Special Issues in Energy Financing & Risk Management

Geopolitical Risk Analysis PERCEPTIONS PAPER

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Figure 1. Components of risk analysis.

People transform risk information **subjectively** so that is reflects the **impact** that an event has on their lives!

Group and **culture**-level variables have an impact on risk perception.

Psychometric (i.e. psychological) measurements (judgment) are used to assess the emotional reaction of people to risky situations).

One way to study perceived risk is to develop a **taxonomy** of hazards.

- This helps explain people's aversion to some and indifference to other hazards.
- This also helps explain the discrepancies between **laypeople** and **experts**.

Taxonomies are developed with the use of psychophysical ("**Likert**") scaling and **multivariate** statistical techniques.

How satisfied are you with our services?

				
○	○	○	○	○
Very Unsatisfied	Unsatisfied	Neutral	Satisfied	Very Satisfied

1. Please indicate the degree to which you agree/disagree with the following statement:
I am happy with my purchase.

	1	2	3	4		NA
Strongly Disagree	○	○	○	○	**Strongly Agree**	○

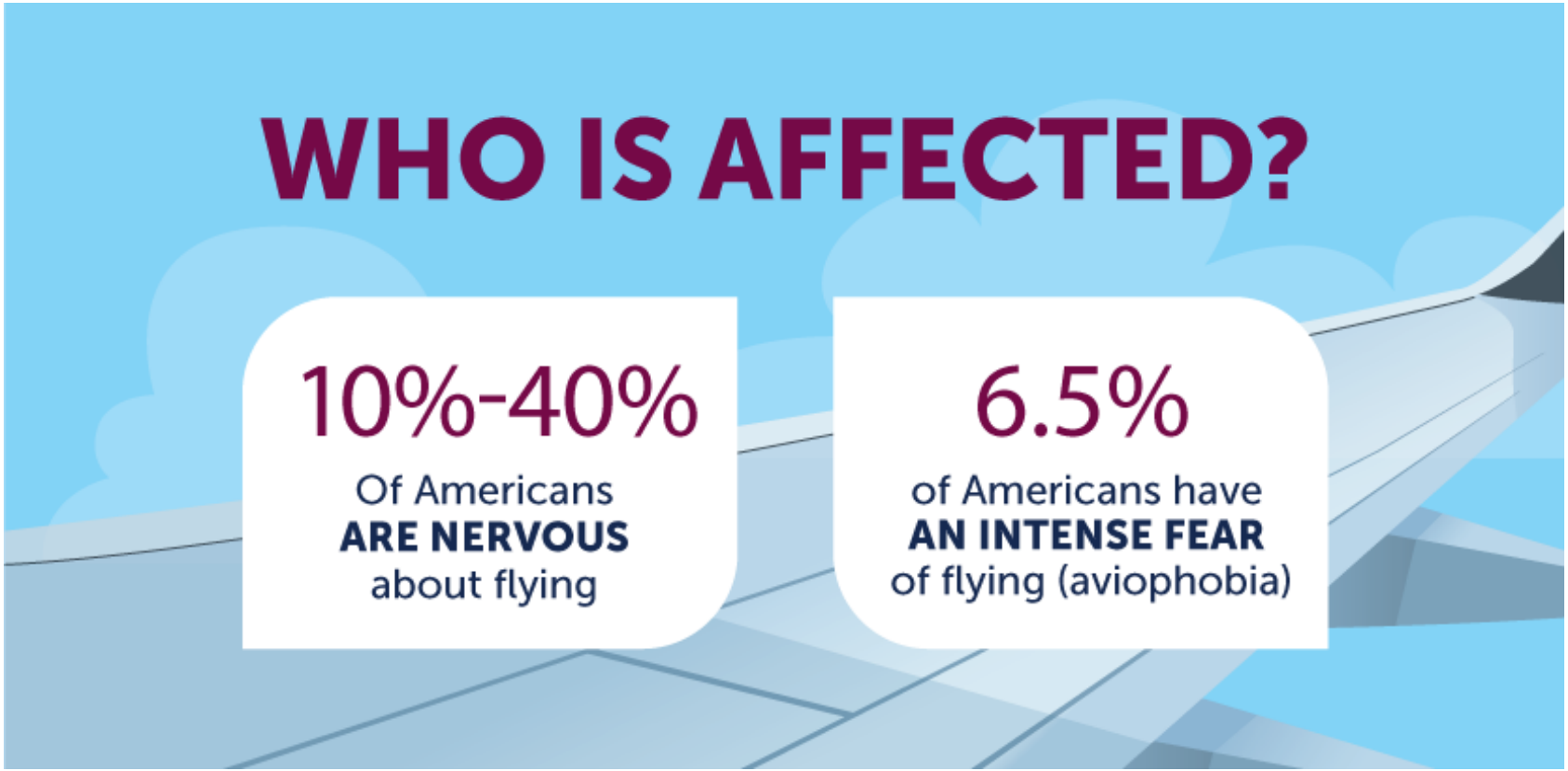
Issues that are taken into consideration:

- the hazard's status or **characteristics**
  - ✓ voluntariness
  - ✓ dread
  - ✓ knowledge
  - ✓ controllability
- the **benefits** that a hazard poses to society
- the number of **deaths** caused by a hazard annually

Table 1. Some Ways of Expressing Fatality Risks

- Deaths per million people in the population
- Deaths per million people within **x** miles of the source of exposure
- Deaths per unit of concentration
- Deaths per facility
- Deaths per ton of air toxin released
- Deaths per ton of air toxin absorbed by people
- Deaths per ton of chemical produced
- Deaths per million dollars of product produced
- Loss of life expectancy associated with exposure to the hazard

Why are some people afraid of flying?



COMMON REASONS
FOR A FEAR OF FLYING:

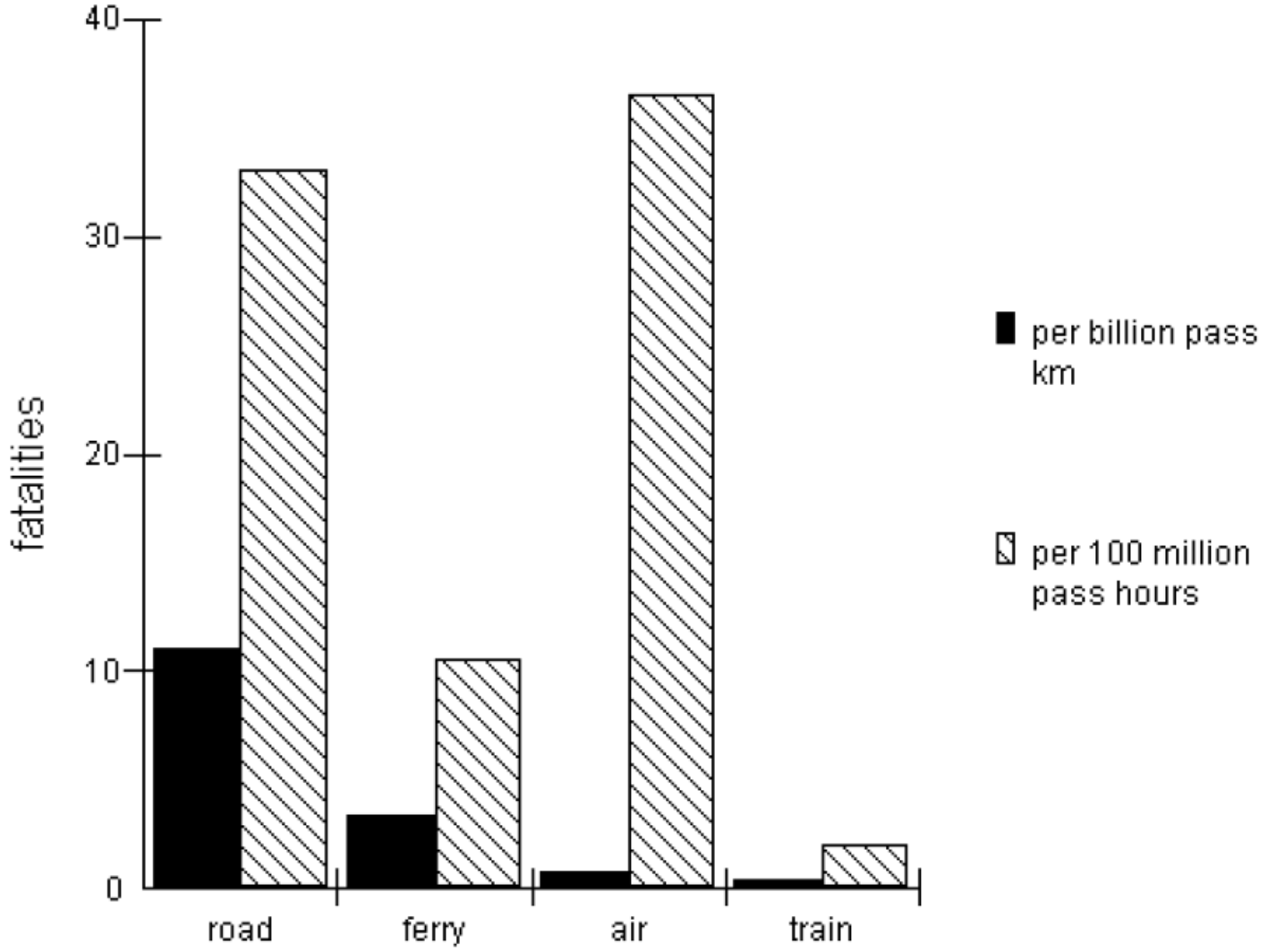
AGORAPHOBIA
A fear of crowds or public places

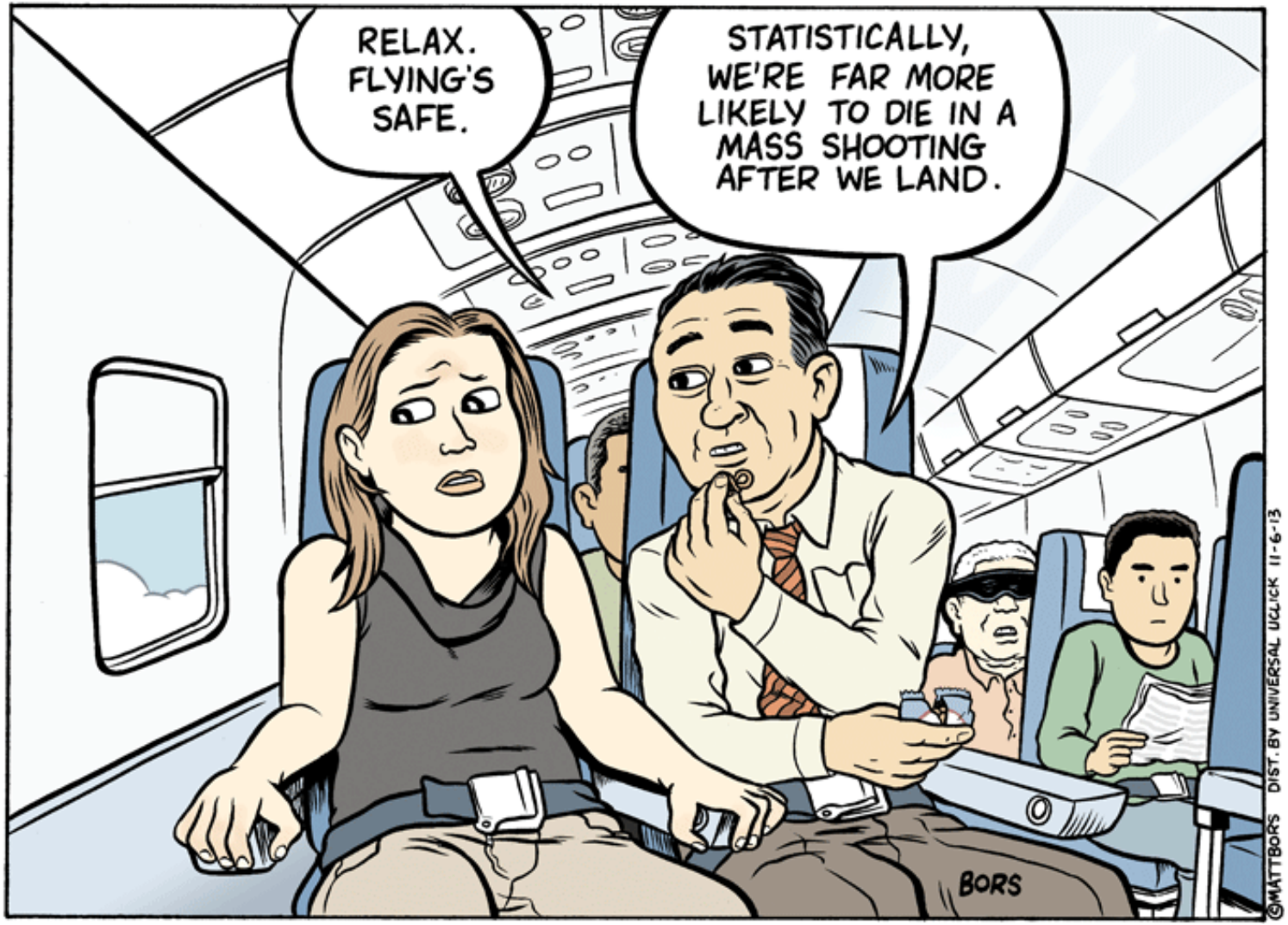
CLAUSTROPHOBIA
A fear of enclosed spaces

DYSTYCHIPHOBIA
A fear of being in an accident

ACROPHOBIA
A fear of heights

BASOPHOBIA
A fear of falling


40
30
20
10
0
fatalities
road
ferry
air
train
per billion pass km
per 100 million pass hours


RELAX. FLYING'S SAFE.
STATISTICALLY, WE'RE FAR MORE LIKELY TO DIE IN A MASS SHOOTING AFTER WE LAND.
BORS
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ENVIRONMENTAL RISK ASSESSMENT

When experts judge risk, they are based on technical estimates of annual **fatalities**.

Laypeople

- can assess fatalities correctly!
- judge risk based on other hazard characteristics, e.g. catastrophic potential (to future generations).

Table 3. Ordering of perceived risks for 30 activities and technologies. The ordering is based on the geometric mean risk ratings within each group. Rank 1 represents the most risky activity or technology.

Activity or Technology	League of Women Voters	Active College Students	Club Members	Experts
Nuclear power	1	1	8	20
Motor vehicles	2	5	3	1
Handguns	3	2	1	4
Smoking	4	3	4	2
Motorcycles	5	6	2	6
Alcoholic Beverages	6	7	5	3
General (private) aviation	7	15	11	12
Police work	8	8	7	17
Pesticides	9	4	15	8
Surgery	10	11	9	5
Fire fighting	11	10	6	18
Large construction	12	14	13	13
Hunting	13	18	10	23
Spray cans	14	13	23	26
Mountain climbing	15	22	12	29
Bicycles	16	24	14	15
Commercial aviation	17	16	18	16
Electric power (non-nuclear)	18	19	19	9
Swimming	19	30	17	10
Contraceptives	20	9	22	11
Skiing	21	25	16	30
X-rays	22	17	24	7
High school and college football	23	26	21	27
Railroads	24	23	20	19
Food preservatives	25	12	28	14
Food coloring	26	20	30	21
Power mowers	27	28	25	28
Prescription antibiotics	28	21	26	24
Home appliances	29	27	27	22
Vaccinations	30	29	29	25

From Slovic, 1987. Copyright by the AAAS. Reprinted by permission.

The relationship among **perceptions**, **behavior** and the qualitative characteristics of **hazard** is both orderly and complex!

Every hazard has a unique profile (pattern of qualities).

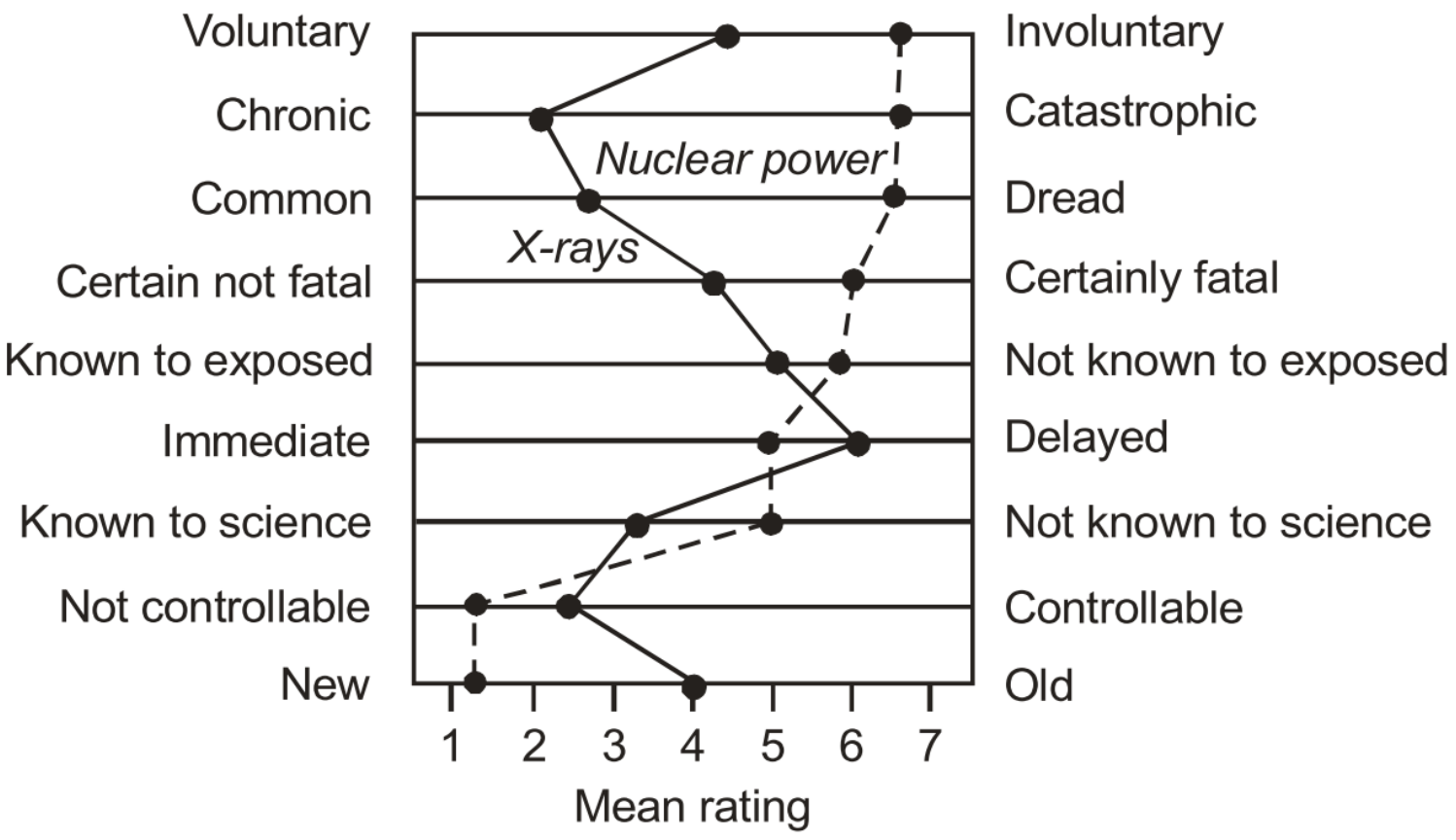
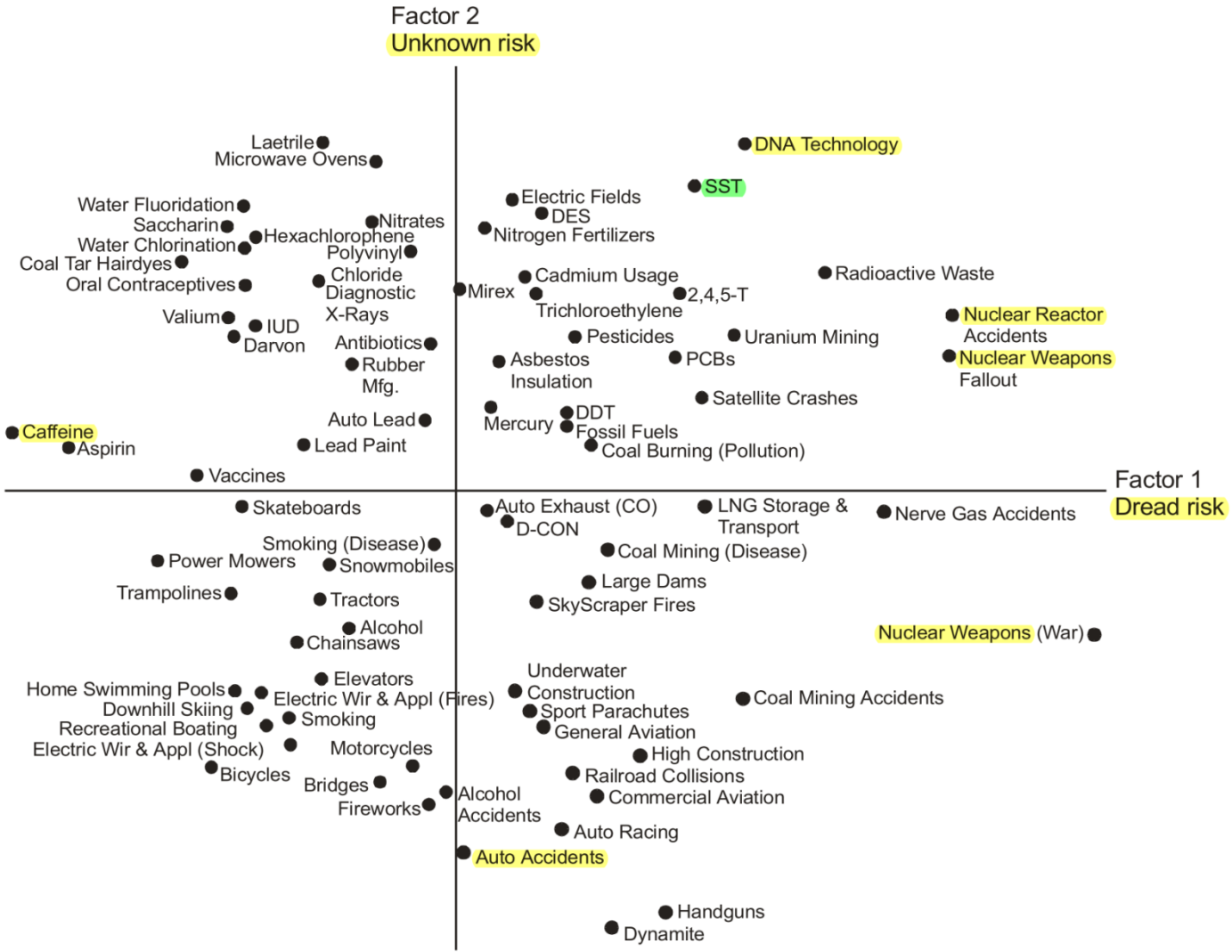


Figure 2. Qualitative characteristics of perceived risk for nuclear power and X-rays across nine risk characteristics.


Factor 2
Unknown risk
Laetrile
Microwave Ovens
Water Fluoridation
Saccharin
Water Chlorination
Coal Tar Hairdyes
Oral Contraceptives
Nitrates
Hexachlorophene
Polyvinyl
Chloride
Diagnostic
X-Rays
Valium
IUD
Darvon
Antibiotics
Rubber
Mfg.
Auto Lead
Lead Paint
Caffeine
Aspirin
Vaccines
DNA Technology
SST
Electric Fields
DES
Nitrogen Fertilizers
Cadmium Usage
Mirex
Trichloroethylene
2,4,5-T
Radioactive Waste
Nuclear Reactor
Accidents
Pesticides
Uranium Mining
Asbestos
Insulation
PCBs
Nuclear Weapons
Fallout
Satellite Crashes
Mercury
DDT
Fossil Fuels
Coal Burning (Pollution)
Factor 1
Dread risk
Skateboards
Auto Exhaust (CO)
D-CON
LNG Storage &
Transport
Nerve Gas Accidents
Smoking (Disease)
Power Mowers
Snowmobiles
Coal Mining (Disease)
Trampolines
Tractors
Large Dams
SkyScraper Fires
Alcohol
Chainsaws
Nuclear Weapons (War)
Elevators
Home Swimming Pools
Electric Wir & Appl (Fires)
Downhill Skiing
Smoking
Recreational Boating
Electric Wir & Appl (Shock)
Motorcycles
Bicycles
Bridges
Fireworks
Underwater
Construction
Sport Parachutes
General Aviation
Coal Mining Accidents
High Construction
Railroad Collisions
Commercial Aviation
Alcohol
Accidents
Auto Racing
Auto Accidents
Handguns
Dynamite

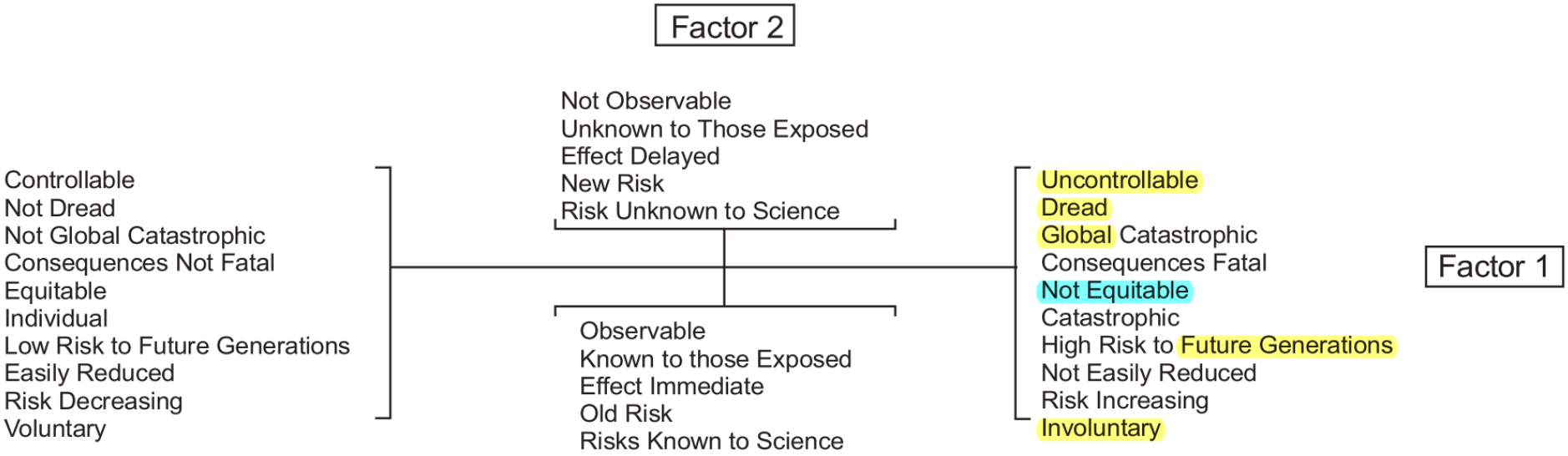


Figure 3. Location of 81 hazards on Factors 1 and 2 derived from the interrelationships among 15 risk characteristics. Each factor is made up of a combination of characteristics, as indicated by the lower diagram. Source: Slovic (1987).

Social amplification of risk is triggered by the occurrence of an adverse event, such as

- a major (or even minor) accident
- a discovery of pollution
- an outbreak of disease
- an incident of sabotage
- a terrorist incident

with potential consequences for a large number of people.

Through **social amplification**, the adverse impacts of hazardous events extend beyond direct damages, e.g.

- litigation (against a company)
- loss of sales
- increased regulation (of an industry).

All companies in an industry may be affected, like a stone dropped in a pond.

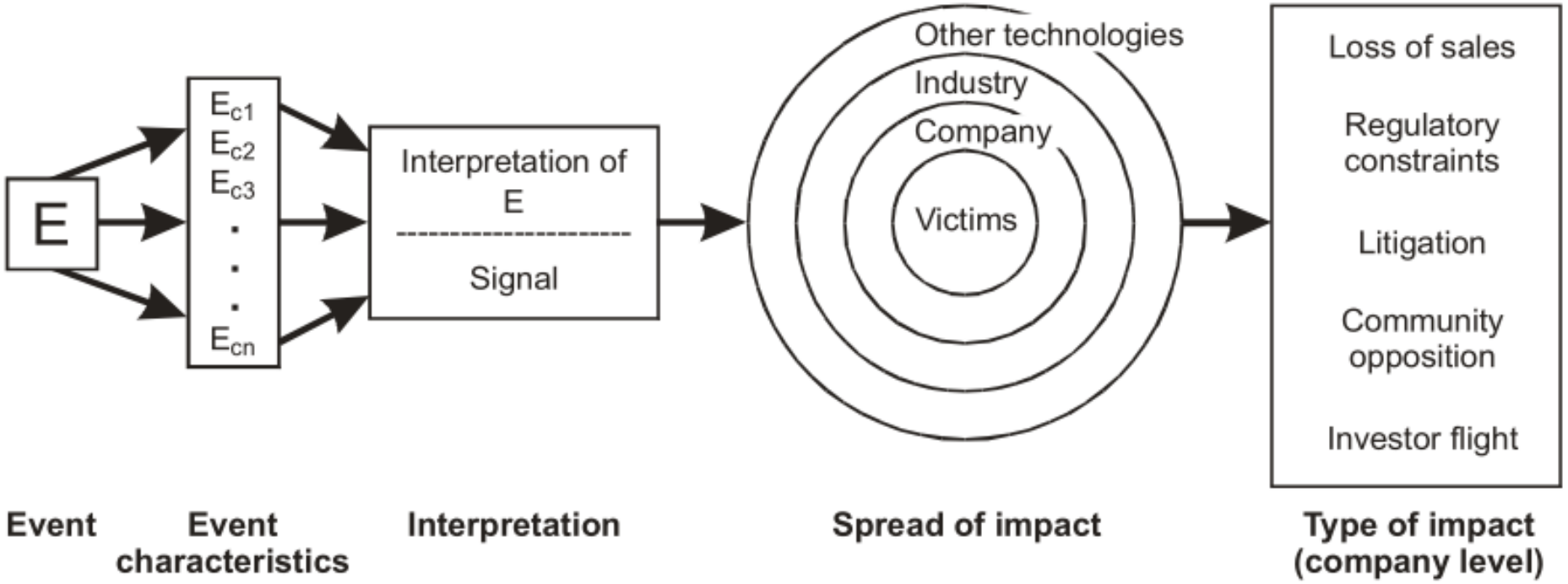
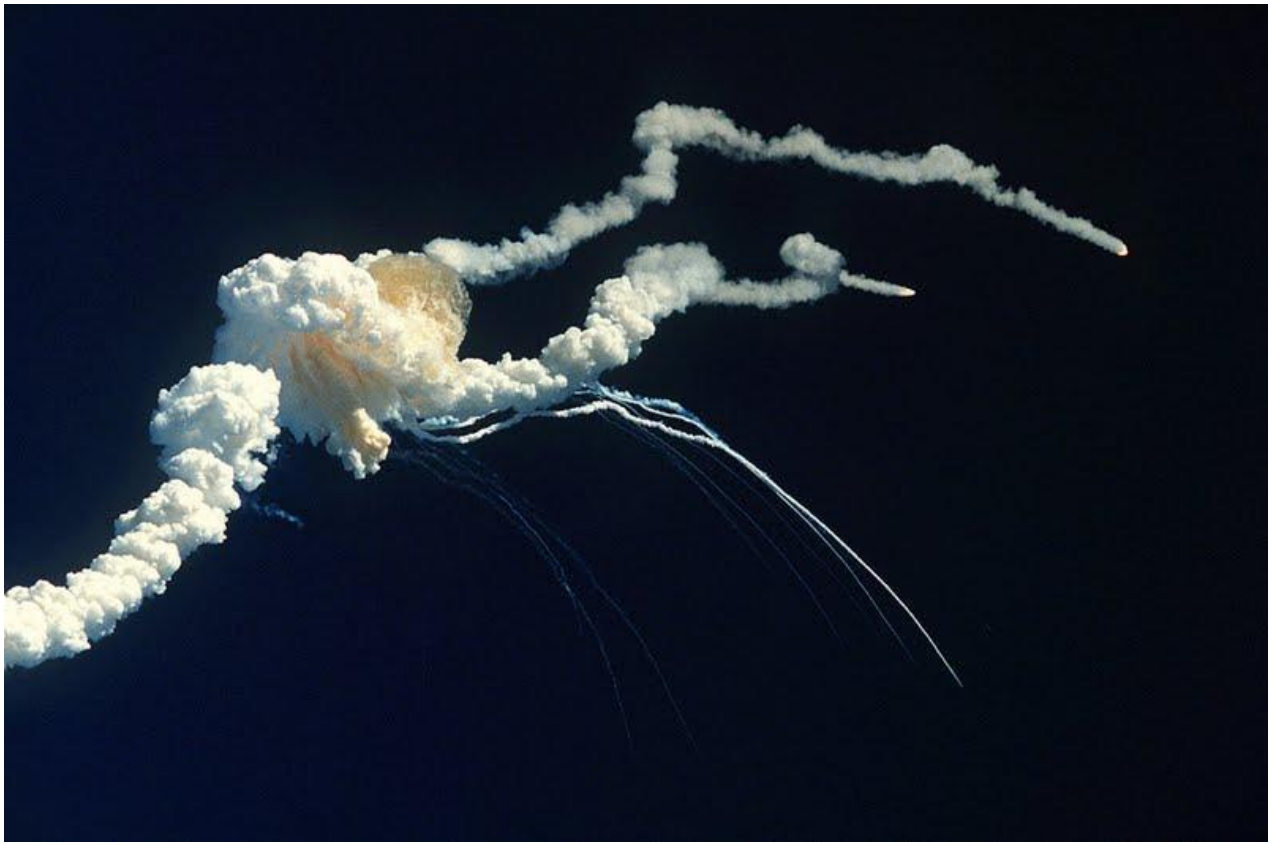


Figure 4. A model of impact for unfortunate events.


The Ripple Effect
ONE SMALL CHANGE
CAN HAVE AN ENORMOUS IMPACT

Chemical manufacturing accident, Union Carbide plant, Bhopal, India, December 2-3, 1984

Disastrous launch of space shuttle Challenger, January 28, 1988



Three Mile Island nuclear accident, near Harrisburg, Pennsylvania, March 28, 1979

Chernobyl nuclear accident, near Pripyat, Ukraine, April 26, 1986

S.T.A.L.K.E.R. video games, based on the Chernobyl nuclear accident

Exxon Valdez oil spill, Prince William Sound, Alaska, March 24, 1989

Terrorist attacks on World Trade Center (“9/11”), New York, September 11, 2001

World's Eyes to Famine Is Dead

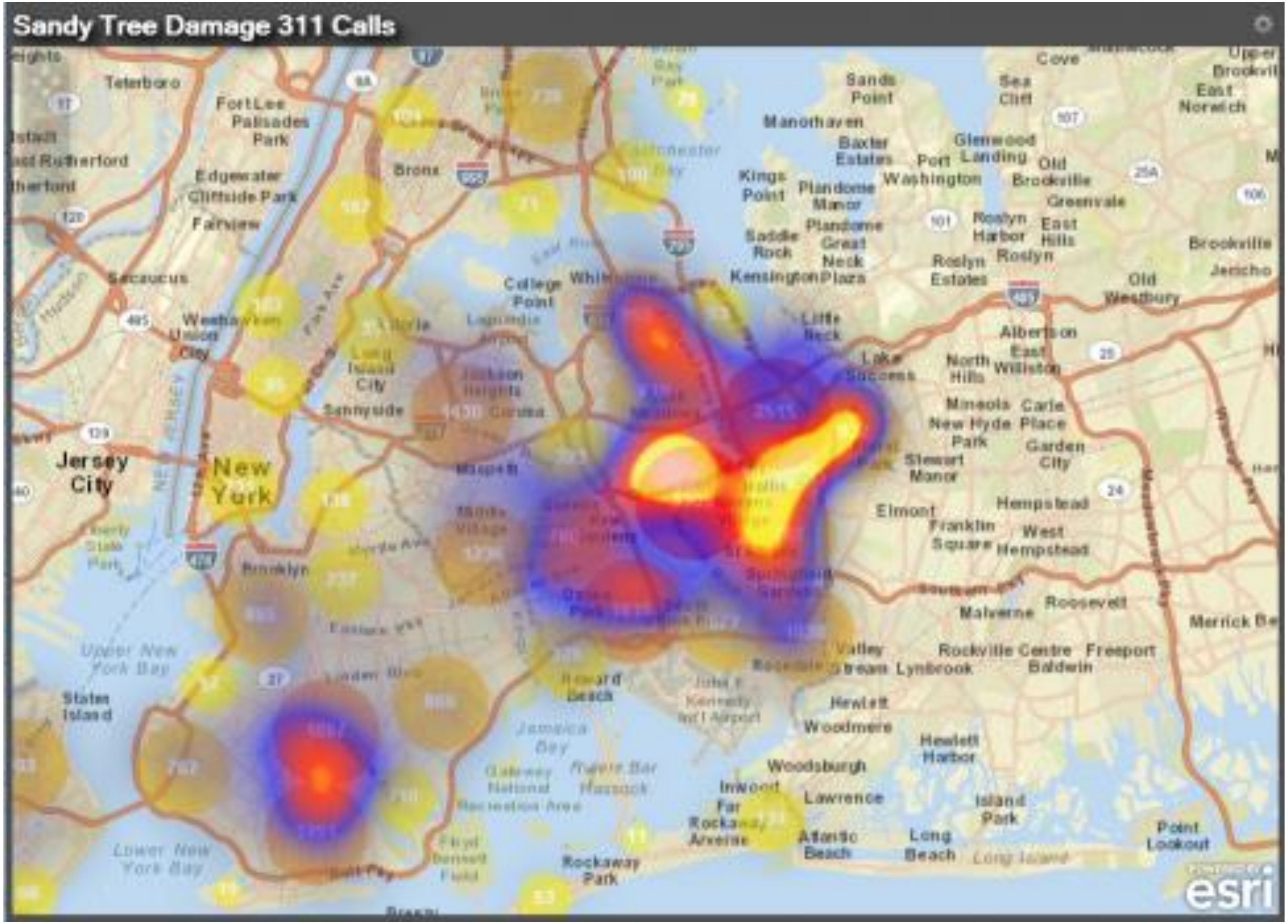
New York Times,
November 1, 2018

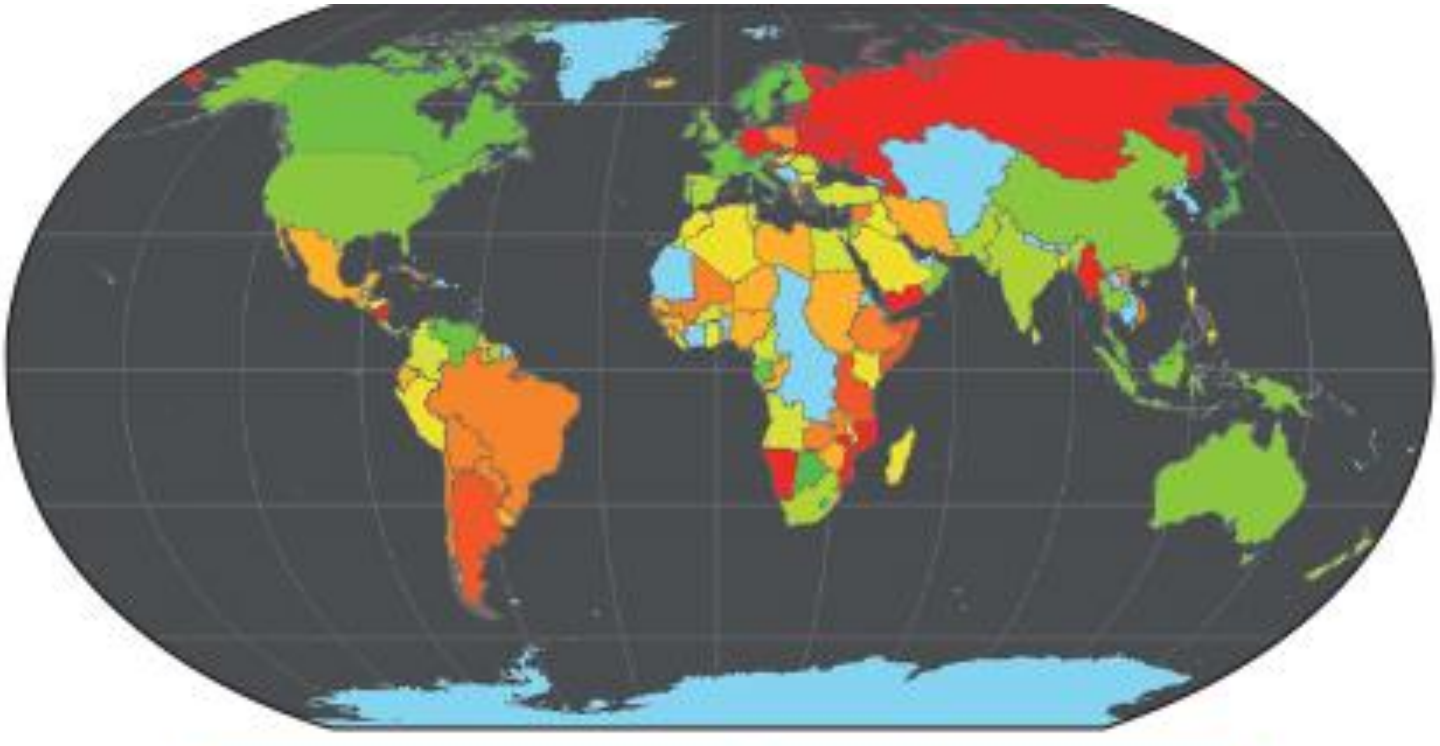
Amal Hussain, who died at age 7. "My heart is broken," her mother said.

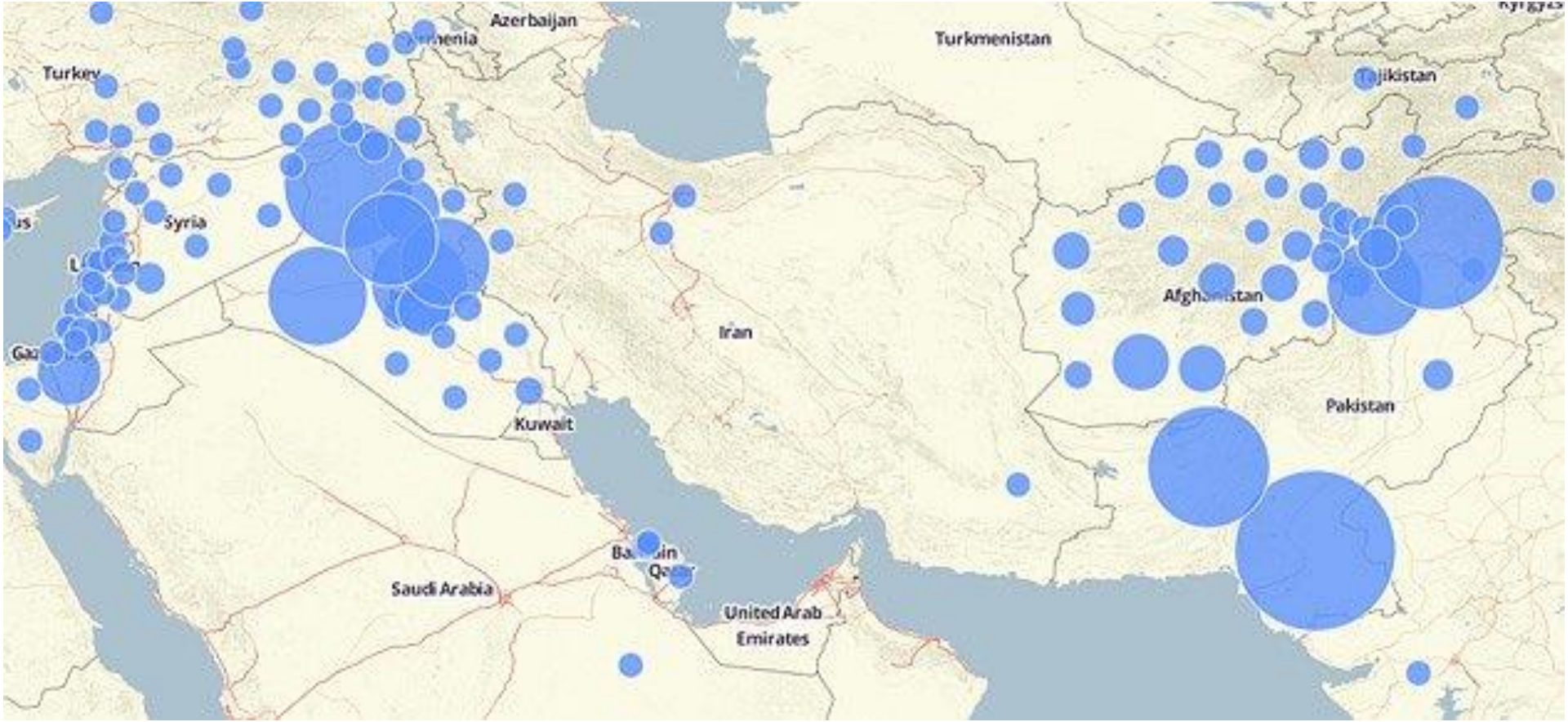
In **social amplification**, direct impacts do not need to be large in order to trigger major indirect impacts.

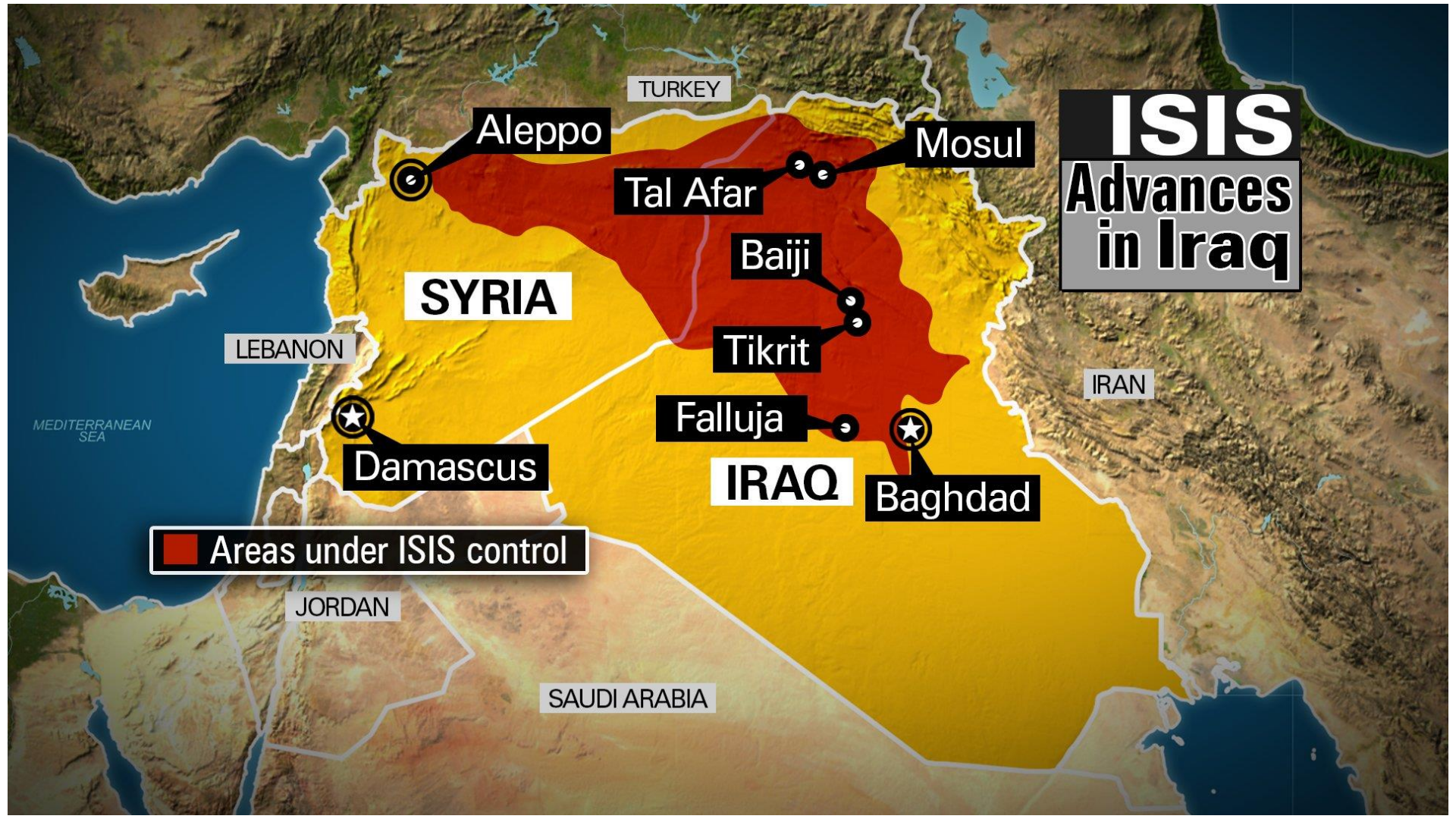
Unfortunate events are interpreted as signals regarding the

- magnitude of risk
- adequacy of risk-management process.


Sandy Tree Damage 311 Calls
Teterboro
Fort Lee
Palisades Park
Edgewater
Cliffside Park
Fairview
Secaucus
Weehawken
Union City
Jersey City
New York
Bronx
Sunnyside
Long Island City
Jackson Heights
Maspeth
Brooklyn
Upper New York Bay
Staten Island
Lower New York Bay
College Point
Whitestone
Kings Point
Sands Point
Manorhaven
Baxter Estates
Port Washington
Plandome Manor
Saddle Rock
Great Neck
Kensington Plaza
Little Neck
Lake Success
Glenwood Landing
Sea Cliff
Old Brookville
Greenvale
Roslyn Harbor
Roslyn Estates
Roslyn
East Hills
Brookville
Jericho
Old Westbury
Albertson
East Williston
North Hills
Mineola
Carle Place
New Hyde Park
Garden City
Stewart Manor
Elmont
Franklin Square
Hempstead
West Hempstead
Malverne
Roosevelt
Merrick
Rockville Centre
Freeport
Baldwin
Valley Stream
Lynbrook
Hewlett
Woodmere
Hewlett Harbor
Woodsburgh
Lawrence
Inwood
Far Rockaway
Atlantic Beach
Long Beach
Island Park
Point Lookout
Long Island
Howard Beach
Jamaica Bay
Rockaway Park
esri


Economic Risk Ratings
0.0 - 6.0
6.1 - 17.0
17.1 - 23.0
23.1 - 26.0
26.1 - 29.0
29.1 - 31.0
31.1 - 34.0
34.1 - 36.5
36.6 - 39.0
39.1 - 44.5
No Data


Azerbaijan
Turkmenistan
Turkey
Tajikistan
Syria
Iran
Afghanistan
Pakistan
Kuwait
Saudi Arabia
United Arab
Emirates


ISIS
Advances in Iraq
TURKEY
Aleppo
Mosul
Tal Afar
Baiji
SYRIA
Tikrit
LEBANON
IRAN
MEDITERRANEAN SEA
Falluja
Damascus
IRAQ
Baghdad
Areas under ISIS control
JORDAN
SAUDI ARABIA


November 18th 2010 • Renaissance Chancery Court, London
HAGEN LINDSTADT
ON MANAGING RISK
WITH GAME THEORY

Apply funnel: Heatmaps visualize suppliers' strategic options and the corresponding value effects