Everyone That Can Go Wrong Listed

FULLERTON, CA—A worldwide consortium of scientists, mathematicians, and philosophers is nearing the completion of the ambitious, decade-long project of cataloging everything that can go wrong, project leader Dr. Thomas R. Kress announced at a press conference Tuesday.

“We are mere weeks from finishing one of the most thorough and provocative scientific surveys of our time,” Kress said. "The catalog of every possible unfortunate scenario will complete the work of the ancient Phoenicians and the early Christian theologians. Soon, every hazardous possibility will be known to man."

“And listed,” Kress added.

From The Union, 7/05

The design of the original levees, which dates to the 1960s, was based on rudimentary storm modeling that, it is now realized, might underestimate the threat of a potential hurricane. Even so, however, the levees were designed to withstand only forces associated with a fast-moving Category 3 hurricane. If a lingering Category 3 storm—or a stronger storm, say, Category 4 or 5—were to hit the city, much of New Orleans could find itself under more than 20 ft (6 m) of water.

-- Civil Engineering Magazine June 2003: “The Creeping Storm” (Greg Brouwer)
KING: All right, hold on. Dr. Forrest, your concept of how can you out-and-out turn down creationism, since if evolution is true, why are there still monkeys?

BARBARA FORREST, AUTHOR, "CREATIONISM'S TROJAN HORSE": Larry, creationism has long ago been discredited by science and it's long ago been declared to be unconstitutional by the Supreme Court. And so, this is an issue that should long ago have been settled. We shouldn't still be debating this.

From Tragic Choices, Calabresi and Bobbitt, 1978

“We cannot know why the world suffers. But we can know how the world decides that suffering shall come to some persons and not to others. … For it is in the choosing that enduring societies preserve or destroy those values that suffering and necessity expose.” (p 17)

“It is honesty which allows us to see clearly … the ways, some subtle and some not honest, by which societies must cope. We want to live, but we cannot. We want men to be equal, but they are not. We want suffering to end, but it will not. Honesty permits us to know what is to be accepted and, accepting, to reclaim our humanity and struggle against indignity.” (p 26)

“No human activity can proceed without making choices– critical acts of the mind– and the ethical impulse in teaching any subject or discipline is to tell how to go about acquiring the edifice of a belief. And from the architectonics of choices a person will emerge, a person who knows how to cope with the vast population of decisions we all live in, a person who can carry on.”

—A. Bartlett Giamatti
(from A Free and Ordered Space: The World of the University, 1988)

The all-time, bar-none, best quote ever about decision theory:

“It is not our abilities that show what we truly are— it is our choices”

—Albus Dumbledore
“Small is Beautiful”– 20 Years and Counting

“The cumulative effect of following the upper-bound path, using a long series of conservative assumptions, can be monumental overestimates of health risks.”

“The goal should be clear: Risk assessments should be as close to expected values… as the state of scientific knowledge permits.”

“Using mouse terrorism, self-appointed ‘environmentalists’ and their allies in regulatory agencies … have been successful in dramatically inflating local, state, and federal budgets to underwrite … a far-reaching, taxpayer-supported, chemical witch hunt.”
- Elizabeth Whelan, Insight (Washington Times magazine), 12/12/94

“Please Phrase your Question in the Form of an Answer”

“OMB requests comments on:
• Ways in which ‘precaution’ is embedded in current risk assessment procedures through ‘conservative’ assumptions in estimation of risk…
• Examples of approaches in human and ecological risk assessment methods addressed by U.S. regulatory agencies… which appear unbalanced.”
- 68 Federal Register No. 22 (Feb. 3, 2003)

“It became clear that policy decisions were heavily embedded within the existing risk assessment practices at some federal agencies, despite administrative requirements that risk assessments be objective, realistic and scientifically balanced. A subsequent informal ‘staff paper’ by EPA scientists documented in detail how its risk assessment practices were deliberately and thoughtfully intended to bias risk management decision-making.”
- Lewis and Hushka, abstract for 2004 SRA mg
Is “Humane Risk Analysis” an Oxymoron?

“Right now risk assessment is used to answer the following sort of question: “How much of these 41 carcinogens can we give industry the right to dump into public waters without killing an unacceptable number of citizens?” Anyone who helps the state answer such an immoral question is essentially keeping the death camp trains running on time.”

--Rachel’s Environment and Health Weekly 11/7/96

“To quiet the bereaved and turn this tragic toll into a form of publicly-sanctioned Russian Roulette, the government and industry are turning to a sham science called risk assessment.”

--Andre Carothers, E Magazine, May 1991

It’s frightening to think that you might not know something, but more frightening to think that, by and large, the world is run by people who have faith that they know exactly what’s going on.”

--Amos Tversky, Discover magazine, June 1985

Sunstein’s “The Experts”

...Any serious revolutionist must often deprive himself of the pleasures of self-expression. He must judge his actions by their ultimate effect on institutions.

--Herbert Simon, Models of My Life

The American people are suffering from what could be called “a syndrome of paranoia and neglect” about potential risks to their health, safety, and the environment.... Large amounts of resources are devoted to slight or speculative dangers while substantial and well-documented dangers remain unaddressed.

--John Graham, Making Sense of Risk

We overreact to some risks and virtually ignore others. Often too much weight is placed on risks of low probability but high salience (such as those posed by trace carcinogens or terrorist action...) Too little effort is placed ameliorating voluntary risks, such as those involving automobiles and diet...

--Richard Zeckhauser and W. Kip Viscusi, “Risk Within Reason”
Only Risk Assessors have Opposable Thumbs

- Risk expert David Ropeik will explore the fact that individuals are often more afraid of lesser risks and less afraid of bigger ones. This means that perception can actually make life more dangerous. Using neuroscience and cognitive psychology, he will explain the way we subconsciously “decide” what to be afraid of and the implications these fears have for government, the press, and public health.

- Dickinson College, Sept. 2003

- “I think I have an advantage over the rest of the public. I am a toxicologist and a risk analyst... I know what the risks are and what they are not... the fact that [chemicals] have kind of scary names seems to make people react more strongly.”

- G. Gray, techcentralstation.com, 3/12/01

- “There are people who for whatever reasons – early toilet training or genetics or whatever – are very risk averse.”

- J. Clarence Davies, Los Angeles Times, 9/13/94

July 13, 2004
PERSONAL HEALTH; Back to Basics: The Real Risks to Children
By JANE E. BRODY

Many parents worry that their children may be harmed by exposure to environmental factors they cannot avoid or control, including pesticide residues on fruits and vegetables, approved food additives, chlorinated drinking water and hormones in milk.

They fear electromagnetic fields as a cause of childhood leukemia, a mercury preservative in vaccines as a cause of autism, and alar, a growth stimulant on apples, as a cause of cancer.

None of these are actual hazards. But even if they were, they are hardly the main threats to the health and lives of fetuses, infants, children and adolescents, says Dr. Robert L. Brent, a professor at Thomas Jefferson University in Philadelphia and a leading expert on what is and is not known about the effects of environmental chemicals and physical agents on developing humans.

Most of the hazards that take the greatest toll on the health and lives of the young people in this country can be prevented, without any need for further research, legislation, environmental cleanup or any other measure that requires the action of anyone besides parents and caretakers. “Nearly every day a child in Florida dies in a swimming pool,” Dr. Brent said. “No environmental agent exacts such a toll.”

Accidents are the leading cause of death in children under 15. But while the word accident implies an unexpected and unavoidable event, most accidents involving children could be prevented by vigilance.

Here are the most important hazards.

POINT SPREADS
Which will be higher: Tiger Woods’ fourth-round score in the FBR Open or Hines Ward’s receiving yards total?

Woods 4 point favorite

Which will be higher: Darrell Jackson’s number of receptions or Tiger Woods’ number of birdies in the FBR Open?

Jackson 1 point favorite

OVER/UNDERS
Total TDs for both teams: 5 1/2
Yardage of shortest touchdown: 2
Number of punts: 9
Number of third-down conversions: 11
Total number of penalties: 12
Which team will have the most first downs? Pittsburgh by 2 1/2
Who will have the most rushing yards, Shaun Alexander or Willie Parker? Alexander by 27 yards
Distance in yards of game’s first field goal: 33
Number of Steelers who will score: 3
Number of Seahawks who will score: 3
Number of Steelers who will catch a pass: 7
Number of Seahawks who will catch a pass: 6
Uncertainty versus Variability

-- same mathematics and terminology (percentiles, standard deviation, expected value, range, etc.), but...

<table>
<thead>
<tr>
<th>U</th>
<th>V</th>
</tr>
</thead>
<tbody>
<tr>
<td>A property of us</td>
<td>A property of nature</td>
</tr>
<tr>
<td>Sometimes reducible through further study</td>
<td>Irreducible (but understandable)</td>
</tr>
<tr>
<td>Forces decisions about whether to be “better safe than sorry”</td>
<td>Forces decisions about “who ends up safe, who ends up sorry”</td>
</tr>
</tbody>
</table>

(from A. Finkel, *Environmental Health Perspectives*, 1995)

Are two (Broad) Similar Distributions "Equal"?

(first 2 quotes from Cohen and Graham, 2003)

- "The central estimate result suggests that banning cell phone use while driving is virtually a break-even proposition..."
- "The fact that the net benefits of the ban are close to zero..."
- "We estimate that a ban on nonemergency use by drivers would save $43 billion in reduced deaths, injuries and property damage. But by estimating how much time a month cellphone customers are driving while phoning, we estimate that people are willing to pay about the same amount — $43 billion per year — to use their mobile phones while they drive. The benefits and costs of a ban are about the same." (Hammitt and Weinstein, *Los Angeles Times*, 2/25/04)

Monte Carlo Simulation of Cell Phone Costs/ Benefits

<table>
<thead>
<tr>
<th>COST</th>
<th>BENEFIT</th>
<th>NET COST</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>47 ($Billion)</td>
<td>45.1</td>
</tr>
<tr>
<td>1st %ile</td>
<td>13.1</td>
<td>21.3</td>
</tr>
<tr>
<td>5th %ile</td>
<td>17.9</td>
<td>24.6</td>
</tr>
<tr>
<td>25th %ile</td>
<td>29.7</td>
<td>32.2</td>
</tr>
<tr>
<td>Median</td>
<td>41.7</td>
<td>39.5</td>
</tr>
<tr>
<td>75th %ile</td>
<td>58.4</td>
<td>51.1</td>
</tr>
<tr>
<td>95th %ile</td>
<td>93.9</td>
<td>84.2</td>
</tr>
<tr>
<td>99th %ile</td>
<td>129</td>
<td>132.6</td>
</tr>
</tbody>
</table>
Risk to “Groundlings” (pre-9/11)

Goldstein et al. (1992): \( \frac{350 \text{ U.S. deaths}}{11 \text{ years}} = 4.2 \times 10^{-6} \) per lifetime

John Graham, founding director of the Harvard Center for Risk Analysis, summed up the human health risk from pesticides when he noted that the U.S. regulatory safety standard for pesticide residues is no more than one additional theoretical cancer per million people, yet a person is 5 times more likely than that to be killed while standing on the ground by a crashing airplane.

Thompson et al. (2002):

\[
4.2 \times 10^{-6} = 0.97 (6.2 \times 10^{-7}) + 0.03 (1.2 \times 10^{-4})
\]

\[
\text{Green: } p=0.5; \text{ Black: } p=0.6; \text{ Red: } p=0.7
\]
Arenas where Interindividual Variability is Sometimes Wholly Ignored

<table>
<thead>
<tr>
<th>Arena</th>
<th>Example(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exposures</td>
<td>&quot;Groundlings&quot;</td>
</tr>
<tr>
<td>Susceptibility</td>
<td>EPA Cancer Guidelines</td>
</tr>
<tr>
<td>Medical Decision-Making</td>
<td>In Vitro Fertilization/ Schneider book</td>
</tr>
<tr>
<td>Regulatory Cost</td>
<td>Alan/ HACCP</td>
</tr>
</tbody>
</table>

Ways we Misuse Information about Interindividual Variability

<table>
<thead>
<tr>
<th>Pitfall</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fractionating population via an irrelevant characteristic</td>
<td>FDA and sperm donors</td>
</tr>
<tr>
<td>Fractionating via a weak cause</td>
<td>Exposure vs. susceptibility</td>
</tr>
<tr>
<td>Fractionating via a group characteristic</td>
<td>Sentencing guidelines</td>
</tr>
<tr>
<td>Fractionating via a characteristic for which ( \sigma_w &gt; \sigma_B )</td>
<td>EPA cancer guidelines</td>
</tr>
<tr>
<td>Treating continuous characteristic as discrete</td>
<td>Birth weight cutoffs</td>
</tr>
<tr>
<td>Scapegoating variability</td>
<td>&quot;Maximally Exposed Individual&quot;?</td>
</tr>
<tr>
<td></td>
<td>Larry Summers on women in science?</td>
</tr>
</tbody>
</table>

Concerns about Misuse of Individual Genetic Information

- stigmatization
- insurability (family and/or self)
- job loss
- loss of autonomy
- “debasement” of society
From Executive Order 13145, signed Feb. 8, 2000 by W. J. Clinton

“...The employing department or agency shall not discharge, fail or refuse to hire, or otherwise discriminate against any employee with respect to the compensation, terms, conditions, or privileges of employment of that employee, because of protected genetic information with respect to the employee, or because of information about a request for or the receipt of genetic services by such employee.”

In general, protected genetic information means: information about an individual's genetic tests; information about the genetic tests of an individual's family members; or information about the occurrence of a disease, or medical condition or disorder in family members of the individual.

Genetic test means the analysis of human DNA, RNA, chromosomes, proteins, or certain metabolites in order to detect disease-related genotypes or mutations.

Arguments in Favor of Protecting for “Unidentifiable Variability”

- provides impetus to advance the science
- already being done for exposure variation
- already being done for economic variation
- Congressional intent
- evidence of public perception
- done, without challenge, in OSHA’s MC rule

ALL Estimates are “Biased”

<table>
<thead>
<tr>
<th>Estimate</th>
<th>Corresponding Value Judgment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Median</td>
<td>Protect &quot;typical person&quot;</td>
</tr>
<tr>
<td>Mean</td>
<td>Protect &quot;most common person&quot;</td>
</tr>
<tr>
<td>95th %ile</td>
<td>Protect persons at increased exposure +/or susceptibility</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>(Airplane ex.)</th>
<th>(Unc. in risk)</th>
<th>(Var. in risk)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mode</td>
<td>Max. probability of arriving just at plane leaves</td>
<td>Max. probability that risk is exactly &quot;acceptable&quot;</td>
</tr>
<tr>
<td>Median</td>
<td>50/50 chance of catching or missing flight</td>
<td>50/50 intervention is too risky/too costly</td>
</tr>
<tr>
<td>Mean</td>
<td>X units &quot;overspending&quot; = X &quot;underspending&quot;</td>
<td>Max. probability of arriving just as plane leaves</td>
</tr>
<tr>
<td>95th %ile</td>
<td>X units &quot;overspending&quot; = 19x worse than converse (precaution)</td>
<td>X min. late = 19x worse than X min. early</td>
</tr>
</tbody>
</table>
These are BOTH Policy Statements:

- “Policy makers should base their decisions about most health risks on the expected value of the risk, not the upper bound”
- “Verily I say unto you, inasmuch as ye have done it unto one of the least of these my brethren, ye have done it unto me … Inasmuch as ye did it not to one of the least of these, ye did it not to me”

- Nichols and Zeckhauser, 1986
- Matthew 25: 40, 43

Ultra-conservative Assumptions about Risk Come Naturally

“We have every reason to assume the worst, and we have an urgent duty to prevent the worst from occurring”
- President Bush, 2002

“Even if there was even a 1 in 10 chance that Saddam Hussein was behind the 9/11 attack maximum priority should be placed on eliminating that threat”
- Paul Wolfowitz, 2001

Not a trick question: “What do you call a well-conducted epidemiologic study where the best estimate of the odds ratio is 3.0 and there is a 94% chance that the OR > 1 ??”

NSF Proposal: “Transferring to Regulatory Economics the Risk-Analysis Approaches to Uncertainty, Interindividual Variability, and other Phenomena”

Project Team:
- Adam Finkel (risk science and policy)
- Eldar Shafir (cognitive psychology)
- Winston Harrington (Resources for the Future/environmental economics)
- Sandra Hoffman (RFF/agricultural economics)
- W. Troy Tucker (Applied Biomathematics/anthropology)
- Scott Ferson (Appl. Biomath./mathematical ecology)
- Carl Cranor (U-Cal Riverside/philosophy, ethics)
- Dale Hattis (Clark University/genetics)

Premises of Proposed Work on Risk Science/Regulatory Economics:

1. The “science” side of cost-benefit analysis, as opposed to the “economics” side, increasingly uses sophisticated methods (or clear caveats) to acknowledge:
   - uncertainty in parameter estimation and model selection;
   - interindividual variability and distributional inequality;
   - non-linearities in implicit utility functions; and
   - second-order effects that may offset primary ones.

2. Errors or deficiencies in cost estimation can mislead, or ruin decision-making, in exactly the same ways that errors in risk estimation can.

3. Inattention to interindividual variability in cost estimation is particularly ironic, because the theoretical last stage of Kaldor-Hicks optimality (“winners” compensate “losers” following an intervention that increases total net benefit) cannot even be contemplated if winners and losers are not informed as to who is who.
Research Tasks for NSF Risk/Economics Work:

1A. Define typical and best-case examples of treatment of uncertainty, variability, and second-order equilibria in regulatory economics.

1B. Examine published regulations, and interview agency staff about ideas rejected due to cost concerns, to impute utility functions for risk and for cost.

2A. Complete two detailed case studies (CGE model of DC economy under air pollution regulations; model of poultry industry after “HACCP” rules) to explore the household- and firm-level distribution of regulatory costs.

2B. Review literature and interview experts to examine possible normative assumptions that permit inattention to U and V.

Research Tasks for NSF Risk/Economics Work (cont.):

3. Improve software and graphical tools to help explore how laypeople and experts process information about U and V.

4A. Conduct psychometric surveys to explore the “cost literacy” of laypeople, toxicologists, and economists.

4B. Perturb baseline psychometric experiments to explore how enriched info. about U and V in cost affects perception and preferences.


Hypothetical Case Involving Inter-individual Variation in Risk and in Cost

“It will cost the nation $10 billion to save 1000 lives”

 Gets “translated” as:

“It will cost me $40 to eliminate a risk of $4 \times 10^{-6}”

Variability in Risk and Cost

<table>
<thead>
<tr>
<th>RISK</th>
<th>4x10^{-8}</th>
<th>4x10^{-4}</th>
</tr>
</thead>
<tbody>
<tr>
<td>COST</td>
<td>$4,000</td>
<td>Depends on Wealth, Health</td>
</tr>
<tr>
<td></td>
<td>$40¢</td>
<td>Protect Me</td>
</tr>
<tr>
<td></td>
<td>Yawn!</td>
<td>Don’t Tread on Me!</td>
</tr>
</tbody>
</table>
Variability in Risk and Cost

<table>
<thead>
<tr>
<th>Diffuse Risks</th>
<th>Concentrated Risks</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cost-Benefit OK</strong></td>
<td><em>(Openly) consider protecting “MEI”</em></td>
</tr>
<tr>
<td><em>(Covertly) consider protecting “M$I”</em></td>
<td>*<em>This Means War</em> <em>(unless the same group pays, game)</em></td>
</tr>
</tbody>
</table>

Adam M. Finkel is a professor of environmental and occupational health at the University of Medicine and Dentistry of New Jersey (UMDNJ) School of Public Health, and a visiting professor at Princeton University's Woodrow Wilson School of Public and International Affairs. Finkel has a doctoral degree in environmental health sciences and a master's degree in public policy, both from Harvard University, and has written many articles in the medical, legal, economics, and statistical literature. For ten years he was a senior executive at the U.S. Occupational Safety and Health Administration (OSHA), serving as OSHA's national director of regulatory programs in Washington and later as chief OSHA administrator in the six-state Rocky Mountain region, based in Denver. He has pioneered methods to quantify and communicate the uncertainties in risk and cost estimation, and to explore the variation in environmental and medical risks individual citizens and patients face due to differences in susceptibility, exposure, and other factors. His research has shown that traditional methods of risk assessment and cost-benefit analysis often underestimate risks and overestimate the economic costs of sensible interventions to reduce them. He designed OSHA's most sophisticated health regulations, as well as its first "enforceable partnerships" that brought government, industry, and labor together to craft protections beyond what traditional regulation could offer.