The Precautionary Principle & Comparative Risk Analysis

Precautionary Principle History

- The precautionary principle has been around in some fashion for a long time
  - Hippocrates: "As to diseases, make a habit of two things—to help, or at least do no harm."
  - “Better safe than sorry”
- Recognizable in environmental politics since the 1970s
  - Term first used in 1988
  - A hugely popular argument

Precautionary Principle vs. Business

- Precautionary principle most commonly invoked to limit business activity
  - BPA in plastic bottles/baby bottles
  - Nuclear power
  - Cell phones
  - High-power transmission lines
- Environmentalists call for limits on business products to avoid harming people

The Precautionary Principle

"In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation."


See http://www.sehn.org/precaution.html

Components of Precaution

1. Take precautionary action before scientific certainty about cause and effect of a risk
   - Science requires overwhelming proof before accepting hypotheses
   - Precaution requires a lower standard of proof

   - If potential for harm is significant, policy makers should act when the evidence seems strong, but not yet up to scientific standards
Components of Precaution

2 Shift burden of proof to proponents
   – People who want to do something should prove that their activity will not cause undue harm to human health or ecosystems
   – Many policy debates are framed by the question, “Do you have scientific proof that an activity is harmful?”
     • Without proof, the activity is allowed
   – Precautionary principle says the bar is set too high
     • Reasonable cause, not scientific proof

Science & Statistical Evidence

• Precautionary principle says move away from strict scientific standards
  – They work for seeking to discover the truth

• Public policy requires different standards
  – We want standards that seek to maximize the public good
  – This differs from discovery of knowledge
  – Some argue that the precautionary standard is the one to use

In Practice, 2 versions of principle

• First, lower the standard of evidence required to accept an hypothesis:
  – E.g., from p < .05 to p < .25
  – (In English): Instead of “overwhelming evidence,” we should use “pretty good evidence”
    – A probability well over 50%

Pretty good evidence: Tobacco

• In the 1950s and early 1960s, medical researchers had good, but not overwhelming evidence, that smoking causes cancer
  – But no regulation of cigarettes

Science & Statistical Evidence

• To confirm a hypothesis, we require overwhelming evidence

• Two types of errors:
  – Concluding a false hypothesis is true
  – Concluding a true hypothesis is false

• Scientists prefer to make the 2nd error
  – We lean toward rejecting new scientific claims
  – If it is true, we will find out eventually

Reverse the Hypothesis

• Second, change the hypothesis to “the product is safe”
  – Hyp 1: smoking causes cancer
  – Hyp 2: smoking does not cause cancer

  – Tobacco companies prefer hypothesis 1
  – Health advocates prefer hypothesis 2
Reverse the hypothesis: Thalidomide

• Thalidomide developed in 1940s
  – Marketed as a painkiller for headaches, insomnia, morning sickness for pregnant women
• Proved to cause birth defects in 1961, removed from market
  – 1962: law passed requiring tests for safety during pregnancy before a drug can receive approval for sale in the U.S.

Precaution & Cell Phones

• Cell phone invented 1973
  – Commercial introduction in early 1980s
  – 4.6 billion cell phone subscriptions globally
• Cancer threat?
  – Small studies found long-term, heavy users have higher risk of some rare cancers
  – Some small studies find damage to DNA
  – YEARS later, large studies found no risk
• Which hypothesis?
  • Prove cell phones are safe? Or prove them risky?

Precaution & Cell Phones

• World Health Organization recommends using the precautionary principle:
  – Avoid old analog cell phones (3.6W)
  – Choose digital (<1W) over standard (2W)
  – Use earphone and hands-off technology

Example: Lead Poisoning

• Congress acted before scientific consensus was reached
  • Unleaded gas introduced 1976
  • Lead was banned from paint in 1978
  • Leaded gas banned 1991
  • Vinyl curtains reformulated 1992
  • Pottery standards established

Consensus: Lead Poisoning Causes

• Irritability, stomach aches, severe abdominal pain, headaches, poor appetite
• Diarrhea, colic, distractibility, lethargy
• Loss of motor coordination, anemia
• Kidney and neurological damage
• Hypertension
• Sterility, miscarriages
• In this case, the precautionary principle worked

Example: Lead Poisoning

• Evidence suggested that lead causes illnesses
  – But the evidence not universally accepted by scientists
  – We had studies, but not overwhelming evidence
• Lead was widespread
  – Paint: chips in dirt around homes, sweet taste
  – Gasoline
  – Herbal medicines from curanderos
  – Pottery glazes & vinyl curtains (lead adds shine)

http://www.who.int/mediacentre/factsheets/fs193/en/

• Note: Lead testing kits are available in the paint sections of large hardware stores
The Precautionary Principle & Nuclear Power

- The precautionary principle has effectively been applied in the case of nuclear power
- Precaution blocked the nuclear industry
  - A new plant is being built in Georgia

A Brief History of Nuclear Power

- A reactor development program started in the military in 1945
  - A goal discussed since 1938 was using reactors to power submarines
  - 1947: a nuclear sub program started
  - 1952: Atomic Energy Commission started a civilian reactor program
  - 1957: Price-Anderson Indemnity Act limited responsibility of reactor owners in the event of accidents

A Brief History of Nuclear Power

- Several reactor types were developed
  - 2 were chosen for commercial development
    - Pressurized light water; Boiling light water
    - Economic advantages of light water reactors prevailed over safety concerns
- First order placed in 1963
  - Nearly 100 ordered during 1965-70

- Joseph Morone & Edward Woodhouse, The Demise of Nuclear Energy?

A Brief History of Nuclear Power-2

- Opposition rose from environmental movement
  - Friends of the Earth formed (David Brower), 1969
  - Union of Concerned Scientists, 1969
- Safety objections from critics slowed progress
  - Engineers promised safety
  - But critical engineers, geologists, etc. found risks
  - The public divided

Inherent Risks of Nuclear Power

- Safety was addressed through redundancy
  - “Defense in depth”
  - Engineered safety was the solution
  - Design, construction, & operation were all assumed to have errors
- But Engineers could not guarantee perfect safety
- The Public saw a debate among scientists
  - Some said it was safe; others disagreed
Inherent Risks of Nuclear Power

- The potential risks were catastrophic
  - Recall: Psychometric Theory of Risk perception
  - New, unknown science with catastrophic potential
  - Radiation causes cancer = dread

- Nuclear power hits all the psychometric theory buttons

Nuclear Power Reactor Design

- [Diagram of Nuclear Power Reactor Design]

Boiling-Water Reactor

Declining Support for Nuclear Power

- [Graph showing declining support for nuclear power]

Precaution & Nuclear Power

- The public followed the precautionary principle
  - Nuclear power seemed risky
  - Public support was falling before 3-Mile Island
  - Public support fell in response to warnings

- Public trust in govt & big corporations was falling
  - Support for nuclear power fell along with trust

- Rejecting nuclear power is how the public & politicians ought to react according to precautionary principle, according to critics

Nuclear Power Advocates Respond

- There have been 3 major accidents
  - 3-Mile Island, Pennsylvania, 1979
    - Zero deaths
    - No measurable increase in radiation outside reactor
    - The engineering worked
  - Chernobyl, USSR, 1986
    - Killed 30 immediately
    - Killed perhaps 2,500 later
    - Chernobyl had no containment vessel

The China Syndrome (1979)

Jack Lemmon, Jane Fonda, Michael Douglas
Fukushima, March 11, 2011
- 18,500 deaths from earthquake, tsunami, evacuation conditions
- Estimates of deaths from radiation are being debated, but the number is small
  - Mostly workers
  - Estimates of future cancer deaths are disputed

Nuclear Power Advocates Respond

- Nuclear power plants emit no greenhouse gas
  - Some leading environmentalists now support nuclear power

Two Policy Approaches

1. **Allow a product unless proven unsafe**
   - Cell phones
   - Plastic products (e.g., baby bottles)
   - Health supplements, herbal remedies

2. **Only approve a product if proven safe**
   - Medicines which doctors prescribe (require FDA approval)

- Most products fall under category 1

Two Policy Approaches

1. **Allow a product unless proven unsafe**
   - We have no regulatory review & approval process for most new products
     - A patchwork in which some types of products require approval
       - Cell phones, baby bottles, health supplements: no regulation
       - Drugs for pregnant mothers, children’s clothing, cribs, motorcycle & bicycle helmets: regulated
   - OSHA, EPA, NHTSA, FDA have authority in some areas, but most are
Two Policy Approaches

- Regulatory patchwork the result of Congress responding to political demands

  Thalidomide babies:
  - Congress controlled drugs for pregnant women
  - Babies die from burns in flammable clothing:
    - Congress requires approval of chemical treatments of children’s clothing
    - Motorcycle accidents cause head injuries
    - OSHA, EPA, NHTSA, FDA have authority in some areas, but most products unregulated

Precautionary Principle’s Weakness-1 (AIDS)

- The Principle ignores other values
  - Ryan White was a hemophiliac who contracted HIV/AIDS from a blood transfusion
  - Parents in his school district prevented him from attending public school
    - Courts eventually reversed the ruling & allowed him to attend school
  - We now know that the chance of him transmitting AIDS to another child was effectively zero

Precautionary Principle’s Weakness-2

- Principle focuses on single projects/proposals
  - Shall we develop nuclear power?
  - Shall we use a specific pesticide?
- The Principle does not focus on policy choices
  - Precautionary Question: Shall we have nuclear power?
  - Policy Question: How do we produce electricity—nuclear power, coal, natural gas?

Precautionary Principle’s Weakness-3

- The Principle ignores economic trade-offs
  - Consider building a factory in a low-income, rural community:
    - The factory pollutes streams, which may cause illnesses
    - The factory creates jobs and raises income, which improves health of local workers
- Economic & health gains may accompany environmental risks

Precautionary Principle: Liberal or Conservative?

- The Principle is invoked most commonly by environmentalists and liberals
  - Limit risky business ventures, …
- The label is rarely used by conservatives, but the principle is often used

Conservative Precautionary Principle

- Conservatives often make arguments that follow the logic of the principle, but do not use the label
- We should take precaution & avoid:
  - LGBTQ teachers
  - Same-sex marriage
  - Legalizing marijuana
  - Restricting religious freedom by forcing small business owners to make wedding cakes or take photographs for LGBTQ weddings
Prop. 6 in 1978 (Briggs Initiative) would have banned gays and lesbians, and possibly anyone who supported LGBTQ rights, from working in California's public schools.

**Cost-Benefit Analysis or Comparative Risk Analysis**

- “Risk” is the probability that an activity, substance, or technology will cause harm
- Comparative Risk Analysis (CRA):
  - Assign economic value to damages or death
  - Compare risks
  - Choose policies to minimize risk

**Programmatic CRA**

- A system for setting regulatory & budget priorities by comparing risks
  - Economists/scientists estimate risks in a common scale
    - e.g., cost per life saved
- A wide range of risks are compared
- Laws are designed to maximize the lives saved per dollar spent
  - If spending on anti-tobacco ads saves more lives than spending on mad cow disease, we focus on smoking.

**Sources of Policy Inconsistency: Program Origins**

- Congress responds to voter demands
- Clean Air Act
  - A response to air pollution crises
  - Santa Barbara oil spill
  - Cuyahoga river fire
  - Surging environmental movement
- Demand for clean air, not for precise risk & cost calculations
Sources of Policy Inconsistency

- Love Canal & the Toxic Waste Superfund
  - Hooker Chemical fills and covers a waste dump in Niagara Falls, NY (1952)
  - Houses are built on it, a school nearby
  - Neighborhood Assn demands an investigation of high cancer rates (1978)
  - Pres. Carter declares area a disaster
  - National media attention
  - Congress passes the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)

Sources of Policy Inconsistency

- Can a politician say, “It costs too much to save your child’s life.”

Sources of Policy Inconsistency

- CRA sounds nice, but it is politically difficult
  - Politicians & voters focus on one issue at a time
    - Few make spending comparisons when passing laws
  - Politicians & voters assign different values to different lives
    - Young vs. old
    - Deserving vs. Undeserving
  - Result: Wide variation in cost per life saved

Sources of Policy Inconsistency

- Cost per life saved:
  - Auto seat belts/passive restraint: $100,000
  - Side impact standards for cars: 800,000
  - Traffic alert/collision avoidance: 1,500,000
  - Rear lap/shoulder belts for cars: 3,200,000
  - Asbestos occupational exposure limit: 8,300,000
  - Cover/move uranium mill tailings (active) 45,000,000
  - Arsenic occupational exposure limit $106,900,000

Another Problem with CRA

- Risks are often unknown or poorly estimated
  - Well-known risks work in CRA
  - Poorly understood risks do not

Sometimes Risk Probabilities are Unknown

- Risk: Based on estimates of probabilities
- Uncertainty: No knowledge of probabilities
  - With uncertainty, we are guessing
**Risk - Uncertainty Continuum**

- For complex problems:
- We break problems into steps & calculate probabilities of failure for each step
  - What is the probability of each component failing?
    - Engineers run lab tests and simulations
    - They may use judgments when data are ambiguous
  - They combine estimates for an overall risk
- Poor risk estimates lead to political problems

**Deepwater Horizon: A poor risk estimate**

**When Does CRA Work?**

- CRA works well when:
  (a) Risks are known
      - e.g., smoking, automobile deaths
  (b) Decisions are made within a single agency
      - This avoids the politics of policy trade-offs
      - e.g., Within Health Dept, not Health Dept vs. NHTSA
- In sum, CRA sounds great, but doesn’t always work

**When Does CRA Work? Side Air Bags in Cars**

- National Highway Traffic Safety Administration passed a rule requiring side air bags
  - 10,000 deaths/year from side crashes
  - Studies show risk cut by > 1/3 with side air bags
  - Risk cut over 50% in SUVs
  - Cost $300-$700/car
  - Mandatory for 2010 cars
- For NHTSA, maximize auto safety is the goal

**Precautionary Principle vs. Comparative Risk Analysis**

- Precautionary principle most relevant with uncertainty
- Comparative risk analysis works best when good data are available for analysis
- People choose which principle to follow for value-based reasons