Howard W. Timm,[1] *Ph.D.*

Effect of Biofeedback on the Detection of Deception

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ABSTRACT: This study examined the effect of audio electrodermal biofeedback training on the detection of deception. The subjects consisted of 68 volunteers enrolled in selected undergraduate college courses. Each subject was required to commit a mock murder, after which a polygraph examiner administered a series of five consecutive "lie detector" tests to ascertain the facts involved in his/her murder. Before testing, subjects were randomly assigned to either a biofeedback condition or to a control group. The detection efficiency associated with the subjects' respiration responses was significantly enhanced by simultaneous auditory biofeedback given during the polygraph testing; however, the feedback's effect upon the detection rates associated with the electrodermal measures that it was reflecting was neither statistically significant nor in the same direction. The results support the premise that audio biofeedback might be useful in enhancing respiration's detection efficiency during polygraph testing.

KEYWORDS: criminalistics, lie detection, biofeedback, polygraph

Several sources indicate that the use of the polygraph in both the private and public sectors is increasing [*1,2*]. In the private sector, the polygraph is being used by some employers to screen potential job applicants and to help detect internal thefts. It is also used in situations in which there is doubt associated with the statements or actions of an employee. In the public arena, the polygraph is used to verify witness statements, to screen for government security, and to screen and eliminate suspects in serious cases. Given the importance of correctly resolving these matters, research on methods which might increase the accuracy of the polygraph technique appears to be both timely and useful.

The purpose of this study was to examine the effects of providing simultaneous audio electrodermal biofeedback on the detection efficiency of the guilty knowledge polygraph procedure. Unlike the study conducted by Mullins and Timm [*3*], no attempt was made to provide the subjects with biofeedback training on how to control their physiological responses before taking the polygraph test. The present study solely examined whether hearing a signal while taking the test which indicated both the direction and rate of skin resistance response (SRR) changes would affect the outcome.

Although the effects of giving subjects feedback concerning their results on prior polygraph tests have been previously examined in several studies [*4-8*], only one prior study directly assessed the effects of providing biofeedback at the time of testing on the detection

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[1]Associate professor, Center for the Study of Crime, Delinquency, and Corrections, Southern Illinois University at Carbondale, Carbondale, IL.

efficiency of the polygraph. In the other studies, feedback was given to subjects in the form of information about the accuracy of the polygraph on an earlier test, as opposed to providing them with simultaneous feedback during the polygraph test of primary interest.

In the only directly related study, Stern et al. [*9*] published the results of two experiments in which biofeedback was provided during detection of deception testing. They reported that audio biofeedback significantly enhanced the performance of the guilty knowledge technique in those situations in which the technique's performance without the feedback was the poorest (that is, paradigms apparently having less relevance and ego involvement for their subjects); however, they reported that the feedback was unable to improve significantly upon the excellent detection of deception rates obtained with that technique in a somewhat more absorbing paradigm. Their findings support Timm's [*10*] premise that most of the variation in the literature regarding the ability of different techniques and factors to alter the accuracy of polygraph detection of deception testing can be attributed to differences in how ego-involving and relevant the subjects consider the testing situation.

Several prior studies have indicated that the detection efficiency of the polygraph could be significantly affected by a variety of factors including: certain physical and mental countermeasures, the subjects' level of socialization, their outcome expectancies, and their level of motivation to try to successfully avoid detection during the testing [*6,7,11–15*]. Other studies, however, have reported that the same types of factors have no appreciable effect on detection efficiency [*4,6,8,16–19*]. It appears that when treatments producing significant differences in detection efficiency have been reported in the past, those studies have employed either a number or word memorization game, or low signal value detection of deception paradigm. Studies that have used mock crime or personally relevant information paradigms usually fail to show significant treatment differences, apparently because the signal values associated with the relevant questions are too high to permit sufficient habituation to occur within the primary treatment conditions.

The present study utilized a previously tested mock crime guilty knowledge paradigm [*3,8*]. A guilty knowledge paradigm was chosen for use in this study because of its relative simplicity, its use in similar treatment situations by other researchers who obtained excellent results [*13,17,20–22*], and its utility in determining which crime out of several possibilities the subject committed.

Method

Selection of Subjects

The subjects consisted of 68 volunteers enrolled in selected criminal justice classes at a large midwestern university during the 1982 fall semester. Before volunteering for the experiment, the subjects were informed of the purpose and design of this study and told that the number of extra-credit points they would receive for participating would be determined by objectively scoring their lie detection charts. If the correct information was identified on 3 or more of the 5 tests, they were to receive only 2% extra credit in their respective class. However, if they successfully deceived the examiner on 3 or more of the tests, they were to be awarded 5% extra credit.

The subjects comprised 52 males and 16 females. Each volunteer was randomly assigned to 1 of 2 equal size treatment groups. The ages of the subjects ranged from 19 to 44 (the median age was 21.7 years, and the standard deviation was 3.61).

Apparatus

A Stoelting field polygraph (Model 122656) was used to record both the respiration and the skin resistance responses (SRR) of the subjects. Respiration was recorded using a pneumatic tube positioned around the subject's thoracic area. The SRR was recorded from two

stainless steel electrodes attached to the volar surfaces of the first and third fingers of the subject's right hand. All SRR recordings were made with the instrument in the manual centering mode. Electrode paste was not used.

The instrument used to score objectively respiration responses was a modified map-distance measurer designed to measure curvilinear distances between two points on a sheet of paper. To make the instrument more accurate, its original 7-mm-diameter circular wheel, which came into contact with the line on the paper being measured, was replaced with a ten-tooth gear having an outer circumference diameter of 2 mm.

Mock Murder Procedure

All subjects reported individually to a room where they were to commit a mock murder. When they arrived they met with a research assistant who worked independently of the polygraph examiner. Subjects were first shown a mock murder contract, which specified the following information: the name of the individual whom the subject was to simulate killing, the victim's occupation, the amount of play money that subject was to receive, the number of shots the subject had to fire at the victim, and the location of the fictitious person who was hiring the subject. A picture of the intended victim also appeared on the contract.

Subjects were randomly assigned to shoot at the image of either a fireman, policeman, soldier, priest, or surgeon. They were also randomly assigned to one of five different options for each of the following categories: victim's name, number of shots to be fired, Mafia family location, and price of the contract. The options to which subjects were assigned were filled in on their mock murder contracts and later used as specifications for the subject's mock murders.

The assistant, who was unaware of the subject's treatment condition, showed the subject one of five sets of slides based on the occupation of the assigned victim. All of the slides shown to the subjects were of the same person who was displayed in their mock murder contract.

The slides were shown on a white paper screen situated directly in front of a bullet stopping device. The subject was given a loaded pellet gun closely resembling a real .38 cal. revolver. The subject was told to stand on a spot on the side of the screen, which was close enough to ensure that each shot would strike the intended victim's image. Before shooting, the subject was required to say "*(victim's name)*, I am shooting you for betraying the *(city where the Mafia family was located)* branch of the Mafia." After the subject had fired at the victim the required number of times, the assistant counted out the appropriate amount of play money and handed it to the subject, who was then also required to count the money.

Polygraph Testing

Within 2 days after committing their mock murders, subjects in both feedback conditions reported individually to the polygraph testing room. The subjects met with the polygraph examiner who was unaware of the mock murder conditions to which the subjects had been assigned. The author served in the role of examiner. Although he had no formal field training or experience, he had previously tested over 300 laboratory subjects in similar contexts using the guilty knowledge technique.

Each of the subjects was given a description of the equipment and the procedure that was to be used. Next, the polygraph test, which consisted of five different subsections, was administered. Each subsection began with a brief, informative statement indicating that the questions would pertain to one of the following areas: the victim's occupation, the victim's name, the number of times he was shot, the location of the Mafia organization paying for the assassination, and the amount of money paid. Six questions relating to the mock crime were contained in each subsection.

The following questions series comprised one of the test sections and illustrates the question format:

During the following series of questions you will be asked about the victim's occupation. Are you ready to begin?

1. Was the image you shot a doorman?
2. Was the image you shot a fireman?
3. Was the image you shot a soldier?
4. Was the image you shot a surgeon?
5. Was the image you shot a priest?
6. Was the image you shot a policeman?

Note that the first question did not represent one of the possible options to which subjects could have been randomly assigned (doorman was not an occupation option); similar initial questions were included on all series to buffer subjects' responses to the introduction of a new question series.

Before testing, subjects were asked to close their eyes and face forward without moving while responding to the questions. The subjects were also instructed to respond "no" to each question asked during the test, except to those questions when they were asked if they were ready to begin the new test series. Those questions were included to make sure the subjects paid attention to the content of the questions.

The audio biofeedback channel of the SRR component on the polygraph was turned on when subjects assigned to the feedback group were tested. The pitch and volume were also adjusted in such a fashion that those subjects could easily hear the signal which reflected their SRR changes. Subjects in the biofeedback group were (*a*) told that they were assigned to the feedback condition, (*b*) told that the study was designed to test whether the feedback made it easier or harder for people to "beat the test", (*c*) given a brief explanation about biofeedback, and (*d*) given a brief demonstration of how it sounded. The demonstration entailed (*a*) the subjects being told that the examiner was going to pinch them on the ear and that they would be able to hear their response to that stimulus; (*b*) the examiner raising his hand close to but not actually touching them on their ear; and (*c*) the examiner stating that they were able to hear how sensitive the equipment was by their response to just the threat of being pinched on their ear.

To increase the standardization of the questioning procedure, the questions were tape-recorded. Questions were asked at 15-s intervals with 20-s intervals between test series (that is, test series were run consecutively without substantial breaks between exams).

After the testing the attachments were removed. Subjects were thanked and informed they would be told later that semester how many extra-credit points they would receive. No subjects were permitted to see their charts or to find out how many points they had received until all subjects had been tested, since feedback to other volunteers might have contaminated the study.

Objective Scoring Procedures

The charts were analyzed by objectively scoring respiration, SRR amplitude, and SRR maximum height. With the field polygraph used, a rising SRR pattern on the polygraph chart indicated less electrical resistance, suggesting an emotional or cognitive reaction or both. To score both the respiration and the SRR responses, it was necessary to correct for the tangent errors, which resulted from the use of fixed length pivoting polygraph pens. This was accomplished by making a tracing of the semicircle path of travel of the polygraph pen when the chart paper was stationary. This tracing was then placed over the polygraph chart and aligned with each question marker tick at the top of the chart. A line was then drawn inter-

secting the points on the SRR and respiration patterns where the constructed tangent error templates crossed them.

Respiration patterns were scored by measuring the curvilinear length of the pattern recorded by the polygraph respiration pen beginning when each question was asked and ending 15 s later. The respiration patterns corresponding to the five questions in each test were ranked from 1 to 5. The respiration patterns were traced with a map measurer and assigned a value that corresponded to their total length. Since breathing suppression is believed to be associated with deception [*23*], the shortest length of respiration was assigned a value of 1. The other four responses were than ranked from 2 to 5, using the same criteria.

The SRR amplitude was scored by measuring the vertical rise of the largest wave occurring between the onset of the stimulus question and a point 15 s later. The length of the vertical rise was measured from its lowest point before the wave began a positive slope to the highest point it reached within the 15-s period. When no positive SRR rise on the chart occurred during the 15-s intervals, those responses were assigned equal ranks, which denoted the smallest measurements. Therefore, if only one nonresponse occurred among the five, it was assigned a rank of 5; if two occurred, they were both given the rank of 4.5; if three occurred, all three were ranked 4; and so on.

SRR maximum height was also objectively determined. This was accomplished by measuring the highest point the patterns reached on the chart during the 15-s interval. This was determined by measuring the length in millimetres of a vertical line drawn from the highest point reached by the pen (during each time interval) to the bottom of the chart paper. If it was necessary to adjust mechanically the position of the SRR pen during a test, the amount of increase or decrease was subtracted or added, respectively, to all the responses in that series of questions which followed the pen adjustment.

If the height of the SRRS to the buffer question was higher than those to the first actual question, and the response to the first actual question was higher than to all four of the other test questions, that test was said to have exhibited a SRR tonic habituation pattern. This pattern indicated that the subject's SRR pattern was falling, which implied that SRR maximum height was not an appropriate measure for detecting guilty knowledge given the manner in which it was scored in this study. When a tonic habituation pattern was present on a test, all five responses for that test were assigned a rank of 3 for their SRR maximum height value. Otherwise, the SRR maximum height values for the five questions associated with each test were determined by ranking them from 1 (largest value) to 5 (smallest value).

Results

A series of t tests was performed to ascertain whether the subjects in the biofeedback training condition had lower mean detection rates than subjects assigned to the control condition. Since it was not known whether or not these two sample populations had statistically significant variance differences, an F test of the sample variance was performed. All F probabilities were found to be nonsignificant at the $p < 0.05$ level. This warranted using the pooled variance estimates for all the t test calculations [*24*]. Because of the violation of t test assumptions and the nature of the measurements used in this study, Mann-Whitney U tests were also conducted. The level of significance of the observed value of U was determined from the computed value of z based on the Mann-Whitney formula with correction for ties [*25*].

The accuracy of polygraph based decisions in the experiment was analyzed using a scoring procedure developed by Lykken [*21*]. If the dependent variable associated with the critical items (questions on the polygraph test specifying the options actually involved in the subject's mock murder) was ranked "one" (most indicative of deception), it was given a score of 2 on that test. If the dependent variable associated with the critical item was ranked "two," it was given a score of 1. After the scores on the five polygraph tests were summed, a perfect score for each of the dependent variables was 10.

None of the subjects in this study were "innocent"; thus, it was impossible to make a direct comparison between the actual scores of innocent and guilty subjects. It was possible, however, to calculate the theoretical distribution by estimating the expected proportion of innocent subjects that would have achieved each of the various scores. For example, the probability that an innocent subject would have received a score of 10 would be $(0.2)^5$ assuming that complete habituation had not occurred and that it was equally likely that the subject's largest response would have been to the critical item, as it was to any of the four noncritical items on each of the five tests. Thus, one would expect 0.032% of all innocent subjects to have a score of 10 if an infinite number of innocent subjects were tested. Table 1 displays the actual and theoretical distributions for all three of the dependent measures.

To determine whether the guilty knowledge scores obtained in this study were greater than those which might have occurred simply by chance, we conducted a series of z tests. As previously noted, the estimated proportions (probability distribution) of innocent subjects that would have obtained each of the scores are presented in Table 1. The population mean of those scores is 3, with a standard deviation of 1.789. The guilty knowledge means attained by SRR amplitude, SRR maximum height, and respiration for the 68 subjects were 5.60 (SD = 2.30), 4.32 (SD = 2.48), and 5.91 (SD = 2.64), respectively. Each of these means was significantly higher than the population means derived from the probability distribution of scores for innocent subjects, each $|z| > 6, p < 0.001$. The actual z scores for SRR Amplitude, SRR maximum height, and respiration were -12.00, -6.37, and -24.25, respectively.

The guilty knowledge means for the biofeedback group ($n = 34$) and the control group ($n = 34$) were also compared individually to chance detection levels. The guilty knowledge means and z scores for SRR amplitude, SRR maximum height, and respiration for the control group were 5.85 (SD = 1.94), $z = -9.30, p < 0.001$; 4.21 (SD = 2.48), $z = -3.93$, $p < 0.001$; and 5.32 (SD = 2.51), $z = -7.57, p < 0.001$, respectively.

The guilty knowledge means and z scores for SRR amplitude, SRR maximum height, and respiration for the biofeedback group were 5.35 (SD = 2.62), $z = -7.67, p < 0.001$; 4.56 (SD = 2.50), $z = -5.08, p < 0.001$; and 6.50 (SD = 2.68), $z = -11.41, p < 0.001$, respectively. Thus, the testing procedure detected the nature of the subjects' mock murder involvement significantly more frequently than chance on all dependent measures.

A t test and Mann-Whitney U test were performed to see if there were statistically significant differences between the biofeedback and control groups with respect to tonic habitua-

TABLE 1—*Actual and theoretical distributions of scores using the Lykken* [21] *scoring procedures.*

	Dependent Variable						Estimated Distribution	
	SRR Height		SRR Amplitude		Respiration			
Score	% Subjects	Cumulative %	% Subjects	Cumulative %	% Subjects	Cumulative %	% Subjects	Cumulative %
10	0.0	0.0	2.9	2.9	5.9	5.9	0.0	0.0
9	2.9	2.9	5.9	8.8	8.8	14.7	0.2	0.2
8	7.4	10.3	17.6	26.4	22.1	36.8	0.8	1.0
7	8.8	19.1	11.8	38.2	11.8	48.6	2.2	3.2
6	20.6	39.7	11.8	50.0	8.8	57.4	6.0	9.2
5	10.3	50.9	16.2	66.2	10.3	67.7	10.6	19.8
4	17.6	67.6	14.7	80.9	14.7	82.4	17.8	37.6
3	7.4	75.0	11.8	92.7	7.4	89.8	20.2	57.8
2	7.4	82.4	2.9	95.6	2.9	92.7	21.6	79.4
1	8.8	91.2	2.9	98.5	2.9	95.6	13.0	92.4
0	8.8	100.0	1.5	100.0	4.4	100.0	7.8	100.2[a]

[a]Figure does not total 100% because of rounding.

tion. As previously noted, tonic habituation indicated a downward trend for the SRR patterns over an entire question series. The possible range for tonic habituation patterns was 0 to 5. A score of zero meant the subject had no SRR tonic habituation patterns, whereas a score of 5 meant the subject demonstrated SRR tonic habituation patterns on all five question series. The mean for the biofeedback group was 1.24 (SD = 1.56) compared to 1.79 (SD = 1.55) for the control group t (66) = −1.48, p = 0.07; U ($n_1 = n_2$ = 34) = 440.5, p = 0.04. Therefore, the biofeedback appeared to have some effect in lessening the amount of habituation which occurred over the course of the five tests.

In addition to comparing the mean guilty knowledge scores of the control and biofeedback groups to chance detection levels, they were also compared to one another on each of the dependent measures. The mean guilty knowledge SRR amplitude, maximum height, and respiration scores for the biofeedback and control groups were 5.35 (SD = 2.62) and 5.85 (SD = 1.94); 4.56 (SD = 2.50) and 4.21 (SD = 2.48); and 6.50 (SD = 2.68) and 5.32 (SD = 2.51), respectively. Mann-Whitney U and t tests indicated that the guilty knowledge mean for the biofeedback group was significantly higher than in the control group for respiration t (66) = 1.87, p = 0.033; U ($n_1 = n_2$ = 34) = 405.5, p = 0.016, but was not significant and was in the opposite direction for both SRR maximum height and SRR amplitude.

The frequency distribution of the guilty knowledge scores associated with the feedback and no feedback groups are displayed in Table 2 for both the respiration and SRR amplitude increase measures. Chi-square tests of independence (2 × 2 employing Yates's correction for

TABLE 2—*Frequency distribution of respiration and skin resistance response guilty knowledge test (GKT) scores attained with and without biofeedback.*

With Biofeedback		Without Biofeedback	
	RESPIRATION		
GKT Score	0 **	GKT Score	0 *
	1		1 **
	2 *		2 *
	3 *		3 ****
	4 *****		4 *****
	5 ***		5 ****
	6		6 ******
	7 ****		7 ****
	8 **********		8 ****
	9 *****		9 *
	10 **		10 **
	Number of Subjects		Number of Subjects
	SKIN RESISTANCE RESPONSE-AMPLITUDE INCREASE		
GKT Score	0 *	GKT Score	0
	1 **		1
	2 *		2 *
	3 ******		3 **
	4 ***		4 *******
	5 ****		5 *******
	6 *****		6 ***
	7 ***		7 *****
	8 ******		8 ******
	9 *		9 ***
	10 **		10
	Number of Subjects		Number of Subjects

continuity, df = 1) were run to determine whether the feedback condition significantly improved detection rates for criterion Guilty Knowledge Test (GKT) scores of 7, 6, and 5 (that is, the levels at which subjects' charts would have been considered indicative of guilt). For respiration $\chi^2 = 5.89, p = 0.015$ with a GKT score of ≥ 7; $\chi^2 = 0.96, p = 0.33$ at ≥ 6; and $\chi^2 = 0.6, p = 0.44$ at ≥ 5. For SRR amplitude increases, $\chi^2 = 0.06, p = 0.80$ with a GKT score of ≥ 7; $\chi^2 = 0, p = 1.0$ at ≥ 6; and $\chi^2 = 0.26, p = 0.6$ at ≥ 5. Thus, biofeedback significantly increased detection for respiration using a GKT criterion score of ≥ 7, but did not significantly improve the "hit rate" at the other levels examined or for the rates based upon SRR amplitude increases.

Another series of *t* tests and Mann-Whitney *U* tests was performed to ascertain whether there were mean rank, as opposed to mean guilty knowledge score, detection efficiency differences between the biofeedback and the control group. As previously noted, the subjects were asked a series of questions which contained five critical item questions. The critical items were the specific options that pertained to the subject's mock murder contract. For example, if a subject's mock murder contract specified that the subject would be paid *$20 000,* should shoot *four shots* at the image of *John Martin,* who was a *soldier* and that the location of the person who had hired the subject was *Miami,* the critical items for that subject would be $20 000, four shots, John Martin, soldier, and Miami.

If the subject's response to the critical item question was the most indicative of deception on a given dependent measure, a rank of "1" was assigned to the response for that question. In similar fashion, if the subject's response to a different question was the most indicative of deception, a rank of 2, 3, 4, or 5 was assigned to it depending on its relative magnitude compared to the responses on other questions. Thus, the range for the five critical items when their ranks were added together was from 5 to 25. A composite rank of "5" indicated a perfect detection rate, whereas a composite rank of "25" denoted that the values for the five critical items were all scored as being the least likely of deception.

Once again, a statistically significant difference was obtained when the biofeedback and control groups were compared with respect to their mean sum of ranks on the critical items for respiration. The mean for the biofeedback group was 9.50 (SD = 3.49) compared to 11.18 (SD = 3.94) for the control group $t\ (66) = -1.86, p = 0.034$; $U\ (n_1 = n_2 = 34) = 424.0, p = 0.029$. When their mean SRR maximum height composite critical item rank values were compared, statistically significant differences were not found between the two groups. The mean for the biofeedback group was 11.17 (SD = 2.97) compared to 11.47 (SD = 3.11) for the control group $t\ (66) = -0.40, p = 0.69$; $U\ (n_1 = n_2 = 34) = 549.0, p = 0.72$. When the two groups were compared with respect to their mean sum of critical item ranks for SRR amplitude, neither statistical significance nor the direction of this relationship was obtained. The mean for the biofeedback group was 10.59 (SD = 3.31) compared to 9.85 (SD = 2.74) for the control group $t\ (66) = 1.00, p = 0.323$ (two-tail); $U\ (n_1 = n_2 = 34) = 503.5, p = 0.36$ (two-tail).

Discussion

The results of this experiment demonstrate that electrodermal biofeedback during polygraph testing increased the detection efficiency of respiration in this particular laboratory mock crime paradigm. Higher mean detection efficiency levels for biofeedback subjects were obtained with respect to respiration for both the critical item total and Lykken [*21*] scoring procedures. The mean SRR amplitude detection values were lower for the biofeedback subjects, however, which might be of equal theoretical and practical significance.

This is the third study in a series that has been conducted which employed both a guilty knowledge procedure and the same mock crime paradigm. In all three experiments (that is, the present study and Refs *3* and *8*), the detection efficiency of the electrodermal measures was substantially poorer than those reported by most other investigators who utilized the

guilty knowledge technique [*17,20–22*]. Conversely, in all three of the studies in this series, respiration was found to be of equal or superior value when compared to the detection efficiency of the electrodermal measures, which is also contrary to the general findings of other laboratory studies [*13,22,26–28*]. It appears that these findings parallel the conclusions reached by a large segment of field polygraph examiners who generally consider electrodermal measures to be of less, or of only equal, use than either respiration or cardiovascular activity for detecting deception (for example, Refs *29–32,* all cited in Ref *26,* and Ref *23*).

Two conceivable explanations for the relatively poor showing of the electrodermal measures in these situations are: (1) that the field polygraph equipment used was unable to monitor electrodermal actively as accurately as laboratory equipment, and (2) that the detection efficiency of electrodermal measures follows an inverted U-shaped curve when plotted against how ego-involving and serious the testing situation appears to the subjects. Although Barland and Raskin [*26*] present strong cases for dismissing both explanations, they might warrant further consideration.

In each of the polygraph studies conducted by Timm, a field polygraph which utilized stainless steel electrodes was used. In addition, the electrodermal measure monitored was SRR. In most of the other laboratory studies, skin conductance was measured or silver/silver chloride electrodes were used for gathering the data. Since electrical resistance is a function (the reciprocal) of electrical conductance, and since only relative differences in electrodermal activity are considered in deriving accuracy levels in detection of deception research, differences between skin conductance and skin resistance should not have been a major factor affecting the results. However, it is possible that the quality of either the electrodes or the electrodermal channel used during the testing might have affected the results.

Another explanation for this discrepancy is that the detection efficiency of electrodermal measures follows an inverted U-shaped curve as one's ego involvement and the perceived seriousness of the testing situation increases. It is possible that electrodermal measures are particularly effective in detection of deception situations involving orienting responses (that is, reactions which help an organism to identify or locate potentially significant stimuli), but begin to lose their use in situations which result in activation responses (that is, reactions which help prepare the organism for events which might affect its general well-being) [*10*]. This explanation appears consistent with the finding that the detection efficiency of the SRR amplitude measure was actually poorer for subjects who received the biofeedback in this study (albeit not at statistically significant levels), as well as for the SRRs generally poor showing in what appears to have been three highly ego involving mock crime experiments.

Despite the relatively poor detection efficiency levels attained by the SRR measures in this study, the mean detection efficiency levels for each of the dependent measures were statistically significantly greater than chance levels in both the biofeedback and the control group. Therefore, the polygraph technique did prove to be useful for detecting deception in this study.

Conclusion

In summary, the results appear to have both practical and theoretical implications. It was found that simultaneous auditory electrodermal biofeedback enhanced the detection efficiency of the respiration measure in this study at a statistically significant level. In addition, two alternative explanations were postulated for the relatively poor detection efficiency levels associated with SRR that was reported in this and in two other related studies. They were (1) that the electrodermal component in field polygraphs might not be as effective for monitoring that parameter as those found in more sophisticated laboratory instruments, and (2) that the detection efficiency of electrodermal measures might follow an inverted U-shaped curve when plotted against how ego-involving and serious the testing situation appears to the sub-

jects. However, additional research is needed before the merit of either of these explanations can be resolved.

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Address requests for reprints or additional information to
Howard W. Timm, Ph.D.
Center for the Study of Crime, Delinquency, and Corrections
Southern Illinois University at Carbondale
Carbondale, IL 62901