

# Psychophysiological and Ocular-motor Detection of Deception

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## Specific-Incident Polygraph Tests

In the United States, polygraph tests are commonly used in criminal investigations and polygraph screening programs. In criminal investigations, the tests are used to decide if statements by suspects or defendants concerning a specific incident are truthful or deceptive. Polygraphs sometimes are used to test victims, but that application is problematic (Ginton, 2010). The test is administered after a pretest interview with the subject by the polygraph examiner. During the pretest, the examiner obtains informed consent, collects basic demographic information, discusses the relevant issues, and obtains the examinee's version of the events. The examiner then attaches the physiological sensors, describes the psychophysiological basis for polygraph testing, and conducts a preliminary demonstration test. The sensors record respiration from transducers wrapped around the chest and abdomen, electrodermal activity from electrodes attached to the tips of two fingers, and cardiovascular activity from a blood pressure cuff on the upper arm.

The pretest phase is followed by the test phase, during which a series of 10 to 12 questions is presented orally by the polygraph examiner at a rate of about two questions per minute while the physiological data are recorded by the polygraph. The question series contains relevant questions that pertain to the specific incident under investigation (e.g., "Did you rob the Quik Mart on June 14, 2014?"). More often than not, the series also contains probable-lie comparison questions. Probable-lie questions are intentionally vague and difficult or impossible to answer truthfully with an unqualified "No" (e.g., "Between the ages of 18 and 28, did you ever lie to someone in authority?"). To avoid appearing like the type of individual who would lie on the polygraph test, subjects answer "No" to the comparison questions, and their answers probably are lies. The test predicts that a subject who answers the relevant questions truthfully will be more concerned about being deceptive to the comparison questions and will react more strongly to the comparison questions than to the relevant questions. Conversely, the subject who is deceptive to the relevant questions is expected to be more concerned about them and react more strongly to them than to the less incriminating comparison questions.

The set of questions is repeated several times with brief rest periods between repetitions. The blood pressure cuff is deflated between repetitions of the questions because it causes discomfort that increases the longer it is inflated. The rest periods restore blood flow to the lower arm and provide a respite from the emotional demands of the examination. At the conclusion of the test, the polygraph examiner compares the physiological reactions to comparison and relevant questions. A subject who reacts more strongly to the comparison questions is considered truthful, and a subject who reacts more strongly to the relevant questions is considered deceptive. The test is inconclusive when there is little or no difference between reactions to comparison and relevant

questions.

In specific incident criminal investigations, the accuracy of comparison question tests is influenced by the skills of the examiner. To be valid, examiners must conduct a proper and professional pretest interview; they must construct relevant questions that are clear, not subject to interpretation, and have probative value; and they must conduct a proper evaluation of the physiological recordings. If these conditions are met, the accuracy of probable-lie tests in specific-incident criminal investigations is approximately 90%, excluding inconclusive outcomes (American Polygraph Association Ad Hoc Committee on Polygraph Techniques, 2011).

### **Screening Polygraph Tests**

In the United States, polygraph tests also are used by various government agencies to screen job applicants, employees, sex offenders, and parolees. In contrast to specific-incident criminal investigations, the relevant issues are more general, e.g., “In the past 90 days, have you used any illegal drugs?” The generality of relevant questions in screening examinations is desirable from the point of view of the government agency that administers the test because the question covers a wide range of illicit behaviors of concern to the agency. However, the generality of the relevant questions may introduce ambiguity in the mind of the examinee about their guilt (“I haven’t used illegal drugs in past 90 days, but I used them 6 months ago, and I know that was wrong.”). The generality of relevant questions also increases their similarity to comparison questions, which are intentionally vague and broad in scope. One would expect the reactions to comparison and relevant questions to be more similar in magnitude and less diagnostic in screening tests than specific-incident tests, increasing the risk of false positive and false negative decision errors.

In screening contexts, the same set of test questions may be used repeatedly for different examinees. Standardization of test protocols lessens concerns about question formulation. However, the validity of a polygraph screening test that includes probable lie questions is likely to be compromised not only by variance in the skills of examiners but also the extent to which the relevant questions are broad enough in scope to meet the needs of the testing organization (Meijer, Verschuere, Merckelbach, & Crombez, 2008).

### **Ocular-motor Deception Test**

We recently introduced the ocular-motor deception test (ODT) for screening applications (Cook et al., 2012; Hacker et al., 2013). The subject sits in front of a computer monitor, reads a set of instructions, and presses one of two buttons (true or false) on a keyboard to answer a series of 48 statements. While the subject reads and responds to the statements, a remote eye tracker records gaze position and pupil size. The statements are presented five times in different orders, and the subject performs an unrelated task between repetitions of the statements. The ODT uses a test format known as the Relevant Comparison Test (RCT), which we developed for an automated polygraph screening system (Kircher, Raskin, Gardner, Jewell, & Patnaik, 2012). The RCT covers two unrelated relevant issues. Typically, one set of relevant statements addresses an issue that is of great concern to the testing organization and the consequences of detection are dire. However,

the behavior occurs very rarely, such as espionage. The other relevant issue also is of concern to the testing agency, has a relatively high base rate of occurrence, and the consequences of detection are relatively minor, such as drug use. A person convicted of espionage may face a long prison term or even death, whereas a person who fails a drug test may be reprimanded, lose a security clearance, or simply not be hired, depending on whether the subject is an employee or a job applicant. The computer extracts measures of reading behavior from eye fixations on the text and measures pupil reactions to the two sets of relevant statements and neutral statements. The ocular-motor measures are combined by means of a logistic regression equation to compute the probability of truthfulness to each of the relevant issues. The mean accuracy of the ODT in several large mock experiments in the U.S. and Mexico was approximately 83% on deceptive individuals and approximately 87% on truthful individuals (Cook et al., 2012; Patnaik, 2013).

### **Advantages and Limitations of the Ocular-motor Deception Test**

The ODT has a number of advantages for screening applications.

- The absence of probable-lie comparison questions in an ODT, eliminates concerns about overlap between relevant and comparison questions. The reactions to two sets of relevant questions are compared, and each relevant issue serves as a control for the other issue.
- The ODT is almost completely automated. Therefore, the validity of the test does not depend on interview skills of the examiner or ability to properly interpret the physiological recordings.
- ODTs can be developed for any language, allowing testing in the native language of examinees and eliminating any needs for a translator
- In contrast to a polygraph test, the ODT is administered by a computer. The examinee does not attempt to appear truthful to an examiner but works on a computer to attempt to establish credibility.
- The ODT is less invasive than a polygraph test. Since a remote eye tracker records gaze positions and pupil size, there is no need to attach sensors to the examinee, one of which may cause discomfort.
- The ODT takes about 40 minutes, in contrast to a polygraph examination that may take 2-4 hours. An organization can conduct six ODTs in the time it takes to conduct one polygraph test.

Although the ODT has a number of advantages, it has at least one serious limitation that is not an issue for polygraph tests. Our research suggests that the accuracy of the ODT depends on the examinee's reading ability. When examinees struggle to read and understand the test questions, they do not show the reading patterns that characterize truthful and deceptive individuals, making them unsuitable for an ODT. Preliminary evidence suggests that this limitation might be addressed with computer-administered audiovisual presentations of test questions. Until an alternative ODT format for people with poor reading skills has been properly validated, the ODT should be used only with competent readers. If there is doubt about the reading ability of prospective examinees, the organization should administer a simple test of reading comprehension prior to the ODT.

We know that countermeasures can have adverse effects on the outcomes of polygraph tests

(Honts, 2014), but we do not yet know if countermeasures can be used to defeat an ODT. Because the ODT requires speeded responses, it may be more difficult to defeat the ODT than the polygraph, but that has not yet been subjected to scientific investigation.

### **Polygraph and Ocular-motor Screening Programs**

Screening programs might benefit from the sequential use of the ODT and the polygraph test. Because of its greater speed and lower cost, the ODT might serve as an initial screen. Depending on the relative costs of false positive and false negative errors in different applications, only those who pass, or only those who fail, the ODT would be given polygraph tests. This approach would reduce the burden on polygraph programs. For pre-employment screening, there may be many more applicants than open positions. In this case, the goal would be to avoid false negative outcomes in which applicants are deemed credible when in fact they were deceptive about some illegal or inappropriate behavior that would preclude employment. To minimize false negative outcomes, the hiring agency could set a high standard for passing the initial ODT, and only applicants who pass the initial ODT would then be given a polygraph test. If the ODT and polygraph provide independent information about the applicant's truthfulness, the probability of a false negative error is the product of the probabilities of false negative errors for the two tests. For example, if the probability of a false negative error is .10 for one test and .20 for the other test, the joint probability that a deceptive applicant would pass both tests would be  $.10 \times .20 = .02$ . Thus, when two independent tests are used in combination, the risk of error drops from 10% or 20% to only 2%. In addition to reducing the number of applicants referred for polygraph examinations, use of the ODT in combination with the polygraph would significantly reduce the risk of undesirable decision errors.

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