
Chapter 2

Varieties of Polygraph Testing and Uses

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INTRODUCTION

Polygraph examinations have been likened to psychological testing (cf. 89, 92, 101). As such, polygraph testing is best described not in the singular but, instead, as a series of tests. These tests are designed to assess truthfulness and deception in situations that range from screening job applicants to investigations of specific criminal incidents. Polygraph examiners, employed both within and outside Government agencies, use a variety of polygraph testing techniques, each of which has a somewhat different underlying logic and demonstrated validity.

The choice of polygraph technique depends primarily on the circumstances under which the

polygraph is being used. The test of a subject who is suspected of a specific criminal activity typically involves application of a different polygraph technique than the examination of a prospective Government employee. Some variation in technique is also related to examiners' training, but such differences probably affect the way in which a technique is employed rather than which technique is used. A description of the instrument used in polygraph testing and an analysis of the types of test situations and polygraph techniques are presented below.

POLYGRAPH INSTRUMENT

Although there are numerous variations in testing procedures, the polygraph instrument itself is fairly standard. The polygraph measures several, usually three, physiological indicators of arousal. Changes in physiological arousal exhibited in response to a set of questions are taken to indicate deception or truthfulness. The polygraph instrument, it should be noted, is not a "lie detector" per se; i.e., it does not indicate directly whether a subject is being deceptive or truthful. There is no known physiological response that is unique to deception (108,122,123). Instead, a polygraph examiner obtains a subject's responses to a carefully structured set of questions, and based on the pattern of arousal responses, infers the subject's veracity. This assessment has been called the "diagnosis" of truthfulness or deception (139).

In actual field testing, subjects' physiological responses are measured by a three- or four-channel polygraph machine that records responses on

a moving chart. Usually, three different types of physiological responses are measured. The rate and depth of respiration is measured by pneumographs strapped around the chest and the abdomen. A blood pressure cuff (sphygmomanometer) placed around the bicep is used to measure cardiovascular activity. In modern polygraph instruments, sphygmomanometer readings are electronically enhanced so as to permit lower pressure in the cuff. The electrodermal response (EDR), a measure of perspiration, requires electrodes attached to the fingertips. This has also been referred to as galvanic skin response (GSR) or skin conductance response (SCR). Each of these physiological assessments has been shown to be related to physiological arousal (36). There is some literature to suggest that one or more of the physiological channels (EDR, in particular) is most sensitive (e. g., 123). Actual field testing, however, almost always involves measurement of all three types of responses.

TYPES OF TESTING PROCEDURES

A polygraph examination normally takes anywhere from 1 to 3 hours, although shorter or longer tests may result in a variety of circumstances. The length of an examination depends on the purpose of the examination, as well as the subject's attitude and a number of other factors. Examinations may be very short because a subject "confesses" or may be lengthy when an examiner seeks to resolve an inconsistent or inconclusive pattern of responses. The examination can be divided into at least three components: pretest interview; question procedure; and post-test interview. The actual questioning aspect of the examination, which may be repeated three or four times, lasts no longer than a few minutes for each question set (limited, in some cases, because the blood pressure cuff can be inflated for only 10 to 12 minutes without causing the subject undue discomfort). Each aspect of a polygraph test is described below in detail. Unless specifically noted, generally used polygraph procedures are described, Federal Government procedures are often different and, where important such differences are noted.

The Pretest Interview

The pretest interview has been considered an indispensable component of the polygraph examination (121,139,194). The importance of the pretest is not only in its role to provide subjects with information about the examination and to inform them of their legal rights, but also in its ability to generate the psychological climate considered necessary for a valid polygraph test. An important purpose of the interview is to persuade a subject that the examination is professionally conducted and that any deception attempted "will be very obvious to the examiner" (20). Such instructions, it is thought, place truthful subjects at ease and increase anxiety in subjects who intend to be deceptive. Persuading subjects about the effectiveness of the examination should sharpen differences between deceptive and nondeceptive subjects in their reactions to questions about a particular incident.

The pretest also allows the examiner to assess the effect of special conditions or circumstances which might affect physiological responsiveness. Thus, for example, subjects are typically queried about medical problems and use of drugs that could influence autonomic responding. Such assessments are usually made without collecting "hard" data, such as blood samples.

Consent Procedures

Depending on which polygraph method is employed, as well as the subject's attitude and the situation under investigation, pretest interviews may take from 20 to 90 minutes (20,27). One aspect of the pretest interview involves obtaining the subject's consent to be examined. Consent procedures vary depending on the nature of the interview, most importantly between criminal or preemployment polygraph tests. According to Barland and Raskin (20), a typical polygraph examination conducted as part of a criminal investigation requires that the examiner advise the examinee of his or her Miranda rights (or rights under the Uniform Code of Military Justice). The subject is also told that the polygraph examination is voluntary. Subjects should also be informed whether or not the examination will be observed from outside the room or recorded. These disclosures are usually included in a written form which the subject is asked to sign. According to Reid and Inbau (139), criminal suspects may already have been informed of their *Miranda* rights and been asked to sign a consent form before coming to the examination room.

Applicants for employment need not be advised of their right to speak with an attorney but may, depending on local laws, need to be advised about the voluntarism of the examination. In the case of such employment-related tests, along with a provision concerning voluntary consent, subjects will be told how the results of the examination will be used. Thus, for example, they may be told that a copy of the test results will be provided to the sponsor of the exam, that the subject has a

right to obtain a copy of the test results, that the subject will not be asked questions concerning such areas as political activities, union affiliations, racial or religious beliefs, or sexual activities unless these areas are specifically related to the issue under investigation (37).

Examples of consent forms used in criminal investigations by Federal agencies are shown in appendix A. The contents of Federal consent forms vary somewhat by agency, although all require that the subject "voluntarily" consent to the examination. Some agencies (e. g., Department of the Treasury (186)) indicate that the subject has the right to stop the examination at any time. Although the National Security Agency (NSA) reports that the full cooperation of the subject "is essential or the results will be inconclusive," NSA also reports (see app. B) that the polygraph examination is part of the Agency's security processing, and that failure to complete processing (which includes polygraph testing) may result in failure to be accepted for employment. As discussed more fully below (see *Current Federal Government Use*), NSA conducts polygraph examinations primarily in the context of preemployment and periodic security screening; most other agencies conduct polygraph examinations as part of specific-incident criminal investigations.

The remainder of the pretest interview also varies. In the method taught to Federal examiners at the U.S. Army Military Police School (USAMPS), * the interview focuses on questions about the subject's background: employment, family, education, health, and any previous legal problems (20). The examiner aims to learn enough to assess the subject's readiness for the examination and to prepare anxiety-provoking control questions, if they are to be used. The polygraph examiner then explains the polygraph technique to the subject and queries the subject in detail about the incident being investigated.

Another form of the pretest interview advocated by Reid (founder of the Reid College of Lie Detection) in criminal investigations makes use of a structured series of questions and deempha-

sizes gathering biographical data (77,139). Questions deal with matters such as the subject's suspicions about who committed the crime and the subject's feelings about the test. Questions are intended to provoke so-called "behavioral symptoms" (139) that are believed to be indicators of deception. These symptoms include evasiveness in answering, or complaints that one's physical disabilities will invalidate the recordings. When an examiner who uses the Reid method later makes an assessment of truthfulness, this information is used to supplement the data gathered from the physiological measures.

Whatever the format of the pretest interview, if control questions are to be used in the test, the last part of the interview will be used to design such questions and review them with the subject. In this phase, biographical and behavioral information collected earlier becomes essential. The information permits the examiner to tailor control questions to the individual subject. The process of designing control questions is complex and is discussed further in the section below which describes the control question technique (CQT).

Testing Procedure

Actual testing procedures have been described in detail by Barland and Raskin (20) and Reid and Inbau (139). Polygraph measuring devices, including pneumographs, a sphygmomanometer, and electrodes, are placed on the subject either during the pretest interview or at its conclusion. After the end of the pretest interview, the sphygmomanometer is inflated, and the recording of responses begins. A short period, of about 10 to 15 seconds, is used to observe initial respiratory cycles (baseline) and to allow any initial response to fade; then, the examiner asks the first question. Between each question, the examiner waits about 15 to 20 seconds until the response to the last question is finished and physiological response is closer to baseline. The examiner notes on the chart when the exam begins, when questions are asked, and when it ends. Extraneous behavior that affects the recordings may also be noted. When questions for the first chart end, the examiner deflates the cuff.

The examiner then inspects the chart and asks the subject about his or her reaction to the questions. The usual purpose for obtaining subjects'

*The USAMPS provides polygraph examiner training for almost all Federal Government polygraph examiners, with the exception of CIA and NSA examiners,

reactions is to allow refinements in the questions. The questions are reviewed again, and, when necessary, further clarified. The examiner may then administer a stimulation test, designed to improve test validity. The examiner will then continue to test and obtain two or three more charts in the same way. The examiner may use other stimulation tests between charts, and different questioning techniques (see below) to record different charts. Different questioning techniques may then be used based on information revealed by the subject. In most techniques, any new questions would be discussed with the subject before being asked. The procedure in preemployment screening or in other personnel screening tests may differ.

Stimulation Tests

Polygraph examiners typically conduct what is known as a “stimulation” or “stim” test, designed to further convince subjects of the accuracy of the polygraph examination. Although not actually a part of the pretest, stimulation tests can be given either before the first actual set of test questions or after the first chart has been recorded. Stimulation tests are intended to reassure truthful subjects and provoke anxiety in deceptive subjects (cf. 15). Their effect should be to increase differential responsivity of deceptive and nondeceptive subjects to different questions on the examination. Some research suggests stimulation tests increase the validity of polygraph examinations (35,149).

The most common “stim” test is a “number” or “card” test. A subject is instructed to select, from a deck, a card that has a number, word, or suit on the back, or to write a number within a certain range (50,57). Sometimes, the cards are secretly marked or otherwise arranged so that the examiner is sure to know the correct answer (139). Many polygraph examiners claim this is unnecessary, however, because the technique is accurate enough without use of such deception (cf. 123), and secret markings are not employed by Federal agencies. The examiner then may repeat a range of suits, numbers or a set of words, asking the subject if each is the concealed item. The suit, number, or word that is actually the concealed item is supposed to provoke the greatest physiological response. Often, the examiner will show the subject the polygram (i.e., the actual chart

recordings) to further convince subjects of the instrument’s efficacy.

Types of Questions

The central element of any polygraph examination is the test of subjects’ responses to a set of questions or items within questions. How these questions are structured represents the principal difference among polygraph techniques. There are four different kinds of questions or items used in polygraph testing, different combinations of questions (generally referred to as question techniques), and different applications for the various techniques. Distinctions among questions and techniques are important. Only one type of question technique in one application (CQT in criminal investigations) has been extensively researched (see chs. 4 and 5); and there are significant differences between CQT and other techniques. The range of questions, techniques, and applications is described more fully below.

Questions

The kinds of questions that are used for polygraph testing have been labeled relevant questions, control questions, irrelevant questions, and concealed information or guilty knowledge questions. Basically, relevant questions are questions about the topic under investigation (a theft, drug use, contact with foreign agents). Suspects’ responses to relevant questions are of greatest interest to polygraph examiners.

Control and irrelevant questions can be grouped together as questions used for purposes of comparison to relevant questions. It is important to note, however, that the name one gives to a question may depend on the specific context in which it is used. Thus, one cannot easily give an example of a relevant question or a control question because in different situations and at different times during an examination relevant questions may be used as control questions. Likewise, irrelevant questions may become relevant, depending on a subject’s response (201).

Relevant Questions

Functionally, relevant questions are questions directly related to the focus of an investigation.

In the investigation of a theft, for example, a relevant question might be “Did you steal that money?” or even more specifically, “Did you take \$750 from Jones’ office?” Relevant questions can be broader, however. In preemployment screening and periodic or aperiodic screening, the area of interest may be the subjects’ entire background. Thus, there may be a series of relevant questions, such as “Have you ever been fired from a job?” or, “Have you stolen more than \$50 in moneys in any one year from any of your employers?” (115). Intelligence agencies may ask broad questions concerning unauthorized contact with foreign intelligence agents or involvement in communist activities. Questions in an intelligence screening may also deal with areas which, potentially, may make an applicant susceptible to blackmail. It is important to note, however, that when several relevant questions relating to different issues are used, subjects are not expected to exhibit physiological responses to all of them; the relevant questions that do not evoke responses are used, after the fact, as a type of control question.

To summarize, relevant questions are questions about the topic under investigation, but topics can be very specific (Did you take \$750 from Jones’ office?) or cover a long period of time and a variety of acts (Have you ever stolen money from an employer? Have you ever had unauthorized contact with a foreign agent?). It is not clear what effect, if any, the breadth of a relevant question has on polygraph results, nor has there been any research done on this issue. As is discussed further in chapters 4 and 5, the preponderance of research evidence concerns the use of relevant questions to evoke reactions to specific acts.

Comparison Questions

In contrast to relevant questions, which concern issues of direct interest to the examiner, control and irrelevant questions are used for purposes of comparison. As noted above, there is no known physiological response unique to lying. Thus, a polygraph examination could not consist merely of relevant questions. If only relevant items were used, an examiner would not be able to establish the actual reason for the response. There are a number of reasons, other than fear

of detection (or another hypothetically lying related reaction (19)) for a subject to become physiologically aroused during the presentation of relevant questions (48,108,136, 194). Even with the addition of nonrelevant comparison items, it is necessary to run several polygraph charts using the same questions (though, perhaps in different order) to be sure that reactions are consistent. If several charts are not run, a subject’s responses could be attributed to surprise, physical movement, or some reasons for concern other than a lying-related cause (203). On the other hand, the administration of several charts could theoretically just repeat the initial situation leading to the physiological response if the cause were not a random one (e.g., presence at the scene, knowledge of the incident, concern over being falsely identified). Thus, the essence of polygraph testing is the comparison of responses to the relevant questions with responses to nonrelevant questions, which have been labeled control questions and irrelevant questions.

Control Questions

Control questions, then, are used for purposes of comparison. Essentially, truthful subjects are believed by polygraph examiners to be more concerned (and, thus, more physiologically aroused) about control than relevant questions. The responses to both control and relevant questions are compared. However, control questions, like relevant questions, vary in breadth and type. One type of control question concerns what is hypothesized to be the same kind of issue that is under investigation at the time of examination. For example, a control question for “Did you take the \$750 from Jones’ office?” might be “Other than what you have told me [during the pretest interview], have you ever stolen anything in your life?” In an investigation of unauthorized disclosure of classified information, a control question might be “Have you ever betrayed anyone who trusted you?” Subjects innocent of the crime under investigation are presumed to be more concerned about having ever done anything of this sort (and, thus, being the “kind of person” who might have committed the crime under investigation). It is theorized that although guilty subjects will also be concerned about control questions, they will

be more concerned about and thus exhibit more physiological reactions to relevant questions.

There are a number of views, however, about what distinguishes a control question from a relevant question. One distinction among control questions is whether a question is inclusive or exclusive. Inclusive control questions are questions which include the specific incident under investigation. An example of an inclusive control question in an investigation of an internal theft would be "Have you ever stolen money from an employer?" Exclusive control questions, on the other hand, cover a period of time not including the incident under investigation. An example is, "Before age 18, did you ever take anything of value?" There is some controversy over how far back in time an exclusive control question must be set for the subject to consider it psychologically separate from the incident under investigation and, thus, not a relevant question. Because inconclusive control questions may, from the suspect's perspective, include the act under investigation, some polygraphers contend that they are really relevant questions; i.e., they cannot be used for purposes of comparison. The Federal Government, for example, typically uses exclusive control questions because it views inclusive controls as relevant questions. Examiners from the private polygraph firm of John E. Reid & Associates use both inclusive and exclusive control questions.

Other kinds of nonrelevant questions other than those that cover the same kind of incident as the one under investigation, or which cover it in a different way, are also considered to be control questions. Thus, for example, "Have you ever fantasized about giving a document to a foreign agent?" is a type of control question used in some intelligence investigations. In some screening examinations, in which contact with a foreign agent is of primary concern (i. e., constitutes the relevant question), "Have you ever done anything for which you are now ashamed?" could be a control question. When a different issue than susceptibility to blackmail is under investigation, "Have you ever done anything for which you could be blackmailed?" can be used as a control question. It is noteworthy that in a different context, such as a broader screening examination, these would be considered relevant questions.

Control questions, then, are questions for which the responses are designed to be compared to responses to relevant questions. In some screening examinations, relevant questions may function as control questions after the fact. That is, if a relevant question produces a relatively mild physiological response, it may be compared to other relevant questions that produce greater response. Most often, control questions are designed to be arousing for innocent subjects (i.e., those who are not being deceptive on the relevant questions), relative at least to relevant questions. This is usually the central point of control questions, and is central to the control question technique (CQT) discussed below.

Irrelevant Questions

Another type of question used, in part, for purposes of comparison to responses to relevant questions is the so-called irrelevant question. Examples of irrelevant questions commonly used in investigations are; "Are you called [subject's name]?" or "Is today Tuesday?" Irrelevant questions are questions which are believed to have no, or very little, emotional impact on a subject. Thus, such questions can be used as an indicator of a particular subject's normal baseline level of arousal; no universal standard of physiological arousal can be applied because individuals differ markedly. Irrelevant questions are hypothesized to serve purposes other than providing a physiological baseline (139). Perhaps most important, irrelevant questions interspersed among relevant questions are hypothesized to provide a type of rest period for the subject.

Concealed Information Questions

Questions about concealed information are the fourth type of question used in polygraph testing. Unlike control and relevant questions, which ask subjects whether they have committed a crime, concealed information items aim to detect information about a crime that only a guilty subject would have. Such information might include details about the site of the crime or the means of committing it, such as the type of murder weapon used. It is hypothesized that guilty subjects will exhibit a different physiological response to the correct (relevant) detail than to the incorrect de-

tails, but that innocent subjects will respond the same to all the items. Different types of concealed information tests are described below (see *Concealed Information Tests*).

Summary

For any technique, deception is detected by comparison of suspects' physiological responses on critical or "relevant" questions or items with their responses on noncritical (irrelevant or control) items. Greater physiological responses to relevant items than to noncritical (control, irrelevant) items are assumed to be indicative of deception.

Polygraph Question Techniques

Three types of question techniques combining the four question types are described below: the relevant/irrelevant (R/I) technique, the control question technique (CQT), and concealed information techniques. Each of these test types tends to be used for particular purposes; e.g., the R/I technique is used in the great majority of preemployment screening interviews, while CQT is normally used in criminal investigations. There have been adaptations of these techniques for other uses, some of which are discussed below. Also, examiners may combine different techniques in an investigation (see, e.g., 139). In general, R/I has the broadest potential use while the concealed information techniques are the least applicable. Within each category, particularly CQT, there is considerable variability and several versions of each technique are employed.

Relevant/Irrelevant (R/I) Techniques

The R/I technique was the first standard method of polygraph questioning. The method was developed by Marston (114), a psychologist and the original proponent of polygraph examinations. An adaptation of this traditional technique is used in most of the preemployment screening conducted in the United States.

However, the R/I technique as used by the Federal Government involves somewhat different types of questions than the traditional R/I, and it must be explained separately. As currently used by Federal examiners, the R/I relies on a type of

control question, and is claimed to be a version of the control question technique. The versions discussed in this section are:

1. the traditional R/I;
2. the Federal version of the R/I; and
3. the R/I as used in typical preemployment screening tests.

In a traditional R/I examination, the two types of questions used are relevant and irrelevant questions. Deceptive subjects are assumed to have a significantly greater reaction to the relevant questions than to the irrelevant questions. An underlying assumption of this technique is that nondeceptive subjects should have an equal response to all questions, because, being nondeceptive, they would not fear questions about the crime any more than irrelevant questions.

There are numerous well-recognized problems with the traditional R/I technique, at least from the perspective of psychologists who have evaluated polygraph test validity (cf. 108,126,136). First, the intent of the relevant and irrelevant questions is transparent, which means that the relevant questions are likely to be more arousing for the truthful as well as the deceptive subjects. Second, questions in the R/I technique are not usually reviewed with the subjects before the test. A larger response to the relevant question may, thus, be due to surprise or misunderstanding, as well as deception. Third, as with any question technique, reactions may be flattened by drugs or by the generally reduced responsivity of certain subjects (136). These effects are probably more difficult to detect with R/I than with other question techniques.

Because of these problems, the confidence one can place in the R/I technique is limited (136). As a consequence, the R/I technique is typically not used in the case of specific incident examinations by either public or private examiners. It is used almost exclusively with employees in nonspecific investigations. The Federal Government occasionally uses the traditional R/I and also a version of the R/I which is claimed to function as a control question test. The Federal Government version of the technique is called the general question test (GQT). Like the Reid CQT (discussed below), it uses inclusive control questions, which pertain to the subject's entire life, such that a complete answer would also include the specific inci-

dent being investigated. Thus, with a question like, "Did you ever steal anything from a place where you worked?" the theft being investigated would in actuality be part of the answer. Technically these are seen as "relevant" questions, because they are pertinent to the incident in question. Yet they are claimed to function as control questions, because they are intended to provoke a greater response in innocent subjects than questions about the misdeed provoke.

An adaptation of the R/I technique is the principal method of questioning used in preemployment and periodic or aperiodic personnel screening. Unlike the questions used with other techniques, R/I questions need not focus on one specific wrongdoing (20,108). The examiner can, thus, use the method to assess any number of issues for which the subject's veracity is to be evaluated.

In polygraph examinations used to screen employees, the polygraph examiner usually presents a series of relevant questions, with several irrelevant questions interspersed to provide a baseline. Most relevant questions ask about past behavior that might disqualify the subject from a job (e.g., employee theft, drug use, fighting on the job, incurring a large debt). Some examinations may include questions about a potential employee's background or intentions regarding a job, for example, "Did you actually graduate from college?" (201) or "Are you seeking a job with this company for any reason other than legitimate employment?" (115). Listed below is an example of questions from a preemployment screening protocol used by a commercial firm (115; also see 56,204).

Relevant questions:

- Did you tell the complete truth on your job application?
- Have you deliberately withheld information from your job application?
- Have you ever been fired from a job?
- Are you seeking a permanent position with this company?
- Since the age of () have you committed an undetected crime?
- Since the age of () have you been convicted of a crime?
- During the past year, have you used marihuana (sic) more than () per ()?
- Have you used any other narcotic illegally in the past () years?

- Have you sold marihuana (sic) or other narcotics illegally in the past () years?
- Have you ever stolen more than (\$) worth of merchandise in any one year from any of your employers?
- Have you even stolen more than (\$) in moneys in any one year from any of your employers?
- Have you ever used a system to cheat one of your employers?
- Have you ever had your driver's license suspended or revoked?
- Have you ever had any traffic citations in the past five (5) years?
- Are you seeking a job with this company for any reason other than legitimate employment?
- Have you deliberately lied to any of these questions?

The method used by John E. Reid & Associates employs four standard relevant questions:

- In the last five years did you steal any merchandise from previous employers?
- In the last five years did you steal any money from previous employers?
- In the last ten years did you take part in or commit any serious crime?
- Did you falsify any information on your application?

These standard questions may be modified depending on admissions made during the pretest (e.g., a revision may be, "In the last five years did you steal any merchandise other than minor office supplies?"). In addition to the standard questions a fifth relevant question (e.g., concerning the illegal purchase or sale of merchandise; use of narcotics) may be added depending on the nature of the job.

The Reid firm also uses what it regards as control questions in preemployment interviews. Control questions include, "Did you ever steal anything in your life?" and "Did you lie to any of the questions you answered during the application process for this job?" It is not clear, however, how the Reid preemployment control questions differ from the relevant questions. It seems reasonable to suppose that both truthful and non-truthful subjects (in terms of the relevant questions) may be just as concerned with the subject matter of the control questions as they are with the relevant questions. It is also not clear why employers would be less concerned with the control than with the relevant questions.

In the R/I questioning technique, a diagnosis of truthfulness or deception indicated is made by comparison of responses to each relevant question with the responses to the irrelevant questions and the remaining set of relevant questions (or in the Reid, and Army examples, control questions). Presumably, an applicant will be deceptive on no more than a few questions. These questions will provoke a greater physiological response than the others, leading to further inquiries and an eventual diagnosis (56,204).

Other types of questions are used in some screening examinations, such as questions about sexual practices or gambling. Such questions seek information about an applicant's character rather than his or her job performance and are considered by some to be unduly invasive (173). In response to this practice, ethical standards have been developed for use of the polygraph in pre-employment screening (cf. 154), and some States (e.g., Illinois) prohibit their use. Preemployment polygraph examinations fall under the guidelines for employment interviewing of title VII of the Equal Employment Opportunity Commission, and so examiners are obliged to conduct the examinations in a way that would not discriminate on the basis of sex, race, etc. (cf. 154). One central principle of ethical standards is that relevant questions be related to the job applied for. Whether questions meet this criterion depends on the job; e.g., information about one's driving record would be important in hiring a delivery person, but not in hiring a bank teller. Screening applicants for positions involving national security apparently require questions about sexual behavior, drug use, and mental health as well as areas more directly related to national security (e.g., involvement in espionage). The range of topic areas covered in national security pre-employment screening examinations by NSA is discussed below under *Current Federal Government Use*.

In so-called periodic or aperiodic checking for internal security purposes, employees are asked to submit to occasional polygraph examinations. These examinations can assess drug use, subjects' own or others' employee theft, and other matters including job satisfaction and commitment. In this type of examination, almost all of the questions

are relevant questions and apparent deception (arousal) in response to any of the items is explored. Examples of the kinds of questions used in aperiodic screening in a supermarket (204), include:

Are you relatively satisfied with this job now?
Do you, as far as you know at this time, intend to stay with this employer?
Have you ever intentionally underpriced or underweighed merchandise?
Is there a particular person at your store that is responsible for damaging merchandise due to real carelessness, not caring or intentionally?

The relevant topic areas covered by NSA in a periodic screening are discussed later. Because of its use of control questions, the Federal version of R/I is discussed in the next section.

Control Question Technique (CQT)

The CQT is the most common technique used in investigations of a specific issue. The CQT was developed to deal with some of the inherent problems in the traditional R/I technique (139). Like the R/I technique, it asks relevant questions about the crime like "Did you steal the \$750 from Jones' office?" As with R/I, the deceptive subject is assumed to produce a greater autonomic response to the relevant than to other questions. But CQT also adds control questions, which, as discussed *briefly above, are* designed to provoke a greater response in subjects who are innocent and truthful about the crime being investigated.

As discussed above, control questions are designed to be arousing for nondeceptive subjects. The questions are designed to cause innocent subjects to be doubtful and concerned about whether they have actually told the truth or told a lie. These questions usually probe for past misdeeds of the same general nature as the crime being investigated but they are transgressions that polygraphers suspect most people have "committed" or considered committing in some form (139). An example of a control question might be, "Before the age of 25, did you ever steal anything from a place *you* worked?" Control questions are designed to cover a long period of time, which may make the subject even more doubtful about the veracity of answers provided,

Considerable attention in the pretest interview is devoted to development of control questions (139). The process of developing control questions, reviewing them with the subject, and then refining them is designed to develop the most appropriate questions, and to convince subjects to view control questions as seriously as relevant questions. In addition, the pretest review is designed to get subjects either to be deceptive to control questions or at least to be concerned about the accuracy of their recollections (20,37,91,139). It is considered crucial to produce in the subject the right psychological set in relation to the control questions. This set is then thought to lead subjects to be more concerned about control questions than relevant questions, and so to respond more to them physiologically. This difference between response to control and relevant questions is then the basis for the diagnosis of deceptive or nondeceptive. Since the subject's psychological set is so crucial when control questions are used, differential responding to relevant or control questions (and ultimately, the validity of CQT), depends on the nature of the interaction between examiner and subject. This is true regardless of the act in question, the particular CQT method used, or the method of making assessments of truthfulness or deception. Even the validity of an entirely computerized system of scoring and diagnosis would depend on the nature of the interaction between examiner and subject. In this sense, CQT examinations, as the technology to conduct polygraph tests now stands, always require examiners to make important judgments about and interventions in their interaction with subjects.

The polygraph examiner does not tell the subject that there is a distinction between the two types of questions (control and relevant). Control questions are described as intending to determine if the subject is the "type of person" who would commit a crime such as the one being investigated (136). The examiner stresses that the subject must be able to answer the questions completely with a simple "yes" or "no" answer, that the polygraph will record any confusion, misgivings, or doubts, and that the subject should discuss any troublesome questions with the examiner (20). Thus, the situation is set up such that the subject is persuaded that the examiner wants the truth.

In reality, however, the examiner wants the subject to experience considerable doubt about his or her truthfulness or even to be intentionally deceptive. According to Raskin (91), "Control questions are intentionally vague and extremely difficult to answer truthfully with an unqualified 'No'."

To produce the final version of a control question, the examiner begins by asking the subject a broad version of the question used in the pretest interview. Thus, for example, the question might be structured, "Did you ever steal anything in your life?" At this point, different polygraph examiners use slightly different methods to handle the discussion of past wrongdoing in response to the control questions asked during the pretest interview. In the USAMPS method (91), if the subject confesses to a small transgression in the past (e.g., taking home pencils from work), the examiner will dismiss it as of no consequence. For other misdeeds, the examiner will rephrase the control questions to rule them out (e.g., "Other than what we have discussed, did you ever steal anything in your life?"). The examiner will actively intervene to prevent subjects from unburdening too much of their anxiety over their past wrongs with the intention of keeping them concerned during the actual polygraph testing. Any troublesome past transgressions the subject brings up are excluded (by such phrases as "Other than what we have discussed, . . . ?") so the subject is always brought to the point at which he or she answers "No" to the control question. The control question is then ready to be used in actual testing.

The Reid method varies from the Federal method in some ways (139). If the subject does not admit to a past wrongdoing, the examiner may probe until the subject admits to one, even a crime as small as stealing pocket change from a relative during childhood. Such transgressions are then ruled out by adding the kind of exclusionary phrase discussed above (i. e., "Other than what we have discussed, . . . ?"). However, as in the USAMPS method, it is assumed at this point that the subject is either concealing other misdeeds or is worried that there are others he or she has overlooked (139). This worry has been heightened because of the examiner's emphasis on learning the truth to "ascertain" that the subject is not the

kind of person that could have committed the crime referred to in the relevant questions. In addition to relevant and control questions, irrelevant questions are included during the actual interview in order to provide a baseline of physiological responsiveness.

Several versions of CQT are regularly employed and adaptations depend both on the training of the examiners and the testing situation. The Reid version can include relevant questions about several aspects of the crime (139). For example, one chart could include questions about breaking into an office, stealing a check, and then cashing it. Examiners who use Reid's CQT make a global comparison between the responses to the relevant and the responses to the control questions. They also note the subject's behavior throughout the interview (as discussed above, the Reid technique includes a series of questions in the pretest interview designed to provoke certain "behavioral symptoms" in deceptive subjects). The examiner uses the global comparison of polygraph responses supplemented by information about the behavior of the subject to make a judgment of the subject's veracity. An example of a Reid control question sequence, excluding the pretest behavior provoking items, follows (139):

1. Do they call you "Red?" (where the pretest interview had disclosed he is generally called "Red.")
2. Are you over 21 years of age? (or reference is made to some other age unquestionably but reasonably, and not ridiculously, below that of the subject.)
3. Last Saturday night did you shoot John Jones?
4. Are you in Chicago (or other city) now?
5. Did you kill John Jones?
6. Besides what you told about, did you ever steal anything else?
7. Did you ever go to school?
8. Did you steal John Jones' watch last Saturday night?
9. Do you know who shot John Jones?
10. Did you ever steal anything from a place where you worked?

In contrast, Backster's (10) zone of comparison (ZOC) technique makes a diagnosis of deceptive or truthful from a standardized numerical scoring of the charts. Each relevant question is paired with a control question. Scores are derived for each relevant question by comparing it only with the previous control question. On each physiolog-

ical measure, the examiner derives a "plus" (truthful) score if the subject responds more to the control question and a "minus" (deceptive) score if the subject responds *more* to the relevant question. A positive score above a certain criterion level is diagnosed as truthful, a minus score below a certain level is diagnosed as deceptive, and scores in between are considered inconclusive.

A version of ZOC is used by Federal polygraph examiners. The Federal version differs from the Backster ZOC in that it may ask about several aspects of the crime in one chart. Relevant questions are asked about primary involvement (e. g., "Did you steal _____?"), secondary involvement (e. g., "Did you help steal _____?"), and so called evidence connecting (e. g., "Do you know where any of that money is now?"). In addition to relevant, control, and irrelevant questions, the Government ZOC test contains a version of the peak of tension test (see below), and "symptomatic" questions of two types. One type of symptomatic question (e. g., "DO you understand that I'm not going to ask any trick or surprise questions?") is designed to test whether the examinee trusts the examiner's word that no surprise questions will be asked. A large response is symptomatic of distrust. A second type of symptomatic question (e.g., "Is there something else you are afraid I will ask you a question about, even though I have told YOU I Would not?") is to test whether there is some other issue the examinee is concerned about (e. g., another crime) that may be absorbing his or her arousal.

Other versions of CQT or related techniques are also used by Federal agency examiners. One, the modified general question test (MGQT), resembles the Reid CQT with the following differences: 1) only the polygraph charts are used to make determinations of truth and deception and global evaluations using inferences about behavior are dispensed with; 2) charts are numerically scored; 3) control questions exclusively concern a time and place separate from the time and place of the crime under investigation, with the intention of clearly separating responses related to the crime and the control question; and 4) the content of control questions is always related to the crime under investigation, i.e., control questions about theft are used to investigate a theft, con-

control questions about assault are used to investigate assault, etc. Presumably, when unauthorized disclosures are at issue, control questions would concern some sort of unauthorized disclosures in the past.

To summarize, there are a number of control question techniques, the most commonly used being the Reid CQT, MGQT, and ZOC. Despite differences among them, they share the same premise and underlying rationale. Use of each of the control question procedures relies on subjects' not knowing when they are being asked the relevant and control questions. If they know which questions are more important for scoring purposes they may be able to make anticipatory responses which could invalidate their charts (see ch. 6).

Concealed Information Tests

Another polygraph questioning technique works on an entirely different premise than either CQT or R/I. Instead of detecting deception about having committed a crime *per se*, concealed information tests aim to detect whether a suspect has information about a crime that only a guilty subject would have or, in some cases (e. g., the actual amount of money embezzled) to detect the information itself. Such information might include details about the site of the crime or the means of committing it (e. g., the type of murder weapon used). Raskin (136) has aptly described these as "concealed information tests." Concealed information tests take two forms: the peak of tension (POT) test and the guilty knowledge test (GKT).

POT was developed by Keeler (cf. 69) and has long been used in criminal investigations. The POT test uses a set of five to nine nearly identical "yes or no" questions asking if the subject knows about a particular detail related to a crime. The detail may be a type of object used, or the color of an item. One question actually includes the relevant detail, while the others include plausible but false details of a parallel nature. The questions and the sequence in which they are asked are reviewed with the subject in the pretest interview. The subject is usually instructed to answer "no" to each question. The question with the true detail is usually presented in the middle of the sequence, so that the subject's physiological reac-

tions will increase up to the critical question, where they will reach a peak, hence the name, and fall back down again. The card and number stimulation tests discussed above are actually examples of POT. Barland and Raskin (20) provide a hypothetical example of a POT in a criminal case:

1. Regarding the color of the stolen car, do you know it was yellow?
2. Do you know it was black?
3. Do you know it was green?
4. Do you know it was blue?
5. Do you know it was red?
6. Do you know it was white?
7. Do you know it was brown?

Occasionally, criminal investigators use the POT technique to discover and develop additional information about a case. The examiner asks the suspect about a series of details, but does not know which is actually relevant to the crime. The detail that provokes an exceptional physiological response is used as a clue in the investigation. For example, an examiner might use POT to determine the exact location where stolen goods were hidden. This kind of examination is called a searching peak of tension test (20). The searching POT technique has been used, for example, in cases in which employees are suspected of having stolen money, but there is no evidence about the extent of the theft (108). The examiner asks the employee if he has stolen money ranging from a small amount to the entire amount taken. The amount that provokes the largest response is assumed to be the amount of the total that the employee stole.

The GKT, described initially by Lykken (105, 106) works in much the same way as POT. GKT, however, often includes a larger set of questions, and the questions may be of the multiple-choice type rather than the "yes or no" type. Also, studies investigating GKT have only used the electrodermal response, while POT tests have employed standard three-channel polygraph recordings. An example of two questions from a GKT used in a laboratory study by Lykken (105) is listed below:

1. If you are the thief, you will know where the desk was located in the office in which the theft occurred. Was it (a) on the left, (b) in front, or (c) on the right?
2. The thief hid what he had stolen. Where did he hide

it? Was it (a) in the men's room, (b) on the coat rack, (c) in the office, (d) on the windowsill, or (e) in the locker?

There is a major difference, however, in the use suggested for GKT as compared to the use of the POT. POT is usually used as a supplement to a CQT, or as an aid in investigation. GKT, however, has been proposed as an alternative to control question techniques (92,107,108). Proponents argue that GKT may reduce the number of false positives, because it focuses on specific details that would be salient only to the perpetrator of a crime (108,110). Also, they claim, the validity of GKT can be substantially improved by increasing the number of questions on the test. Critics claim that it is especially susceptible to false negatives (136), that is, guilty persons not detected, and that GKT

proponents do not adequately assess the consequences of false negatives.

Concealed information tests have, according to several reviewers (e.g., 108,136), other important limitations. One problem is that they may not be widely applicable. Knowledge about an incident may not differentiate between a guilty and innocent person where, for instance, a suspect is present at the scene of a crime but claims that someone else is responsible (108,136). Furthermore, concealed information tests require investigators to gather information that is not always possible to obtain, or must be disclosed to suspects in other parts of the investigation (136). In some cases, publicity about the details of a crime eliminates the possibility of a concealed information test, since the information is public knowledge (136).

POST-TEST INTERVIEW

Interspersed among test questioning and measurement of physiological responses are a number of opportunities for examiners to discuss the test with the subject. At each occasion, the examiner reviews the questions, and, depending on the responses, questions subjects about their responses. At the end of the examination, the examiner will make an assessment of whether a subject is being deceptive or nondeceptive. In some methods, e.g., Reid's (139), the assessment is a global one employing behavioral as well as polygraph data. But

the USAMPS Backster's ZOC and other methods attempt to rely strictly on polygraph chart interpretation (11,20). In examinations conducted by the Federal Government, the final official determination is made after supervisory review of polygraph charts. If the subject is judged to be deceptive during the examination, the examiner will attempt to elicit a confession. Usually, this is not done directly but is couched in terms of providing the subject with an opportunity to clarify/explain the responses and differences obtained.

USES OF POLYGRAPH TESTING

As has been implied in much of the above discussion, polygraph examinations are used for a variety of purposes. The goal of all such applications of the polygraph is the detection of deception or substantiation of truthfulness. The nature of the test situation, however, leads to important differences in the way a polygraph examination is conducted. Unfortunately, the published research literature deals almost exclusively with the use of the polygraph by police and military examiners for criminal investigations. The research literature on a number of important uses of poly-

graph testing, such as for national security purposes and for employment screening, is extremely limited.

Current Use

The majority of uses of polygraph testing appear to be on behalf of private employers, the next greatest number are in the context of local criminal justice investigations, and the remainder are done by the Federal Government. Of greatest concern for the present analysis are the numbers and types

of examinations currently conducted by agencies of the Federal Government. This section will devote most attention to such uses, although local government and private use are briefly discussed in order to place Federal use in context.

Current Federal Government Use

In order to assess the extent of polygraph use among Federal agencies, the Office of Technology Assessment (OTA) conducted a survey of Government use during May 1983. The request for information was sent to the Departments of Defense (DOD), State, Justice, Treasury, the U.S. Postal Service, and the Central Intelligence Agency (CIA), all of which were believed to employ polygraph examinations. Information was requested about the number of examinations, purposes, and results, as well as about research conducted and/or planned (see app. B). At the time of this technical memorandum, all agencies excepting CIA had provided written responses to the request for information about the number and type of polygraph examinations that have been administered.

CIA declined to respond because of the classified nature of the information. However, some data about CIA's use for background investigations were reported in a 1980 study (165). The number of polygraph examinations are summarized in table 1. Table 1 indicates that Federal agencies reported administering a total of 22,597 polygraph examinations in fiscal year 1982. As shown in appendix B, about half of these were in the context of criminal investigations. Polygraph examinations are also reported to be used for intelligence and counterintelligence investigations (some (NSA) at aperiodic intervals), and preemployment screening. The largest single number of polygraph examinations conducted in 1982 were conducted by NSA, a component of DOD, primarily for preemployment screening. These numbers can be compared to previous surveys conducted in 1963, when Federal agencies, excluding NSA and CIA, conducted 19,796 polygraph examinations, and 1973, when 6,946 examinations (including 3,081 by NSA) were conducted.

As shown in appendix B, NSA reports that it uses primarily the R/I technique. NSA reports that counterintelligence-type screening examina-

Table 1.—Polygraph Examinations Conducted by Federal Agencies, 1982^a

Agency ^b	Total
Department of Defense:	
Army Criminal Investigation Command	3,731
Army, Intelligence Command	279
Navy	1,337
Air Force	3,019
Marines	263
National Security Agency	9,672
Department of Justice:	
Federal Bureau of Investigation	2,463
Drug Enforcement Agency	211
Department of the Treasury:	
Secret Service	714
Bureau of Alcohol Tobacco and Firearms	256
U.S. Postal Service	652
Central Intelligence Agency	n.a. ^c
Totals	22,597

^aData were also reported for fiscal years 1980, 1981, and, in some cases year to date 1983. See app. B for complete report.

^bThe U.S. Customs Service (Department of the Treasury), Department of Health and Human Services, and Tennessee Valley Authority conduct a limited but

^cunknown number of polygraph examinations

^dClassified or partly classified.

SOURCE: Office of Technology Assessment

tions—i.e., tests given to NSA (or affiliated) personnel who already have access to classified information—would have relevant questions on the topics of involvement in espionage or sabotage against the United States; knowledge of others involved in espionage or sabotage against the United States; involvement in giving or selling classified materials to unauthorized persons; knowledge of others giving or selling classified material to unauthorized persons; and unauthorized contact with representatives of a foreign government (187). Examinations that are given to applicants for employment and contractors who are applying for access to Sensitive Compartmented Information (SCI) consist of questions about the topics covered in counterintelligence-type aperiodic screenings (phrased as “Do you plan to commit. . . ?”) as well as questions about a broader range of issues: involvement in communist, fascist, or terrorist activity; commission of a serious crime; involvement in adult homosexual activity; involvement with illegal drugs or narcotics; deliberate falsification of security processing forms; treatment for a serious nervous or mental problem (187). According to NSA, the scope of specific issue examinations is limited to questions that are relevant to the issue to be resolved. Pre-

sumably, specific issue examinations would be conducted using the control question technique,

Current DOD regulations also allow the use of polygraph examinations to investigate situations in which credible derogatory information about an individual with clearance is provided to officials. The frequency of this type of investigation, however, was not reported. Prior to the President's National Security Decision Directive of March 11, 1983, use of the polygraph in personnel investigations of competitive service applicants and appointees to competitive service positions was limited to executive agencies with highly sensitive intelligence or counterintelligence missions affecting the national security (e. g., a mission approaching the sensitivity of that of CIA; see 188). Approval to use the polygraph could be granted for only 1-year periods. Refusal to consent to a polygraph could not be made a part of an applicant or appointee's personnel file. See chapter 3 for a description of proposed changes in Federal use of polygraph testing.

Non-Federal Government Use

Outside the Federal Government, polygraph examinations are administered as part of criminal investigations, as well as preemployment screening and periodic screening of employees for purposes of controlling internal crime and recommending promotions. Less frequent uses include examinations in such situations as paternity investigations and workers' compensation cases. It has been estimated that over a million polygraph examinations are given a year (107), 300,000 of them for employment purposes alone (128),

Both private and police polygraphers use polygraph examinations in the process of criminal

investigations (see 136). In some cases (most typically, rape and kidnapping cases, but also, for example, investigations of improper or illegal conduct by public officials (177)), witnesses and victims whose veracity is in doubt are asked to take a polygraph examination. Suspects who claim innocence may be asked by their defense attorneys or the prosecution to support their claim by taking a polygraph examination. In such cases, prosecutors and defense attorneys may make informal agreements to drop the charges if the polygraph examination indicates no deception. Or, the prosecution and the defense may formally stipulate that if deception is indicated, results of the polygraph examination will be admissible at trial. In some cases (New Mexico, Massachusetts, and the 9th Federal Circuit Court of Appeals (8,136, 156,157)) polygraph evidence has been admitted over objection. Polygraph evidence is also used occasionally in postconviction proceedings such as sentencing and motions for a new trial (136). In polygraph examinations as part of criminal investigations, some version of the control question technique is typically used.

The use of the polygraph examination by employers is reported to be widespread (144). Although it is illegal to ask employees to take an examination in 19 States and the District of Columbia, it is legal to do so in 31 States (8,156,157). Polygraph examinations are used most commonly in commercial banking, investment banking, and retail operations. In such settings, both risk of theft and fraud are high and, in addition, employee turnover is high. The use of polygraph examinations is also recommended to employers as a check before making promotion decisions (204).

CONCLUSIONS

What is often referred to as "the polygraph" is actually a set of relatively complex procedures for asking questions and measuring physiological responses in order to detect deception or establish truth. Polygraph testing is employed for a variety of uses, ranging from ascertaining the guilt of a criminal suspect to assessing the honesty of a

prospective employee. Because different polygraph procedures are required depending on intended use, it is necessary to consider validity by polygraph technique and situation. In subsequent chapters, such a variegated analysis is presented and the scientific and policy contexts are more fully described.