EVIDENCE, PROBABILITY, AND PATERNITY

To the Editor: I will discuss just a few of the many fallacies propounded by Mikel Aickin in "Some Fallacies in the Computation of Paternity Probabilities," [1].

Two of the arguments hinge on inappropriate use of the notion of probability. In the section The Null Hypothesis Fallacy in One-Man Cases, a hypothetical observer is introduced who knows a great deal about "plausible fathers," and the point is made that he would compute a different probability of paternity than we who know less. The fallacy lies in concluding that our probability of paternity is therefore wrong. In fact, there is no paradox and no error should be inferred.

It is in the nature of the concept of probability that it only makes sense in the context of some presumed state of knowledge. To verify this assertion, consider the following familiar and extreme example: A die is thrown, and we claim it will land a four with probability ⅙. Clearly, this claim presumes that we do not have accurate information about the precise manner and orientation of throwing—otherwise, a more informative prediction would be possible.

So it is with alleged fathers. The probability of paternity is not a characteristic intrinsic to the situation, which can therefore be known to some ideal observer and which we try to approximate from our limited data. Rather, a probability of paternity is a summary of whatever data we may possess. If it is an approximation of anything, it is an approximation to 1, in the case of paternity of the alleged father, or to 0, in the case of his nonpaternity.

To see the matter another way, consider that the so-called collection of "plausible fathers" ("men for whom one might have some reasonable belief, however small . . .") is not well-defined. To the mother, it might mean the collection of men with whom she has had sexual contact. To a nosy neighbor, it might mean the collection of men who have visited her. To a truly omniscient observer, it would consist of just one man—the true father. Each observer might compute a different probability of paternity as regards the alleged father; each probability could correctly express that observer's state of knowledge.

Another point in the article depends on the same misapprehension about probability. A man is typed 2 in a system with a rare silent allele, s. Thus, the man is probably (2-2), but possibly (2-s). The child is type 1. Aickin is reluctant to accept the conventional conclusion that the man is unlikely to be the father. He argues that the man is either (2-2), and "excluded," or (2-s), in which case "there is rather little evidence [to exonerate him]. . . . Substitution of probabilities for knowledge is unacceptable, because of the divergence between the conclusions in particular cases."

This line of thought assumes that the man's genotype is a sacred piece of evidence, and, if we only knew it, we could compute the "true" probability of paternity—again the fallacy of assuming that probability is something intrinsic. What is correct to say is this: "If we *knew* that the man were (2-2), he *would be* excluded; if we *knew* that he were (2-s) there *would be* rather little evidence to exonerate him." But from where we actually stand, there is a lot. So we

compute a low likelihood ratio, aided by which a judge or jury ultimately decides between the markedly divergent conclusions of paternity or nonpaternity. This is typical of situations in life where we have to make decisions based on incomplete information.

To touch one further point—the case is posited wherein we judged a man a priori 40% to be a *non-father*. Upon serologic testing, the man was not excluded and the likelihood ratio was 500, so by Bayes' theorem, the posterior (overall) likelihood of nonpaternity is .00133. We are advised that "we may be forgiven for wondering how our .4 belief in the father's [sic] story dwindled to .00133 just on the basis of the fact that he is not excluded from biological fatherhood." I suppose there is no harm in wondering per se, but the rhetorical meaning of this sentence seems to be that having once formed an opinion, you needn't by swayed by mere evidence. And what evidence! This man survived a veritable gauntlet of tests, such as would exclude 500 out of 501 non-fathers (and no fathers). Maintaining one's anyway rather moderate faith in his nonpaternity might be a touching show of loyalty from his friends and his mother, but is unreasonable from a juror and bad advice from an expert.

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REFERENCE

1. AICKIN M: Some fallacies in the computation of paternity probabilities. *Am J Hum Genet* 36:904–915, 1984

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CHROMOSOMAL IMPRINTING AND THE PARENT TRANSMISSION SPECIFIC VARIATION IN EXPRESSIVITY OF HUNTINGTON DISEASE

To the Editor: The increased severity of Huntington disease in the offspring of males compared to that of females has been of interest and comment to clinicians and human geneticists observing Huntington disease for some time [1, 2]. An old observation, now being applied to mammals by mouse geneticists, may be relevant to this difference [3, 4]. The observation is that of chromosomal imprinting. It is clear in certain insects that chromosomes transmitted through the female contain different information by being so transmitted, that is, compared to when they are transmitted through the male [5]. In this case, the imprinting results in differential elimination of the chromosomes in the male. It is now clear that such differences in chromosomal imprinting also affect the mammalian genome. The best two examples of this concern the X chromosome [6] and a chromosome 17 mutation in mice, T^{Hp}. In the former case, the mammalian male X chromosome functions differently than that of the female such that it is inactivated preferentially in extraembryonic tissues [7, 8], while X-chromosomal inactivation is random in the embryo proper. This difference in