

THE PUPILLARY RESPONSE AND THE DETECTION
OF DECEPTION

BY

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Abstract

The pupillary response was measured in a "lie detection" or detection of deception paradigm in an attempt to: a) determine the utility of this measure, and b) to assess some theoretical assumptions about the detection of deception paradigm. All subjects selected a number from one to five. They were then asked, in random order, questions of the nature, "Is it one?", "Is it two?"... (etc.) ... Depending on which group, they either answered "No" verbally to all five questions (overt), remained silent but said "No" to themselves in response to all questions (covert), or simply listened to each question (control). In Experiment 1 no differences were found between the groups but pupillary responses to the number selected (critical stimulus) were larger than the average of responses to noncritical stimuli over groups and significant detection rates were found in each group. In Experiment Two these results were replicated. In addition two blocks of five trials were presented to each subject. Differential responding to the critical question was evidenced over the first block but not the last block in all three groups. No differences emerged between the groups on habituation trials. The fact that the control group evidenced differential responding to critical stimuli suggested that a "lie" was not a necessary event in the detection of deception paradigm. It was concluded that "short term attention" is a sufficient condition to evoke

differential responding in this paradigm. It was also concluded that detection was most likely to occur on early trials, rather than later ones.

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Responses of physiological systems innervated by the autonomic nervous system (ANS) have been used as indicies of emotional, sensory and mental activity (Sternbach, 1966). Generally, these responses have been considered involuntary or at least difficult to control when a subject is exposed to meaningful stimuli and to the degree that this is true represent objective physiological manifestations of on going psychological phenomena.

"Lie detection" methods of police, government, and employers have relied heavily on the measurement of autonomic responses as indicants of a suspect's attempts to conceal, mislead or lie during an interrogation (Inbau and Reid, 1966). Usually several measures are taken and recorded on a device known as a polygraph. Those who use the polygraph for applied or practical purposes claim that it is a scientific assessment of a suspect's guilt or innocence. However, many polygraph experts have difficulty when asked to verbalize just what the specific indicants of deception are. Over all, the judgement process appears to be very subjective (Davis, 1961). To the scientist this state of affairs is unsatisfactory. One preliminary task should be aimed at objectively delineating the responses concomitant with deception. Further work is also needed in identifying specific aspects of situations and individuals which make the detection of deception possible.

History of Lie Detection

Historically the belief that certain types of cognitive activity are accompanied by perceptible physiological or behavioural alterations has been prevalent. This is especially true with regard to the detection of deception or "lie detection" (Boring, 1942; Larson, 1932; and Trovillo, 1939). Persons suspected of attempting deception were often subjected to special ordeals. It was believed that only a person not guilty of deception could pass these ordeals. Zoroaster proved the truth of his words by touching a red hot iron to his tongue nine times without scorching it, ancient Chinese were required to speak with their mouths full of rice to prove their innocence. In both cases if emotion interfered with salivation the suspects might have failed in their tasks. Witchdoctors sometimes leapt at suspects smelling them feverishly. Distinctive odours indicated guilt and it is possible that the fear of being caught produced such an odour. Another test had the suspect immerse his arm in boiling water and if it blistered the next day, he was considered guilty.

How effective these ordeals were in discriminating between guilty and innocent individuals is debatable. Some ordeals such as the one reserved for the Roman Catholic clergy in the middle ages, were very unlikely to cause anyone to be declared guilty. The accused clergyman was

instructed to eat a piece of barley bread and cheese while other clergymen prayed for an angel to stop the accused's throat if he was guilty. There is no recorded instance of a priest having been choked in this manner (Trovillo, 1939). Another ordeal involved the use of a very accurate balance beam. The accused was placed in one scale while the other side was carefully counterbalanced. A groove was filled with water for the purpose of detecting the slightest deflection either way. The suspect then stepped out of his scale, listened while a judge exhorted the balance to discover the truth, and finally got back in. If he were lighter than before he was considered innocent. Such a test depends more on how long the judge takes to make his speech than guilt or innocence since the body undergoes a constant loss of water of about 12 grams per hour. A long speech would free the accused (Trovillo, 1939).

More modern and scientific investigation into behavioural and physiological differences accompanying deception began around the turn of the century. In 1906 Jung (see Orne, Thackray and Paskewitz, 1972) studied differential reaction times to stimuli on which subjects hoped to deceive the experimenter. Inbau and Reid (1953) report that Cesare Lombroso used a "hydrosphygmograph" to record blood pressure changes during interrogation. Blood pressure was measured with this instrument by having the

suspect place his hand in a vessel of water topped by a rubber seal. Pulsations of blood caused water level changes which affected an attached air filled tube. These changes were recorded on a revolving drum. Marston (1917) used a sphygmomanometer to record blood pressure during questioning and reported 96% accuracy in detecting deception with the device. Luria (1932) showed that psychomotor responses can be impaired while the subject is lying. He required the subject to hold one hand steady while depressing a plunger with the other. Munsterberg (Troville, 1939) pointed to the possibility of using the galvanic skin response (GSR) for lie detection purposes. Larson (1921) put together an instrument capable of taking blood pressure, pulse and respiration all at once and finally Keeler (1930) developed the polygraph. His device measured respiration, relative blood pressure and the GSR. These have remained the major physiological measures in "lie detection" since that time (Davis, 1961).

Field Work

Field work or the practical application of lie detection in criminal investigations has dominated much of the work in the detection of deception. Orne, Thackray and Paskewitz (1972) mention that little systematic scientific investigation has been done. Practitioners involved in lie detection specifically try to structure a situation to

achieve the goal of a successful diagnosis of deception. How they achieve this goal is, in part, left up to the individual discretion of the investigator. Further, there have been few reports that deal with attempts to validate findings. Field work is characteristically more of an art than a science. Inbau, Moenssen and Vitullo (1972) stress that since the polygraph technique in criminal investigation involves a diagnostic procedure rather than a mechanical operation, an examiner must be intelligent and well educated, with suitable personality characteristics "to get along well with others and to be persuasive in his dealings with them." (1972, p.153).

The recording of autonomic responses on the polygraph represents only part of a structured interrogation session aimed at convincing the suspect of the infallibility of the lie detector. To accomplish this, individual interrogators may alter their style, mannerisms, subtle cues, and tone of voice as they see fit. In addition the scoring of responses has not been specified in quantitative terms. Inbau, Moenssens and Vitullo (1972) write that in approximately twenty-five percent of the examinations conducted by a competent polygrapher, truthfulness or deception is so clearly disclosed that any layman could be shown the results and convinced of their significance. However, in sixty-five percent of the cases, the indicators

are sufficiently subtle as to require expert interpretation. This expert interpretation is carried out in the context of an investigation where the interrogator may already possess much other information including the investigative knowledge and conviction of his colleagues as to the suspect's guilt. This alone may be a powerful source of bias affecting the subjective interpretation of objective records (Orlansky , 1962).

Questioning Techniques in the Field

Practitioners in criminal lie detection have developed and come to rely on certain techniques and procedures to present questions during an interrogation.

The guilty person technique The guilty person technique (Lykken , 1960) or "undisguised question method" (Burack, 1955) is a modification of a direct confrontation questions such as "are you guilty?". The suspect is asked several questions, some relevant, some irrelevant to the crime. If responses to relevant questions differ from those to irrelevant questions the suspect is considered guilty. Reid has formulated this procedure, labelled the Reid Control Questioning Technique, such that four relevant questions are asked along with four irrelevant questions (Reid and Inbau, 1966). Unfortunately, questioning a suspect about whom he may have killed can yield responses interpretable as deception even though the suspect is

innocent (Burack, 1955). Orne, Thackray and Paskewitz (1972) have called for more investigation into what is termed "false positives" where because of innocent fear, for example, a suspect may respond as if guilty. Inbau and Reid (1966) have suggested the addition of control questions which are irrelevant to the crime being investigated but are questions to which a suspect will probably respond with a lie. These could be questions such as "did you ever steal anything else"? The particular questions are worked out for each individual suspect by the interrogator in a pre-lie detection test interview to insure a lie response. If the lie reaction to the irrelevant question is the same as or greater than the response to a question relevant to the crime then the suspect is considered innocent. An additional question about a fictitious crime of the same seriousness may be asked and if the suspect's reactions to this question are equal to or greater than the response to the relevant question then the suspect is considered innocently nervous.

Lee (1953) has added "secondary relevant questions" which concern themselves with details only a guilty suspect could know. Since the innocent suspect could have no information about certain aspects of the crime it is assumed that questions about those aspects would be considered irrelevant and nonthreatening and thus would not be expected to create strong reactions.

The above techniques have been based on the assumption that a "lie response" is being measured rather than an emotional reaction to the content and implications of such questions. But, the literature does not support the conception of a "lie response" (Kugelmass, Lieblich, and Bergman, 1967). Day (1972) states that a lie is not a critical factor in causing a detectable physiological response. Orne, Thackray and Paskewitz (1972) suggest that "no specific physiological responses are pathognomic of lying" (1972, p. 755).

The disguised question technique Another technique, actually anticipated by Lee (1953) termed the "disguised questions test" (Burack, 1955) or the "guilty knowledge technique" (Lykken, 1960) relies on the differential impact of questions on knowledge only the guilty person could have. One variation of the technique presents stimuli in serial order and the interrogator looks for a gradual rise (or fall) of baseline readings which reach a peak at the item. Thus a series of questions could be asked all in the form of "did you steal \$100.00?" and continue through to the actual amount stolen. Day (1972) points out that the disguised question or guilty knowledge technique has a fairly solid rationale in that there may be some involuntary physiological response to remembered details of a crime.

Measures used in the Field

The ANS responses measured for the detection of deception in field work have been generally limited to respiratory responses, cardiovascular responses, and the galvanic skin response (Inbau and Reid, 1966).

Respiratory responses Inbau and Reid (1966), acknowledged experts in the lie detection field, consider respiration to be their most reliable measure. Unfortunately, although respiration measures have long been used in the detection of deception (Trovillo, 1939), field workers have not identified a specific response as an indicant of deception. Instead they have tended to judge any marked change from the baseline of breathing rate (cycles per second) and/ or amplitude as indicative of deception. Thus, a suspect could speed up or slow down his breathing rate and or increase or decrease amplitude. Any of these responses would arouse the interrogator's suspicion. Davis (1961) has noted that respiration in the early part of an interrogation session is often irregular and as such is not a good indicator of deception responses. However in a longer test session discrimination becomes much better. The early irregularity is thought to be a response to the general interrogation situation (Davis, 1961).

Horvath and Reid (1972) may have overcome some of the difficulties associated with respiratory measures. They found, in a field investigation, that differences between

respiratory responses to critical and neutral questions were enhanced when the suspects were requested to remain mute during the interrogation session. The enhancement is attributed to elimination of sources of variability associated with talking. Horvath and Reid (1972) have outlined several respiratory irregularities associated with an audible answer. Having the suspect remain mute eliminates distortions where a suspect may either inhale or suppress inhalation just to give an audible answer. Answers given at the height of inhalation can produce substantial distortion. Subjects who prepare for an audible answer by physical movement cause distortion, as do those who loudly bellow their answers, feel compelled to talk in addition to a "yes" or "no", or have throat irritation when they respond. Unfortunately, Horvath and Reid (1972) have only presented selected samples of the polygraph record. These samples illustrate instances of relatively dramatic differences between neutral and critical questions but Horvath and Reid (1972) failed to supply data of the over-all rate of detecting deception responses.

Cardiovascular responses Blood pressure is the measure relied on by most practitioners in the field (Davis, 1961). A measure of relative blood pressure is obtained by inflating an arm or wrist cuff to a point equal to the pressure half way between systolic and diastolic blood

pressure levels. Unfortunately, the apparatus can be painful and dangerous since the cuff pressure far exceeds vein pressure and does not allow the blood to return from the arm or the hand. It is quite possible that the pain produced using the pressure method may result in reactions of other autonomically controlled responses including blood pressure itself. In spite of this, Davis (1961) has reported that blood pressure is one of the better indicators of deception. A drawback with the blood pressure measure is that discrimination is poor (almost nil) in the early part of the session. However, it does improve greatly later on (Davis, 1961).

The galvanic skin response It is not clear how useful the GSR is for lie detection in the field. Davis (1961) has concluded that the GSR is the best indicator of deception in short time intervals but poor in longer questioning periods. Inbau and Reid (1966) criticize the GSR because they are unable to obtain a high degree of accuracy with it. The GSR is easily triggered but slow in recovery and in a routine examination the next question may be introduced before recovery to baseline is complete. In a series of questions the GSR may adapt out simply because each new question is asked before the GSR has returned to the level it was at when the prior question was asked.

The opposite problem of failure for the GSR to occur

has also been brought up. Woodworth and Schlosberg (1965) have documented evidence suggesting that the GSR is an inadequate measure during strong emotion. Part of this evidence is dependent on Darrow's (1936) findings that adrenalin, contrary to the expected effect, seems to inhibit the GSR. Such evidence would be consistent with the claim of Inbau and Reid (1966) that the measure is poor for field work since many suspects could be highly emotional.

Another possibility for the failure of the GSR in field work has been raised by Ferguson (1966). He reported that a commonly used field instrument employing a self centering pen feature reduced the effectiveness of the instrument 75-80 percent.

Laboratory Research

In general, although the polygraph "lie detector" is construed as a scientific instrument (which it is), ample room in its application is left for uncontrolled and nonsystematic sources of variance. Previously it was mentioned how various factors relegate the field interrogation procedures to an art. In spite of this, the detection of deception situation or paradigm is appropriate for laboratory investigation.

Questioning Techniques in Laboratory Research

Orne, Thackray and Paskewitz (1972) have discussed the

major experimental designs used in the detection of deception paradigm. These involve the guilty information technique, the guilty person technique and the mock crime situation.

The guilty information technique The guilty information situation is structured so that the subject is known to be guilty of attempting to deceive the experimenter about a particular item of information. Cards or numbers are presented to the subject who is instructed to choose one, keep his choice in mind and answer "no" to all questions of the nature "Is it card (or number) ___?". The result of this format is that the subject tells the truth on all cards except for the one selected, which in following the instructions he automatically lies about. The experimenter's task is to identify the specific card or number on which the subject is attempting deception. This procedure has been fairly common (Alpert, Kurtzberg, and Friedhaff, 1963; Block, 1957; Block, Rourke, Salpeter, Tobach, Kubis and Walch, 1952; Burt, 1921; Geldreich, 1941; Landis and Wiley, 1926; Langfeld, 1921; Obermann, 1939; Van Buskirk and Marcuse, 1954).

The guilty person technique The guilty information situation is contrasted with the guilty person procedure in that the experimenter attempts to discriminate between a guilty or innocent person, which more closely resembles the