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Office
ul. Herlinga-Grudzińskiego 1; 30-705 Kraków
mail: m.krasnowolska@gmail.com
oleg1998@gmail.com
www.polygraph.pl

Language Editor
Martin Cahn

Statistics Editor
Tadeusz Stanisz

Cover design
Joanna Sroka, Oleg Aleksejczuk

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Tuvya T. Amsel*
Tel Aviv
Israel

Polygraph Examinations Contaminating Factors

Факторы искажающие полиграфические исследования

Key words: Contaminating factors, polygraph examinations

A box containing expensive medication went missing from a pharmaceutical manufacturer's warehouse. Five stockmen who had access to the box were sent to take a polygraph test. Jim the senior stockman was the least probable suspect for several reasons: he was a devoted and loyal employee, he had no visible motives to steal and he was absent on the day of the theft. In the test he was fully cooperative and his behavior symptoms displayed veracity. Although he was truthful and in spite of very effective comparison questions, his charts were inconsistent and erratic, which led to borderline charts with a strong tendency toward deception. While reasons such as excessive interrogation prior to the test, examinee's excessive concern over the outcome, etc. might have been the reasons behind the results, what emerges as the leading

* ta@amsel.co.il

cause is mental contamination. Contamination as such is defined as the presence of a minor and unwanted constituent in another substance. To put it in plain English: something concerning the investigated issue is bothering the examinee. The probable polluting agent in our case is the examinee's concern that the test will expose another wrongdoing he committed or he feels responsible for what happened (guilty feeling or complex).

Contamination may be found in all types of examinations, from pre-employment tests when the candidate fears detection of a past misdeed, through periodical screening, where the examinee fears that a minor lie will be revealed, all the way to almost any specific test, where the examinee fears detection of a similar violation he performed in the past.

Contaminations factors can roughly be divided into: Cognitive i.e. thoughts, emotional and physical, as well as into pretest and in-test factors (A list of common contamination factors can be found at the end of this article)

The idea of contamination goes back to the early days of polygraphy. Trovillo [1] points out that "A suspect may give a large response […] not because he is guilty of robbing […] but because he has robbed [in] other […] places". Later Backster labeled the phenomenon as the "Outside Issue Factor", a factor that in some instances has a "Dampening (or Super Dampening) effect" that may suppress the examinee's reactivity to the relevant (in the case of a guilty examinee) or to the comparison (in the case of a truthful examinee) questions", [2] resulting in an inconclusive chart.

While unanimous about the phenomenon, scholars disagree about its effect. Some "suggest negligible or nonexistent consequence" [3] that result in noisy and erratic charts. On the other hand, Honts et al. [4] found that its presence "had a strong differential impact on the participants who were innocent of the tested issue, and it dramatically moved their scores toward deception. The impact of an outside issue on the guilty was minimal".

It should be emphasized that the mere existence of an outside issue does not necessary have to contaminate the examinee's charts. So far there is no research indicating who might be possibly contaminated, but it seems that educated examinees, who are more sensitive to nuances (which eventually enhance responsiveness), are more probable candidates for contamination by an outside issue.

Remedies

Reid [5] suggested "the control questioning technique is of particular value […]. With this advanced technique the subject is informed that, except for the general control question, the relevant test questions will be confined to the particular issue under investigation, the theory that this instruction will result in a subsidence of the disturbing effect of any other possible offenses". Yet, Reid himself raised some doubts around his solution: "however, some truthful subjects will continue to produce generally disturbed polygraph records". [6]

Backster incorporated into his Zone Comparison test format two symptomatic questions aimed toward isolating the possible existence of an outside issue which may suppress the examinee's responses to the relevant or comparison questions. Backster assumed that "With 'super-dampening' the only expected reaction to occur is to the symptomatic question under discussion". [7]

While the symptomatic questions were designed as a mean of detecting the existence of an outside issue and as such they were not analyzed or scored, "some US Government agencies such as the Army CID and the Naval Investigative Service went as far as using them as comparison questions to the relevant questions". [8]

As for the effectiveness of Backster's remedy, scholars' opinions are diverse. On one hand Capps et al. found that their "research provides evidence to substantiate Backster's claim that the inclusion of symptomatic questions in the control question polygraph examination significantly reduces the inconclusive calls made by the examiner. The numbers of inconclusive calls were reduced by two-thirds, exactly as Backster predicted. This study found, as Backster did, that the symptomatics do make a significant difference in terms of alleviating inconclusive results". [9] On the other hand Honts et al. concluded that the "(Symptomatic) test questions about possible outside issues were ineffective in detecting the presence of the outside issue". [10] Krapohl et al. as well as Honts found that "reactions to symptomatic questions had no correlation with the strength of polygraph scores in either the manual 7-position scorings or the automated ROSS. The predicted super-dampening effect was not found". [11]

As mentioned, the symptomatic question's purpose is to identify the existence of an outside issue. But when the examinee – who is not familiar with the purpose of the question – is asked "Are you completely convinced that I will not ask you a question during this chart that has not already been reviewed?" (Matte, p. 198) or "Is there something else you are afraid I will ask you a question about, even though I told you I would not?" he or she may believe that the actual question being asked is "Do you

trust / believe me or not?". Consequently, when presented with the symptomatic questions, many examinees spontaneously respond with "I have believed you until now…". And so, if the examinee identifies the symptomatic question as a trust question, then her/his response merely reflects her/his trust or mistrust for the examiner rather than presence of an outside issue. However, a significant reaction to the symptomatic question indicative of examinee mistrust of the examiner requires Backster's application of his 8-Reaction Combination Guide (Matte, pp. 199, 281, 292, 325), designed to establish the examinee's trust in order to avoid the interference of an outside issue.

Solution

As in many other aspects of polygraphy, there is no magic formula or solution (or in this case, a magic question) here, but rather a thorough painstaking pretest to increase the chances of being told of an outside issue as well as establishing good rapport and trust.

Although most examinees may have an outside issue that may contaminate their responses, surfacing it in the pretest may turn it from a **non-issue** to an **outside issue**. For this reason, it should only be touched briefly without further questioning. The examiner should ask questions regarding past involvement but once the examinee denies it, no further questions should be asked. Only upon concluding at least two charts that are erratic and noisy, and allow the suspicion of being contaminated, should the examiner commence a thorough in-depth questioning. To demonstrate the effect of contamination, the examinee should be informed that a grain of salt is enough to prevent water from boiling at 100°C, so she/he should rather tell what was on her/his mind upon hearing the relevant question. Once the examinee has opened and shared her/his concerns, the examiner should proceed to the successive charts adding the prefix "other than what you have told me…" to the question. If the examinee does not add anything, the examiner should assure her/him that s/he has no interest in other violations or wrongdoing but only the issue in hand, and then proceed to the next chart. If the charts are still noisy the examinee should be confronted and be told that unless she/he cooperates, the examiner won't be able to reach a conclusion, which usually makes truthful examinees cooperate with the examiner and share their conscience. If no further information is provided and the charts are inconclusive, it is strongly suggested to have the examinee re-tested on a later day by another examiner. The examinee should be informed that because the results are not significant in some of the questions, the examiner would like to submit the examinee to an additional test. In such a retest, the comparison questions

should be replaced. If the examiner has used a nonexclusive comparison question (without a time bar), it should be replaced with an exclusive comparison question which excludes the current violation by time and/or place. The retest should consist of at least two charts. A retest usually produces clearer charts, which allows the examiner to reach a decisive conclusion.

List of contaminating factors

Factor source	**Solution**
Cognitive	
anger	Ventilation: discuss and let it surface and "steam out".
concealment of another crime	Discuss and try to obtain the information.
concealment of relevant information	Discuss and try to obtain the information.
fear of consequences	Nothing to be done.
fear of the unknown ("It's my first time and it seems like an electric chair.")	Explain the instrument/physics in length.
fear of the examiner's lack of objectivity: perceiving the examiner as an adversary	Assure your objectivity and avoid convincing. In an event of an Inconclusive finding, consider the use of Quadri-Track ZCT that addresses Fear of Error.
disbelief in examiner professionalism: this may be his failure	Assure your professionalism and avoid convincing. In an event of an Inconclusive finding, consider the use of Quadri-Track ZCT that addresses Fear of Error.
disbelief in the polygraph – the test does not pose any treat of detection	Explain the instrument/physics in length.
inadequate comparison questions – either poor phrasing or improper introduction	Rephrase.
ineffective RQ or CQ – double meaning, too long, unclear phrasing	Rephrase.
lack of education	Explain in a very simple manner.
loss of control ("It's not in my hands but in the hands of a machine.")	It's the examiner not the machine.
mental abnormality	Avoid testing!
misunderstanding of the RQ or CQ – language and/or the examinee's limited cognitive capability being an obstacle; lack of education causing misunderstanding of questions	Explain in a very simple manner.

outside issues: distraction due to the examinee's mind being focused on an unrelated matter (family, work, etc.)	Discuss and try to obtain the information. Establish examinee's trust – no unreviewed questions will be asked.
excessive anxiety caused by the possibility of failure ("I always fail tests.")	Ventilation: discuss and let it surface and "steam out".
prejudice against polygraph (rumors, online gossip)	Explain the instrument/physics in length.
prior tests (either mistaken results or bad experience)	Reassure your professionalism.
rationalization and self-deceit	Explaining the instrument/physics in length create a fear of consequences.
resentment ("A machine will determine my truthfulness.")	It is the examiner not the machine.
Emotional	
excessive interrogation prior to the test	Don't test close to any other questioning.
extreme emotional tension and nervousness	Try to relax and establish rapport.
extreme emotional tension and nervousness regardless of the test scope	Discuss and try to obtain the information.
guilt complex	Discuss and try to obtain the information.
guilty feeling of being responsible for the occurrence	Discuss and try to obtain the information.
humiliation ("It's a test for criminals.")	Show understanding and explain that more innocent than guilty takes the test.
induction – transferring reactions from one relevant question to the others	If MGQT separate test to numerous single issues.
insufficient time to digest the test	Delay the test to a later hour/date.
insult ("After so many years they still doubt my honesty?")	Discuss and try to obtain the information.
invasion ("You are penetrating my soul.")	Discuss and try to obtain the information.
lack of proper incubation: test given without any proper prior notification	Delay the test to a later hour/date.
lack of concern over the possibility of detection	Try to create concern.
shame ("They all believe that I did it.")	This is your chance to prove otherwise.
trauma in case of a victim, eyewitness or suspect (e.g. a parent)	Consider a confirmatory type test.
Physical	
adrenal exhaustion	Delay the test to a later hour/date.
drug influence – sleepy, unfocused, drowsy	Delay the test to a later hour/date.

fatigue – lack of proper rest prior to the test, hard to focus, falling asleep, fighting sleep	Delay the test to a later hour/date.
an illness effecting body functions and mental attentiveness	Delay the test to a later hour/date.
physical obstacles (blindness, deafness, etc.)	Depending on the obstacle, consider not testing .
physical discomfort caused by room temperature, air flow, noise, uncomfortable chair, bad smells, etc.	Ask for the source and try to solve the problem.

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John C. Kircher*
David C. Raskin
University of Utah,
Salt Lake City, UT, USA

Laboratory and Field Research on the Ocular-motor Deception Test

Лабораторные и практические исследования применения «ocular-motor» для выявления лжи

Key words: ocular-motor", "ocular-motor detection test, instrumental detection of deception

Disclosure: The authors have financial interests in Converus Inc. (www.converus.com), a company that has commercialized the technology described in this report. We have disclosed those interests to the University of Utah and have in place an approved plan for managing any potential conflicts that arise from involvement in Converus.

The present paper reviews the rationale and theoretical assumptions that underlie the ocular-motor deception test (ODT) as well as empirical evidence of its criterion-related validity. The research suggests that the ODT may contribute to pre-employment and periodic screening programs, particularly in government agencies concerned with law enforcement and national security.

* John.Kircher@utah.edu
** davidc.raskin@me.com

Rationale underlying the Ocular-motor Deception Test (ODT)

Cook et al. (2012) introduced a new method for detecting deception called the ocular-motor deception test (ODT). In contrast to the polygraph, the ODT is automated and can be completed in approximately 40 minutes. A computer presents voice-synthesized and written instructions followed by written true/false test statements concerning the examinee's possible involvement in illicit activities. The instructions inform the examinee that if they do not answer quickly and accurately, they fail the test. The examinee then reads statements presented serially by the computer while a remote eye tracker recording eye movements and pupil size changes. The examinee presses a key on the keyboard to answer true or false. The computer processes the ocular-motor data, combines its measurements in a logistic regression equation, and classifies the individual as truthful or deceptive on the test.

The ODT uses a test format known as the Relevant Comparison Test (RCT). Originally, we developed the RCT as a new polygraph technique for use at ports of entry to screen travelers for possible trafficking of drugs and/or transporting explosives (Kircher et al., 2012). The RCT includes questions about two relevant issues (R1 and R2) that are intermixed with neutral questions, and it uses the difference between reactions to the two sets of relevant questions to determine if the examinee was truthful or deceptive to either of the relevant issues. Each relevant issue serves as a control for the other. Examinees reacting more strongly to questions concerning one of the issues are found deceptive in their answers to questions about that relevant issue. Examinees who show little or no difference in reactions to the two sets of relevant questions are considered truthful to both issues.

The ODT is based on the assumption that lying is cognitively more demanding than telling the truth. A recurrent theme in the literature on deception detection techniques (Johnson, Barnhardt, & Zhu, 2005; Kircher, 1981; Raskin, 1979; Steller, 1989; Vrij, Fisher, Mann, & Leal, 2006). In contrast to truthful people, a deceptive individual must identify questions answered truthfully and questions answered deceptively. When they recognize a question as inculpatory, they must inhibit the pre-potent truthful response and do so consistently, quickly, and accurately. While they are performing the task, deceptive individuals may also self-monitor their performance for signs revealing their deception, by either answering too slowly or making too many mistakes. The recruitment of mental resources to accomplish these additional cognitive and meta-cognitive activities could account for the observed impact on pupil dilation, eye movements, response time, and error rates (Hacker et al., 2012; Kahneman, 1973; Loewenfeld, 1999; Rayner, 1998).

The pupil reacts not only to cognitive load but also to emotional stimuli. Several investigators have reported that emotional stimuli evoke pupil responses whose mag-

nitude depends on the intensity but not the valence of the emotional stimulus (Bradley, Micolli, Escrig, & Lang, 2008;. Hess & Polt,1960; Hess & Polt, 1964; Steinhauer, Boller, Zubin & Pearlman, 1983). Polygraph tests are based on the concept that deceptive individuals will show stronger emotional responses to test questions answered deceptively than to those answered truthfully. To the extent that emotional reactions to test questions distinguish deceptive from truthful individuals, pupil responses should reflect those differences and be diagnostic of deception. Consistent with this prediction, several investigators have reported that during concealed information and probable lie polygraph tests the pupil dilates more when people are deceptive than when they are truthful (e.g., Bradley & Janisse, 1979; Dionisio et al., 2001; Janisse & Bradley, 1980; Webb et al., 2009).

A reader who has difficulty reading or comprehending text shows more eye fixations, pupil enlargement, and longer reading times (Rayner, 1998; Rayner, Chace, Slattery & Ashby, 2006). If deceptive individuals experience greater cognitive load and difficulty processing test items than truthful individuals, we should see differences between the groups on these measures.

Mock crime laboratory research on the ODT

We have conducted a series of laboratory and field studies to determine if ocular-motor measures discriminate between truthful and deceptive individuals. The laboratory studies use a mock crime procedure that we modeled after laboratory research on polygraph techniques. Realistic mock crime experiments produce diagnostic effects on electrodermal, cardiovascular, and respiration reactions that are similar to those obtained from actual criminal suspects (Kircher, Horowitz & Raskin, 1988; Raskin & Kircher, 2014). In our experiments, we recruit participants from the university campus or the general community and randomly assign them to guilty and innocent treatment conditions. We instruct guilty participants to commit a mock crime, such as stealing an exam from a professor's office, or taking $20 from a secretary's purse, and then lie about it on the ODT. To simplify the research design, we have begun conducting experiments with one rather than two mock crimes. Participants in these experiments are led to believe that some guilty participants take an exam from a professor's office, whereas others take $20 from a secretary's purse. In actuality, all guilty participants take $20 from the purse. Because examinees in field settings usually are highly motivated to pass the test, we offer participants a substantial monetary bonus to appear innocent of the crimes.

The ODT consists of 16 True/False statements concerning the theft of the $20 (e.g. "I took the $20 from the secretary's purse."), 16 statements concerning the theft of

the exam (e.g. "I did not take the exam from the professor's office."), and 16 neutral statements (e.g. "I am seated before a computer, taking a test."). In the standard format, we arrange the 48 statements so that no two statements of the same type appear in succession. The computer presents the set of 48 items 5 times with a brief break between repetitions during which the examinee answers simple arithmetic problems. Excluding the arithmetic problems, the examinee answers a total of 80 T/F statements of each type. The correct (non-incriminating) answer to half of the items of each type is True and the correct answer to the other half is False.

Ocular-motor and Behavioral Measures. The eye trackers in our experiments measured horizontal gaze position, vertical gaze position, and one or two channels of pupil diameter depending on whether the tracker recorded data from the left and right eyes or from the right eye only. The trackers stored samples of each channel at either 30Hz or 60Hz. When the tracker measured left and right eyes, we computed the mean of measures from both eyes, because the two channels were highly correlated.

Mean change in pupil size for a mock crime experiment reported by Cook et al. (2012) is shown in Figure 1. It shows the evoked pupil response for four seconds following the onset of the statement for neutral statements, statements about the theft of the cash, and statements about the exam. As predicted, guilty participants reacted more strongly to statements about the cash than the exam, whereas innocent participants showed little difference between cash and exam statements. It is noteworthy that the mean change in pupil diameter (PD) was less than 0.1 mm.

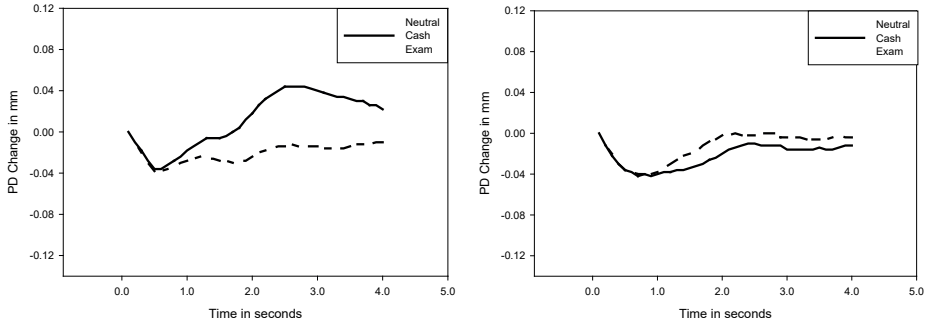

Figure 1. Mean change in pupil diameter (PD) from statement onset for guilty (left) and innocent participants (right)

To adjust for individual differences in reactivity and differences in ambient light conditions, we transformed the pupil data for each of the five repetitions of test items to standard scores. Standardization also established a common metric across repetitions within individuals. From the standardized pupil response curves, we extracted

two features: the area under the response curve and the level of the response at the participant's answer.

We derived reading measures from analyses of eye fixations on the text. A computer identified eye fixations on the text where there was little variance in both horizontal and vertical gaze positions for a minimum duration of 100ms and a maximum duration of 1000ms (Cook et al., 2012). An area of interest was defined for each test item prior to the calculation of the reading measures. The area of interest began with the first character of the item and ended after the period at the end of the item. From the set of fixations for a test item, the computer measured three features:

- **number of fixations** was a simple count of the fixations in the area of interest
- **first pass duration** was the total duration of all fixations in the area of interest until a fixation fell outside the area of interest, and
- **reread duration** was the total duration of all fixations in the area of interest associated with leftward eye movements.

We divided the three reading measures by the number of characters to adjust for differences in the length of test statements.

Behavioral measures included participants' *response times* and *error rates*. We also measured blink rates per second for each item (*item blink rate*) and for the subsequent item (*next item blink rate*). Based on pioneering work by Stern, Walrath and Goldstein (1984), we expected a decrease in item blink rate when the participant was highly focused on reading an incriminating statement and an increase in blink rate when the participant encountered a less incriminating subsequent item (*next item blink rate*).

For a given type of measurement, such as pupil size at the time of the participant's answer, we calculated two contrasts. We subtracted the pupil size for statements concerning the theft of the exam (R2) from the pupil size for statements concerning the theft of the $20 (R1); i.e. (R1 – R2). The other contrast was between the mean reaction to statements answered truthfully (neutral and R2 statements) and statements answered deceptively by guilty participants (R1); i.e. (R1 – (neutral + R2) / 2). If the rationale underlying the ODT is correct, we should see relatively high or low scores on each of these contrasts for guilty participants and scores near zero for innocent participants.

We assessed the ability of ocular-motor measures to discriminate between guilty and innocent participants by correlating within-subject contrasts between statement types with guilt status, where guilt status was a dichotomous variable that was either 0 if the participant was innocent or 1 if the participant was guilty.

In addition to measuring the diagnostic validity of various ocular-motor measures, we also use coefficient alpha to assess the reliability of those measures (Chronbach, 1951). Reliability indicates the extent to which the measurements obtained from the five repetitions of the test items are consistent. For example, if the data from the first repetition indicated that the individual was deceptive, did the person also appear deceptive in the second, third, fourth, and fifth repetitions?

Accuracy of the ODT in laboratory studies

Table 1 presents validity and internal consistency (reliability) coefficients for the set of features in experiments conducted by two of our students (Patnaik, 2015; Webb, 2008). It also shows internal consistency reliability statistics for the computer-generated features.

Table 1. Validity and reliability coefficients for two mock crime studies of the ODT

			Webb (2008)		Patnaik (2015)		Mean	
	Area under the curve	R1 - R2	**0.409**	0.640	**0.586**	0.615	**0.505**	0.628
	Area under the curve	R1 - (NT+R2)/2	**0.396**	0.759	**0.554**	0.639	**0.482**	0.699
	Level at answer	R1 - R2	**0.557**	0.465	**0.585**	0.510	**0.571**	0.488
	Level at answer	R1 - (NT+R2)/2	**0.548**	0.527	**0.634**	0.575	**0.593**	0.551
Reading								
	Number of fixations	R1 - R2	**-0.509**	0.572	**-0.406**	0.627	**-0.460**	0.600
	Number of fixations	R1 - (NT+R2)/2	**-0.329**	0.807	**-0.293**	0.720	**-0.312**	0.764
	First pass duration	R1 - R2	**-0.549**	0.582	**-0.253**	0.540	**-0.427**	0.561
	First pass duration	R1 - (NT+R2)/2	-0.293	0.622	-0.166	0.585	**-0.238**	0.604
	Reread duration	R1 - R2	**-0.488**	0.516	**-0.342**	0.397	**-0.421**	0.457
	Reread duration	R1 - (NT+R2)/2	**-0.224**	0.683	-0.115	0.407	**-0.178**	0.545
Behavioral								
	Response time	R1 - R2	**-0.529**	0.434	**-0.497**	0.329	**-0.513**	0.382
	Response time	R1 - (NT+R2)/2	**-0.312**	0.788	**-0.348**	0.671	**-0.330**	0.730
	Error rate	R1 - R2	0.082	0.052	0.093	0.209	**0.088**	0.131
	Error rate	R1 - (NT+R2)/2	**0.242**	0.741	-0.002	0.690	**0.171**	0.716
Blink rate								
	Item blink rate	R1 - R2	-0.014	0.247	**-0.388**	0.182	**-0.275**	0.215
	Item blink rate	R1 - (NT+R2)/2	-0.015	0.572	-0.191	0.101	-0.135	0.337
	Next item blink rate	R1 - R2	0.169	0.104	-0.088	0.351	0.135	0.228
	Next item blink rate	R1 - (NT+R2)/2	0.010	0.315	-0.105	0.381	0.075	0.348

Bolded validity coefficients are statistically significant at $p < 0.05$.

The strong positive correlations for pupil features indicated that guilty participants showed greater increases in pupil size in response to R1 (cash) than to R2 (exam) statements. These findings are consistent with the data presented in Figure 1. The negative correlations for reading and response time measures indicated that guilty participants made fewer fixations and spent less time reading R1 than R2 statements. The effects on response time are substantial and consistent over multiple experiments and cultural groups. Based on the psychology of reading literature, we initially thought that guilty participants would experience more difficulty and spend more time on R1 than R2 statements. However, the data suggest that guilty participants invest more mental effort in answering those statements quickly and accurately in an attempt to avoid detection (Cook et al., 2012). Guilty participants achieve their objective but reveal their deception. This hypothesis explains the effects on response time and reading measures as well as the observed increases in pupil size associated with R1 statements.

Examination of mean validity coefficients indicates that the pupil measures were more diagnostic than reading, behavioral, and blink rate measures. The (R1 – R2) contrast for response time was almost as diagnostic as pupil size. Blink rate and error rate measures were the least predictive of guilt status.

Decision Model. To classify individuals as truthful or deceptive, we combine the scores on a subset of diagnostic measures in a mathematically optimal manner to compute the probability of deception. If the probability of deception exceeds 0.5, we classify the person as deceptive; if the probability is less than 0.5, we classify the person as truthful. Several statistical procedures have been developed to identify a subset of diagnostic measures that will represent most of the diagnostic variance in the full set of measures and work well when tested on an independent sample of cases. These procedures tend to select measures that are more highly correlated with guilt status and less highly correlated with each other. We then use logistic regression analysis to derive a unique weight for each ocular-motor measure that maximizes the separation between truthful and deceptive groups.

Much of our research has been designed to assess the effects of factors that could affect the accuracy of the ODT and to explore alternative methods for presenting test items. In regard to the latter objective, we have not improved on the presentation format and mock crime procedures evaluated in our first mock crime experiment (Osher, 2005), which we call the standard protocol. Because our attempts to improve on the standard protocol have yielded inferior results, Table 2 presents the results obtained with the standard protocol, and Table 3 presents results for non-standard protocols.

Table 2. Percent of correct decisions under standard conditions in mock crime experiments

Experiment	Factors	N	n_G	n_I	Guilty	Innocent	Mean	Validation $_G$	Validation $_I$	Mean
Osher (2005)[a]	issues; serial format	40	20	20	85.0	85.0	85.0	85.0	70.0	77.5
Webb (2008)[b]	sex; motivation; difficulty	112	56	56	82.1	89.2	85.7	89.3	80.4	84.9
Patnaik (2013)[a]	direct interrogation	48	24	24	83.3	95.8	89.6	83.3	83.3	83.3
Patnaik (2015)[a]	distributed; pretest feedback; post-response interval	80	40	40	82.5	90.0	86.3	80.0	90.0	85.0
Patnaik et al. (2016)[c]	language; culture	145	82	63	84.1	87.3	85.7	81.9	87.5	84.7
Middle East (2016a)	language; culture	112	51	61	80.4	88.5	84.5			
Middle East (2016b)[d]	language; culture	101	52	49				75.0	85.7	80.4
Standard Protocol		638	325	313	82.8	89.0	85.9	82.1	84.1	83.1

[a] Validation results were obtained with the leave-one-out procedure

[b] The decision model based on Patnaik et al. (2016) was used to classify participants in Webb (2008)

[c] The decision model based on Webb (2008) was used to classify participants in Patnaik et al. (2016)

[d] The decision model based on Middle East (2016a) was used to classify participants in Middle East (2016b)

The results presented in Table 2 indicate that the standard protocol in mock crime experiments yielded approximately 86% correct classifications in the original, standardization sample, and approximately 83% correct when tested on independent samples (cross-validation). On cross-validation, accuracy was slightly higher for innocent (84.1%) than guilty participants (82.1%).

Table 3 summarizes results from non-standard conditions. The results from Osher (2005) suggest that we obtain more diagnostic information from serial presentations of individual test statements than with the simultaneous display of multiple test statements. Webb (2008) found that the person's sex does not moderate the effects of deception on ocular-motor measures, whereas higher motivation to pass the test and semantic simplicity in the phrasing of test statements improves the diagnostic validity of some ocular-motor measures.

Table 3. Percent of correct decisions under non-standard conditions in mock crime experiments

Experiment	Factors	N	n_G	n_I	Guilty	Innocent	Mean
Osher (2005)	issues; parallel format	40	20	20	70.0	95.0	82.5
USTAR (2010)	pretest questionnaire; issues	71	47	27	59.6	77.8	68.7
NSA (2012)	standardization	94	51	43	72.5	88.4	80.5
NSA (2013)	validation	60	34	26	50.0	80.8	65.4
Patnaik (2013)	indirect interrogation	48	24	24	58.3	79.2	68.8
Patnaik (2015)	blocked	80	40	40	77.5	85.0	81.3
Non-standard protocols		393	216	180	65.3	84.5	74.9

Together, the USTAR (2010) and Patnaik (2013) studies indicated that test statements that refer directly to the matter at hand ("I did not take the $20.") produce higher accuracies than statements that ask indirectly if the person falsified information to cover up their guilt ("I did not falsify my answers to questions about the theft of the $20."). In the NSA studies, we recruited employees and tested them about minor security violations. The studies used a non-standard protocol because we were not permitted to provide incentives for government employees to pass the ODT, many participants were federal polygraph examiners who knew that there were essentially no consequences to failing the ODT, and we had to rely on self-report as a proxy for ground truth.

Patnaik (2015) found that the standard pseudo-random sequencing of NT, R1, and R2 statements improves the diagnostic validity of ocular-motor measures, whereas feedback about performance on a pre-ODT practice test and lengthening the interval between the answer and the presentation of the next item does not. Patnaik et al. (2016) found that the effects on ocular-motor measures were similar for tests administered in English or Spanish to native speakers enrolled as university students. The experiments in the Middle East required modification of the display software to present Arabic text from right to left. Accuracy rates on cross-validation in the Middle East were slightly lower than those obtained in the USA and Mexico, particularly for guilty participants. Although the differences in decision accuracy between Middle Eastern and Western participants were not statistically significant, we found it necessary to reduce the number of repetitions of test statements for measures of pupil response to achieve comparable levels of discrimination between truthful and deceptive Arabic-speaking participants as we had found for English- and Spanish-speaking participants. We are uncertain why it was necessary to make those changes.

Field study of the ODT

We have recently completed a field validity study of the ODT that evaluated applicants for positions in the office of Mexico Attorney General's, immigration, and federal police. We tested some applicants for recent use of illegal drugs (R1) compared to either corruption, arms trafficking, or affiliation with a religious terrorist organization (R2). Ground truth for deceptive cases were admissions by applicants during a subsequent polygraph test that they had used illegal drugs in the period covered by the statements on the ODT (n = 71). Lack of an admission is insufficient to establish conclusively that an individual was truthful on the ODT. To obtain data from truthful people, we created a new test for applicants for positions in immigration that asked if they had committed espionage (R1) or sabotage (R2). We assumed that all of the tested individuals were truthful in their answers to both relevant issues because the base rate of deception on those issues in Mexico is very low, especially for people who had no prior government employment (n = 83).

To develop and validate a decision model with the field data, we extracted ocular-motor measures from the eye tracker data. We computed validity coefficients for the measures and used linear regression to select a subset of four measures to distinguish between the confirmed truthful and deceptive groups. We then used the selected variables in a 5-fold validation of a binary logistic regression model to classify cases as truthful or deceptive. To conduct the 5-fold validation, we divided the sample of 154 field cases into five random subsamples such that each subsample consisted of approximately 20% of the deceptive cases (n=14 or 15) and 20% of the truthful cases (n=16 or 17). The first subsample of 14 truthful cases and 16 deceptive cases (N=30) was removed, and a decision model was created with the remaining four subsamples (N=124). We used that decision model to classify the holdout sample of 30 cases and recorded the percent correct for each group. The second subsample was then set aside (N=30), a new decision model was developed with the remaining 124 cases, and the accuracy of classifications was calculated for the second holdout sample. We repeated this process for the remaining three subsamples. The results are brought together in Table 4.

Table 4. Percent of correct decisions in five decision models on independent subsamples

	Fold 1	Fold 2	Fold 3	Fold 4	Fold 5	Mean	Mean
	N=30	N=30	N=31	N=31	N=32		N=154
truthful	75.0	87.5	88.2	88.2	100.0	87.8	86.1
deceptive	100.0	71.4	85.7	78.6	86.7	84.5	

Percent of correct decisions varied between the five subsamples from 75% to 100% for truthful applicants and from 71.4% to 100% for deceptive applicants. Our best estimates of the performance of the model based on all 154 cases when tested on a new sample of field cases are the means for truthful (87.8%) and deceptive (84.5%) applicants. Although the results obtained in the 5-fold validation using actual applicants for positions in the Mexican government suggest that the ODT may add value to a pre-employment screening program, to some degree our methods may have capitalized on chance and produced accuracy rates that are too optimistic. Specifically, we used the entire sample to select the subset of ocular-motor measures for the decision model that was subsequently validated. This particular subset of measures worked well in the 5-fold validation but might be suboptimal for a new set of confirmed field cases. For this reason, we recommend that the current decision model be re-evaluated with new cases from representative field settings.

Conclusions

The results of laboratory and field research indicate that the ODT yields accuracy greater than 80% on both truthful and deceptive examinees, although the accuracy rates tend to be 3% to 6% higher for truthful than for deceptive individuals. The accuracy rates generalize across English and Spanish languages, US and Mexican cultures, and to a lesser extent, Arabic in the Middle East. We believe the ODT to be a promising new technology that is best suited for screening applications. We also believe it is better suited to screening applications than specific-incident, criminal investigation, because it would be difficult to construct a RCT that contains two non-overlapping relevant issues with face validity. For the same reason, polygraph examiners rarely if ever use the Guilt Complex question for specific-incident polygraph examinations (Office of Technology Assessment, 1983).

Unpublished pilot research with poor readers indicated, as expected, that the ODT was ineffective. It appears that the cognitive difficulties experienced by examinees who struggle to comprehend test statements overshadow effects of deception on ocular-motor measures. We are exploring audio-visual and audio-only alternatives to the current text-based ODT. However, as yet we have not developed a functional audio version of the test that might be effective for a broader population of individuals, including those with poor reading skills.

With specialized training and practice, polygraph tests can be defeated (Honts, 2012). To date, there have been no attempts to investigate effects of countermeasures on the ODT. However, because examinees are under pressure to respond quickly and accurately, attempts to implement countermeasures may be ineffective or easily

detected with behavioral measures, such as response time and error rates. Additional research is needed to explore these possibilities.

Finally, research on the ODT has primarily been conducted in a single laboratory by one team of investigators. As high quality eye tracking equipment and data analysis software become available at lower costs, we are hopeful that other investigators will contribute new knowledge to this area of applied science.

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Practicum

The Pretest

by Tuvya T. Amsel*

A polygraph test is a composition of three elements: an examinee, an instrument, and a test procedure. The examiner's role is to synchronize all these elements into perfection just like an orchestra conductor synchronizes the players, instruments, and music notes. The key to a fully synchronized orchestrated test is the **pre-test interview**. The pre-test is defined as "the first phase of the psychophysiological veracity examination which precedes the collection of the physiological data recorded on the polygraph charts, comprising the acquisition of examinee background data, refinement and finalization of test question formulation, and explanation of the examination procedure" [1]. This accurate albeit dry, factual, and technical definition fails to mention the crux of the matter: the examiner's ability to understand fully the examinee's mentality, mental and emotional condition, state of mind, and the way s/he perceives the situation. Settling into the examinee's shoes requires empathy, understanding, and an almost immediate bonding and rapport.

* e-mail.ta@amsel.co.il

Pre-pretest

For the examinee the pretest starts once s/he is told where and when to report for the test. As the date gets closer her/his fears – such as fear of the unknown, fear of error of the truthful examinees or fear of detection of the deceptive, fear of consequences following the test results, resentment ("A machine will determine my integrity?"), humiliation ("These tests are only made for criminals!"), insult ("I have worked here over 30 years and they still don't trust me."), invasion of privacy, loss of control, etc. – grow. Besides the natural "test anxiety", all these feelings have a psychophysiological impact resulting in anxiety and discomfort condition. To ease this condition, an "incubation period" prior to the test is suggested so that the examinee could gain confidence in her/his innocence or increase concern over the outcome with the deceptive. It should either be done by the examiner on the phone or by the investigator, and include:

- informing the examinee of the test date and place *at least* 24 hours prior to the test
- informing the examinee of the examiner's credentials
- informing the examinee that her/his anxiety is a normal phenomenon that has no impact on the results
- informing the examinee that if s/he is consuming any drugs on a regular basis s/he should continue to do so regardless of the test
- giving the examinee a brief explanation about the test procedure
- informing the examinee about the subject of the test
- informing the examinee about their legal right to refuse to take the test and the legal status of the test results, if any
- advising the examinee to try and have a good night's rest
- avoiding any type of questioning of the examinee on the day of the test.

For the examiner, the pretest actually starts with reviewing the case data and/or discussing the case with the end user, which unwillingly forms bias and expectations. In order to eliminate them, all the examiner should do is to remember that if the examinee's guilt or innocence was obvious, there would be no need for the test.

It is recommended that the examinee reads the leaflet containing test information described in Appendix A upon arrival. It is also recommended to have the examiner's and her/his organization's code of ethics as well as the APA code of ethics clearly displayed on waiting room walls. Most examinees reported that the provided information eased their tension.

Pretest interview

Once the examinee meets the examiner additional factors, such as natural uneasiness arising from alienation, eeriness, invasion of privacy, the need to open up to a total stranger on a private and confidential matter, etc. arise. All these feelings bear a negative effect on the examinee and make her/him nervous, jumpy, and snappy. It is the responsibility of the examiner to reduce these effects and to diffuse the examinee's tension and anxiety. It is simply done by being empathetic with the examinee's mental and emotional state of mind, and by avoiding any aggression or insensitivity to her/his condition, or to put it shortly by *passing no judgments*.
The best pre-interview starter is to discuss openly the examinee's anxiety and be empathetic about it, later proceeding to a brief explanation of the polygraph and the test procedure, and ensuring the examinee that her/his anxiety has no effect at all on the test outcome. ("I am operating a 'lie detector', and not a 'nervousness detector'.")
An additional key factor to a successful pretest interview is to gain the examinee's trust and confidence in the examiner's proficiency. How do laymen assess the level of proficiency of a professional? Reputation, appearance, attire, and location all play minor roles. The decisive factor is trust that is gained if the professional seems a candid and understanding person, and a good active listener sensitive to the examinee's concerns.

Pretest interview approach:

In addition to empathy, the examiner should employ a non-accusatory, non-threatening approach free of any judgment, and all along constantly remind herself/himself about the presumption of examinee's innocence.

The examiner should encourage the examinee to detail and provide as much biographical, medical and case data information as possible. With the exception of critical information, if the examinee's statement contradicts her/his prior given statement, the examiner should try and clear the contradiction, but accusations should be avoided.

Pretest interview goals:

The examiner should aim for the following:

- establishing rapport by having a positive interpersonal communication using the described approach

- establishing the examiner's professionalism
- establishing the examiner's objectivity (the most important)
- establishing the validity of the polygraph and its ability to detect deception and overcome the examinee's test anxiety or countermeasures (which will reduce truthful examinee's fear of error and deceptive examinee's hope of error)
- neutralizing contaminations resulting either from the issue under investigation or any external issue
- learning the subject's idiolect ("lingo") to avoid misunderstanding when phrasing the questions
- letting the subject tell in full detail her/his version of the issue under investigation in order to take it off her/his chest so that she/he will feel that the examiner is listening to her/him, which in return creates rapport and helps to phrase the most effective relevant questions
- collecting background data to phrase the most effective comparison questions
- if using PLCQ: discussing the comparison questions in detail to become almost sure that the examinee's answers are not a probable but a certain lie
- establishing the subject's physical and mental inability to take the test e.g. because she/he is using a medication that might affect the test or her/his mental cognitive ability is too limited to comprehend the questions fully
- minimizing examinee's bias against the polygraph, examiner, situation, etc. by explaining the basics of polygraph.

It should be emphasized that *any* objections to the test expressed by the examinee must be dealt immediately, postponing or ignoring them does result in constant conflicts. Ask for the source of the objection, and try to disarm it with counterexplanation

Examiners should keep in mind that they are not technicians who deal with lifeless objects. Examiners handle individuals with emotions, fears, concerns, imagination and much more, which in return requires being sensitive to the examinee's feelings and needs. This does not mean that the examiner should satisfy the examinee's desire to pass the test. It simply calls for sympathizing with the stress and anxiety that have nothing to do with their truthfulness or deception but only with the situation. The more objective the examiner, the more confident the examinee, which will have an impact on the chart clarity.

Internalize Thomas Jefferson's phrase (paraphrasing Aristotle):
"There is nothing more unequal than the equal treatment of unequal people."

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Appendix A. The explanatory leaflet (To be read by the examinee in the waiting area)

Hi and welcome to our laboratories,
This is probably the first time when you, like many others, are undertaking such a test. So, naturally, there are concerns, anxiety and perhaps a bit of fear. Most examinees with whom we have spoken have also expressed concern about the unknown. Truthful examinees are usually concerned about failing the test in spite of being truthful while deceptive examinees naturally fear detection and exposure due to the accuracy and validity of the polygraph. Some examinees have reported various feelings such as: insult, humiliation, etc. In order to set the record straight, we bring you the most common questions and answers presented to us:

What is a polygraph? The polygraph is an instrument that uses sensors to measure uncontrollable physical changes such as increased blood pressure, pulse changes, skin conductivity changes, and others that occur in the examinee's body when she/he is lying. The polygraph sensors are placed on and attached to the examinee's body externally so there is no need to undress and/or invade the examinee's body

Is the test painful, harmful or hazardous to my health? The test does not involve any pain except for slight discomfort caused by the blood pressure cuff. There is no impact on your health, and the test does not cause any physical harm.

Can a sick person or someone who consumes medication take the test? Generally speaking the answer is YES. Nonetheless, the examiner will discuss your physical condition prior to the test, and in addition she/he will perform an adjustment test to verify your ability to take the test. Please, reveal your medical status to the examiner. It is for your own benefit.

Does my nervousness and anxiety bear any effect on the test outcome? This is the most common concern amongst examinees, concern that despite being truthful

they will fail the test. The answer to this concern is clearly a NO. The examiner and the polygraph can differentiate between situational anxiety and deception. So if you are truthful you will pass the test and if you are deceptive your body will disclose it.

What is the test procedure? After verifying your identity and a short explanation about the test and the instrument, you will be asked to submit biographical and medical data and full details of the events that have led to this test. Based on your information the examiner will phrase the questions that you will be asked in the test. Only then will the polygraph sensors be attached to you and the test will commence. During the test these questions will be presented to you at least three times in order to establish your truthfulness or deception.

Can I refuse to take the test? Definitely YES!!! And your refusal could not be taken against you.

What is the accuracy of the polygraph? Researchers point to an accuracy of around 90%, which is a higher and better accuracy rate than that of most forensic and medical diagnostic tools.

Are polygraph test results admissible in court? You should consult your lawyer for an accurate answer but generally speaking the admissibility differs from state to state and is subject to stipulation between the parties involved.

"I don't want an instrument to determine my innocence or guilt" We have heard this statement many times and it is totally incorrect. The polygraph is ONLY a diagnostic tool used by a qualified examiner and she/he is the only one who determines the results.
Our examiners are accredited, qualified, and experienced members of the American Polygraph Association and other professional associations, expert witnesses in court, with government and law enforcement background. Moreover, we have conducted these tests for over [XX] years with great success.

Brief background of the examiner and the experience of the organization's polygraph unit

Appendix B
Pretest step-by-step check list:

Prior to the test

- obtain all case data, including the purpose of the test set by the end user
- decide if the case is testable
- pay attention to your appearance and attire
- calibrate the instrument if necessary
- set up the examination room: temperature, lack of noise, etc.

Upon the examinee's arrival in the office

- should be acknowledged by the receptionist
- the receptionist should ask the examinee to read the information leaflet (Appendix A)
- have your organization's and association's code(s) of ethics displayed in the waiting area

Upon entering the examination room

- greet the examinee
- have some small talk
- identify the examinee
- discuss her/his anxiety
- briefly describe the polygraph and the test procedure
- gain examinee's trust in the polygraph instrument and procedure
- decrease fear of error and increase fear of detection, using expressions that will demonstrate examiner's professionalism and objectivity
- ask for biographical and medical data to help the examiner establish rapport, collect background information for comparison questions and assessment of the examinee's psychological and physiological capacity to undergo the test
- verify verbally her/his consent to take the test
- obtain a detailed description of the events leading to the test from the examinee
- phrase the test questions (by order of relevant, comparison, irrelevant & sacrifice)
- ask the examinee to sign the consent form (by doing so at this stage instead of an earlier one, the examinee gives her/his consent to the test questions as well)
- review the questions making sure that the examinee has understood them fully
- attach polygraph components to the examinee
- instruct the examinee how to behave during the test
- start the test.

Literature review

Look from the East...

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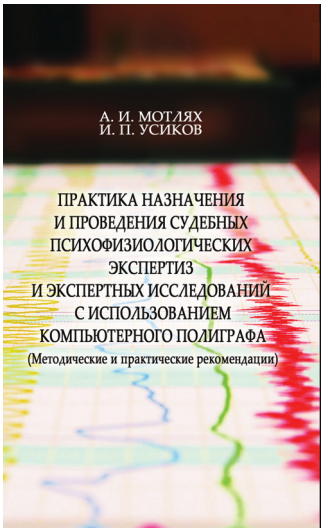

Motlyah A.I., Usikov I.P., Practice of appointing and conducting forensic psychophysiological examinations and expert studies using computer polygraph: handbook
[Мотлях А.И., Усиков И.П. ***Практика назначения и проведения судебных психофизиологических экспертиз и экспертных исследований с использованием компьютерного полиграфа*** (in Russian)]
Osvita Ukrainy, 2016, 228 pp.

Authors:
Aleksandr Motlyah, leading researcher of Problems of Pre-Trial Investigation scientific laboratory in Education and Research Institute No. 1 of the National Academy of Internal Affairs, Doctor of Law, professor, recognised Ukrainian jurist.

Igor Usikov, head of the Ukrainian Bureau for Psychophysiological Research and Safety, chairman of the Ukrainian Polygraph Collegium, polygraph expert with long-term experience in conducting forensic psychophysiological examinations.

The book is mostly devoted to methodological and practical aspects of preparing and conducting forensic psychophysiological assessment and expert examination using computer polygraph.

Authors refer to the private practice of forensic psychophysiological assessments carried out by polygraph experts of the Ukrainian Bureau for Psychophysiological Research and Safety (Ukrainian Bureau). Based on their experience, they give practical recommendations on using polygraph tests as part of forensic psychophysiological assessment, describe methodological techniques of pretest interview, and offer guidelines for test preparation to detect and study countermeasures attempted by the subjects. The final section of the book gives examples of expert conclusions made by polygraph examiners of the Ukrainian Bureau.

The final part of the book contains appendices with examples of documents from the Ukrainian Bureau practice and a samples conclusion of psychophysiological examination with a computer polygraph.

The handbook is intended for polygraph practitioners, as well as for law enforcement officials, prosecution staff, court authorities, and polygraph researchers.

Vitaliy Shapovalov

The Basic Information for Authors

To publication will be accepts unpublished research papers as well as review article, case reports, book reviews and reports connected with polygraph examinations.

Submitted manuscripts must be written in English.

All papers are assessed by referees (usually from Editorial Board), and after a positive opinion are published.

Texts for publication should be submitted in the form of normalized printout (1800 characters per page) and in electronic form (diskette, CD), or sent by e-mail to Editorial Office.

The total length of research papers and review article should not exceed 12 pages, case reports – 6 pages, and other texts (book review, report) – 5 pages.

The first page of paper should contain: the title, the full name of the author (authors), the name of institution where the paper was written, the town and country.

Figures should be submitted both in printed form (laser print, the best) and electronic form.
Tables should be numbered in Roman numerals and figures in Arabic ones.

Figures, tables, titles of figures and titles of tables should be included on a separate page. The places in the text where they are to be included should be indicated.

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For example (in references):

Reid J., Inbau F. (1966), *Truth and Deception: the Polygraph ("Lie-detector") Techniques*, Williams & Wilkins, Baltimore.

Abrams S. (1973), *Polygraph Validity and Reliability – a Review*, Journal of Forensic Sciences, 18, 4, 313.

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