D9 The Topic of Anchoring When Determining Likelihood Ratios in Fingerprint Comparison

Ivo Alberink, PhD, Arent De Jongh, PhD, and Crystal Rodriguez, MSc, Netherlands Forensic Institute, Laan van Ypenburg 6, Den Haag, 2497 GB, NETHERLANDS*

After attending this presentation, attendees will understand the importance of correct conditioning when determining likelihood ratios in fingerprint comparison.

This presentation will impact the forensic science community by illustrating the importance of correct conditioning when determining likelihood ratios in fingerprint comparison.

Following recent challenges in court on fingerprint evidence evaluation, statistical research on this topic has become more and more important. The question is how to evaluate the strength of evidence for the similarity of high-quality, rolled fingerprints, and low-quality fingermarks, which may be distorted, partial, or smudged. The similarity is based on the comparison of discrete characteristics (such as general pattern of prints and marks) and continuous characteristics (such as the minutiae, level II characteristics of the finger denoting locations and orientations of ridge endings and bifurcations). The Likelihood Ratio, or LR, is a statistical measure of the strength of the similarity, defined as:

$LR = \Pr(E \mid H_p, I)/\Pr(E \mid H_d, I)$.

Here Pr(.|.) indicates the conditional probability of an event, E the evidence (some expression of the similarity between marks and prints), H_p the hypothesis that the mark and print have a common origin, H_d the hypothesis that this is not the case, and I all relevant background information (such as tactical information). Evaluation by LRs yields an objective measure of the strength of evidence, as opposed to assessment by expert opinion (which is basically subjective). In the current study, the focus is on the impact of different ways of conditioning numerator and denominator of the LR on the numerical result.

In two papers by Neumann et al (J.For.Sci., 2006, p.1255-66, 2007, p.54-64), an analysis is given for LR computations based on the general pattern of print and mark, the number of minutiae on the mark, and the similarity of the minutiae configurations. A Euclidian distance is used to quantify similarity of the minutiae configurations. In Egli et al

(For.Sci.Int., 2007, p.189-95), the similarity between marks and prints is determined by an automated fingerprint identification system (AFIS), and LRs are evaluated based on prints made by one fixed thumb. Moreover, a simulated case study is performed with a fingermark containing 10 minutiae, leading to an LR of 85.6 million. This finding indicates that high LR values can be attained for fingermarks that in most countries would be unusable in court since the number of minutiae is too low.

For forensic application, it is important to know whether the reported LRs are accurate and robust. It turns out that within-source variability of similarity scores may differ for different fingers, even from the same donor. Next to this, the distribution of between-source similarity scores may depend on the fact whether a fixed mark is compared to a non-matching database of prints, whether several marks of the same finger are compared to one fixed fingerprint, or to several marks of different fingers, etcetera. The above is closely related to the topic of “anchoring” of evidence (which can be suspect anchored, crime scene anchored, or not anchored at all). In Neumann et al, it is unclear what conditioning is used to obtain distribution for the within – and between – source variability. In Egli et al, both in the numerator and the denominator the LR is conditioned on the number of minutiae of the mark. However, the conditioning is asymmetric in the sense that for the within-source variability comparisons are used of multiple marks with multiple prints of a fixed finger, whereas for the between-source variability comparisons are used of a fixed mark with multiple prints of databases of non-matching prints.

The results of the current study, which uses similarity scores generated by an AFIS system, show that there is a considerable effect of both the particular finger, and of any particular reference print used on the distribution of within-source similarity scores. This illustrates that there is a choice to condition either on a particular reference print of the suspect, or on several reference prints. Whatever the choice is though, it has to be used both for the numerator and denominator of the LR formula. The resulting LRs may be quite different from the ones obtained when using non-symmetric conditioning in numerator and denominator of the LR formula.

Bayesian Approach, Anchoring, Fingerprint Comparison

 ** Presenting Author*