F31 Logical Reasoning: Old Solutions for Current Issues

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After attending this presentation, attendees will understand the difference between posterior probabilities and likelihood ratios and appreciate that the logical approach to evidence interpretation is nothing new in the evaluation of forensic science results.

This presentation will impact the forensic science community by bringing awareness to the error of the transposed conditional and by drawing attention to publications explaining the logical approach to evidence interpretation dating back to the Dreyfus case at the end of the 19th century and beginning of the 20th century.[1]

A current discussion topic in forensic science is the scale of conclusions a forensic scientist uses to report the evaluation results of the examination of scientific evidence. Some conclusion scales used in forensic science today consist of verbal equivalents of posterior probabilities (i.e., probabilities that take into account all of the evidence) of propositions of interest in a case.[2,3] For example, "There is strong probability that the John Doe of the known material wrote the questioned material."[3] From a logical perspective, one can only arrive at such a conclusion if one has the following two ingredients: (1) the odds or the probability that the John Doe of the known material wrote the questioned material before examining the known material and the questioned material; and, (2) how much more probable (or less probable) the observations on the questioned material are if John Doe of the known material wrote the questioned material than if someone else wrote the questioned material.

This is nothing new. More than a hundred years ago, French mathematicians Jean Gaston Darboux, Paul Emile Appell and Henri Poincaré explained this reasoning process in the opinion they gave in the notorious Dreyfus case.[4] Not knowing the prior odds or prior probability described in point (1) above, they argued that they could only report a conclusion of the type "the odds of the proposition of interest after examining the evidentiary material become X times greater than what they were before this examination." Further, this logical reasoning process was not specific to France and Europe: in the 1930s American forensic scientist Wilmer Souder of the National Bureau of Standards (now the National Institute of Standards and Technology) published similar ideas for the evaluation of observations made on typewritten documents.[5]

The study of these historical ideas on the interpretation of scientific evidence illustrates a way forward for reporting conclusions for examinations conducted in casework and highlights the importance of transparency regarding the assumptions made by the forensic scientist that lead to the scientist's conclusions.

Reference(s):

1. Taroni F., Champod C., Margot P. Forerunners of Bayesianism in Early Forensic Science. *Jurimetrics J.* 1998; 38: 183-200.
2. ASTM International, Standards formerly under the jurisdiction of E30.02 on Questioned Documents. *Terminology for Expressing Conclusions of Forensic Document Examiners*. Available at: https://www.astm.org/COMMIT/forensic-docs/index.html (last visited on July 27, 2016).
3. Department of Justice. *Proposed Uniform Language for Testimony and Reports for the Forensic Footwear and Tire Impression Discipline.* Available at: https://www.justice.gov/dag/forensic-science (last visited on July 27, 2016).

4. Appell, Darboux, Poincaré. *Examen Critique des Divers Systèmes ou Etudes Graphologiques Auxquels a Donné Lieu le Bordereau.* In: Affaire Dreyfus—La Révision du Procès de Rennes—Enquête de la Chambre Criminelle de la Cour de Cassation, Tome Troisième. Ligue française pour la defense des droits de l'homme et du citoyen, Paris, 1908.
5. Souder W. The Merits of Scientific Evidence. *Am. Inst. Crim. L. & Criminology.* 1934-35; 25: 683-684.

Interpretation, Likelihood Ratio, Conclusion