

*... in this world there is nothing certain but
death and taxes.*

Benjamin Franklin

***Uncertainty in Medicine:
Declare, Explore, or Hide It?***

Gerd Gigerenzer



HIV

Counseling & testing



Should you be tested?

Illinois Department of Public Health

What does a positive test mean?

A positive test result means antibodies to HIV were found. This means you are infected with the virus and pass HIV to others – even if you have no symptoms. You are infected for life.

Illinois Department of Public Health 2005

➔ **Leben mit HIV**

*Wenn der HIV-Test
positiv ist*

*Informationen und
Orientierungshilfen*

Was bedeutet das positive Testergebnis für meine Lebensperspektive?

Ein positiver HIV Antikörpertest bedeutet zunächst nur, dass eine Infektion mit dem HI-Virus stattgefunden hat. Er bedeutet nicht, dass Sie nun zwangsläufig Aids haben und jetzt alles „zu Ende“ ist.



Bundeszentrale
für
gesundheitliche
Aufklärung

Twenty AIDS Counseling Centers

Client: *"If one is not infected with HIV, is it possible to have a positive test result?"*

Counselor:

- | | | | |
|----|---|----|---|
| 1 | <i>"No, certainly not"</i> | 11 | <i>"False positives never happen"</i> |
| 2 | <i>"Absolutely impossible"</i> | 12 | <i>"With absolute certainty, no"</i> |
| 3 | <i>"With absolute certainty, no"</i> | 13 | <i>"With absolute certainty, no"</i> |
| 4 | <i>"No, absolutely not"</i> | 14 | <i>"Definitely not" ... "extremely rare"</i> |
| 5 | <i>"Never"</i> | 15 | <i>"Absolutely not" ... "99.7% specificity"</i> |
| 6 | <i>"Absolutely impossible"</i> | 16 | <i>"Absolutely not" ... "99.9% specificity"</i> |
| 7 | <i>"Absolutely impossible"</i> | 17 | <i>"More than 99% specificity"</i> |
| 8 | <i>"With absolute certainty, no"</i> | 18 | <i>"More than 99.9% specificity"</i> |
| 9 | <i>"The test is absolutely certain"</i> | 19 | <i>"99.9% specificity"</i> |
| 10 | <i>"No, only in France, not here"</i> | 20 | <i>"Don't worry, trust me"</i> |

Innumeracy: An AIDS Counseling Session

Client: If one is infected, is it possible to receive a negative test result?

Physician: When there are enough antibodies, the test identifies them. If you are infected, you get a positive result with a 99.9% chance.

Client: And if I am not infected, can I get a positive result?

Physician: If you take the test here, including a confirmatory test, the test is extremely certain: in any case, the specificity is 99.9%.

Client: How frequent is the virus in my risk group, that is, among heterosexual men with no known risk factor such as IV drug use?

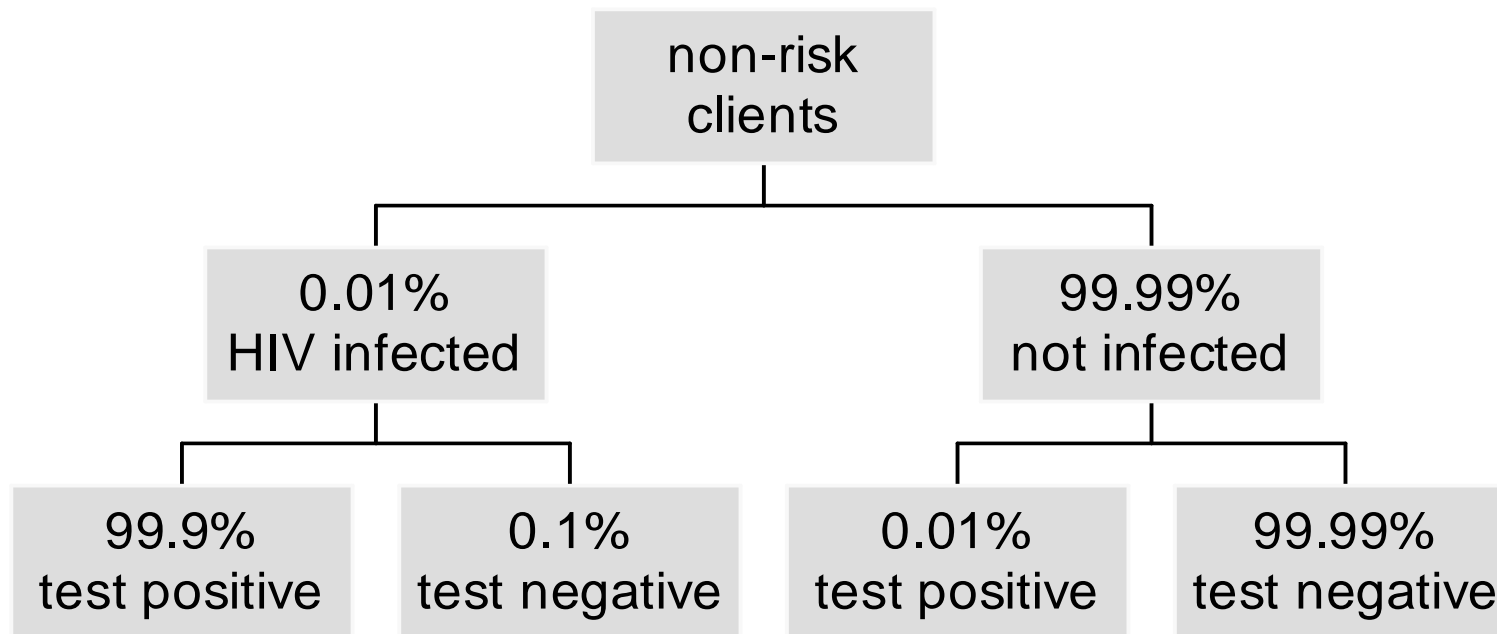
Physician: 1 in 1,000 or less.

Client: What are the chances that men in my risk group actually have HIV given a positive result?

Physician: As I already have said: extremely certain, 99.9%.

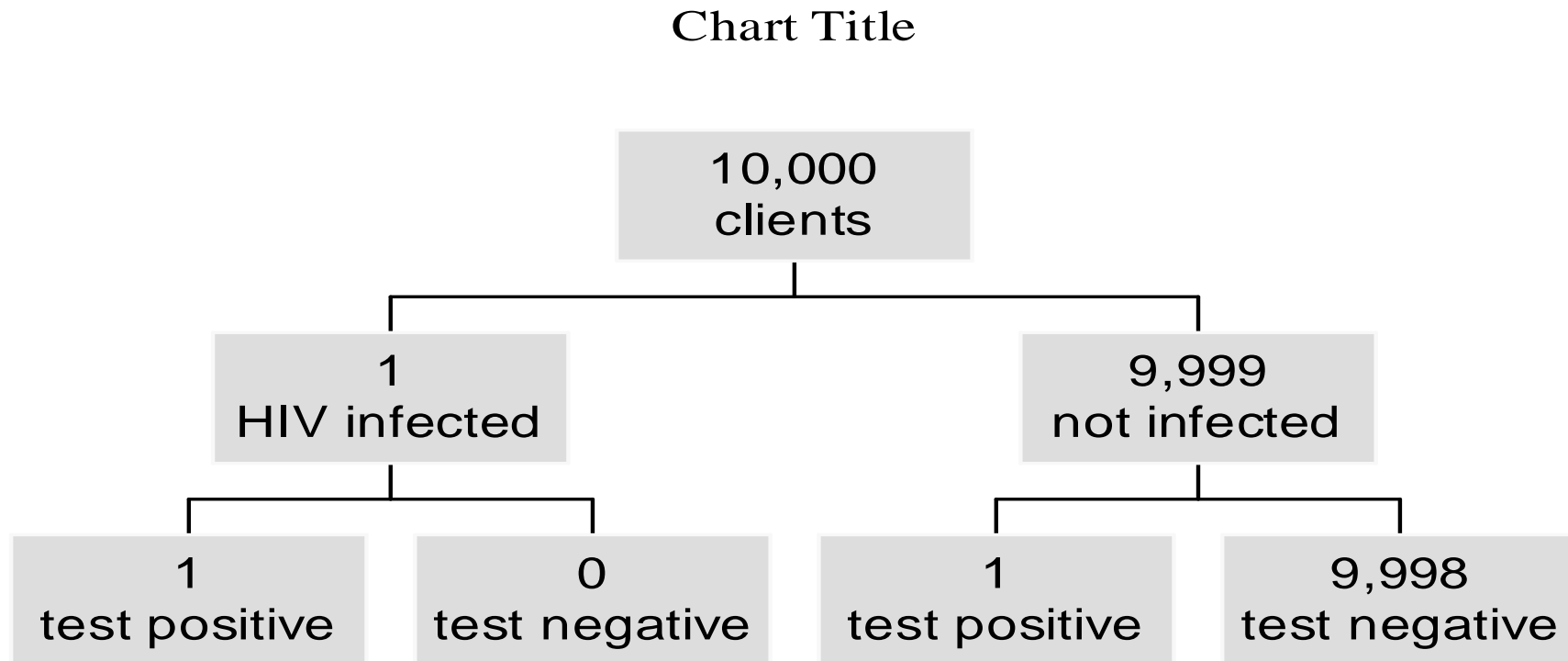
What is the chance of an HIV infection given a positive screening test?

Chart Title



Representation: Conditional probabilities

What is the chance of an HIV infection given a positive screening test?



Representation: Natural frequencies

Suffering from Collective Innumeracy

-- Then - two weeks ago, I had an HIV test. I'm newly married and newly pregnant, and the test is a standard procedure now for pregnant women. They called me a week later and said I had tested positive for HIV. I asked about the false positive rate; the doctor told me it was 5/100,000. They gave me some handouts from the internet about living with HIV, and sent me off to tell my husband and my family the news.

It was a bad evening and next morning, but at work the next day I got to thinking... I reread your article, considered my low-risk lifestyle, and began to feel some hope. I went with my husband that weekend to a different clinic, where they had the 20-minute pinprick test, and we both tested negative; every subsequent test has been negative.

Your article saved me from a degree of despair I cannot even put into words; it gave me enough stamina to continue to research the issue and get tested again immediately. I appreciate the article for its contribution to the risk assessment arena, but I also wanted to tell you how important it was to me on a much deeper level.

Sincerely,

A. B.
Berkeley, California
November 2004

Risk Communication

Representations that produce innumeracy

***Single-event
probabilities***

***Conditional
probabilities***

Relative risks

Prozac's Side Effects

"You have a 30 to 50 percent chance of developing a sexual problem"

"Out of every 10 of my patients to whom I prescribe Prozac, 3 to 5 experience a sexual problem."

"Something goes awry in 30% to 50% of my sexual encounters!"

DNA Fingerprinting

"The probability that this match has occurred by chance is 1 in 100,000."

"Out of every 100,000 people, 1 will show a match."

Risk Communication

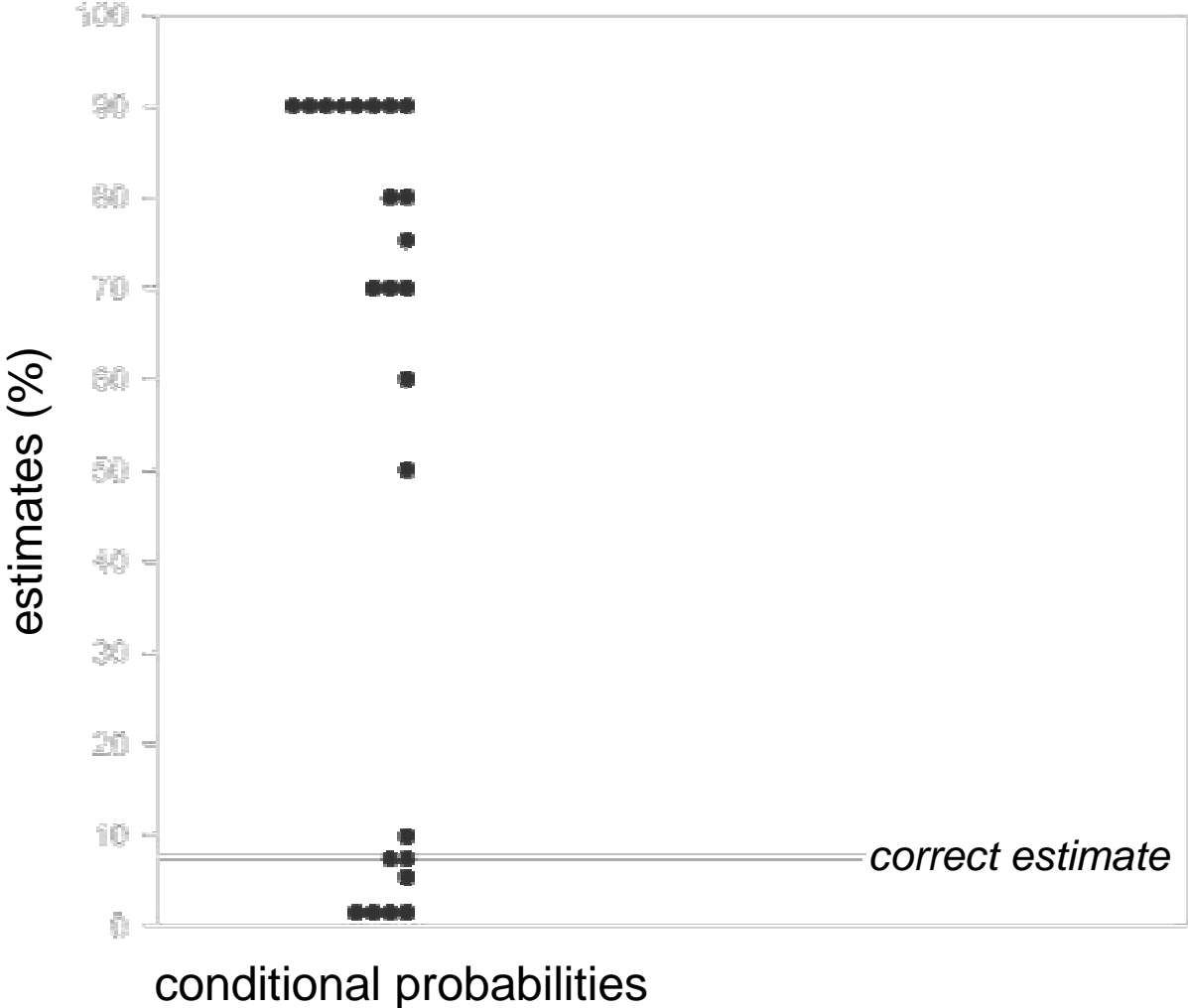
Representations that produce innumeracy

***Single-event
probabilities***

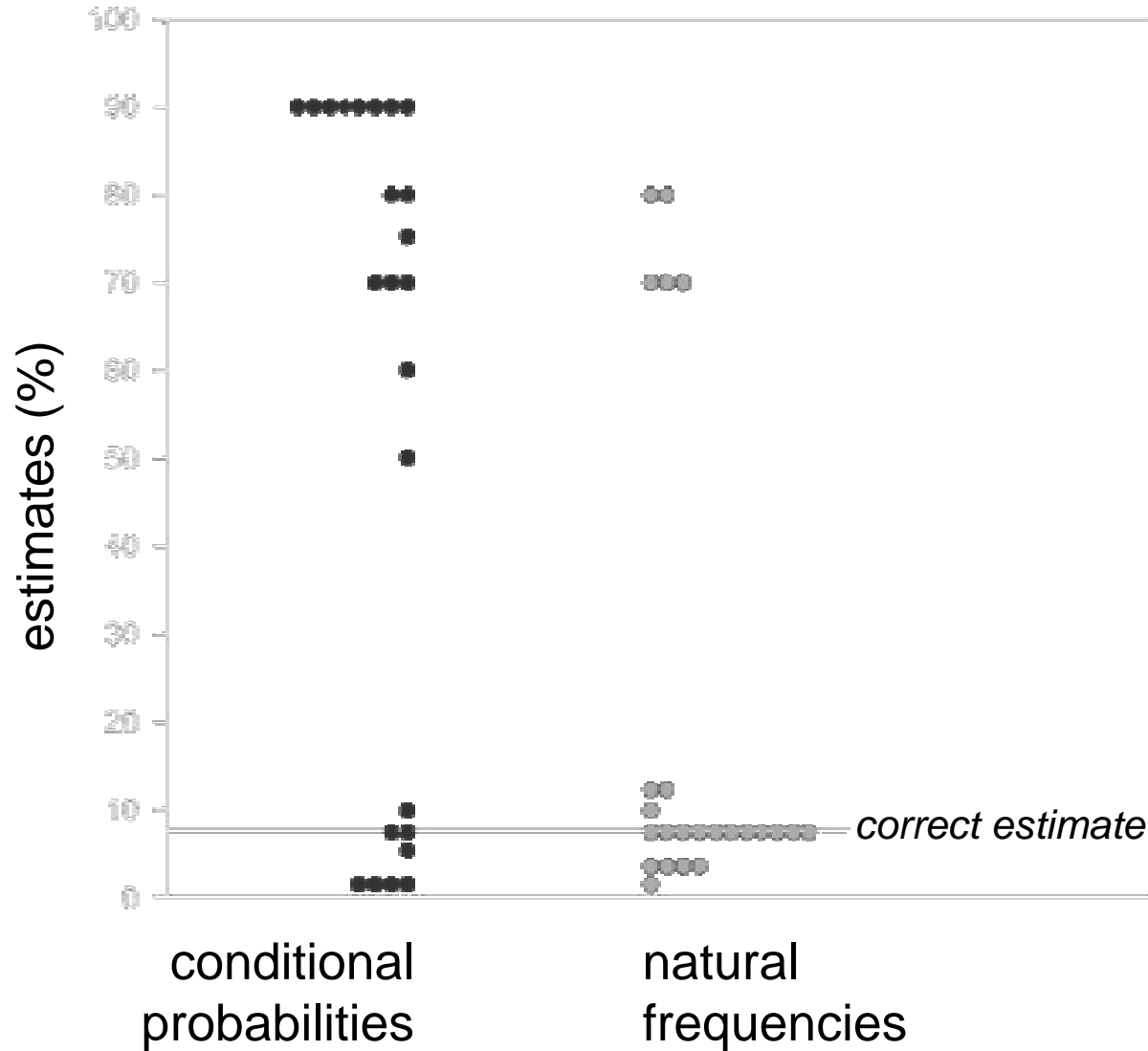
***Conditional
probabilities***

Relative risks

Mammography



Mammography



Risk Communication

Representations that produce innumeracy

***Single-event
probabilities***

***Conditional
probabilities***

Relative risks

Benefits of Mammography Screening

Deaths from breast cancer (per 1000 women)

No screening	4
Screening	3

Three ways of presenting the benefits:

Relative risk reduction: Mammography screening reduces the risk of dying from breast cancer by 25 percent

Absolute risk reduction: Mammography screening reduces the number of women who die of breast cancer by 1 out of 1,000—that is, 0.1 percent

Number needed to screen: In order to prevent one death from breast cancer, the number of women who need to participate in screening for 10 years is 1,000



Bundesministerium
für Gesundheit
und Soziale Sicherung

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“In response to criticisms by the Berlin Medical Council of the decision made by the German Bundestag Health Committee to implement mammography screening, the Federal Minister of Health Ulla Schmidt clarifies:

...

For women in this age group (50 to 69) who participate in screening programs, breast cancer mortality decreases by up to 35%.”



Nationales Netzwerk
Frauen und Gesundheit
(Hrsg.)

Brustkrebs Früherkennung

Informationen zur Mammografie

Eine Entscheidungshilfe



Brust- krebs

Die blauen
Ratgeber

2



What information do women get?

Information	% of leaflets	
	Australia 1997	Germany 2001
<i>Benefit</i>		
Relative risk reduction	22	7
Absolute risk reduction	NEVER	7
NNT (number needed to screen)	NEVER	4
<i>Harm</i>		
Consequences of false positives	14	11
Discovery & treatment of non-progressive cancers	NEVER	11
Cancer caused by mammography	NEVER	44
<i>Quality</i>		
Sensitivity (or false negative rate)	26	19
Specificity (or false positive rate)	NEVER	4
Positive predictive value	NEVER	15

GERMANY: 27 leaflets on mammography screening by Bundesamt für Strahlenschutz, Deutsche Krebsgesellschaft, Krebsinformationsdienst, Krankenkassen, Mammographie-Screening Planungsstelle u. a. Source: Kurzenhäuser (2003).
 AUSTRALIA: 58 leaflets, Slaytor & Ward (1998), *British Medical Journal*

Innumeracy in Health Care

Size of the problem

- An estimated 80-90% of physicians and most patients are innumerate.
- This fact turns the ideal of informed consent and evidence-based medicine into science fiction.

Causes

- Innumeracy is not a mental disease, but largely caused by the representation of information (aside from conflicts of interest).

Treatment

- Innumeracy can be reduced by
 - (i) transparent representations in written and oral risk communication, and
 - (ii) teaching risk communication to physicians and patients. This can be done in a few hours.

The best technology is of little value if people do not comprehend it

- Learning to live with uncertainty *instead of* illusion of certainty
- Transparent risk communication *instead of* collective confusion

Just in case you got curious ...

Gerd Gigerenzer:

Quando i numeri ingannano: Imparare a vivere con l'incertezza

Raffaello Cortina 2003

(Original: Reckoning With Risk. Penguin)

German Bundestag, June 28, 2002: Mammography screening is law

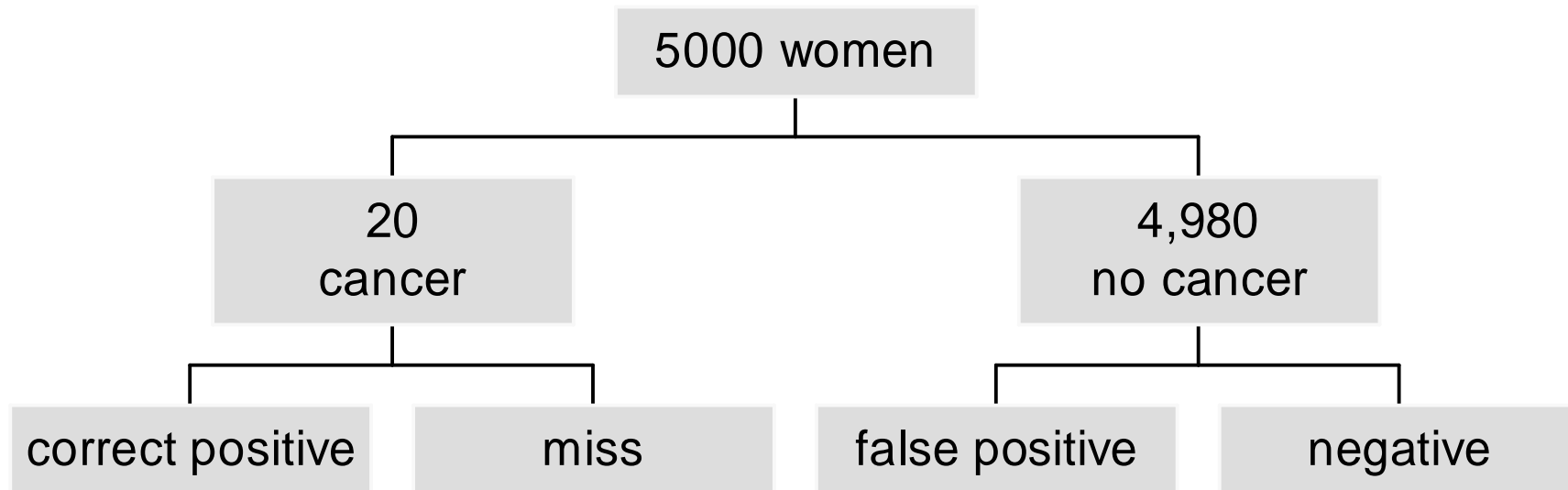
***$p(\text{cancer}) = 0.4\%$; $p(\text{positive}) = 5\%$;
 $p(\text{cancer}|\text{positive}) = 20\%$***

Source: Beilage zum Deutschen Ärzteblatt, January 23, 2004.

$p(\text{cancer}) = 0.4\%$; $p(\text{positive}) = 5\%$;
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Chart Title



⤵ 250 women test positive.

⤵ 50 of these have cancer.

⤵ ***There are 50 women with cancer among 20 women!***

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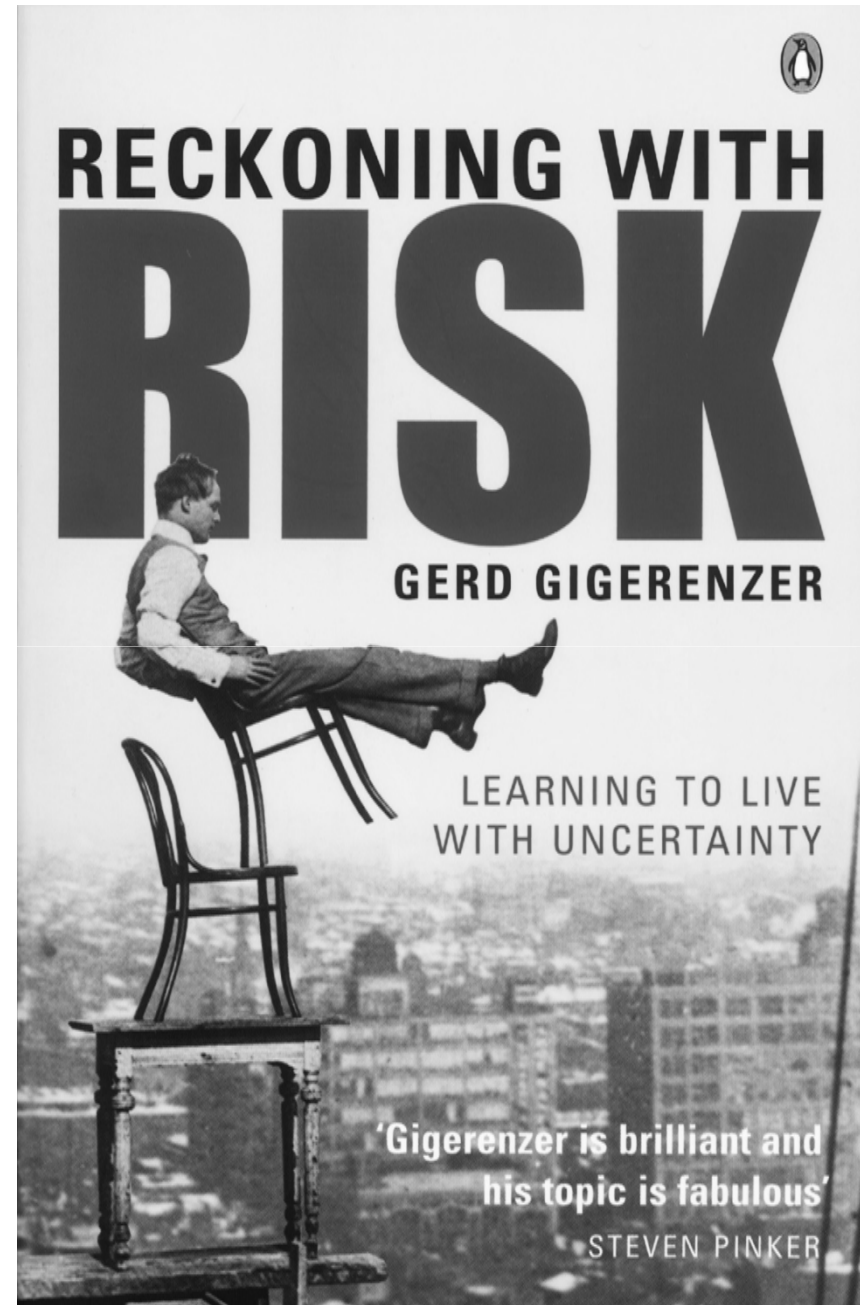
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If you got curious...

German Translation:
Das Einmaleins der Skepsis



Wells 3 Punkte` ; US weather forecast; 30% probability of rain; pill scare; 9/11: Es verlieren alle Beteiligten: die Fluggesellschaften, die Reisebüros, und die Bürger. (wie Anti-Baby Pille)

- 8.Nov. 04, Bayer. Fernsehen “Die Sprechstunde” Thema: Erkrankungen der Prostata. Moderatorin: Dr. Antje-Katrin Kühnemann. Einführungsstatement:”Jeder neunte von 10 Männern kann geheilt werden. Gehen Sie zur Früherkennung” . [Mortalitätsreduktion durch PSA ist kein Thema, nur dass Bestrahlung genauso gut ist wie Operation, selbe Nebenwirkungen.K’s Schlussstatement: “Nur 15% der Männer nehmen an der Früherkennung teil. Und liebe Männer, wirklich, Früherkennung!”]

Der 4. Voraussetzung für mündige Bürger in einer Demokratie: Transparenz

- Mervin King ist der Governor der Bank von England, das was Alan Greenspan für die USA ist. Er erzählte mir, dass er den Vorgänger von Greenspan um Rat bat: in einem Wort “mystique”. King realisierte das Gegenteil: Transparenz -- Unsicherheit wird offengelegt, interne Debatten veröffentlicht. Anders als die meisten Politischen Entscheidungen. Regierung für A, Opposition für B.
- Steuergesetz: Merz [get facts]

Zahlenblindheit kann durch Transparenz geheilt werden

- Feuchte Makula Degeneration: 50% Erfolg bei Fotodynamischer Therapie 4-5 Behandlungen.GG:Beziehen sich die 50% auf die erste Behandlung oder auf die Sequenz von 5? Arzt:Die erste, und dasselbe gilt für die zweite. Wieder 50%. GG: Aber das heisst, dass nach 5 Behandlungen etwa 95% der Patienten Erfolg haben. Arzt: Nein, nach allen Behandlungen ist es auch bei 50%. GG: Nach dem zweiten Mal sind es schon 75%, ... Arzt sieht nun das Problem. [Heide Sattler sagt mir später, dass er sich bei ihr über mich beschwert hat; sein Unfehlbarkeitssinn war verletzt. Hat sich aber am nächsten tag in der Literatur kundig gemacht.]
- AIDS-Virginia; Illusion der Gewissheit: BSE. Damals erschreckte man sich über den 1.Fall und zwie Minister mussten ihren Hut nehmen, heute haben wir pro Jahr etwa 50 Fälle von BSE, und wir alle essen wieder Rindfleisch.
- Feynman

Coronary Care heuristic: Why is there no gender variable in the heuristic, given that men are more likely to experience chest pain. Any Thompson: Sex does not predict heart attack, but females would not experience the pain (= angina). Gender predicts angina. The seriously ill woman is picked up by the first variable, the man is picked up by the chest pain. Men get early warnings by chest pain. Women have sore throat, whereas

Is the illusion of certainty simply a matter of knowing?

“After 9/11, I explained the greater risk of driving compared to flying to my wife; that did not do the trick.”

A Professor of Psychology, Loyola University, USA

Wells, Weather forecast, 30% of rain; contraceptive pill.
Franklin: Nothing

Funding for HIV/AIDS:

Cumulatively through the fiscal year 2004, the US government has invested approximately \$150 billion for domestic and international HIV/AIDS programs.

For 2005, the President's budget request includes \$19.8 billions, a proposed increase of 7%.