E68 A Step Toward Likelihood Ratios in Pattern Recognition Disciplines

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After attending this presentation, attendees will understand how to represent the value of evidence in the form of a likelihood ratio addressing the issue of interest to the court. Attendees will also recognize the important role of probabilities for representing and combining information and uncertainty.

This presentation will impact the forensic science community by providing the attendees with the fundamental principles for interpreting pattern recognition evidence in a logical framework. It will highlight the importance of probabilities in this endeavor. Application of these principles allow the forensic scientist to assign the value of evidence in a transparent and scientific manner.

The role of a forensic scientist is to present the value of scientific observations and analytical results to the court. For this value to be scientifically sound, it should not only be based on scientific knowledge, but also be transparent in how it depends on this knowledge. Hence, subjective judgments and opinions may fulfill the first requirement, but it is difficult for them to fulfill the second. On this second aspect, probabilities provide a framework that allows the scientist to combine different pieces of information in a transparent way.

This presentation explains the fundamental principles of the logical approach to assigning a value to forensic findings in the context of a case. The focus is on pattern-recognition disciplines, yet the basic principles apply to all types of evidence. From a logical perspective, the value of the observed scientific results is determined by the ratio of two probabilities: (1) the probability of the observed results given the prosecution's (or the plaintiff's) position; and, (2) the probability of the observed results given the defense's (or the defendant's) position. This ratio forms what is commonly known as the likelihood ratio. In pattern recognition disciplines, the first probability (i.e., the numerator in the ratio) represents the intra-variability; that is, how the observed features vary if they were produced by the same source, and the second (i.e., the denominator in the ratio) the inter-variability; that is, how the observed features vary if they were produced by different sources in the relevant population of potential sources.

In this presentation, examples will illustrate the basic principles of how to combine numerous pieces of information to assign these probabilities and thus measure the weight of the forensic scientist's findings with regard to the issue of interest to the court. These examples will cover how to combine the value of general characteristics of the observations (i.e., the general pattern of a shoemark or the overall ridge flow of a fingermark) with the value of specific features (i.e., observations indicating cuts or wear on a shoemark or observed minutiae and pores on a fingermark), how to choose the most appropriate database to help inform what numerical values to assign to the required probabilities, and how to recognize what additional information is required to assign a probability, and therefore a likelihood ratio, in a particular case. These examples illustrate how a probabilistic framework helps the forensic scientist gather, organize, and present the relevant scientific knowledge in a likelihood ratio addressing the question of interest to the court.

Probability, Likelihood Ratio, Weight of Evidence