2018 Engineered Nanomaterials--No Small Issue

Engineered nanomaterials in societal context—risk perception and social response

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CNS-UCSB Center for Nanotechnology in Society
UCCEIN
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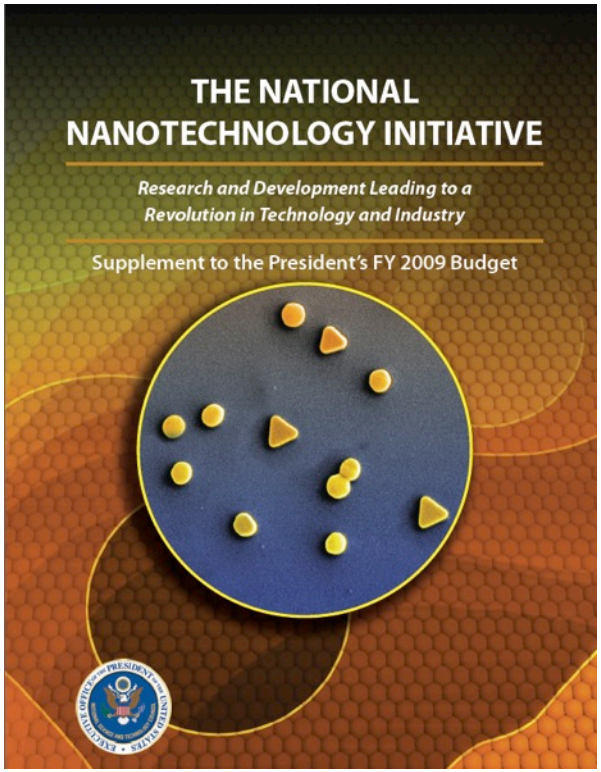
NSF SES 0938099

Main points of talk

- Why public perceptions? Why expert perceptions?
- Main issues with studying nanotec risk perceptions
- What we've learned so far
- Policy implications

National Nanotechnology Initiative



- 27 federal agencies (2013)
- ″…a future in which the ability to understand and control matter at the nanoscale leads to a revolution in technology and industry that benefits society″

NNI 2008, p. 3

CNS-UCSB
Center for Nanotechnology in Society

SES 0938099

Mission: Nanotechnology Origins, Innovations, and Perceptions in a Global Society

CNS-UCSB challenge: Will nanotechnology mature into a transformative technology, in our rapidly changing international economic, political & cultural environment?

- Social and environmental sustainability, 'responsible development'
- Many methods, disciplines, new approaches

Key factors we focus on:

- Global nano-enterprise (US, Asia, Europe & Latin America)
- Multiple party risk perception
- Modes of dialogue with the public
- Historical contexts for S&T development

http://www.cns.ucsb.edu/

UNIVERSITY OF CALIFORNIA

UC CEIN Center for Environmental Implications of Nanotechnology

about | research | education | people | places | resources | events | publications

Nano News

Nano-safety studies urged in China

Ions, not particles, make silver toxic to bacteria

Advantages of mechanisms-based toxicity testing of nanomaterials

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Study Shows Confusion On Protecting Nano Workers

CEIN Home

How to Reach Us

Nano News

Employment

Research Highlight

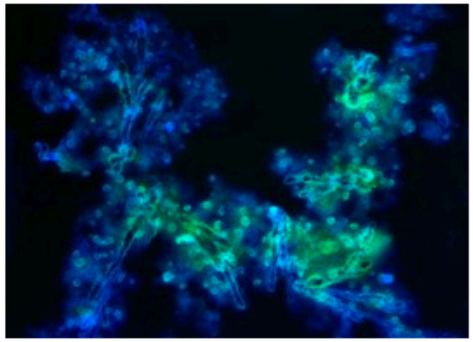
PerkinElmer, the world's largest supplier of analytical instruments, has just featured the work of UC CEIN associate Prof. Jorge Gardea-Torresdey and his group at the University of Texas at El Paso and their research in nanomaterials in our food supply . . . more

Events

Recent Events . . . more

Challenges and Opportunities for Businesses Engaged in Nanotechnology
September 25, 2012 • CNSI Auditorium • UCLA
Workshop to discuss the current state of the nanotechnology industry in California and identify opportunities and pitfalls for the continued expansion of this key technology sector. . . . more

Nano Art - Science and Art Intersect



"Nano Puppy" by Dr. Tian Xia

Public Release of High Throughput Data Analysis Tools

The UCLA Center for the Environmental Implications of Nanomaterials (CEIN) is proud to announce the public release of an integrated set of High Throughput Data Analysis Tools (HDAT) for rapid analysis of HTS nanotoxicity data. HDAT allows analysis of . . . more

SPECIAL NEWS

The CEIN was honored to host a visit by EPA Administrator Lisa Jackson in February 2012. She chose to visit the Center, toured labs, met with . . . more

About

The mission of **the University of California Center for Environmental Implications of Nanotechnology (UC CEIN)** is to use a multidisciplinary approach to conduct research, knowledge acquisition, education and outreach to ensure the responsible use and safe implementation of . . . (more)

Nanotoxicology Training Program

http://www.cein.ucla.edu/

What is risk perception?

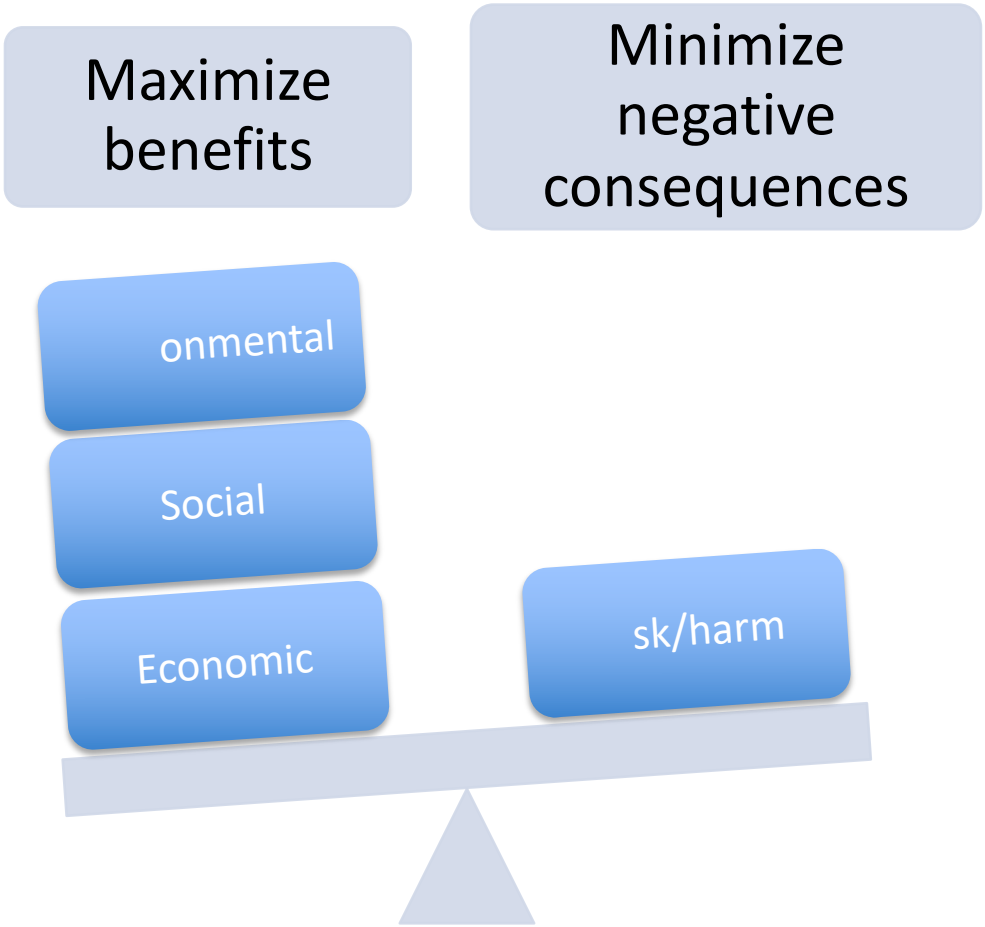
- Study of people's opinions and attitudes when asked to evaluate and make sense of hazardous activities and technologies [includes benefit perception]
- Aims to aid risk analysis and risk management:
  - Improve methods for eliciting such opinions
  - Provide a basis for understanding and anticipating public responses to hazards
  - Improve risk communication among publics, experts, and policy makers
  - [Fulfill normative, ethical obligation to enhance public participation]

Source: Slovic Fischhoff & Lichtenstein 1982

Why public perceptions and participation in technology assessment?

- *Normative:* Right thing to do—those affected should be informed and share in decision-making (US Congress 2003: *21st Century Nanotech R&D Act mandates public participation*)
- *Instrumental:* Contributes to other goals (e.g., building trust through equitability) (Fiorino 1989)
- *Substantive:* Contributes useful knowledge—(e.g., adds local knowledge about useful applications) (Dietz & Stern 2008)

National Academies of Science 2006: "**responsible development** [of nanotechnologies] … implies a commitment to develop and use technology to help meet the most pressing human and societal needs, while making every reasonable effort to anticipate and mitigate adverse implications or unintended consequences."



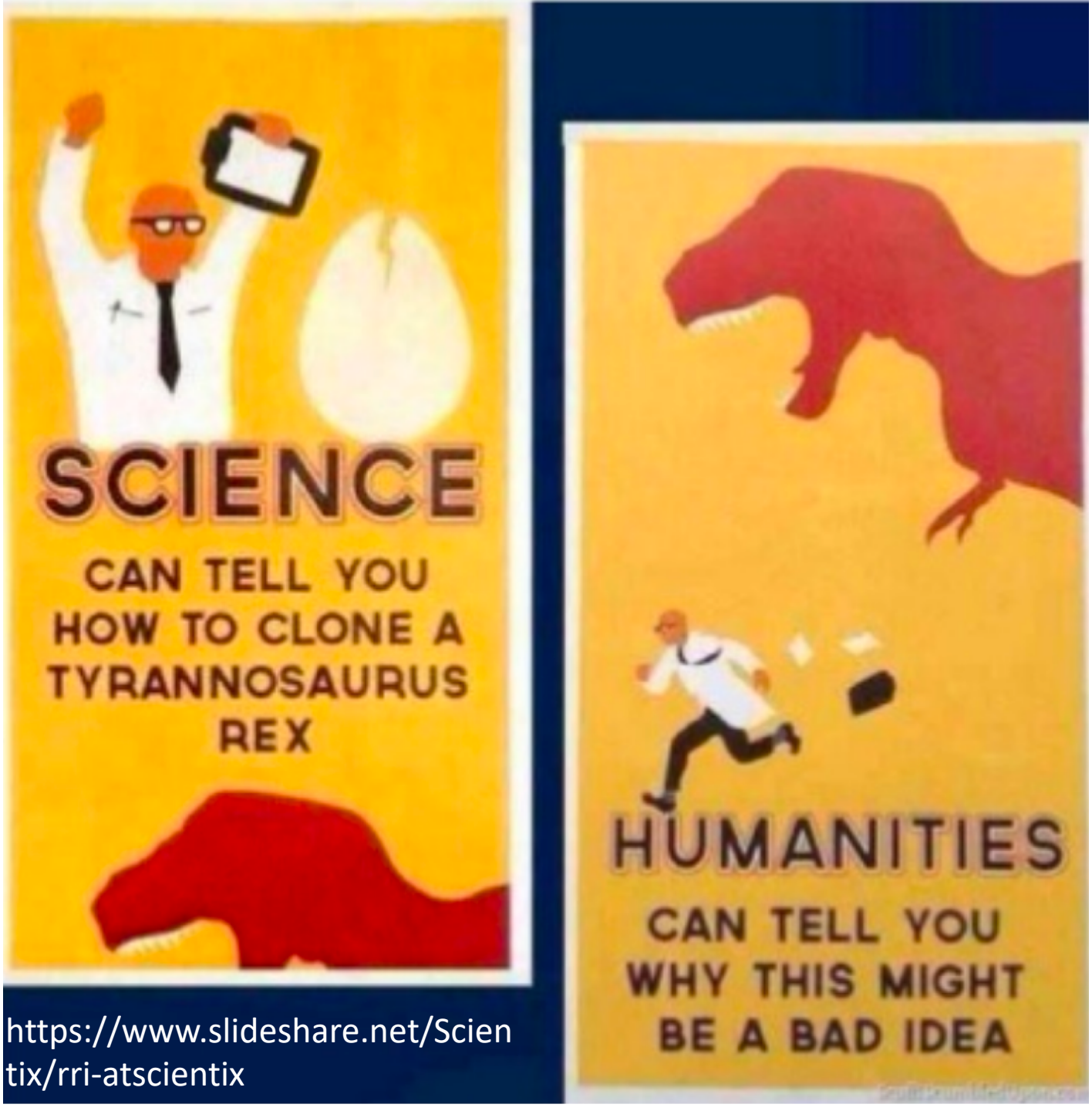
Responsible Research & Innovation (RRI)

The EU has taken the lead on fostering new RRI paradigm among all stakeholders (e.g., Horizon 2020)—"Science with and for Society"

RRI = **Anticipatory, Participatory, Reflexive, Responsive**

- **Involving society in science and innovation** 'very upstream' in the processes of R&I to align its outcomes with the values of society.
- **A wide umbrella connecting different aspects of the relationship between R&I and society**: public engagement, open access, gender equality, science education, ethics, and governance.
- **Horizon 2020**, the EU Programme for Research and Innovation 2014-2020-cross-cutting issue.

Sources:Owens et al. 2013; https://ec.europa.eu/programmes/horizon2020/en/h2020-section/responsible-research-innovation



https://www.slideshare.net/Scientix/rri-atscientix

Why expert perceptions?

- Direct responsibility for technology assessment
- Variance in risk perceptions likely and potentially impactful
- Upstream process—filled with uncertainties, yet need decision making—new methods needed
- Two-way (or more-way) communication—need evidence-based views of all

Issues with nanotech risk perception research

Publics

- Little or no public awareness
- 1st ever major upstream risk perception research
- Malleable, potentially mobile views
- Major structural change in public communication system (internet proliferation)

Experts

- No standards for materials
- Huge array of materials and potential applications
- Limited protocols for expert engagement and decision making under uncertainty

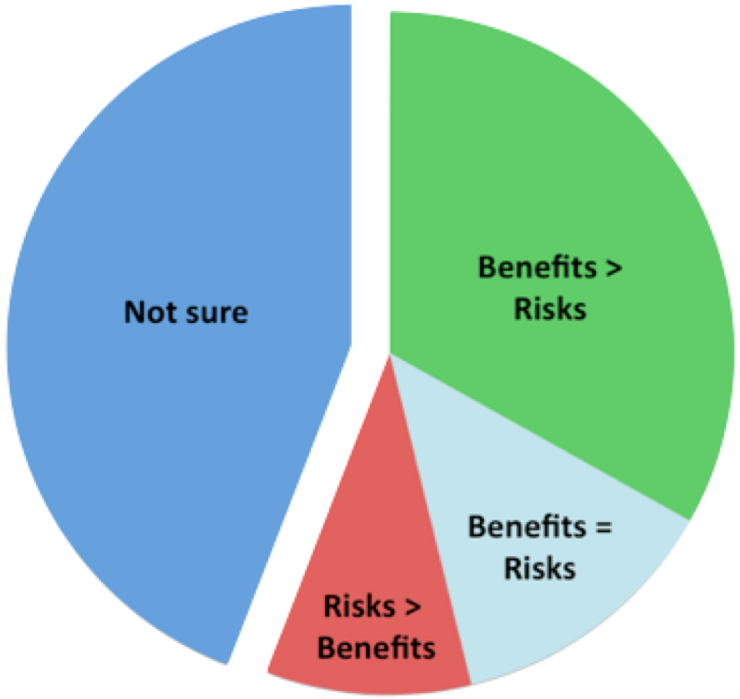
Public & expert risk perception

Main findings on public perceptions

- Public acceptability driven by benefit perception, application, risk messages from trusted sources, stable over time.
- Social risks, esp. equity and politics, are primary drivers of perception and need to be fully addressed
- Upstream dominance of benefit perception does NOT mean unconditional public acceptance can be assumed over time—conditional acceptance
- Almost no public sensitivity to differences in ENMs—whole class could become vulnerable to stigma effects

Harthorn, Pidgeon & Satterfield. 2016. CNS-UCSCB IRG 3 Synthesis Report

Public perceptions of nanotechnologies: benefit centric, but high uncertainty and potential malleability



Slide courtesy of C. Beaudrie

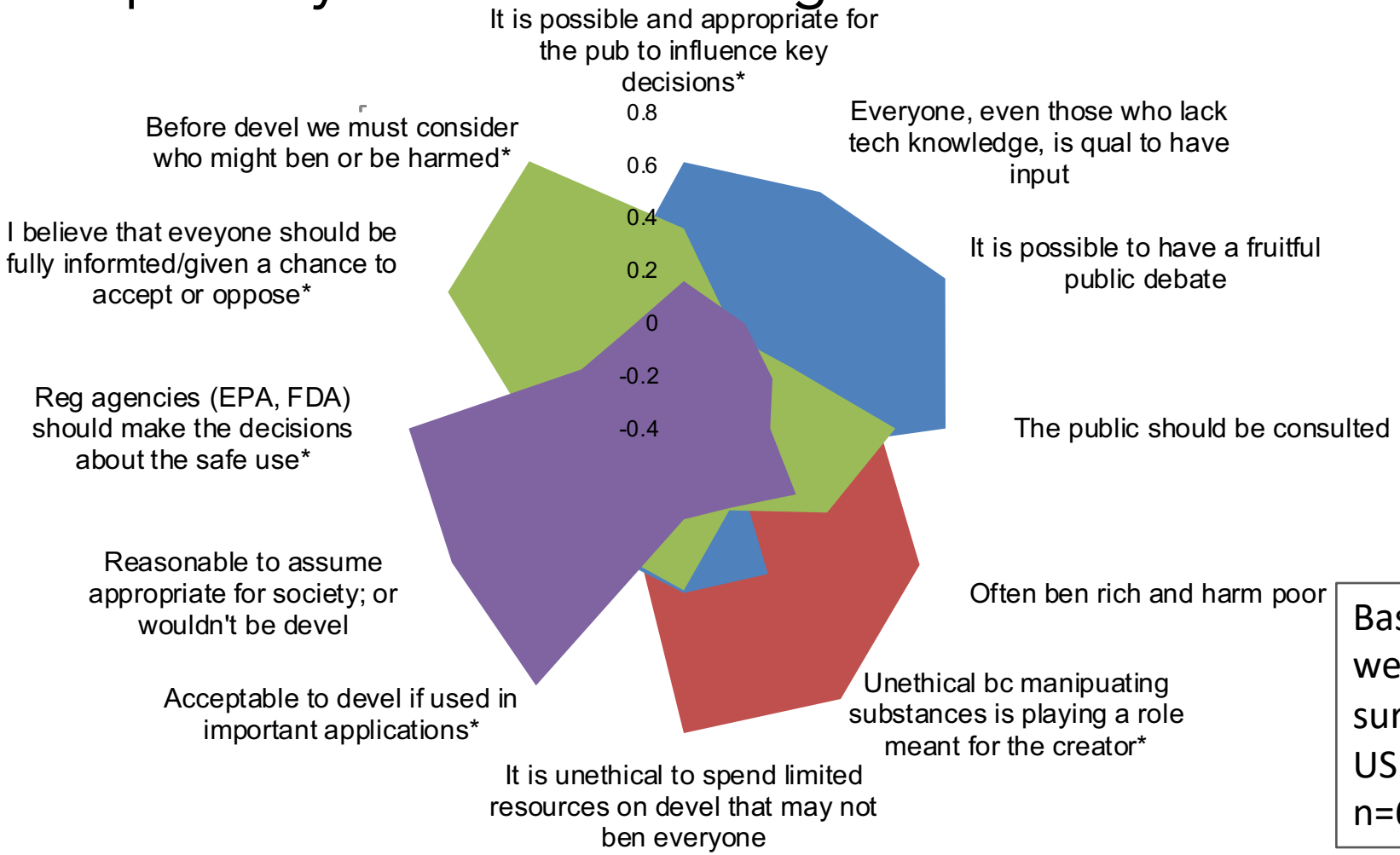
Source: Satterfield, T. et al. 2009 Anticipating the perceived risk of nanotechnologies. Nature Nano 4: 752–758.

Application Matters: Cross-National US-UK Energy-Health Deliberation Study

1. Benefits rather than risks frame nano risk perception
2. US-UK comparative differences: subtle and contextual
3. Different application: Different perceptions
4. The social trumps the technological in the discussion of 'risk'

Pidgeon, N., Harthorn, B., Bryant, K. & Rogers-Hayden, T. (2009) Deliberating the risks of nanotechnologies for energy and health applications in the United States & United Kingdom. *Nature Nanotechnology* 4 (2): 95-98.

Public views upstream ethics linked to environmental acceptability of nanotechnologies



Based on web survey of US public n=697

Value a role for the public | **Equity and power**

Informed consent to develop | **Institutional trust**

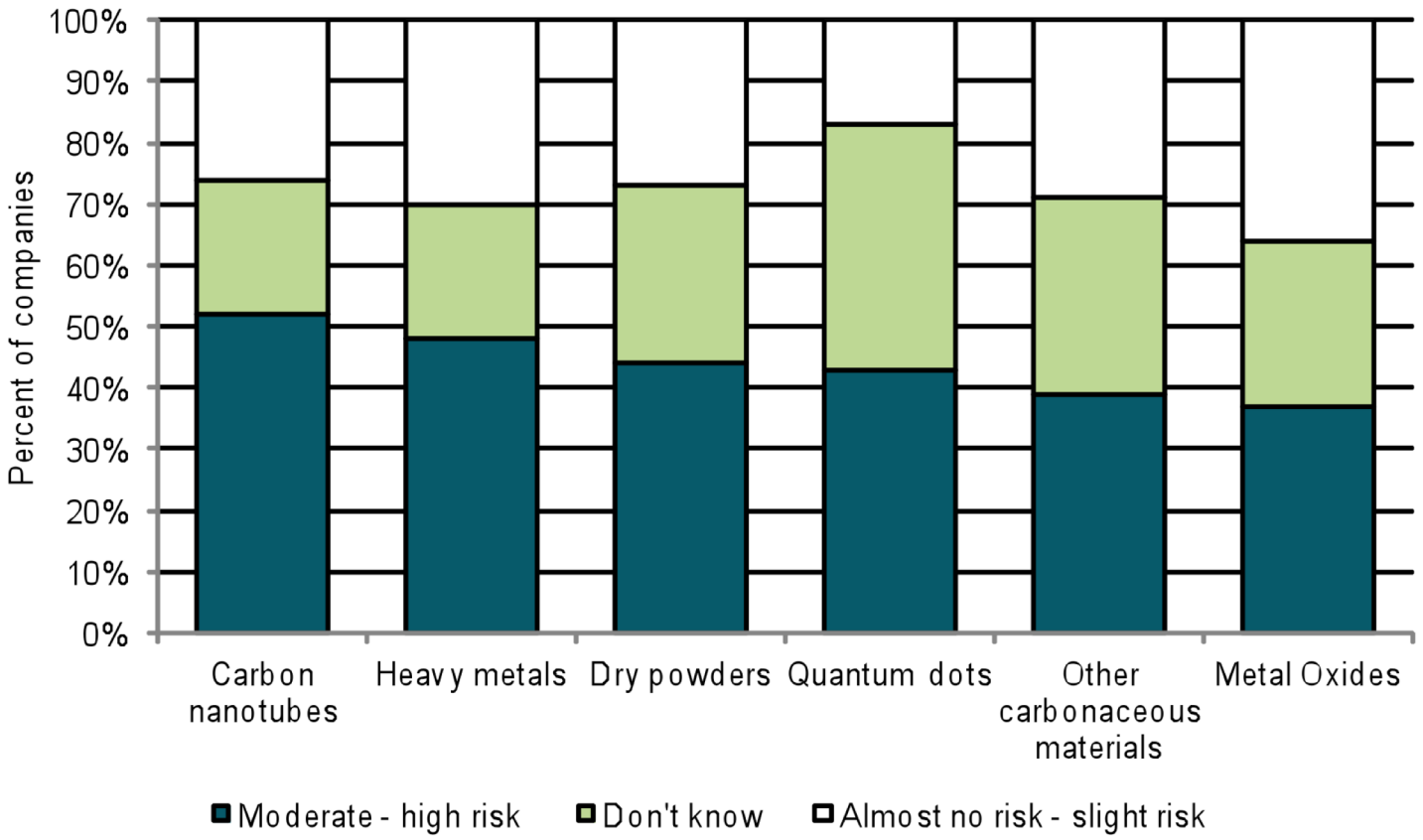
Harthorn, Collins, & Satterfield 2018 in preparation

Main findings on expert perceptions

- ENM industry leaders show high perceived risk re: all ENMs yet are strongly opposed to regulation, which puts workers at risk [NIOSH has taken precautionary steps]
- Reliance on intuitive risk judgments evident among experts as well as publics
- Experts differ in their risk judgments by affiliation, context and gender, so group composition for decision making important
- Among expert groups, regulators show lowest confidence in regulatory capacities

Harthorn, Pidgeon & Satterfield 2016. CNS-UCSCB IRG 3 Synthesis Report

Nano Industry EHS and Risk Perception



2010 phone and web survey of 78 ENM companies in 14 countries

29% of respondents uncertain re: risks of 6 types of ENMs. Combined 'don't know' plus moderate-high risk per type = 64%(metal oxides) - 83% (quantum dots)

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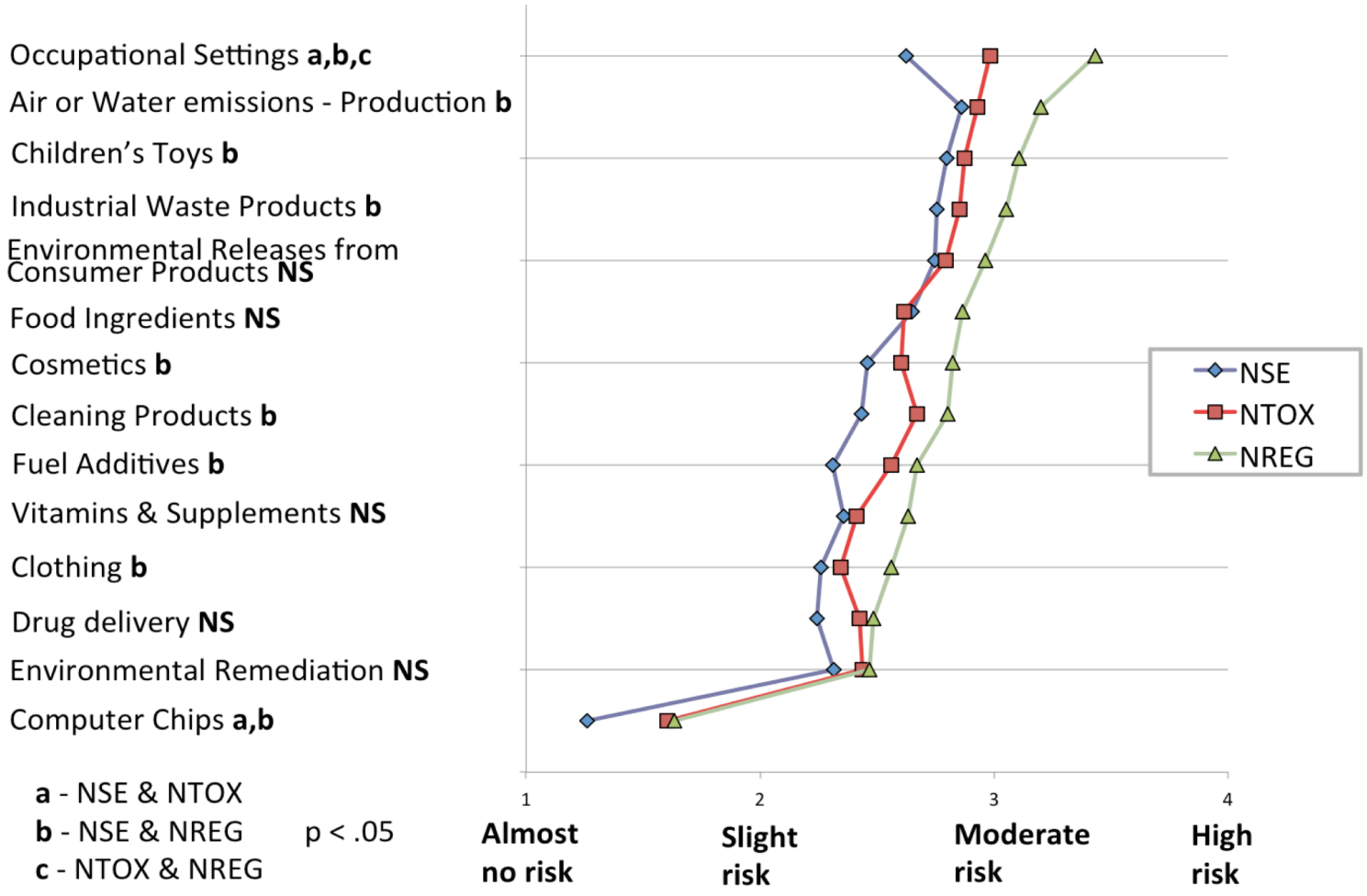
Engeman et al. JNR (2012) 14:749-760

NSF: DBI 0830117
NSF: SES-0531184
NSF: SES-0938099

Scientists' and Regulators' MNM Risk and Benefit Perceptions — Application context effects & group differences



Web-survey of 424 nano experts on their views of MNM risk and regulation

NSE – Nanosci and engineers

NTOX – Nano EHS researchers

NREG – Nano regulators, risk assessors in govt

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Beaudrie, Satterfield, Kandlikar, & Harthorn. 2013. PLoS One

Experts workshop: Nanotech Risk Screening Using a Structured Decision Making Approach

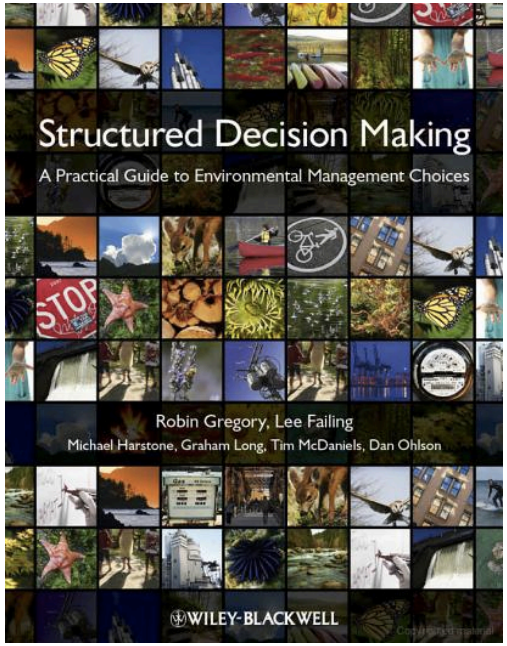
May 24-25 at UBC, Vancouver, Canada

- **Nanotoxicology**
  - *Human Toxicology*
  - *Eco-Toxicology*
- **Human Exposure**
- **Environmental Fate and Transport**

- NIOSH
- Lawrence Livermore National Lab
- UCLA
- Washington University
- University of Alberta
- University of Rochester
- University of South Carolina
- University of Minnesota

Structured Decision Making (SDM) approach

- Appropriate when decisions are characterized by:
  - *Complexity and uncertainty*
  - *Difficult judgments – weighing the science, consequences of alternatives, priorities, risk tolerances*
  - *High stakes, limited resources*
- Engages experts and decision makers in productive decision-oriented analysis and dialogue



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Source: Beaudrie, Kandlikar, Long, Gregory, Wilson & Satterfield 2013

Implications for policy makers and service providers

Public & expert perception

Longer-Range Governance Concerns

- Risks *beyond EHS/toxicity*:
  - Surveillance and civil liberties
  - **Lack of trust** over responsible governance
  - Profound **lack of trust** of industry, concerns about government collusion
  - Human enhancement and impacts upon identity
  - Equity of access and exposure to harm big issues for nanomedicine technologies
  - Energy technologies perceived as so urgently needed, people not at all sensitive to risks (new in our nano work?)

Normative Bases for Risk Communication

- Duty to inform/informed consent
  - Contains info needed for effective decision making
  - Users can access the info
  - Users can understand what they access
- Uncertainty → construction of preference; more stable preferences produced when provide:
  - Alternative perspectives
  - Range of possible outcomes
  - No hidden values (biases) embedded in choices (e.g., must achieve acceptance)
  - Quantify risks, quantify benefits

Evidence needed at every level for effective risk communication practices

- Information needs to **fit needs/concerns of people** whose beliefs or behaviors you're trying to change (e.g., publics, but also policymakers)
- We should **expect a mismatch** between values and needs/concerns of experts, policymakers, and publics, so need to study them
- Context(s) drive risk perceptions, so need to characterize
- Effective communication process requires research/evaluation

→ **'Evidence-based guesses about best practices'** (cf. Fischhoff 2011)

Thank you!

- Research participants
- Lead collaborators: Terre Satterfield at University of British Columbia and Nick Pidgeon at Cardiff Univ, UK
- Colleagues, collaborators, students, and postdocs in the CNS-UCSB and UC CEIN, in particular: Milind Kandlikar & Christian Beaudrie (UBC), Paul Slovic & Robin Gregory (Decision Research), Shannon Hanna (NIST), Mary Collins (SUNY ESF), Patricia Holden & Cassandra Engeman (UCSB), and Hilary Godwin & Andre Nel (UCLA).
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