

Marisa,

Thank you for contacting us and providing an opportunity to respond to your questions.

Much of the information you have is incorrect, and it appears surprisingly similar to the distorted criticism that a competitor has disseminated in the past. This causes us to wonder who is standing to benefit from your current investigation. As you may already know, the polygraph profession is a small niche market in which only a few manufacturers participate, and competition between manufacturers can be vigorous at times. We believe that misinformation is damaging to the goal of making informed decisions, damaging to the profession, and also damaging to the public good. For these reasons, we are interested in providing you with more accurate information regarding the LX4000 and LX5000 devices. While competitors may experience their own temptations and motivations for generating misconceptions and misinformation, we are hopeful that you have approached this matter as an objective search for information without foregone conclusions about the causes of the phenomenon about which you are asking. We understand that some of your questions and information may be based upon a simple misunderstanding of the subject material, and we will attempt to respond in a manner that will help you to understand more accurately and more completely.

One significant and primary concern we have is that your questions do not seem to ask whether your information is correct at all, or which components of your assertions are correct or incorrect. Instead, you have presented your questions as matters of conclusion. Inquiry about the accuracy and inaccuracy of your information and concerns would be the most appropriate place to start. Therefore, we are approaching your questions as if you are remaining objective and unbiased on this matter, and that you are in fact asking for clarification about the accuracy and inaccuracy of the information and conclusions you are presenting in your questions.

Because you have submitted a number of questions and assumptions to us, we will attempt to respond to them individually.

**“Hello,
I’ve been looking at complaints having to do with the LX4000 and the 5000. I wanted to tell you what I’ve found and then follow up with questions.**

Polygraphers in the federal government say they first noticed a problem with plunging EDA in the manual mode of the LX4000 dating back at least ten years. In fact, I’ve been told the CIA began using the LX4000 as early as 1999 even though Lafayette didn’t market it until 2002.”

There is simply no way to respond to this except to advise you that your information is not accurate and cannot be accurate. First, we suggest more carefully verifying your sources on any information suggesting the use of an LX4000 device during 1999. As indicated in our publications and on our website (www.lafayetteinstrument.com), the LX4000 was introduced to the market during 2002. Development of the LX4000 would have been occurring during the years leading up to 2002;

therefore, it would not have been possible for anyone to have used a device that did not exist.

Secondly, EDA data has been known for decades to drift downward for some individuals, and this is the reason that engineers and developers began adding Auto (i.e., self-centering) EDA modes to analog polygraph instruments long before Lafayette was manufacturing the LX4000.

Images 1 and 2 show older analog instruments with hardware-based auto-centering (i.e., high-pass filtered) EDA options. Image 3 shows a computerized instrument with hardware-based filtering. Images 4 and 5 shows the default installation settings of software-based high-pass filter solutions offered by competitors of Lafayette Instrument Company.

Image 1
Older field instrument with auto-centering EDA feature visible in the lower right side

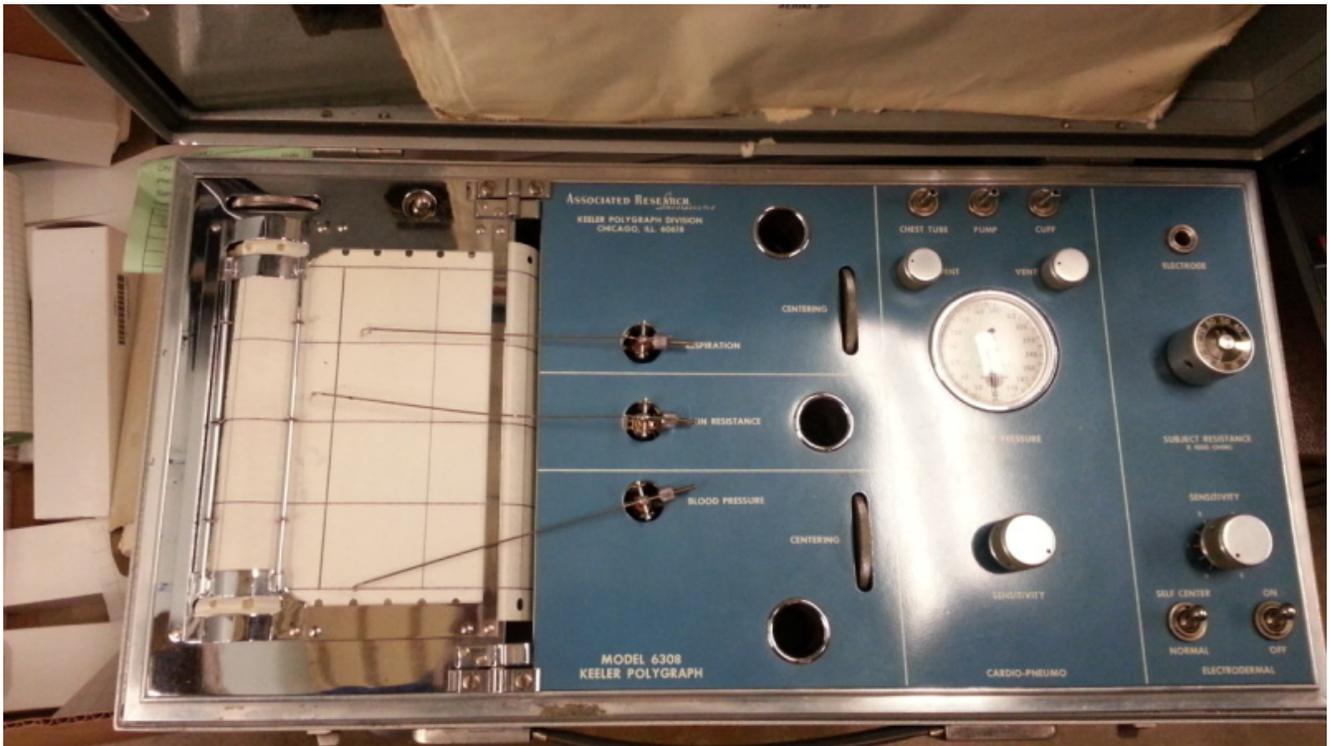


Image 2
Older field instrument with auto-centering EDA feature in lower right side of the image

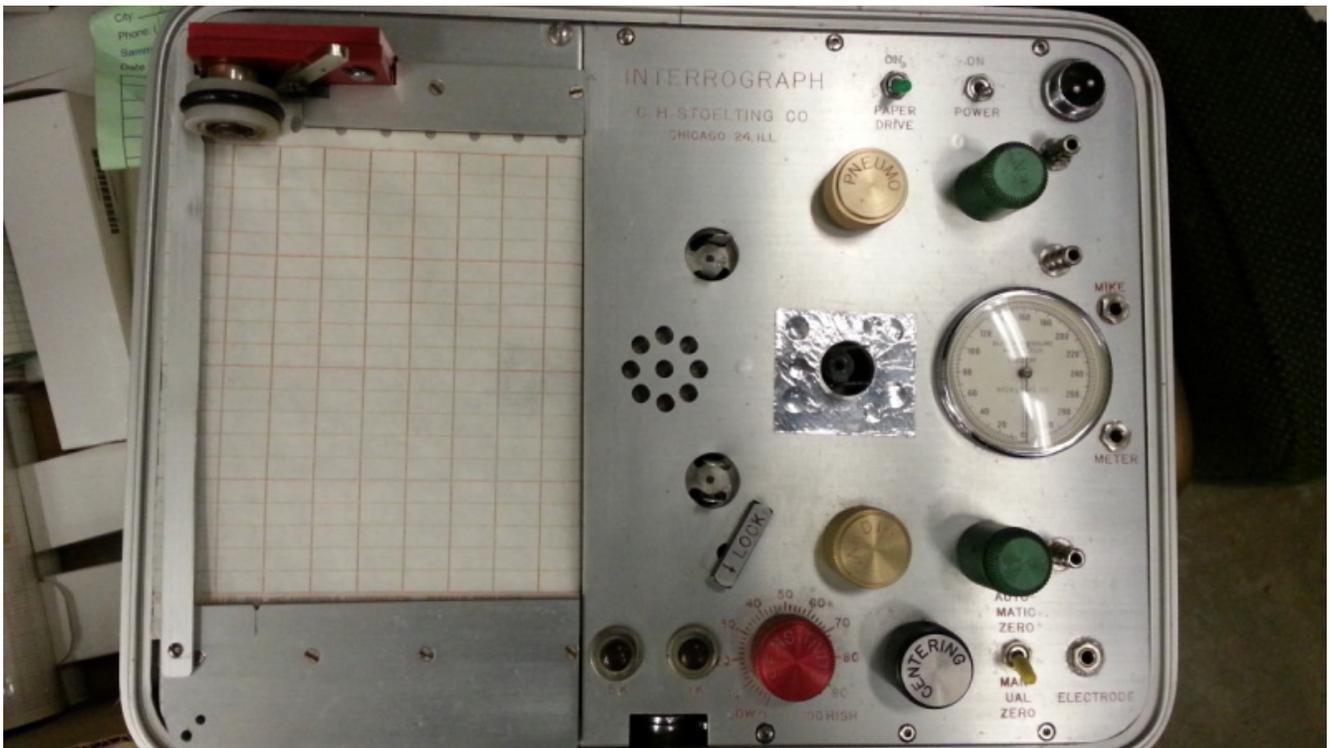


Image 3
The switch for a hardware-based Auto-EDA mode of a computerized field instrument developed by a competitor of Lafayette Instrument Company



Image 4
Example of software settings that control the selection of Auto EDA implementations using digital signal processing (DSP) filters

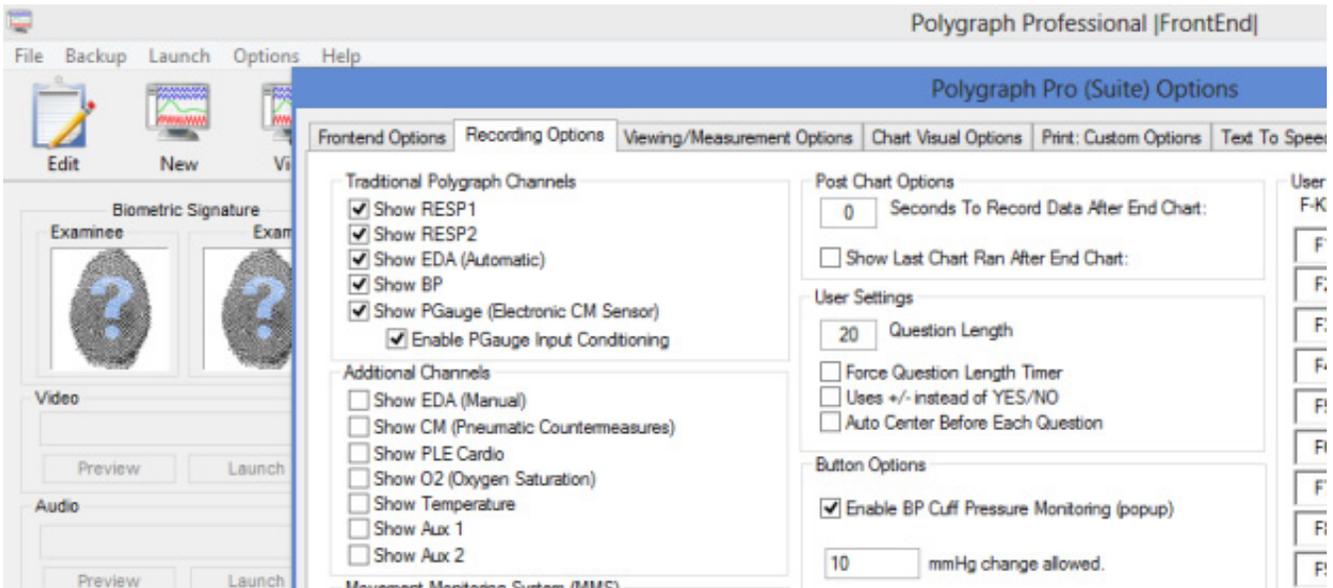
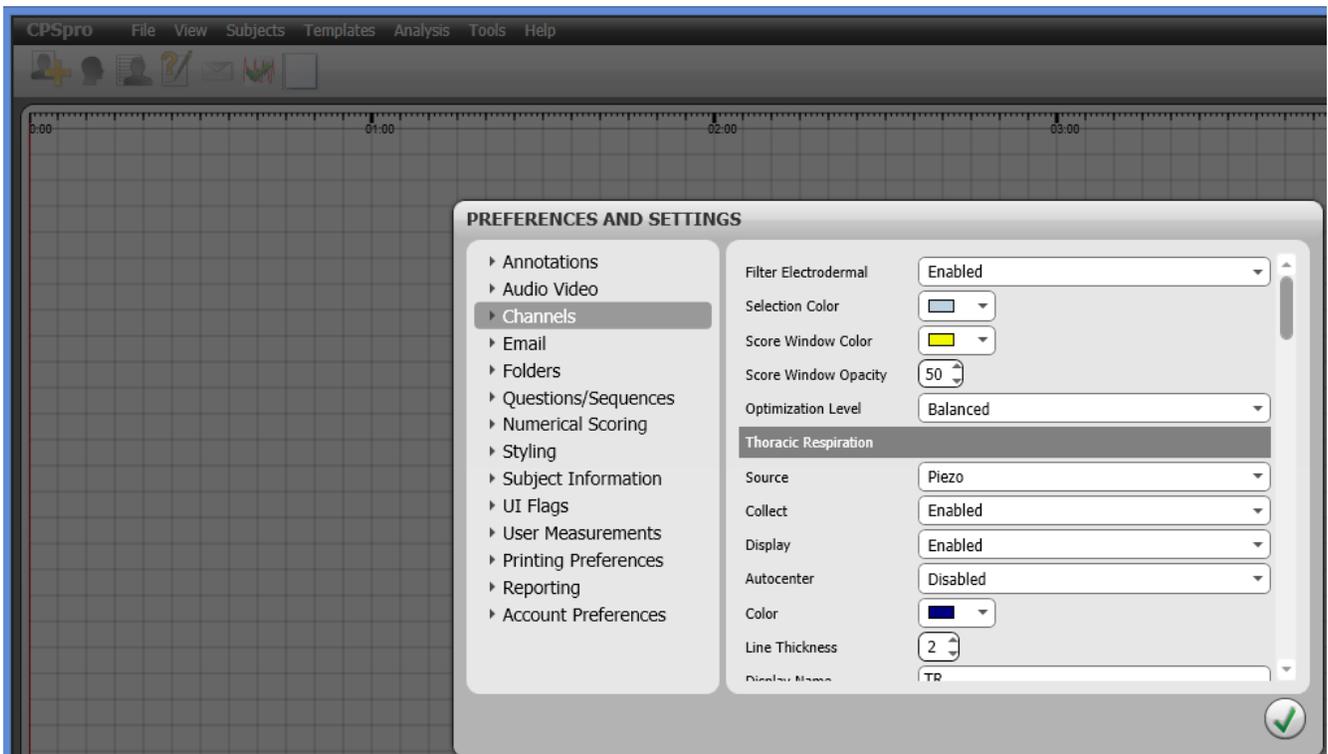


Image 5
Example of software settings that control the selection of Auto EDA implementations using digital signal processing (DSP) filters



I've attached an email that shows that Lafayette acknowledged a problem in 2007. I also have seen other correspondence from Mark Lane that says "While we believe we can minimize the occurrence of the plunging artifact, we are unsure if it can ever be completely eliminated."

Mr. Lane's email is a private communication for which the privacy was subsequently violated. It is also taken out of context and the meaning appears to be distorted to someone's advantage. There are several aspects of Mr. Lane's statement that are, in retrospect, clearly inaccurate – though he may not have known that at the time.

Any realistic and informative discussion of complex phenomena should begin with a discussion of words and terms. The term "plunging" is a metaphorical term referring to a phenomenon known to psychophysiologicals, and described in the psychophysiological literature, in which EDA data of some persons does not conform to a stable baseline level.

As you appear to be seeking accurate information, we will have to insist on forgoing vague and inaccurate metaphors in favor of empirically founded description of known phenomenon and defined constructs. To do otherwise would only facilitate reactive misunderstanding and drama instead of accurate understanding. The known phenomenon you are asking about is not unique to our devices, and is discussed in the psychophysiological literature. What is most important to understand is that it is commonly observed phenomenon for EDA to drift from the $Y = 0$ baseline for some persons.

EDA data are known for some persons to not conform conveniently to a stable tonic baseline (i.e., the plotted Y-axis zero point). Unfortunately, there are some things about physiology that are at times inconvenient. EDA instability is a known phenomenon that is described in the published literature in psychophysiology (Boucsein, 2012; Cacioppo, Tassinari & Berntson, 2007; Stern, Ray & Quigley, 2001). These effects are not unique to devices from Lafayette Instrument Company, and can be observed in data collected using technology from any manufacturer. In other words, its causes are physiological and known to occur for some persons. EDA tonic drift can include descending data, ascending data or data that varies between a descending and ascending pattern. Descending EDA data is the most commonly described. These phenomena are the very reason that filtered (i.e., self-centering/automatic) EDA modes were added to both field and laboratory instruments decades ago. The goal of a recording system is to maximize the signal to noise ratio, by reducing frequency spectra that are not of interest and retain frequencies that contain useful signal information.

Dawson, Shell and Filion (2007) wrote the following: "It is common for SCL (skin conductance level) to gradually decrease while subjects are at rest, rapidly increase when novel stimulation is introduced and then gradually decrease again after the stimulus is repeated" (p. 164). Because they are mathematically inverse, a decrease in conductance will correspond to an increase in resistance. It is important to remember that skin conductance level during both research trials and field polygraph testing is not synonymous with resting state. It is also important to realize that while descending tonic EDA is more common, ascending tonic EDA data has also been observed. Harris (personal

communication, May 10, 2005) stated: “such trending is a fact of life.” Harris and Olsen (1994) describe the use of a detrending procedure in their description of the PolyScore algorithm. Several researchers in psychophysiology have discussed the use of high-pass filters to improve the usability of EDA data (Bach, Flandin, Friston & Dolan 2010; Boucsein, 2012; Cacioppo, Tassinari & Berntson, 2007; Dawson, Shell & Fillion, 2007; Figner & Murphy, 2011; Spottiswoode & May, 2003; Stern, Ray & Quigley, 2001). Not surprisingly, publications have begun to indicate a convergence of evidence that the frequency spectrum of trending noise exists at or below .015Hz (Bach, Flandin, Friston & Dolan 2010; Figner & Murphy, 2011), while we have determined a corner frequency of .01Hz as capable of both managing data and increasing the degree of concurrence with visual and numerical analysis of unfiltered EDA solutions.

Filtering, whether hardware-based or software-based, is a commonly used solution to improve the signal to noise ratio of data of interest to many, if not all, fields of technology. It is known that filtering can alter the visual appearance of a waveform. That is often intended to improve the usability of the waveform data. Realistically, it would be naive to attempt to improve the signal to noise ratio without also altering the visual appearance. Manual test data analysis protocols rely on visual analysis and therefore it should not be surprising to encounter occasional differences in numerical scores when comparing data in different signal processing modes and this is best understood as a feature of normally occurring uncontrolled testing variance. The potential for these occasional differences has been discussed for decades in the psychophysiological and signal processing literature, and in published literature on field polygraph testing (Pochay, 1986). It is incorrect to characterize these occasional differences as a defect of either hardware or software, or as a wholesale defect of the basic technological premise. Instead, it is important to remember that all testing data is a matter of controlled variance and uncontrolled variance (i.e., signal and noise) with the goal of maximizing this difference through technology, procedure, use of evidence-based decision models based on validated feature/symptomology, and the mathematical/statistical aggregation of multiple stimulus-response observations.

As for Mr. Lane's speculation about the effective management of this or any phenomena – we will point out that Mr. Lane was simply “unsure” and not conclusive on this matter. Many people in the past have speculated about more complicated achievements as somehow impossible, and the result has been quite often wrong.

When Lafayette tried to address the 2007 plunging problem with a software update, the federal government discovered a difference between manual and auto amplitudes. That's when examples of the EDA disparities were collected and forwarded on by the federal government to Lafayette. The federal government was not able to resolve both the different amplitudes and plunging issue with a software update. The plunging issue was also seen by police departments.

This summation is incorrect. Occasional differences between manual (i.e., unfiltered) EDA data, also referred to as raw EDA data, and Auto (i.e., auto-centering, filtered) EDA data have been discussed for decades and was described in the published literature long before the LX4000 ever existed. For example: Pochay (1986) discussed the differences between the Auto EDA and Manual EDA circuits of analog instruments, and Barland and Decker asserted anecdotally that a loss of 60-75% of duration info and 25-30% of amplitude can be expected using Auto EDA mode. Auto EDA modes at that time were designed with time-constants (i.e., mathematical coefficients describing the length of time that data will normally take to return 63% of the way back to baseline/tonic level) intended to return the data to baseline in 10 seconds or more.

Modern computerized polygraphs eliminate concerns about lost amplitude because data can be easily amplified with linear multipliers. Differences in response duration, influenced by both phasic and tonic EDA, may not be important in consideration of inconsistencies in the finding of feature development studies regarding the diagnostic value of response duration data. For example: Kircher & Raskin (1988) reported duration data as diagnostic using data recorded without filtering, while Kircher, Krisjansson, Gardner & Webb (2005) reported that duration data was non-diagnostic using sample data recorded using computerized field polygraph instruments with hardware-based Auto filtering. In contrast, response amplitude has consistently been described as a strong diagnostic indicator (Ansley, 1999; Harris, Horner & McQuarrie, 2000; Kircher & Raskin, 1988; Kircher, Krisjansson, Gardner & Webb, 2005; Raskin, Kircher, Honts & Horowitz, 1988).

Prior to 2007, unstable EDA data was managed with a high-pass filter that was designed to replicate the functionality of older analog polygraph instruments, with time-constants that returned all data to the baseline within a period of approximately 10 to 15 seconds. A description of the filter coefficients is on our website. During 2007 our customers began to request our assistance at better understanding and reducing the potential for occasional scoring differences, resulting in a mathematical detrending procedure for which the current version is a simple solution that produces an essentially perfect correspondence with Manual EDA responses ($r \geq .99$) while providing completely normal operation for persons whose EDA data is stable and also managing at a stable baseline the EDA data for persons who exhibit the known phenomenon of descending tonic EDA data. A description of the detrending procedure design and function is on our website. We are preparing to publish our analysis and will, as is generally expected of new scientific information, make data available for critical peer review.

Lafayette advised U.S. agencies (including then-DODPI now NCCA) as far back as 2002 to run tests in automatic.

This is also incorrect. Lafayette Instrument Company has offered different solutions with different advantages, and has helped customers to select technology and procedures that best serve their objectives. We are aware that one of our competitors openly recommends automatic (hardware-filtering) EDA mode, while another encourages the use of their automatic EDA mode. We understand that one other competitor previously did not previously include an Auto EDA mode, but subsequently included a high-pass EDA mode in response to customer concerns about data usability. Our approach has been to advise our customers that there are both known and hypothesized advantages to different EDA signal processing solutions, and to assist customers in selecting an optimal solution according to their needs (Nelson 2011).

In his January 2007 communication Mark Lane said that “We are currently reviewing the area of the electrode and the formulation of the gel to minimize the occurrence of the plunging artifact.”

It is now known that neither the electrode nor gel formulation have a substantial effect on reducing the known tendency for the EDA data of some persons to be less tonically stable than others. Psychophysicists have long described persons as “stables” and “labiles” regarding EDA activity patterns (Boucsein, 2012), and there are well known phenomena in which EDA data for some persons does not conform to a stable baseline. This is the reason that Auto (i.e., self-centering) EDA modes were added to analog instruments long before Lafayette Instrument began manufacturing EDA recording technologies.

I understand Lafayette last week sent out a notice about EDA acknowledging the differences between manual and automatic, but characterized this as “rare” and the potential for scoring differences as low.

To better illustrate the types of concerns that researchers, field examiners and program managers are concerned about we have included several graphical examples. Image 6 shows an example of the occasional situations in which the response amplitude of Auto EDA and Manual EDA data may differ. EDA data for question C4 shows a greater reaction than question R6 using the Auto EDA (green), while R6 shows a greater reaction than C4 using the Raw EDA (purple).

Image 6

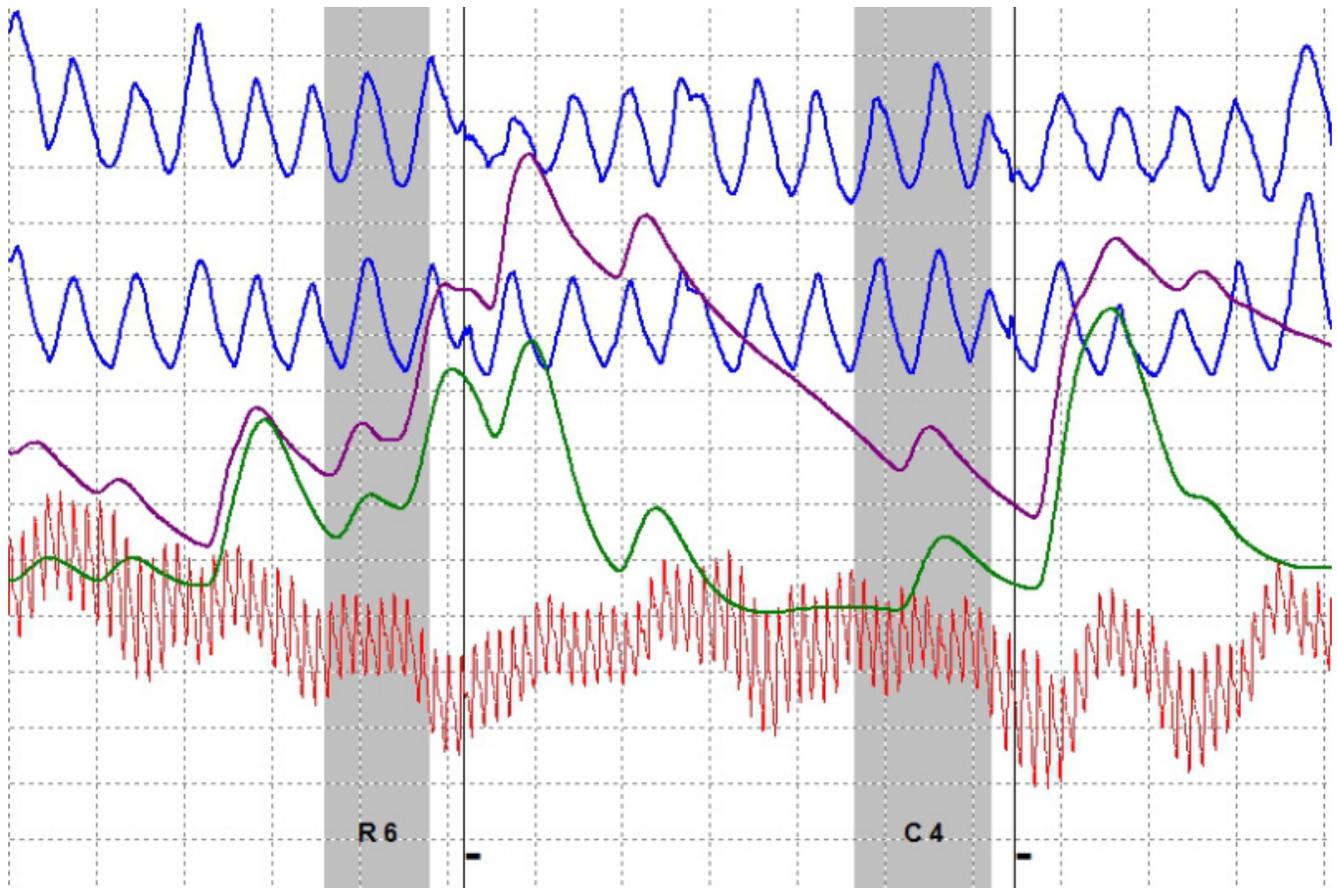


Image 7 shows another example of the same phenomenon. C6 and R7 appear to have nearly equal vertical response magnitude using the Auto EDA (green) though you will see that C6 is slightly larger if you look closely. Using the Raw EDA (purple) you will notice that R7 is greater than C6.

Image 7

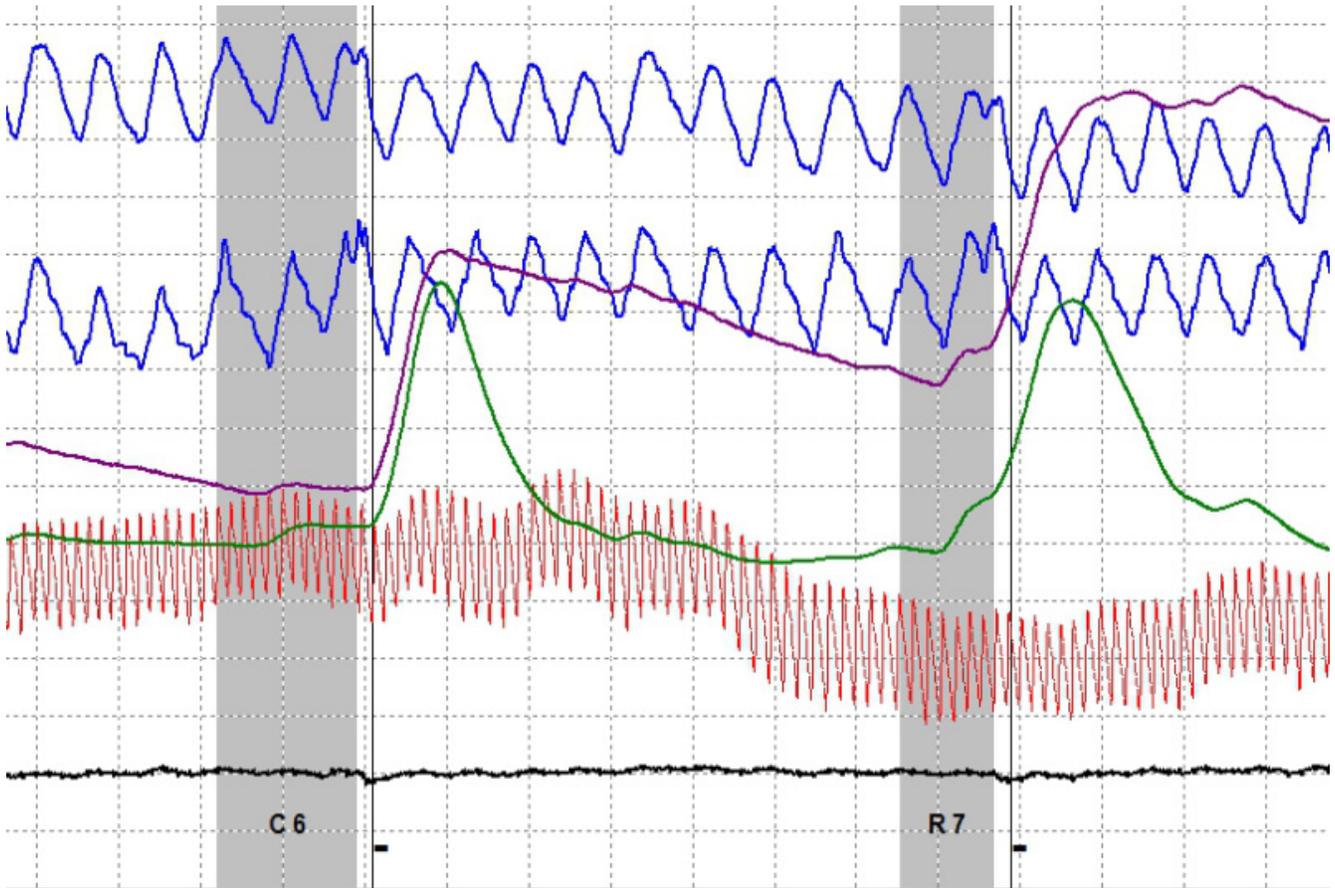


Image 8 shows an example of downward trending EDA data. Increasing the gain/sensitivity setting will dramatize the visual appearance of phenomenon, while decreasing the gain setting will reduce the appearance and keep the data on the screen or page. Neither increasing nor decreasing the gain/sensitivity setting will actually change the data or the measurable response. Gain/sensitivity settings affect only the visual display when using modern computerized polygraph systems. At R4 the Auto EDA shows a slight upward slope beginning during the question stimulus, while the Raw EDA (purple) is persistently going downward at the same time. There is a slight reduction in the rate of downward activity – which is actually a change in the frequency spectrum of the wave form (i.e., a reduction of the proportion of very low frequencies and increase in the proportion of higher frequencies). Another issue here is a sudden, though brief, stoppage of data acquisition. Another issue in Image 8 is the brief stoppage of data acquisition in all recorded channels shortly after question C7.

Image 8

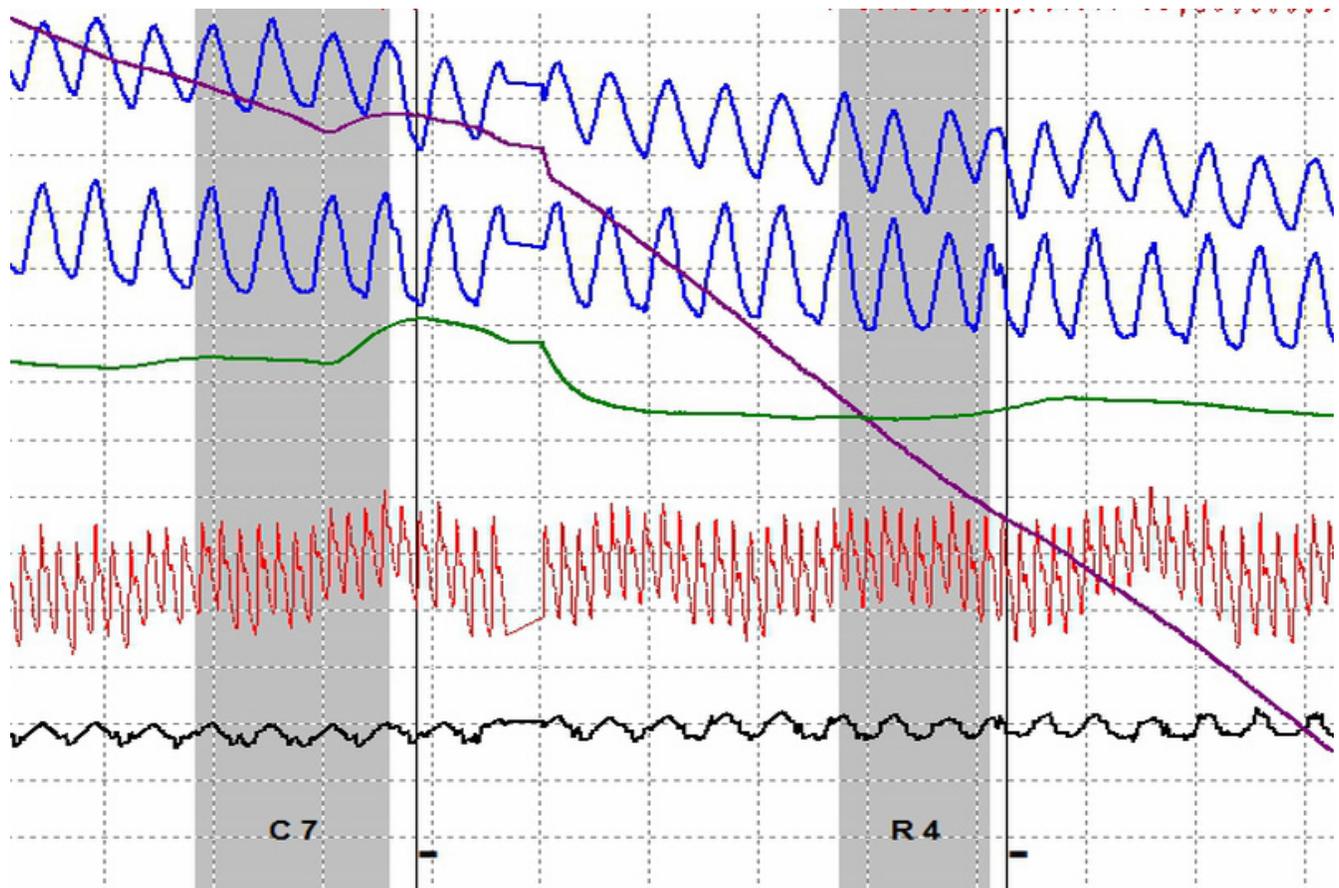


Image 9 shows another example of downward tonic drift. In this example the Auto EDA (green) and Raw EDA (purple) seem to go different directions at R7.

Image 9

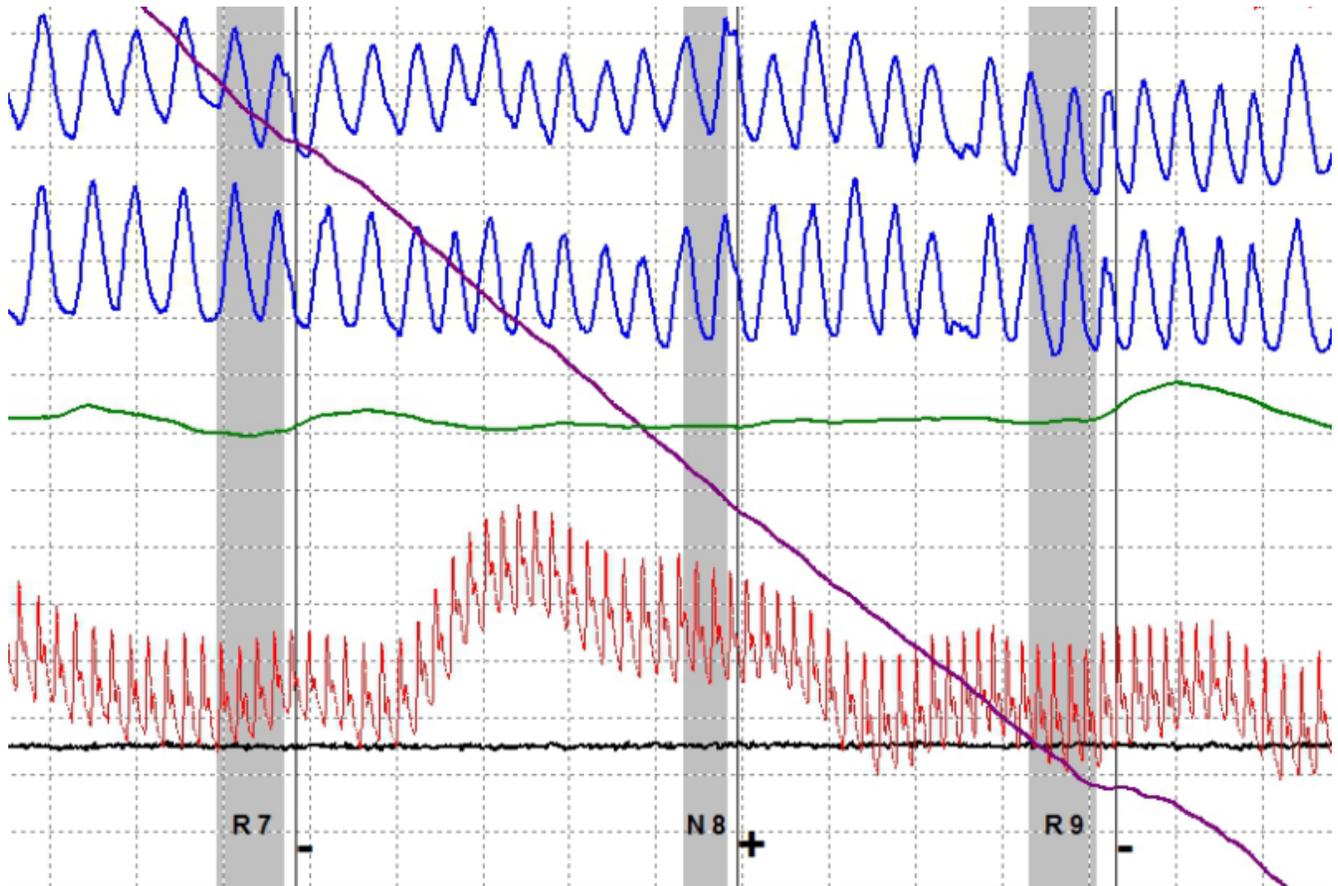


Image 10 shows another example of the same potential at R4.

Image 10

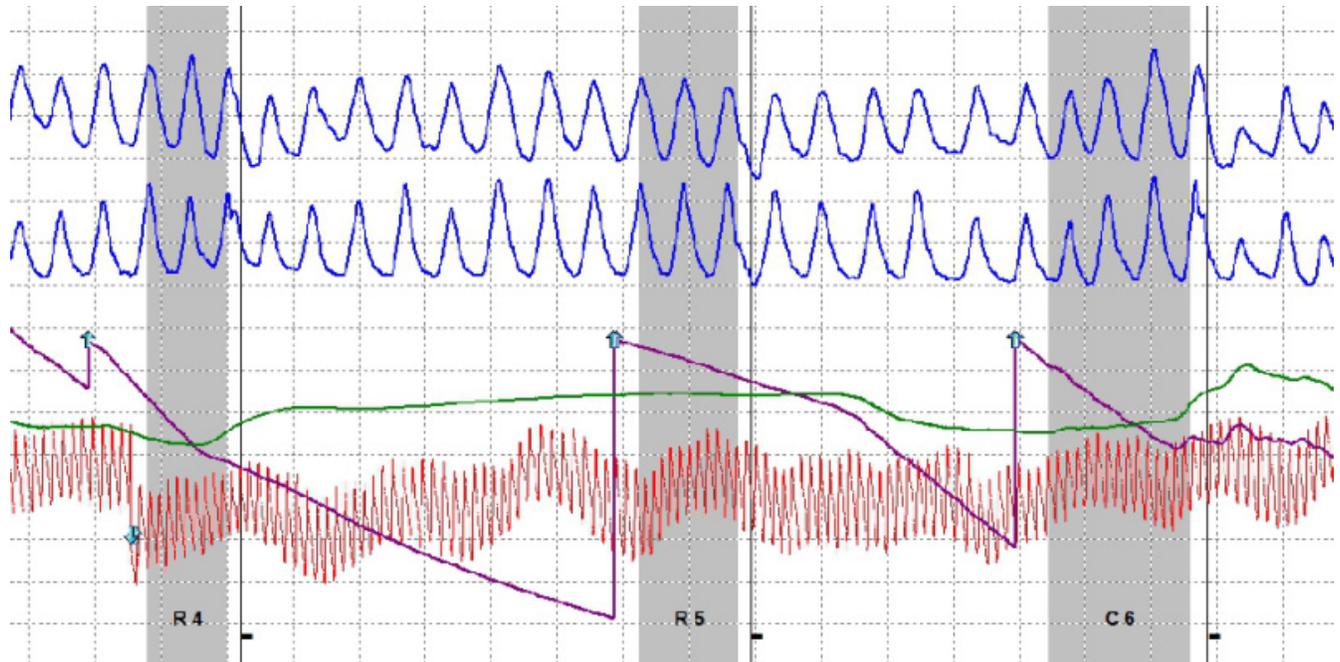


Image 11 shows that phasic response data (i.e., upward response after R4) can sometimes be observed in data that exhibits the known phenomenon of tonic EDA drift.

Image 11

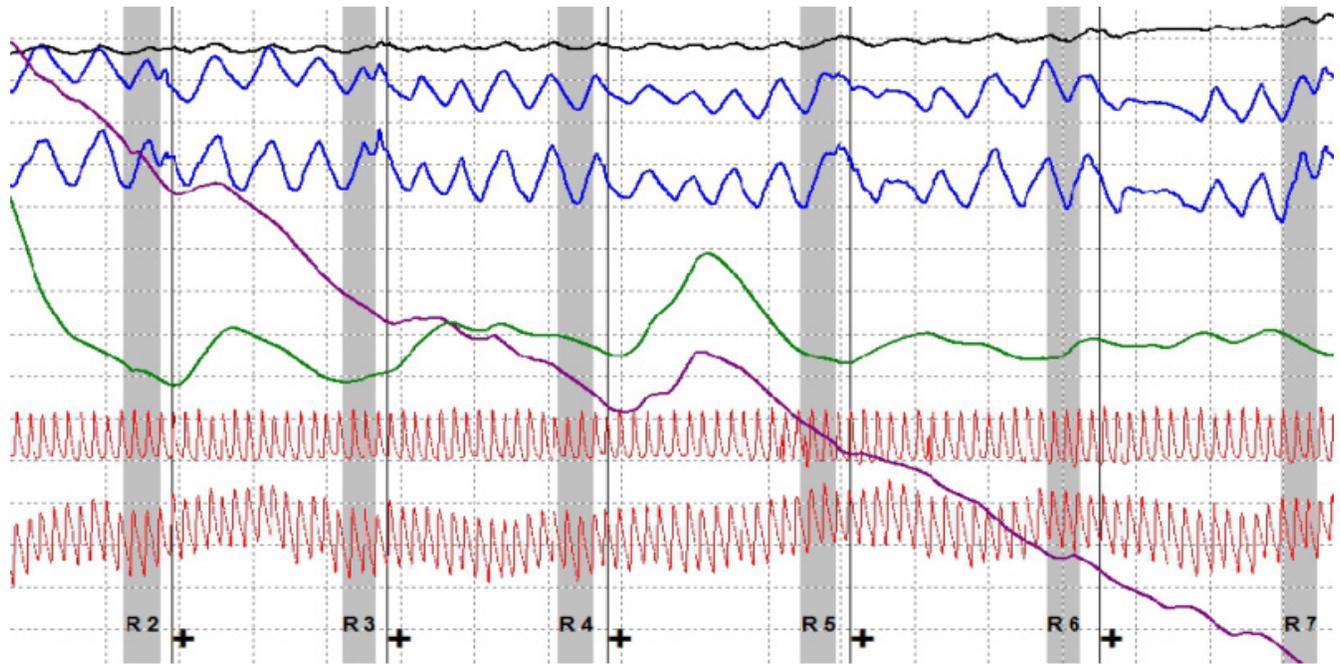


Image 12 shows EDA data with obvious downward drift along with other high-frequency noise. EDA data in Image 12 are subject to automatic filtering and the actual magnitude/proportion of the high-frequency noise is actually much greater than shown. It is unknown whether the high-frequency noise is due to physiological causes, radio-frequency/electrical interference, or signal processing phenomena.

Image 12

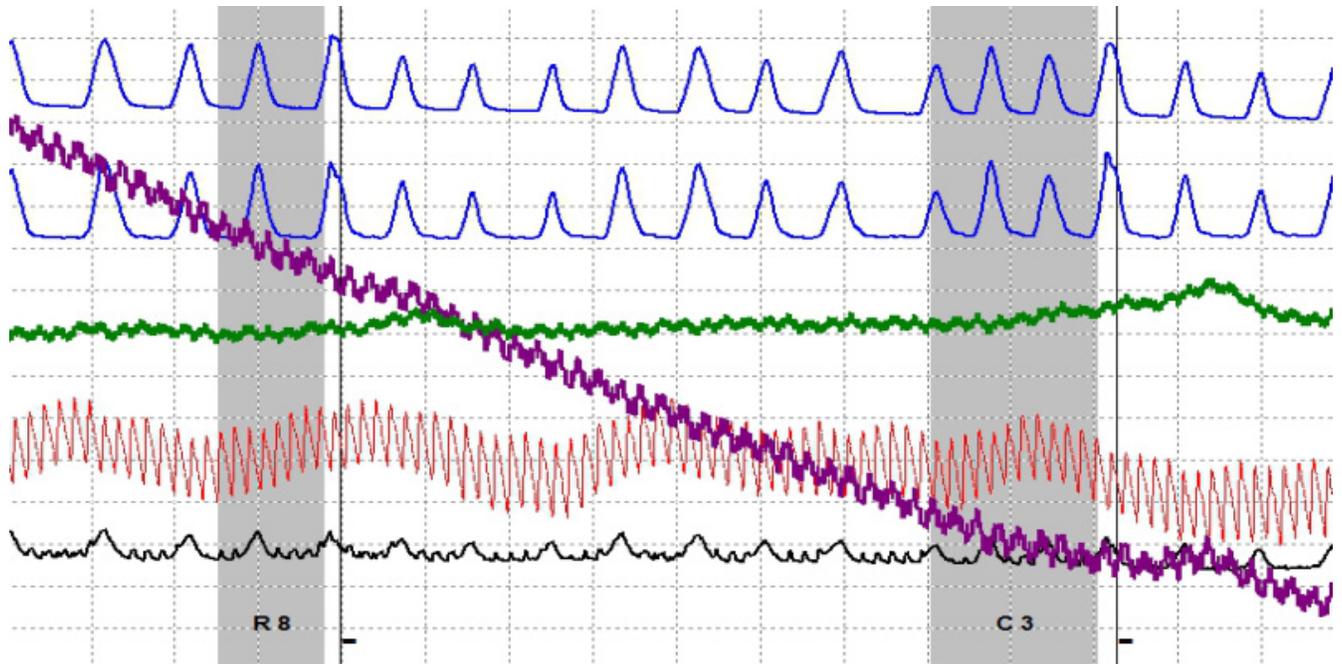
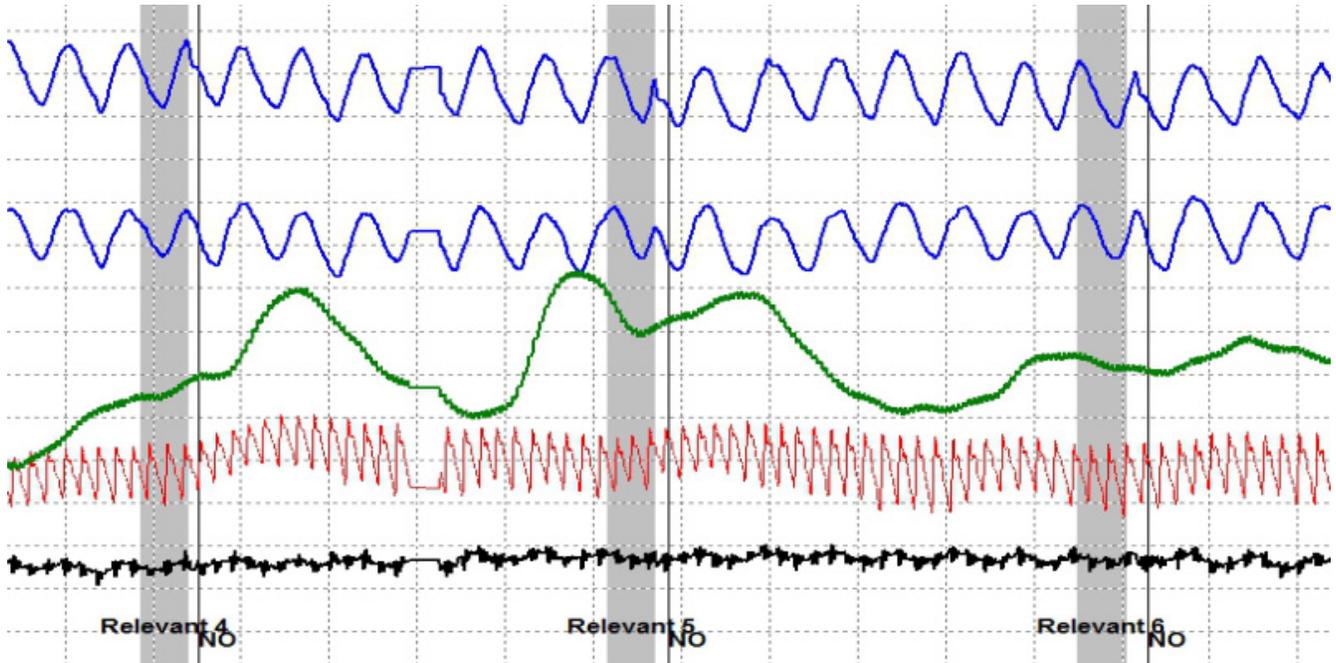


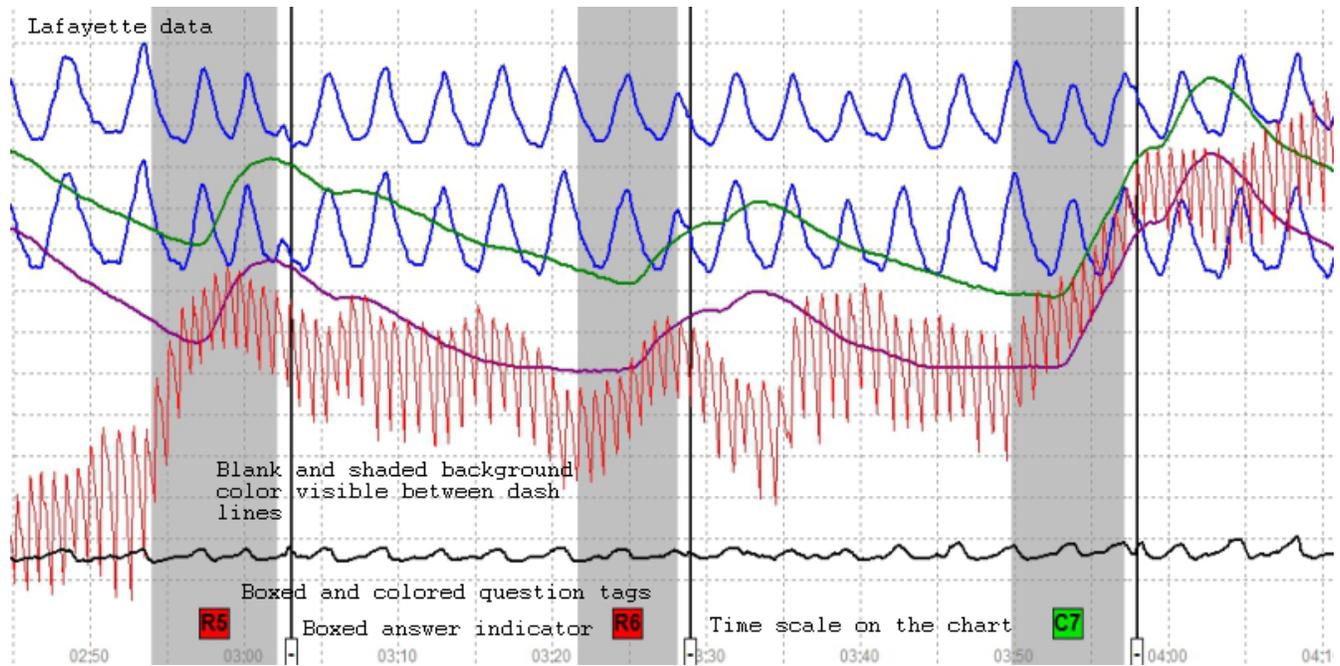
Image 13 shows the potential for phasic responses to be observable despite the presence of high-frequency noise, along with another example of stoppage of data-acquisition.

Image 13



It is important to note that **NONE** of the previous images (8 to 13) are depicting data obtained using the LX4000, LX5000 or Lafayette software. All of the images were obtained from exams conducted using an instrument manufactured by a competitor of Lafayette Instrument Company. Image 14 shows an example of polygraph data collected using the Lafayette system, along with some information about the subtle indicators that reveal the difference between Lafayette test data and that from competing products.

Image 14



It is not a new revelation that Auto EDA and Manual EDA scores may occasionally differ, and it is important to remind that the examples provided herein are in fact not common whether using our instrument or those our competitors. We provide these examples only to clarify this discussion. The occurrence of tonic drift phenomenon is such that if any instrument manufacturer were to claim or provide data for which the phenomenon was never observed, the only sensible conclusion would be that all data subject to high-pass filtering that is unaccounted for. The potential for occasional differences has been discussed for decades and has been described in the published literature for over a quarter of a century. To appreciate the actual meaning – significance and insignificance - of these differences it is important to understand the basis of scientific testing. All testing is a matter of stimulus and response, and multiple measurements are often taken before a conclusion can be reached or action is taken (think “measure twice, cut once”). All data is a matter of variance, consisting of that which is the same and that which is different. Variance is thought of as either controlled/explained/diagnostic variance or uncontrolled/unexplained/error variance.

An ideal test (for which there is no such thing in reality) would provide the ability to control/explain all response variance with a proportion of zero uncontrolled/unexplained/error variance. In reality, all test data, from all types of tests, are a combination of controlled/explained/diagnostic variance and uncontrolled/unexplained/error variance. Good tests will have a greater proportion of diagnostic variance and smaller proportion of unexplained variance. This concept is applicable in both esoteric and practical ways. For example: in weapons technology, we might aim a weapon at a target-center every time, but in reality different bullets seem to always go through slightly different holes. This seems to occur even when the technology is physically anchored and human error-variance is eliminated.

As a practical matter, both manual/unfiltered EDA and automatic/high-pass filtered/self-centering EDA have been shown to work satisfactorily. Published studies for both scoring feature development and criterion accuracy have used both manual/unfiltered EDA data (Kircher & Raskin, 1988; Raskin, Kircher, Honts & Horowitz, 1988) and filtered/self-centering EDA solutions (Harris, Horner & McQuarrie, 2000; Kircher Krisjansson, Gardner & Webb, 2005). As with nearly all forms of testing and diagnosis, multiple correlated features/symptoms are required and multiple stimulus/response measurement trials are used to achieve a sufficient quantity of data to effectively evaluate diagnostic variance contained in the testing data. Under most circumstances no single measurement, nor any single feature, nor any single test item, can provide satisfactory testing accuracy when isolated from the remainder of the testing data – regardless of whether the test is medical, psychological, academic or forensic. Although always implicit, it is worth reminding that the ethical and empirical function of testing is to provide information while judgments and decision making tasks remain a human concern that belongs to the involved professionals according to established professional practice.

Questions:

How rare is the disparity exactly? How does the company know that it's rare if the company only recently began "quantifying the rate of occurrence"?

Other than to say that anecdotal experience tells us that different EDA modes are in agreement most of the time, this is a question that should be answered by research evidence and not by opinion. Anyone who looks at a lot of data will observe occasional differences in isolated segments of data. It would be naïve to expect otherwise, and it would be irresponsible to attempt to guess at a numerical estimate for any matter for which evidence is forthcoming.

How many people did the notice go out to?

Referring to the newsletter that was sent by Lafayette on March 1, 2013, it was sent to both customers and other polygraph professionals.

So what did Lafayette attribute the plunging to? Does Lafayette suspect stainless steel electrodes? Was it an artifact that caused the plunging?

To answer this, it will be important to define the word “artifact” as used in this context. In forensic psychophysiology, “artifact” refers to changes in the recorded bio-signal which do not stem from the signal source in question. Technologists and research psychophysiologicals (Boucsein 2012; Cacioppo, Tassinari & Berntson, 2007; Stern, Ray & Quigley, 2001)) have used the word “artifact” to refer to instrumentation effects, while field psychophysiological detection of deception (PDD) examiners have used the same word to refer to any change in the recorded physiological data that is not attributable to the test stimuli (ASTM, 2005; Krapohl, Sturm, & Handler, 2012) – typically due to movement or stimuli external to the testing context. As such, artifacts represent a deviation from the normal tonic pattern of activity for each examinee, and are attributable to an unknown cause that is outside the electrodermal system. Therefore a descending pattern of data is *not* regarded as an artifact in either a basic psychophysiological sense or a field practice sense. The term “artifact” is being misused in the above question.

In general, Raw/Manual EDA data are useful for measuring absolute values of tonic skin conductance level (SCL) and phasic skin conductance response (SCR), which can also be understood as tonic skin resistance level (SRL) and phasic skin resistance response (SRR). Skin conductance is the inverse of skin resistance, i.e., mathematically conductance (C) is equal to 1 over resistance (R) or $C = 1/R$. Automatic (i.e., self-centering) EDA modes remove tonic level and maintain the data at or near the baseline (Y-axis = 0). It is important to understand that Automatic/self-centering EDA means “filtered”. This can be done with electronic components such as resistors and capacitors, and the exact same mathematical solutions can be enacted through software filters. Software filtering offers a number of practical advantages and these are the common approach today in many fields of science and technology.

Field polygraph examiners are not interested in measuring absolute tonic level, but are interested in phasic responses that are attributable to (i.e., are timely with) test stimuli.

Any hypothesis that electrode type influences the phenomenon of tonic EDA drift is easily investigated simply by changing the electrode type and observing whether the phenomenon persists. Practical experience is abundant on this matter. Electrode type has little, if any, real effect on the known phenomenon of tonic EDA drift. To elaborate: electrode type may optimize but will not itself alter what is occurring physiologically, such as the tendency of EDA data to descend persistently for some individuals. If an individual has tonic EDA instability the choice of electrode type will not change that. Tonic EDA instability is a physiological phenomenon not a matter of instrumentation – except to the degree that filters and DSP solutions may or may not increase the ratio of diagnostic and non-diagnostic variance (i.e., signal to noise ratio) depending on how the solutions are implemented.

If so, why didn't Lafayette advise its customers to use different electrodes and always use gel?

Electrolyte compounds can be used to optimize EDA data acquisition but will not alter or correct well known phenomena that are physiological, such as the tendency for tonic EDA (SCL/SRL) data of some persons to exhibit a tonic trend (i.e., downward or upward) or tonic instability. So, use of electrode gel may improve data acquisition but cannot change what is occurring physiologically.

Lafayette says an investigation in 2007 led to the detrended filter and the subsequent improvements to that filter. What was the nature of the investigation? What did Lafayette discover about the disparities between manual and auto?

It was a case by case investigation of the anecdotal reports by a team of engineers and researchers in 2007. Nothing new was discovered regarding the rate of occurrence because that does not seem to have been the focus of the investigation. The potential for occasional differences to be observed was already clearly described in the published literature, not limited to the Lafayette polygraph system, and anecdotal experience confirms it is an occasional occurrence. Polygraph data, like other tests and other technologies, achieves a level of accuracy by aggregating responses to multiple stimulus events through the interpretation of multiple diagnostic features. Although the potential of observed differences was already known long ago, customers during 2007 began to request that we attempt to develop improvements. We discovered a way to stabilize SCL/SCR trends without traditional filters, using mathematical detrending. We also discovered that the most effective way of doing this (i.e., the method that maximized the criterion coefficient), was to only detrend the data that is below the Y-axis baseline, and it is best to do this without altering the sympathetic response data in which field examiners are interested.

Why didn't Lafayette send out a notice in 2007 after noticing this problem? I've seen evidence that Lafayette was given charts with different amplitudes in manual versus automatic that could make a difference in scoring. (Examples include a 16 point difference) Why didn't that prompt Lafayette to notify customers? In retrospect, does the company now believe it should have sent a notice earlier?

When training psychotherapists and counselors, we teach that questions about "why" regarding past actions are often not productive because they are so often used for the intended effect of making others feel defensive. In this case it is impossible to speculate about "why" because what you perceive as a newly discovered "problem" is actually a known phenomenon in psychophysiology and has been described in published literature and training for some time. The polygraph profession had a vague idea that someone would eventually have to study the phenomenon, and develop answers to the tangible questions about the reasons for the phenomenon and optimal solutions for managing it. As the leaders in polygraph field technology it seems to have naturally fallen on Lafayette to study this and advance our knowledge and understanding. While we view this as responsible and responsive to

the needs of the profession, one of our competitors, and possibly a few other individuals, seem to have attempted to incorrectly and aggressively characterize our efforts as indicative of a unique form of deficiency. Our concern is that your investigation into this matter is already biased, and/or that your admirable zeal to investigate and inform the public about important topics may have led to you being manipulated into participating in a market/competition issue, thereby missing an opportunity to develop a more complete and accurate understanding of known issues in polygraph and psychophysiology.

If you have access to that data we would like the ability to determine for ourselves whether standardized scoring protocols and published normative data were used to achieve that alleged difference. Until we are provided the data for our own analysis we will have to reserve the right to remain skeptical about the veracity of any claim that a known phenomenon of occasional testing variance – and all test data have inherent variance - could change a test outcome in any extreme way.

The notice said Lafayette recently started its own tests to determine how often the disparity between auto and manual occurs. When did the tests start exactly and who will oversee the testing? Why wasn't this testing conducted before?

Lafayette researchers are evaluating Auto and Manual modes as a continuation of the normal process of product improvement in response to customer requests and/or new information in the areas of psychophysiology, data acquisition, signal processing, signal detection, time-series analysis and decision theory. Lafayette has been steadily approaching a time at which our knowledge and technology may permit a more complete understanding of this in the future.

The notice details design specs. I'm told by experts that to fully evaluate the filter algorithms, someone needs to look at the performance specs, under a broad range of potential conditions (e.g., plunging baselines). Is that what you're doing now? Would you be willing to let independent experts evaluate them?

A satisfactory investigation would minimally include investigation of the filter performance under both optimal and sub-optimal conditions. In this context your use of the words "plunging baselines", while referring to wide range of testing conditions, exemplifies your understanding that the tonic instability is actually an issue of expected testing variance and not a function of any deficiency in instrumentation. We agree with the premise underlying your question, that SCL or SRL – including instability in SCL or SRL- are known physiological phenomena that are recorded by but not caused by circuit and software design. Research for journal publication is routinely subjected to critical peer review prior to acceptance, and there is no reason not to expect continuation of that process. Our publication of the circuit specifications and signal processing specs already permits independent analysis and replication. To our knowledge, we are the only instrument manufacturer to subject themselves to this high standard of accountability and transparency.

Considering the EDA problem, why does Lafayette advise its government clients to run tests in automatic?

This question is premised on a mistaken assertion that Lafayette has made such a recommendation. Lafayette has refrained from making such recommendations until we have a position based on empirical data. The presently available solutions provide functionality under a wide variety of conditions, and we have assisted customers in evaluating their concerns and identifying solutions that will provide for their unique situational needs (Nelson, 2011). We are aware that our competitors have at times recommended the use of Auto EDA, due to the more satisfactory user experience, in direct response to the known phenomenon of tonic EDA instability.

In Mark Lane's January 6, 2007, communication, he describes three procedures for eliminating baseline drift: adaptive trend removal, adaptive high-pass filter, and adaptive pulse-matched filter. The adaptive high pass filter sounds like a simple filtering out of standing voltages and very low frequency components. Is that correct? If so, am I correct in understanding that you do not use an electronic filter (resistor-capacitance coupling between the signal and the input to the amplifier) but rather use a computational formula to effect the filtering? Assuming that to be the case, how did you develop this formula and what, exactly, does it do? Also, what are the other two procedures (adaptive trend removal, adaptive pulse-matched filter)?

Mr. Lane's use of these words was most likely not intended to communicate a defined solution but to describe the types of solutions that might be investigated and/or developed in response to a particular customer need. Adaptive trend removal could be described as detrending. Adaptive high-pass filtering and adaptive pulse-matched filtering might mean different things to different engineers and represent only vague conceptual potential until they are operationalized in tangible products. Our preference is to employ solutions that are non-esoteric and easily accounted for. Butterworth filters are common in signal processing, and can be implemented as low-pass, high-pass, band-pass and stop-band solutions to different needs. Low-pass filters are often used to reduce high frequency noise artifacts, and high-pass filtering is used to attenuate low frequency components with a time-series data set. Low-pass and high-pass filters can be combined to produce band-pass and band-stop filters. Lafayette's automatic filter utilizes software-based Butterworth filters as described in the technical discussion presented on our web site. Formulae for Butterworth filters and the methods of calculating their frequency coefficients are well described in signal processing literature.

In documents related to the LX4000, the voltage output of the circuit is said to be directly related mathematically to the subject's resistance. That implies that the method of measuring EDA is the constant current method (as opposed to the constant voltage method). Is that correct and, if so, what is the current applied to the electrodes? Is there any control of current density—i.e., microamps/square centimeter of skin contact?

This question, again, reflects a misunderstanding of the issues and the technology. Regardless of whether EDA is *measured* through constant voltage or constant current methods, data can be *reported* as either resistance or conductance units because they are mathematically inverse. This is a well understood issue as exemplified in our discussions with Berntson (personal communication, May 5, 2005). Our recently published document describes the current specs for each instrument. Surface area for all electrodes is approximately ~2 square centimeters. Maximum current from any instrument is 10uA, meaning that all of our devices are well within published recommendations (Boucsein, Fowles, Grimmes, Ben-Shakkar, Roth, Dawson, & Filion, 2012).

Also, are all data generated by the equipment still in resistance units (kilohms), or are they transformed arithmetically to conductance units (microsiemens)? Assuming they are in kilohms, is there any correction for initial value effects?

This question represents another misunderstanding. Data is not generated by the equipment. Data originates with the test subject, and is then measured, recorded and reported by the equipment and software. Regardless of whether *measured* through constant current or constant voltage methods, both conductance and resistance must be calculated from the voltage and current data using Ohm's law. How the data is reported is a separate, though related, concern from how the data is measured. Conductance and resistance are mathematically related and data can be reported either way regardless of how it is measured. Psychophysicologists have standardized on reporting conductance values while field polygraph examiners have traditionally worked with resistance values. GSR circuits in polygraph instruments have typically reported resistance units. One of our competitors uses a GSC circuit that reports conductance units. Another competitor uses a GSC circuit that displays resistance units. We are unsure about a third competitor. The Lafayette system has reported linear resistance for both GSR and GSC circuits, though our GSC circuit may be slated for a change in values to report native conductance units.

Concerns about initial values relate to the potential for change, and pertain to the measurement of tonic and phasic EDA. Tonic EDA is described by the terms SCL or SRL, while phasic responses are described by the terms SCR or SRR. Actual SCL and SRL are of interest to some psychophysicologists. Field polygraph examiners are not interested in measuring actual SCL or SRL but use relative SCL and SRL information to identify the location of response onset with time-series waveform. Neither psychophysicologists nor field polygraph examiners actually correct for initial value effects in a mathematical or statistical way, though they may attempt to manage these effects procedurally by ensuring that stimuli are presented during tonic activity segments and not during phasic response segments. Unfiltered Manual EDA (i.e., without high-pass filtering) is useful to measure actual tonic

level or SCL and SRL, while Automatic EDA (i.e., high-pass/self-centering) is useful for measuring phasic responses or SCRs and SRRs (Stern, Ray & Quigley, 2001). Actual tonic level is little interest to field polygraph examiners, and so Auto EDA is thought to increase the ease and reliability of test data analysis tasks by increasing the ratio of diagnostic variance to non-diagnostic variance in the testing data. Use of high-pass filters, and other filters, is well described in the psychophysiological literature (Bach, Flandin, Friston & Dolan 2010; Boucsein, 2012; Cacioppo, Tassinari & Berntson, 2007; Figner & Murphy, 2011; Stern, Ray & Quigley, 2001; Spottiswoode & May, 2003)

My understanding is that the FBI, CIA, DIA, DEA, ATF, OSI, NCIS, NRO, Secret Service, and Postal Inspection Service have used the LX4000. Can you tell me when each agency began using them? I understand the FBI now has the LX 5000. Have other agencies on this list updated to 5000s? How many police departments in the country are using the LX 4000? How many sex offender programs?

It would be best to contact those agencies for answers to this question. We are not able to answer market survey questions at this time.

One of your dealers has claimed that Lafayette has 90 percent of the world market. Is that accurate?

This is another market survey question that cannot be answered at this time.

Is Lafayette now considering advising its customers to use the manual instead of the auto?

As described earlier, our position has been to inform customers of the advantages of different solutions, and to provide solutions that can be applied to the range of known phenomena that are encountered in field and laboratory settings. Our position has been to assist customers in evaluating their needs and in understanding the capabilities of the available solutions (Nelson, 2011). While a single recommendation would be simple and convenient, questions about superiority of one solution over another are a matter of opinion, which we regard as a hypothesis that is best answered through analysis of the data. That analysis will be forthcoming when it is complete.

What do your U.S. dealers collect in commission? If they don't get commission, how are they compensated?

Business and financial details will not be discussed at this time.

I understand the LX5000 has a cardio centering problem. What causes this problem and what has Lafayette suggested for fixing it?

We have received no information from customers regarding a cardio centering problem. You are welcome to provide us more information on this, if any is available. The question appears to be premised on incorrect assumptions or intended to create negative impressions. Again, we will have to exercise our right to remain skeptical about the veracity of any concerns about a cardio centering problem until someone provides us with some actual evidence upon which to base this question or discussion.

Does the LX5000 have the same manual and auto disparity? If not, what did the company do to address it?

As described earlier, all polygraph instruments that include different signal processing options will have the potential for occasional differences to be observed when processing data in different ways. It is impossible to handle the data differently and expect it to always be exactly the same. There are advantages and disadvantages to each different solution.

Does your company submit its machine to UL or any other entity that certifies or inspects electronic or computerized devices?

Given the application, the controlled environment, the extremely low power of the device, and the unlikely possibility that an examinee could contact a high voltage source during testing, UL certification is not warranted. There is no entity that certifies or inspects devices of this type. We have attempted, in the context of professional seminars to engage in discussion intended to move the profession towards more standardized and evidence-based solutions. One of our competitors seemed to appreciate the importance of this idea. Another may not have appreciated the importance of evidence-based standardized protocols for EDA signal processing. Still another competitor chose to use the opportunity to engage in aggressive and critical questioning of technology and solutions provided by Lafayette Instrument Company, and we are unsure whether they will choose to participate in any future discussion efforts towards standardized signal processing models. We do however use in-house technicians and testing equipment to thoroughly evaluate our products for quality and safety regardless of third party requirements.

Does the LX5000 have six different modes or measures of EDA now? If so, what are they?

The LX5000 is a data acquisition device that collects physiological responses and sends them to a computer for signal processing display/printing and analysis. EDA modes were implemented in physical hardware devices in older polygraph systems, using electronic components such as resistors and capacitors. However, it is more expedient today to complete signal processing with software solutions. The same mathematical functions can be implemented in hardware and software, with the advantage of software being more convenient design, development, validation and maintenance. Like the LX4000, the LX5000 sends a single EDA data-stream to the computer.

Is there anything else I should know about the EDA plunging and differences in amplitudes between manual and auto?

We will take this time to point out that this discussion of technical detail is possible only because of our willingness to provide accountable detail for our products and devices, and only because of our responsiveness to customer requests for the capabilities to access more information and study the important issues pertaining to psychophysiological data acquisition, signal processing, and decision theory. All fields of science will forever face continued learning challenges and the need to develop additional information. We are aware that the ethical pursuit of knowledge and ethical use of knowledge based solutions requires that we remain at once persistent in our search for new information and knowledge, and also humble around the simple axiomatic fact that it is impossible to know everything. We've provided a lot of information; please let us know if you have any further questions.

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