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EXPERIMENTAL EVALUATION OF GALVANIC SKIN RESPONSE AND BLOOD PRESSURE CHANGE INDICES DURING CRIMINAL INTERROGATION*

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The modern professional approach to "lie detection" is based on the utilization of a number of physiological measures obtained simultaneously. Standardization of practice has led to the employment of a limited number of Polygraph instruments which usually include the following channels: (1) blood pressure and pulse rate, (2) respiration, and (3) galvanic skin response (GSR). The procedure for measuring blood pressure includes the use of a cuff placed around the upper arm of the subject. This cuff is inflated to a pressure somewhat above the diastolic blood pressure of the subject, and this condition is maintained during the interrogation. The usual pressure used is about 90 mm. Hg., and this pressure may be held as long as two and a half minutes, depending, of course, on the number of questions to be used in a particular portion of the investigation.

The U.S. congressional committee has recently summarized its review of the use of Polygraphs as "lie detectors". Among other things it was concluded that there is a striking deficiency in experimental data concerning the validity of the Polygraph that has been collected under conditions similar to those existing in "real life" police interrogation.¹ Much of the existing research

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¹ HEARING BEFORE THE SUBCOMMITTEE OF THE COMMITTEE ON FEDERAL GOVERNMENT OPERATIONS, ON

literature is of limited value because of the poor control in the field studies, or the low relevance of the artificial atmosphere in the usual laboratory study.

A current review of the literature indicated an interesting discrepancy regarding the usefulness of the GSR channel which seemed of both theoretical and practical importance. The professional opinion of leading police authorities is that field experience has shown the GSR to be of limited value in lie detection.² The experimental laboratory studies, in contrast, have indicated a comparatively high degree of success with this channel which has probably become the most frequently used index in this type of research.³

Close examination of most of the laboratory investigations would suggest that the conditions created would be of little, if any, stress to the

THE USE OF POLYGRAPHS AS "LIE DETECTORS" BY THE FEDERAL GOVERNMENT, PART 3, PANEL DISCUSSION WITH SCIENTISTS. Government Publications Office, Washington, D.C., 1964.

² INBAU, F., AND REID, J. E., LIE DETECTION AND CRIMINAL INTERROGATION, (1953).

REID, J. E. AND INBAU, F. E., TRUTH AND DECEPTION 291 (1966).

³ ELLISON, D. C., DAVIS, R. C., SALTSMAN, I. V., BURKE, C. J. A report on research on detection of deception. CONTRACT N60NR-18011, OFFICE OF NAVAL RESEARCH, 1952. GUSTAFSON, L. A., AND ORNE, E. T., *Effects of heightened motivation on the detection of deception*. 47 JOURNAL OF APPLIED PSYCHOLOGY, 408 (1963). KUBIS, J. F. *Studies in lie detection: computer feasibility considerations*. RADC-TR 62-205, 1962. LYKKEIN, D. T., *The GSR in the detection of guilt*. 43 JOURNAL OF APPLIED PSYCHOLOGY, 385, 1959. VIOLANTE, R., AND ROSS, S. A. *Research on interrogation procedures*, CONTRACT NONR 4190(00), 1964.

college students performing as experimental subjects. One possible explanation for the above mentioned discrepancy in the evaluation of the GSR channel may be the difference in stress between the laboratory and field studies. This, of course, is not the only difference between these two types of studies. In general it would appear worthwhile to consider all of the possible differences between the experimental studies and the actual field operations if we hope to use the former to evaluate and improve the latter. Following the above reasoning, a series of experiments have been undertaken in our laboratory.

Kugelmass and Liebllich⁴ in 1966 attempted to study experimental lie detection under different levels of stress using police cadets. Analysis of the physiological data indicated that while some degree of stress was created, the experimental examinations were less stressful than those encountered during police interrogation. At this level of stress the efficiency of the GSR channel was found to be essentially similar to that found for this channel in mild experimental situations, and far superior in detection efficiency to an index of heart rate change. The results of this study suggest that a certain level of stress need not impair the efficiency of the GSR channel, and that a further controlled study under "real life" stress would be necessary to examine the stress explanation of the discrepancy in the evaluation of the GSR index in detection.

The study also included an attempt to investigate the possible interference of the blood pressure measurement part of the Polygraph with the measurement of skin conductance. The inflated cuff system of measuring blood pressure which is common to police work is rarely used in the experimental laboratory studies for reasons described by Lacey.⁵ The results obtained indicated that the simultaneous recording of GSR and blood pressure using the inflated cuff reduced the efficiency of the GSR to the level of chance prediction. This finding suggested that part of the poor performance of the GSR during police interrogation could result from the standard procedure employed.

The present study was designed as an attempt to replicate the earlier study under real life condi-

tions. In addition, an attempt was made to evaluate the efficiency of the blood pressure channel in a controlled "real life" situation. While this channel is very highly rated by police practitioners,⁶ very few laboratory studies of its validity were found by Davis.⁷

METHOD

Subjects: Sixty-two criminal suspects interrogated in connection with serious offences served as subjects. None of them had been informed that a part of the interrogation would be used for scientific purposes.

Apparatus: A standard three channel Stoelting Polygraph model with attachments for breathing, blood pressure and GSR⁸ used at the central laboratory of the Israel Police.

Procedure: A part of most Polygraph examinations in our laboratory includes a card test, which is a standard procedure in many laboratories.⁹ Instead of this usual card test a standard technique was used that had been developed for the previous experimental study.¹⁰ The suspects, however, did not know about this change of procedure nor did they know that it differed in any way from routine practice. The testing took place in the usual soundproof examination room. The suspect sat facing a blank wall. Stoelting GSR electrodes were attached to the volar surfaces of the second and fourth fingers of the left hand. The pneumatic tube used to record respiration was placed on the suspect's chest, and the blood pressure cuff was wrapped around the upper part of the right arm.

Following the attachment arrangements and the comfortable seating of the suspect, the experimental procedure was introduced. Each suspect was tested under two variations of the procedure, thus serving as his own control in a random balanced design to control for order effects. During the *GSR and Cuff condition* the Stoelting sphygmomanometer was inflated to a pressure of 90 mm. Mercury. This pressure was maintained for about ninety seconds during the experimental examination. The blood pressure cuff was *not* inflated during the *GSR condition*. During both of these

⁶ INBAU, F. LIE DETECTION AND CRIMINAL INTERROGATION (2nd ed. 1948).

⁷ Davis, R. C. *Physiological responses as a means of evaluating information*. IN A. D. BIDERMAN AND H. ZIMMER (Eds.), MANIPULATION OF HUMAN BEHAVIOR, (1961).

⁸ The Stoelting apparatus is not designed to obtain measures of basic conductance.

⁹ INBAU, F., op. cit.

¹⁰ KUGELMASS, S. AND LIEBLICH, I., op. cit.

⁴ KUGELMASS, S., AND LIEBLICH, I. *Effects of realistic stress and procedural interference in experimental lie detection*. 50 JOURNAL OF APPLIED PSYCHOLOGY 211, (1966).

⁵ HEARINGS BEFORE THE SUBCOMMITTEE OF THE COMMITTEE ON FEDERAL GOVERNMENT OPERATIONS, op. cit.

conditions the suspect was required to choose one of a pack of six cards, to record the number of this card, and to answer "no" to all of the subsequent questions, "did you choose card number . . .?" The number sequences were randomized while each number appeared twice during ninety seconds of questioning to each condition. The first number presented in each condition—number eighteen—served as a buffer against initial startle, since it had not been included in the pack.

RESULTS

GSR channel: The two GSR responses (maximal change in mm. from baseline; within five seconds after the presentation of the number) to each card were averaged. The card yielding the highest average mm. value was considered the "selected" card. Actual success in detection could be evaluated by comparing this card number with the one actually chosen by the subject and recorded by the S during the experiment. The number of "hits" and "misses" in the *GSR and Cuff condition* were 32, and 30 respectively, and in the *GSR condition* 35, and 27.

The data were analysed against an assumed binomial model (62, 1/6). The number of "hits" or correct detections in the *GSR condition* as well as in the *GSR and Cuff condition* were significantly greater than chance ($\alpha < .001$). A chi square test for dependent proportions showed no significant difference in detection efficiency between the two conditions ($\alpha > .05$).

Blood pressure channel: In order to evaluate the efficiency of this channel the "notches" of this curve were connected, and deflections were measured from the baseline within five seconds following the presentation of the card number. As before, the card yielding the highest mean deflection in mm. from the baseline was considered to be the "selected" card and was checked against the number recorded by the suspect. With this method employed 28 "hits" and 31 "misses" were obtained. Assuming the same binomial distribution as before the efficiency of the blood pressure channel appears to be better than chance at the .001 level. A chi square analysis for dependent proportions indicates that the efficiency of the GSR in the *GSR condition* is not significantly greater than the efficiency of the blood pressure channel during the *GSR and Cuff condition* ($\alpha > .05$).

A Phi correlation was computed to evaluate any relationship between detectability using the GSR index and the detectability based on the

blood pressure index. The value of the coefficient obtained was 0.08 which suggests that no significant correlation exists between the two means of detectability. Detectability using pulse rate changes (both acceleration and deceleration) was found not to be significantly different from chance which confirms the findings in the previous study.¹¹

DISCUSSION

The results of the present experiment may be taken as additional support for the efficiency of the GSR channel during stress. The ratio of the observed correct identifications to the expected rate of identifications by chance may be computed for comparison with other experimental studies. The ratio obtained during this high level of realistic stress is 3.3, a bit higher than our previous results,¹² and about equal to that obtained in the most detectable group studied by Gustafson and Orne.¹³ It seems reasonable to conclude that the GSR channel does not lose its efficiency over the range of stress relevant to lie detection. In addition to its practical implication for actual lie detection this would appear to be of interest in connection with the theoretical analysis offered in Woodworth and Schlosberg.¹⁴

The present results have shown a minimal interference effect of blood pressure measurement procedure on the GSR channel. This is in contrast to the substantial effect found by Kugelmass and Liebllich¹⁵ in an experimental situation which involved little or no stress. It may be that there is an interaction between the stress level and the development of the interference effect. It is conceivable that the 90 mm. Hg. pressure of the cuff had less impact on the circulatory system during high stress which changed the subject's blood pressure. It is apparent that the length of time of application of the cuff must also be considered. One aspect of this problem has already been shown to be a function of time.¹⁶ The marked similarity in detection rate to previous laboratory studies obtained in this field experiment suggests that the police equipment as such is probably not the

¹¹ Ibid.

¹² Ibid.

¹³ GUSTAFSON, L. A., AND ORNE, E. T., op. cit.

¹⁴ WOODWORTH, R. S., AND SCHLOSBERG, H., EXPERIMENTAL PSYCHOLOGY, (1956).

¹⁵ KUGELMASS, S., AND LIEBLICH, I., op. cit.

¹⁶ Yankee, W. J., *An investigation of sphygmomanometer discomfort thresholds in polygraph examinations.* POLICE, 18-18, July-August, 1965.

source of the reports of inadequacy of the GSR channel in actual interrogation.¹⁷

While the blood pressure channel has been considered to be of prime importance in actual field interrogation with theoretical support for its potential success under high stress,¹⁸ it has been reported as less promising for "experimental cases".¹⁹ This position suggests that different psychological situations will be differently reflected in these two different channels of "activation". While this hypothesis is interesting, it cannot be supported by the present data which suggest that the blood pressure index is approximately equal to the GSR index in card test detectability.

It should also be noted that there was little or no correlation between the two card detectabilities across individuals. This appears to support the notion of "response stereotypy" suggested by Lacey and Lacey,²⁰ which points to the likelihood

¹⁷ Lindsley, D. B. *The psychology of lie detection*. In: DUDAYCHA, G. J. (ED.) *PSYCHOLOGY FOR LAW ENFORCEMENT OFFICERS* (1955).

¹⁸ WOODWORTH, R. S., AND SCHLOSBERG, H. op. cit.

¹⁹ INBAU, F., AND REID, J. E., op. cit. ELLSON, D. C., DAVIS, R. C., SALTSMAN, I. V., BURKE, C. J., op. cit.

²⁰ Lacey, J. I., and Lacey, B. *Verification and exten-*

that different people can best be detected through different channels. It would thus appear to be possible to increase detectability efficiency by finding a system of matching the appropriate channel to the person in interrogation. Systematic success in this direction would contribute to better theoretical understanding of psychophysiological reactivity as well as improved applied lie detection.

It is necessary to remember that all of the above conclusions are based on experimental variation of the card test. Because of the fixed structure it is possible to compare results from different laboratories, and to apply an appropriate model of statistical analysis. On the other hand, it is possible that generalization of results to the more complicated structure of actual interrogation may be unwarranted. Until it becomes possible to construct an experimental model of much greater complexity the present results can only be suggestive, and must be supplemented by other means of evaluating this important tool of criminal investigation.

sion of the principle of response stereotypy. 71 AMERICAN JOURNAL OF PSYCHOLOGY, 50, 1958.

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