THE PATTERNS OF TRUTH AND LIE, AS SEEN ON THE POLYGRAPH DIAGRAMS: AN EMPIRICAL STUDY

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Abstract: *Drawing conclusions out of the polygraph diagrams can be a very difficult process. The difficulty is based on various reasons, as shown in the further presentation. We found that, usually, on a given case, not only one reason of difficulty in interpreting a polygraph diagram is found, but two or more. This paper presents the results obtained through an empirical study. A number of 10 polygraph tests were performed, on subjects who were students at the time of the experiment, using the Reid technique of control questions. The analyses of the results focuses on identifying the differences between truth and lie, as well as on finding arguments in order to draw a reasoned conclusion referring to the relevant question.*
Keywords: *Polygraph; forensic science; criminal investigation; lie detection; control question; relevant question.*

INTRODUCTION

The polygraph has been fascinating people since its discovery. The potential uses of the polygraph cover a wide range of human activities, from solving criminal cases to verifying the credibility of employees and even to influencing future moral behaviour (Peleg *et al*. 2019; White, 2018; Injodey & Joseph, 2007). Despite its quite extended use, the efficiency of the polygraph in detecting lie is the subject of a wide debate. There are both sustainers (Lucero, 2015; Horvath & Reid, 1971; Ginton, 2013) and opponents (Cook & Mitschow, 2019; Bingaman, 2004; Zelicoff & Rigdon, 2017; Faigman *et al*., 2003; Iacono & Ben-Shakhar, 2019) of the accuracy, which can be provided by a polygraph. In addition, there are authors who recommend further tests, in order to create a coherent theory, which, eventually, may give polygraph its scientifically correct place (Nortje & Tredoux, 2019). In this paper, we try to bring a little more light on the value of the polygraph examination, by presenting the results we obtained after an empirical research.

METHODS AND TECHNIQUES

In our experiment we tested a number of 10 persons, using the Lafayette LX4000 Computerized Polygraph. The method used was based on the Reid technique of "control questions" (Reid, 1947; Inbau *et al*., Abrams, 2009). The Reid technique was adapted to the specific of the experiment. The testing was carried out in an academic institution, and the persons who were tested were, at that time, students in their final year. In the testing procedure, we first had a pre-test interview with the persons which were about to be tested. Based on this pre-test interview, we established a number of 10 questions which were to be used. The questions were structured on three levels: neutral, control and relevant questions. Our "target" was to find out if the students had copied on the written final

examination at a specific discipline (we will name it here "discipline X"). This was our way to simulate a "criminal offence". In this context, the relevant question we used was: "Have you copied at the written final examination at the discipline X"? The control question used was: "Have you ever copied at a written examination?". We have chosen this control question because students are likely to deny that they ever copied at any written examination. If they deny and they did copy at least once at a written examination, the polygraph will usually register a significant response, compared to the neutral questions. Still, if they deny and they did not ever copy at a written examination, the wide implications of the question are likely to lead to a reaction, visible on the polygraph diagram, even at a non-deceptive subject; this is because there is a great chance that the subject at least thought of copying. Also, the subject is likely to get nervous at the thought that he or she might be suspected of copying. Even more, copying has multiple ways in which it can be done; for example, if the subject has involuntarily seen a few words on the paper of a class mate, he or she may be in doubt about the significance of this "incident" (if it was or not an act of copying).

In refer to the relevant questions and to the control questions, we did not make any suggestions to the subjects. However, in refer to all the other questions (the neutral questions), we asked them to lie at least at one question.

After the test had been carried out for each of the subjects, they told us at which of the neutral questions they lied. Based on all these data, after analysing the polygraph diagrams, we had a twofold goal:

A. To compare the sections of the diagrams corresponding to lies to those corresponding to truthful answers;

B. To find out if, at the relevant questions, the subjects lied or if they told the truth.

RESULTS AND DISCUSSION

We will present the results by reference to the two categories of goals we had.

A. As regards the comparison between sections corresponding to lies and sections corresponding to truth in the polygraph diagrams, the results obtained through this experiment can be structured in three categories:

a. results which prove that, in some cases, there are different lie patterns at the same person;

b. results which prove that, in some cases, there are similarities between sections corresponding to truth and sections corresponding to lies, at the same subject;

c. results which prove that, in some cases, there are a series of reactions when the subject tells the truth which may be interpreted as indicating deception.

B. As regards the truthful or deceptive answer to the relevant question, our results can be structured in two categories:

a. cases where the answer to the control question presents a significant alteration, compared to the answer to the relevant question (we found only one such a case);

b. cases where no significant conclusions can be drawn out of the comparison between the answer to the control question and the answer to the relevant question (the majority of cases in our experiment).

We must emphasize the fact that we specifically wanted to obtain information about the accuracy of the polygraph test in refer to the relevant question. This is because in a real polygraph test, conducted by a forensic investigator, the main purpose would be to obtain

crucial information indicating any involvement of the suspect in committing a crime. As we presented above, one of the two purposes of our experiment was to determine if we can make a solid statement about the subject`s behaviour at the written examination at "discipline X", based on the interpretation of the diagram. In achieving this particular goal, our method, based on Reid technique, consisted in comparing the section of the diagram corresponding to the control question with the section of the diagram corresponding to the relevant question. We found that it was considerably harder to achieve this category of results (referring to the relevant question), compared with achieving the first category of results (referring to the aspect of truthful and deceitful answers).

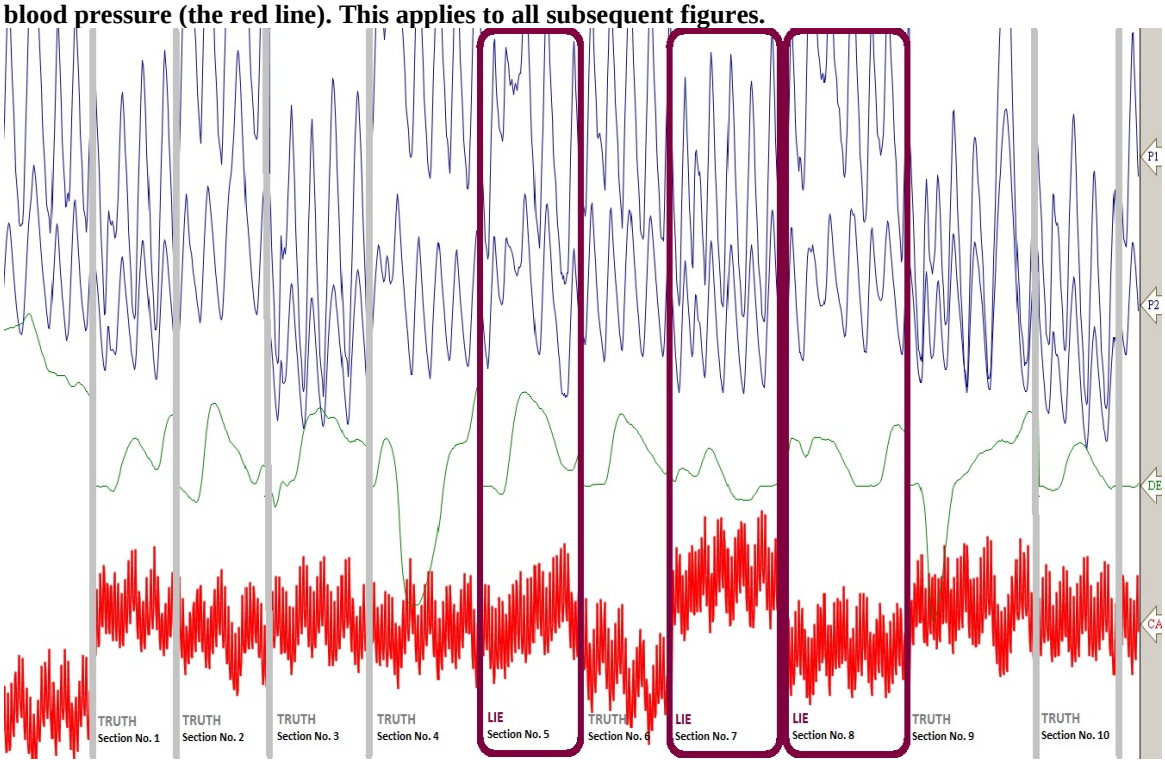
In the following lines we will analyse each category of results.

Different lie patterns at the same person

In this first group of results we include the cases when the same subject had different patterns corresponding to different moments when he or she lied.

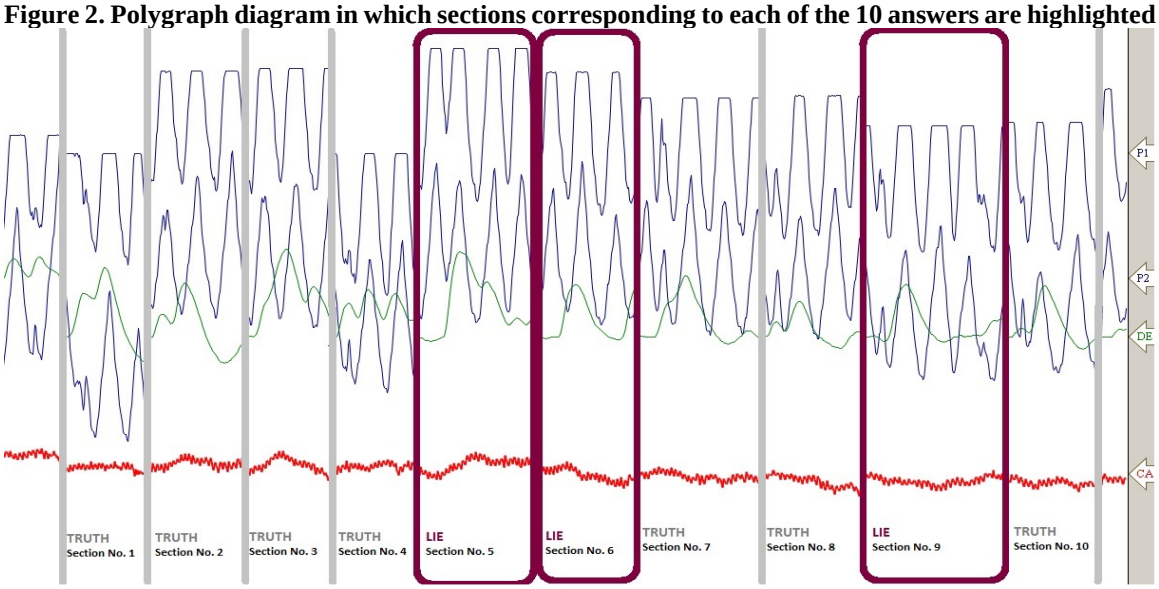
On Figure 1, we can see on the subject`s first lie (Section No. 5) an alteration of his respiratory activity (the blue lines), but the alteration is no longer found, at least not in the same form, on his subsequent lies (Sections No. 7 and 8). Also, the pattern of his blood pressure (the red line) on the three lies is different (see Sections No. 5, 7 and 8).

Figure 1. Polygraph diagram in which sections corresponding to each of the 10 answers are highlighted. The sections corresponding to lies are encircled with purple. The parameters seen on the diagram indicate: respiratory activity (the blue lines), electro-dermal activity (the green line), and blood pressure (the red line). This applies to all subsequent figures.



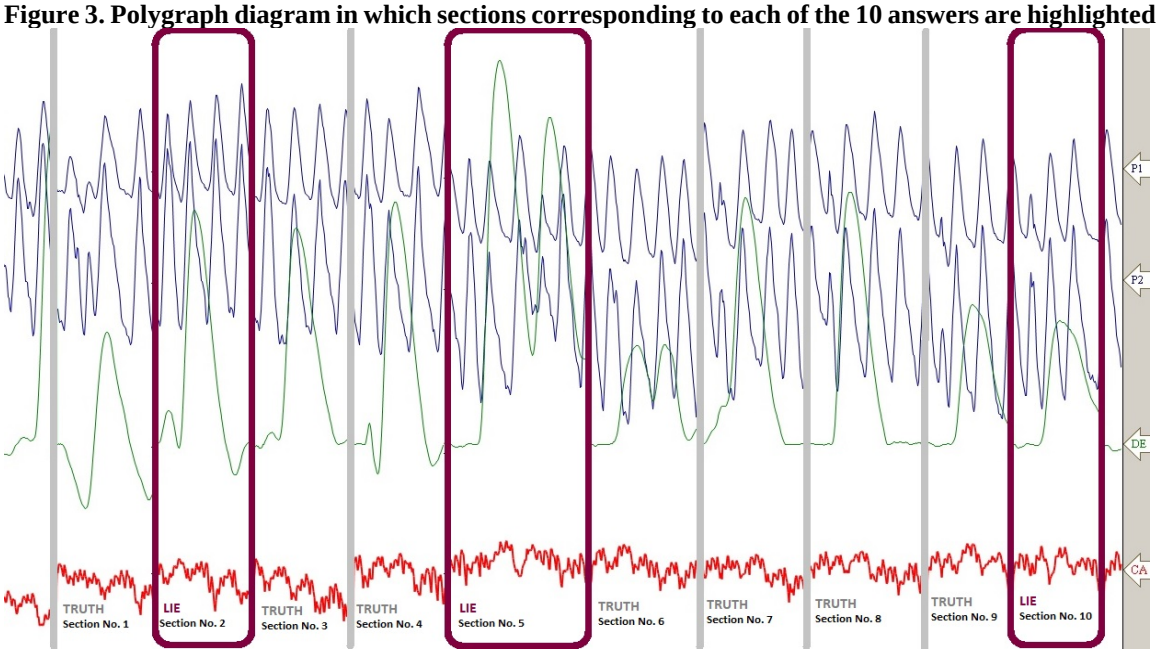
On Figure 2, we can see that the patterns of all parameters are different on each of the subject`s lies, namely the sections No. 5, 6 and 9.

Figure 2. Polygraph diagram in which sections corresponding to each of the 10 answers are highlighted



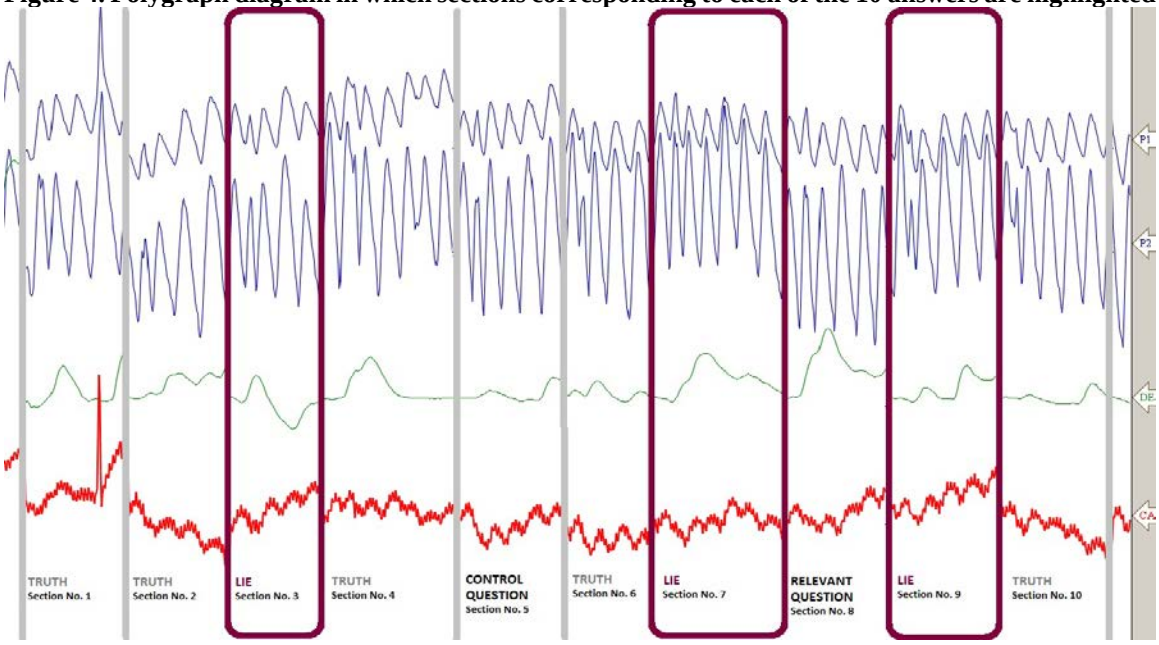
On Figure 3, we can see that the pattern of Sections No. 2, 5 and 10, corresponding to lies, are different. The difference can be seen on the electro-dermal activity (the green line), which is significantly higher at Section No. 2 and, especially, at Section No. 5, compared to Section No. 10. Also, the difference can be seen on the respiratory activity (the blue lines) and on the blood pressure (the red line).

Figure 3. Polygraph diagram in which sections corresponding to each of the 10 answers are highlighted



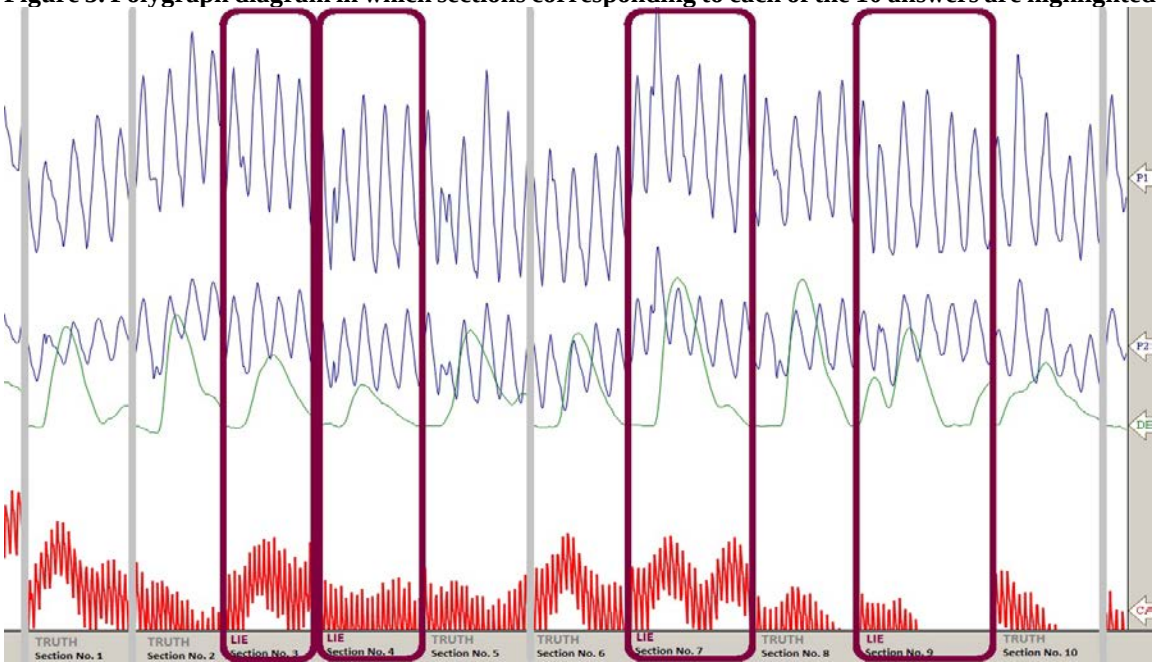
On Figure 4, we can see the differences between Section No. 3 (corresponding to a lie), and Sections No. 7 and 9, also corresponding to lies.

Figure 4. Polygraph diagram in which sections corresponding to each of the 10 answers are highlighted



On Figure 5, we can see the differences between Sections No. 3, 4, 7 and 9, all corresponding to lies.

Figure 5. Polygraph diagram in which sections corresponding to each of the 10 answers are highlighted



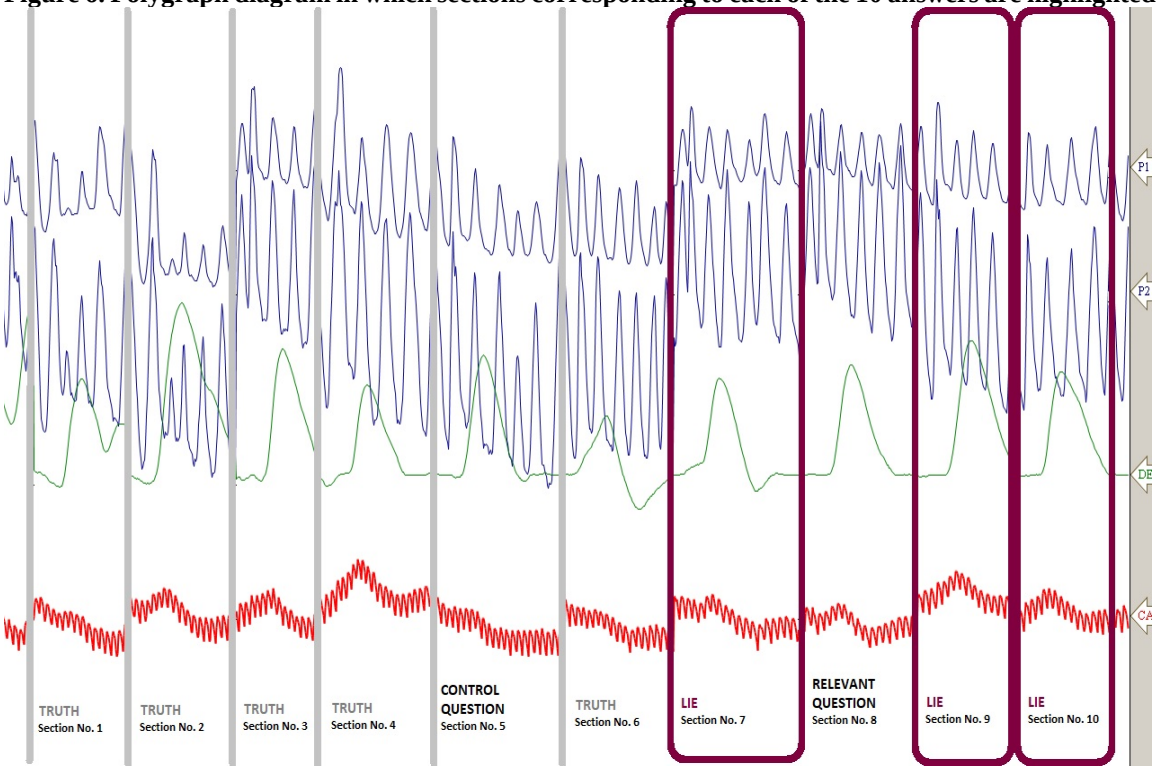
Similarities between sections of the diagram corresponding to truth and those corresponding to lies

Our test proved that, in some cases, there are similarities between sections corresponding to truth and sections corresponding to lies on the polygraph diagrams. This

can be interpreted in the sense that the subject can control his or her reactions and, therefore, deceive the investigator.

On Figure 6, we can see similarities between Sections No. 3 and 7, although Section No. 3 corresponds to a truthful answer, and Section No. 7 corresponds to a lie.

Figure 6. Polygraph diagram in which sections corresponding to each of the 10 answers are highlighted



On Figure 3 (presented above), we can see the similarities between Section No. 9 (corresponding to truth) and Section No. 10 (corresponding to a lie).

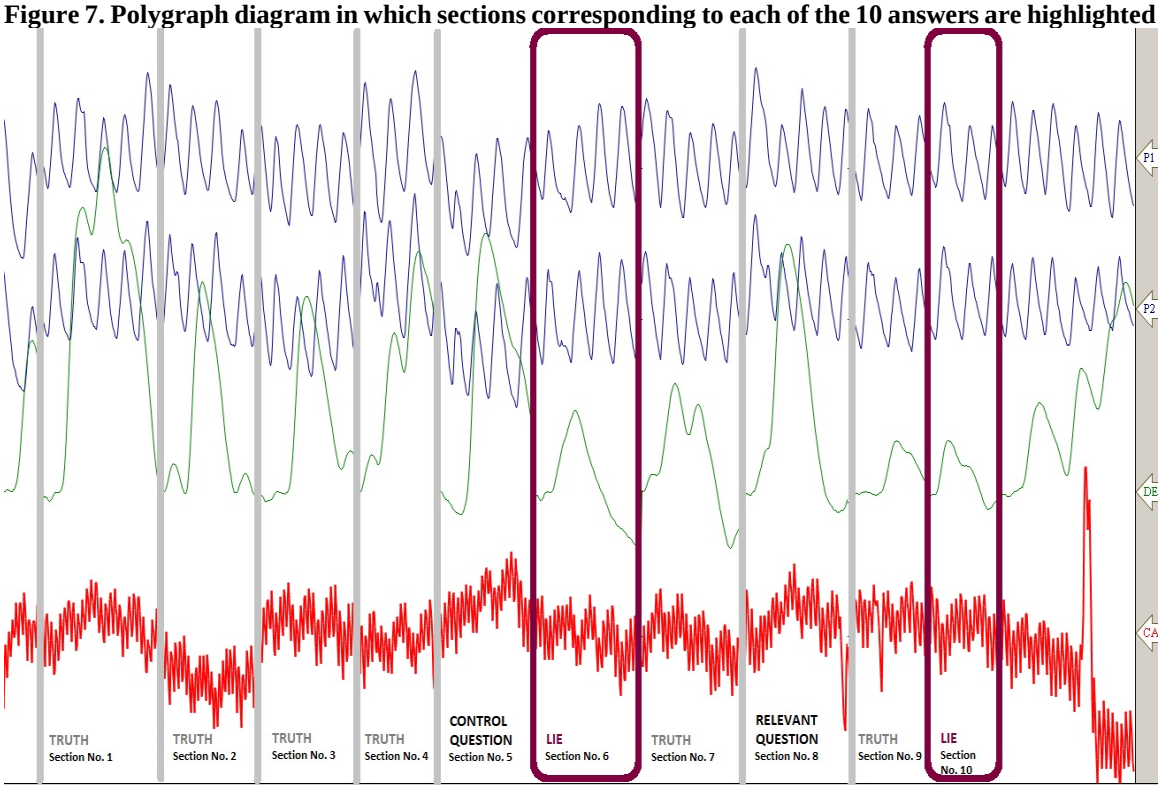
Truthful answers which may be interpreted as deceitful

The analysis of the diagrams showed us some situations where the reactions of the subject while telling the truth were significantly high, which would normally indicate a lie.

In Figure 6 (presented above), we can see at Section No. 2 that the subject had a significant variation on his respiratory pattern (the blue lines) and on his electro-dermal activity pattern (the green line), although he told the truth. This result is particularly interesting, because we do not find this variation at any of the other answers, including the deceitful ones of this subject.

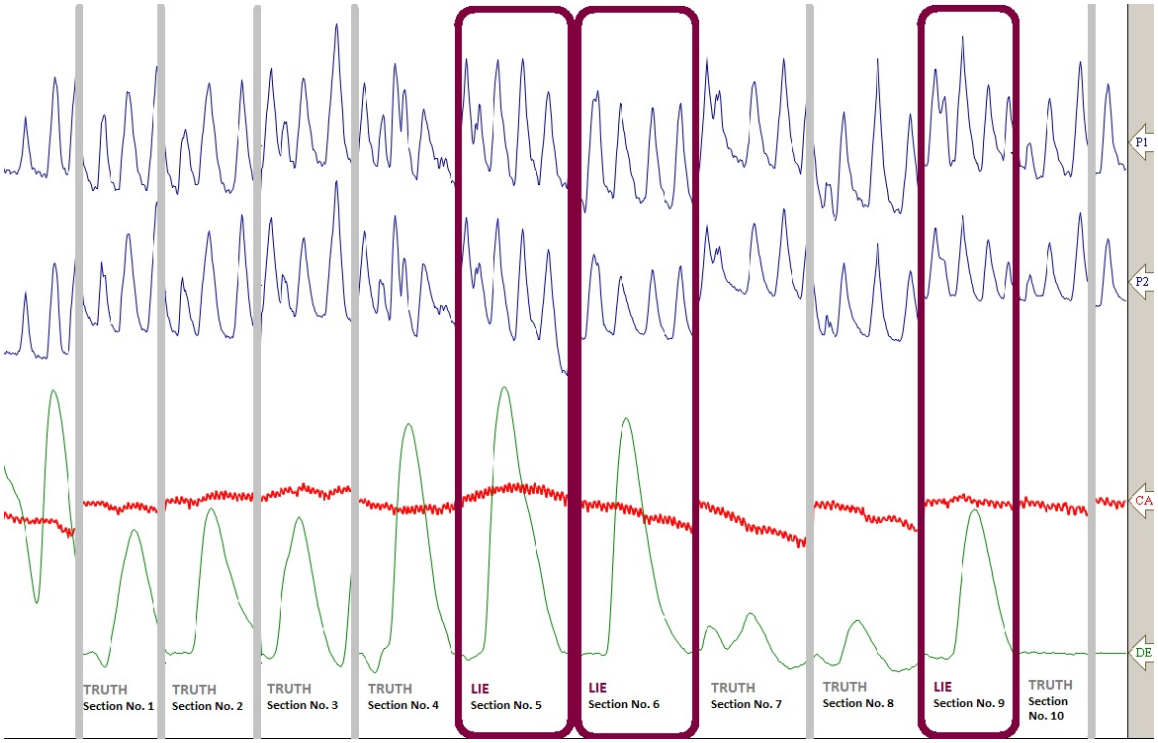
In Figure 7, Sections No. 1 and 4, which correspond to truthful answers, show significantly increased responses than sections corresponding to other answers. At Section No. 1, we can see a high electro-dermal response (the green line), actually the highest on the diagram. At Section No. 4, we can see an altered respiratory pattern (the blue lines), along with a high electro-dermal activity (one of the highest on the diagram). These observations become relevant, when we compare Section No. 1 and Section No. 4 with Section No. 10, where, although the subject lied, there is no significant variation.

Figure 7. Polygraph diagram in which sections corresponding to each of the 10 answers are highlighted



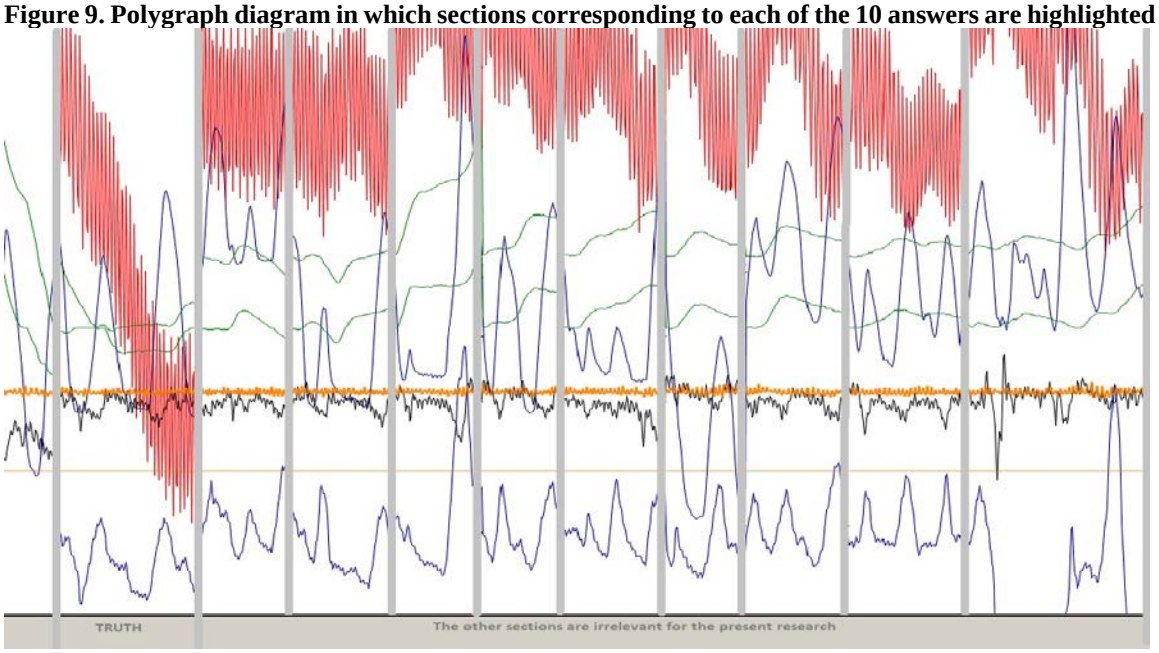
In Figure 8, Section No. 4 presents an alteration of the respiratory activity and, also, an increased electro-dermal activity. This section corresponds to a truthful answer. Due to the pre-test interview, we were able to see that this question had a particularly emotional significance for the subject. So, we can conclude that, when a question is emotionally relevant for the subject, the answer may generate an altered pattern on the polygraph diagram. This pattern can be mistakenly interpreted as indicating a deceit, although the subject has told the truth.

Figure 8. Polygraph diagram in which sections corresponding to each of the 10 answers are highlighted



In Figure 9, we can see an obvious exaggerated blood pressure reaction (the red lines) on Section No. 1, although the person has told the truth.

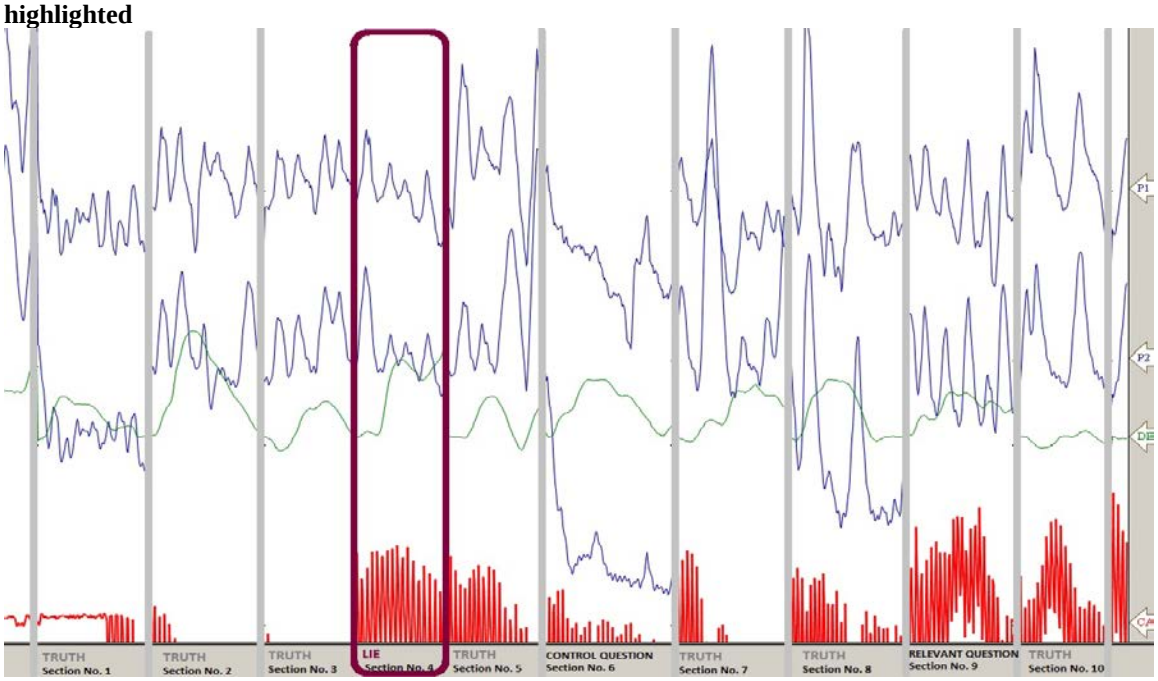
Figure 9. Polygraph diagram in which sections corresponding to each of the 10 answers are highlighted



Indicators that the answer to the relevant question is truthful

As a result of our experiment, we have found only one situation which, according to the Reid technique, indicates with a high degree of certainty that the subject had been truthful in the answer to the relevant question. In Figure 10, it is obvious that, at the control question (Section No. 6), the subject had an exaggerate reaction, pointing out that he lied. The subject`s reaction at the relevant question (Section No. 9) is significantly lower, compared to the control question; this, according to Reid technique, indicates that the subject`s stress was considerable lower when answering to the relevant question than when he answered to the control question. The common interpretation of such indicators is that the subject told the truth to the relevant question.

Figure 10. Polygraph diagram in which sections corresponding to each of the 10 answers are highlighted



Cases where no significant conclusion could be drawn referring to the relevant question

Contrary to what we initially expected, we found it very hard to draw viable conclusions referring to the deceitfulness of the answer to the relevant question. This was mainly because it was hard to find significant differences, but, interestingly enough, it was also hard to find significant similarities between sections corresponding to the control question and to the relevant question. In the following lines we will explain our assertion, based on the analysis of some eloquent diagrams.

For example, in Figure 4 (presented above), we can see differences, along with similarities, between Section No. 5 (corresponding to the control question) and Section No. 8 (corresponding to the relevant question). A difference can be seen in the electro-dermal activity (the green line), which is higher at the relevant question. However, we do not consider this difference to be significant, as we can see peaks of high electro-dermal activity on other sections, for example at Section No. 4 (where the subject has told the truth) and at Section No. 7 (where the subject has lied). A similarity can be seen on respiratory activity (the blue lines), but this similarity is not significant, because this respiratory pattern is also similar with the one found at other sections (for example, at Section No. 6, where the subject had told the truth, and Section No. 9, where the subject lied).

Another example of ambiguous results can be seen on Figure 6 (presented above), where we can also see differences, along with similarities, between the sections corresponding to the control question and to the relevant question. A difference can be seen in the respiratory pattern (the blue lines), but this is not eloquent, as the respiratory pattern of the relevant question can be found also on Section No. 3 (where the subject has told the

truth) and on Section No. 7 (where the subject lied). A similarity can be seen on the electro-dermal activity (the green line) between the control and the relevant question, but, also, this similarity is not specific, as we can see that the subject has high electro-dermal activity at virtually all answers.

In addition, Figure 7 (presented above) is eloquent for the difficulties existing in the interpretation of the polygraph diagrams. Here, we can see a difference on the respiratory activity (the blue lines) between Section No. 5 (corresponding to the control question) and Section No. 8 (corresponding to the relevant question). However, the relatively high peak of the respiratory line at Section No. 8 cannot be undoubtedly interpreted as a sign of deceit, as we can see a similar peak at Section No. 4, where the subject has told the truth. A similarity between the control section and the relevant section is seen in what regards the electro-dermal activity, but this kind of pattern (at even a larger degree) can also be found at Section No. 1, where the subject has told the truth; however, at the Section No. 1, the respiratory pattern is different than those found on Section No. 5 (corresponding to the control question) and on Section No. 8 (corresponding to the relevant question), so we cannot necessarily correlate the high electro-dermal activity on Section No. 5 and Section No. 8 with an overall pattern which could indicate a truthful answer.

CONCLUSIONS

Our experiment highlighted the difficulties existing in the interpretation of the polygraph diagrams. We have seen that the same person can have different lie patterns and, also, similarities between patterns of truthful and deceitful answers. In real-life forensic investigations, this kind of results can be confusing and not susceptible of leading to useful information. Although we have obtained in one case a result which can be seen as a clear one, we take into account that this was only one out of ten cases. The low percentage of precision makes us conclude that polygraph examination must be used with caution and that the results provided by a polygraph test must be supplemented with other information, no matter how clear a polygraph diagram may seem.

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Compliance with ethical standards

The persons who were tested with the polygraph have voluntarily agreed to participate in this research. The experiment was conducted in accordance with the legislation existing at the time of data collection. The persons remained anonymous and there is no information which could lead to the identification of the participants in this empirical study.

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