psychological and cultural based gender aspects of male and female, is important in conducting and evaluating some of the studies on the interaction between opposite sex and same sex. To date, whether a relationship exists between examiners' and examinees' race, gender, or ethnic background and the validity of polygraph tests is unknown.

There is evidence that polygraph tests do work in a wide variety of cultures (Ansley, 1990). High field validity rates in criminal cases are obtained by Japanese when testing Japanese (Yamamura & Miyake, 1980), while Poles polygraph other Polish people (Widacki, 1982), when Serbo-Croations are tested in Yugoslavia (Aleksic, 1972), and when Hispanic Americans are tested in Spanish by Hispanic Americans (Arellano, 1984).

Despite the diverse cultures found in India, polygraph testing is used throughout the country (Ganguly, 1987). Israel, which also has a variety of cultures, uses polygraph testing extensively, and they have high rates of field validity (Elaad & Schahar, 1985; Shterzer & Elaad, 1985). In India and Israel, as it is in the United States, there are often considerable differences in the race and culture of examiner and examinees. Despite that, there is no scientific or anecdotal information to suggest that this creates a significant problem.

Method

This study was designed to investigate the effects of race and gender on the validity of polygraph subjects physiological responses to relevant and control questions during a control question examination. The sample collected for this study consisted of 40 sets of polygraph charts, of which 20 were from Caucasian subjects and 20 from Black subjects. In each group 10 charts were from subjects who confessed to the issue under investigation following the examination, and the remaining 10 charts were from subjects whose truthfulness was verified through another person's confession. Within each of these subcategories of ten, half of the subjects were male and half female.

These polygraph charts were sequentially selected from the 1985 verified case files of John E. Reid and Associates. As each chart was pulled, it went into the study until each group was complete (e.g., once five verified truthful Caucasian females were selected, that category was closed). The polygraph charts were not reviewed before the case was selected for the study. Each chart contained between 3 and 5 separate polygraph tests, during each test relevant, control, and irrelevant questions are asked of the subject. The polygraph instruments used to administer these examinations recorded abdominal and thoracic respiration, blood pressure, pulse rate, and electrodermal resistance. The Reid Control Question Technique (Reid & Inbau, 1977) was used in all of these examinations. The issues investigated during these examinations represented theft, arson, and the possession and sale of illegal drugs.

These 40 sets of polygraph charts then were independently evaluated under four conditions by nine examiners. These examiners were from the staff of John E. Reid and Associates and ranged in experience from 18 months to eight years, with the average experience being 4.4 years. The chart evaluation was conducted blindly, that is, any subject identification was covered on the polygraph chart, and the examiners were not provided any information about the subject's truthfulness, race, gender, age, or emotional and medical health. The examiners were merely told that each examination investigated a specific issue of an undefined nature. The examiner's opinions, therefore, were based strictly on analysis of physiological responses.

Chart evaluation involved comparing the significance and duration of arousal occurring during relevant (issue) questions to corresponding control (probable lie) questions. In the Reid technique, the relevant, irrelevant and control questions are identified on the chart by uniform numbers, and therefore it is possible to render opinions without knowing what specific relevant or control question was asked.

The nine examiners were initially instructed to render opinions of the 40 subjects by evaluating the complete polygraph chart, with all three physiological indices (cardiovascular, respiration, electrodermal). Thereafter, on three subsequent occasions at about three month intervals, the examiners were again asked to render opinions on the same 40 polygraph charts. In each of these conditions, however, two of the parameters were covered, thereby allowing the examiner to base his opinion on only one physiological recording; for instance, if the respiration recordings were to be evaluated, the cardiovascular and electrodermal recordings were masked

and concealed from the examiner. During this entire process, the examiners were instructed not to discuss their evaluations among themselves.

Results

Evaluation of All Three Parameters

When the nine examiners evaluated all three parameters (cardiovascular, respiration, electrodermal) they achieved similar reliabilities between their evaluations of subjects by gender [Pearson's r = .68] and race [Pearson's r = .73]. Table 1 indicates the nine examiners' combined results in rendering opinions of the truthfulness of the 20 subjects within each category when evaluating all three parameters.

Table 1

Combined Results of Evaluating All Three Parameters by Race and Gender

	Correct	Incorrect	Inconclusive
Caucasians	154	18	8
Blacks	148	15	17
Male	156	11	13
Female	146	22	12

Excluding inconclusive results, the mean accuracy of these nine examiners was 89.5% for Caucasians, 90.6% for Blacks, 93.4% for males, and 86.9% for females. Chi-square tests indicated no significant difference between race [$x^2 = 3.63$ (2) $p < .05$] or gender [$x^2 = 4.04$ (2) $p < .05$].

It is of interest in this research to determine whether or not racial or gender differences may influence the direction of polygraph errors, e.g., false positive, false negative. Table 2, therefore, list the combined examiners' evaluations of the subject's polygraph charts by race, gender, and ground truth criterion.

Table 2

Combined Examiner's Results By Category and Ground Truth

	Correct	Incorrect	Inconclusive
Truthful Caucasian	75	9	6
Deceptive Caucasian	79	9	2
Truthful Black	68	11	11
Deceptive Black	80	4	6
Truthful Male	80	4	6
Deceptive Male	76	7	7
Truthful Female	63	16	11
Deceptive Female	83	6	1

Chi-square tests indicated no significant difference between any of the subgroups except truthful and deceptive females [$x^2 = 15.62$ (2) $P < .05$]. Excluding inconclusive results, the accuracy of truthful females was 79.75% whereas the accuracy of deceptive females was 93.26. To further investigate this difference the subcategories of truthful and deceptive females was analyzed. These results are listed in Table 3.

Table 3

Combined Examiners' Results of Females by Subcategories

Females	Correct	Incorrect	Inconclusive
Truthful Caucasian	33	7	5
Deceptive Caucasian	42	3	0
Truthful Black	30	9	6
Deceptive Black	41	3	1

Chi-square tests comparing results by race indicated significant differences between truthful and deceptive Caucasians [$x^2 = 7.68$ (2) $p < .05$] and truthful and deceptive Blacks [$x^2 = 8.26$ (2) $P < .05$]. In the instance of Caucasians this difference was attributable to the inconclusive rate; when correct vs. incorrect decisions alone were considered, there was no significant differences [$x^2 = 2.39$ (1) $P < .05$]. This same effect, however, was not achieved with the Black female; the difference here is clearly attributed to the significant difference between a relatively low accuracy of truthful Black females (77%) and the high accuracy of deceptive Black females (95%).

Evaluation of Individual Parameters

When individual parameters were independently evaluated, the nine examiners had a mean accuracy, excluding inconclusives, of 87% with respiration, 85% with cardiovascular, and 87% evaluating only the GSR. Table 4 lists the examiner's combined results of each parameter by race and gender subgroups where "Corr" indicates correct opinions and "Inc" indicates incorrect opinions.

Table 4

Individual Parameter Results Listed by Race and Gender

	Respiration		Cardio		GSR	
	Corr.	Inc.	Corr.	Inc.	Corr.	Inc.
Caucasian	149	22	116	20	121	18
Black	150	19	116	22	112	30
Male	150	15	123	19	120	18
Female	149	26	109	23	113	30

Chi-square tests for each parameter indicated no significant differences between race or gender variables. To further investigate the previous

findings related to Black females, the results of each parameter for female subjects was independently analyzed. These findings are listed in Table 5.

Table 5

Independent Parameter Results for Female Subjects

Female Subjects	Respiration		Cardio		GSR	
	Corr.	Inc.	Corr.	Inc.	Corr.	Inc.
Truthful Caucasian	34	10	25	6	25	8
Deceptive Caucasian	38	5	31	1	27	8
Truthful Black	35	8	19	15	31	6
Deceptive Black	42	3	34	1	30	8

Within female subjects, there was no significant difference between accuracy rates of respiration or GSR within either Caucasian or Black subgroups. However, the cardiovascular parameter produced significant difference for both Caucasian females [$x^2 = 4.20$ (1) $p < .05$] and especially within the Black females [$x^2 = 16.48$ (1) $p < .05$]. This difference is attributable to the truthful Black female who only produced a 56% accuracy within the cardiovascular parameter. It should be noted that while the cardiovascular parameter did not produce an accuracy rate above chance levels for truthful Blacks [$x^2 = .24$ (1) $p < .05$], when the examiner evaluated all three parameters, the truthful Black female was correctly identified well above chance levels [$x^2 = 6.10$ (1) $p < .05$].

Discussion

Based on the results from this initial study exploring the possible influence of race and gender on the accuracy of polygraph examiners' diagnosis, it would appear that when considering the overall sample, race did not effect the general accuracy of test results (Whites - 89.5%, Blacks - 90.7%) nor did gender (females - 86.9%, males 93.4%). The finding of a significant false positive error rate for Black females (compared to other subgroups) was traced to the cardiovascular parameter. While it may be tempting to attribute this result to documented cardiovascular differences between Blacks and Whites, e.g., increased angiotensin production, higher incidence of hypertension, etc., if such physiological differences indeed affected the accuracy of the polygraph technique, similar findings would be expected for Black males. This research, however, found no significant differences between truthful or deceptive Black males and truthful or deceptive White males. In fact, truthful Black males produced a 94.4% accuracy rate when all three parameters were evaluated and a 90.3% accuracy within the cardiovascular parameter. In all probability this finding was an anomaly, possibly the result of having only five deceptive Black subjects within the sample. Further research investigating this finding is obviously warranted.

These findings, of course, represent only relative accuracy rates of the polygraph technique which are, in all probability, lower than what an examiner would obtain if he was provided with case facts, information regarding the subject's medical and emotional health, and was able to observe the subject's behavior symptoms during the examination. Nonetheless, the

results of this study demonstrate that experienced polygraph examiners, evaluating only physiological responses on polygraph charts, can identify truth-tellers or liars well above chance levels. When examiners are provided with auxiliary information research had demonstrated that their accuracy increases (Holmes, 1958; Wicklander & Hunter, 1975; Horvath, 1977). The overall accuracy range found in this study, (90.1%), is comparable to other Reid studies which utilized a similar method of blind chart interpretation (Horvath & Reid, 1977; Hunter and Ash, 1973; Slowik & Buckley, 1975; Wicklander & Hunter, 1975; Jayne, 1990).

It is important to emphasize the finding that the examiners accuracy in this study was highest when all three physiological indices were evaluated as opposed to evaluating any single parameter independently. This finding is consistent with other studies of a similar nature (Slowik & Buckley, 1975; Jayne, 1990). Empirically, field examiners have observed that significant autonomic arousal may appear in only one or two indices so that an examiner who relies exclusively on one parameter in forming opinions will be more prone to errors.

Of the three individual physiological indices, respiration was the measure with the greatest degree of accuracy for both White and Black subjects (87.1% and 89.3%).

Of the three physiological systems monitored by the polygraph, the respiratory system is by far the most complex in that it is innervated and affected by autonomic arousal, somatic reflex responses and somatic voluntary control. The possible voluntary control a subject has over their respiratory pattern allows for an additional class of deceptive responses termed purposeful non-cooperation (Jayne, 1981). Although many prior studies of relative parameter accuracy were previously noted, most of these utilized experimental design involving laboratory situations and cooperative students as subjects. However, there are some studies of real-life situations involving criminal suspects as found in the present study (Capps, 1991; Jayne, 1990; Matte & Reuss, 1989; Rafky & Sussman, 1985; Ryan, 1989).

Although several studies are described in Capps' (1991) summary, the study which is most similar to the present one is Jayne (1990) in which confession verified polygraph charts were blindly read by three experienced examiners. That study also found respiration the most accurate at 87%, 83% for cardiovascular, and 69% for GSR. The overall average accuracy for 100 charts in Jayne (1990) was 90%. Other researchers have found other values for the channels in blind analysis. Matte and Reuss found that for innocent subjects the pneumo was most valuable, followed by the GSR and cardio, and for the deceptive the cardio was most useful, followed by the pneumo and electrodermal. Rafky and Sussman, however, reading channels separately for the second chart of confirmed cases, found the cardio most useful, followed by electrodermal, then pneumo. This was also trued when the examiners saw all of the charts. Ryan, whose study is similar to ours, found the GSR most productive, followed by respiration and cardio. Also similar was Slowik and Buckley, with respiration and electrodermal alike, followed by the cardio. While the research has yet to establish which of the three physiological channels is most productive, it is important to note the utility of all the channels.

Although this study establishes a high degree of polygraph examiner accuracy for both Black and White, male and female subjects, one must again realize that only by taking advantage of a properly trained and experienced examiner, in an actual case situation, using a verified technique and depending upon more than one physiological measure, can the examiner prove that the polygraph technique justifiably deserves an acceptable place in the evaluation of this phase of human behavior.

Conclusion

The purpose of this research was to identify whether or not there were intrinsic differences between the accuracy of the polygraph technique as a function of the subject's race or gender. Utilizing nine examiners who blindly evaluated 40 sets of polygraph charts, neither the subject's race nor gender significantly affected the examiners' accuracy of diagnosing truth or deception from polygraph charts. The overall accuracy achieved by these examiners on the sample of 40 charts was 90.14%.

One finding, which at this time is considered a possible result of sampling error, is that truthful Black females were significantly more likely to produce false positive errors within the cardiovascular parameter. While this finding warrants further research, because of the absence of similar effects for truthful White females or truthful Black males, it would appear unlikely, that this result was indeed influenced by the subject's race or gender.

The findings from this study contribute to a growing body of literature which supports a high degree of accuracy based on blind analysis of physiological data recorded during a control question polygraph examination. As with other studies utilizing a similar design, examiners in this study were most accurate in their diagnosis of truth or deception when allowed to evaluate all three physiological systems (respiration, cardiovascular, and electrodermal).

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