Comment: Some Causes for Concern about DNA Profiles

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1. INTRODUCTION

The author has surveyed many aspects of the current debate on the forensic use of DNA profiles. It is our view that, despite the profuse literature on the topic, several important issues have not yet been adequately addressed. We hope that the present paper will assist in widening the debate within the statistical community and hence lead to clarification of these issues.

2. INTERPRETATION OF THE LIKELIHOOD RATIO

Only recently has a consensus emerged that the appropriate measure of the strength of forensic evidence is the likelihood ratio. However, some of the implications have not been fully appreciated. How is the likelihood ratio to be interpreted? What is to be made of the various likelihood ratios which the author reports, each contrasting H_1 with a different H_0? How should the effect of other, possibly exculpatory, evidence be incorporated with the DNA evidence?

There may have been a tacit assumption by some commentators (e.g., the NRC and Collins et al., 1994) that reported likelihood ratios should be the basis of hypothesis tests. We believe that such an approach is inappropriate. The most serious concern is that it is extremely difficult in such an approach to allow for the effect of the non-DNA evidence. Consider two hypothetical cases of assault. In one case the assailant is recognized by the victim to be a man living at a neighbouring address. The man is duly arrested and his profile is found to match that of the crime sample. In the second case the victim did not see the assailant. A DNA profile match is discovered "by chance," through a forensic scientist noticing a similar profile from a man living in another part of the country. However, this man produced an apparently valid alibi and subsequent investigation could reveal no link with the crime. How could these very different sets of evidence be accounted for in a hypothesis testing framework, if the relevant likelihood ratios were the same in each case?

We believe that the only logical method of weighing the DNA evidence in conjunction with the other evidence is to use Bayes' rule. If one accepts that the concept of probability can be applied to hypotheses such as H_0 and H_1, as for example the author does in Section 2.1, then it is simply a matter of elementary probability that Bayes' rule gives the correct method for updating these probabilities in the light of the DNA evidence. The controversy over Bayesian techniques in other areas of statistics is not directly relevant here.

In the legal context, Bayes' rule makes clear the distinction between the domain of the expert witness, the likelihood ratio, and the domain of the court, the assessment of other evidence. There is a substantive debate about the extent to which probabilities and mathematical reasoning, in any form, are appropriate in court (e.g., Tribe, 1971) and the extent to which juries should be educated in—and encouraged to use—Bayes' rule. We do not address this debate here. Our point is that concerns which arise in consequence of the logical analysis are legitimate regardless of the method of analysis actually adopted by juries. Nevertheless there are real dangers in reporting a likelihood ratio to an untrained jury without an explanation of its interpretation (Kaye and Koehler, 1991; Donnelly and Balding, 1994).

One crucial consequence of the appropriate interpretation of the likelihood ratio concerns the widely held view, expressed by the author in Section 8, that an error of one or two orders of magnitude "will have little practical impact on likelihood ratios as large as several million." This is incorrect. The assessment of the strength of the other evidence lies in the domain of the court, not that of the expert witness. It is quite plausible that in some cases this would correspond to extremely small prior odds. For example, in a case in which there is little or no evidence other than the DNA match, it may be reasonable to estimate that there are 10,000 individuals who, before examining the DNA profiles, were just as likely as the

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