Reasonable Doubt:

What kind of probability is at issue?

Tony Gardner-Medwin, UCL

Physiology Dept. (Neuroscience, Inference)

C. Adv. Learning & Teaching (Certainty-Based Marking)

a.gardner-medwin@ucl.ac.uk

Significance Paper available at:

http://www.ucl.ac.uk/~ucgbarg/doubt/significance.htm

Scenario

A jury tries a case of alleged double infanticide by parent X, in which the direct medical evidence and witness statements are consistent with either murder or SIDS. The jury knows that accepted medical opinion is such that double SIDS in one family, though rare, is not so rare as to be ruled out altogether 'beyond reasonable doubt'. Legal precedent has normally acquitted such defendants unless there is additional evidence of a crime. The jury nevertheless convicts X in this case, seemingly swayed by convincing evidence that X's minority culture is associated with a much higher incidence of infanticide than the precedent cases, though the incidence of SIDS is the same.

- Was the jury correct to take account of the higher incidence?   No
- Does this evidence increase one's judgment of P that X is guilty?   Yes
- Does it affect one's judgment of P that such evidence could arise without guilt? No
- Does it affect one's judgment of P that the evidence **did** arise through SIDS?   Yes
- Are the issues here statistical / ethical / legal / political ?

Letter from the RSS President to the Lord Chancellor regarding the use of statistical evidence in court cases (23/1/02)

[…] *"The jury needs to weigh up two competing explanations for the babies' deaths: SIDS or murder. **The fact that two deaths by SIDS is quite unlikely is, taken alone, of little value. Two deaths by murder may well be even more unlikely. What matters is the relative likelihood of the deaths under each explanation**, not just how unlikely they are under one explanation."*

What is he saying, in statistical terms ?
What are the implications ?
What is the justification ?
What is the alternative ?
How could the alternative be justified ?

What is he saying, in statistical terms ?

What matters is the relative likelihood of the deaths under each explanation

The probability of guilt, given the evidence:

$$P(\,G|E\,) \;=\; \frac{P(E \;\&\; G)}{P(E \;\&\; G) + P(E \;\&\; \text{not-}G)}$$

1. The implication is that it is P(G|E) that matters
2. At first sight, this certainly seems natural
3. It can readily be expressed in Bayesian terms:

$$\frac{P(G|E)}{P(\text{not-}G|E)} \;=\; \frac{Po(G)}{Po(\text{not-}G)} \quad \frac{P(E|G)}{P(E|\text{not-}G)}$$

posterior odds ratio   =   prior   x   likelihood ratio

[as elaborated by Dawid, 2002]

What are the implications for lawyers ?

Two deaths by murder may well be even more unlikely.

1. A jury should consider evidence of the statistical incidence of an alleged crime

2. On the same physical evidence, the fact that a crime is common should favour conviction (and *vice versa*)

3. If a characteristic of the defendant is statistically associated with higher incidence of the alleged crime (maybe cultural or ethnic background, upbringing, prior conviction, age, gender, etc.) then this should favour conviction (and *vice versa*)

- Courts usually regard such evidence as inadmissible.

- Reasons given are often rather contorted : supposed balance of probative vs prejudicial value, supposed irrelevance of statistics to individual cases, supposed inability of juries to handle statistical issues, supposed double jeopardy, moral issues, etc.

- To a scientist or statistician, the notion of improving a decision by ignoring evidence is extremely odd.

Is there an argument for convicting on the basis of P(guilt) ?

Certainly there is. Decisions in the face of uncertainty in other risk situations (medicine, finance, etc.) are normally (and rationally) based on maximisation of expected utility:

<u>Utility</u> :

	Guilty	Innocent
Convict	**+**	**- -**
Acquit	**-**	**0**

For

c	**-b**
-a	**0**

convict if $P(G) > \dfrac{b}{a+b+c}$

- Doctors routinely consider evidence of statistical associations with ethnic status, prior disease etc. when deciding on diagnosis & treatment.
  Is the RSS right to say the same should happen in court?
  So are lawyers (and many people's liberal instincts about what constitutes a fair trial) wrong to say such evidence is irrelevant or prejudicial ?

Is there an alternative ?

My View:

- To "doubt" = to entertain the hypothesis that D is innocent

- "Reasonable doubt" means then that the defence case seems, to a reasonable person, plausible

---

The key question becomes:

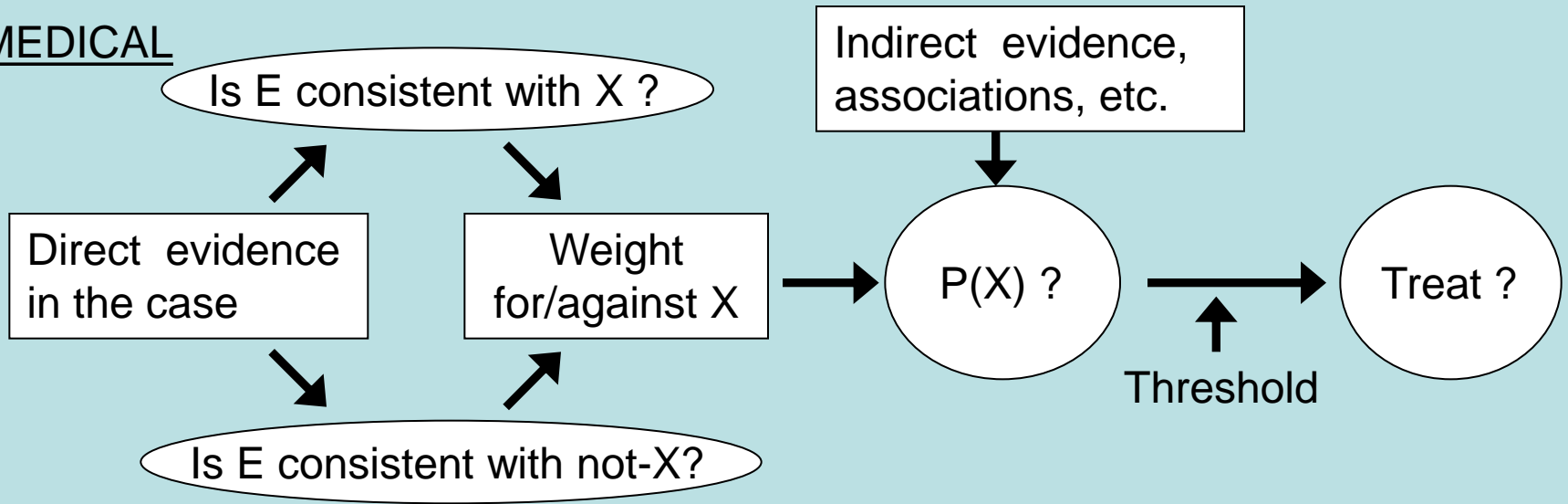*Is it believable that the evidence could have arisen without guilt?*

not

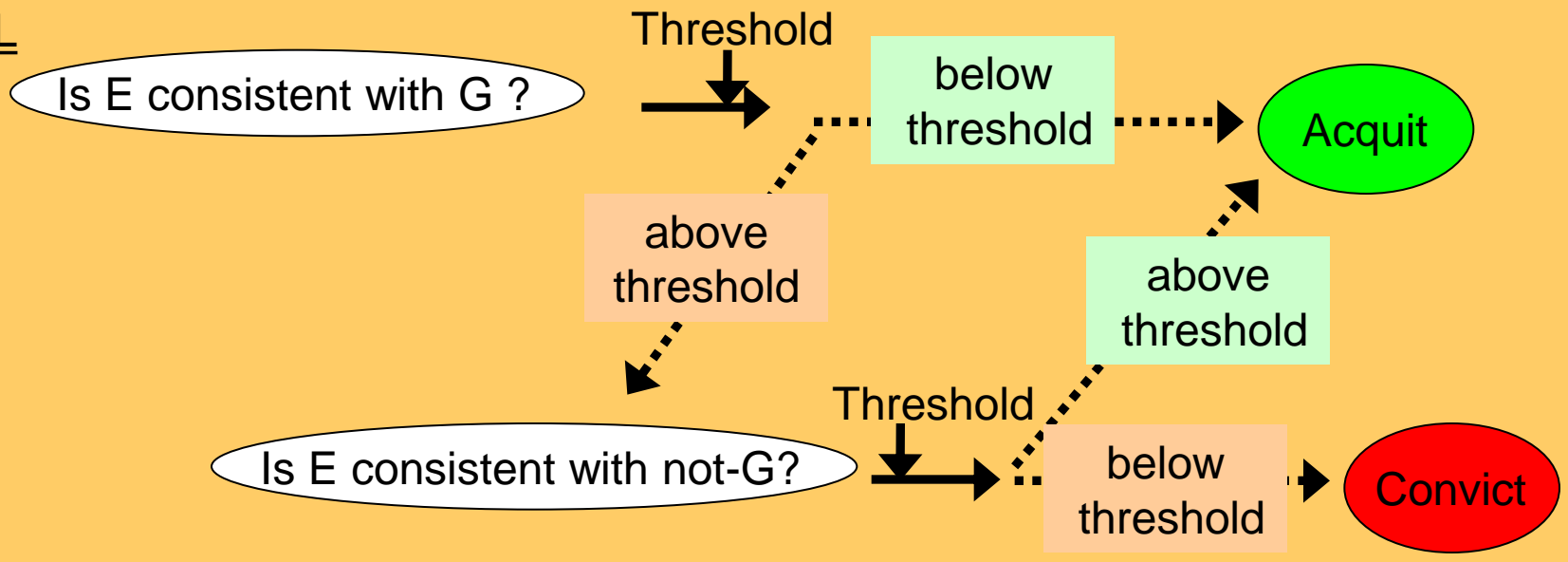*Is the defendant guilty ?*

A jury may rationally believe both

    a) The evidence could have arisen without guilt, and

    b) It is extremely probable that D is guilty

            ... then they should acquit.

MEDICAL

Is E consistent with X ?

Indirect evidence, associations, etc.

Direct evidence in the case

Weight for/against X

P(X) ?

Treat ?

Threshold

Is E consistent with not-X?

LEGAL

Is E consistent with G ?

Threshold

below threshold

Acquit

above threshold

above threshold

Is E consistent with not-G?

Threshold

below threshold

Convict

Acquittal despite a high P(G) :
Can it be reconciled with maximisation of expected utility ?

- Immediate utilities (false conviction, etc.) are not the only utilities

- Immediate utilities are usually unknown (nobody knows if the defendant is <u>actually</u> guilty) so perceived utility arises from society pronouncing: "You made a just (or unjust) decision"

- Such opinion may – in a democracy - have its basis in psychology, e.g. perception of a "fair trial" if one were involved, and political utilities, e.g. pressure on law-enforcers to provide solid evidence.

> **A society that acquits people because they could be innocent, however much more likely it may be that they are guilty, may be preferred rationally on the basis of higher level utilities: the notion that this is the most comfortable and stable form of society.**

Conclusion: What is "Reasonable Doubt"?

(1) Conventional Wisdom: "guilty beyond reasonable doubt" means

P(D is guilty) > some high value, e.g. ~ 0.95

(2) My View: "Reasonable doubt" =

... it is believable that the evidence could have arisen without guilt

Either way, the threshold criterion is a matter for jury's judgment.

- **It may be an issue of probability, credibility, or expected occurrences per annum and per unit of population.**

- Some evidence (e.g. defendant's background, associations, incidence of crime) may be relevant to (1) but not (2)

- Good rules of evidence have evolved (without, I would argue, very clear rationale) to hide evidence that affects (1) but not (2).

- Adopting a new perspective & more subtle statistical approach can help to clarify the task of a jury and to rationalise legal principles.

- A fully rational jury, addressing (2), would benefit from having <u>all</u> relevant information, without being shielded by restrictive rules.

Perhaps Bentham may yet preside over a coming together of statistics, utilitarianism, liberalism and law.

www.ucl.ac.uk/~ucgbarg

(or Google :   UCL Reasonable Doubt)