Using the Lafayette Respiration Line Excursion Tool

Raymond Nelson
Lafayette Instrument Company

Pneumograph data, combined with data from other recording sensors, can be an important and useful source of information about deception and truth-telling during polygraph testing. Respiration data can also be a rich source of information about changes in behavioral cooperation and posture during testing, and may also be affected by physical conditioning and factors related to health.

Respiration data are sufficiently complex that human experts do not attempt to numerically quantify much of the information they interpret. Instead, visual interpretation of pneumograph data remains in some ways qualitative. Quantitative interpretation of respiration data is generally limited to the identification of reduction of respiration activity in response to the test stimuli. Reduction of respiration activity has been shown to be correlated with deception (Kircher & Raskin, 1988; Raskin, Kircher, Honts & Horowitz, 1988; Podlesney & Truslow, 1993; Harris, Horner & McQuarrie, 2000; Kircher, Kristjiansson, Gardner & Webb, 2005; Kircher & Raskin, 2002). Visual pattern recognition approaches to the quantification of respiration data - which rely heavily on the knowledge, skill, training, and experience of human examiners - can produce only suboptimal levels of reliability. Computational methods for pneumograph feature extraction – which can provide automated reliability – have involved the actual measurement of the change in vertical excursion of the plotted respiration data. This measurement has been called *respiration excursion* and is the computerized allegory for the *respiration line length* measurements that were developed for manual measurement of plotted polygraph data on rolled paper chart output from pre-computerized analog polygraph instrumentation.

Introducing the Respiration Line Excursion Tool

Figure 1 displays the LXSoftware preferences setting that can be used to enable the *RLE Tool*. Figure 2 displays a segment of pneumograph data from a comparison question polygraph test, including the upper and lower respiration sensor data, along with the abstracted tracing from the *RLE Tool*, showing the relative change in respiration activity for each test stimulus. The change in vertical activity includes information about both the degree of change with each inhalation/exhalation cycle along with information about the rate of change during the measurement period.

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Figure 1. LXSoftware preference setting for the RLE Tool.

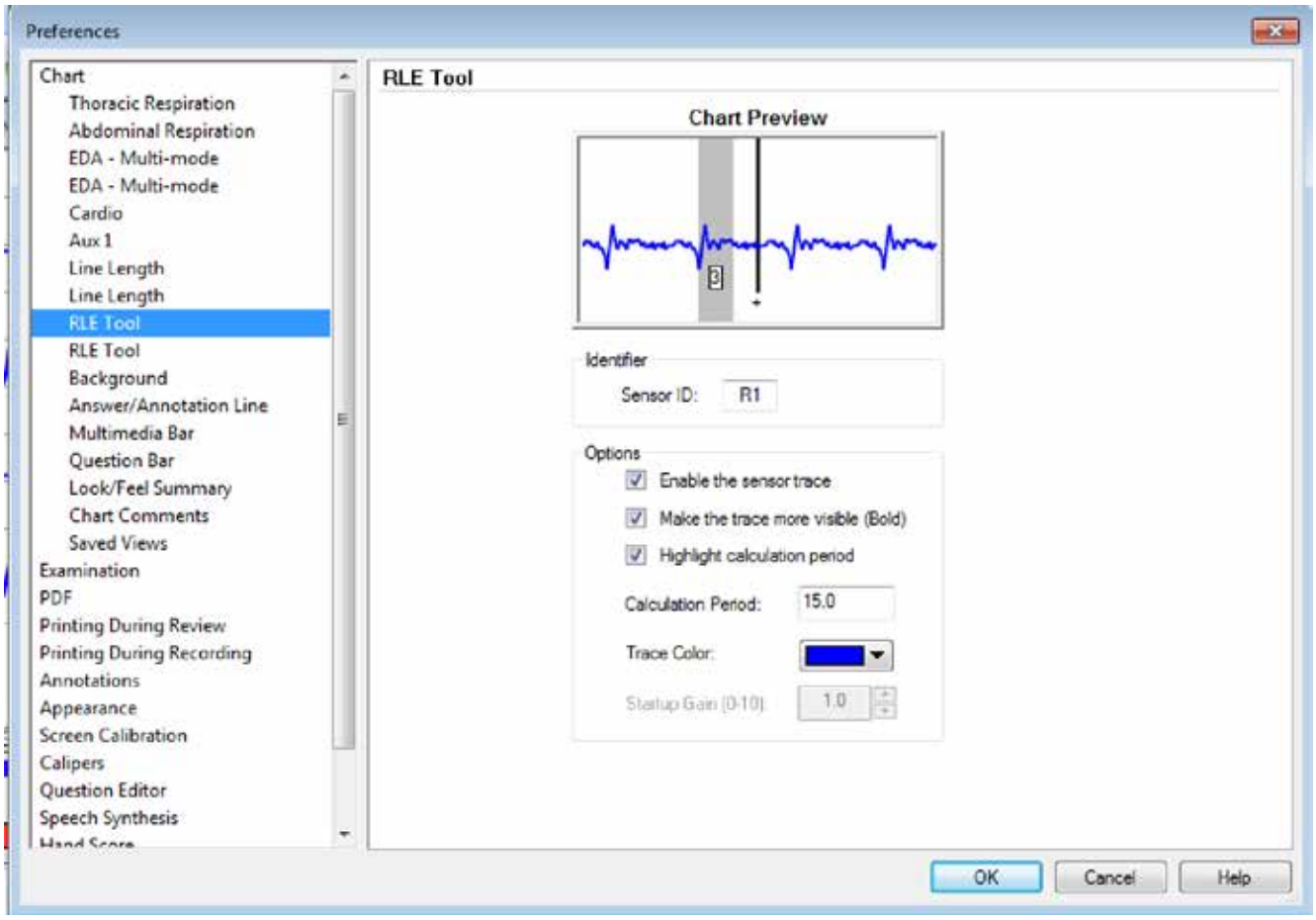
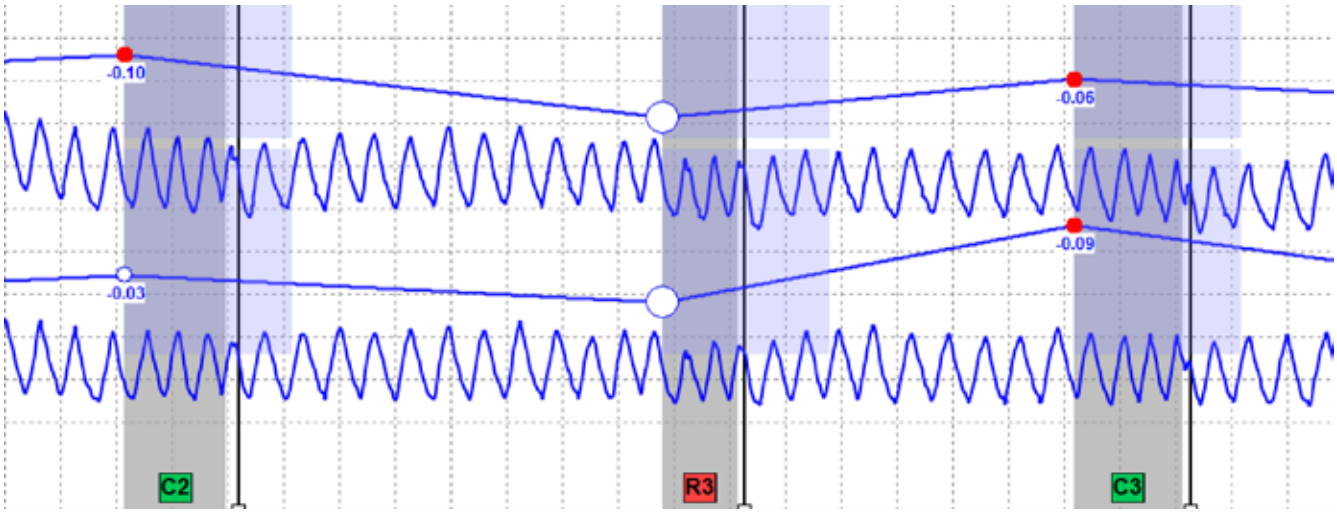


Figure 2. Pneumograph data with RLE Tool.



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The important difference between *respiration excursion* and *respiration line length* is that line length measurements will include both vertical changes that are indicative of physiological activity and horizontal changes that is independent of physiology and are influenced only by the design of the polygraph data machine, whereas excursion measurements include only vertical changes that are indicative of physiological activity.

Greater or lesser changes in physiological activity are shown by an *RLE Index Point* - at the onset of each stimulus question - at a higher or lower vertical position at the onset of each stimulus question. The RLE measurement itself is made in digital units. The *RLE Score*, shown on the displayed polygraph chart, is a dimensionless score that is calculated using the respiration excursion length of selected question compared to the other questions. Dimensionless values have no physical units of measurement (i.e., they are cancelled out algebraically when calculating the *RLE Score*) and are useful because they give a stable and consistent numerical values that remains intuitive and easy to understand even when the physical size of the plotted and displayed data is enlarged or reduced.

The *RLE Score* is calculated as the logged ratio of a selected stimulus question compared to the other questions. The advantage of using a logged ratio is that the RLE Score is more easily conforms to traditional polygraph intuition in a positive *RLE Score* is a potential candidate for a positive *Numerical Score,* and RLE Score less than zero is a potential candidate for a negative *Numerical Score*. Positive numerical scores, in traditional polygraph analysis models, are correlated with truth-telling while negative scores are correlated with deception. This differs from the more general scientific use of the terms *positive* and *negative* when applied to the test result itself, wherein positive results are indicative of the positive state or presence of a condition being tested while negative results are indicative of negative state or the absence of a condition.

How to use the RLE Tool

Using the RLE Tool is simple, involving only two steps: 1) click on the relevant question that you wish to score, and 2) observe the *RLE Score* at the comparison question. The *RLE Index Point* for the selected questions will be colored white and will be larger than the *RLE Index Points* for the other questions. Selecting each different relevant question will result in the recalculation of all displayed *RLE Scores* because the selected question is compared to all other test stimuli. There will be no *RLE Score* at the selected question because there is nothing useful about comparing the RLE measurement to itself. Also note that clicking on any question will result in the re-calculation of the *RLE Scores* for the selected question compared to each of the other questions.

In addition to the calculation of an *RLE Score, the RLE Tool* will also make a recommendation for a *Numerical Score*. This recommendation is illustrated by the color of the RLE index point at each comparison question. A green *RLE Index Point* at a comparison question indicates a recommendation for a positive *Numerical Score* for the selected question. A red *RLE Index Point* at a comparison question indicates a recommendation for a negative *Numerical Score* for the selected question.

In order to optimize the diagnostic coefficient of recommended *Numerical Scores*, and to reduce the occurrence of erroneous score recommendations that might result from artifacts such as deep breath or physical movement, some constraints are imposed on the *RLE Score* when recommending a *Numerical Score*. Negative *Numerical Scores* are recommended when the RLE Score is between -.0488 and -.4055. These coefficients correspond to linear ratios of 1.05 and 1.5. Positive Numerical Scores are recommended with the *RLE Score* is between +.2231 and +.4055, corresponding to linear ratios of 1.25 and 1.5. The recommended *Numerical Score* will be zero (0) when the *RLE Score* is outside these constraint coefficients. These constraint

coefficients have been found to optimize the correlation coefficient of the recommended *Numerical Scores* while minimizing scoring errors.

At this time, the *RLE Tool* is not intended to replace the expertise of the polygraph field examiner, and the examiner must select the correct comparison question for each relevant question. Selection of the correct comparison question is determined via a number of possible variables including combination of the position of the relevant question, the relative change in physiological activity for different comparison questions, and the existence of data artifacts that hinder the use of a data segment. It remains the role and responsibility of the examiner to select the correct comparison question for each relevant question and to combine the upper and lower respiration data into a single respiration score.

References

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