When batterer turns murderer

SIR — Alan M. Dershowitz, who advises the defence lawyers in the O. J. Simpson trial, stated on US television in early March that only about a tenth of 1% of batterers actually murder their wives. His statement, though presumably true, is highly misleading for the woman in the street. A probability of greater relevance for legal purposes would be based on the knowledge that the woman was both battered by her husband and also murdered by somebody. An approximate estimate of this probability will now be made, based on Dershowitz's statement.

I shall write P for "the probability of" and O for "the odds of". Let G mean "the husband is guilty (did the murder in 1994)". Let $\bar{G}$ mean that he did not murder his wife. Let M mean "the woman was murdered by somebody in 1994". Let *Bat* mean that the woman was battered by her husband, not necessarily with a bat.

The given information is M and *Bat*. We would like to estimate $P(G/M \text{ and } Bat)$. I shall assume throughout that the woman is known to be alive in 1993, so it is not necessary to express this fact in the notation. It is then reasonable to assume that if the husband commits the murder, then the probability is at least 1/10 that he will do it in 1994. (Some would say 1/20 here; the details of this argument are available from the author on request.) Thus, assuming Dershowitz's statement, we have the probability that a man will murder his wife in 1994 given that he is a batterer:

$$P(G/Bat) > (1/10) \times (1/1{,}000) = 1/10{,}000 \quad (1)$$

or instead

$$P(G/Bat) > 1/20{,}000 \quad (1a)$$

Therefore,

$$O(G/Bat) > 1/9{,}999 \approx 1/10{,}000 \quad (2)$$

or

$$1/20{,}000 \text{ instead} \quad (2a)$$

Further, the probability of a woman being murdered given that her husband has murdered her (whether a batterer or not) is clearly unity:

$$P(M/G \text{ and } Bat) = P(M/G) = 1 \quad (3)$$

Also, if the husband is innocent, the fact that he was a batterer becomes irrelevant to the probability of M. It is known that there are about 25,000 murders per year in the US population of about 250,000,000 (*World Almanac*, 1994, p. 964; I do not know the statistics for women alone, or for women of a specific age or race, so I am using the overall statistics from the *World Almanac*. Further refinements are possible, but I am aiming at simplicity.). Thus, the probability of a woman being murdered, but not by her husband is:

$$P(M/\bar{G} \text{ and } Bat) = P(M/\bar{G}) \approx 1/10{,}000 \quad (4)$$

(The denominators in equations (2) and (4) happen both to be 10,000, but for two distinct reasons.)

Therefore, from equations (3) and (4), by division, the Bayes factor in favour of G provided by M, given *Bat*, is ~10,000. Therefore, from equations (2) or (2a),

$$O(G/M \text{ and } Bat) > 10{,}000/10{,}000 = 1 \quad (5)$$

or instead

$$> 10{,}000/20{,}000 = 1/2 \quad (5a)$$

In other words, the probability that a murdered, battered wife was killed by her husband:

$$P(G/M \text{ and } Bat) > 1/2 \quad (6)$$

or instead

$$P(G/M \text{ and } Bat) > 1/3 \quad (6a)$$

based only on the information M and *Bat*. Most members of a jury or of the public, not being familiar with elementary probability, would readily confuse this with $P(G/Bat)$, and would thus be badly misled by Dershowitz's comment.

The inequality in equations (6) or (6a) shows that if the wife of a batterer is murdered by somebody, then it is reasonable to suspect the husband. (There is not much practical difference, in such legal matters, between the assertions that the probability of guilt exceeds 1/2 or exceeds 1/3.) This is, of course, before other evidence is taken into account. From a remark that was presumably intended to support the defence, we have deduced that it supports the prosecution in that it brings the accused under suspicion.

Of course, the argument applies much more generally than to the O. J. Simpson trial. It shows once again, and dramatically, that the simple concept of the Bayes factor is basic for legal trials. It is also basic for medical diagnosis and for the philosophy of science. It should be taught at the pre-college level!

I have sent a copy of this note to both Professor Dershowitz and the Los Angeles Police Department.

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A human *BRCA1* gene knockout

SIR — Dominant high-penetrance breast and ovarian cancer susceptibility mutations in the *BRCA1* gene on chromosome 17q21.1 are present in the UK population at a frequency of about one in 1,600 (ref. 1). Women who are heterozygous for such mutations have an 85% risk of breast cancer and a 63% risk of ovarian cancer during their lives[2]. The *BRCA1* gene was mapped in December 1990 and isolated in October 1994[3–5]. *BRCA1* germline mutations have been identified in more than 80 families where these cancers are prevalent[6–9].

The *BRCA1* gene has 24 exons and encodes a protein of 1,863 amino acids and unknown function. We have been screening lymphocyte DNA from affected individuals from breast and ovarian cancer families living in Scotland for predisposing germline *BRCA1* mutations. To search for mutations, we amplified using polymerase chain reaction (PCR) all 22 coding exons of the *BRCA1* gene and carried out sequence and single-strand conformation polymorphism (SSCP) analysis on the PCR products.

We detected variant bands from exon 11 in samples from five families, including the family (pedigree 475) shown in Fig. 1. Surprisingly, only the variant SSCP bands, and no normal-sized bands, were seen in DNA from the index case arrowed in pedigree 475 (Fig. 2). This woman had breast cancer diagnosed at age 32, and her mother and four of her maternal aunts had breast and/or ovarian cancer. She also has a first cousin on her paternal side of the family who was diagnosed with ovarian cancer at age 22 (Fig. 1).

We repeated the amplification of exon 11 for the index case and sequenced the PCR product on an ABI373A automated DNA sequencer. Sequencing revealed that the individual had a deletion of two A nucleotides at position 2,800 in the *BRCA1* sequence (AA_{2800}), resulting in an in-frame stop codon at nucleotide 2,820. This allele would be expected to encode a 900-amino-acid protein. The AA_{2800} mutation was previously reported in a breast/ovarian cancer family from the United States[8].

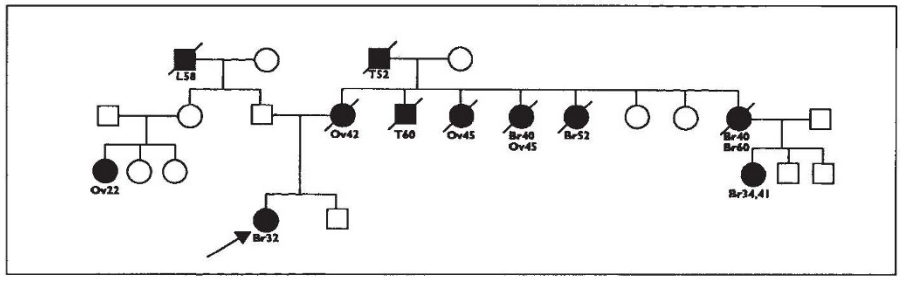

FIG. 1 Pedigree 475. Individuals with cancer are indicated by black squares (males) and circles (females). Cancers are as follows: Br, breast cancer; Ov, ovarian cancer; L, lung cancer; T, cancer of the throat. Ages at diagnosis are also indicated. The *BRCA1* homozygote is arrowed.