Ethical Positions and Nanotechnology Acceptance: *A Social Component of Environmental Sustainability*

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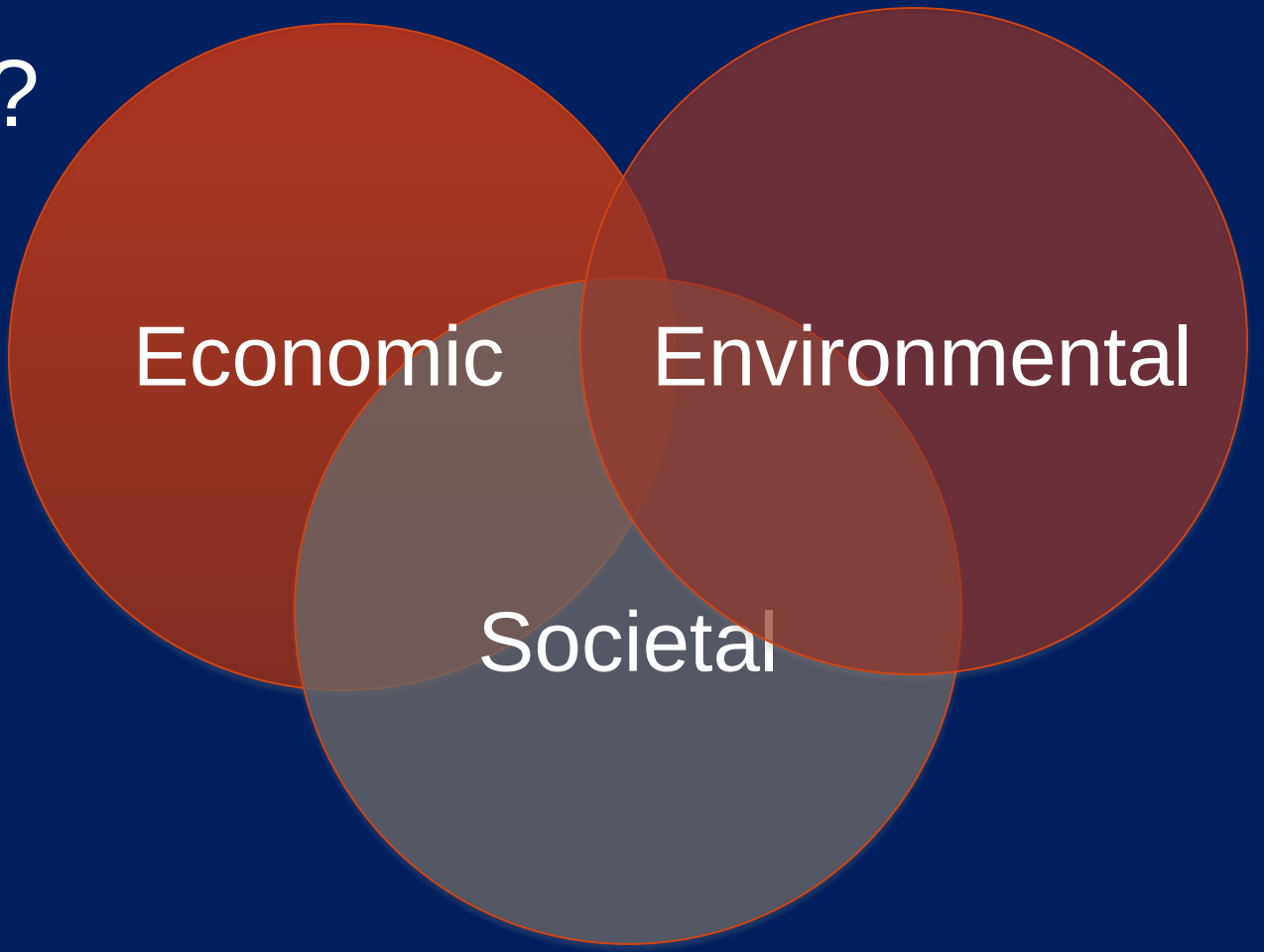
Sustainability?



"…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."

—National Academy of Sciences 2006

Research Question

- *What values do publics hold regarding the ethics of responsible development?*

- *How are ethical positions or values related to acceptance of nanotechnologies?*

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Environmental Risk Perception (ERP) Survey

- 2010
  - n=698 (Generalizable to US Population)
  - 15-item *Upstream Ethics* question battery
    - Assesses respondent ethical positions in the context of both "new technologies" and "nanotechnologies."
    - Respondents rate on 4-point agreement scale.
  - 13 vignettes describing nanotechnology particles, their uses, and potential environmental risks.
    - Include various:
      - nanoparticle types (CNTs, Fe, TiO2, Al, Ag, Dot);
      - media types (air, water, soil);
      - applications (military, environment, products, medical); and
      - risk signals (minimal, some, uncertain, significant)
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Public Environmental Risk Perception Survey

Upstream Ethics

a. It is possible to have a fruitful public debate about new technologies.

b. New technologies often benefit the rich and harm the poor

c. It is acceptable to develop nanotechnologies as long as they are used only in important applications and not on unnecessary consumer products

d. Even if it is difficult and costly to do so, I believe that everyone who might be affected by nanotechnology research should b fully informed and given a chance to accept or to oppose the research

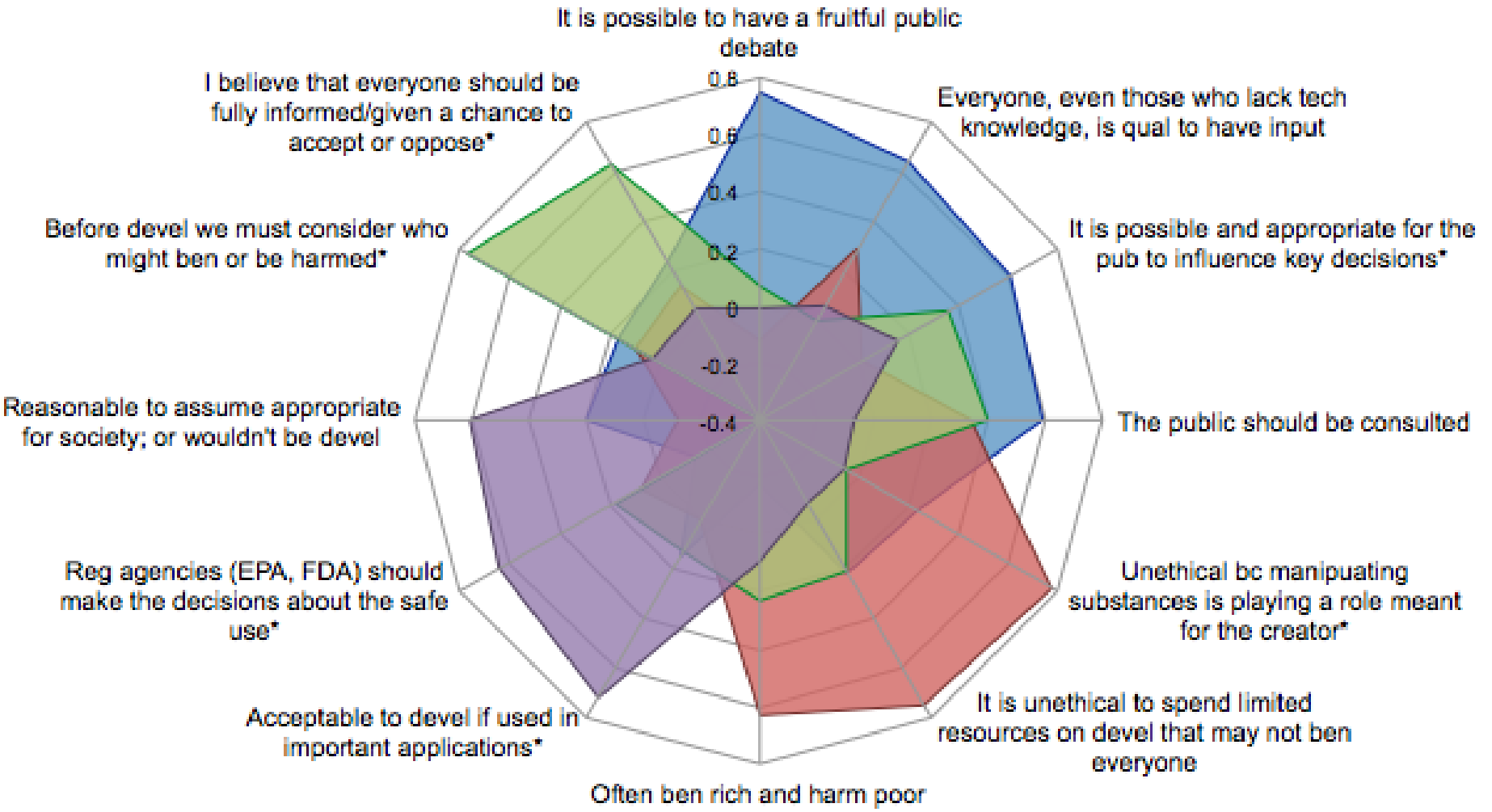
Methods

PCA: Principal Components Analysis

- Multivariate exploratory analysis
- Describe a large data set with a smaller set of new, synthetic variables
- These variables are *principal components*

	Value a Role for the Public (15% Variance Explained)	Issues of Equity and Power (14% Variance Explained)	Institutional Trust (12% Variance Explained)	Informed Consent to Develop (9% Variance Explained)
New technologies often benefit the rich and harm the poor	-	0.63	-	-
Nanotechnology is unethical because manipulating substances at the level of atoms and molecules involves 'playing a role meant for the creator, not humans'	-	0.78	-	-
It is unethical to spend limited resources developing nanotechnologies that may not benefit everyone	-	0.75	-	-
Even if it is difficult an costly to do so, I believe that everyone who might be affected by nanotechnology research should be fully informed and given a chance to accept or to appose the research	-	-	0.63	-
Before developing nanotechnolgies, we must consider who might benefit or be harmed by them	-	-	0.77	-
It is possible and appropriate for the public to influence key decisions about nanotechnology	0.61	-	-	-
Everyone, even those who lack technical knowledge, is qualified to have input into policies governing new technologies	0.64	-	-	-
It is possible to have a fruitful public debate about new technologies	0.74	-	-	-
The public should be consulted when major new technolgies are being developed	0.59	-	-	-
It is acceptable to develop nanotechnologies as long as they are used only in important applications and not on unnecessary consumer products	-	-	-	0.72
It is reasonable to assume that new technologies are appropriate for society; othewise, they wouldn't be developed	-	-	-	0.61
Regulatory agencies (such as the EPA or the FDA) should make the decisions about the safe use of nanotechnologies -- this is what they are designed to do	-	-	-	0.64

PCA: Principal Components Analysis



* Asked specifically in the context of nanotechnology

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Public Environmental Risk Perception Survey

Nano Risk Acceptability Vignettes

a. Silver is being developed in its nanoparticle form to make antibacterial filters to improve the efficiency of water desalination. Some silver nanoparticles may get into the water where, according to scientists, they may pose significant risks.

b. Iron is being developed in its nanoparticle form for use in cleaning up environmental pollution such as arsenic and other toxins in soil and water. Scientists find that nano-sized iron may pose some risk to the environment.

c. Quantum dots are also being developed for use as coatings to help conceal military targets from detection by laser systems. However, this use is likely to cause the dots to circulate in the environment, where scientists have found the risks they pose to be minimal.

Public Environmental Risk Perception Survey

Nano Risk Acceptability Vignettes

a. **Silver** is being developed in its nanoparticle form to make antibacterial filters to improve the **efficiency of water desalination**. Some silver nanoparticles may get into the water where, according to scientists, they may pose **significant risks.**

b. **Iron** is being developed in its nanoparticle form for use in **cleaning up environmental pollution** such as arsenic and other toxins in **soil and water.** Scientists find that nano-sized iron may pose **some risk to the environment**.

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Logistic Regression Model

- Dependent variable:
  - Nanotechnology/New Technology acceptability (4-point ordinal scale)

- Independent variables:
  - Ethical Positions
  - Demographic Characteristics
  - Nanotechnology Knowledge level

Logistic Regression Model

Ordered Logistic Regression:

Nanotechnology Environmental Acceptability and Responsible Development

	Value	Std. Error	t Value	
Value a role for the public	0.10857	0.027429	3.9585	*
Issues of equity and power	0.17941	0.032417	5.5346	*
Institutional trust	0.18843	0.048827	3.8592	*
Informed consent to develop	0.06104	0.031973	-1.9091	.
Age	0.01596	0.005755	2.7737	*
Educational attainment	-0.01198	0.054364	-0.2204	
Gender	-0.22509	0.150129	-1.4993	.
Race	0.05307	0.179998	0.2948	
Political affiliation	0.21778	0.100276	2.1718	*
Income	0.01897	0.046835	0.4051	
Nanotechnology knowledge	0.03927	0.034321	1.1442	

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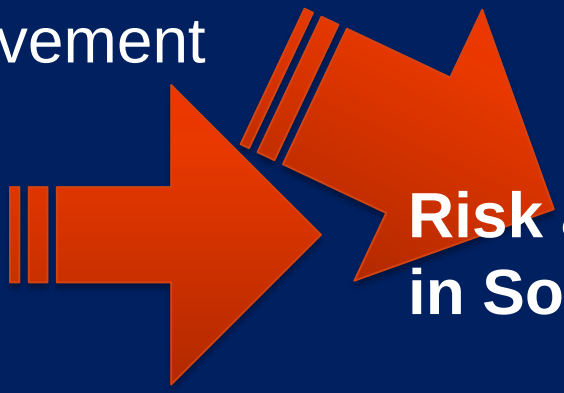
Those who see environmental uses of nanotechnology as potentially unacceptable

- Have heighted concern about equity and power related to development
- Tend to support ideas about informed consent to develop
- Have lower levels of trust in institutions
- Believe in public involvement
- Tend to be older
- Tend to be female
- Tend to be liberal



Discussion Points and Conclusions

- Responsible development is measurable among US publics and has important links to technological acceptability.

- Nano R&D is likely to continue.
  - How can we do this successfully and ethically?
    - Public participation incorporation

- We should have an ongoing and open discussion about (and with) publics and responsible nanotechnology development.

THANK YOU

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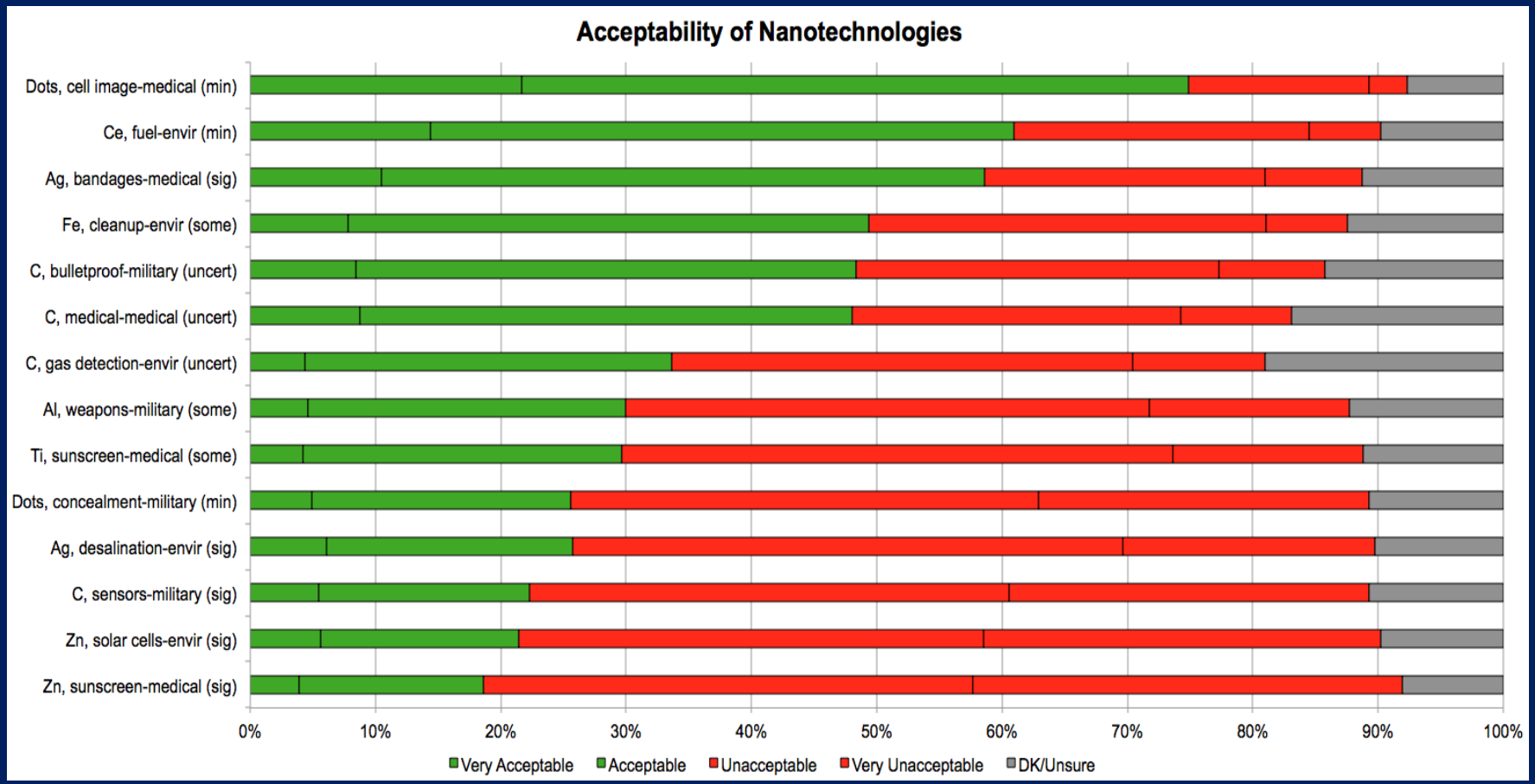
Public Environmental Risk Perception Survey

Nano Risk Acceptability Vignettes



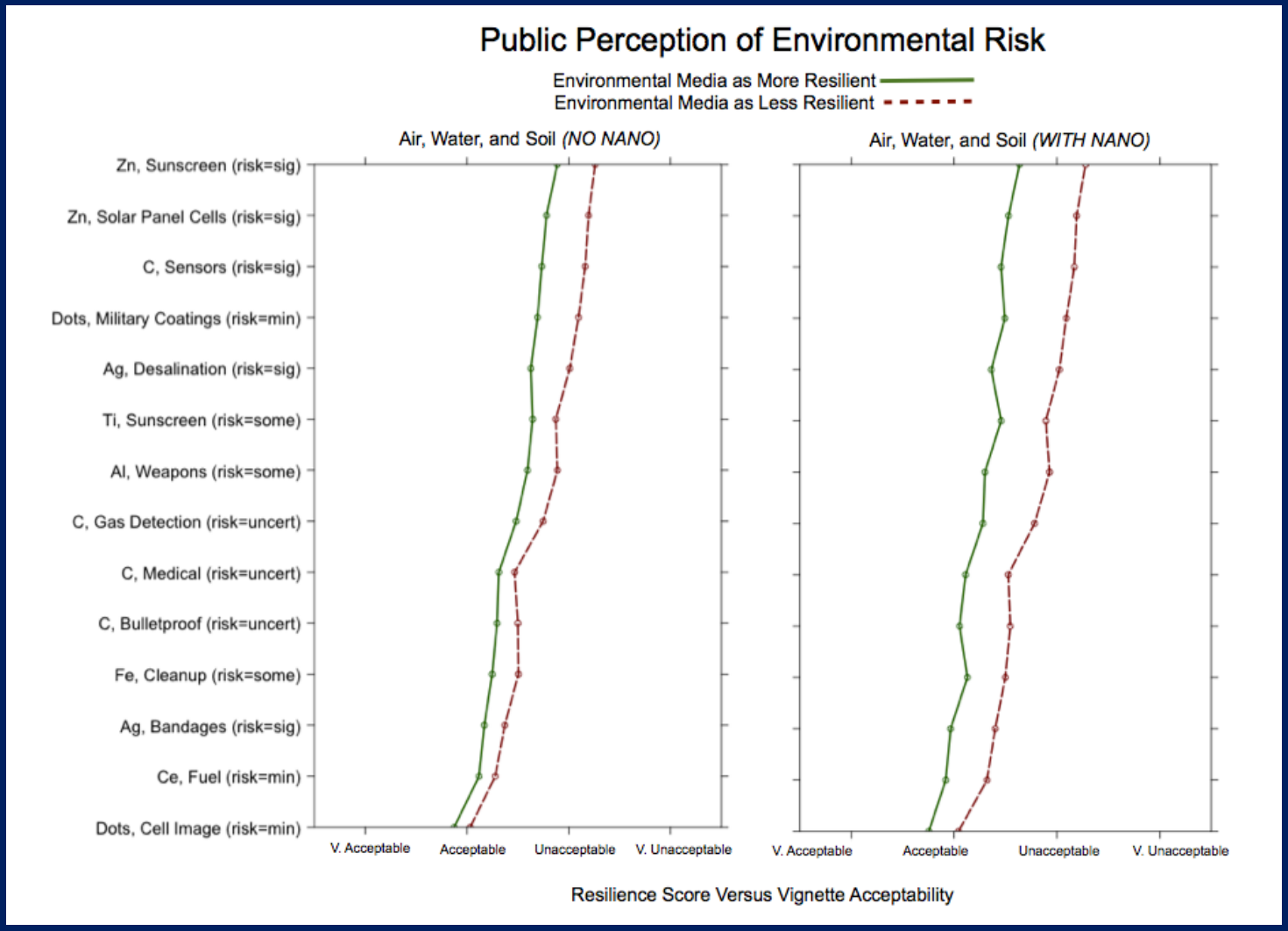
Public Environmental Risk Perception Survey

Table V. Fractional-Factorial Analysis of Nano-Applications

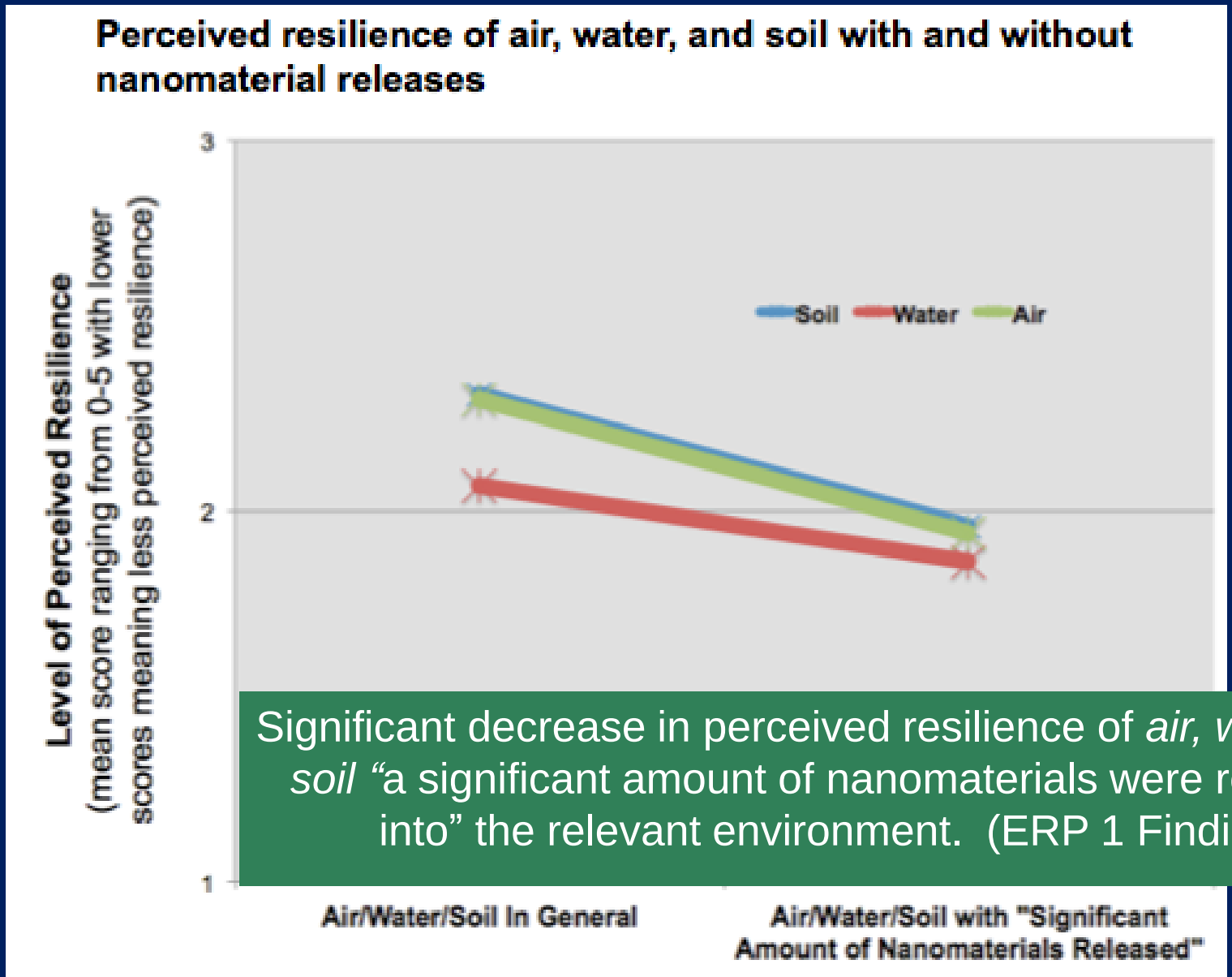
Domain	Dimensions	Sum of Squares	df	F	Partial n^2
Nanofood	Scientists' risk judgments	3.07	1	1.09	0.003
	Control	0.77	1	0.27	0.001
	Bodily invasion	20.47	1	7.26**	0.02
	Justice	11.67	1	4.14*	0.01
	Error	908.10	322		
	Corrected total	944.11	326		
Nanopill	Scientists' risk judgments	7.03	1	2.16	0.007
	Control	1.29	1	0.4	0.001
	Bodily invasion	45.29	1	13.92***	0.04
	Justice	49.77	1	15.30***	0.05
	Error	1018.28	313		
	Corrected total	1112.78	317		
Nanofuel	Scientists' risk judgments	52.49	1	17.01***	0.05
	Control	8.86	1	2.87	0.009
	Bodily invasion	55.71	1	18.06***	0.06
	Justice	55.06	1	17.84***	0.05
	Error	956.57	310		
	Corrected total	8670.00	314		
All Applications	Scientists' risk judgments	51.41	1	16.17***	0.02
	Control	1.06	1	0.33	0.000
	Bodily invasion	135.75	1	42.71***	0.04
	Justice	126.94	1	39.93***	0.04
	Error	3175.56	999		
	Corrected total	3480.16	1003		

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.
Notes: No risk = 1, expert concern for risk = 0; ability to control = 1, inability to control = 0; impossibility of bodily invasion = 1, bodily invasion = 0; socially just = 1, unjust = 0.

Conti, Joseph, Terre Satterfield, and Barbara Herr Harthorn. 2011. "Vulnerability and Social Justice as Factors in Emergent U.S. Nanotechnology Risk Perceptions." Risk Analysis 31 (11): 1734–1748.


Public Perception of Environmental Risk
Environmental Media as More Resilient
Environmental Media as Less Resilient
Air, Water, and Soil (NO NANO)
Air, Water, and Soil (WITH NANO)
Zn, Sunscreen (risk=sig)
Zn, Solar Panel Cells (risk=sig)
C, Sensors (risk=sig)
Dots, Military Coatings (risk=min)
Ag, Desalination (risk=sig)
Ti, Sunscreen (risk=some)
Al, Weapons (risk=some)
C, Gas Detection (risk=uncert)
C, Medical (risk=uncert)
C, Bulletproof (risk=uncert)
Fe, Cleanup (risk=some)
Ag, Bandages (risk=sig)
Ce, Fuel (risk=min)
Dots, Cell Image (risk=min)
V. Acceptable
Acceptable
Unacceptable
V. Unacceptable
V. Acceptable
Acceptable
Unacceptable
V. Unacceptable
Resilience Score Versus Vignette Acceptability

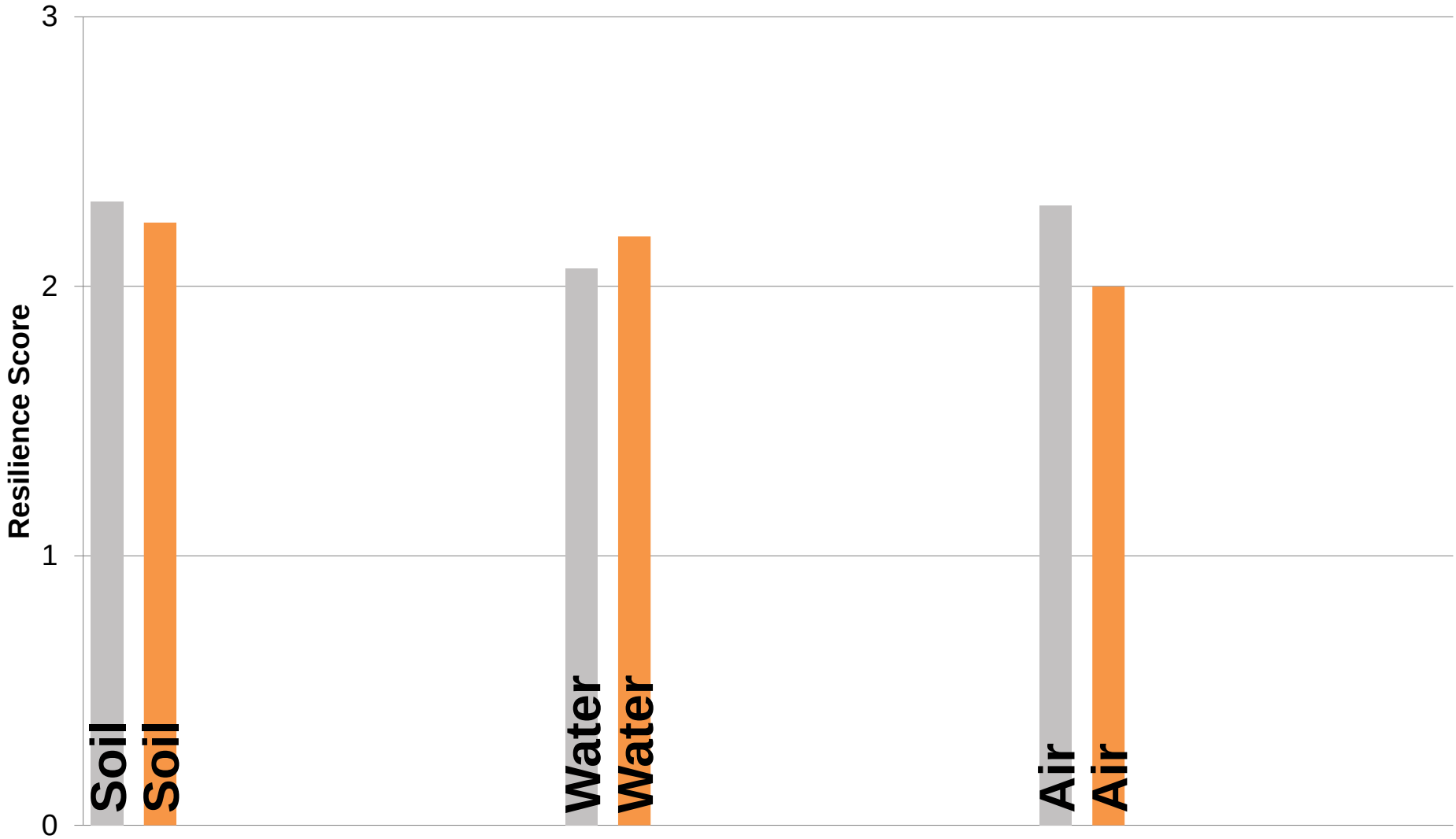
How do nanomaterials impact perceived environmental resilience?



Significant decrease in perceived resilience of *air, water*, and *soil* "a significant amount of nanomaterials were released into" the relevant environment. (ERP 1 Finding)

How do ecotypes impact perceived environmental resilience?

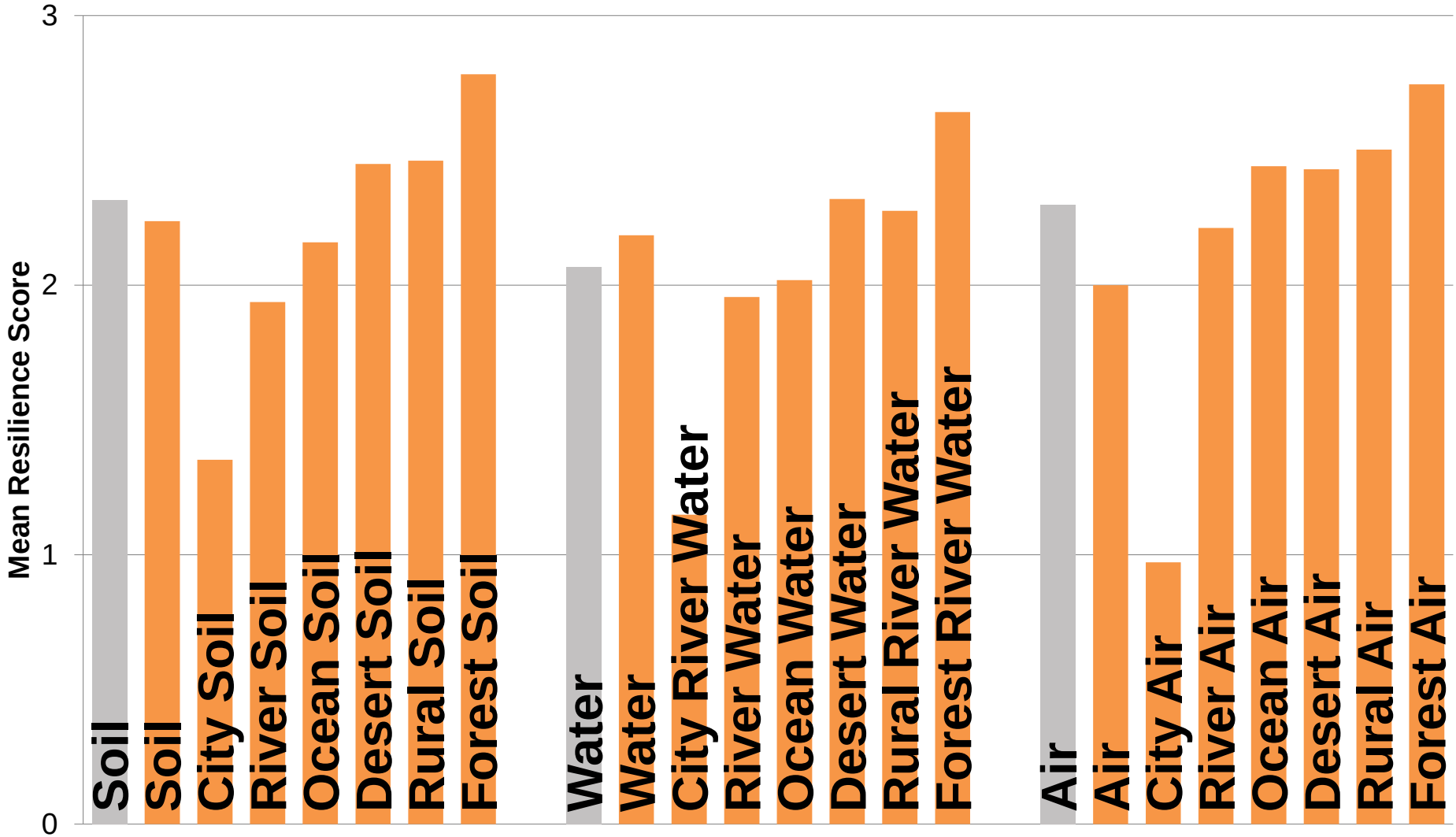
Perceived Resilience of Soil, Water, Air, and Related Environments



- 2010 Survey, N=698
- 2012 Survey, N=2500

Minimal change from 2010-2012
Improved sample

Perceived Resilience of Soil, Water, Air, and Related Environments



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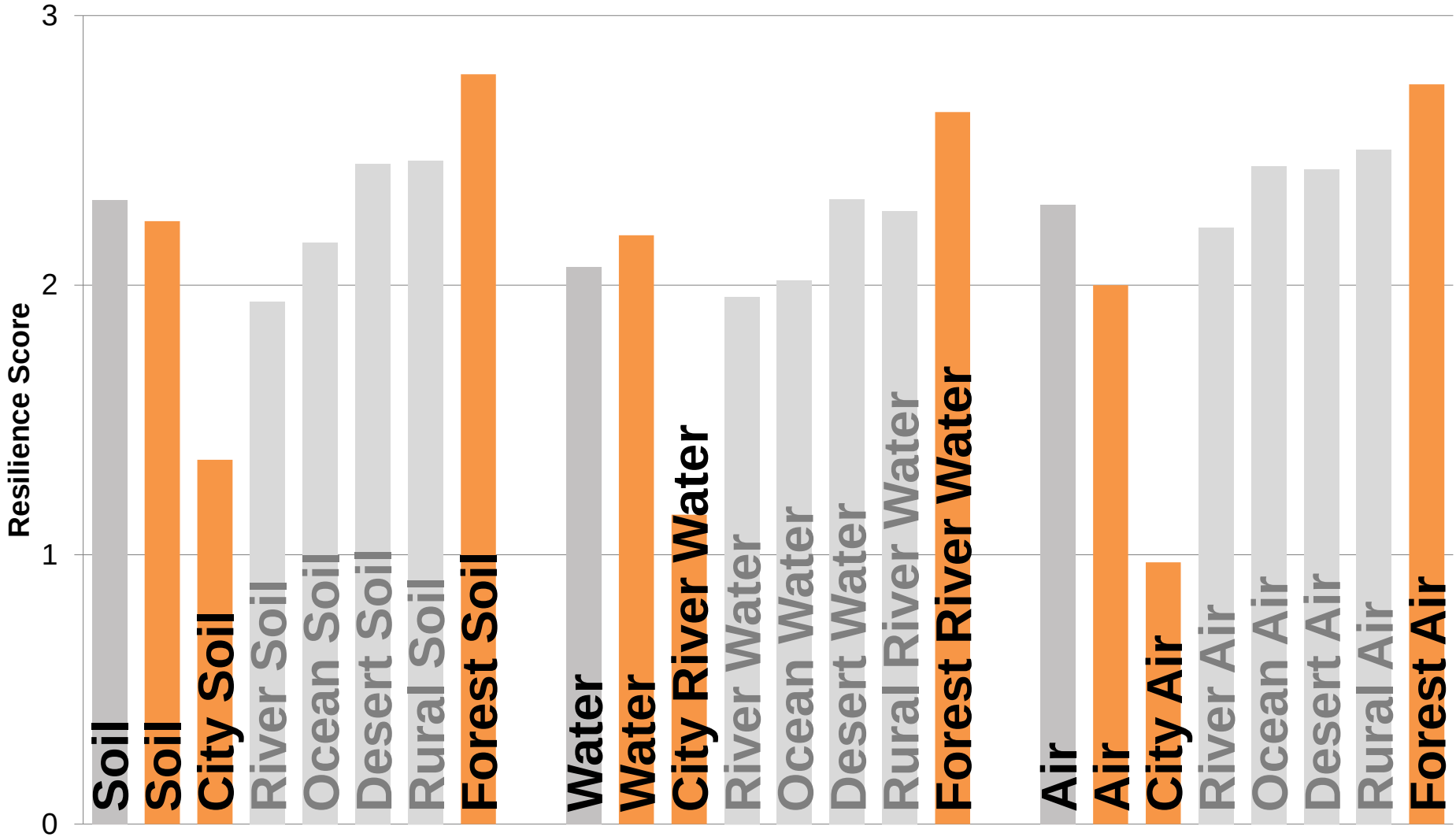
Consistent pattern between types of environments
High variability within media group

Perceived Resilience of Soil, Water, Air, and Related Environments



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"City" consistently seen as least resilient
"Forest" seen as most resilient