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Contents

James Allan Matte,
Effect of Habituation to Least Threatening Zone Questions on the Most Threatening Zone Comparison Questions in Psychophysiological Veracity Examinations 97

Henryk Polakowski, Mariusz Kastek, Jarosław Pilski
Analysis of Facial Skin Temperature Changes in Acquaintance Comparison Question Test 107

Anna Ibek
The Result of a Polygraph Examination as an Argument in Criminal Investigation 123

Vitas Saldžiūnas, Aleksandras Kovalenka
Efficiency Formula for Polygraph Examination 135

Michał Widacki, Aleksandra Cempura
Legal Admissibility of Employee Polygraph Examinations in Poland 143

Report

Natalia Mirska, *Report from the 4th Interdepartmental Polygraph Seminar, Waplewo 2011* 157

The Basic Information for Authors 161

Rules and regulations concerning publishing papers in *European Polygraph* 163

Subscription: Terms and Conditions 165

Reviewers assessing articles in the European Polygraph in the previous year 167

Erratum to the "European Polygraph" 2011, 5, 2 (16)

The following paragraph in the article of James Allan Matte (p. 50) should read as follows, with the **amended wording in bold type**:

In the Shurany, et al 2009 field study, the Inside Track reduced the Inconclusives for the Truthful from 31% to Zero and the Deceptive from **71% to 7.1%.** Overall accuracy 96.5% with Zero Inconclusives.

The following paragraph contains the correction in bold:

In the Shurany, et al 2009 field study, the Inside Track reduced the Inconclusives for the Truthful from 31% to Zero and the Deceptive from **71.5% to Zero.** Overall accuracy 96.5% with Zero Inconclusives.

Therefore, 71% to 7.1% is incorrect and should be changed to 71.5% to Zero.

EUROPEAN
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Effect of Habituation to Least Threatening Zone Questions on the Most Threatening Zone Comparison Questions in Psychophysiological Veracity Examinations

During the past 39 years of conducting psychophysiological veracity (PV) examinations, this author observed a phenomenon wherein the responsivity of the confirmed deceptive and truthful examinees remained constant and often increased with each chart collected on the relevant questions if deceptive or the control questions if truthful.

This author suspected that the reason for this occurrence was due to the truthful examinee's habituation to the relevant questions and the deceptive examinee's habituation to the control questions, as a result of their psychological set being focused on the tests questions having the greatest threat to their security.

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This empirical observation was based on charts collected from the administration of the Quadri-Track Zone Comparison Technique, a single-issue test that clearly separates the relevant questions (Red Zone) dealing with a single-issue from the control questions (Green Zone) embracing earlier-in-life experiences with the use of non-current exclusive control questions that employ time bars that enable the "Either-Or" rule. In essence, the examinee is presented with two threats, the red zone questions and the green zone questions from which he/she must choose which of those two threats offer the greatest threat to his/her well-being, thus creating a double-bind effect (Bateson, et al, 1956), and this is determined and discovered from the physiological data collected from the examinee during the presentation of those two threats.

This empirical observation prompted this author to review and examine the raw data acquired in a field study (Matte-Reuss, 1989) comprising 122 confirmed real-life cases that used the Quadri-Track Zone Comparison Technique where the scores for each chart collected were recorded and reported.

There were 62 confirmed Deception Indicated (DI) cases, 53 confirmed No Deception Indicated (NDI), and 7 Inconclusives.

Results

Of the 62 confirmed DI cases, 39 cases (62.9%) had an average greater score for charts succeeding the first chart (Chart #1), and 4 cases (6.4%) had average equal scores for charts succeeding the first chart. There were 10 cases (16.1%) where a fourth chart was collected. Five of those cases (50%) had greater scores than the first chart collected. Raw data available in Appendix A.

The scores for each chart collected were tallied and divided by the number of cases to obtain the average score for charts number 1 thru 4. The results are as follows:

Deception Indicated	**CHART #1**	**CHART #2**	**CHART #3**	**CHART #4**
Total Score:	-516 (n.62)	-617 (n.62)	-387 (n.42)	-83 (n.9)
Average Score:	-8.32	-9.95	-9.21	-9.22

Of the 53 confirmed NDI cases, 23 cases (43.3%) had an average greater score for charts succeeding the first chart, and 7 cases (13.2%) had average equal

scores for charts succeeding the first chart. There were three cases (5.6%) where a fourth chart was collected. Two of those cases (66.6%) had greater scores than the first chart collected and one of those cases (33.3%) had scores equal to the first chart collected.

No Deception Indicated	**CHART #1**	**CHART #2**	**CHART #3**	**CHART #4**
Total Score:	+355 (n.53)	+301 (n.53)	+80 (n.10)	+26 (n.3)
Average Score:	+6.6	+5.6	+8.0	+8.6

Discussion

The data for deceptive cases clearly indicate a lack of habituation to the relevant test questions throughout the collection of the four charts. Indeed the scores from charts 2 through 4 are higher than chart 1 indicating increased responsivity to the relevant questions, which may be due to habituation to the control questions.

The data for the truthful cases indicate a slight score decrease in Chart #2 (+5.6) versus Chart #1 (+6.6), but this is followed by Chart #3 with +8.0 and Chart #4 with +8.6 indicating an overall increase in responsivity to the control questions versus the relevant questions. It is recognized that the number of charts available in Charts #3 and #4 for NDI were small, and additional field research needs to be conducted. It must be noted that this data was collected from a true single-issue zone comparison technique where, unlike multiple-issue tests, the examinee is confronted with only two distinctly separate threats which permits one threat to dampen the other thus creating a double-bind effect that can result in eventual habituation to the least threatening questions.

The implications from this data are that polygraphists should be receptive to the collection of additional charts beyond the customary three-charts when confronted with an inconclusive result, especially when using a single-issue polygraph technique that employs an increasing score threshold with each chart collected rather than a fixed score threshold that does not increase with each chart collected. The data further supports the Quadri-Track Zone Comparison Technique's increasing score threshold, which multiplies its initial scoring threshold with the collection of each subsequent chart, clearly showing that its increasing score threshold does not contribute to inconclusive results. Published field studies by Matte-Reuss 1989; Mangan, et al 2008; Shurany, et

al 2009, comprising a total of 319 subjects reported a combined inconclusive rate of only 2.2 percent.

Notes

[1] The term "control" question has been replaced with the term "comparison" to conform to the scientific literature. Nevertheless, in this study the term "control" is still used to avoid duplication of the term comparison in succession which could cause confusion, such as comparison of the comparison versus relevant questions.

[2] The "Either-Or" Rule is unique to the Backster ZCT and the Quadri-Track ZCT. Research by Meiron, et al 2008 showed that the "Either-Or) rule was an essential element of the Backster ZCT and its high accuracy. For a full explanation of the "Either-Or" Rule, see Matte, 1996; Mangan, et al 2008; and Shurany, et al 2009.

[3] Double-bind: A situation in which a person must choose between equally unsatisfactory alternatives; a punishing and inescapable dilemma. American Heritage Dictionary.

[4] The Quadri-Track ZCT employs the following increasing score threshold: Chart 1, -5 DI, +3 NDI; Chart 2, -10 DI, +6 NDI; Chart 3, -15 DI, +9 NDI; Chart 4, -20 DI, +12 NDI. A minimum of 2 charts must be collected in order to render a decision of Truth or Deception. Scores below the indicated threshold fall into the inconclusive category.

Appendix

Page No. 1
06/17/89

TABLE 4 POLYGRAPH GRANDSCORE WITH ZONE 4 LISTED BY RANK SCORES

NUM	CASE	CONF	CONC	C13	C23	C33	C43	GS23
43	M11	DI	DI	-9	-17	-19		-45
87	M53	DI	DI	-1	-17	-9	-18	-45
118	M70A	DI	DI	-15	-13	-5	-11	-44
7	L7A2	DI	DI	-18	-11	-9		-38
57	M23	DI	DI	-10	-14	-13		-37
47	M13B	DI	DI	-11	-11	-14		-36
1	A1A	DI	DI	-10	-12	-13		-35
112	M67A	DI	DI	-8	-15	-12		-35
60	M26	DI	DI	-8	-10	-5	-11	-34
114	M68A	DI	DI	-13	-7	-14		-34
75	M41	DI	DI	-10	-11	-12		-33
14	A12A	DI	DI	-3	-17	-12		-32
93	M56	DI	DI	-12	-11	-9		-32
15	A13A	DI	DI	-17	-14			-31
92	M55B	DI	DI	-9	-3	-12	-7	-31
107	M64A	DI	DI	-13	-11	-7		-31
72	M38	DI	DI	-5	-3	-10	-12	-30
89	M54B	DI	DI	-9	-12	-9		-30
98	M59A	DI	DI	-10	-1	-19		-30
113	M67B	DI	DI	-9	-8	-13		-30
119	M70B	DI	DI	-9	-9	-12		-30
61	M27	DI	DI	-4	-9	0	-16	-29
34	M2	DI	DI	-12	-13	-2	-1	-28
111	M66	DI	DI	-12	-7	-9		-28
91	M55A	DI	DI	-9	-11	-5	-2	-27
95	M57B	DI	DI	-15	-12			-27
40	M8	DI	DI	-15	-11			-26
77	M43	DI	DI	-4	-11	-11		-26
121	M71B	DI	DI	-9	-17			-26
46	M13A	DI	DI	-6	-10	-9		-25
110	M65B	DI	DI	-10	-8	-7		-25
41	M9	DI	DI	-12	-12			-24
115	M68B	DI	DI	-2	-9	-13		-24
32	A26B	DI	DI	-12	-11			-23
103	M62A	DI	DI	-10	-13			-23
106	M63B	DI	DI	-9	-14			-23
117	M69B	DI	DI	-7	-6	-10		-23
122	M71C	DI	DI	-16	-7			-23
73	M39	DI	DI	-11	-11			-22
88	M54A	DI	DI	0	-12	-10		-22
99	M59B	DI	DI	-9	-13			-22
100	M60	DI	DI	-4	-8	-10		-22
30	A25	DI	DI	-6	-15			-21
104	M62B	DI	DI	-9	-12			-21
105	M63A	DI	DI	-11	-10			-21
120	M71A	DI	DI	-3	-12	-6		-21
31	A26A	DI	DI	-10	-9	-1		-20
33	M1	DI	DI	-1	-4	-10	-5	-20
90	M54C	DI	DI	-9	-11			-20
94	M57A	DI	DI	-7	-6	-7		-20

Page No. 2
06/17/89

TABLE 4 POLYGRAPH GRANDSCO
ZONE 4 LISTED BY RANK SC

NUM	CASE	CONF	CONC	C13	C23	C33	C43	GS23
101	M61A	DI	DI.	2	-10	-11		-19
109	M65A	DI	DI	-6	-7	-6		-19
11	A10B	DI	DI	-3	-15			-18
16	A14A	DI	DI	-8	-6	-4		-18
20	A17	DI	DI	-8	-10			-18
108	M64B	DI	DI	-7	-11			-18
5	A5A2	DI	DI	-8	2	-9		-15
8	L8A3	NDI	INC	-8	-4	0	-3	-15
10	A10A	DI	DI	-4	1	-12		-15
28	A23B	DI	DI	-4	-4	-7		-15
42	M10	DI	DI	-7	-8			-15
96	M58A	DI	DI	-5	-8			-13
102	M61B	DI	DI	-5	-8			-13
13	A11B	DI	INC	-7	2	-5		-10
97	M58B	NDI	INC	3	-3			0
116	M69A	DI	INC	5	-2	-1		2
74	M40	NDI	INC	-4	3	4		3
86	M52	NDI	INC	3	2			5
9	A9A	NDI	INC	3	-1	4		6
18	A15B	NDI	NDI	-1	9			8
25	A21B	NDI	NDI	6	2			8
29	A24	NDI	NDI	7	1			8
35	M3	NDI	NDI	4	4			8
36	M4	NDI	NDI	4	4			8
39	M7	NDI	NDI	4	4			8
49	M15	NDI	NDI	6	2			8
50	M16	NDI	NDI	0	8			8
53	M19	NDI	NDI	3	5			8
55	M21	NDI	NDI	6	2			8
71	M37	NDI	NDI	-2	10			8
84	M50	NDI	NDI	8	0			8
59	M25	NDI	NDI	12	-3			9
82	M48	NDI	NDI	2	7			9
4	A4A1	NDI	NDI	8	3			11
12	A11A	NDI	NDI	5	6			11
63	M29	NDI	NDI	8	3			11
66	M32	NDI	NDI	11	0			11
83	M49	NDI	NDI	8	3			11
52	M18	NDI	NDI	7	5			12
79	M45	NDI	NDI	2	-5	15		12
80	M46	NDI	NDI	6	6			12
2	A2A1	NDI	NDI	4	4	5		13
3	A3A2	NDI	NDI	10	3			13
22	A19	NDI	NDI	0	7	6		13
48	M14	NDI	NDI	3	0	5	5	13
81	M47	NDI	NDI	6	7			13
38	M6	NDI	NDI	10	4			14
64	M30	NDI	NDI	1	13			14
69	M35	NDI	NDI	7	7			14
70	M36	NDI	NDI	9	5			14

Page No. 3
06/17/89

TABLE 4 POLYGRAPH GRANDSCORE WITH ZONE 4 LISTED BY RANK SCORES

NUM	CASE	CONF	CONC	C13	C23	C33	C43	GS23
78	M44	NDI	NDI	7	7			14
51	M17	NDI	NDI	7	8			15
76	M42	NDI	NDI	2	13			15
54	M20	NDI	NDI	7	9			16
85	M51	NDI	NDI	8	8			16
27	A23A	NDI	NDI	6	11			17
44	M12A	NDI	NDI	-2	7	12		17
45	M12B	NDI	NDI	7	10			17
19	A16	NDI	NDI	14	4			18
23	A20	NDI	NDI	12	6			18
67	M33	NDI	NDI	5	13			18
17	A15A	NDI	NDI	9	10			19
26	A22	NDI	NDI	13	6			19
58	M24	NDI	NDI	12	8			20
68	M34	NDI	NDI	9	12			21
6	L6A1	NDI	NDI	8	-1	5	11	23
21	A18	NDI	NDI	8	8	7		23
24	A21A	NDI	NDI	1	13	10		24
37	M5	NDI	NDI	10	0	4	10	24
56	M22	NDI	NDI	11	3	11		25
65	M31	NDI	NDI	18	10			28
62	M28	NDI	NDI	20	10			30
***	Total	***		***	***	***	-60	-847

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Analysis of Facial Skin Temperature Changes in Acquaintance Comparison Question Test

Introduction

Polygraph instruments have been used in criminal investigations for a long time now, and several types of tests using the polygraph have been developed. One such test is called the Acquaintance Comparison Question Test

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(ACQT) [1], which is extremely effective when traditional polygraph measures are used. However, the devices used to record these measures still resemble the first models from 20 years ago [2, 3] and most often include metal electrodes attached to the fingers, pneumatic tubes surrounding the thoracic and abdominal areas, and a pneumatic blood pressure cuff attached to the upper arm overlying the brachial artery. These sensors require time to attach, and the examinee can feel certain discomfort when the blood pressure cuff is inflated for more than approximately five minutes. Additionally, the autonomic nervous system (ANS) measures of the orienting response rely on such cognitive phenomena as memory updating rather than emotional responses to the test questions [4–7]. Many believe that increases in polygraph accuracy might be possible if questions could be determined. This would be useful not only in the ACQT format, but in other polygraph test formats as well. Research has documented a link between behavioral reactions and the expression of specific emotions [8–11]. The cited studies typically involve detailed measures of facial muscles as specific emotions are invoked. One technology that shows promise in overcoming some of the limitations of traditional polygraph measurements is thermography.

Thermography is a technique used for measuring the infrared emission (heat) from the human body [11]. Using infrared (IR) radiometry, non-contact heat measurements from large areas of the body surface are possible. Skin surface temperature (SST) is affected by changes in underlying muscle activity and microcirculation [12], suggesting that it might bridge the gaps among behavioral studies of facial expression, emotion, and the ANS measures traditionally used to score polygraph tests. In the studies described below, facial SST was recorded from deceptive and non-deceptive individuals while a ACQT was performed. It has been shown that the periorbital region around the eye exhibits increased SST during arousal, which might be associated with specific emotions. The hypothesis was tested that skin temperature in the eye region could be used to discriminate deceptive and non-deceptive examinees in a manner similar to traditional polygraph measures [13]. On the basis of the published test results [14–19], it can be concluded that emotion-related thermal effects can be observed not only in the region surrounding the eye. During the experiments facial regions were identified in which significant temperature changes were observed. The temperature distributions were recorded by two thermal cameras during polygraph tests.

Description of experiment

The Polish Military Gendarmerie is a separate, specialized service within the structures of the Polish Armed Forces. Its actions cover tasks including criminal investigations and prosecution of perpetrators. In the Military Gendarmerie polygraph tests are performed by the Psychophysiological Test Department. Due to the actual needs of this department, related to lie detection, the thermal cameras were applied supporting the polygraph tests. The experiment was aimed at the recording of facial temperature changes of persons undergoing polygraph examination during intentionally false statements. The thermal image sequence was recorded simultaneously with standard polygraph data. Further analysis of the recorded sequences revealed the skin regions of significant temperature changes as well as latency time between a false response to a question and thermal reaction on the skin.

During test preparations all legal aspects, conditions and regulations were considered, as included in the relevant articles 192a and 308 of the penal code. The tested persons voluntarily agreed to take part in the experiment. Three persons were chosen who had never before been examined using polygraph, in order to avoid any habits they might have developed during previous tests. The objectivity level of the test was further increased by informing the examinees about the details of the test procedure just before the beginning of the experiment.

1. Measurement procedure

In order to guarantee the repeatability of the results of the thermal measurements for the consecutive subjects, the people were seated on a comfortable chair in a room at a temperature between 20°C and 23°C (Fig. 1). Participants were asked not to use any makeup or facial products on the day of the experiment. In addition, they were asked not to eat or drink hot substances and not to smoke during the hour preceding the experiment. Their facial skin was washed with 70 percent alcohol to remove any interfering substances. The experiment details were then described, and the participants rested for 15 min to acclimatize with the surrounding temperature. The stimulation test procedure was used because the reliability of results was of primary importance. Two test types were applied: name test and numbers test.

In the latter test, the examined person chose one number (by crossing it) and thus the selection could be verified afterwards, showing which number the

examinee tried to conceal. Other tests do not offer such a quick verification method, and their results can be verified only with the full co-operation of the tested person, who, in some cases, may not be willing to do so. This kind of situation may occur in those tests where very personal questions are being asked and the expert opinion is then the only verification method available. An important and, in fact, necessary condition of the aforementioned test procedure is that the tested person gives a negative answer (NO) to all the questions about the numbers regardless of the actual number in question, including the correct one. In this scheme the examinee gives the same NO answer eight times, one of them being an intentional lie.

The purpose of this test was to evaluate the symptomatic reactions evoked by each question, especially by the question about the number chosen. This was the case when the tested person was forced to lie intentionally and the characteristic reaction could then be observed [20, 21].

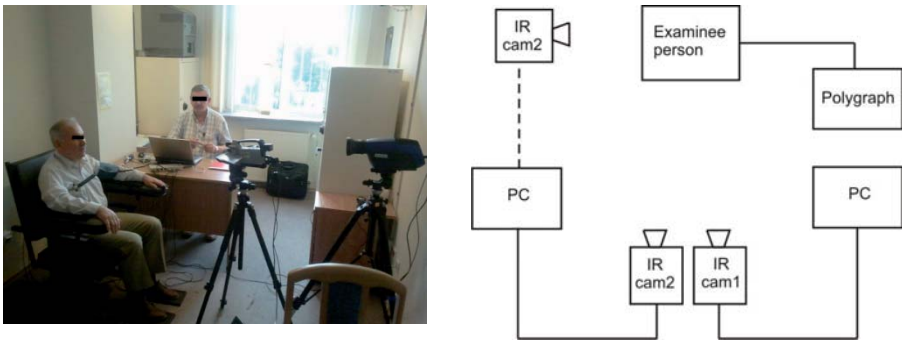


Fig. 1. Experiment settings: photo taken during experiment (a), schema of stand (b)

2. Stand and systems used in experiment

Tests were conducted in the laboratory of the Psychophysiological Test Department of the Military Gendarmerie. The measurement equipment used during the tests consisted of a computerized polygraph (by Lafayette Instruments) and a set of two infrared cameras: FLIR SC 5600 with cooled InSb focal plane array and FLIR P640 with uncooled microbolometer focal plane array. The symptomatic reactions of the examined person were recorded by LX-4000 polygraph using traditional physiological parameters: Pneumo (two respiration input channels), EDA (galvanic skin response) and Cardio (blood volume/pulse rate).

The two thermal cameras used during the experiment provided a high thermal sensitivity of less than 0.02 °C for temperatures between 20 °C and 120 °C. The cameras were set for human skin emissivity (ε = 0.98). Using this emissivity, temperature fluctuations brought on by illumination and other ambient changes will not affect the system. The temperature data were recorded with FLIR AltaIR software. The image acquisition rate was fixed at 60 Hz (one image per 17 ms).

Fig. 2. Placement of thermal cameras during the experiment

Data analysis

Both the polygraph sensor data and thermal images recorded by the applied cameras were analyzed in order to determine the time delays between the false answer and the resulting changes in recorded sensor data and temperature distributions.

1. Polygraph results

Polygraph examinations were conducted on a three-person test group: two females and one male. The research assumptions were as follows:

- the participants had never been tested by a polygraph before
- the participants were taking the test voluntarily and would act strictly according to the instructions given
- the participants were fully aware that the test would have no consequences of any kind to them
- the whole test procedure would be recorded (audio, video and thermal imaging registration)

– stimulation tests (name test and numbers tests) would be used in the experiment.

According to standard procedures of stimulation tests the research team was unaware of the number chosen by the examinee in the numbers test, and in the name test the questioning was conducted in such a manner that the names of the persons tested remained undisclosed till the end of the procedure. A typical example of polygraph signals recorded during the numbers test is presented in Fig. 3. There, the personal, specific symptomatic reactions can be seen of the examinee who picked up the number "5" during the test. The arrows show increased responses in the time window related to the question about this chosen number, significantly different to sensor data recorded for the other numbers used in the test. In Fig. 3 the time interval between the vertical, grey dotted lines is 5 seconds. The whole time window covering the reaction to one question (long red arrow in Fig. 3) lasts about 22 seconds.

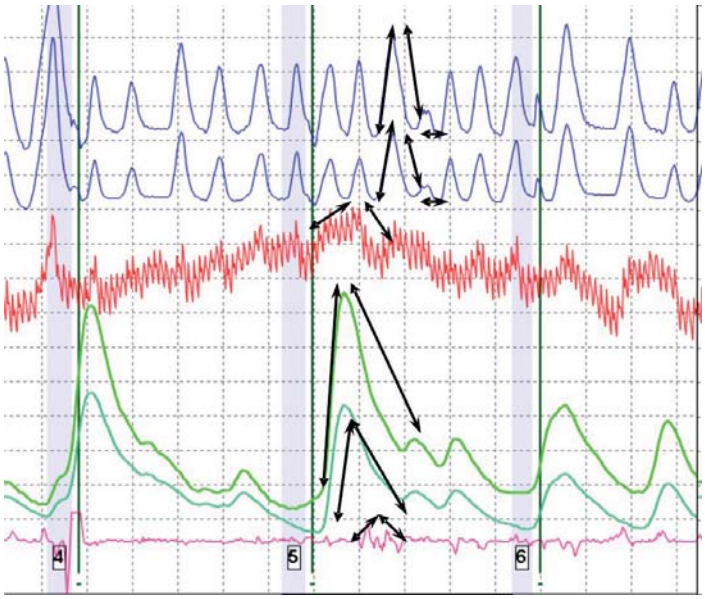


Fig. 3. Typical example of polygraph signals recorded during numbers test

Black arrows indicate the differences in the response to the number "5" in comparison with the reactions to any other number in the test. Significant differences can be observed in GSR sensor data (green plots). The reaction starts about 3 seconds after an intentionally false answer. Also the blood pressure

sensor (red plot) indicates an abnormal reaction, which starts 1 second before the question was even asked. An increased symptomatic reaction can also be observed in respiration sensor data (blue plots – 7 seconds after the answer) and in the muscular strain monitor (pink plot – 5 seconds after the answer).

2. Infrared camera results

The facial areas of interest for the thermographic examinations had to be determined by identifying the areas where the temperature distribution can be altered as a result of psychophysiological reaction.

Surface skin temperature distribution is determined by the anatomic structure of the human skin and the tasks it performs. Skin has a layered structure and is composed primarily of the epidermis and dermis, connected by a basement membrane (Fig. 4a). The epidermis, being the outermost layer of a human body, forms the waterproof, protective wrap over the body's surface. It also contains tactile receptors and thermoreceptors. The surface temperature, however, is mainly influenced by mechanisms located in the dermis layer, namely the presence of blood vessels. This network of vessels, 50-100 μm in diameter, plays an important role in the heat transfer mechanism. Stress invoked during the stimulation test triggers a symptomatic reaction and as a result the blood pressure and flow are increased, which in turn causes the increase in temperature. Then the rising temperature triggers the sweating mechanism, because sweat glands are activated to lower the skin temperature. All the aforementioned effects were observed during thermographic registrations.

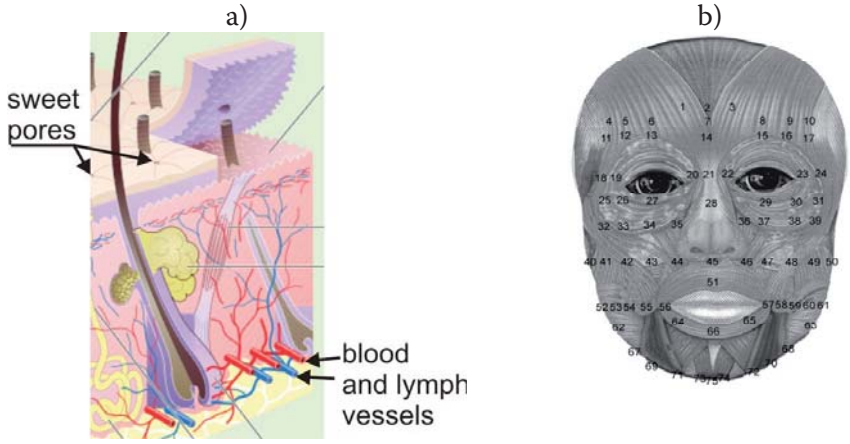


Fig. 4. Sectional view of the skin (a), facial muscle map (b) [18]

There are many literature references in which the facial region chosen for experiments involving thermal imaging is described [13, 16, 17, 18]. However, by analyzing the facial muscle map (Fig. 4b), it can be concluded that certain regions should be avoided, because the temperature changes in those regions also originate from muscle operation while answering questions. Attention should then be focused on areas that are well supplied with blood and densely populated with sweat pores. Local temperature changes in such regions will be mainly induced by psychophysiological reactions. The areas chosen according to these criteria are shown in Fig. 5.

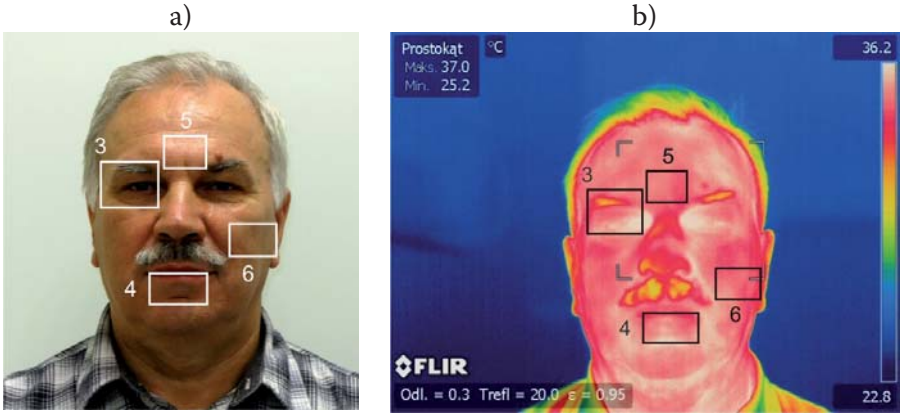


Fig. 5. Selected areas of skin temperature evaluation

The sequences of thermal images, registered synchronously with polygraph sensor data, were analyzed with AltaIR software. For the areas indicated in Fig. 6 temperature plots were created showing the changes in minimal, maximal and average temperature values over time. Additionally, a correction of the emissivity coefficient was introduced in order to obtain proper absolute temperature data. It was assumed that emissivity is constant at analyzed time intervals, which, as was shown in Fig. 3, do not exceed 25 seconds. It is known from literature references [13, 14, 22] that skin emissivity can change by 0.09 if the examination lasts longer than 10 minutes. This, in turn, may introduce the temperature measurement error of 0.35 °C. The influence of an emissivity coefficient to the measurement results can be compensated by adopting several methods from pyrometer non-contact temperature measurements. There are many known methods [23-26] for such compensation, and an algorithm taking into account real emissivity values should be included in this kind of measurement.

In order to detect the temperature changes in the selected regions the image sequence was analyzed, starting from the instant when the answer to the particular question was given by the tested person. Usually such a sequence lasted about 20 seconds. The facial temperature distributions recorded one second after the answer are shown in Fig. 6 (Fig. 6a – truth, Fig. 6b – lie). It can be stated that the initial temperature distribution patterns are basically identical in both cases.

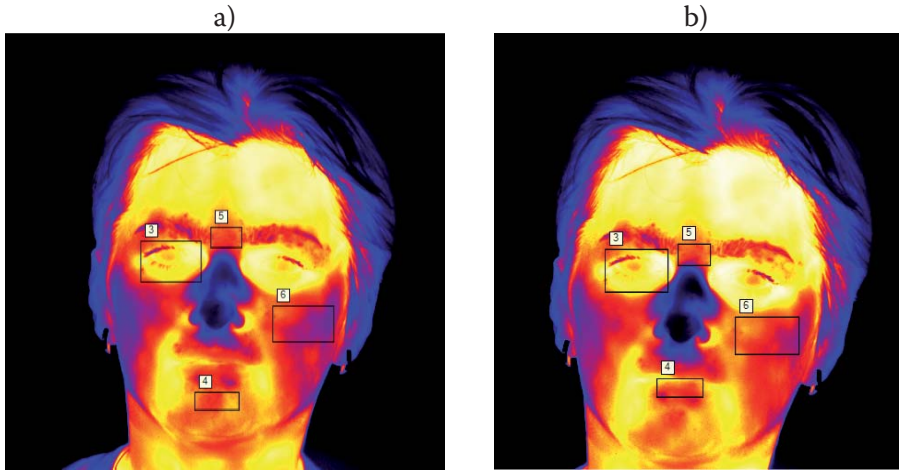


Fig. 6. Thermal images of surface skin temperature: (a) truth, (b) lie

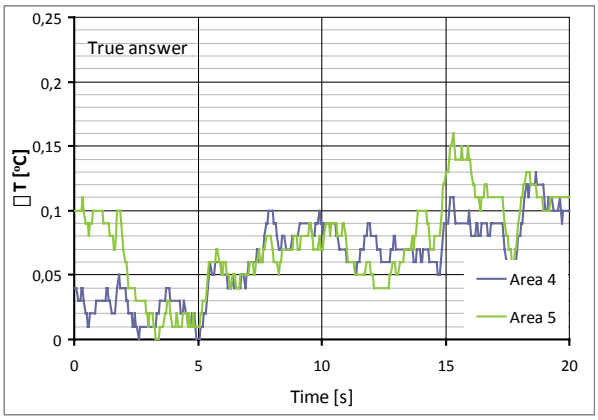
The thermal data for all four analyzed regions in case of a false answer are presented in Table 1. It can be seen that the biggest changes in mean temperature occurred in regions 4 and 5, and those regions were chosen for further analysis.

Tab. 1. Results of temperature analysis in all selected regions

	After 1 sec				After 4 sec				After 8 sec			
Area Label	3	4	5	6	3	4	5	6	3	4	5	6
Min (°C)	30.49	32.35	31.03	32.09	30.64	32.34	31.48	32.11	30.87	32.37	31.77	32.10
Max (°C)	35.34	34.22	34.03	33.74	35.32	34.35	33.96	33.76	35.34	34.47	33.98	33.77
Mean (°C)	34.05	33.22	33.01	32.94	34.03	33.32	33.11	32.95	34.05	33.39	33.19	32.98

Similar temperature changes in the selected regions were observed for all examined persons. Sample results of mean temperature changes in the regions 4 and 5 after a true answer are presented in Fig. 7a, whereas Fig. 7b shows the same data extracted from the recorded thermal images after a false one. A true answer resulted in a rise of mean temperature value not greater than 0.15°C, whereas a mean temperature increase of about 0.2°C was detected in the case of a lie.

a)



b)

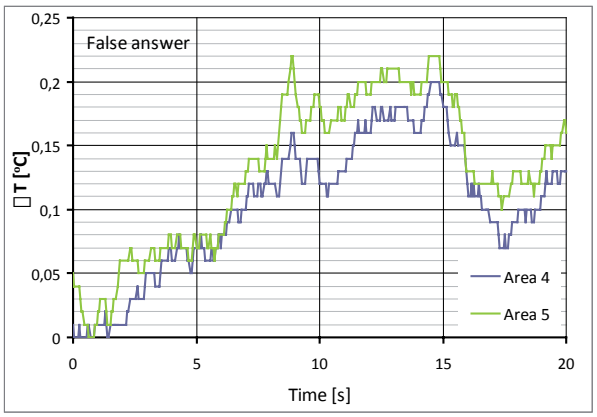


Fig. 7. Changes in mean temperature value in regions 4 and 5 after a true answer (a) and a false answer (b)

The effectiveness of the thermographic procedure in the detection of skin temperature changes caused by an emotional reaction is determined by the correct choice of test area. This effect is illustrated in Fig. 8. The plots show the comparison of thermal readings for true and false answers recorded in

region 4 (Fig. 8a) and region 5 (Fig. 8b). It is clearly visible that the difference in mean temperature values between the true and false answer is much more pronounced in region 5. The maximum temperature difference was recorded about 14 seconds after the answer had been given.

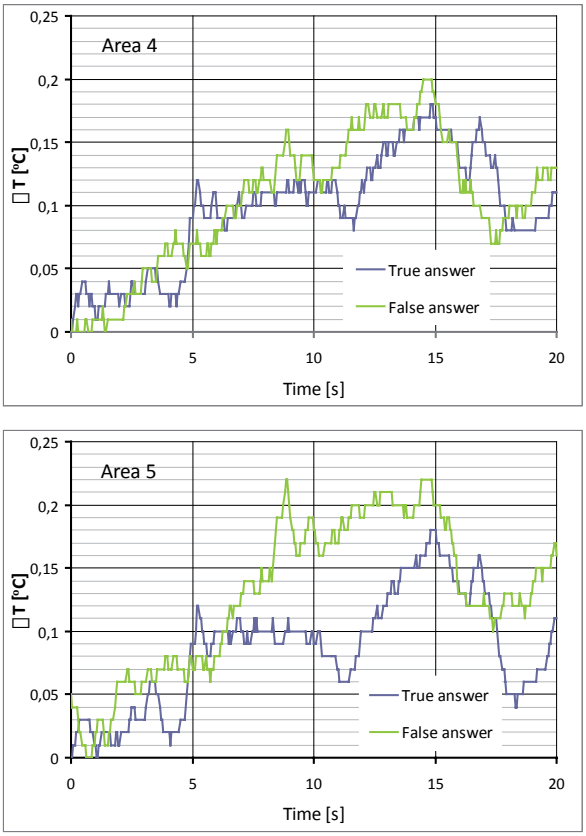


Fig. 8. Comparison of changes in average temperature value for true and false answer in region 4 (a) and region 5

Practical application of temperature measurements in lie detection requires specialized software, capable of automatic tracking of the area of interest in the thermal image, image analysis (digital filtering and FFT transform) for the extraction of diagnostic parameters and real-time operation. The development of such software has already started, and digital filtering was applied for the recorded thermal images. The results of digital image processing are shown in Fig. 9. The presented images show the facial temperature distribution after

one, four and eight seconds after the false answer. Digital image transformation visualizes the temperature changes in the selected regions and also emphasizes additional areas where the temperature changes occurred.

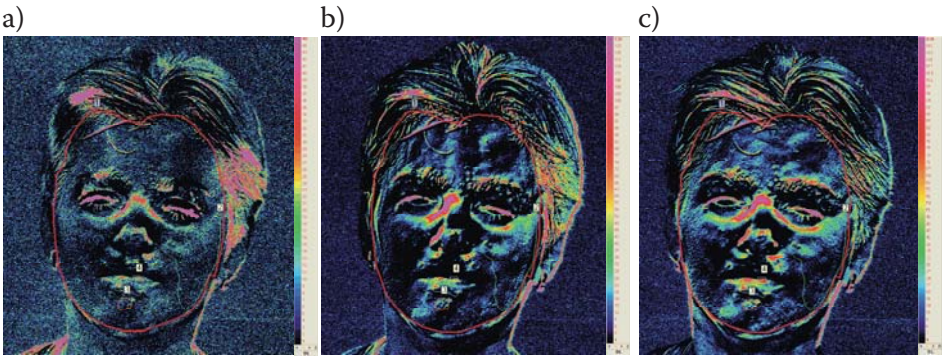


Fig. 9. Results of image processing using a digital filter: evaluation of face temperature after false answer after 1 sec. (a), 4 sec. (b) and 8 sec. (c)

Conclusions

The results of the experiment suggest that the thermal signatures of the periorbital regions are useful in lie detection procedures. The presented researchers aim to combine thermography and traditional polygraph measures, with an increase expected in sensitivity and specificity expected to result, relative to those using either approach alone. Thermal imaging analyses using digital data transformations that more effectively isolate and discriminate the region of skin facial surface response could lead to further accuracy increases in the thermal detection of deception. This means that the development of a method for real-time analysis of thermal images combined with polygraph data will bring an entirely new quality in lie detection procedures. The analysis of the presented initial results proves the correctness of the presented approach. However, further research is required on a larger test group, which will allow for statistical evaluation of results.

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The Result of a Polygraph Examination as an Argument in Criminal Investigation

The result of polygraph examination is a testimony put forth by an expert after concluding examination on a subject who agreed to undergo the procedure. The subject of consideration here is only the results acquired in examinations conducted as part of criminal investigations, which implies the omission of pre-employment examinations, post-conviction sexual offender testing (PCSOT), and other uses. Moreover, the analysis focuses on only those examinations that ended in indication that the subject of examination was deceptive as a result of the expert using one of the comparison question techniques, or as a person recognising an event in the case of applying the Concealed Information Test (CIT) technique. Nor does the study account for the results of inconclusive examinations.

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Thus the result of a polygraph examination $\boldsymbol{R}$ covered by the scope of this article can assume the form of one of two propositions (as proposed in Widacki, 1982):

$\boldsymbol{R_1}$: Person $\boldsymbol{A_i}$ reacted to the relevant questions in the tests like a subject providing deceptive answers to these questions,
or
$\boldsymbol{R_2}$: Person $\boldsymbol{A_j}$ recognises the event $\boldsymbol{p_n}$.

Because $\boldsymbol{R_1}$ and $\boldsymbol{R_2}$ are the testimonies of an expert, who can be called $\boldsymbol{E}$ here, it can be said that
$\boldsymbol{T_1}$: $\boldsymbol{E}$ states that $\boldsymbol{R_1}$,
or
$\boldsymbol{T_2}$: $\boldsymbol{E}$ states that $\boldsymbol{R_2}$.

Because propositions of the $\boldsymbol{R_1}$, $\boldsymbol{R_2}$ (generally: $\boldsymbol{R}$) type and of the $\boldsymbol{T_1}$, $\boldsymbol{T_2}$ (generally: $\boldsymbol{T}$) type are produced for the use of the investigation, one should assume that they belong to the mass of evidence. This article aims to consider such propositions as arguments in the investigation procedure.

In the context of the matter in question, an argument is a certain inferential structure composed of a single premise or premises, on whose grounds, with the use of appropriate generalisations, the conclusion is deduced. The premise is a particular "basis", a certain knowledge base that provides grounds for performing intellectual operations, in a word: information. Pure information, however, is not yet evidence, though it can become such as far as it fits being used in inferential reasoning, or, in the simplest terms, in indirect inference; this "fitting" being the basic and common feature for all pieces of evidence (Twining 2006, p. 438). In our case, this means that pure $\boldsymbol{R_1}$ information is not yet evidence, and the interference performed by the investigator, which transforms the result of a polygraph examination into a piece of evidence, has the following form: if $\boldsymbol{T_1}$ then $\boldsymbol{R_1}$. The same is true about the $\boldsymbol{T_2}$ and $\boldsymbol{R_2}$ propositions and the if $\boldsymbol{T_1}$ then $\boldsymbol{R_2}$ inference. It is only recognition of these inferences that introduces the propositions $\boldsymbol{R_1}$ or $\boldsymbol{R_2}$ to the mass of evidence (see: Stein 2005, p. 35).

An investigation can be interpreted as a multiple, repetitive process of generating, testing, and justifying various hypotheses explaining the individual questions in the given matter. The conclusion of the proving argument assumes the form of a hypothesis which can become a constituent of the description of

the given course of events. Hypotheses together make up the crime scenario (Braak 2010, p. 18). Before the incorporation of a given hypothesis into the main scenario of the event (i.e. that which explains the circumstances of the crime best), it needs testing to eliminate the potential false positive which it exposes (Bex 2009a, p. 23).

Thus two questions arise: (a) why did ***E*** consider the $\boldsymbol{R_1}$ or $\boldsymbol{R_2}$ propositions, and (b) what can the role played by the $\boldsymbol{R_1}$ or $\boldsymbol{R_2}$ propositions be in the main scenario of the investigated event?

The analysis of the argument from the expert's opinion was conducted by Walton, Reed, and Macango (Walton, Reed, Macango 2010, pp. 14–15) , who developed the scheme of Stein's inference quoted above into the following syllogism (using the symbols applied above):

(*Major premise*) Source ***E*** is an expert in the field of polygraph examinations, which contains the propositions $\boldsymbol{R_1}$ or $\boldsymbol{R_2}$. (*Minor premise*) E claims that the propositions $\boldsymbol{R_1}$ or $\boldsymbol{R_2}$ are true. (*Conclusion*) The propositions $\boldsymbol{R_1}$ or $\boldsymbol{R_2}$ may credibly be considered true.

The authors, rightly pointing to the natural readiness to accept experts' opinions, equally justly write that there are no reasons to consider them infallible and omniscient, suggesting at the same time treating the arguments from their opinions as defeasible. To facilitate the analysis of such arguments, the authors propose a tool composed of six questions, the answers to which will help in solving the problem of opinion credibility. In the context analysed here, the questions are as follows: (1) how credible is ***E*** in the capacity of an expert? 2) Is ***E*** an expert in polygraph examinations? (3) According to ***E***, what do the propositions $\boldsymbol{R_1}$ or $\boldsymbol{R_2}$ result from? (4) Is ***E*** personally a reliable source? (5) Are the propositions $\boldsymbol{R_1}$ or $\boldsymbol{R_2}$ coherent with the claims of other experts? (6) Are the claims of ***E*** based on the mass of evidence?

Questions (1) and (2) refer to the qualifications and personal properties of ***E***. The answer should be sought in ascertaining the certification that the expert might have. That can for example be a certification issued by the institution that employs the expert or by a professional corporation. They can also be certificates of training completed, scientific achievements, etc. The answers to question (1) can also be sought in the expert's biography, his or her references, and the opinions about the expert in the professional community.

Question (4) may be interpreted as a problem concerning the quality of the expert's work. Primarily, this is about the correctness of the method of polygraph examination used. Therefore, it is worth reiterating that correct and allowed in practical use is a method with precision defined in an independent and fully published study, sufficient diagnostic value (at least 80% for investigation purposes), and a range of other features (Krapohl 2006, for other quality requirements see: Konieczny 2009).

Question (5) is not fully clear. If one assumes that it refers to a polygraph examination of the same person (persons $\boldsymbol{A}_i$ and $\boldsymbol{A}_j$), conducted by other experts to achieve the same goal, they will either support, much like $\boldsymbol{E}$, propositions $\boldsymbol{R}_1$ or $\boldsymbol{R}_2$ (which will entail the use of the *communis opinio doctorum* principle), or if they recognise some other propositions, there will be a dispute. The sense of such disputes and means of tackling them are described in D. Dwyer (2008). If the consistency of the result of polygraph examinations is to concern its alignment with other expert opinions, then the case is decided at the stage of building a scenario, as discussed below.

Question (6) actually concerns the persuasive skills of the expert, and specifically whether he or she will be capable of convincing the recipients of his or her opinion about the correctness of the inference made on the grounds of the materials gathered, primarily the charts acquired while conducting the tests. The question can be considered a "subquestion" to (3).

Question (3) is definitely the most important of the entire set quoted above. It concerns the grounds for forming opinions, that is generalisations that allow the construction of an argument. If such a generalisation is used in evidence-based reasoning, it can be defined as generalisation on evidence. It allows inference from premises to conclusions, in this way influencing the power of the given evidence-based argument, and becomes the "cement" bringing the given argument together (Bex et al. 2007, p. 146).

According to the definition proposed by Anderson, generalisations are general claims concerning the way of perceiving the mechanisms in the world surrounding us, human behaviours and intentions, environment, and interactions between the environment and individuals (Anderson, Schum, Twining 2005, pp. 262–288). They may be based on empirical studies, but can also result from everyday experience and/or general common-sense knowledge. Generalisations cannot be assigned the feature of "certainty"; they are qualified with the

use of a modal quantifier, such as "usually", "often", "generally", "sometimes" (Schum 1994, pp. 81–82). Yet, as far as they are statements achieved through scientific procedures, the level of their probability is (or at least should be) known. The generalisations constructed, which have their modal quantifier provided or whose probability is known, allow potential criticism of their use in a specific situation, as a scrupulous analysis is a procedure that is equally important as the formulation of generalisations (Bex 2009, p. 93). It goes without saying, therefore, that the use of generalisations provides the necessary grounds for every step in the complicated chains of evidence reasoning (Bex, Koppen, Prakken, Verheij 2010, pp. 127–128).

Generalisations can assume the form of a statement, but also that of a conditional.

Below are examples of generalisations used in polygraph examinations.
(I) "Comparison questions are designed to provide the innocent suspect with an opportunity to become more concerned about questions other than the relevant questions, thereby causing the innocent suspect to react more strongly to the comparison than to relevant questions" (Ruskin, Honts 2002, p. 7).

This statement provides the grounds for a number of various polygraph techniques, known as comparison question techniques. Their precision is known and may, as is the case with the Utah Zone Comparison Technique, exceed 90% (Krapohl, 2006). This technique leads to propositions of the $\boldsymbol{R}_1$ type.

(II) "If a subject has committed the crime, he or she will be able to distinguish the critical item among non-critical items during the polygraph test, while an innocent subject will not. When the deceptive subject discovers the critical item in the question sequence, specific involuntary changes are triggered in the autonomic nervous system" (Nakayama 2002, p. 49).

This generalisation provides the grounds for inferring propositions of the $\boldsymbol{R}_2$ type and provides the grounds for the CIT technique. Its precision is known: in laboratory tests it amounts to 82% among both sincere and deceptive people; in actual cases it verges on 100% among sincere and deceptive people. It is contained between 60% and 90% (McCloughan 2006). The generalisation can be used in practice, but it can also be criticised quite fundamentally (Konieczny 2009, pp. 84–85).

Not every generalisation known in the field of polygraph examinations has its probability defined as well as (I) and (II). In the following case, even the modal quantifier is little known:
(III) The electrodermal recording might lack responsiveness and in some cases be totally devoid of responsiveness due to the examinee's ingestion of a drug or meditation which has anti-muscarinic properties such as antipsychotic and antidepressant meditations" (Matte 1996, p. 175).

Although necessary during the evidential reasoning, generalisations can be dangerous for the correctness of reasoning, especially when they are not expressed directly and are undefined in reference to the scope, level of abstraction, modal quantifier, empirical enforceability, and generally, their power (Twining 2006, pp. 334–335). This is why a procedure that is equally important to their use is their critical testing to minimise the related threats. This can be achieved through a simple test proposed by Anderson, Schum, and Twining. It comprises 12 questions divided into two categories, depending on their generalisation being expressed directly or remaining hidden. In the case of an articulated generalisation its precision and equivalence are studied and attempts are made to adjust the model coefficient/index, while in the case of a hidden generalisation attempts are made to "portray" and reconstruct it by the formulation of its convincing version, and later test it just like in the case of generalisations expressed directly (Anderson, Schum, Twining 2005, pp. 279–280).

To keep things ordered, let us also add that the generalisation itself is not sufficient to perform a proper evaluation of a polygraph examination, as there are also other factors that are decisive for the correctness of that action (Widacki, 2011).

Let us now assume that the result of a polygraph examination provided the grounds for formulating hypotheses in the main scenario of the event investigated. Possible, then, are three ways of criticising (conflicting) such an argument: an attack on the conclusion, an attack on the premises, and an attack on the rule of inference used in the argument (Braak 2010, p. 28).

These options are illustrated in the chart below:

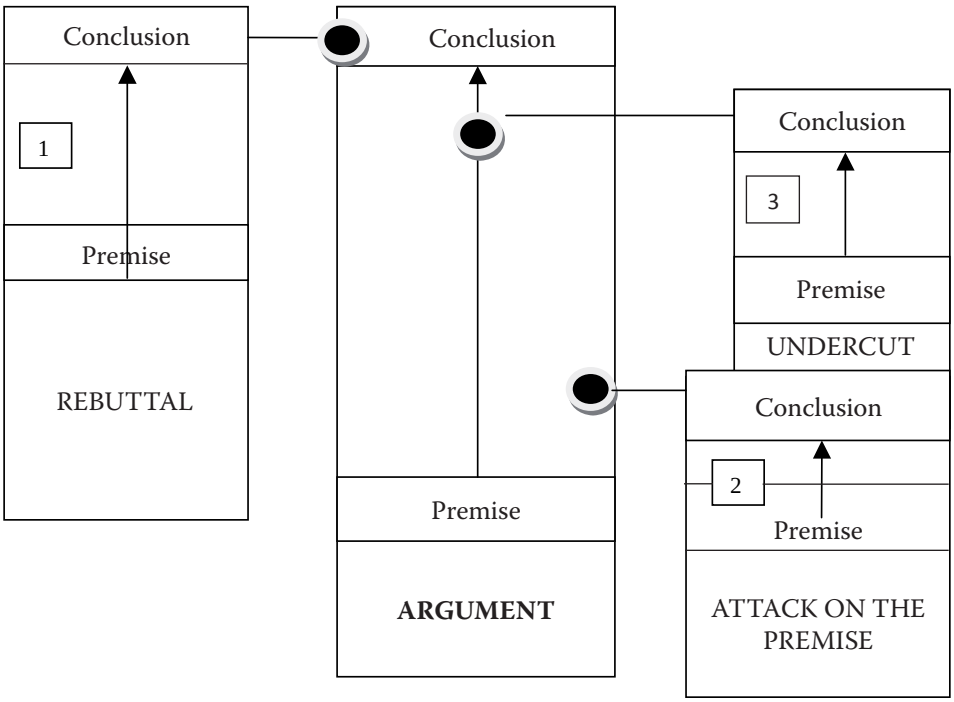

Fig. 1. Ways of attacking arguments

Source: S. van den Braak (2010), Sense-making software for crime analysis, SIKS Dissertation Series No. 2010-12, Universiteit Utrecht

The arguments that originated while using defeasible reasoning where – despite the correctness of the premises – the conclusion achieved on such grounds can be false, as the premises guarantee only a certain degree of certainty to the conclusion, can be conflicted by the first and third means of attack, that is, respectively, rebuttal of an argument by a counter argument with an opposite conclusion, and an attack on the rule of the conclusion, by negating its use in the given circumstances (undercutting); this does not mean that the conclusion in the argument attacked is false, but only that it is not sufficiently justified by its premises (Bex, Prakken, Reed, Walton 2003, p. 138).

A practical (and actually occurring) case of such a situation can be conducting fewer tests during an examination than required by the procedure for the given technique: for example, in the stead of three envisaged tests of comparative questions, an expert conducts only one, explaining the situation later as due

to lack of time or orders from a superior (an actual case known to the author). Another example can be the questioning of the rule of inference by proving (after CIT technique examination) that the examinee knew the details of the event investigated from a source other than participation in the event.

After ascertaining which of the arguments is stronger than the other, their dialectical status can be established (Prakken 2004, p. 5). This concerns the interaction between arguments and counterarguments. In this sense, three types of status of arguments can be distinguished: justified argument, that is one that triumphs when faced with counterarguments; overruled argument, namely one that loses such a "battle"; and the last, neutral – i.e. a defensible argument which "draws", leaving the "battle" of arguments inconclusive (Prakken, Sartor 2009, p. 233).

For example, if we assume that argument $\boldsymbol{R}_1$ is for some reason stronger than the argument from the explanation of $\boldsymbol{A}_i$, who does not plead guilty, the former can be defined as justified, and the latter as overruled. Significantly, the testing of the dialectical status of the arguments can be conducted only after the majority of them have been generated in a case, which means that various interactions may be perceived between them (Braak 2010, p. 28).

A significant phenomenon in this context is the so-called reinstatement of an argument (Bex, Verheij 2009c, p. 171). Even if for some reasons we prefer the argument provided by ***E***, it can be overruled by a new argument containing one of the following conclusions: the expert who issued a polygraph opinion is not credible, he misinterpreted the results, etc. In this way, this new argument may "reinstate" the argument taken up by the examinee (refusal to claim guilty), which was initially considered overruled. The phenomenon of reinstatement, let us reiterate, corroborates the requirement that – to be able to consider the mutual interactions between the arguments – all the relevant proof and information available in the case must be acquired, which will allow the final evaluation of the dialectic status of the arguments.

Closing, let us cite the so-called abductive practical reasoning scheme proposed in a work by Bex, Bench-Capon, and Atkinson (Bex, Bench-Capon, Atkinson 2009b, pp. 81–86). The scheme has the following form:

Conducting of actions ***A*** serves the attainment of goal ***G***. Thus, person ***P*** has the goal ***G***. Hence, person ***P*** should embark on action ***A***.

The significance of such reasoning may be refuted by the "discovery" that there is a better way of reaching goal *G*. Then action *A* and the previous inference will be challenged, which will allow the construction of successive arguments (Bex, Verheij 2009c, p. 173). It is easy to notice that if *G* marks the discovery of a criminal by the person *P* conducting the investigation, and *A* the use of an investigation method that remains inefficient in the given case, then the idea of conducting a polygraph examination may dawn to *P*, which will bring more benefit than persevering with method *A*, as it will allow the acquisition of new, relevant information, expansion of the pool of arguments, and – most probably – approaching, if not attainment, of the goal.

Conclusions

This essay is only a very small step towards involving the conceptual apparatus of contemporary methodological investigation modelling in the context of polygraph examination. Nevertheless, it seems that even such a small example of the possibility of looking at polygraph examinations from the angle of the modern theory of argumentation seems useful for a number of reasons. It provides notions that make it easier to note the problems and consider them critically, allows the identification of weak points in reasoning, and primarily allows gaps to be found in the existing knowledge and the directions of its expansion to be pointed to.

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Efficiency Formula for Polygraph Examination

In all known handbooks of psychophysiological polygraph examinations (Abrams, 1989; Konieczny, 2009; Matte, 1997), there is little information on when the polygraph examiner should perform a polygraph examination and when it is better not to carry out an examination.

Polygraph examiners from Moscow (Charin, 2006) were probably the first to focus on the fact that under certain conditions polygraph examination may be

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less successful or completely ineffective. This is very important to polygraph examiners from the private sector. If the private polygraph examiner performs ineffective polygraph examination, the customer may not pay for the service. Polygraph examiners working in government institutions do not face the risk of not receiving payment after unsuccessful examination. However, a polygraph examiner working in a government institution wastes time and money on the examination. In our view, the most damage is related to the fact that after an unsuccessful polygraph examination, the society loses confidence in the effectiveness of polygraph examination.

A polygraph examiner from Moscow (Charin, 2006) suggested evaluating the effectiveness of polygraph examination based on the parameters laid out in Table 1.

Table 1. Evaluation of the effectiveness of polygraph examination (in official checks)

Information on the case	5	10	15	20	25
Realization of the case	7	14	21	28	35
The significance of the case to the examinee	8	16	24	32	40

Information on the case – when almost all employees of the institution know about the details of the case, 5 points are given; when the employees of the institution where the examination is performed are poorly informed about the case, 25 points are given; an intermediate number of points is given in other cases.

The realization of the case is the examinee's ability to evaluate the circumstances in the case. If he/she was under the strong influence of alcohol or in a state of trance following consumption of drugs, 7 points are given. If during the event the examinee was fully sober, 35 points are given.

The significance of the case to the examinee – if the case is of little significance (for example, a sum of 5 dollars is missing), 8 points are given; when the case is very significant (for example, a sum of 20,000 dollars is missing), 40 points are given.

The points of the three parameters are summarized for each case. If the sum of points is less than 50, Moscow polygraph examiners do not recommend

starting a polygraph examination. If the sum of points is from 50 to 70, the test may be both successful and unsuccessful. If the sum of points exceeds 70, there is a high likelihood that the polygraph examination of this case may be successful.

Since we perform criminal polygraph examination only with the event knowledge test (EKT) (Saldžiūnas et al., 2008), our tests are not influenced by the leak (publication) of information on the case. In the polygraph examinations, the following parameters are also important to us: the qualifications of the polygraph examiner, the time elapsed between the case and the polygraph examination and the preparation of good versions of the case. Polygraph examinations are, of course, influenced by other factors (Saldžiūnas et al., 2009); however, in our opinion, the use of too many parameters is irrational in the practical evaluation of polygraph examination effectiveness.

For several years we have been using the following formula created in an empirical way for the evaluation of effectiveness of polygraph examination:

$$P = \frac{30(2S+K+2I)}{15+G^3+T}, \ \%$$

P – the likelihood that psychophysiological polygraph examination will be performed successfully (%)
S – the significance of the case (3–10)
K – the qualifications of the polygraph examiner (3–10)
I – the quality of information gathered on the case or versions (3–10)
G – the inebriety of the person during the event (0.5–5 per mille)
T – the time elapsed between the case and the examination (0,1,2,.....years).

N.B. Indicated here are the optimum limits of parameters. In the case of lower values than of S, K and I, there is no point in performing the polygraph examination. The influence of alcohol from 0 to 0.5 per mille practically does not influence the result. Parameter G should also reflect the influence of drugs on the examinee during the case. In such a case, the polygraph examiner sets the value of parameter G based on his experience.

Figures 1, 2 and 3 show how the likelihood of the successfulness of psychophysiological polygraph examination varies together with the change in parameters S, K, I, G and T.

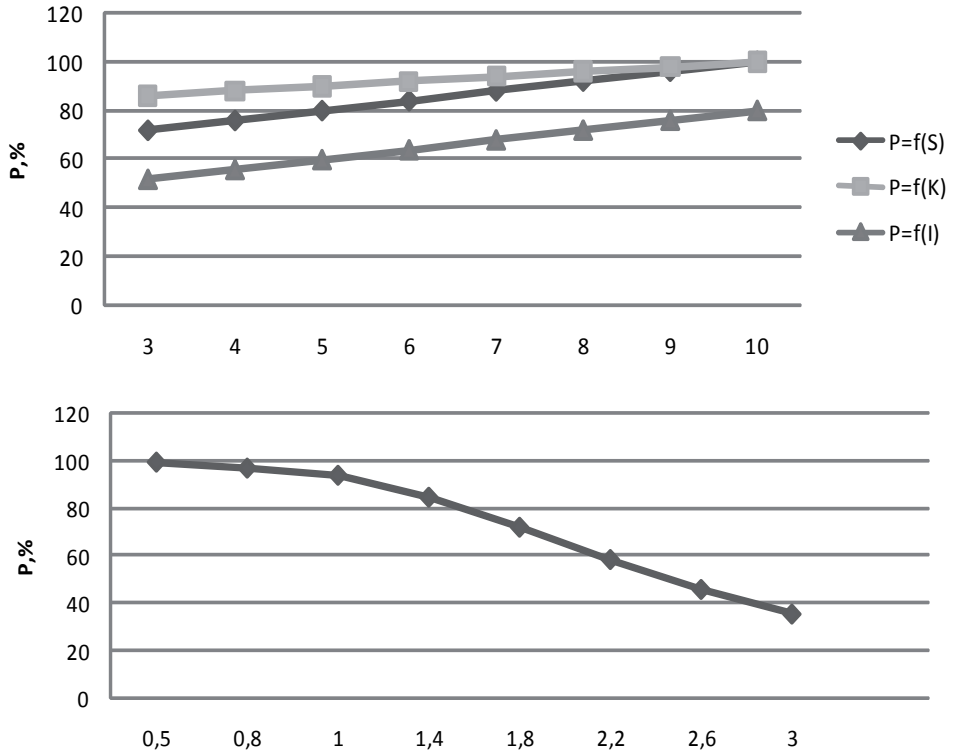

Figure 1. The dependence of the effectiveness of psychophysiological polygraph examination on S, K and I in the case of fixed remaining parameters:
P=f(S), when K=10, I=10, G=0 and T=0 (no more than 1 year passed from the event);
P=f(K), when S=10, I=10, G=0 and T=0;
P =f(I), when K=10, S=5(crime of little significance), G=0 and T=0.

Figure 2. The dependence of the effectiveness of psychophysiological polygraph examination on G in the case of fixed other parameters (S =10, K =10, I =10, T =0)

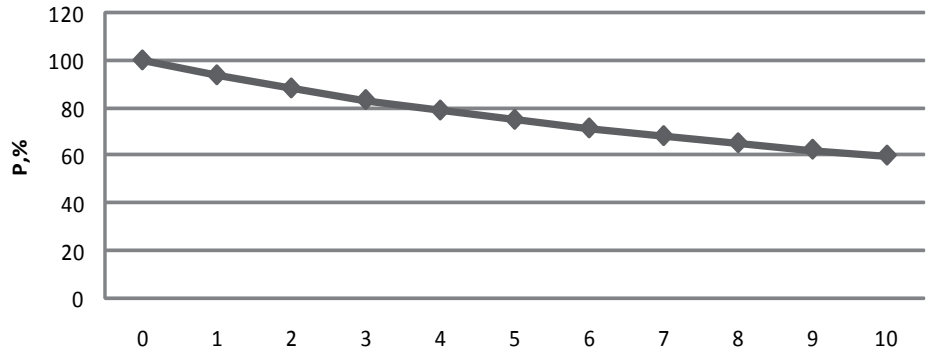

Figure 3. The dependence of the effectiveness of a psychophysiological polygraph test on T in the case of fixed other parameters (S =10, K =10, I =10, G =0).

The information illustrated in Figures 1–3 is not absolutely precise. These values are only for orientation purposes. For example, the effectiveness of the examination can depend on time elapsed after the case completely differently, as the stability of memory is different among all individuals.

We recommend the following:
a) when P is less than 50%, psychophysiological polygraph examination should not be performed;
a) when P is more than 50%, but less than 70%, psychophysiological polygraph examination can be problematical;
c) when P is more than 70%, it is likely that polygraph examination will be successful.

The application of formulae in practical polygraph examinations is illustrated with two examples.

Example 1. A murder was committed seven months ago. Forensic medicine experts established approximately how many times and to which body parts the victim was hit, presumptions were made about the murder weapon and the causes of death were determined. The police arrested two suspects who were present during the crime. Both suspects provided their own versions of the case, i.e. made allegations towards each other of having beaten the victim. Both claimed that they had not beaten the victim personally. The criminal police applied to the polygraph examiner with an application to determine how many times, to which body parts and with which tool each suspect hit the

victim. At the time of the crime, each suspect had a bottle of beer. Before the examination period, the polygraph examiner had successfully tested about 300 criminal cases and on about 20 occasions explained the conclusions of polygraph examination in courts.

The following values can be inserted into formula: S=10 (murder), K=9, I=9 (two versions of suspects which perfectly suit the forensic medicine conclusion regarding the injury), G=0, T=0. The calculation showed: P=94%.

N.B. The polygraph examination was performed successfully. The court made the judgement based on the conclusion of polygraph examination.

Example 2. An elderly woman died as a result of falling down the stairs. The prosecution service suspected that she could have been pushed down the stairs by her son. In the process of the criminal investigation, it was established that the son was under the strong influence of alcohol during the accident. The polygraph examination was planned to be performed within half a year of the event. The polygraph examiner was highly qualified.

The following values can be inserted into the formula: S=10 (murder), K=9, I=3 (criminal investigation versions have almost no proof), G =2.5, T =0. The calculation showed: P=31%. The polygraph examiner refused to examine the suspect with a polygraph.

Summary

The effectiveness of psychophysiological polygraph examination is not precise; it can be useful only for the prediction of a potential result.

In order to avoid complexity of the formula, only several main parameters of the effectiveness of psychophysiological polygraph examination P are used.

Knowing the effectiveness of psychophysiological examination, the polygraph examiner can make the decision:

– to perform a polygraph examination
– to refuse to examine the case (person)
– to offer the client to gather more information (carry out expertise) on the case in order to develop better versions or find another polygraph examiner with higher qualifications.

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Legal Admissibility of Employee Polygraph Examinations in Poland

Polygraph testing in Poland is associated mostly with criminal cases and discussion about the power of evidence from such examinations in criminal investigations. The use of the polygraph in Poland in criminal cases has been described extensively.[1] Nevertheless, recently the discussion has increasingly frequently pertained to the use of such examinations in other fields, and especially in labour and employment. Court cases related to labour law increasingly frequently feature the question of admissibility of such examinations and the consequences that they entail for the employee, including also the option to dissolve an employment contract on the power of such an examination. Moreover, the enrolment procedure of the future employee using such an examination is questionable. The above concerns questions related to rights of employees in the private sector, while the

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admissibility of such examinations towards officers of specified police forces is regulated by separate acts of law.

In Polish legal terminology, *badania poligraficzne*[2] (polygraph examinations) are also called *badania psychofizjologiczne*[3] (psychophysiological examinations) and *badania wariograficzne*[4] (variographic examinations). They have no legal definition in the Polish Code of Criminal Procedure,[5] and are only described as "using technical means aimed at controlling the involuntary reactions of the organism".[6]
The scope of use of polygraph examination in criminal procedures has been regulated since 2003 by the code of criminal procedure (Art. 171 §5 p. 2,[7] Art. 192a,[8] and Art. 199a[9]), and also by the judgements of the Supreme Court and Appellate Courts.[10] Thus, the question of admissibility in investigations and in criminal cases as such is decided.

As far as labour law is concerned, a fundamental question arises, namely whether and on what grounds such an examination can be conducted on employees. And – should there be no clearly defined grounds and/or norms – can one infer that such examinations are permissible from the fact that the act does not forbid them expressly? It must be remembered that polygraph examination of employees occurs in two basic varieties: examinations of candidates for work (service), i.e. pre-employment, and control testing of employees or officers (screening).

While the former aims at barring undesirable people from work (service), primarily those who use false information in the application procedure, the latter – sometimes referred to, though not very precisely, as "loyalty examination"[11] – serves the detection of people who have infringed the rules binding at work (in the service), for example disclosed confidential information to other parties, leaked personal data, and/or acted to the detriment of the company and/or its clients.

First, to be able to consider the admissibility of such examinations in the private sector, worth analysing are the legal regulations that concern the examination of officers in certain state services and candidates for such services.

Such examinations are common in many countries, especially in the United States and recently also in Russia and other countries of the former USSR.[12] In the US, such examinations are generally used on police and special services

officers, and also on various civil employees of the federal administration should these have access to confidential information, drugs, etc.[13]

On the grounds of acts of law, undergoing such examinations in Poland are candidates for various police and special services, and also officers. In the case of candidates for service in the Foreign Intelligence Agency (AW), Internal Security Agency (ABW), Central Anticorruption Bureau (CBA), Police, Border Guard, and Military Gendarmerie, the admissibility of such examinations results directly from the act. In reference to the candidates for the Military Intelligence Service (SWW), Military Counterintelligence Service, and Customs Services, it results only from the provisions of bylaws published as fairly general delegations from the act. On the other hand, polygraph examination of officers serving in the Police, CBA, Customs Services, AW, ABW, and Border Guard are admissible on the grounds of the acts.

The legal admissibility of such examinations of officers, as defined in the acts, remains consistent[14] with Article 60 of the Constitution,[15] which requires that principles of access to public service are the same for all citizens enjoying full public rights.

Moreover, there is no contradiction between articles 30 and 47 of the Constitution and conducting polygraph examinations if their results primarily serve the protection of constitutionally guaranteed rights and freedoms.[16]

To explain how the question of polygraph examination is regulated in the case of officers in individual services, the pertinent regulations are described below.

In Chapter 5, Service of Central Anticorruption Bureau officers (Art. 50), the Act on the Central Anticorruption Bureau[17] stipulates that a candidate is admitted to serve at the CBA after undergoing a qualification procedure, which consists among other things of determining the physical and psychological fitness to work at the CBA. Yet, in the case of candidates applying for CBA posts that require special skills or predispositions, the qualification procedure may be expanded with actions aimed at testing the usefulness of a candidate to work in such a post, including conducting a polygraph examination. An officer, in turn, can be referred by right of office or on his own request to a medical committee, to have the following ascertained: his health condition, physical and psychological fitness to perform the service, and also the connection between individual illnesses and the service. The officer may also

be subjected to polygraph examination. The decision about preparing an officer for such an examination is made by the Head of the CBA, and such a decision of the Head of the CBA does not require justification (Art. 63 of the Act on CBA). In further detail, conducting the examination is regulated by the published bylaw, which mentions polygraph examination by name, and also refers to psycho-technical examinations, a term that encompasses polygraph examinations as well.[18]

Subjected to such examinations may also be candidates for work for the Internal Security Agency and Foreign Intelligence Agency, and also officers who already work for them.[19] The procedure of examinations is determined in detail by the bylaw.[20]

The admissible goals and scope of polygraph examinations were described in detail in a regulation of the Minister of Internal Affairs of 20th March 2007, concerning the way and conditions of defining the physical and psychological fitness of police officers to serve in specific posts or in specific organisational units of the Police Forces.[21] In §9 of the document, the scope of polygraph examination is described in the form of a catalogue. This contains the options for testing loyalty in service, drawing undue profits (in any form) related to serving in the Police, potential pathologies and addictions that are undesirable in service. The scope of polygraph examinations is also described in the bylaws to the Act on the Customs Service.[22] The regulation speaks of conducting physical fitness tests and psychological and psycho-physiological examinations. The document not only defines the scope and the goal of polygraph examinations, as is the case in the bylaw to the act on the Police, but also describes the entire procedure of the examination. In §23, it states that polygraph examinations may not use questions referring to denominations, political views, and sexual preferences. Moreover, the paragraph contains information that one examination must consist of at least three tests.

The thus defined goals of the examination and the *a contrario* defined scope limit the possibility of free definition of the goal and object of examinations, and specifically, asking the officers and candidates questions that are not related to the thus defined goal and scope of the examination. Asking questions that concern personal matters, for example, and those not related to the service is not allowed.

Another question that needs considering is the admissibility of employee examinations among people who are not officers of the services and

formations listed above. What is meant here is primarily the admissibility of polygraph examinations for governmental and regional and local authority staff, and the possibility of conducting such examinations among the staff of private firms.

It seems that an investigation of the question must begin with a reiteration of the principle of the rule of law, which stipulates that public bodies may do only what the law orders or allows them to, while legal persons and natural persons can do whatever is not forbidden by law.

Based on this principle, it seems obvious that polygraph examinations may be extended only to those employees (officers) who are envisaged in the acts as potential and necessary subjects of such examinations. Therefore, candidates for work in state institutions other than the ones mentioned above (i.e. the Police, Internal Security Agency, Central Anticorruption Bureau, Foreign Intelligence Agency, Military Intelligence Service, Military Counterintelligence Service, Border Guard, Gendarmerie, and Customs Services) must not be subjected to polygraph examinations, nor may be the employees or officers working in these institutions.

However, what remains an open question is the admissibility of polygraph testing of candidates and staff of private businesses. Such examination is significant in the case of posts that entail employee access to important information (related to the protection of personal rights, bank and corporate secrets, etc.), access to valuable goods (e.g. escort officers), access to security systems (e.g. airport staff, court IT personnel), and weapons.

Polish labour law does not expressly forbid polygraph examination of such people. Especially, polygraph examination is not forbidden by the Labour Code. In turn, the Labour Code (specifically, Art. 11^1) provides that the employer is obliged to respect the dignity and other personal rights of the employee. Among the personal rights, the Labour Code expounds only the dignity of the employee, which is to be construed as the respect due to the employee in regard to his or her personality, individuality, gender, civic and social attitude, and the system of values professed.[23] The assessment of an employee's qualifications may not infringe his or her personal rights (Art. 11^1 Labour Code, and Art. 23 and Art. 24 of the Civil Code), even though, in its essence, such an assessment may enter these areas.[24] Thus, the borders of admissibility of examinations may additionally be defined by regulations concerning the protection of personal rights, should the examination enter

the legally protected realm of privacy of the examinee. Thus, an examination as such is not forbidden, but one can imagine a situation in which a certain way of conducting the examination can be ruled out due to the manner of conducting it, and especially the scope of questions used in it. When these conditions are met, the qualms expressed among others by J. Wócikiewicz (Badania poligraficzne (wariograficzne) pracownika i funkcjonariusza, doctrina Multiplex Veritas, Toruń 2004, p. 38), namely, that polygraph examination infringes the guarantees resulting from Art. 11^1 of the Labour Code, are unjustified. Such prohibitions may also result from the professional ethical principles of expert polygraphers. One may doubt whether the principles of ethics allow, for example, examinations to be held in so-called marital cases. Moreover, examinations in which the religion of the examinee, his or her political views, and sexual preferences are tested would be illegal. Moreover, it is certain that the subject must not be forced into polygraph examination, but must express voluntary and informed consent to the examination being conducted. Any examination without the consent of an employee, irrespective of the lawful scope and objective, will be illegal in its essence, as any person forced to take an examination faces a restriction on his or her liberties.

Due to the character of many jobs, it is necessary to support the admissibility of conducting such examinations among employees in the private sector, yet governed by specific rules and regulations. A polygraph examination should be constructed in such a way that it does not infringe the Act on the protection of personal data,[25] and used in a way that does not infringe the Code of Criminal Procedure or the Labour Code, while the test questions should not in their scope go beyond the subjects accepted for a personal questionnaire of an employee and the employee's CV. The questions asked during the test may not encroach on the private realm of the life of the individual, nor infringe the individual's rights, including dignity, the right to protection of private life, honour, good name, etc. Moreover, the form and manner of conducting the examinations may not infringe the dignity of the examined employee. The questions formulated by the polygrapher must not be obtrusive, nor can they concern the realm of private life. Probably the most important question is the consequences of such employee examinations.

In employee-related cases, the result of a polygraph examination conducted as part of the investigation or procedure before the court never forms the only grounds for undertaking certain decisions in the trial, and especially it cannot constitute the only grounds for sentencing or acquittal. The result of

a polygraph examination is always subject to the judgement of the court and is confronted with the mass of evidence. The Polish judiciary has examined cases when a polygraph examination of the employee was the reason for the employer to apply disciplinary discharge. Such a practice must be considered non-permissible. The more so, as, for example, in the case of a negative result of a polygraph examination, even the legal regulations referring to the officers of e.g. Customs Services do not envisage discharge.[26] Such an outcome results only in transferring an officer to another post, where conducting such tests is not required – consequences towards the employees in the private sector should not go further.[27]

Independently of the selective function of polygraph examination in labour and employment relations, their results, much like in criminal procedures, must be treated only as ancillary evidence, and a suggestion for the employer that the given employee should have no access to corporate secrets and/or access to information of special significance, or that the employee requires special supervision.

In summary:
1. The Polish legal system allows pre-employment and screening polygraph examination of officers of specific police and special services.
2. Testing of officers and administrative staff, other than those mentioned in 1. above, is not allowed.
3. Examination of candidates and employees of private businesses is not forbidden.
4. All polygraph examinations, of the people mentioned in 1. as well as 3. above, must be performed with the consent of the subjects, while the scope of examination may cover only the information to which the supervisors or employers have the right to access. In this way, they cannot concern other questions (e.g. private/personal questions).
5. The results of the examination cannot, on their own, constitute grounds for dismissal.

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[1] J. Widacki (2007), European Polygraph, 1.

[2] Such a notion is contained in the Act of 9th June 2006 on the Central Anticorruption Bureau (*Dz.U.*, 2006.104.708).

[3] Such a notion is contained in numerous acts of law including the Act of 24th May 2002 on the Internal Security Agency and Foreign Intelligence Agency; the Regulation of the President of the Council of Ministers of 24th April 2003 concerning the standard for personal questionnaire and detailed principles and mode of conducting the qualification procedure towards candidates for service in the Foreign Intelligence Agency; Regulation of the President of the Council of Ministers of 29th November 2002 concerning the standard personal questionnaire and detailed principles and mode of conducting qualification procedures towards candidates for service in the Internal Security Agency; Regulation of the Minister of National Defence of 26th July 2006 concerning the qualification procedure towards soldiers applying for nominations for posts in the Military Counterintelligence Service; Regulation of the Minister of National Defence, of 26th July 2006 concerning the qualification procedure towards candidates for service in the Military Counterintelligence Service; the Act of 12th October 1990 on the Border Guard; the Act of 27th August 2009 on the Customs Service; the Act of 6th April 1990 on the Police; the Act of 24th August 2001 on the Military Gendarmerie and military policing forces.

[4] Such a notion is contained in the Regulation of the Minister of Internal Affairs and Administration of 20th March 2007 concerning the mode and conditions of defining physical and psychological fitness of police officers to serve in specific posts and in specific organisational units of the Police, and the Regulation of the Minister of Finance of 20th December 2010 on conducting a physical fitness test, psychological examination, and psychophysiological examination of customs officers.

[5] Act Code of Criminal Procedure of 6th June 1997 (*Dz.U.*, 1997.89.555 with later amendments).

[6] Art. 171 §5 p. 2 Code of Criminal Procedure, Art. 192a §2 Code of Criminal Procedure, Art. 199a Code of Criminal Procedure.

[7] According to Art. 171 §5 p. 2, it is forbidden to use hypnosis, and/or chemical or technical means that influence the psychological processes of the interrogated person, or aimed at controlling the involuntary reactions of such person's organism in relation to an interrogation.

[8] Art. 192a provides the grounds for conducting psychophysiological tests to narrow down the group of suspects and define the evidence value of traces. In line with the article, to narrow down the group of suspects, or to define the evidence value of discovered traces, the following can be collected: fingerprints, a pap test from mucous membrane of the cheek, hair, saliva, samples of handwriting, and scent; furthermore, a photograph of a person can be taken or a voice can be recorded. Having finished using the above in an investigation, the material sampled or recorded should immediately be removed from the files and destroyed, if not necessary for further procedures. In the case mentioned above, with the consent of the examinee, an expert may also apply technical means aimed at controlling the involuntary reactions of that person's organism.

[9] In turn Art. 199a of the Code of Criminal Procedure allows psychophysiological tests to be conducted on a suspect, the defendant, and – which needs emphasising – a witness.

[10] The Supreme Court referred to the problem of polygraph examinations as early as in a sentence of 25th September 1976, II KR 171/76 stating that "such examinations are only of ancillary and indirect character and cannot be construed as independent evidence providing grounds for specific decisions", with later case decisions of courts, supporting the option to conduct polygraph (variograph) examinations for the purpose of court procedures, pointing at the same time to their limited practicality (e.g. the verdict of the Supreme Court of 28th October 2004, III KK 51/04).

[11] J. Pietruszka, O dopuszczalności i silnie prewencyjnym oddziaływaniu badań poligraficznych w stosunkach pracy, Monitor Prawa Pracy 2006, 4.

[12] Y. Kholodny (2008), Interrogations using polygraph in Russia: 15 years of legal application, European Polygraph, 2.

[13] J. Widacki (2008), Kryminalistyka, C.H. Beck, Warszawa, p. 384–386.

[14] As the Constitutional Court stated in the sentence from 9th June 1998, the act must define objective criteria for the selection of candidates for service and regulate the principles and procedure of recruitment, so as to assure that the principle of equal opportunities is obeyed towards all candidates, without any discrimination and unjustified limitation. In this, the above does not in any way render it impossible for public authorities to

define detailed conditions of access to a specific service due to its type and essence. Moreover, the act should define the criteria of release from the service and the procedure of making decisions relevant, so as to exclude all and any freedom in the operation of public authorities. Moreover, it is necessary to develop appropriate guarantees of legality of decisions concerning access to public service, therefore, primarily decisions about the admission or refusal of admission to the public service and release from this service (K. 28/97, OTK ZU, 1998, 4, 302).

[15] Constitution of the Republic of Poland, Act of 2nd April 1997 (*Dz.U.*, 1997.78.483 with later amendments).

[16] "Here the question arises as to whether providing a citizen with an additional argument to defend and prove his innocence is harmful to human dignity and rights (especially the right to defence), honour, good name, and the right to decide about one's personal life." – quoted in: J. Pietruszka, O dopuszczalności i silnie prewencyjnym oddziaływaniu badań poligraficznych w stosunkach pracy, Monitor Prawa Pracy 4/2006.

[17] *Dz.U.*, 2006.104.708.

[18] Regulation of President of the Council of Ministers of 20th July 2006 concerning standard personal questionnaire for candidates for service in the Central Anticorruption Bureau provides in § 6 that, during the qualification procedure, a candidate is submitted to psychological and medical testing aimed at defining the candidate's physical and psychological fitness to serve in the CBA. Further, in line with § 7, a candidate who applies for a CBA post requiring special skills or predispositions may be subjected among others to additional psychological and polygraph examinations; a psychotechnical examination.

[19] On the power of the Act of 24th May 2002 on the Internal Security Agency and Foreign Intelligence Agency (uniform text: *Dz.U.* 2010, No. 29 item 154).

[20] Regulation of the President of the Council of Ministers of 29th November 2002 concerning standard personal questionnaire, and detailed principles and mode of conducting a qualification procedure towards candidates for service in the Internal Security Agency. Moreover, Regulation of the President of the Council of Ministers of 24th April 2003 concerning

the standard personal questionnaire and detailed principles and mode of conducting the qualification procedure towards candidates for service in the Foreign Intelligence Agency states, in § 7, that a candidate applying to serve in the Foreign Intelligence Agency in a post requiring special skills or predispositions may be subjected to: a psychophysiological examination; a psychotechnical examination.

[21] Regulation of the Minister of Internal Affairs and Administration of 20th March 2007 concerning the mode and conditions of defining physical and psychological fitness of police officers to serve in specified posts or in specified organisational units of the Police.

[22] Regulation of the Minister of Finance of 20th December 2010 concerning conducting of physical fitness tests, psychological examination, and psychophysiological examination of customs officers.

[23] J. Jończyk, Spory ze stosunku pracy, Państwo i Prawo 1966, 3, 134 and ff.

[24] Sentence of the Supreme Court – Chamber of Labour, Social Insurance and Public Matters of 6th April 2011, II PK 274/2010.

[25] Act on the protection of personal data of 29th August 1997 (*Dz.U.*, 2002.101.926).

[26] Regulation of President of the Council of Ministers – Conducting physical fitness test, psychological and psychophysiological examination of customs officers (*Dz.U.*, 2010.230.1515) states in § 6 that a refusal to undergo a test of physical fitness, and/or psychological and/or psychophysiological examination results in transfer of the officer to another post, where conducting of such tests/examinations is not required.

[27] P. Ciszek, M. Chakowski, Badać czy nie badać (wariografem) – oto jest pytanie, Personel, 2005, 12, 57.

Report

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Report from the 4th Interdepartmental Polygraph Seminar, Waplewo 2011

Held from 20th to 23rd September 2011 in Waplewo was the 4th Interdepartmental Polygraph Seminar organised by the Department of Psychophysiological Studies of the Investigation Board at the Headquarters of Military Gendarmerie in Warsaw. The leading subject of the meeting was The refusal to undergo psychophysiological polygraph testing as a right of the examinee.

The significance and importance of the conference was emphasised by the presence of scientists (including Professor Jan Widacki, director of the Law Enforcement Institute at the Andrzej Frycz Modrzewski Kraków University, Professor Ryszard Jaworski, the head of the Chair of Criminology at the Faculty of Law, Administration and Economics of the University of Wrocław, and Dr Michał Gramatyka from the Chair of Criminology at the Faculty of Law and Administration of the University of Silesia). Participating in the sessions were also representatives of law enforcement, Military Gendarmerie, The Police, Border Guard, and special forces.

The session was opened by Colonel Marek Baranowski, head of the Investigation Board at the Headquarters of the Military Gendarmerie, who delivered a paper on behalf of the Commander in Chief of the Military Gendarmerie Major General Dr Mirosław Rozmus on structural changes in military Gendarmerie. Presented were the principle, the role and the tasks performed by the Military Gendarmerie, the main indicators of development, structural and

employment changes, and also the international obligations of Polish Military Gendarmerie.

Colonel Mikołaj Przybył of Regional Military Prosecutor's Office in Poznań delivered a presentation on the refusal to undergo polygraph testing as a right of the examinee: the problem of the court from the point of view of persecution.

The successive lecture, delivered by Colonel Marek Baranowski, presented the history of polygraph testing by military Gendarmerie. By the way, the author presented the legal grounds for polygraph testing and the questions related to the refusal of being tested with a polygraph.

Professor Ryszard Jaworski (University of Wrocław) presented The individual case study in the assessment of the results of a polygraph test.

Colonel Jan Wilk, MD of the 10th Military Clinical Hospital presented the question of the refusal to undergo polygraph testing from the point of view of an expert psychiatrists/psychologist. The author focused primarily on the presentation of difficulties in the evaluation of the refusal to undergo polygraph testing, emphasising that such a refusal is a multidimensional phenomenon and cannot be treated solely in a light that is negative for the subject, as it may result from numerous premises, with psychological and sociological factors (e.g. group solidarity) being among the potential decisive factors.

Tomasz Majewski of the Headquarters of Border Guard discussed the fundamental questions related to conducting polygraph tests among candidates to Border Guard.

The paper presented by Dr Piotr Herbowski (Warsaw School of Social Sciences and Humanities (SWPS)) on The polygraph vs. the right to defence focused especially on the portrayal of the very essence of the right to defence being a fundamental right of the defendant in a trial, the difficult position of the accused concerning the options for the defence, and the opportunities that polygraph testing gives to the innocent in becoming freed from suspicions and charges. Moreover, the author addressed a subject that is frequently embarked on in discussions, namely that in the general understanding the polygraph still operates under an erroneous concept, which puts the method in the shadow of suspicion, namely as "lie detector", which influences the recognition of this method

as controversial and is, as the author believes, unjustly perceived in most cases as an additional incriminating proof.

Dr Artur Marchewka (Institute of Experimental Biology of the Polish Academy of Sciences (PAN)) presented the new directions in the development of neurophysiological research, focusing especially on the options for using functional magnetic resonance in lie detection in laboratory conditions. Moreover, the author presented own studies concerning the influence of emotions of the process of obtaining false results using the fMRI technique and Voxel Based Morphometry (VBM). Presented were also studies on instructed lie. The presentation caused plenty of interest and resulted in a discussion concerning the possibility of using multimodal tests in lie detection.

The presentation by Dr Henryk Polakowski (Division of Infrared Technology and Thermal Imaging of the Institute of Optoelectronics of the Military University of Technology) in collaboration with Lieutenant Colonel Jarosław Pilski concerned, the use of a thermal imaging camera in registering human emotions during psychophysiological tests. Presented were own studies: an experiment with the use of a thermal imaging camera in ascertaining emotional states related to communication of lie.

Dr Michał Gramatyka (University of Silesia) presented studies on the use of the voice analysis technique in pre-employment polygraph testing. After an empirical presentation of the technique, the author expressed a critical opinion on the method.

In his presentation, Michał Widacki (Andrzej Frycz Modrzewski Kraków University) shared the conclusions from polygraph tests of employees of protective services companies, pointing also to the justification of conducting polygraph tests among the employees of such businesses being a significant complementation of the enrolment procedure.

Dr Krzysztof Wróblewski (Lublin, Kraków) presented a broad range of memory disturbances/syndromes perceived in the context of various illnesses including diabetes, epilepsy, and post-alcohol disorders.
Presentation by Jan Widacki (Andrzej Frycz Modrzewski Kraków University) concerned the role of the professional organisation of polygraphers in developing and conforming to expert and ethical standards of testing. The discussion ensuing concerned developing a joint methodology of studies for all entities that run polygraph tests.

Lieutenant Colonel Piotr Sukiennik, head of the Department of Psychophysiological Testing at the Investigation Board at the Headquarters of Military Gendarmerie delivered a lecture concerning polygraph tests in combat and extreme conditions.

All the persons interested had an opportunity to participate in workshops for polygraphers conducted by Renata Dąbrowska of Internal Security Agency (ABW). A presentation entitled The questions concerning the principles of building control questions and their use in polygraph testing was delivered during the workshop.

The proceedings were closed by Colonel Marek Baranowski, who thanked the participants for active participation, and emphasised the high expert level of all the presentations. He devoted his address also to the question of building a joint website that would serve the exchange of experience and information between polygraphers, in which it would help people from various institutions dealing with practical use and execution of polygraph testing to come together.

The programme of the conference allowed a lively exchange of opinions. The need to emphasise the establishment and observance of expert and ethical standards of polygraph testing was recognised, and the initiative put forth by Professor Jan Widacki and Colonel Marek Baranowski to reactivate the Association of Polish Polygraphers (Stowarzyszenie Poligraferów Polskich) was taken up.

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

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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.

and (Reid, Inbau, 1966), (Abrams, 1973) inside text.

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