

# Wahrscheinlichkeitsrechnung im Gerichtssaal

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Universität Wien



*Niemand darf verurteilt werden, weil er **wahrscheinlich** schuldig ist!*

# Wahrscheinlichkeiten im Gericht?

**Ein Blick in die Praxis:**

Schon vor 1600 Jahren...



**«Wir Menschen [...] lieben es, unsere Vermutungen Gewissheit zu nennen oder, wenn wir einige Wahrscheinlichkeitsgründe dafür haben, für sicher zu halten; und doch sind manche wahrscheinlichen Dinge unwahr, wie manche unwahrscheinlichen wahr.»**

**Aurelius Augustinus (354-430)** als Bischof von Hippo an einen Strafrichter seiner Diözese

# Max Hirschberg:

## Das Fehltrteil im Strafprozess (1962)



*Dr. Max Hirschberg, München*

«Die meisten Fehltrteile entstehen dadurch, dass der Richter bei der **Wahrscheinlichkeit** stehenbleibt, statt **Gewissheit** zu verlangen.»

«Die Evidenz, das Bewusstsein der Gewissheit, ist nicht ein höherer Grad von Wahrscheinlichkeit [...]. **Gewissheit ist vielmehr die Überzeugung von der [...] Unmöglichkeit des Andersseins.**»

**Überzeugung:** aus Untersuchung des Tatablaufs

(Motiv, logische Nachvollziehbarkeit der Tat, gesicherte Spuren und Aussagen).

# Wie kommen Wahrscheinlichkeiten in den Gerichtssaal?

- intuitiv (Plausibilität als Teil des abstrakten Denkens)
  - technische Verfahren, die an eine math. Auswertung gekoppelt sind (z.B. DNA-Tests)
  - bei Risiko-Bewertungen für mögliche Rückfalltäter
- <https://www.propublica.org/article/machine-bias-risk-assessments-in-criminal-sentencing>

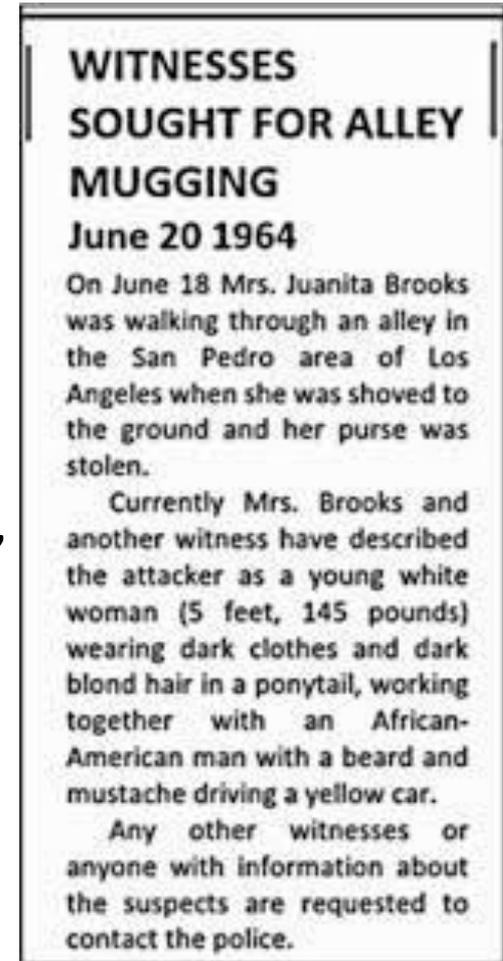
## In jedem Fall liegt ein Modell zugrunde.

- Ist es mathematisch korrekt?
- Ist es realitätsnah?
- Welchen Einfluss haben ungenaue Ausgangsdaten?

# Vier Fallstudien

## Beispiel 1: Fall Collins

- Strassenraub, Los Angeles, 1964
- Fakten: Juanita Brooks wurde zu Boden gestossen und bestohlen.
- Angeklagt: Ehepaar Janet und Mark Collins, weil sie den Tätern sehr *ähnlich* sehen.



<https://law.justia.com/cases/california/supreme-court/2d/68/319.html>

# Eine aussergewöhnliche Ähnlichkeit

Das Täterpaar war **gemischtrassig**, ebenso wie Familie Collins.

**Selten:** Vollständige Aufhebung der Rassentrennung erst im *Civil Rights Act* vom 2. Juli 1964.



## Die Beweislage

- Ein Tatzeuge
- Weder Opfer noch Zeuge konnten einen der Beschuldigten identifizieren.

# Argumente des Staatsanwalts

Festgestelltes Merkmal für Paare	Wahrscheinlichkeit
M1: blonde jüngere Frau	1/3
M2: jüngere Frau mit Pferdeschwanz	1/10
M3: gelbes Auto	1/10
M4: Mann mit Schnurrbart	1/4
M5: bärtiger Afroamerikaner	1/10
M6: gemischtrassiges Paar im Auto	1/1000

**Multiplikation**  $p = \prod_{k=1}^6 p(M_k) = \frac{1}{12 \cdot 10^6}$

als Wahrscheinlichkeit für ein anderes Täterpaar

Urteil: **schuldig**

# Kritikpunkte

- Die Wahrscheinlichkeiten sind Schätzwerte und können nicht belegt werden.
- Ihre Multiplikation setzt die Unabhängigkeit voraus.  
Jedoch M1, M5, M6 abhängig!
- unsichere Zeugenaussagen → nicht alle Merkmale gesichert

# Hauptkritik: «Trugschluss des Staatsanwalts»

Aus

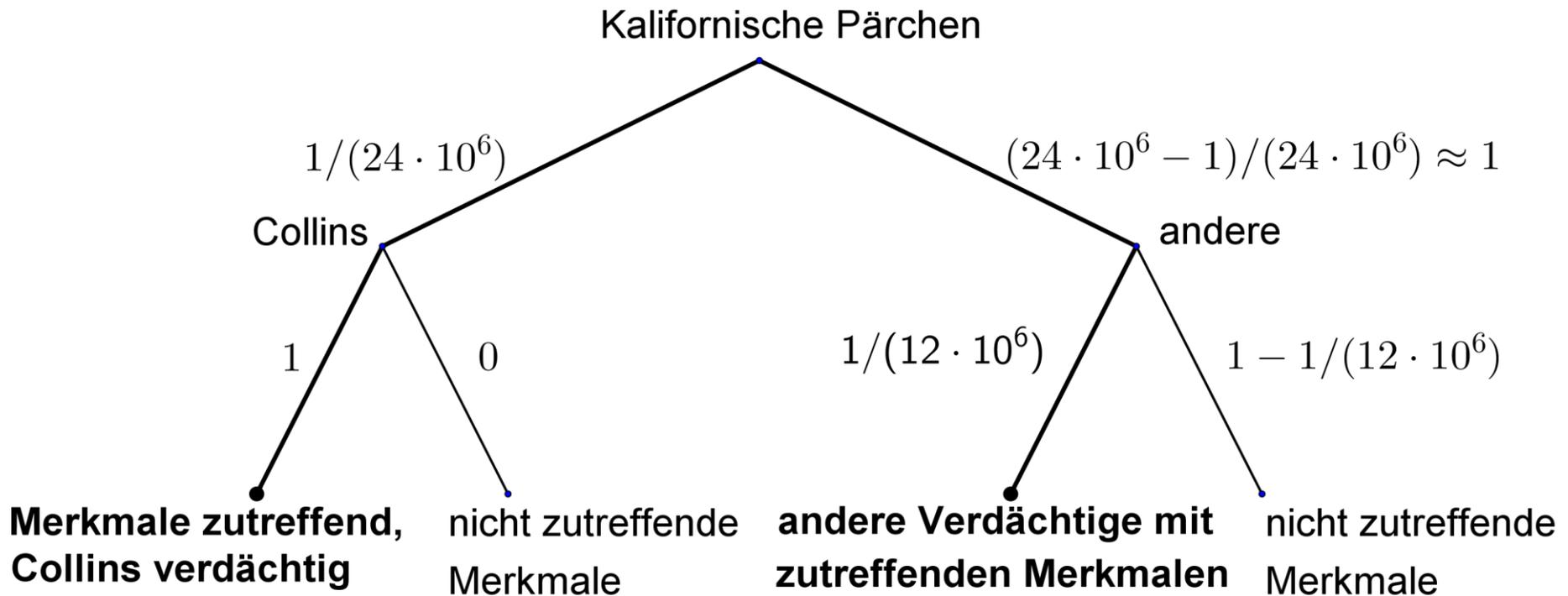
$$p(\text{Tätermerkmale zutreffend}) \approx 0$$

folgt **nicht**

$$p(\text{schuldig} \mid \text{Tätermerkmale zutreffend}) \approx 1$$

Mit seltenen Tätermerkmalen ist man **nicht** sofort schuldig, weil es viele Menschen gibt.

Kalifornien um 1964:  
ca. 24 Mio. Paare im tatverdächtigen Alter



Ereignisse:

T = «Tätermerkmale treffen zu»

Cs = «Collins sind schuldig»

$$\begin{aligned} p(Cs | T) &= \frac{p(T \cap Cs)}{p(T)} = \frac{p(Cs)}{p(T)} \\ &= \frac{\frac{1}{24 \cdot 10^6}}{\frac{1}{24 \cdot 10^6} + \frac{1}{12 \cdot 10^6}} = \frac{1}{3} \end{aligned}$$

**... reicht zur Verurteilung nicht aus.**

Verteidigung:

Revision.

Oberstes Gericht von Kalifornien: **Freispruch.**



# Beispiel 2: Fall Johnson-Sneed

## Mord, Silver City (New Mexiko), 1964

Joe Sneed:

- kehrt von einer Reise zurück,
- findet seine Eltern zu Hause erschossen vor,
- benachrichtigt die Polizei.

→ Anklage: Ermordung der Eltern

## 'Olympic Star' Shifts Orbit, Heads To Relay Post For Tokyo Games

By HOWARD BENEDETT  
CAPE KENNEDY, Fla. (AP) — The Syncom 3 communications satellite, intended to relay television pictures of the October Olympic Games in Japan, today is en route to a planned stationing 400 miles above the Pacific Ocean.

Officials were cheered by the early success of the mission. But the "Olympic Star" satellite must execute a number of complex maneuvers in the next 10 days to shift its orbit and reach its goal as the world's first truly synchronous — stationary — satellite.

While Syncom 3 is a research vehicle and television is not its main job, successful intercontinental transmission of Olympic pictures would be the most dramatic performance so far by communications satellites.

U.S., Japanese, Canadian and European interests today spent nearly \$1 million to demonstrate Olympic television capability with Syncom 3. Practically none of the transmission will be live, primarily because of time differences, and mostly Canadian and Japanese viewers probably will see some of the film relayed by Syncom 3 that will show in the United States.

The three-stage TAD — thrust augmented Delta — rocket launched away from Cape Kennedy at 7:15 a.m. EST to propel the drum-shaped satellite into the "transfer" orbit — a great egg-shaped orbit ranging from about 100 to 22,300 miles above the earth and requiring about 11 hours for each pass.

The National Aeronautics and Space Administration expected 20 minutes after launching that all three rocket stages had performed as planned and the 145-pound

package of communications instruments was on course and sending strong signals.

Syncom 3's rocket "birds" will be coasted about 28 hours after launching — about 11 a.m. Tuesday — when it reaches the 22,300-mile-high point of its orbit for the first time. Then a small rocket

is to be fired by ground command to adjust the satellite and its wirewoven transfer path into a circular orbit about 22,500 miles up.

This is to occur about 11 a.m. Tuesday. Then ground controllers commanding small payload jets by radio, plus to guide Syncom 3

delicately for more than 10 days to the desired mid-Pacific position. The jets are at arrest if there.

The payload's final target area is a point 27,000 miles above the intersection of the Equator and the International Date Line. It is the "Olympic Star" on Page 2.

## Santa Rita Masons To Break Ground For New Building

Groundbreaking rites for Santa Rita Lodge 41, A.F.M.M., will be held at 9 p.m. Thursday as the membership begins construction of a new lodge home.

A. R. York, master of the lodge, announced at a Masonic meeting last night that all Masons, Master Masons, Past Masters and DeMolays are invited to the groundbreaking.

The new building will be constructed on two lots near the George Shannon residence on the old Hinkle road, across the highway from the Upper Drive Inn.

## Barrycrat Governors Snub LBJ

JACKSON, Miss. (AP) — Gov. Paul B. Johnson has snubbed an invitation from President Johnson to meet with other Democratic governors.

Johnson said Tuesday he had no intention of attending the Democratic National Convention and would not meet with the President at the White House Saturday.

Louisiana Gov. John McKeithen and Arkansas Gov. Orval Faubus also said they would not attend the White House meeting of the convention.

The three governors were among the Democrats who made chief executives who held a secret strategy meeting in New Orleans last Friday and were, Florida Gov. Farris Bryant and Alabama Gov. George C. Wallace.

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## Funeral Services For Slain Couple Planned Friday

Funeral services for Mr. and Mrs. Joe Sneed, victims of a dual slaying Monday night, will be held at the Santa Rita Baptist Church, officiating. Burial will follow in the Silver City (Memphis) Cemetery. The couple were slain in a double slaying Monday night.

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Vol. LXX 5 Pages Silver City, New Mexico Wednesday, August 19, 1964 No. 46

## Shot Three Times Each, Couple's Autopsy Discloses

The mystery surrounding the slaying of a Silver City couple, Joe Earl Sneed, 48, and his wife, Mrs. Elizabeth Sneed, 46, was solved Monday when a pathologist's report disclosed that the couple had been shot three times each, and from different directions.

The pathologist, Robert Nicholas, M.D., of Las Cruces, said a couple Monday that he examined yesterday when a pathologist's report disclosed that the couple had been shot three times each, and from different directions.

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## Johnson Demands Citizens' Respect For Rights Law

By HARRY KELLY  
WASHINGTON (AP) — Speaking in a speech Friday on racial troubles, President Johnson has declared the nation's fate will not be decided by street rioters and "light raiders."

"We demand — and we are going to have respect for law and order in this land," Johnson said Tuesday in addressing members of the Citizens' Commission for Community Relations that will help implement the new Civil Rights Act.

Using the occasion to lecture the country on the racial issue, Johnson spoke sharply about "speculation on the effects of the 'white backlash' in the forthcoming election.

He said it is time to face this critical question of who will be helped—who will be hurt—by disorder and disobedience and disrespect for the rights of our society.

"All will be hurt — none will be helped — if responsible citizens sit on the sidelines regarding the stability of our society in a specious moment."

"The question facing the nation," he said, "is not how white or Negroes will vote in November. The question is how we shall work together and succeed together for the next hundred months to come."

Americans, he said, can master the racial problems "by not can leave it to master us" and the question of citizens must be: "How can we give up our prepared to give up our prepared

and peace and let our private male partners of us all? We are one of the greatest to be remembered for allowing America's progress to be argued on the issue of race?"

A full-on of courage, courage and common sense, Johnson added, "must not and will not allow its progress to be degraded by those who work only for their divisions."

The president returned to the subject of racial problems later in the day when he spoke to some 90 U. S. marshals in town for a conference, gathered on the White House lawn.

He reminded the marshals that lawlessness is found in many places and many forms, and added: "Sophisticated agitators who often systematically evade the law are no more tolerable to a law-abiding society than spontaneous street disorders which degenerate into a lawless state."

## Turkey Returns Aircraft To NATO

PARIS (AP) — Turkey has withdrawn from the Atlantic Air Force a number of aircraft units were returned today to NATO command.

The Turkish units were withdrawn for use in carrying out operations over Greece's coast from the Aegean Sea.

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## Graveside Service Held For Mother Of Lofal Man

Mr. and Mrs. Earl Strong left for a trip Monday for Albuquerque to attend graveside services for their son, Lofal Strong, who was killed in a plane crash.

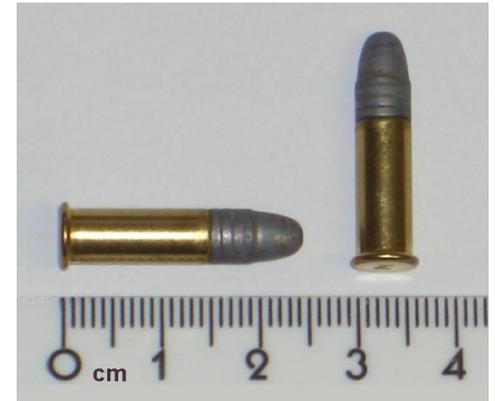
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## Verdachtsmomente

- Kugeln aus Kaliber 22.  
(Revolver blieb verschwunden)

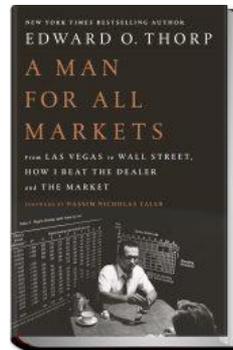
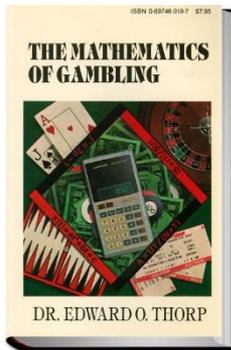
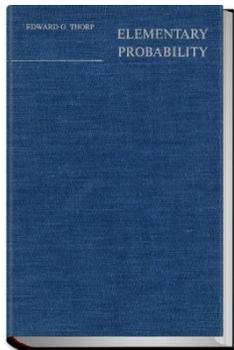
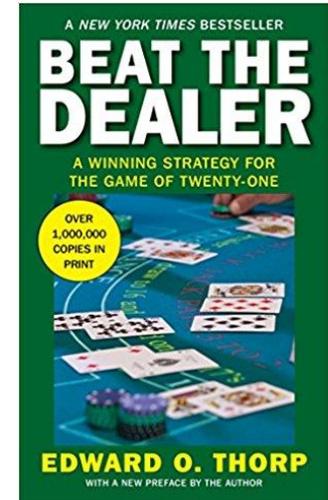
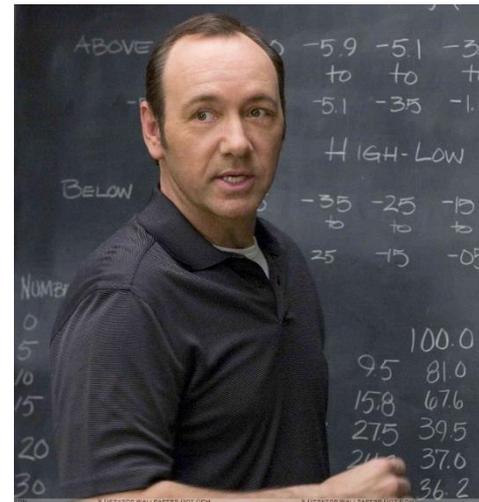
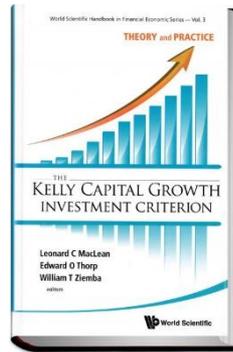
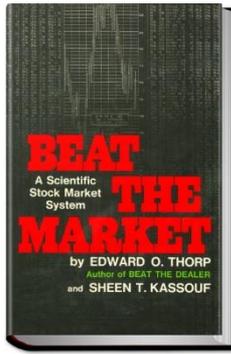


- «Robert Crosset» hatte am Vortag in der Nachbarstadt einen Revolver dieses Kalibers gekauft.  
*Verkäufer: weiss, 1,75m, braune Augen und Haar*
- In Sneeds Auto findet man eine Hotelquittung auf «Robert Crosset» mit derselben Postadresse.
- Joe Sneed behauptet, den Namen nie benutzt zu haben.

# Der Experte: Edward Thorp

Mathematiker und Hedgefonds-Manager

- Professor an der New Mexico State University
- Spezialist der angewandten Wahrscheinlichkeit



... schon damals Bestseller-Autor:  
Kartenzählen als Gewinnstrategie  
im Casinospiele Black Jack

... später Hollywood-Verfilmung: «21»

# Das Gutachten

## Prof. Thorp:

- «Robert Crosset» ist im Westen der USA selten.
- Wahrscheinlichkeit für ähnlichen «Robert Crosset»

$$\frac{1}{2,4 \cdot 10^{11}}$$

**Jury:** Sneed hat die Waffe unter falschem Namen gekauft

Urteil: schuldig, **lebenslange Haft**

# Mathematische Pseudobeweise / Hypothesen anstelle juristischer Beweise

**Experte:**

$$p(\text{Existenz einer fiktiven Person}) \approx 0$$

*Obwohl* ohne Rechnung klar:

$$p(\text{Robert Crosset} + \text{Postadresse}) = 0$$

**Staatsanwalt:**

- Diese Person ist Sneed, denn er hat eine Quittung.
- Folglich hat Sneed auch die Pistole Kaliber 22 gekauft.

*Obwohl* Beweise fehlen (Weder Waffenhändler noch Hotelpersonal kann ihn identifizieren.)

**Staatsanwalt:** Er hat die Eltern getötet, denn es war dasselbe Kaliber.

*Obwohl* Beweise fehlen, ob es dieselbe Waffe war.

# Fortsetzung

- **Revision**
- **zweiter Prozess:**
  - ohne Wahrscheinlichkeiten
  - Urteil: schuldig, **lebenslänglich**

## Was sprach gegen ihn?

- Sneed stritt ab, das Pseudonym benutzt zu haben.  
(Es gab keinen Beweis.)
- Gericht: **Lüge** → **Schuldindiz?**
- **Verfahrensfehler:** nachträgliche Identifizierung



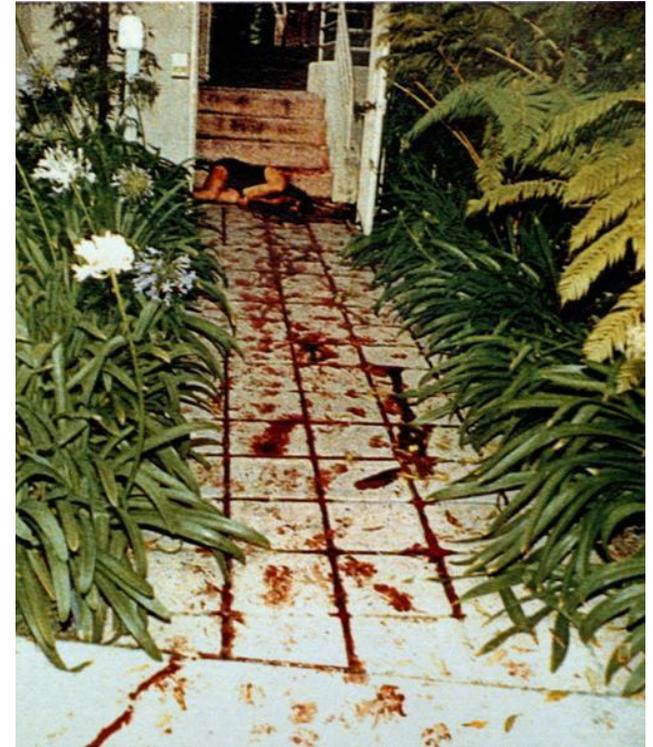
## Beispiel 3: Der Mordfall Nicole Brown

Nicole Brown: Ex-Frau von O. J. Simpson (Footballstar, Schauspieler, Multimillionär)



# Ausgangslage

- Nicole Brown und Ronald Goldman wurden 1994 in ihrem Haus in Los Angeles ermordet.
- Hauptverdächtiger des Massakers:  
O.J.Simpson.
- Belastungsmoment:  
mehrfache schwere Misshandlungen
- **Anklage: Die Misshandlung endete im Mord.**



# O.J. Simpsons Verteidigung



## «Dream Team» (6 Mio.\$):

Beste Verteidiger und Spezialisten, die für Geld erhältlich waren.

**Alan Dershowitz:** Staranwalt und Havard-Professor

- $< 1/2500$  aller Schläger  $\rightarrow$  Mord.
- **Misshandlung ist nicht relevant.**

# Der Freispruch

**EXTRA**  
**Los Angeles Times**

CIRCULATION: 1,000,000 DAILY 1,017,500 SUNDAY  
TUESDAY, OCTOBER 3, 1995  
COPYRIGHT 1995 THE TIMES-MIRROR COMPANY. 105¢ PER PAGE  
DAILY ONE  
DEDICATED AREAS HEADLINE

## Simpson Not Guilty

### He Is Freed After 15 Months in Jail

**Voices**  
"Thank you."  
—O.J. Simpson, looking toward the jury, and mouthing the words.  
"He's going to start his life all over again."  
—Simpson attorney Johnnie L. Cochran  
"Me and my family want to thank God, without whom, I don't know where we'd be."  
—Newspaper



■ **Trial:** Defendant is cleared in the killings of his ex-wife Nicole Brown Simpson and Ronald Goldman. Prosecutors are stunned by the verdicts. As Goldman's sister sobs, his father mutters, 'Murderer.'

By STEPHANIE SIMON and JIM NEWTON  
TWO STAFF WRITERS

O.J. Simpson was acquitted Tuesday on charges of killing Nicole Brown Simpson and Ronald Lyle Goldman, free after a wrenching trial that ranged from explosive accusations of police misconduct to the dry science of DNA technology. Within minutes of his release, he was driven away from the courthouse after more than 15 months in jail.  
Simpson let out a long, shuddering sigh when Superior Court Judge Lance A. Ito's clerk pronounced the verdicts. Lead defense attorney Johnnie L. Cochran Jr. clapped him on the back and pumped his hand in the air. And his longtime friend Robert Kardashian pulled him close for a hug, wiping away tears.

- Das Gericht berücksichtigte die Misshandlung nicht.
- Simpsons DNA-Experten:  
schlampige Polizeiarbeit, Verunreinigung der Proben

# Modell von Dershowitz

Ereignisse:

- «P tötet F» Partner bzw. Ex-Partner tötet seine Frau
- «P schlug F» Partner bzw. Ex-Partner misshandelte seine Frau

$$p(\text{„P tötet F“} \mid \text{„P schlug F“}) = \frac{1}{2500}$$

# Wo steckt der Fehler?

Der Mord wurde begangen, selbst wenn Täter unbekannt

Ereignis «Mord»      Die Frau wurde (von jemandem) ermordet.

Wir suchen

$$p(\text{„P tötet F“} \mid \text{„P schlug F“} \cap \text{„Mord“})$$

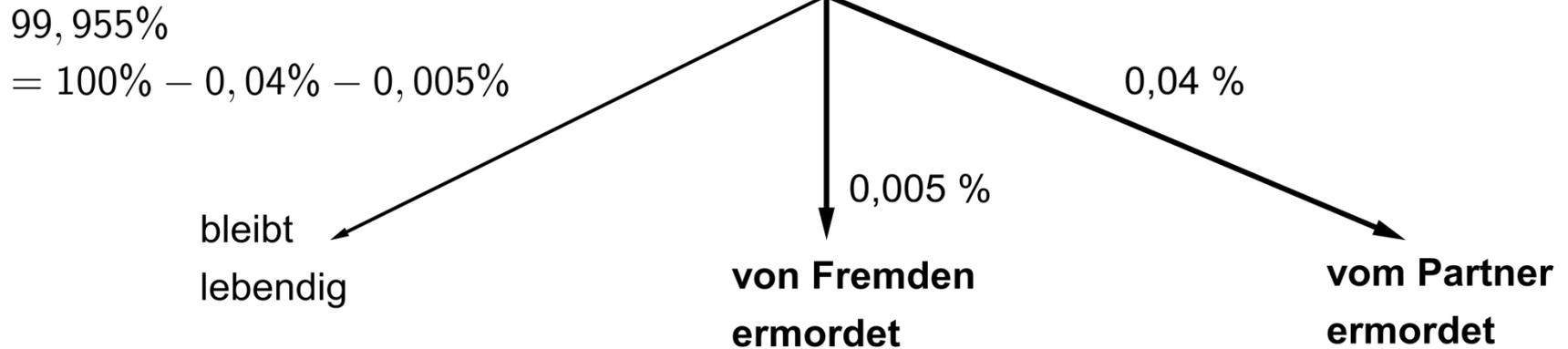
# Statistische Fakten

Landesweite Mordrate für Frauen =0,005%

Eine **misshandelte Frau** ist von einem fremden Mörder keinem höheren Risiko ausgesetzt.

(Diese wählen nach Gelegenheit, ohne die Vorgeschichte zu kennen.)

## vom Partner misshandelte Frau



$$\begin{aligned} p(\text{"P tötet F"} \mid \text{"P schlug F"} \cap \text{"Mord"}) &= \\ \frac{p(\text{"P schlug und tötet F"})}{p(\text{"Mord"})} &= \\ \frac{0,04\%}{0,04\% + 0,005\%} &= 89\% \end{aligned}$$

**Die Misshandlung war relevant!**

# Fehler rechtzeitig erkannt, aber ignoriert

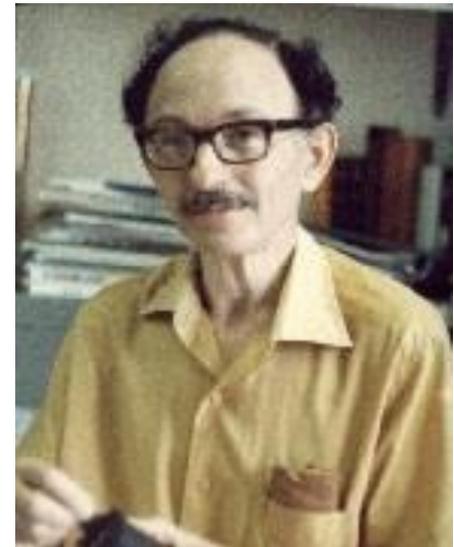
Der Fehler wurde bemerkt, u.a. vom emeritierten Statistikprofessor Irving John Good.

Good schrieb an die Zeitschrift Nature, Simpsons Verteidigung und die Polizei von Los Angeles, jedoch ohne Erfolg.

Good I. J. (1995) When batterer turns murderer.  
Nature, 375(6532):541.

Good I. J. (1996) When batterer becomes murderer.  
Nature, 381(6532):481.

Merz J. F. and Caulkins J. P. (1995) Propensity to abuse  
- Propensity to murder? Chance, 8(2):14.



Irving John Good (Isadore Jacob Gudak), 1916-2009

# Beispiel 4: Ein Prozess wegen Kindesmord

- Familie Clark (Cheshire/England):  
verlor im Laufe eines Jahres zwei Kinder.
- Dezember 1996: Christopher (11 Wochen)  
Todesursache: Atemwegsinfekt (Pneumokokken?)
- Etwa ein Jahr später: Harry (8 Wochen)  
Nach Impfung am selben Tag gestorben  
Arzt: **keine eindeutige natürliche Todesursache**



→ **Mordanklage gegen Sally Clark**

Gleichzeitig Überprüfung des ersten Todesfalls

# Zu klären: SIDS ?

(*sudden infant death syndrome, Alter unter 1 Jahr*):

## Sammelbegriff:

- Tod durch **mehrere natürliche** Faktoren
- Einschliesslich Todesfälle **unbekannter Ursache**, die **nicht vorsätzlich** herbeigeführt wurden.

selten → wenig erforscht

## Problematik:

Unbekannte Ursachen  
sind nicht zwangsläufig  
natürlich

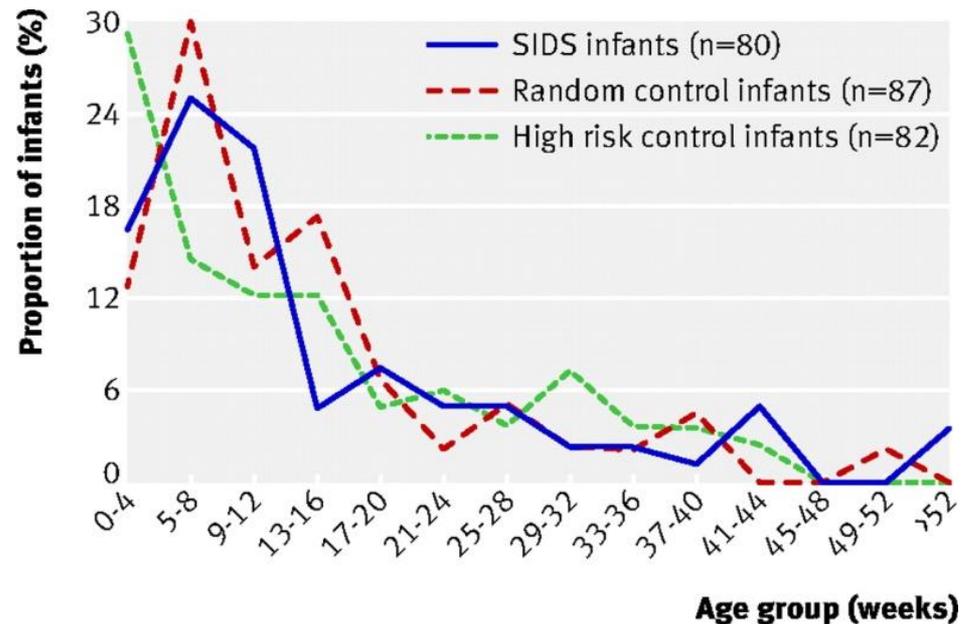


Bild: <https://www.bmj.com/content/339/bmj.b3666>

# Einflussfaktoren für SIDS

- Gesundheitszustand des Kindes
- Lebensgewohnheiten der Eltern (z.B. Zigaretten-, Alkoholkonsum)
- Lebensgewohnheiten des Kindes (z.B. Lage beim Schlafen)

**REDUCING THE RISK OF SIDS**  
Creating a Healthy Sleep Space



**YES**

- ✓ Sleep on back
- ✓ Bare crib
- ✓ Firm sleep surface
- ✓ GREENGUARD certified crib mattress
- ✓ JPMA certified crib or bassinet
- ✓ Breastfeed
- ✓ Pacifier
- ✓ 68-72° for sleeping

**NO**

- ✗ Sleeping on belly
- ✗ Soft sleep surfaces
- ✗ Co-sleeping
- ✗ Toys, crib bumpers, or loose bedding
- ✗ Drop-side cribs
- ✗ Hot bedrooms
- ✗ Smoking
- ✗ Cribs near cords or strings



# SIDS und Mord sind schwer unterscheidbar:

## Gefährdung von Säuglingen

- **Leichte Verletzbarkeit** (z.B. durch Druck auf Brustkorb)
- **Wichtige Organe/ Immunsystem funktionieren unvollständig**  
(z.B. Antikörper gegen Polysaccharide erst zwischen 2. und 5. Jahr entwickelt)  
→ Empfindlichkeit gegen *Streptococcus pneumoniae*)

## → Anspruchsvolle Obduktion

- Relevanz vorhandener Erkrankungen (z.B. Streptokokken)
- Relevanz bewusster/ unbewusster Fehlbehandlung  
z.B. Wiederbelebungsversuch oder Mordversuch

# SIDS- Wahrscheinlichkeit

→ Unterteilung der Eltern in Risikogruppen

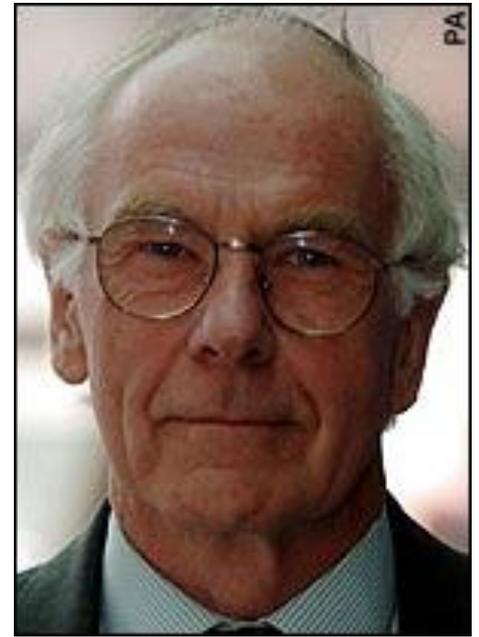
England:

- 1/1303  
(höchste Risikogruppe)
- 1/8500  
(niedrigste Risikogruppe)



F. G. Waldmüller: Erschöpfte Kraft. Belvedere, Wien

# Gutachter: Sir Roy Meadow



- **Münchhausen-Stellvertretersyndrom (subtile Kindesmisshandlung durch ein Elternteil)**
- 1980: Professor für Pädiatrie, St James's University Hospital, Leeds
- 1998: Adelstitel für Verdienste bei der Kindergesundheit

# Gutachten: Wie wahrscheinlich wäre 2 x SIDS?

**Prof. Meadow:**

Familie Clark → keine typische Risikofaktoren → tiefste Risikogruppe

Wahrscheinlichkeit des doppelten Kindstodes:

$$\left(\frac{1}{8500}\right)^2 = 1,37 \cdot 10^{-8}$$

in England nur etwa alle 104 Jahre → Mord ist wahrscheinlicher.

**Dr. Williams (Pathologe):**

2. Kind: **Rippenbrüche, Blutungen,**  
**keine Krankheiten,**

1. Kind: unnatürl. Erstickungstod

→ **Jury:**

**Doppelmord; lebenslänglich**

# Kritische Stimmen

nach Urteilsverkündung im November 1999:

- starke Proteste gegen das Gutachten
- u.a. von Presse und Abgeordneten

**I didn't kill my babies**

In November 1999 solicitor Sally Clark, 36, was convicted of one of the most horrific crimes any mother could imagine – the murder of her baby sons, Christopher, aged 11 weeks, and Harry, eight weeks.

Throughout the trial she maintained her innocence and revealed that she had done nothing to harm her babies. It was the prosecution who claimed the chances of Sally having two dead sons in five years were 1 in 11 billion. It was because that was, they said, the likelihood of her young children dying of cot death.

Have more evidence than a last death panel could muster on the prosecution's claim. It is not even clear how many babies would be given out, Sally wanted the coroner to give to the coroner with her conviction that was.

**Four heads**

It took her having three dead sons to convince the coroner that she was innocent. It was not until she had three dead sons that she was given out, Sally wanted the coroner to give to the coroner with her conviction that was.

**When he died, a part of me died too**

When he died, a part of me died too. When he died, a part of me died too. When he died, a part of me died too.

**Why I think Sally Clark is innocent**

'This was a serious misuse of statistics'

by first estimating the odds of a single cot death in one in 1,000 from reputable data which he does not take issue with.

Prof Hill then multiplied the odds of two cot deaths in the same family by multiplying the number of deaths.

Prof Hill says this was not a valid calculation. It is clear that two cot deaths occurring in the same family cannot be regarded as independent events," he said. "Genetic and environmental factors will be the same in both cases and so, after the first cot death, the odds the second would be considerably reduced.

There is no doubt that many people interpreted the 1 in 11 billion as being the odds against Sally Clark being innocent.

It is a common, but completely erroneous interpretation of the statistics, known to mathematicians as the 'prosecutor's fallacy'.

Prof Hill has used the same data as Sir Roy but has calculated which he believes in the last would be considered as valid.

He still says Sir Roy needed his figure nothing like the once in a hundred years estimate

claimed by the prosecution. Indeed, according to the *Statistical Enquiry into Still Births and Deaths*, which was carried out from 1985 to 1996, a total of 67,000 children were born in five regions of England. Out of those 50 were cot deaths. Of those, five were second cot deaths in the same family.

Solicitor John Hill – speaking on behalf of Sally Clark's family said: "We are most grateful for the prosecutor's interest in the case. We have not focused on him in any way to find a particular view."

"The problem with statistics is that the Court of Appeal agreed with the prosecution that it was a fallacy. This is incorrect, because the figure of 1 in 11 billion was not a probability of one in 11 billion for the chance of two cot deaths in the same family.

The calculation stems from a study called *The Co-*

**Why know my best friend didn't murder her children**

When solicitor Sally Clark was convicted in 1999 of murdering her sons Christopher and Harry, her friends were shocked. But one woman, friend Sally, is in court. She's her best friend Fiona who now plays surrogate mum to her twins surviving son. Here the two women tell their stories...

**Sally Clark, 36**

When I was told that Sally Clark was convicted of murdering her two sons, I was shocked. I knew Sally was a brilliant woman and I knew she was innocent. I was shocked. I knew Sally was a brilliant woman and I knew she was innocent.

**When he died, a part of me died too**

When he died, a part of me died too. When he died, a part of me died too. When he died, a part of me died too.

# Zu den Kritikern gehörten

- der Präsident der Royal Statistical Society (RSS),
- der Präsident der Mathematical Association
- Professoren für Statistik (Oxford, London)

## Bemängelt:

- Multiplikation ohne Begründung
- Interpretation

## Meadows Law:

"one sudden infant death is a tragedy, two is suspicious and three is murder, unless proven otherwise".



# Prof. Ray Hill untersucht wiederholten SIDS

## Bezeichnungen:

- S1 erster SIDS-Fall
- S2 zweiter SIDS-Fall

**Datenbasis:** CESDI SUDI Studies 1993–1996

S2 und S1 sind abhängig:  $p(S2 | S1) = \frac{1}{100}$

Wegen Wiederholung war Risiko im ersten Fall höher :  $p(S1) = \frac{1}{1303}$

Wahrscheinlichkeit wiederholter SIDS-Fälle (England, Wales) pro Geschwisterpaar

$$p = p(S1) \cdot p(S2 | S1) = 7,67 \cdot 10^{-6}$$

**→ Fast jedes Jahr ein wiederholter SIDS-Fall in England/ Wales**

# Konsequenzen

- Okt. 2001: öffentliche Stellungnahme der Royal Statistical Society zu "invalid probabilistic reasoning in court".
- 2002: wird bekannt, dass der Gerichtsmediziner bei Harry eine **Staphylokokken- Infektion** verheimlicht hatte.
- Jan. 2003: Revision und Freispruch für Sally Clark**  
Revision weiterer SIDS-Fälle, bei denen Prof. Meadow zuständig war. (zwei Doppelmorde und ein Dreifachmord)
- 2005: neue Fakten über den Pathologen:  
Beim Verschweigen der Staphylokokken-Infektion änderte er auch die Meinung zum ersten Todesfall (von Atemwegsinfekt zu unnatürlichem Erstickungstod).  
→ Dreijährige Berufssperre
- Dr. Meadow verliert die ärztliche Zulassung
- 2007: Sally Clark stirbt an Alkoholvergiftung

# Falsches Gutachten richtiggestellt? – Ist alles so einfach?

Sesardic (2007): kritischer Blick auf Gegengutachten

**Datenbasis:** *CESDI SUDI Studies 1993–1996*

**Ansatz:** 
$$\frac{p(S_1 S_2 | TT)}{p(M_1 M_2 | TT)} = ?$$

(Verhältnis wiederholter SIDS-Fälle zu wiederholten Morden)

**Eingangsparameter:**

$$\frac{p(S|T)}{p(M|T)}$$

(Verhältnis SIDS-Fälle zu Morden)

$$\frac{p(S_2 | S_1)}{p(M_2 | M_1)}$$

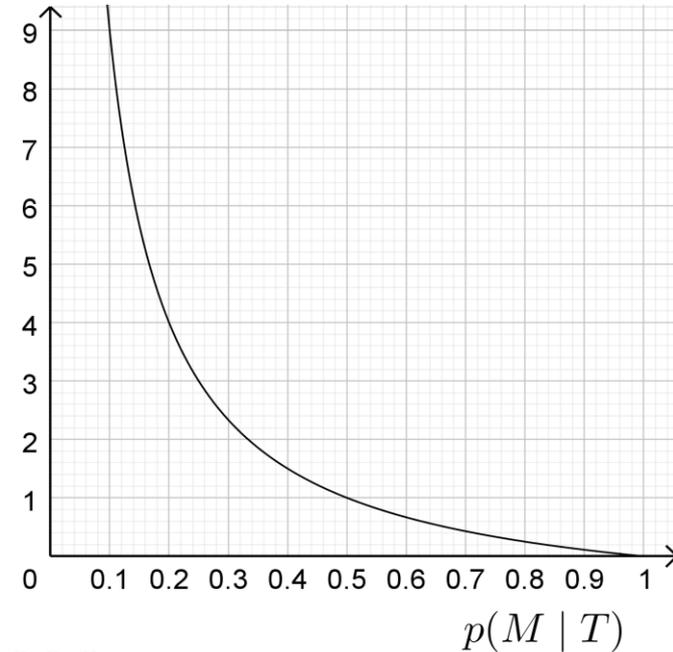
(Verhältnis der Wiederholungs-Wkten)

# Verhältnis SIDS-Fälle zu Morden

$$p(S | T) + p(M | T) = 1$$

$$\frac{p(S | T)}{p(M | T)}$$

$$\frac{p(S | T)}{p(M | T)} = \frac{1}{p(M | T)} - 1$$



***Geringer Umfang der CESDI –Studie 1993–1996:***

Wenige falsch zugeordnete Fälle (Mord oder SIDS)

→ geringe Veränderung der Mordrate

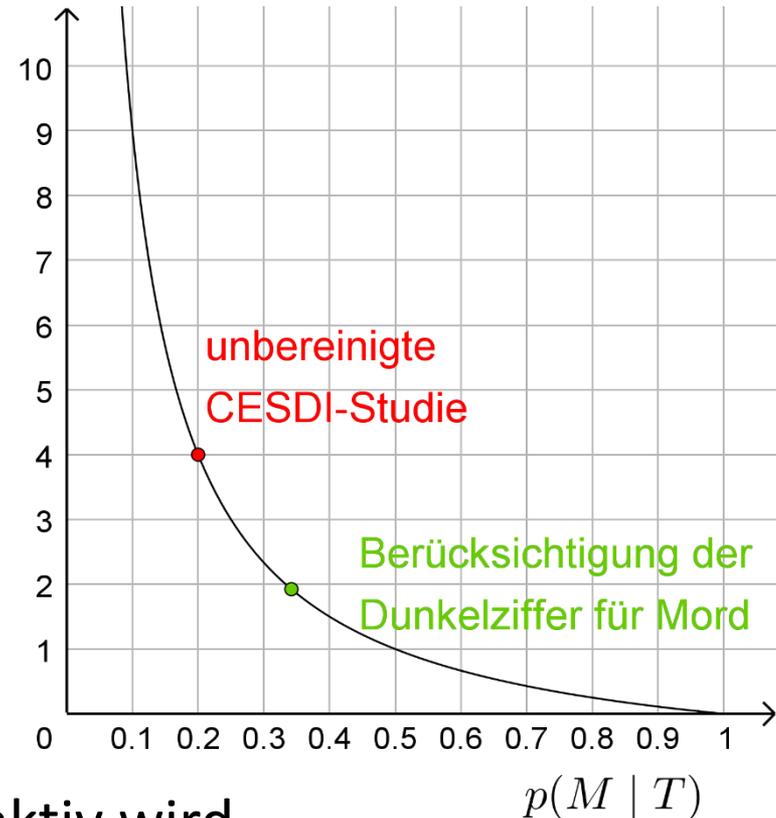
→  $\frac{p(S|T)}{p(M|T)}$  stark verfälscht

# Dunkelziffer in *CESDI* – Studie

## 10-20% SIDS ist Mord

- Mord relativ leicht als SIDS darstellbar
- Kindesmörder täuschen SIDS vor, aber SIDS-Eltern behaupten keinen Mord.
- Justizirrtum: SIDS fälschlich als Mord klassifiziert.  
jedoch: Risiko bei Wiederholung, da Justiz beim ersten Mord selten aktiv wird.

$$\frac{p(S | T)}{p(M | T)}$$



→ CESDI- basierter Parameter  $\frac{p(S|T)}{p(M|T)}$  zu gross?

## Wiederholte Todesfälle

$$\frac{p(S_2|S_1)}{p(M_2|M_1)}$$

**Mord:** erhebliche Wiederholungsgefahr (z.B. überforderte Mütter)

→ abhängige Ereignisse

**SIDS:** widersprüchliche Studien und Aussagen

Viele behaupten sehr geringe Abhängigkeit bei mehrfachem SIDS,  
statistisch **nahezu Unabhängigkeit**

CESDI – Studie: kleiner Datenumfang, Dunkelziffer?

→ CESDI- basierter Parameter  $\frac{p(S_2|S_1)}{p(M_2|M_1)}$  zu gross?

# Schlussfolgerungen

- Gegengutachten auf Basis von *CESDI Studies 1993–1996* überschätzen

$$\frac{p(S_1 S_2 | TT)}{p(M_1 M_2 | TT)}$$

- Meadow **und** Hill → Beide Modelle sind Extremfälle.

Meadow:  $p(S_1 S_2 | TT)$  zu klein.

Hill:  $p(S_1 S_2 | TT)$  zu gross.

# Rückblick im Fall Sally Clark

## Fakten im 2. Todesfall:

Ein erkranktes (!) Kind bekam Mehrfachimpfung, sein Zustand verschlechterte sich und es erhielt zusätzliche Verletzungen.

## Möglichkeiten:

- Impfschaden mit unbeabsichtigter Körperverletzung bei Rettungsversuch
- SIDS
- Mord

## Juristische Fehler:

- Pathologe verschweigt Fakten
- Prof. Meadow: einseitiges Gutachten
- Verteidigung: Experte für Statistik wäre notwendig
- Jury: Fehlinterpretation von Wkt

**Freispruch (Mangel von Beweisen) wäre auch mit Meadows Modell möglich.**

# Zusammenfassung der Fallbeispiele

Ausser mathematischen Fehlern wurden weitere begangen:

## **Fehlende juristische Beweise**

- ergebnislose Gegenüberstellungen,
- unvollständige pathologischen Gutachten,
- mangelhafte Spurensicherung

Lücken wurden durch **Hypothesen** ersetzt.

**Wahrscheinlichkeiten** wurden (wissentlich oder unwissentlich) zur Verschleierung missbraucht.

# Vermeidung derartiger Fehler

Juristen (Richter, Verteidiger, Staatsanwälte) müssen erkennen,

- ob zusätzlicher Experte für Statistik benötigt wird (Fall 3,4)
- wenn juristische Beweise durch Zahlenspiele ersetzt werden (Fall 1,2)
- dass die Aussagekraft einer Statistik nur bei einwandfreier Datenbasis gewährleistet ist (Fall 4)

→ *Grundkenntnisse in Wkt und Interpretation unverzichtbar.*

# Wahrscheinlichkeit ist Abstraktion

## Bei **Prozessführung / Analyse:**

- Wkten sind nützlich
- Sie dienen zur **Eingrenzung von Hypothesen (bzw. Ausschluss falscher Hypothesen).**
  - Hilfe bei Rekonstruktion des Ablaufs der Tat

## Bei **Urteilsfindung:**

- Wktn ohne Beweise sind unzureichend, denn sie beschreiben einen abstrakten Fall.

## **Stattdessen:**

- Falls die Tat glaubhaft (Beweise!) und widerspruchsfrei rekonstruiert wurde → **Gewissheit im konkreten Fall**
- Sonst «In dubio pro reo»

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