Toxic Safety: Flame Retardants, Chemical Controversies, and Environmental Health

DR. ALISSA CORDNER
Assistant Professor of Sociology
Whitman College

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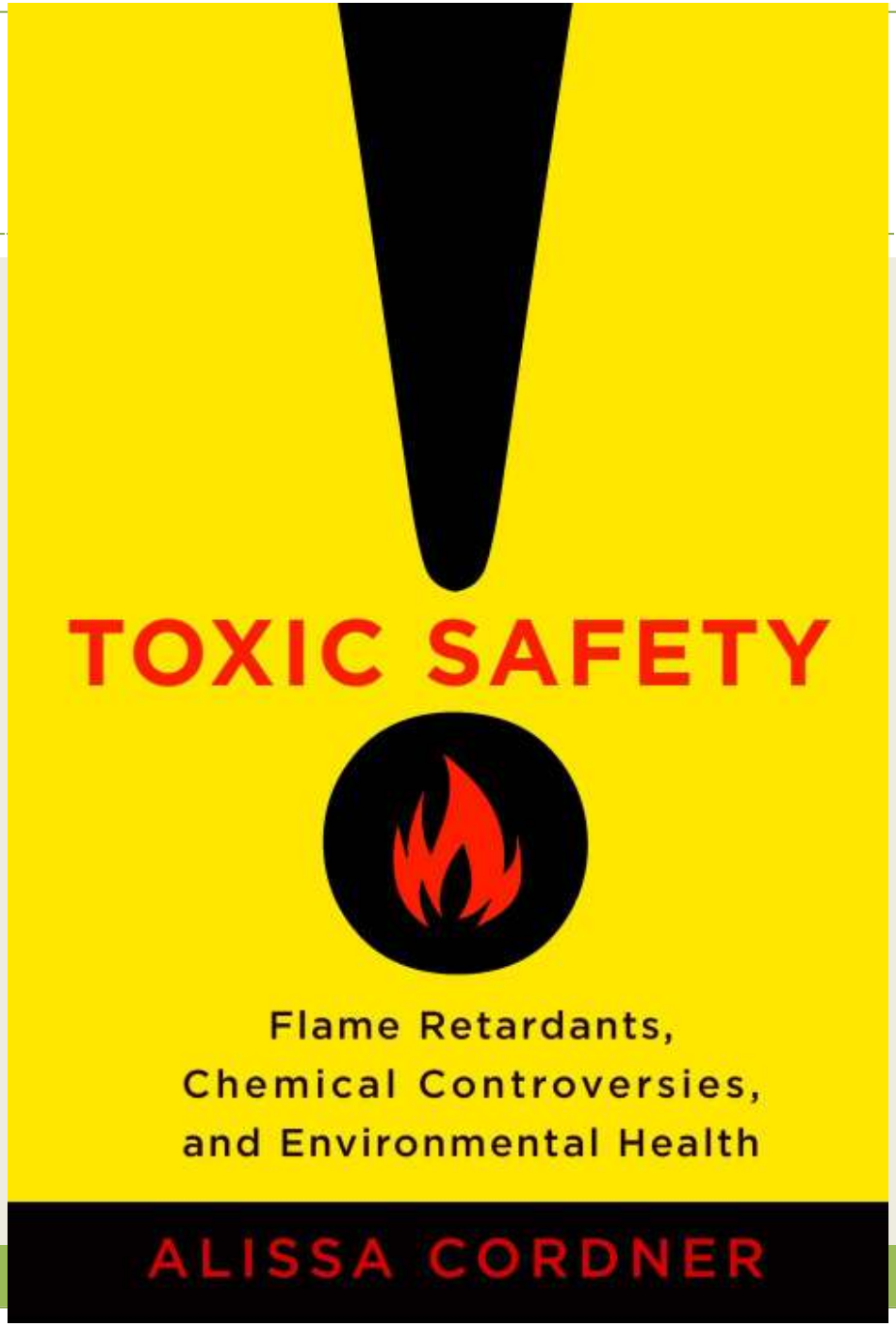


Columbia University Press, 2016

Research Questions

1. How do stakeholders engaged in the field of flame retardant chemicals define and act upon the risks and hazards of those chemicals?

2. What is the role of scientific knowledge in decision-making about chemical risks?

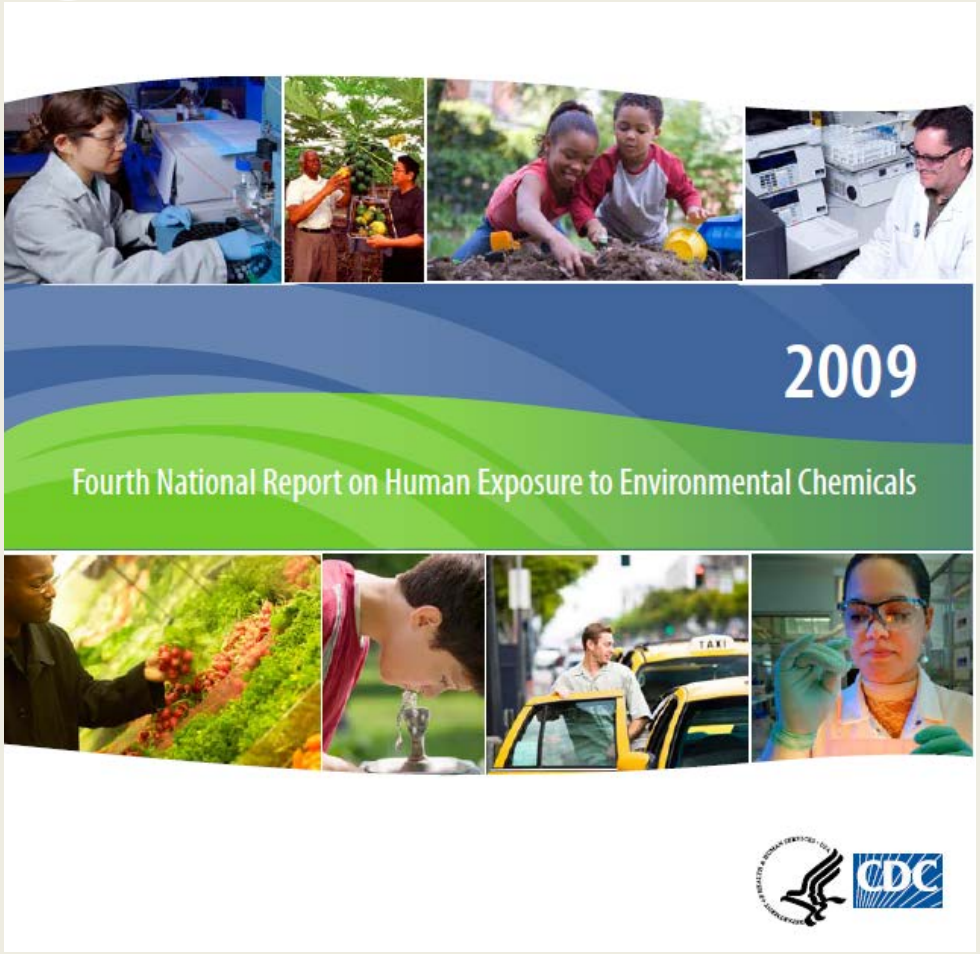
3. What are the implications of stakeholders' different risk assessment paradigms for chemicals use and regulation in the United States?

Data and Methods

- Participant Observation
  - Chemical manufacturer
  - EPA's Office of Pollution Prevention and Toxics
  - EPA's Office of Research and Development
  - Academic environmental chemistry lab
  - Environmental Health NGO
- 116 in-depth interviews
- Literature and public document research
- All respondents anonymized
- Funding: 3-year EPA STAR Fellowship (FP-917119) and NSF (PI: Phil Brown, SES-0924241)

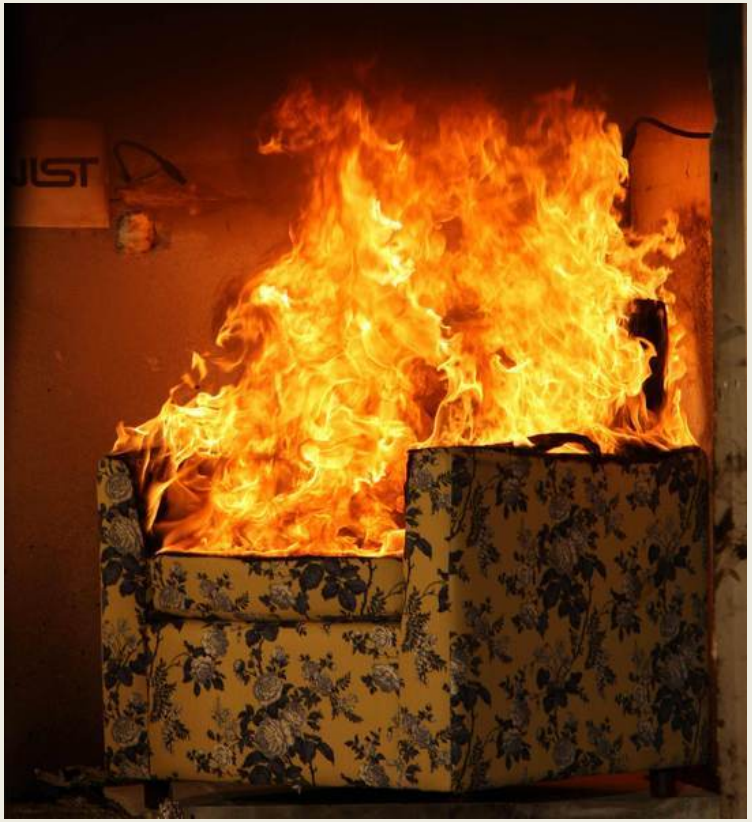
Chemicals and Environmental Health

- ~100,000 chemicals have been inventoried in US commerce
  - **Exposure data** – less than 1/5 of chemicals have *any* exposure data (Egeghy et al. 2012)
  - **Toxicity data** – 34% have *no toxicity data* and only 28% had a high quality toxicity evaluation (Judson et al. 2009)



Flame Retardant Chemicals

- Widely used as additives to consumer products to decrease flammability
- Hundreds of individual chemicals and mixtures
  - PBDEs
  - Chlorinated Tris (TDCPP, TCEP, TCPP)
  - TBBPA
  - HBCD
  - Firemaster 550 (TBB and TBPH)



Fire Safety Regulations

- Intended to reduce fire occurrences, injuries, and deaths
- Annual Fire Deaths:
  - 1971 – 12,000
  - 2011 – 3,005

  Source: US Fire Administration
- Flame retardants remain a large and profitable international industry

Environmental Inequality

Environ. Sci. Technol. 2010, 44, 5691–5692

ENVIRONMENTAL Science & Technology Viewpoint

Are PBDEs an environmental equity concern? Exposure disparities by socioeconomic status

AMI R. ZOTA*
University of California, San Francisco, California

GARY ADAMKIEWICZ
Harvard School of Public Health, Boston, Massachusetts

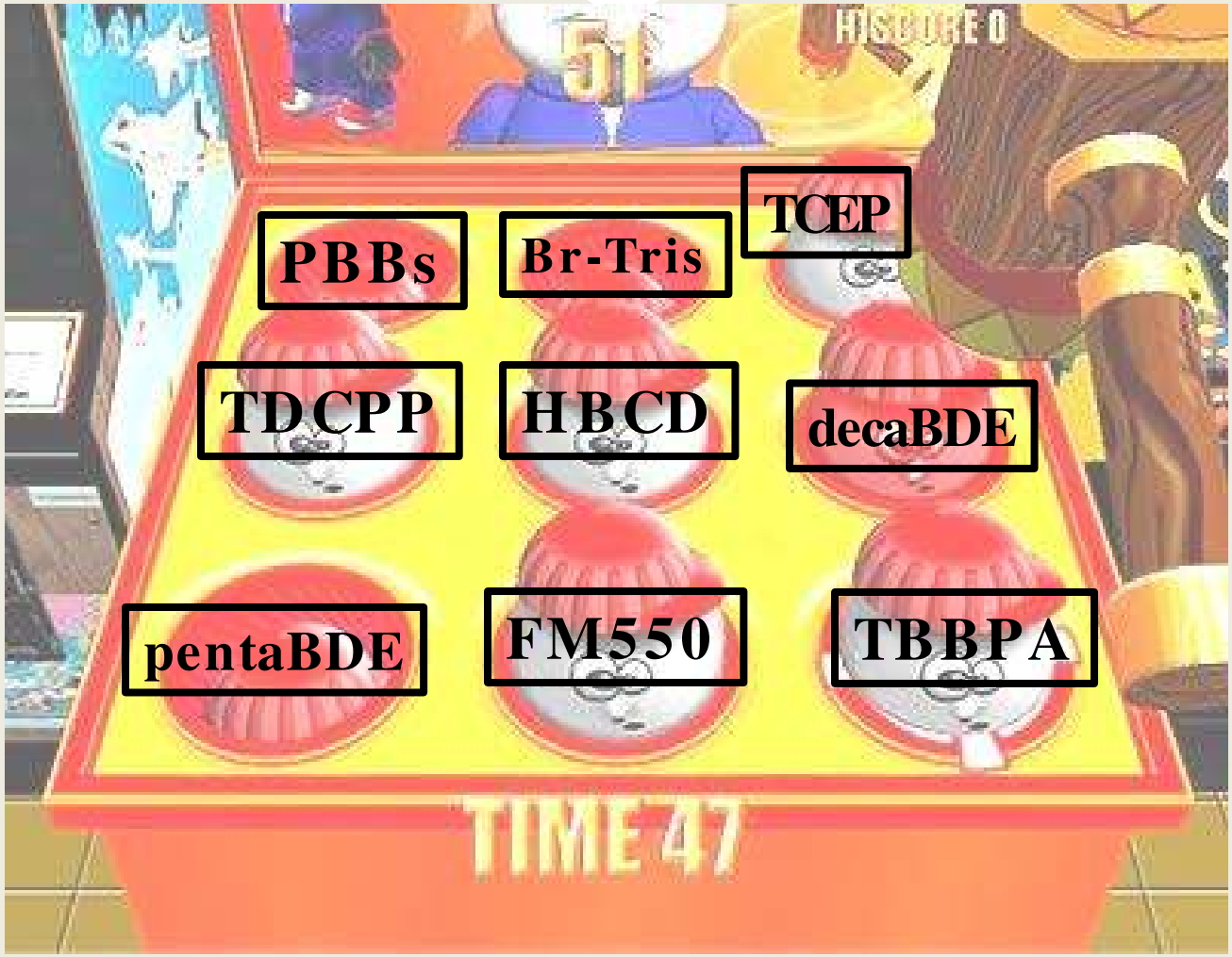
RACHEL A. MORELLO-FROSCH
University of California, Berkeley, California

For example, recent studies have shown higher exposures among young children compared to adults (*1*). This finding is consistent with exposure profiles of other environmental contaminants, such as lead, where dust is an important exposure media; indeed, children spend more time close to the ground and engage in hand-to-mouth behavior which may increase their dust intake. There are also significant geographic differences in PBDE exposures with much higher serum, breast milk, and house dust levels reported in the U.S. compared to Europe. Within the U.S., PBDE congeners characteristic of penta-BDE (e.g., BDE-47, -99, and -100) occur at higher concentrations in house dust and blood samples collected from Californians compared to other U.S. residents. This difference in exposure levels within the U.S. is likely due to California's unique furniture flammability standard (TB117), which appears to be associated with body burdens that are twice as high as the rest of the U.S. and 10-fold higher than levels in Europe (*2*).

Health Effects of Some Flame Retardants

- **Persistent, Bioaccumulative, Toxic (PBT)**
- **Endocrine disruptors** (Rudel and Perovich 2009)
- **Reproductive disorders** (Main et al. 2007, Harley et al. 2010)
- **Neurological and behavioral outcomes in children** (Roze et al. 2009, Herbstman et al. 2010, Messer 2010)
- **Changes in hormone levels** (Meeker et al. 2009, Chevrier et al. 2010)

Flame Retardants as Case Study



Regulation of Flame Retardants

- Regulation has been chemical-by-chemical
- State level bans
- United States
  - Environmental Protection Agency (EPA)
  - Consumer Products Safety Commission (CPSC)
- Internationally
  - Europe – Registration, Evaluation, and Authorization of Chemicals (REACH)

Limitations of Federal Chemicals Regulation

- Toxic Substances Control Act (TSCA)
- Limitations of TSCA include:
  - Limited authority to regulate "existing" chemicals
  - Risk-based regulations must be justified as "least burdensome"
  - No required toxicity or exposure data for new chemicals
  - Exemptions from full reporting for many chemicals
  - Confidential Business Information
- Pending Federal Legislation

State Level Regulation and Activism

- Broad coalition, including:
  - Environmental and health nonprofits
  - Public interest organizations
  - Parent groups
  - Environmental scientists
  - Legislators and regulators
  - Supply chain manufacturers and distributors
  - Firefighters
  - Fire scientists and fire safety experts

Blue-Green Alliances

- Environmental groups have successfully partnered with firefighters and fire safety experts

NEW SOLUTIONS
A Journal of Environmental and Occupational Health Policy

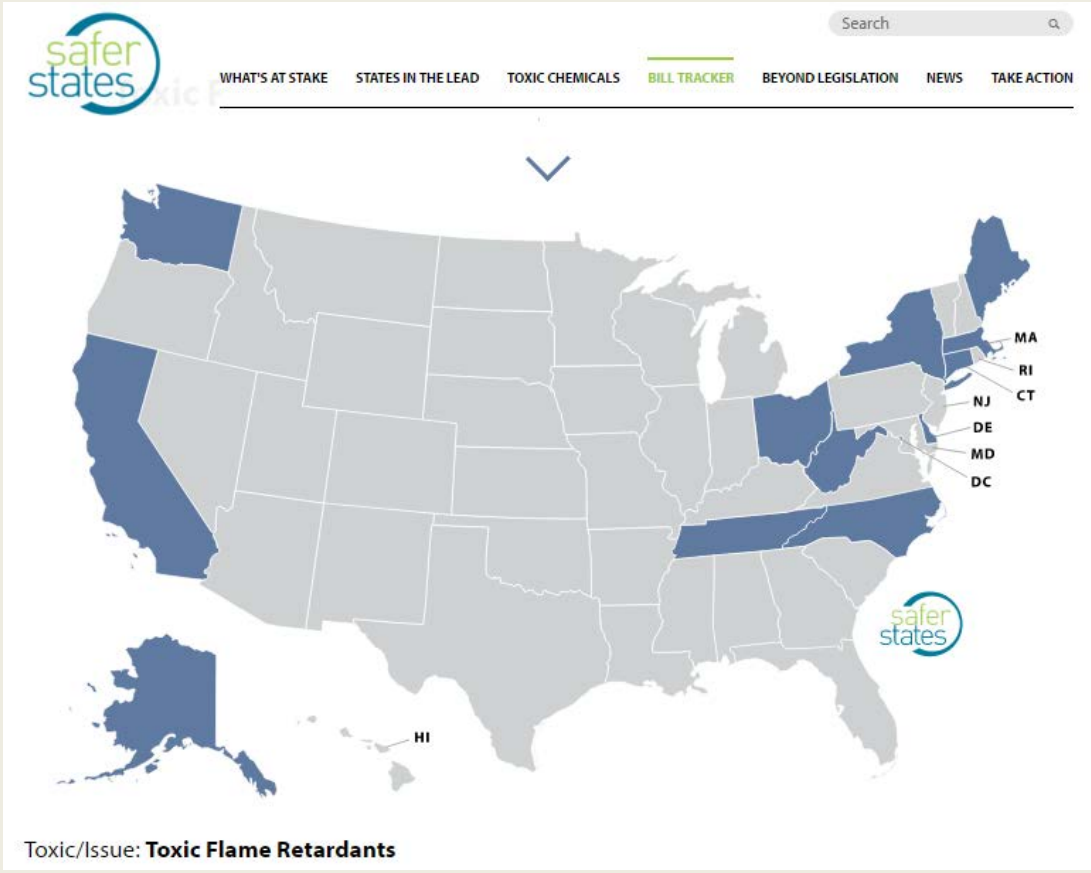
Features

FIREFIGHTERS AND FLAME RETARDANT ACTIVISM

ALISSA CORDNER
KATHRYN M. RODGERS
PHIL BROWN
RACHEL MORELLO-FROSCH

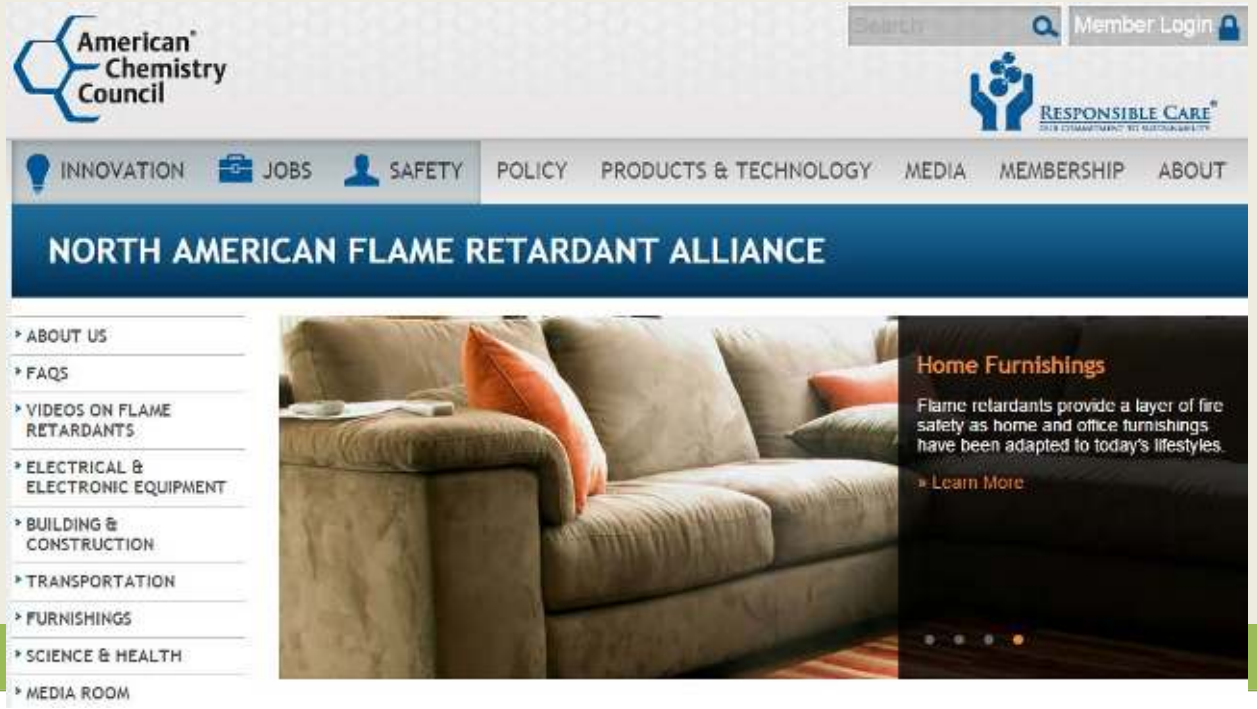
State Level Regulation and Activism

- "Patchwork Quilt" of state regulations
- "Retail regulation" and market campaigns



Corporate Advocacy

- Citizens for Fire Safety (no longer active)
- Bromine Science and Environmental Forum
- American Chemistry Council's North American Flame Retardant Alliance



Conceptual Risk Formulas

Risk

Hazard

Exposure

Uncertainty

Conceptual Risk Formulas

- Classic Risk Formula
- Exposure-Centric Risk Formula
- Either-Or Risk Formula
- Emerging Toxicology Risk Formula
- Exposure-Proxy Risk Formula
- Hazard-Centric Risk Formula

Classic Risk Formula

- Risk = *f* (Hazard * Exposure)
- Assumes a linear dose-response relationship
- Absence of data suggests absence of risk
- Widespread in environmental regulation, public discourse, and the chemical industry

Exposure-Centric Risk Formula

- Risk = *f* (Hazard * Physical-Chemical Properties * Use Scenarios * Exposure Pathways * Measured Levels)
- Formula is multifaceted and strictly multiplicative
- Exposure is controllable
- Widespread in the chemical industry

Either-Or Risk Formula

- Risk = *f* (Hazard) or *f* (Exposure)
- Critique of multiplicative risk assessment
- "We prefer a hazards-based approach, which is, 'let's look at the chemicals. If it's hazardous, don't use it.'"

  OR
- "You don't even have to show a health effect. If you're showing that these chemicals are getting into my body, that trespass is unauthorized."
- Widespread in environmental and health activism

Implications of Conceptual Risk Definition

- Risk definition is strategic
- Reactionary versus precautionary risk management
- Protecting markets versus protecting public health
  - Risk definition as another tool used by industry to delay chemicals management

Questions?

Alissa Cordner

cordneaa@whitman.edu

Toxic Safety is available for purchase on the Columbia University website (cup.columbia.edu).

Use the discount code **CORTOX** for a 30% discount.