



Center for Nanotechnology in Society

NSF SES 0531184

Nanoscale Science and Engineering Center at

University of California, Santa Barbara

Year 5 Annual Report

for the period

March 16, 2009 to March 15, 2010

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3. PROJECT SUMMARY

The center addresses questions of nanotech-related societal change through research that encompasses four main areas: **IRG-1: Historical Context of Nanotechnologies** seeks to develop an understanding of the historical underpinnings of the contemporary nano-enterprise, including recent histories of its scientific communities and institutions, instrumentation, policy and public support; **IRG-2: Innovation & Intellectual Property** examines the nanotechnology innovation system, with a specific focus on solar technologies and identification of impediments to full and rapid realization of research & development goals for the industry; **IRG-3: Risk Perception and Social Response** studies risk perception and social response to emerging nanotechnologies, with attention to expert judgments, media coverage and framing, and public benefit and risk perception of nanotechnologies for health/enhancement, energy, and food, along with themes of environment, privacy, and inequality, in comparative US-UK focus; and **IRG-4 Globalization of Nanotechnologies** addresses global industrial policy and development of nanotechnology, with a particular focus on China, Japan & India and pathways to the use of nanotechnologies to spur equitable development. The Center's four IRGs combine expertise in many fields: technology, innovation, culture, health, global industrial development, gender and race, environment, space/location, and science and engineering. In combination, these four efforts address a linked set of issues regarding the domestic US and global creation, development, commercialization, production, and consumption, and control of specific kinds of nanoscale technologies. Important features of CNS' approach are participatory research and engagement with nanoscientists; a focus on specific nanotechnologies; comprehensive consideration of their applications in industries like electronics, energy, food, environmental, and health; and employment a global framework for analysis. **IRG 3's** research also develops methods for cross-national comparative study of modes of public participation. Collaborators in the CNS-UCSB are drawn in the US from UC Berkeley, Chemical Heritage Foundation, Duke University, Quinnipiac University, Rice University, SUNY Levin Institute, SUNY New Paltz, University of Washington, and University of Wisconsin-Madison, and internationally from Beijing Institute of Technology (China), Cardiff University (UK), University of British Columbia (Canada), University of East Anglia (UK), and University of Edinburgh (UK). CNS is a lead partner in the NSF Network for Nanotechnology in Society and a co-founder of the new international scholarly organization, S.NET, that held its first meeting in Seattle, Sept 2009 and plans the next Sept 2010 in Germany. CNS is a research partner in the recently founded NSF/EPA UC Center for Environmental Implications of Nanotechnology.

Education and Public Engagement programs at CNS-UCSB aim to nurture an interdisciplinary community of nano scientists, social scientists, and educators who collaborate in CNS IRGs and achieve *broader impacts* through engagement of diverse audiences in dialogue about nanotechnology and society. The CNS-UCSB provides fellowships for graduate students in social science and nanoscale science and engineering to participate jointly in CNS bi-weekly seminars and IRG research; a similar approach for undergraduate internships integrates university and California community college students into CNS activities. Through a year-round bi-weekly seminar program, a speakers series, conferences, visiting scholars, informal science education events for the public (Nano-Meeters), electronic dissemination of a popular nano and society-related Weekly News Clips service to about 500, series of public deliberation events with local community members, and increasing outreach to key sectors of government and industry, the CNS has gained a solid following of campus, local, and national and international media, as well as interest by government, industry, NGOs, and the general public. In November 2009, CNS-UCSB convened a large international conference in Washington DC on *Emerging Technologies/Emerging Economies: [Nano]technologies for Equitable Development* in collaboration with the Woodrow Wilson International Center, and with strong support from the NSE community; the conference included a National Press Club event and an event on Capitol Hill for Congressional workers.

In 2009-10 CNS-UCSB has made substantial progress in research on pathways and impediments to socially and environmentally sustainable futures for nanotechnologies. CNS research teams produced 51 new publications in the past year, bringing total publications to 82 since inception 4 years ago, and made 121 presentations this year at academic, industry, policymaker, and community venues for a cumulative total of 361. CNS IRG 3 had 2 research papers published in *Nature Nanotechnology* in 2009. CNS principals Appelbaum, Harthorn, and Pidgeon gave testimony before national policymaking bodies (a US Congressional Committee, a US Congressional Caucus, a PCAST panel, the UK House of Lords and the UK House of Commons). Between Mar 2009 and Mar 2010, CNS researchers made 54 presentations to key audiences in government, industry, NSE, and the public.

4A. LIST OF CENTER PARTICIPANTS*UCSB*

David Awschalom	Professor, Director	Physics, CNSI
Richard Appelbaum	Professor	Sociology, Global & Int'l Studies
Edwina Barvosa	Assoc Professor	Chicana and Chicano Studies
Bruce Bimber	Professor	Political Science, Communication
Tim Cheng	Professor	Electrical and Computer Engineering
Brad Chmelka	Professor	Chemical Engineering
Julie Dilleuth	Education Coordinator/ Education Director	CNS
William Freudenburg	Professor	Environmental Studies
Fiona Goodchild	Education Director	CNSI
Michael Goodchild	Professor	Geography
Craig Hawker	Professor, Director	Chemical Engineering, Materials Research Laboratory & MRSEC
Barbara Herr Harthorn	Assoc Prof., Director	Feminist Studies, Anthropology, Sociology, CNS
Trish Holden	Professor	Microbiology, Environment Sciences
W. Patrick McCray	Professor	History of Science
John Mohr	Assoc Professor	Sociology
Meredith Murr	Director	UCSB Research Development
Christopher Newfield	Professor	English
David Seibold	Professor	Communication
Susan Stonich	Professor	Environmental Studies, Anthropology

Collaborators

Gerald Barnett	<i>Univ of Washington, Director</i>	University technology transfer
Daryl Boudreaux	<i>Boudreaux and Associates, CTO</i>	Commercialization
Karl Bryant	<i>SUNY New Paltz, Asst. Professor</i>	Sociology & Women's Studies
Cynthia Cannady	<i>Private sector, IPSEVA, lawyer</i>	International IP expert
Cong Cao	<i>SUNY Levin Institute, Res. Assoc</i>	Sociology, China
Hyungsub Choi	<i>Chemical Heritage Foundation</i>	History of Science
Joseph Conti	<i>Univ of Wisconsin, Asst. Prof</i>	Sociology and Law
Zhu Donghua	<i>Beijing Institute of Tech., Vice Dean</i>	Management and Economics
Gary Gereffi	<i>Duke University, Professor</i>	Sociology, Global Value Chains
Hillary Haldane	<i>Quinnipiac Univ, NY, Asst Prof</i>	Anthropology
Patrick Herron	<i>Duke University, Researcher</i>	Data mapping and visualization
Milind Kandlikar	<i>Univ of British Columbia, Assoc Prof</i>	Science Policy & Regulation
Timothy Lenoir	<i>Duke University, Professor</i>	History, Data visualization, Visual Studies
Howard Lovy	Consultant	Science writer
David Mowery	<i>UC Berkeley, Professor</i>	Economics, Business School
Cyrus Mody	<i>Rice University, Asst Prof</i>	History, Technology Studies
Nicholas Pidgeon	<i>Cardiff Univ, Wales, UK, Professor</i>	Social Psychology, Env. Risk

Tee Rogers-Hayden
Terre Satterfield
Suzanne Scotchmer

Univ of East Anglia, UK, Fellow
Univ of British Columbia Assoc Prof
UC Berkeley, Professor

Environment, Deliberation
 Culture, Risk & Environment
 Economics

UCSB

Postdoctoral Scholars

Phillip McCarty
Mikael Johansson
Yasuyuki Motoyama
***Jennifer Rogers**
Matthew Eisler
***Gwen D'Arcangelis**
** co-funding*

Sociology
 Social Anthropology
 City and Regional Planning
 Sociology
 History
 Women's Studies

Technical Staff

Jerry Macala

UC Santa Barbara, technical staff Chemistry

Graduate Fellows

Kasim Alimahomed
 Karl Bryant
 Yiping Cao
Meredith Conroy
 Joseph Conti
 Scott Ferguson
 Alan Glennon
Summer Gray
 Hillary Haldane
Indy Hurt
 Mary Ingram
Erica Lively
 Gerald Macala
Tyronne Martin
Rachel Parker
 Alexis Ostrowski
Claron Ridge
 Aaron Rowe
 Kim Stoltzfus
 Joseph Summers
 David Weaver
Christine Shearer
James Walsh

Communication
 Sociology
 Environmental Science
 Political Science
 Sociology
 Mechanical Engineering
 Geography
 Sociology
 Anthropology
 Geography
 Sociology
 Electrical Engineering
 Chemistry
 Chemistry
 Sociology
 Chemistry
 Chemistry
 Chemistry
 Chemistry
 Communication
 Electrical Engineering
 Political Science
 Sociology
 Sociology

Affiliated Postdoctoral Scholars

Adam Corner
 Tee Rogers-Hayden
 Elena Simakova
Joe Summers
Cardiff University, UK
University of East Anglia, UK
Cornell University
Massachusetts Institute of Technology

Social Psychology
 Environment, Public Participation
 Science & Technology Studies
 Physics, Engineering

Affiliated Grad Researchers

Christian Beaudrie, *University of British Columbia, Canada*

Vincent Dorie, *Duke University*

Eric Giannela, *Stanford University*

Ryan Ong, *Duke University*

Stacey Frederick, *Duke University*

Laura DeVries, *University of British Columbia, Canada*

Undergrad Interns & Researchers:

Beatrice Balfour

William Bausman

Brian Billones

Sarah Bunch

Lamar Bush

Jason Cannon

Staci Chirchick

Josie Garong

Gary Haddow

Jon Lo Kim Lin

Christian McCusker

Dayna Meyer

Carlos Perez

Olivia Russell

Sarah Schultz

Nicole Tyler

Guanglei Zhang

Adélaide Chopard

Sean Bronston-Wilson

Javier Martinez

Ryan Shapiro

Andrea Tran

Samantha Rohman

CNS staff

Shawn Barcelona

Jaquelyn Bernuy

Sage Briggs

Marisol Cedillo Dougherty

Eric Davila

Anna Davison

Justin Dodds

Randall Ehren

Barbara Gilkes

Emily Kang

Brendy Lim

Michelle Olofson

Jessica Suseno

Valerie Walston

CNS Graduate Student Researchers

***Lynn Baumgartner**, Environmental Science & Management

Jill Briggs, History

***Ben Carr**, Environmental Science & Management

Olivier Dufault, History

Roger Early-Pryor, History

***Cassandra Engeman**, Sociology

***Allison Fish**, Environmental Science & Management

Angus Forbes, Media Arts & Technology

Zach Horton, English

***John Meyerhofer**, Environmental Science & Management

Emily Tumpson Molina, Sociology

Adélaïde Veyre, Political Science

* *co-funding*

CNS Graduate Student Assistants

Moira O'Neil, Sociology

Mario Guerrero, Political Science

Margaret Moody, Education

Yuan Yi Fan, Media Arts & Technology

David Weaver, Sociology

Silke Werth, East Asian Languages & Cultures

Qian Yang, East Asian Languages & Cultures

Participants affiliated, not receiving Center support:*UCSB*

Peter Alagona	Asst Professor	History & Environmental Studies
Kevin Almeroth	Professor	Computer Science
James Blascovich	Professor	Virtual Environments, Psychology
Daniel Blumenthal	Professor	Electrical & Computer Engineering
David Clarke	Professor	Materials, Mechanical Engineering
Andrew Flanagan	Professor	Communication
Arthur Gossard	Professor	Materials, ECE
Anita Guerrini	Professor	History & Environmental Studies
Elisabeth Gwinn	Professor	Physics
Stephanie Hampton	Deputy Director	Center for Ecol Analysis & Synthesis
Evelyn Hu	Professor	Materials & CNSI
Miriam Metzger	Assoc Professor	Communication
Umesh Mishra	Professor	Electrical & Computer Engineering
Laury Oaks	Associate Professor	Anthropology, Feminist Studies
Jim Reichman	Professor, Director	NCEAS; Ecology
Ram Seshadri	Professor	Materials, Chemistry & Biochemistry
Hyongsok Soh	Associate Professor	Env Engineering
Nicola Spaldin	Professor	Materials
Matthew Tirrell	Professor, Dean	Chemical Engineering & Materials, College of Engineering
Win Van Dam	Assistant Professor	Computer Science

Other Institutions

Robert Ackland	<i>Australian Nat'l Univ, Res.faculty</i>	Economics
Francesca Bray	<i>Edinburgh Univ, UK, Professor</i>	Gender & Technology, China
Magali Delmas	<i>UCLA, Associate Professor</i>	Corporate Environmental Mgmt.
Vladi Finotto	<i>Venice Int'l Univ, IT Researcher</i>	Economics
Guillermo Folodari	<i>Univ Autónoma de Zacatecas, Mexico, Professor</i>	Sociology
Stéphanie Lacour	<i>Centre National de la Recherche Scientifique, France, Research Fellow</i>	IP, Law & New Technologies
Stefani Micella	<i>Venice Int'l Univ, Director</i>	Technologies in Distributed Systems
André Nel	<i>UCLA, Professor, Physician, Director</i>	UCLA Med School, UCLA CEIN
Mathiu O'Neil	<i>Australian Nat'l Univ, Postdoc</i>	Computer science, sociology
Ismael Rafols	<i>Sussex University, Researcher</i>	Science Policy
Shyama Ramani	<i>INRA & Ecole Polytechnique, Paris, Researcher</i>	Development Economics

Nanotechnology in Society Network PIs:

David Guston, CNS-ASU
 Davis Baird, University of South Carolina
 Richard Freeman, Harvard University
 Lynne Zucker, UCLA

4B. EXTERNAL ADVISORY BOARD

John Seely Brown, Visiting Professor at University of Southern California and former Chief Scientist of Xerox Corporation and the director of its Palo Alto Research Center (PARC), [Board Co-Chair](#)

Ann Bostrom, Professor and Dean in School of Public Policy at University of Washington, Seattle, [Board Co-Chair](#)

Craig Calhoun, President of the Social Sciences Research Council and University Professor of the Social Sciences at New York University

Vicki Colvin, Professor of Chemistry and Executive Director of the Center for Biological and Environmental Nanotechnology at Rice University

Ruth Schwartz Cowan, Professor in the History and Sociology of Science Department at the University of Pennsylvania

Susan Hackwood, Executive Director of the California Council on Science and Technology

Martin Moskovits, Professor of Physical Chemistry, UCSB (formerly, AIP Nanotronics)

Willie Pearson, Jr., Chair of History, Technology and Society at Georgia Tech

Robert Westervelt, Director of the Nanoscale Science and Engineering Center-NSEC at Harvard University

Thomas Kalil, UC Berkeley, currently a team Lead of the Executive Office of the President, Co-Lead of the White House OSTP Review Team, and a member of the Technology, Innovation & Government Reform Policy Working Group in the Obama administration, [Board Chair Emeritus](#), 2007-2008

Julia Moore, of Research, Pew Health Group, Pew Charitable Trusts; former Deputy Director of Foresight and Governance Project at the Woodrow Wilson International Center for Scholars, [Board Co-Chair Emeritus](#)

4D. LIST OF PARTICIPATING ACADEMIC INSTITUTIONS

Allan Hancock Community College
Arizona State University
Australian National University, Canberra, Australia
Beijing Institute of Technology
Cal Poly San Luis Obispo
Cardiff University-Wales, UK
Cornell University
Cuesta Community College
Duke University
Ecole Polytechnique, Paris
Harvard University
Howard University
Jackson State University
Massachusetts Institute of Technology
Michigan State University
Oxnard Community College
Quinnipiac University
Rice University
Santa Barbara City College
SUNY Levin Institute
SUNY New Paltz
Universidad Autónoma de Zacatecas
Université de Lyon 3
University of British Columbia, Vancouver, Canada
University of California, Berkeley
University of California, Los Angeles
University of California, Santa Cruz
University of East Anglia, Norwich, UK
University of Edinburgh, UK
University of South Carolina
University of Southern Florida
Sussex University
University of Washington
University of Wisconsin-Madison
Venice International University, Venice, Italy
Ventura College
Centre National de la Recherche Scientifique (CNRS), France

4D. LIST OF PARTICIPATING NON-ACADEMIC INSTITUTIONS

American Bar Foundation
American Institute of Physics
Boudreaux and Associates
Chemical Heritage Foundation
Cynthia Cannady Legal Services
Decision Research
Environmental Defense Fund
International Council on Nanotechnology (ICON)-Rice University
International Risk Governance Council (Switzerland)
Knowledge Networks
Meridian Institute
Nanoholdings, LLC (NY)
Nanoscale Informal Science Education (NISE) network
Northwest Survey and Data Services
Woodrow Wilson International Center, Project on Emerging Nanotechnologies

Table 1: Quantifiable Outputs						
Outputs	Reporting Year -4	Reporting Year -3	Reporting Year -2	Reporting Year -1	Reporting Year	Total
Publications Resulted From NSEC Support						
In Peer-Reviewed Technical Journals	1	4	6	22	24	57
In Peer-Reviewed Book Chapters, Other	0	1	1	1	0	3
In Trade Journals	0	0	0	0	22	22
With Multiple Authors:	1	2	6	20	22	51
Multiple Authors: Co-Authored with NSEC Faculty	1	2	6	20	22	51
NSEC Technology Transfer						
Inventions Disclosed	0	0	0	0	0	0
Patents Filed	0	0	0	0	0	0
Patents Awarded	0	0	0	0	0	0
Patents Licensed	0	0	0	0	0	0
Software Licensed	0	0	0	0	0	0
Spin-off Companies Started(if applicable)	0	0	0	0	0	0
Degrees to NSEC Students						
Bachelor's Degrees Granted	0	0	0	0	0	0
Master's Degrees Granted	0	1	1	0	0	2
Doctoral Degrees Granted	0	1	3	2	1	7
NSEC Graduates Hired by						
Industry:	0	0	0	0	0	0
NSEC Participating Firms	0	0	0	0	0	0
Other U.S. Firms	0	0	0	0	0	0
Government	0	0	0	0	0	0
Academic Institutions	0	1	3	1	0	5
Other	0	0	0	1	1	2
Unknown	0	0	0	0	0	0
NSEC Influence on Curriculum (if applicable)						
New Courses Based on NSEC Research	0	1	3	1	0	5
Courses Modified to Include NSEC Research	0	0	6	8	11	25
New Textbooks Based on NSEC Research	0	0	0	0	0	0
Free-Standing Course Modules or Instructional CDs	0	0	0	0	0	0
New Full Degree Programs	0	0	0	0	0	0
New Degree Minors or Minor Emphases	0	2	2	0	0	4
New Certificate	0	0	0	0	0	0
Information Dissemination/Educational Outreach						
Workshops, Short Courses to Industry	0	2	0	0	1	3
Workshops, Short Courses to Others	0	0	0	1	1	2
Seminars, Colloquia, etc.	17	41	17	83	141	299
World Wide Web courses	0	0	0	0	0	0

6. MISSION AND BROADER IMPACTS

Nanotechnology Origins, Innovations, and Perceptions in a Global Society

The global vision to have nanotechnology mature into a transformative technology depends on an array of interconnected and complex factors situated within a rapidly changing international economic, political, and cultural environment. These include the resolution of scientific and technological questions, the safe creation, development, and commercialization of nano-products, and the acceptance of nanotechnology by diverse publics. The NSF Center for Nanotechnology in Society at UCSB provides a clear and comprehensive approach to understanding the challenges to the successful development of nanotechnology in the US, Europe, Asia and other regions. Through a mixed and complementary portfolio of interdisciplinary research, education, and engagement activities, the CNS-UCSB produces basic knowledge about a linked set of social and environmental issues at a time of sustained technological innovation. This is achieved through close examination of the development, commercialization, production, consumption, and control of nanoscale technologies. The Center also addresses education for a new generation of social science and nanoscience professionals as it fosters research on the origins of the nano-enterprise, the innovation systems for nanotechnology, globalization, cooperation and competition in the development of nanotechnology, and the social response, media framing, and multiple publics' emerging risk perceptions of nanotechnology. With an outlook that is global in scope, detailed in its focus, and rigorous in its methodologies, the CNS-UCSB uses its evolving international research infrastructure to create a genuine learning community of diverse participants who can pool their knowledge for the simultaneous benefit of society and technology.

Broader Impact

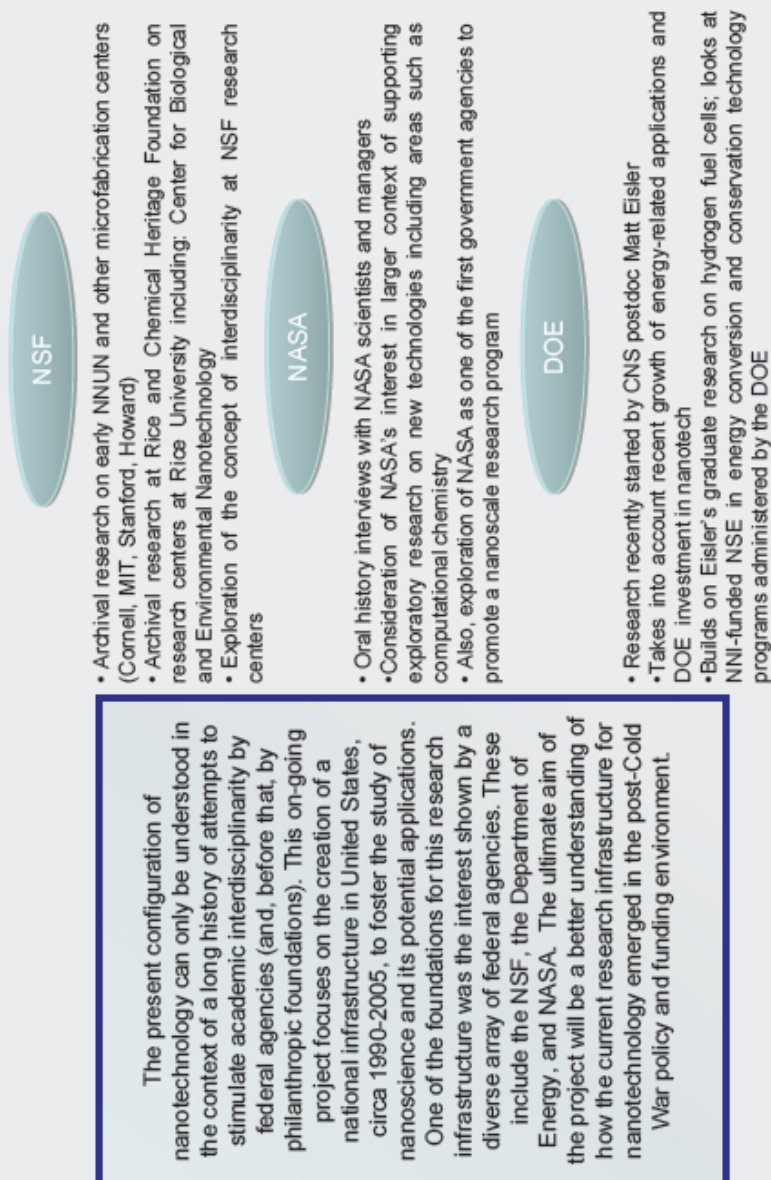
CNS's education and outreach programs, which are central to its mission, include a diverse range of students and participants. The Center provides novel interdisciplinary educational opportunities for a new generation of social science, humanities and nanoscience professionals via graduate fellowships and research assistantships (13 social science/humanities fellows; 9 NSE fellows to date); graduate research assistantships (2 at UCSB; 4 w/ external collaborators), undergraduate summer research internships to regional community college students (2 in the past year, 10 since inception) and UCSB undergrads (2 in 2009, 10 total since 2006) who are mentored by UCSB graduate students (20 mentorships to date), and 1-3 interdisciplinary social science/humanities postdocs per year since 2007-08 (5 in residence in 2009-2010, 2 of them co-funded). CNS convenes a year-round graduate seminar for credit that includes scholarly discussion, professional training and development, research colloquia, and other activities. CNS integrates content based on Center research into courses for undergraduate and graduate students in science and technology studies (10 content added), and CNS-UCSB has plans for a new program to prepare educational modules for introduction of CNS-UCSB research materials into the NSE undergrad science and engineering curriculum, community college science and social science curricula, and for California high school teachers to use in social science and science classes. CNS aims to disseminate both technological and social scientific findings related to nanotechnology in society to the wider public and to facilitate public participation in the nanotechnological enterprise through public engagement in dialogue with academic researchers from diverse disciplines (in 2009-10) held 1 Nano-Meeter, and 2 annual NanoDays with nearly 700 adults and children). CNS-UCSB commits significant resources to conferences and workshops for diverse audiences, alternating smaller, more specialized meetings for educators (Nano societal implications education 2008) and researchers (Nanotech risk perception 2010, Nanotech innovation systems 2010) with larger-scale international conferences and workshops (large international conference on Nanotechnology Equitable Global Development in Nov, 2009 in Washington DC). CNS serves as a key connection hub in the growing nano in society network, via speaker series, short- and medium-term visiting scholars, a founding role in the new society,

the Society for the Study of Nanoscience and Emerging Technologies (S.NET), and a dissemination point for research results (as requested by Chemical Heritage Foundation, UC Center for the Environmental Implications of Nanotechnology, and others). Outreach to still wider publics and interested parties takes place via electronic forms such as our popular “Weekly Clips” (15 transmissions in 2009-10), our blog (cns.ucsb.edu), podcasts of interviews with researchers, and media briefings, and anticipated new media methods in the future. The CNS also engages and informs policymakers and governmental agencies (e.g., Rich Appelbaum to the US-China Economic Security Commission, March, 2009; Barbara Herr Harthorn to the US congressional caucus, March, 2009, to the NNI and California Council on Science & Technology in Jan 2010, to PCAST/OSTP in Feb 2010, to the NNI and to NNCO in Mar 2010; Nick Pidgeon with the UK House of Lords in March 2009, the US National Academy of Sciences in Dec 2009, and the UK House of Commons Science and Technology Committee in Jan 2010). Results of CNS research are being disseminated to wider audiences via traditional media as well as through concerted efforts to use new media (e.g., posts to the prominent blog, *Science Progress*, and through contributions to sources like *AzoNano* and *ChemE* that reach a wide array of industry, policy, and academic audiences).

Plans for the coming year include 3 culminating volumes on aspects of CNS’ work (*Social Life of Nano* edited volume that draws from all 4 IRGs and education, a book from the 2009 NanoEquity conference contracted by Routledge, and a planned special issue of *Risk Analysis* from the IRG 3 risk perception specialist meeting in Jan 2010), one of them for a wider public audience. CNS-UCSB also plans as summative activities development of a series of policy briefs to will extend the implications of the maturing research mission. CNS’ distinguished National Advisory Board allows regular consultation with leaders of all stakeholder constituencies, at all phases of research and dissemination. In years 6-10, in collaboration with the UC CEIN, CNS proposes to work with government and industry to develop risk communication for particular audiences grounded in empirical knowledge of the public, emerging views of nanotech, and past risk controversies.



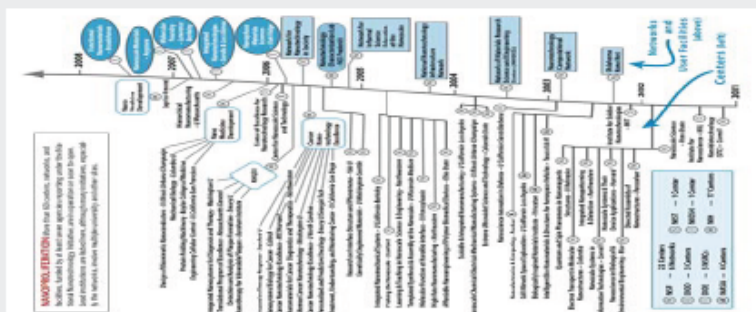
Building an Infrastructure for Nanoscale Research



Researchers: Patrick McCray, UCSB; Cyrus Moddy, Rice University; Hyungsob Choi, CHF; Matthew Eisler, CNS-UCSB; Summer Gray, CNS-UCSB Fellow.

How did this proliferation of research centers emerge?

Source: <http://pubs.acs.org/cen/coverstory/85/8515cover.html>





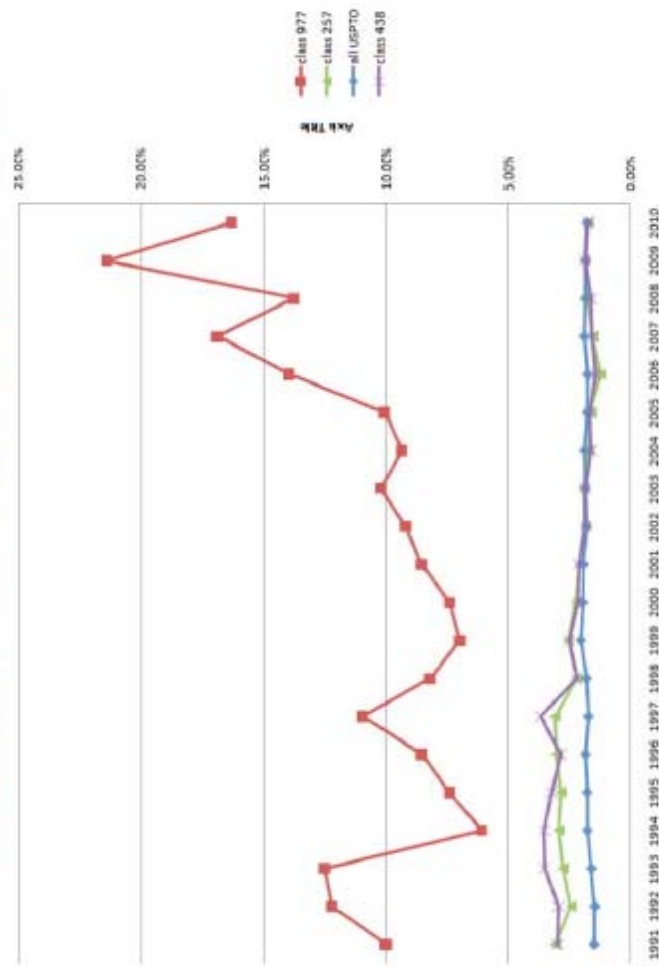
Seeking the Impact of NNI on Issued Patents

• Federal law requires that patents declare a "Government Interest" when created in part with federal funds. Although nearly 30% of all R&D is federally funded, GI declarations (right) are generally well below 5%. Could difficulty with identifying links between a public initiative like the NNI and resulting IP reduce public contact with and support for public research? How does nanoscale research, defined as the USPTO's 977 "nanotechnology" class, compare to rates of disclosure of public sponsorship in related fields?

• The 977 class declares a Government's Interest at far higher rates than co-occurring classes, and increased Class 977 declarations roughly correlate with the existence of the NNI.

• We speculate that the NNI may have created heightened awareness among patentees of nanoscale R&D's public status. Data to test this possibility is not currently available. We recommend improved monitoring of compliance with existing regulations.

Percentage of USPTO Patents Declaring "Government Interest" (by Year)



Newfield, C and J Macala, . "Declaring Government Interests in Nanotechnology Patents: an Impact of the National Nanotechnology Initiative? *in preparation*



NSF SES 0531184



Deliberating Nanotechnologies in the US: Gendered Beliefs about Benefits and Risks as Factors in Emerging Perception and Participation

2009/2010 Study: Gender, Risk, and Equitable Participation¹

Six deliberative workshops were conducted in Fall 2009 in Santa Barbara, CA. Workshops focused on dialogues about nanotechnology in (1) energy and other environmental applications, and (2) health and human enhancement applications.

•The workshops varied gender composition systematically to allow for a comparative analysis of gender and risk perception.



Preliminary Results:

- Similar findings to 2007 study: greater perceived benefits over risks, but dependent upon application context.
- Strong gender effects, with women more cautious than men about forming risk vs. benefit judgments.
- Concern about equal access, fairness, and distribution.
- Concern about governance: distrust in U.S. government and corporations to responsibly manage nanotechnology.
- Strong interest in "informed public consent" of nanotechnology usage.

¹Harthorn, B.H. (Fem Studies, UCSB), Rogers, J.B. (Soc, UCSB), Shearer, C. (Soc, UCSB), Martin, T. (Chem, UCSB), Hurf, I. (Geog, UCSB). 2010. *In Progress*. NSF SES-0824042 and NSF SES-0531184

2009/2010 Study: Methods

- Formal and self-directed learning were incorporated through Powerpoint presentations and World Café-style small group discussions.
- Participants were selected to match local demographics.
- Two co-facilitators, plus one "expert" CNS science fellow moderated the discussion and facilitated the world cafés.

•Small group size suitable for focused discussion-based interaction (n= 9-13)



•Pre-tests and post-tests to measure attitude change and changes to risk perception, pre and post-workshop.

Comparative Analysis to 2007 Study²

- Comparative analysis with our 2007 US workshops will allow depth analysis of changing views about benefits and risk.
- Four parallel deliberative workshops were conducted in February 2007, two in the US and two in the UK. Workshops focused on dialogues about nanotechnology applications in either energy or health & enhancement.

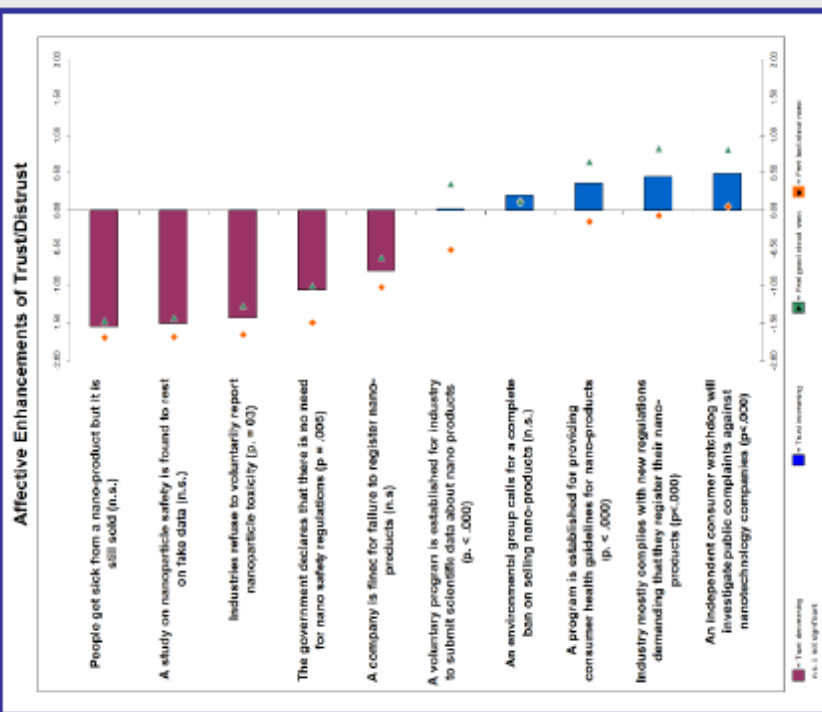
²Pidgeon, N. (Cardiff), Harthorn, B.H. (UCSB), Bryant, K. (SUNY-NP), & Rogers-Hayden, T. (U East Anglia). 2009. "Deliberating the Risks of Nanotechnologies for Energy and Health Applications in the United States and United Kingdom." *Nature Nanotechnology* 4(2): 95-98.



Affective-Trust and Asymmetry in Nanotechnology Regulation

- Studying public perceptions of nanotechnology under conditions of low awareness and a priori any stigmatizing risk events necessitates relying on known predictors of risk. Two well-known predictors of risk perception are measures of trust and affect. The former includes trust judgments about reports on different management practices whereas the latter [affect] refers to rapid pre-conscious or pre-analytic judgments expressing strong or weak feelings about the "goodness" or "badness" of an object [nano].
- Reporting on a nationally representative phone survey of U.S. residents (N=1,100), participants were asked (1) their affective response to nanotechnology and (2) their trust judgments of different risk management practices. Management scenarios were intentionally balanced from extremely positive to extremely negative. Findings illuminate the fact that affective ratings largely enhance the principle of trust asymmetry – that trust is easier to destroy than gain. Enhancing trust (blue bars) is more difficult to achieve than the reverse (red bars), and even in the best scenarios those who offered negative affective judgments were not converted to trusting positions in the face of trust-enhancing events.

Satterfield, T.; Conti, J.; Pidgeon, N.; Harthorn, B.H. *in preparation*, ES&T





Anticipating Perceived Risk of Nanotechnologies – Meta-Analysis

INTRODUCTION

The goal of this project was to investigate the multiple studies of perceived risks of nanotechnologies to identify challenges posed for health and safety regulators, and to understand emerging trends in public judgments of both benefit and risk.

We conducted a meta-analysis of all quantitative surveys of nanotechnology risk perceptions and attitudes published from their first appearance in 2000 through to January 2009.

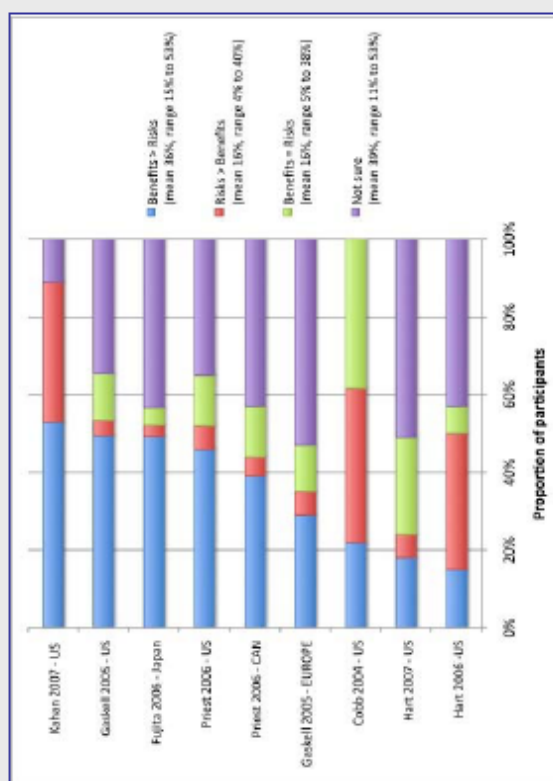


Figure 1. Risk/benefit judgments before risk/benefit information is provided

RESULTS

- most people see benefits as outweighing risks; there is little evidence for risk aversion toward nanotechnologies per se
- a very large number of respondents across studies (average of 39%) have reserved or declined judgment (that is, they refuse to acknowledge risk or benefit)
- more positive judgments of nanotechnology are driven by both familiarity and knowledge of the technologies, which is itself a limited subset of most representative samples
- few studies have examined in depth the ideas that have most characterized studies of risk including those on the social attenuation and amplification of risk through media and other social institutions, as well as the role of intuitions about toxicology and their influence of judgments of risk and benefit.

Terre Satterfield, Milind Kandlikar, Christian E. H. Beaudrie, Joseph Conti and Barbara Herr Harthorn.
Anticipating the perceived risk of nanotechnologies. *Nature Nanotechnology* 4(11):752-748.



Designing for Upstream Research: Anticipating Stigma Effects in Judgments about Nanotechnologies

INTRODUCTION

Anticipating public response is difficult, given limited public knowledge of nanotechnology and the complex relationships between perceived benefits and risks, emotional and symbolic characteristics of nanotechnology, and the trust or lack of trust placed in those managing this new class of technology.

One concern amongst regulators as well as the scientific community is the emergence of stigma, a measure of avoidance once an object has become 'marked' – often by a risk event and/or the positive or negative news stories that can follow. Figure 4 shows a correlation between risk aversion (a kind of 'stigma susceptibility' score) versus risk tolerance score, both of which effect acceptability scores.

RESULTS

- Stigma measures (figure to the right) indicated that judgments might easily change as a result of how this plays out in the media and/or should a controversial stigmatizing event occur.

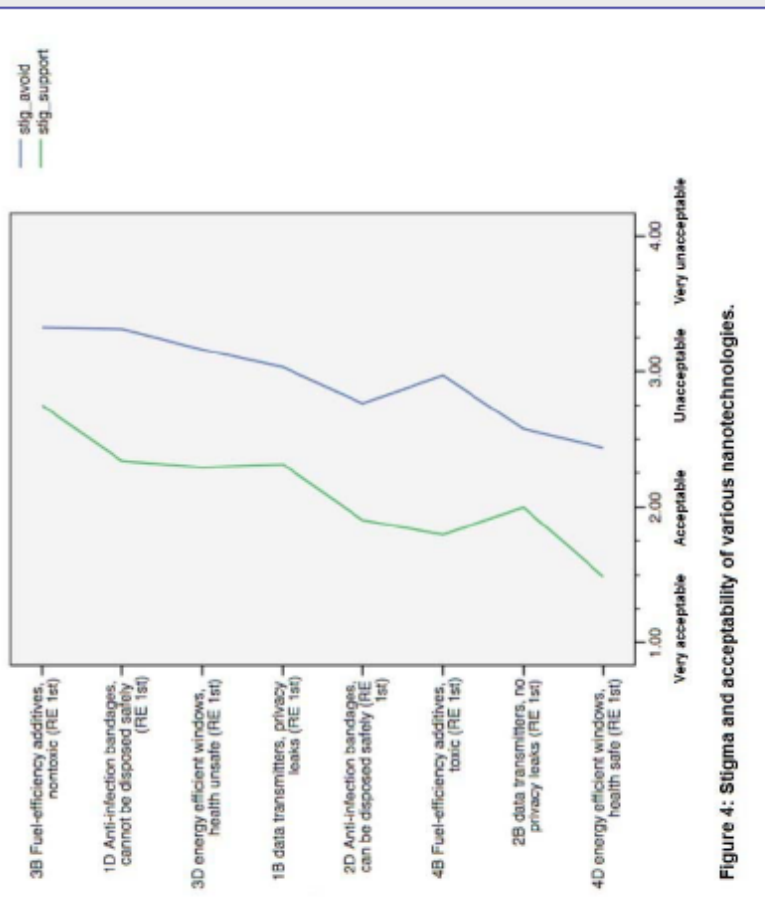


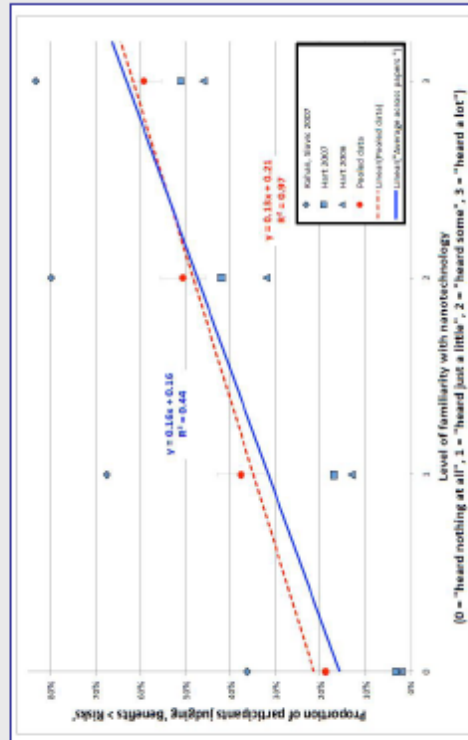
Figure 4: Stigma and acceptability of various nanotechnologies.

Terre Satterfield, Joe Conti, Milind Kandlikar, Christian Beaudrie, Barbara Herr Harthorn, and Nick Pidgeon. In preparation, *Risk Analysis*, special issue.



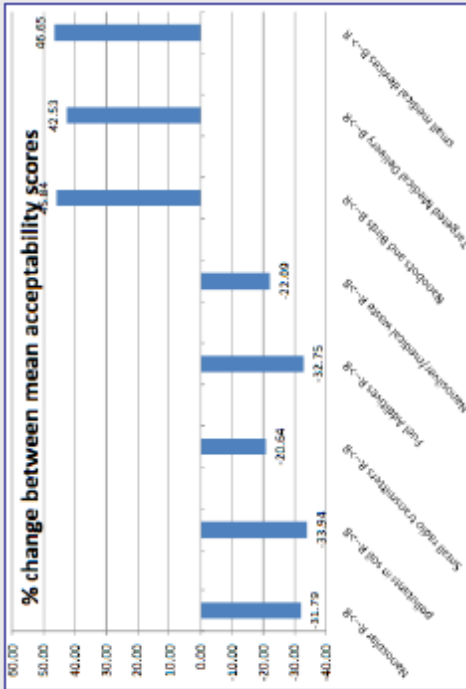
Unpacking benefit judgments - the Nanotechnology Case

We examined how people change their judgments when provided benefit and then risk information for the same nanotechnology applications.



Currently, the majority of surveys report that people regard benefit as outweighing or equal to risks. The above figure indicates that it is also the case that as familiarity with nanotechnology increases, the proportion of participants judging that benefits will exceed risks increases significantly. Benefit judgments in this sense can be said to be a function of knowledge or familiarity and not a knowledge deficit per se.

However, one concern is that the current mood of technological optimism or benefit centrism might be quickly reversed in the event of a risk event. To explore this we offered people two forms of information: Benefit information first followed by risk information and the reverse (2nd figure).



When information is initially positive, followed by a risk message, the reversal of the first judgment is much stronger (and more significant) than the reverse order. For example, across risk to benefit scenarios, initial judgments were reversed on average by 28.24 percentage points, while in benefit to risk scenarios the average change score across vignettes was 45.01 percent. This indicates high sensitivity in this judgment forming 'upstream' moment, whereby any sense of surprise in the face of unanticipated risk information could produce a betrayal-like effect and hence strong reversals of acceptability.

Terre Satterfield, Joe Conti, Barbara Herr Harthorn, Nick Pledgeon, in preparation for *Journal of Nanoparticle Research*



Vulnerability and Environmental Justice as Factors in Emergent US Nanotechnology Risk Perceptions

Introduction

The question generally posed by social scientists interested in perceived risk is: How might current growth in nanotechnology research and development be viewed by different publics and will the products and capacities derived from nanomaterials be met with optimism or a version? Will nanotechnologies be the subject of controversy? Or, will benefit appreciation prevail over risk aversion and if so, why?

Results

- When the distribution of risks and benefits from nanotechnologies is perceived as unfair, concerns for social justice lead to heightened perception of the nanotechnologies as risky (see figure 1)
- Experiences of vulnerability also amplify perceptions of risk associated with nanotechnologies.
- There is significant variation in risk perception between application domains.

Recognizing the embeddedness of technological innovation in social contexts, including experiences of vulnerability and normative evaluations related to social justice, extends the conventional foci of risk perception research and demonstrates how justice has thus far been under-recognized as a factor in perceptions of risk.

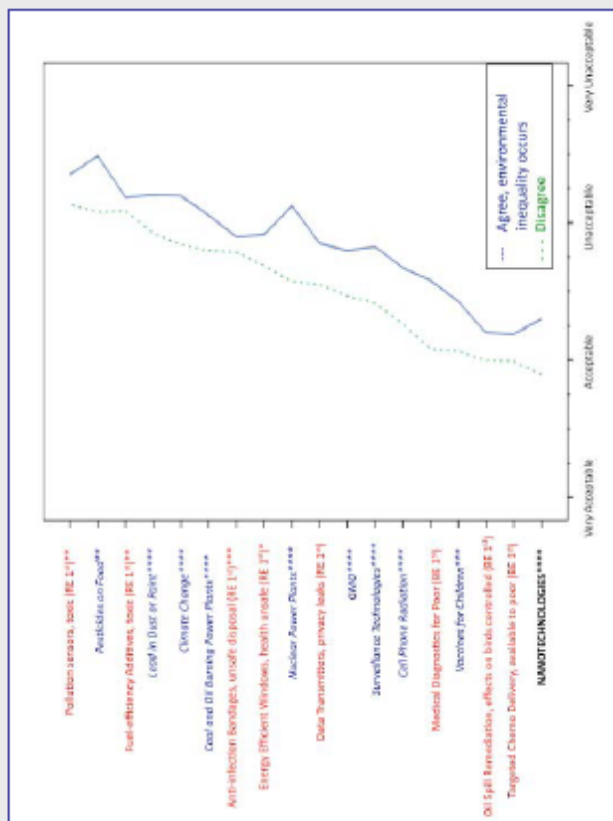


Figure 1. Risk judgments from respondents who acknowledge environmental inequality (blue) significantly differ from those that do not (green) on 14 of 18 items, including all non-nano risk objects.

Joe Conti, Terre Satterfield, Barbara Herr Harthorn, under review, *Risk Analysis*.



NSF SES 0531184; NIRT SES 0608791

The Impact of Testing Costs on the Regulation of Nanoparticles

Costs of testing the toxicity of nanoparticles are important for determining how nanoparticles might be regulated. Here we analyze whether testing costs might reasonably be borne by industry.

Based on publicly available information we estimate that there are 265 distinct nanoparticle types for sale in the US. Testing costs vary from \$70,000 (Level 1 – physical characterization) to \$4.48 million (Level IV – in-vivo animal models) depending on level of testing. Four scenarios assumed different proportions (“distribution”) of nanomaterials that are tested at different levels. In the optimistic scenario only 10% of nanoparticles will need the full range of tests, while in the precautionary approach all nanoparticles need testing at all levels. Costs of testing range from \$249 million (Optimistic) to \$ 1.18 billion (Precautionary) At current levels of R&D spending on nanomaterial toxicity this translates into between 11 and 43 years for testing currently existing nanoparticles.

Testing level		Level I	Level II	Level III	Level IV	Total
Testing cost per substance		\$0.07	\$0.83	\$2.15	\$4.48	
<i>Optimistic</i>	Distribution	0.60	0.15	0.15	0.10	1.00
	Number of materials	159	40	40	27	265
	Costs of testing (a)	\$11.4	\$33.0	\$85.6	\$118.8	\$249
<i>Neutral</i>	Distribution	0.25	0.25	0.25	0.25	1.00
	Number of materials	66	66	66	66	265
	Costs of testing	\$4.7	\$55.0	\$142.7	\$296.9	\$500
<i>Risk Averse</i>	Distribution	0.10	0.20	0.20	0.50	1.00
	Number of materials	27	53	53	133	265
	Costs of testing	\$1.9	\$44.0	\$114.1	\$593.9	\$754
<i>Precautionary</i>	Distribution	0.00	0.00	0.00	1.00	1.00
	Number of materials	0	0	0	265	265
	Costs of testing	\$0.0	\$0.0	\$0.0	\$1,187.7	\$1188

New approaches that increase the efficiency of testing are needed, especially as the numbers of nanoparticle types increase.

Jae-Young, C.,
Ramachandran, G.
Kandlikar, M. 2009
"The Impact of Toxicity
Testing Costs on
Nanomaterial
Regulation",
Environmental Science
and Technology
43(9):3030-3034.

Emerging Nanotechnologies and Life Cycle Regulation

While several US federal regulations are expected to apply to emerging nanomaterials, questions remain as to whether current regulatory frameworks are sufficient for managing risks that may emerge. This work investigates the federal health, safety, and environmental regulations that apply over the life cycle of a typical nanomaterial to determine whether novel properties and high uncertainty over risks significantly challenge the current regulatory system.

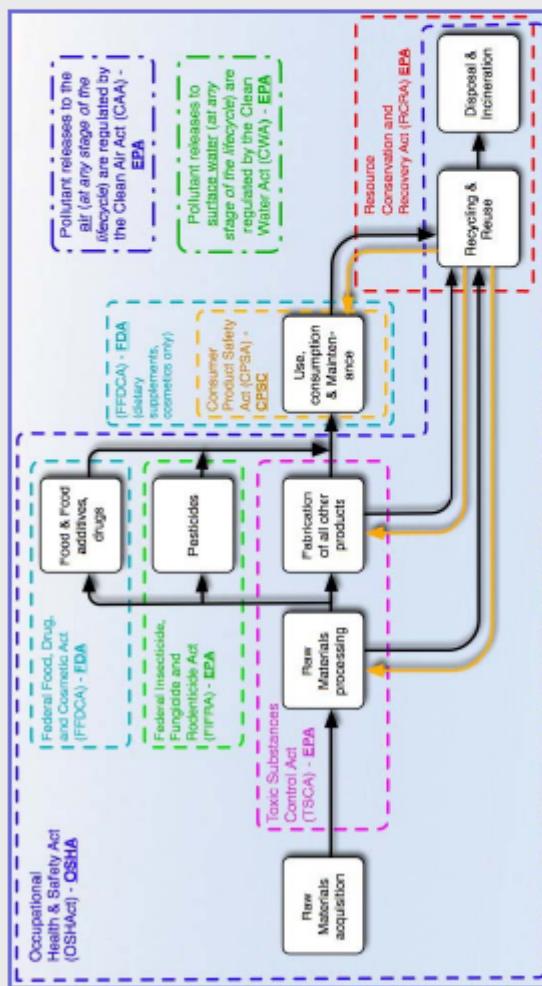
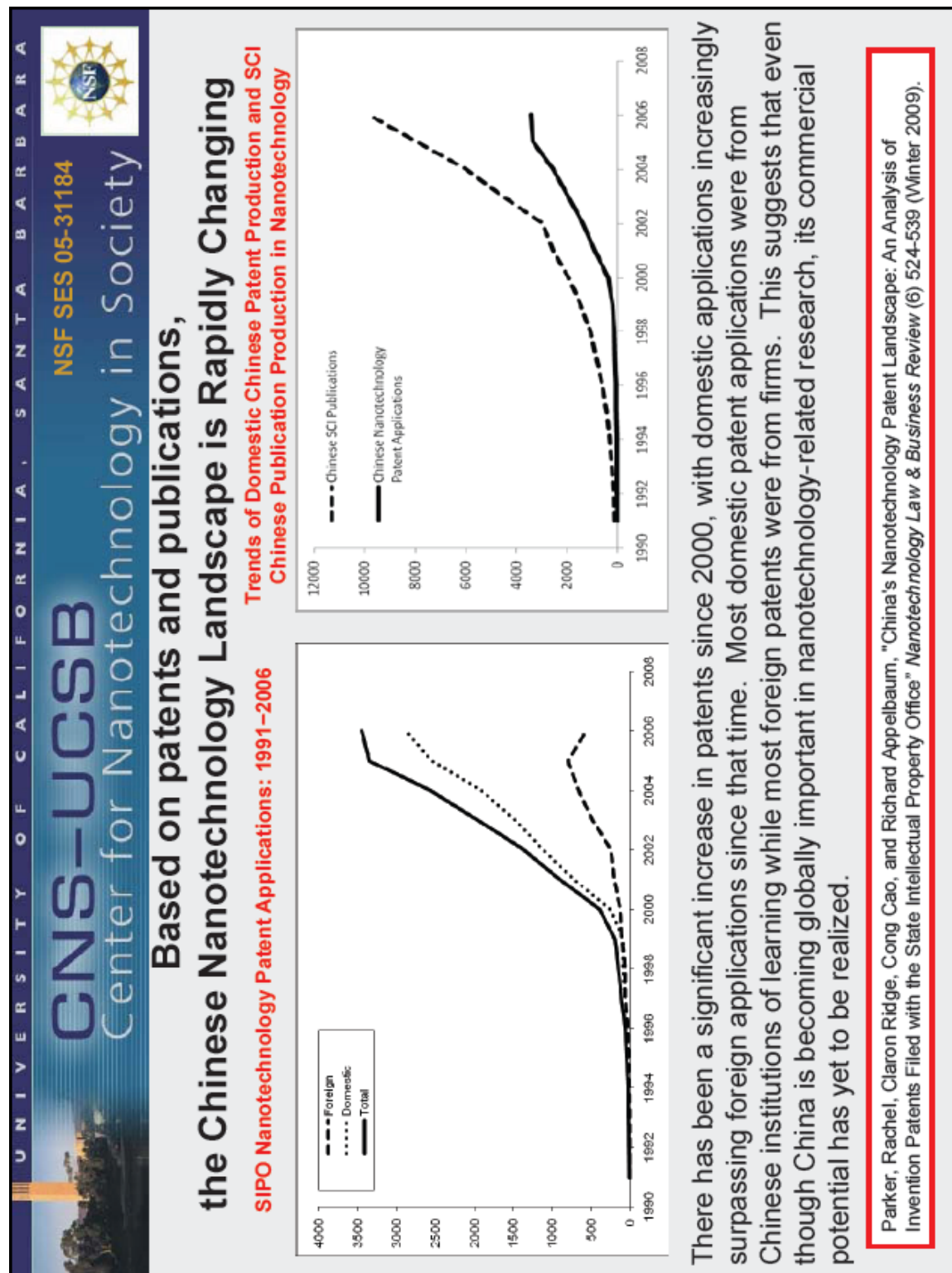


Figure 1. Federal health, safety, and environmental regulations that apply along the life cycle of a typical nanomaterial. Dashed boxes denote the life cycle stages at which each regulation's primary regulatory mechanisms are in effect.

While existing regulations are widely considered to provide adequate authority to regulate nanomaterials, novel properties, low production volumes, sparse data, and a lack of standards and protocols severely challenge the applicability of regulations. Furthermore, a shortage of resources and inadequate authority to require testing or recalls severely limit regulators' effectiveness in managing risk. Many nano-products as a result will go largely unregulated along their life cycle, while others may fall through gaps in regulation as they move from one stage of their life to the next. Overall, improvements in authority to require testing of a wider range of products, a systems approach to regulation that better engages stakeholders in risk management, and improvements in regulatory oversight at the 'use' stage are recommended.

Christian E.H. Beaudine (2010), "Emerging Nanotechnologies and Life Cycle Regulation: An investigation of federal regulatory oversight from nanomaterial production to end-of-life", Center for Contemporary History & Policy, Chemical Heritage Foundation, Studies in Sustainability White Paper Series.





Emerging Technologies/Emerging Economies:
(Nano) technology for Equitable Development
 CNS-UCSB • 2009 CONFERENCE • November 4-6 • Washington DC

[Home](#) [Description/Abstract](#) [Registration](#) [Conference Programming](#) [Contact](#)

This conference - held in Washington, D.C. November 4-6, 2009 - was a joint effort between the University of California's NSF-funded Center for Nanotechnology in Society, the Woodrow Wilson International Center for Scholars (which hosted the conference), and Rice University's Center for Biological and Environmental Nanotechnology.



WILSON CENTER on the Hill

The Road to Copenhagen:
Energy Solutions for Emerging Economies

Introduction Remarks By:
 SENATOR RON WYDEN
 Co-Chair Congressional Nanotechnology Caucus

DAVID IRVINE-BALLIDAY
 Founder, Light Up the World

CHEN WANG
 Director, National Center for Nanoscience and Technology of China

ANURADHA GANESHI
 Professor and Head, Department of Energy Science and Engineering, Indian Institute of Technology Bombay

Thursday, November 5
 12:00-1:15 p.m.
 B-139 Reardon House
 Office Building

Please R.S.V.P. acceptance
 Only to: Oshadhi@biolinks.ucsb.edu
 or (415) 893-4317

The 85 conference participants came from the United States, Europe, and Japan, three of the largest emerging economies (China, India, and Brazil), and other emerging economies.

- Focused discussions designed to bridge north/south divide (facilitated by Meridian Institute)
- plenary papers & breakout workshops around four themes, problem-solving, networking
- National Press Club luncheon with Keynote address from Aneesh Chopra, Federal Chief Technology Officer
- Wilson Center on the Hill
- Edited Volume published through Routledge 2011

NSF SES 05-31184



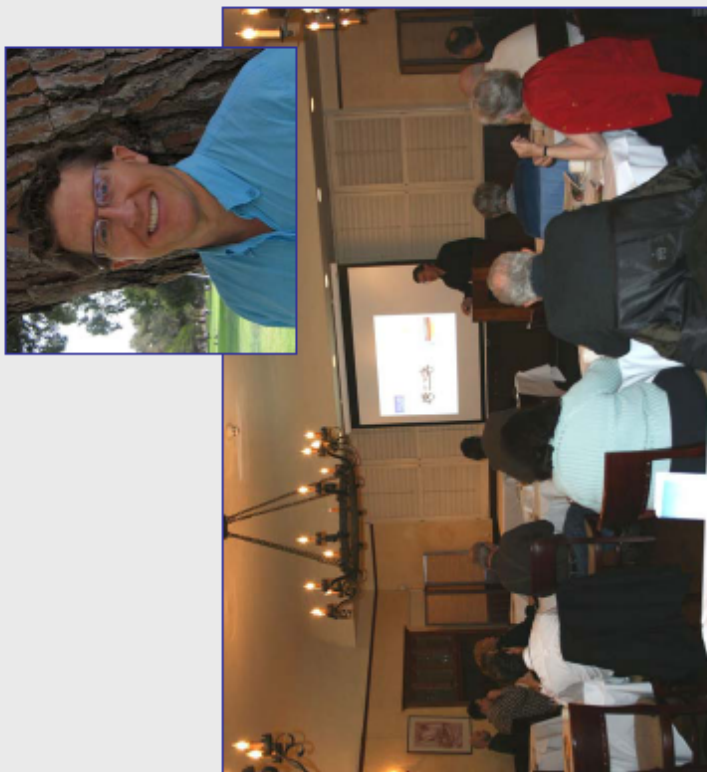


‘NanoMeeter’ brings researchers into the community

How will new nanoscale materials change the electronic devices we use everyday, and what promise do they hold for new technologies?

That was the question of the hour for CNS-UCSB's NanoMeeter on "New Nanoscale Materials for the Future of Energy" featuring Dr. Brad Chmelka, UCSB Professor of Chemical Engineering and Materials Research Lab faculty, and Dr. Rich Appelbaum, UCSB Professor of Sociology and Global & International Studies, and CNS-UCSB co-PI.

Local community members of all ages ranging from college students to seniors came out for this evening of presentation and discussion. NanoMeeter events are free and open to the public, and no science background is required.



Dr. Brad Chmelka discusses his research on nanotechnology for fuel cells with a Santa Barbara community audience.

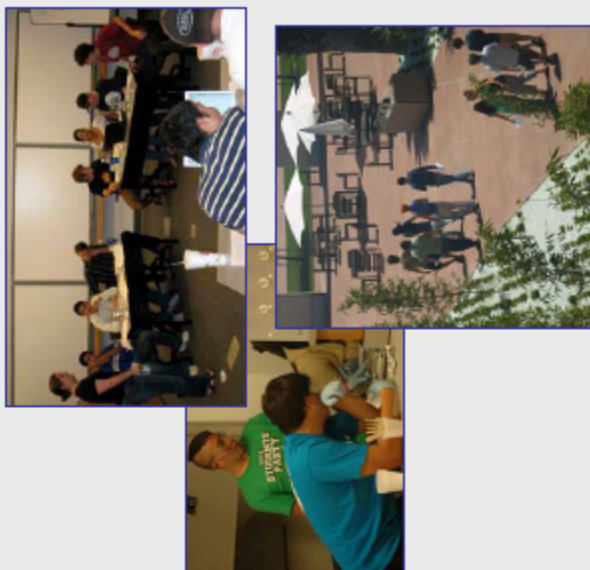


Innovative Nanotechnology & Society Course Developed with Community College

An innovative education program funded through the NSF STS Program teams up CNS-UCSB with Santa Barbara City College (SBCC) to bring a UCSB-developed course around nanotechnology and sustainability to the community college.

"Green Works: Exploring Technology and the Search for Sustainability" was developed at UCSB in 2008 with the INSCITES program, a partnership of the California Nanosystems Institute (CNSI) and CNS to blend historical context, basic scientific principles, societal implications, and technological understanding in truly interdisciplinary courses, open to all majors, with no prerequisites.

With the 2010 award, CNS faculty, Education Director, UCSB graduate students and an SBCC instructor and administrator are revising the *Green Works* course from a 10-week quarter to a 16-week semester and incorporating new nanotechnology and sustainability content. The course will launch at SBCC in Spring 2011, and a subsequent workshop for community college instructors will begin dissemination of the course to others around the state.



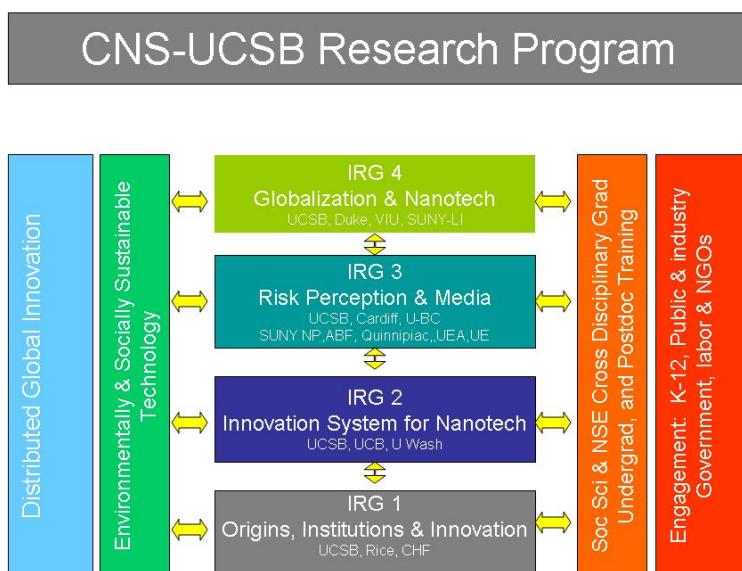
Innovative pedagogy during class (top photo) mixes lecture with discussions, debates and group work. Labs (middle and lower photos) include science, engineering, and social science methodologies.

8. STRATEGIC RESEARCH PLAN

The Center's research program is designed as a systematic analysis of historical and contemporary aspects of nanoscale science and engineering (NSE) innovation and technology transfer systems for successful commercialization, globalization as a key factor in comparative economic development in East and South Asia, and emerging social perceptions of nanotechnologies as media and diverse publics become aware of them. Research in the past year has been slightly reorganized into four interdisciplinary research groups: **IRG 1** – *Origins, Innovations, and Institutions* seeks to develop a rich understanding of the historical underpinnings of the current landscape of the nano-enterprise; **IRG 2** -- the *Innovation Group* looks at collaboration and innovation, patenting systems, and technology transfer in the leading edge California innovation system and in comparison to UK, France, Germany, and other sites; **IRG 3**--*Risk Perception and Social Response*--focuses on understanding the dynamic nature of publics' and experts' perceptions and social intelligence about nanotechnologies, media framing of nanotech risks and benefits, social amplification and attenuation of risk, and methods for public engagement and deliberation. **IRG 4** -- *Globalization and Nanotechnology* examines nanotechnology development under differing governmental approaches in China, Japan, and elsewhere in E. and S. Asia, to ask how different industrial policies in combination with international cooperation and collaboration among researchers, shape distinctive nanoscience and industry outcomes. Together these provide a comprehensive understanding of current processes for successful innovation, commercialization, and global distribution of nanotechnologies. CNS-UCSB uses a strategic mixture of social, cultural, economic, political, and historical methods to address these issues at different scales, temporal frames, and resolutions. The composite picture of the emerging and growing nano-enterprise rendered by CNS-UCSB's research portfolio identifies and analyzes the critical issues for the safe, successful, *responsible development* of nanotechnologies in the global society. Important features of our collective approach are an integrated, participatory relationship with nanoscientists and engineers; a focus on specific nanotechnologies such as nanoelectronics, nanoparticles such as quantum dots, thin films, and nanoporous materials; comprehensive consideration of their applications in industries like electronics, energy, environmental, food, and health; and employment of advanced spatial analytic methods and a global framework for analysis.

CNS-UCSB views the linked set of foci of the CNS-UCSB on the scientific invention and economic development aspects of new nanotechnologies (IRGs 2 & 4), the meanings for risks and benefits that accrue on the societal side through media, expert & public processes (IRG 3), and the historical grounding of these in social, institutional, and policy contexts (IRG 1) as a highly productive, intersectional yet distinct mode of organizing a center's collaborative interdisciplinary research and education. The 4 IRGs that form the core of CNS research are connected by numerous threads of common interests, some shared personnel, and the processes for integration that CNS-UCSB as a centralized, single campus center provides and continues to refine and develop. One aspect of these processes in the past year is the decision to separate the two innovation-focused groups that originally formed IRG 2 into two separate IRGs, consistent with their original conceptualization. IRG 2 takes a case-study approach, focuses increasingly on a specific application area (3rd Generation Solar with a range of nanoscale enabling technologies), and attempts to analyze the content of patents to determine lines of development and of commercialization interest. IRG 4 is working at the level of nanotechnological aggregates, conducting a comparative analysis of differing industrial policies on nanotechnology innovation and commercialization. The two groups' methods are complementary, as are the regions on which they focus: for example, IRG 2 uses the USPTO and European Patent Office databases, and pays particular attention to assignees and technology developers that are based in the US and the EU. IRG 4 led by Rich Appelbaum has focused from the start on carefully collected and interpreted Chinese patent data and firms, as part of its emphasis on Asian and Pacific Rim developments. All of the industries that both groups will look at are fundamentally global, and the combination of their respective data and analyses will contribute to an integrated picture of selected

global nano-enabled industries. IRG 3's research is moving more explicitly into experimental design modes to conduct multifactorial analysis of the drivers of emerging nanotech risk perceptions, looking specifically at the construction of (and reversals of) judgments of benefits *and* risks, counterintuitive findings and behavioral patterns that are of particular import to policy makers. New deliberative work funded by an award 2008-2010 to PI Harthorn allows a closer focus on gender as a factor in risk perception and interactions in small group deliberative settings. Funding to Harthorn's group from the new UC Center for Environmental Implications of Nanotechnology is producing new work on industry and public views of environmental risks of nano. Altogether, the CNS focuses on globalization, innovation, and risk, with central themes of inequality, vulnerability, product stigma, environment, and the production of policy-relevant results. CNS teams use a variety of comparative case analyses across specific nations (US, EU, E Asia), across applications for energy, environment, health, food, and water, and varying institutional practices (e.g., IP regimes) to highlight US nanotech R&D and public views and situate them in their comparative global context



CNS' extensive collaborations with the UCSB CNSI, the UCSB Materials Research Laboratory (MRSEC) the College of Engineering and new Institute for Energy Efficiency, NSE participation on our National Advisory Board, and the funded collaboration of the CNS-UCSB with the UC CEIN (and with the CEINT at Duke, through our collaborators Gereffi and Lenoir) serve to provide a strong web of connections to the NSE, nanotoxicology and materials research communities. Years 6-10 of the CNS will serve to further develop and strengthen these ties, for example through shared course development with the MRL's IGERT program, through joint programming, joint community college course development, and many other means. These connections and the highly interdisciplinary exchanges that are resulting from them are absolutely essential to the fulfillment of the CNS-UCSB research and education mission. Science and society work of the sort that is expected of the CNS requires the development of mutual regard and understanding across very great disciplinary divides, a process we as social scientists and humanists know needs to grow and develop organically to produce lasting institutional change. UCSB provides a possibly unique context for this experiment.

The integration, aggregation and synthesis of research results in the CNS take a number of forms. Years 1-5 are culminating with the production of numerous publications, reports, and other materials that contribute to cutting edge theoretical and substantive issues in disciplinary research as well as the interdisciplinary space constructed by a highly multi-disciplinary national center such as CNS-UCSB. Center funding with its longer horizons and IRG collaborative enterprise enable a focused, summative

evaluation of research that is not possible at the individual project level. At the IRG level, this includes plans in 2010 to conduct state of the art analyses based on cumulative knowledge from the first 5 years of funding. For example, IRG 3 is producing a synthesis piece on nanotechnology upstream and midstream deliberation, based on what they will have learned from conceptual work by Pidgeon and Rogers-Hayden in the UK, two sets of deliberative workshops in 2007 and 2009 by the full team (Harthorn, Pidgeon et al.), and meta-analysis of the published literatures (Satterfield et al.). IRG 3 will develop a special journal issue based on its Jan 2010 specialist meeting that convened an international group of leading scholars to assess the state of knowledge about nanotech risk perception. IRG 2 (Newfield et al.) is hosting a workshop on global nano innovation in April 2010 in France that will convene a dozen or so of leading innovation system analysts and will result in a synthesis publication. IRG 4 (Appelbaum et al.) took the lead on a large scale CNS-wide international conference in Nov 2009 in Washington DC on impediments to use of nanotechnologies for water, energy, health and food to help the world's poor. The results of that are currently being developed into an edited volume under contract to Routledge that aims to respond to the deep commitment in the CNS to ensure that issues of equitable development are addressed as a key aspect of responsible development of nanotechnologies.

In addition to the increasingly prolific production and dissemination of research results from individual IRGs via peer-reviewed journals, book chapters and pieces to many different kinds of audiences, CNS plans to culminate the first 5 years of Center support by producing an edited volume with a working title of *The Social Life of Nanotechnologies*, edited by CNS Director Harthorn and sociologist Mohr. The volume will bring together original work from the research groups, will include education for nanotechnology in society, and will include reflexive examination of the origins and sociology of the Center for Nanotechnology in Society at UCSB and its interactions with the NSE community. Board Co-Chair John Seely Brown (author of *The Social Life of Information*, Harvard, 2000) has agreed to author a foreword to the book, which we hope will be consistent with the aims of his text to remind scientists, technologists, business and government that the social contexts of technologies demand close and careful attention and understanding.

As the CNS is actively developing a robust set of empirical data we plan a stepped up plan for interaction with and dissemination to diverse audiences from NSE researchers and students, to policy makers, to the diverse publics we study in our research. In the changing media environment, it is a challenge to create a thoughtful and effective approach to reaching key government, industry, labor, environmental, and public audiences with the implications of our research. CNS research has much to offer such audiences. Currently, for example, IRG 3 survey research provides experimental evidence that it may be harmful to public acceptance to focus exclusively on the presentation of information about a new nanotechnologies' benefits, something many in both science and industry assume as the preferred approach. IRG 4's comparative work suggests US investment in private sector early stage development may be necessary to effectively launch nanoenabled commercial developments in the current economy. And the CNS NanoEquity conference 09 provided a strong basis for promotion of open source development strategies for humanitarian technological development. All CNS IRGs are using center resources to develop and consolidate policy relevant results that Center infrastructure in turn will enable us to disseminate effectively.

9. RESEARCH PROGRAM, ACCOMPLISHMENTS, & PLANS

IRG-1: Historical Context of Nanotechnology

W. Patrick McCray , leader	History	UC Santa Barbara
Cyrus Mody	History	Rice University
Hyungsub Choi	History	Chemical Heritage Foundation
Peter Alagona	History	UC Santa Barbara
Howard Lovy	Science journalism	Consultant

2 Postdocs, 1 Grad, 2 Undergrads

<i>Post-doctoral researchers:</i>	Matthew Eisler, History (beg. Oct 2009)
	Mikael Johansson, Anthropology
<i>Graduate Students</i>	Summer Gray, Sociology
<i>Undergraduate Students</i>	UCSB: Olivia Russell, Samantha Rohman

IRG-1's goal is to produce and integrate a diverse range of historical sources and research tools in order to understand specific facets of the nano-enterprise's history. Understanding nanotech's societal implications is predicated on possessing a clear and comprehensive understanding of its historical context. This requires examining nanotech's history at multiple levels of analysis – scientists' careers, research communities, instrumentation, national and state policy, and the role of public imagination and interest in "visionary engineering ideas."

Much of IRG-1's time for the first 5 months of 2009 was spent preparing for several major events. One of these was the research Summit which was in January 2009. We used this time to prepare sections for both the Annual Report as well as the Phase 2 Renewal Proposal. A great deal of our time after this was spent drafting the final versions of these documents and preparing for both the Advisory Board meeting in April and the NSF Site Visit in May. Despite the bureaucratic work associated with the renewal process, IRG-1 has been remarkably productive during the first four years of the CNS. In 2009-2010, this trajectory continued as our group has written, published or submitted for publication *14 articles, reports, essays, opinion pieces, book chapters, and reviews and 1 book*. In addition, researchers from WG1 gave *31 talks or presentations at conferences and other forums* in the United States and abroad. Details on the research performed by IRG-1 in the period between March 2009 and March 2010 follows. In addition to research productivity, IRG 1 has been highly successful in leveraging CNS research and education funds, including a new collaboration with [Alagona](#) on an NSF STS curriculum development grant (see section 20).

IRG 1-1: Semiconductor Technologies and the Road to Nanoelectronics ([Choi](#), [Mody](#), [McCray](#))

IRG 1-1 continued to build on the previous work on nanoelectronics by [Choi](#), [Mody](#), and [McCray](#). Building on [Choi](#)'s dissertation work, he and David Brock (a consultant to the Chemical Heritage Foundation who will formally join our group in 2011) have worked on a new project examining the role of the Semiconductor Technology Roadmap. The importance of the roadmap in the semiconductor industry's trajectory since the 1990s has been widely acknowledged by commentators. However, a more detailed examination of its operating mechanisms has not been studied. In particular, we have been focusing on the developments in institutional infrastructure (Semiconductor Research Corporation, Sematech, etc) that have preceded and made possible the smooth operation of technology roadmaps. Into the 21st century, some of these institutions have retooled themselves as a nanotechnology organization.

Choi continued to work toward the completion of his book manuscript on the history of technology transfer in the semiconductor industry. Since September 2009, he has been staying in Tokyo on a postdoctoral fellowship, conducting follow up research on the topic.

Utilizing his geographical advantage, Choi has also collaborated with colleagues in IRG-4 on the development of nanotechnology in South Korea. In January 2010, Choi made a week-long trip to Seoul, during which he had informal meetings with key policy makers, scientists, and representatives of trade associations. Based on the meetings, he has prepared a five-page report on the general status of Korean nanotechnology. This will be the basis for IRG-4's plan to visit Seoul in May 2010.

IRG 1- 2: Nanotechnology Oral History Project (McCray, Choi, Mody)

Activities in IRG 1-2 focused on completing the oral history interviews conducted in previous years, as well as conducting new interviews in areas of new research. The Chemical Heritage Foundation has completed final processing of most interviews that were in the pipeline and delivered the bound copies to CNS. In addition, two of the new interviews on the institutional development of materials science at the University of Pennsylvania (Robert Maddin and Louis Girifalco) are complete and processed. Choi also conducted an interview with a Cornell materials scientist, Arthur Ruoff, which is still in processing.

During his research leave to Tokyo, Choi also interviewed Hideki Shirakawa, a Nobel laureate in chemistry along with Alan MacDiarmid and Alan Heeger. This was of particular interest to IRG-1, given that Mody has already conducted interviews with MacDiarmid and Heeger in previous years. Thus, we have successful closed loop on the trio that worked on conductive polymers. The interview with Shirakawa also opened up new avenues for conducting research on the practice of Japanese nanotechnology by introducing Choi to several materials science/nanotechnology institutions, including the National Institute of Materials Science and the Institute for Molecular Science.

In 2009-2010, McCray conducted several interviews with scientists and administrators involved with NASA's nanotechnology initiative in the 1990s through the early 2000s. This work was concentrated at NASA's Ames Research Center near Palo Alto. McCray interviewed: Meyya Meyyappan, Richard Jaffe, Scott Hubbard, Deepak Srivastava, and Al Globus. Most of these interviews, which CHF transcribed, are complete and available for use. They constitute a record of early, pre-NNI nano research and also speak to the development of computational nanotechnology techniques.

In preparation for the second 5 years of CNS, IRG-1 has drafted plans to initiate the "Pioneers of Nanotechnology" oral history project, with David Brock as project leader. The list of potential interviews for this series will be determined in consultation with others at CNS, as well as external experts.

IRG 1- 3: Institutions of Interdisciplinarity (Mody, Choi, Gray)

Much of Area 3's activities this year were taken up with securing supplemental funding that will allow our members to do research now and to have time to produce articles and books based on that research in the future. Mody, Gray, and McCray successfully won small research grants from the Center for Biological and Environmental Nanotechnology at Rice and from the National Nanotechnology Infrastructure Network headquartered at Cornell. Mody, McCray, Choi, and future IRG-1 member Mara Mills submitted proposals to the ACLS and NEH for collaborative research. Our ACLS proposal has been accepted and NEH support is pending.

IRG 1-3a: The Origins of Academic Interdisciplinarity Research: Emergence and Transformation of Materials Research Laboratories, 1960-1975 (Choi)

Utilizing seed funding provided by CNS, Choi has conducted archival and oral history research in Philadelphia (University of Pennsylvania) and Ithaca (Cornell University). He has examined the records of the two “Interdisciplinary Laboratories (IDL)” program in materials science, which were among the first group of such laboratories to be established in 1960. In particular, the focus of IRG 1-3a has been on the spatial rearrangements made possible by the influx of large-scale funding in a new area of science and technology, and its impact on scientific practice and community formation. The next step is to examine the records at Northwestern University, which hosted the third IDL.

Early results of this research have been presented by Choi at various venues in the U.S., Japan, and South Korea. Also, Choi and Mody are preparing an article on the evolution of institutions, communities, and disciplines at Cornell University, which will be submitted to *Historical Studies in the Natural Sciences* in spring 2010.

In terms of external collaboration, Choi has been in discussion with those at the University of Pennsylvania, in particular with Ph.D. candidate Jon Milde and Wharton professor Sarah Kaplan. Unfortunately, Milde is no longer with the program and Kaplan moved to Toronto. However, he has identified another Penn graduate student, Brittany Shields, whose research interest includes the role of buildings and research spaces. Ruth Cowan indicates that Shields will be replacing Milde on the Penn NBIC grant, working on “nanotech spaces.”

IRG 1-3b: Building Interdisciplinary Institutions, 1975-2005 (Mody, Choi)

This project picks up where IRG 1-3a leaves off, by examining the proliferation of interdisciplinary research centers, journals, conferences, funding areas, etc. after the Mansfield Amendment and other Vietnam-era reforms. Mody has used the group’s NNIN funding to travel to interdisciplinary nanofabrication facilities at the University of Washington, University of Texas, Harvard, and Stanford, with further trips planned this spring. He and Choi are preparing to submit an article based on that research to *Historical Studies in the Natural Sciences*. Mody has also submitted a chapter on interdisciplinary microelectronics research at Stanford to the *Sound Studies Handbook* (Oxford University Press) and will be writing a follow-on article with Andrew Nelson (University of Oregon Lundquist College of Business) for inclusion in a special issue of *Osiris*.

One exciting development of the past year is that this project’s research is entering the realm of public history, as Mody has given talks at the Feynman Anniversary Symposium (celebrating the 50th anniversary of “Plenty of Room at the Bottom”), has spoken to the PCAST NNI review panel, joined an external advisory committee of the Rosenbach Museum for a proposed exhibit on *The Year of the Miniature*, and is liaising between Rice and the Chemical Heritage Foundation on the plans for a celebration of the 25th anniversary of the discovery of buckminsterfullerene.

IRG 1-3c: The Contested Nature of Interdisciplinarity in Nanoscience (Gray, McCray, Mody)

Fostering collaboration across disciplinary boundaries has been one of the major goals of federal nanotechnology policy in the United States, and has been central to the development and vision of the emerging field. New institutional forms have proliferated into an ensemble of national academic centers, programs, and networks designed to stimulate innovation by bringing scientists from wide ranging disciplinary backgrounds together. Over a decade later, the question remains, to what extent has this vision been realized?

Research conducted in this project is concerned with contextualizing the emerging field of nanotechnology within the disciplinary and political landscapes of science and engineering. So far, research on interdisciplinarity in nanotechnology has relied on bibliometric analyses, often overlooking historical and institutional dynamics as well as important interactions among policy makers and scientists; what happens on the ground among these communities is crucial for understanding the social character of nanoscience. Focusing on the rhetorical role of interdisciplinarity during the formative years of the field, this project addresses the question of why such a vision became a desired goal and how attempts to realize this have been translated into practice.

In the past year, Gray has conducted qualitative research measuring interdisciplinary activity as both ideology and practice, paying attention to U.S. federal policy discourse, important milestones in the institutional history of nanotechnology, and the internal dynamics of an NSF-funded nano center and its community of scientists. In July of 2009, Gray traveled to Houston, Texas to collect in-depth interviews with seven chemists, biologists and environmental scientists involved with the Rice University's Center for Biological and Environmental Nanotechnology (CBEN). The questions were designed to gauge the extent to which these nanoscale researchers value interdisciplinarity in the context of their work. Taken together, the interviews shed light on the question of whether or not interdisciplinarity is a shared value among nanoscale researchers. While at Rice University, Gray also surveyed the archival holdings of The Center for Nanoscale Science and Technology, established by Nobel laureate Richard E. Smalley in 1993, to document how interdisciplinarity was discussed at the first major university-funded nanoscience research center. In a similar fashion, Gray also surveyed the archival holdings of CBEN throughout its ten-year institutional lifespan.

The next phase of IRG 1-3c is to produce a book chapter from the findings for the upcoming UCSB-CNS edited volume, and to incorporate newly published findings concerning the disciplinary breakdown of users of national nanotechnology facilities into this analysis.

IRG 1-4: (Nano)Technological Enthusiasm and the Public Imagination (McCray, Russell, Rohman)

McCray continued work on the book manuscript for this research area. This largely consisted of revising chapters written in late 2008 as well as starting two new chapters. At this point, a first draft of the book is about 50% complete. In the past year, McCray also continued to collect and analyze primary source materials and conducted interviews (phone, email and in person) with a broadened set of informants and participants. The expected date for completion of this project is sometime in late 2011, subject to other constraints and factors. A full description of this project was provided in last year's report. The book is under contract with Princeton University Press.

IRG 1-5: Nanoscale Science and Engineering, Federal R&D Policy, and Energy Conversion Technology (Eisler, McCray)

This project attempts to root nanoscale science and engineering (NSE) in the continuum of U.S. federal research and development policy after the Second World War. Postdoctoral Scholar Eisler's specific goal is to understand how the National Nanotechnology Initiative (NNI) influenced existing and subsequent large R&D programs, and their material practices therein, in federal agencies, public and private corporations, and universities. His broader goal is to understand the historical relationship between domestic and foreign economic, political, and socio-cultural factors and industrial trends in the traditional "heavy" sector and the emerging sectors of electronics and biotechnology and how this informed the timing and structure of federal R&D programs culminating in the NNI. Eisler approaches these objectives by exploring NNI-funded NSE in

energy conversion and conservation technology programs administered by the Department of Energy, activities that are not widely known or understood.

Since joining CNS Working Group One in October 2009, Eisler has completed an encyclopedia article, substantially completed a draft of an article for the upcoming UCSB-CNS edited volume, and planned a program of archival research in support of his main project at the Chemical Heritage Foundation of Philadelphia, the National Archives in Washington, D.C, and Rice University, to be executed in April 2010. This work may inform subsequent human subject interviews. He has also begun organizing a panel entitled "Engineering Social Landscapes for Nano" as part of the Society for Nanoscience and Emerging Technologies conference to be held in Darmstadt (Hesse, Germany) in fall 2010, where he will present his research findings for the year.

IRG 1-6: CNS Postdoctoral Scholar Research: Ethnographic Explorations of Nanoscience and Nanotoxicology Laboratories (Johansson)

Funded by cross-working group funds as an interdisciplinary researcher, postdoc Mikael Johansson is being mentored in his work by IRG 1 leader McCray. During 2009 Johansson conducted ethnographic fieldwork among nanoscientists and toxicologists studying the adverse effects of nano particles. In January 2010 he began intensive analysis of the collected material started with the aim of writing a book about the social lives of scientists working within the field of nanoscience and technology.

IRG-1 Publications in 2009-2010

- 1) **Mody, Cyrus C.M.**, "Instruments of Commerce and Knowledge: Probe Microscopy, 1980-2000," in *Science and Engineering Careers in the United States: An Analysis of Markets and Employment*, ed. Richard Freeman and Daniel Goroff (Chicago: University of Chicago Press, 2009): 291-319.
- 2) **McCray, W. Patrick**, "Unintended Consequences" *Science Progress* (<http://www.scienceprogress.org/2010/03/unintended-consequences/>), Mar 22, 2010
- 3) **Mody, Cyrus C.M.**, "Introduction [to special issue on the history of nanotechnology]," *Perspectives on Science* 17.2 (2009): 111-122.
- 4) **Mody, Cyrus C.M.** and **McCray, W. Patrick**, "Big Whig History and Nano Narratives: Effective Innovation Policy Needs the Historical Dimension," *Science Progress* (<http://www.scienceprogress.org/2009/04/big-whig-history-and-nano-narratives/>), April 6, 2009.
- 5) Maddin, Robert. 2008. *Oral History Interview by Hyungsub Choi*. April 22, 2008. Philadelphia: Chemical Heritage Foundation. (not previously reported)
- 6) Mikael Johansson. 2009. *Next to nothing: A study of nanoscientists and their cosmology at a Swedish research laboratory*. ACTA-series, Gothenburg studies in Social Anthropology. Gothenburg University: Sweden. (monograph)
- 7) **Mody, Cyrus C.M.** and Michael Lynch, "Test Objects and Other Epistemic Things: A History of a Nanoscale Object," *British Journal for the History of Science* 42 (on-line edition; printed version forthcoming).
- 8) **McCray, W. Patrick**, "From L-5 to X-Prize," book chapter for edited collection on California aerospace history, edited by Peter J. Westwick. University of California Press. Forthcoming, early 2011.

- 9) **McCray, W. Patrick**, "Faith in Futures: California and Radical Technological Optimism, 1970-1990," book chapter for *Minds and Matters: Technology in California and the West*, ed. Volker Janssen. University of California Press. Forthcoming, early 2011.
- 10) **Mody, Cyrus C.M.**, "Conversions: Sound and Sight, Military and Civilian," in *Sound Studies Handbook: New Directions*, ed. Trevor Pinch and Karin Bijsterveld (Oxford: Oxford University Press, accepted/in revision).
- 11) **Mody, Cyrus C.M.**, "Atomic Force Microscopy," "Center for Biological and Environmental Nanotechnology," "Electron Microscopy," "Exotic Microscopies," "IBM," "International Council on Nanotechnology," "Interdisciplinary Research Centers," "Optical Microscopy," "Scanning Probe Microscopy," "Scanning Tunneling Microscopy," and "Timeline of Nanotechnology," Entries in *Encyclopedia of Nanoscience and Society*, ed. David Guston and J. Geoffrey Golson. Thousand Oaks: Sage. (Forthcoming Nov 2010).
- 12) Eisler, Matthew N., "Department of Energy," Entry in *Encyclopedia of Nanoscience and Society*, eds. David Guston and J. Geoffrey Golson. Thousand Oaks: Sage. (Forthcoming Nov 2010).
- 13) Mikael Johansson. "Nano Culture." Entry in *Encyclopedia of Nanotechnology and Society*. Sage. Forthcoming Nov 2010.
- 14) **Choi, Hyungsub** and Christophe Lecuyer. "How Did Semiconductor Firms Manage Technological Uncertainties?" Under review at *Revue d'Histoire Moderne et Contemporaine*
- 15) Mikael Johansson. "Vi är dina provexemplar" – om etnografiskt fältarbete i laboratoriemiljö (We are your samples-On ethnographic fieldwork in laboratory environments). Book chapter in anthology "Att tänka genom kulturer" (*To think through cultures*), Bärmark, Jan (ed.) under Review by Carlssons förlag.

In preparation

- 1) **McCray, W. Patrick**, "When Space Travel and Nanotechnology Met at the Fountains of Paradise," book chapter for proposed CNS volume *The Social Life of Nanotechnologies*.
- 2) Eisler, Matthew N., "'You Say you Want a Revolution:' Nanofuturism as (Post)Industrial Policy," in preparation for CNS edited volume *The Social Life of Nanotechnologies*.
- 3) **McCray, W. Patrick**, book in preparation on (Nano)Technological Enthusiasm and the Public Imagination, under contract to Princeton Univ Press
- 4) **Choi, Hyungsub**, book in preparation on the history of technology transfer in the semiconductor industry
- 5) **Mody** and **Choi** are preparing to submit an article based on IRG 3-b research to *Historical Studies in the Natural Sciences*.
- 6) **Mody** will be writing a follow-on article on interdisciplinary microelectronics research at Stanford with Andrew Nelson (University of Oregon Lundquist College of Business) for inclusion in a special issue of *Osiris*.
- 7) **Johansson** is working on a book based on his CNS-funded research on nano labs in the US.

IRG-1 Presentations 2009-2010

- 1) **Choi, Hyungsub**. "Interdisciplinary Laboratories: The Institutional Origins of Materials Science," *Chemical Heritage Foundation Brown Bag Lecture*, Philadelphia, PA, 24 March 2009.
- 2) **Choi, Hyungsub**., "Manufacturing Knowledge in Transit: A Transnational History of the Semiconductor Industry in the U.S. and Japan," *Institute for Applied Economics and the Study of Business Enterprises*, Johns Hopkins University, Baltimore, MD, 31 March 2009.
- 3) Mikael Johansson. Interview on Radio Show, Science Guys. KCSB 91.9 (UCSB student radio). April 23, 2009.

- 4) **McCray, W. Patrick**, "Of Fringes and Futures: Technological Enthusiasm, 1970-1990," talk at University of California, San Diego, May 2009.
- 5) **McCray, W. Patrick**, "Of Fringes and Futures: California's Technological Enthusiasts, 1970-1990," paper presented at *Mind and Matter: Technology in California and the West*, Pasadena, May 2009.
- 6) **Choi, Hyungsub** and David C. Brock and (Brock presenting), "Semiconductor Technology Roadmapping: Origins, Functions, and Exemplary Status," *2009 Sloan Industry Studies Conference*, Chicago, IL, 28-29 May 2009.
- 7) **Choi, Hyungsub**. "Interdisciplinary Laboratories: The Spatiality of Materials Research in the 1960s," *The 5th Laboratory History Conference*, Baltimore, MD, 3-5 June 2009.
- 8) **McCray, W. Patrick**, Invited commentator, "Instruments and Manufacturing," NSF sponsored workshop at Rice University, June 2009
- 9) **Mody, Cyrus C.M.** and Sonali Shah (Shah presenting), "Innovation, Social Structure and the Creation of New Industries: User Communities as Paths from Innovation to Industry," (Houston: Instruments in Manufacturing workshop, June 18, 2009).
- 10) **Mody, Cyrus C.M.**, "Institutions as Stepping Stones: Rick Smalley and the Commercialization of Nanotubes" (Houston: Instruments in Manufacturing workshop, June 18, 2009).
- 11) **Choi, Hyungsub**. "From the Laboratory to the Factory: An Early History of the Transistor in the United States and Japan," *History and Philosophy of Science Colloquium*, Seoul National University, Seoul, Korea, 4 September 2009.
- 12) **Choi, Hyungsub**. "Interdisciplinary Laboratories: Institutions, Communities, and Disciplines at Cornell University, 1960-2000," *Science and Technology Policy Colloquium*, Korea Advanced Institute for Science and Technology, Daejeon, Korea, 7 September 2009.
- 13) **Mody, Cyrus C.M.**, "Institutions as Stepping Stones: Rick Smalley and the Commercialization of Nanotubes" (Seattle: Society for the Study of Nanoscience and Emerging Technologies meeting, September 9, 2009).
- 14) Johansson, Mikael. "Nanoscientists and the media – a miniscule affair," presentation at S.NET, Seattle, September 8-11, 2009.
- 15) **Choi, Hyungsub**. "Manufacturing Knowledge in Transit: A History of the Semiconductor Industry in the United States and Japan," *School of Electrical Engineering Seminar*, College of Engineering, Seoul National University, 11 September 2009.
- 16) **Mody, Cyrus C.M.** and Sonali Shah (Shah presenting), "Innovation, Social Structure and the Creation of New Industries: User Communities as Paths from Innovation to Industry" (Seattle: West Coast Research Symposium, September 11, 2009).
- 17) **Mody, Cyrus C.M.**, "Microscience/technology and Vietnam-Era Protest at Stanford" (Austin: Microelectronics Research Center talk, October 12, 2009).
- 18) **Hyungsub Choi**, "The Long Tail of the Third Industrial Revolution: Technology Platform and Supply Chain Relationships at SEMATECH," *Society for the History of Technology*, Pittsburgh, PA, 15-18 October 2009 (presenter and co-organizer, with Andrew L. Russell, of the session "Technological History of the Third Industrial Revolution").
- 19) **Mody, Cyrus C.M.**, "Conversions: Sound to Picture, Military to Civilian" (Pittsburgh: annual meeting of the Society for the History of Technology, October 16, 2009).
- 20) Johansson, Mikael. "Our culture consists of being international and speaking English – How nanoscientists in Sweden form a global place by excluding the local community," paper presentation on "STS and Space" panel at 4S, Arlington, VA. October 28-31, 2009.
- 21) Gray, Summer (rapporteur). "Health" breakout session, Emerging Technologies /Emerging Economies: (Nano)technology for Equitable Development conference, Washington, D.C. November 4-6, 2009.
- 22) **Mody, Cyrus C.M.**, "Conversions: Sound to Picture, Military to Civilian" (Maastricht: Sound Studies Handbook workshop, November 21, 2009).

- 23) **McCray, W. Patrick**, "Hidden Histories of Nanotechnology," seminar talk, UCSB, December 2009.
- 24) Mikael Johansson, Organizer, session on "Nanotechnology in Public and Expert Discourses." American Anthropological Association annual meeting, Philadelphia, Dec 4, 2009.
- 25) Mikael Johansson, "The dose makes the poison" – How Nano-toxicologists reason about risk and danger. Paper presented at the American Anthropological Association annual meeting, Philadelphia, Dec 4, 2009.
- 26) **Mody, Cyrus C.M.**, "Context in the Classroom: Co-Teaching Our Way to Societal Dimensions of Nano," (Philadelphia: American Anthropological Association annual meeting, December 4, 2009).
- 27) **Choi, Hyungsub**. "Institutional Origins of Materials Science at Cornell University, 1958-1972," *Tuesday Seminar in History of Science (Ka-Zemi)*, Tokyo Institute of Technology, Tokyo, Japan, 2 February 2010.
- 28) **Mody, Cyrus C.M.**, "Fifty Years of Nanotechnology" (Columbia, SC: Feynman Anniversary Symposium, February 13, 2010).
- 29) **Mody, Cyrus C.M.**, "Fifty Years of Nanotechnology," (Palo Alto, CA: President's Council of Advisers on Science and Technology NNI Review, panel on environmental, ethical, societal, and legal concerns, February 18, 2010).
- 30) **Choi, Hyungsub**. "Semiconductor Technology Licensing in the 1950s," *Forum on Innovation Studies*, Hitotsubashi University, Tokyo, Japan, 9 March 2010.
- 31) Mikael Johansson. "Working for Next to Nothing: Labor in the Global Nanoscientific Community." Paper presented in the panel, "Labor and Morality in the Global Economy," at the *Society for Applied Anthropology Annual Meeting*. Merida, Mexico. March 24-27, 2010.

IRG 2: Innovation Group

Chris Newfield , Leader	English/American Studies	UC Santa Barbara
Gerald Barnett	Technology Transfer	Univ of Washington
John Mohr	Sociology	UC Santa Barbara
David Mowery	Economics	UC Berkeley
Suzanne Scotchmer	Public Policy and Economics	UC Berkeley

Affiliates

Ismael Rafols	Sci & Tech Policy	University of Sussex, UK
Stéphanie Lacour	Law	CNRS, Paris
Shyama V. Ramani	Developmental Economics	INRA, Paris
Daryl Boudreaux	Commercialization	Boudreaux and Associates

4 Grads, 3 Undergrads, 1 Professional staff

<i>Graduate students:</i>	Social Science/Humanities: Kasim Alimahomed, Communication Angus Forbes, Media Arts & Technology Zach Horton, English Adélaïde Veyre, Institut d'Etudes Politiques, Grenoble
<i>Undergraduate Students:</i>	Andrea Tran, UCSB Sean Bronston-Wilson, SBCC Adélaïde Chopard, Institut d'Etudes Politiques, Grenoble
<i>Professional staff</i>	Gerald Macala, Chemistry

IRG 2 --Overview: This group's topic is the impact of the current US innovation system on nanoscale research. Highlights this year include completion of the final 8 of their round of 33 interviews about nanoscale technology transfer, the discovery of a likely positive NNI impact on reporting government interests in nanotechnological patents, the development of a unique international workshop on innovation theory, the successful implementation of Zotero as a medium of long-distance collaborative practice, and the creation of a website clearinghouse to make the team's growing archive of innovation materials available to a wider public.

The group has continued its strong publication performance. With two active senior faculty members—and Newfield occupying an 11-month administrative appointment in France—they have this year 9 articles published or in press, 1 under review, and 5 others in preparation.

As previously reported, our 5-year strategy is to analyze the deep structures of nanoscale research within the U.S. innovation system. The group offers unique perspectives in several ways: by linking the study of societal implications to underlying scientific detail; by integrating qualitative and quantitative methods; by linking the micro, meso, and macro-levels of this system; by focusing on the role of university-based technology transfer as a crucial mechanism of nanoscale innovation; by comparing the US system to selected national systems abroad; and by incorporating a fourth level that we call *innovation culture* into our analysis of nanoscale innovation. Our goal is to improve linkages between nanoscience and nanotechnology (NST) and the larger intellectual currents that are transforming public attitudes towards science, the adoption of technology, and the meanings of upstream and downstream engagement. Our research offers insights about innovation from the humanities and social sciences to science practice; conversely, much of our publishing brings research on nanoscale innovation to audiences in arts, letters, and media studies that are generally out of reach of the NSF. Some of

our work is experimental and high-risk, with potential for original perspectives where these methods succeed.

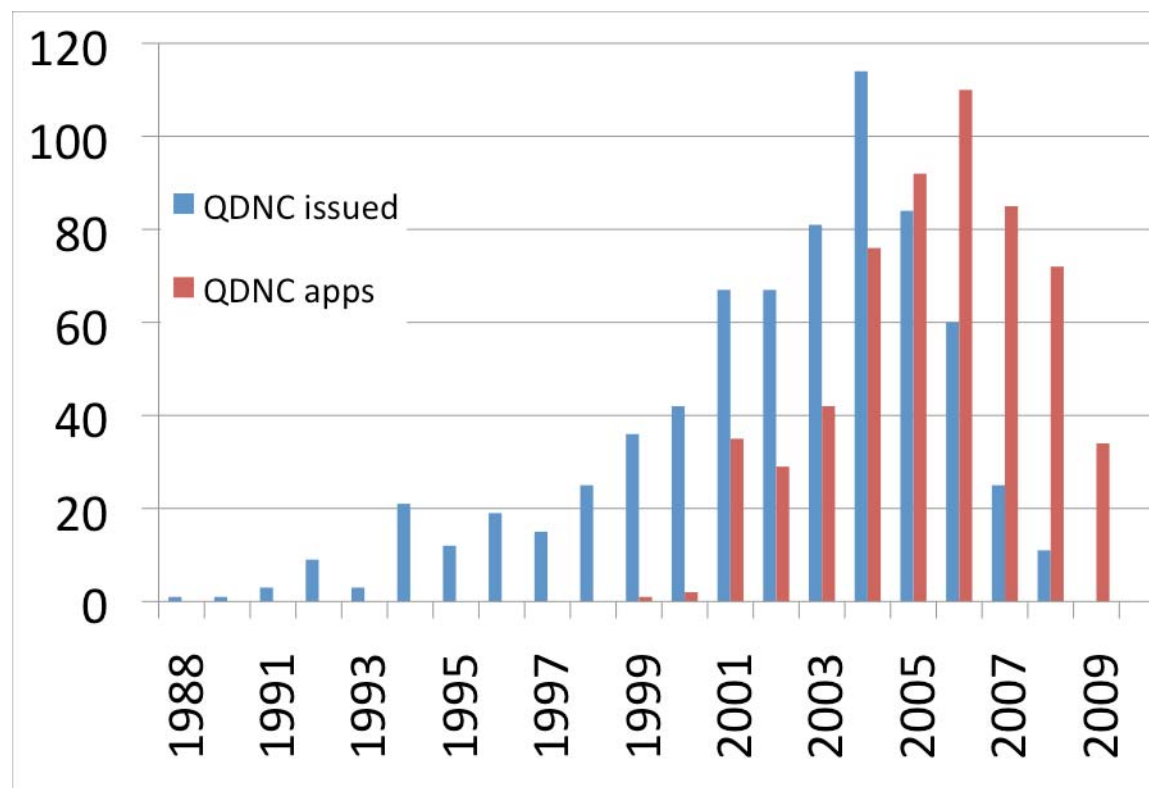
IRG 2-1: On the micro level (Newfield, Alimahomed, Macala) this project investigated laboratory dynamics through in its 2007 collaboration survey. We hypothesized that “nanotechnology” currently functions less as a professional identity than as a term for a subset of specific research activities; that researchers who define themselves as involved in nanoscale research are more inclined to collaborate across interdisciplinary lines; and that interdisciplinary collaboration would be seen less as desirable than as obligatory in nanoscale research. These three hypotheses were confirmed. Though our subjects were receptive to interdisciplinary collaboration at the nanoscale, and could identify limited benefits, we conclude on the basis of our first survey that nanotechnological research will need to develop additional institutional mechanisms if it is to enhance existing rates of scientific collaboration. A publication from this work is currently under review at *Nature Nanotechnology*.

In 2009-10, an attempt to leverage this pilot survey into a national inter-institutional study was concluded after sociologist collaborator Mohr was unable to take the lead on the proposed larger scale project due to overcommitment with other projects and university administrative duties.

IRG 2-2: On the meso level (Newfield, Macala) of the nanoscale innovation system, this project completed analysis on research lineages in and commercial uptake of patents in quantum dots and nanocrystals. As previously reported, the team’s research in 2007 found that the larger “nano” category contained too many diverse and even unrelated developments to be studied as an aggregate group. They then moved to study a specific, high-impact area: Quantum Dots (QD) and related structures that are paradigmatic nanoscale structures, currently bridging “1st generation” and “2nd generation” NST development. QDs have transformative potential in application areas such as biological tagging, light-emitting diodes (LEDs), photographic sensors, and photovoltaic modules. The project goal has been to move beyond aggregate patent counts in relation to particular classes, keywords, and so on, to identify concrete developments in QD-related applications that have been funded through the NNI and related programs. Our focused contact with scientists in the domain confirmed our existing concern that concrete technological pathways could not be identified without qualitative interpretation, without “reading the patents” as attorneys and patent consultants do. Patent counts as used in benchmarking exercises do not provide the kind of information researchers seek. The team’s patent case study will be described below in Stream 3.

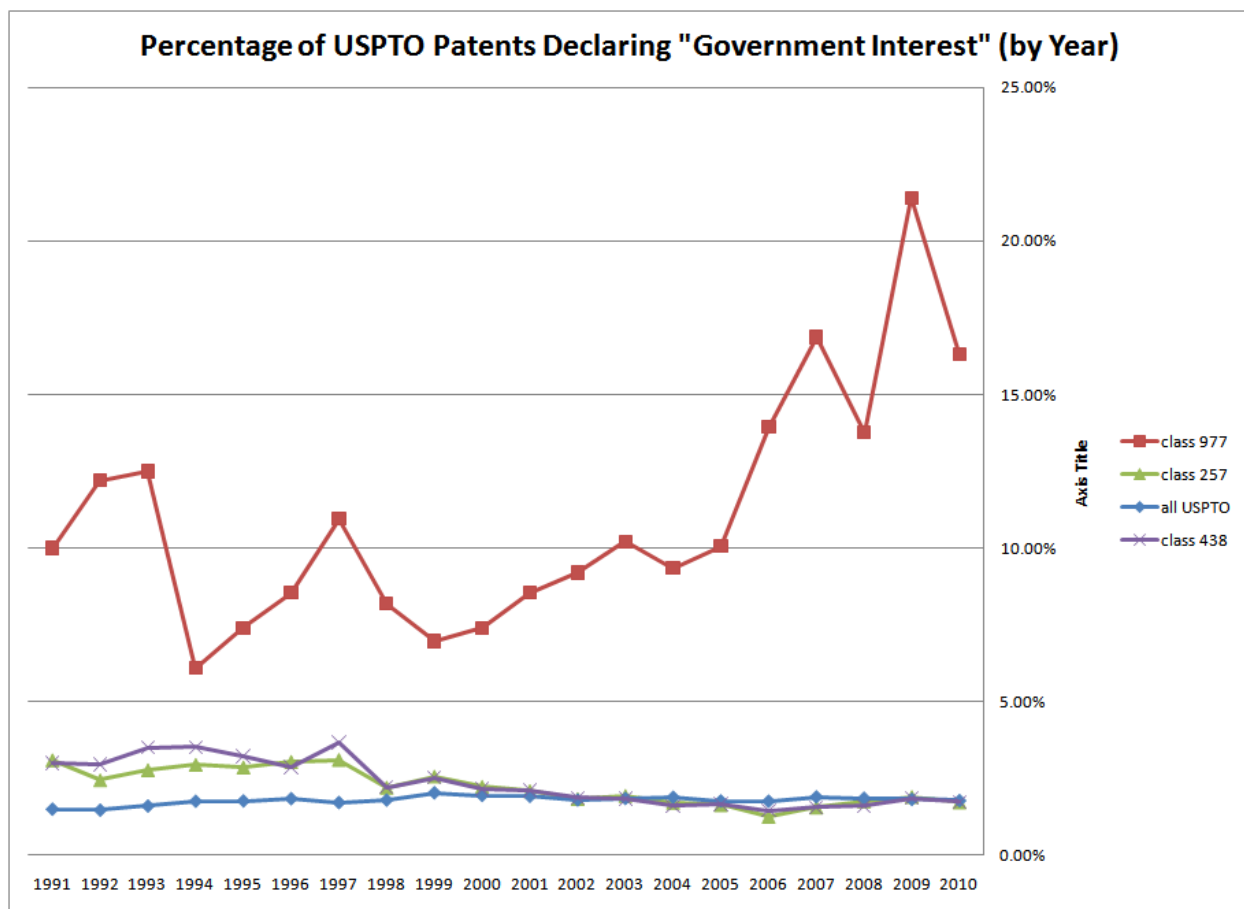
IRG 2-2 has also continued to conduct quantitative analysis on QD/NC, using their custom PHP script for downloading USPTO data and focusing on specific classes and subclasses (977, 257, 438, 428, 117, 372, 385, 435, 252, 436, 250, 423, 359, 136, 365, 427, 430, 313). Last year, they found an important anomaly in the QD/NC data. Contrary to the general trend of ever-increasing numbers of nanoscale patents in the 977 USPTO class and related classes, QD/NC patents issuances and applications seemed to be in decline. The most likely explanation was that the multi-year delay between applications and issuances caused an artificial lowering of the number of issued patents in recent years.

This year the team used updated USPTO data (February 2010) to determine that *applications* are also in decline.



Since applications are also in decline, the group appears to have found a shift away from QD/NC patenting. They are currently preparing a publication that compares patent to publication counts in this area and that offers several interpretations of this data, but at the very least they are looking at an important area of nanoscale research that is not escalating as expected. The group proposes a possibly widening gap between research and development that may be suppressing incentives to patent, and argue that this phenomenon needs more careful monitoring than it has received.

In 2009, they opened a new area of inquiry with nanoscale patents, here moving back to nanoscale patents as a whole. In keeping with Stream 4, described below, they sought an empirical basis in patent data on which to rest their NNI-based science development narratives. They identified as one likely source the required reporting of a “government interest” in patents developed in part with federal funding. In principle, such notification in the patents could be cross-referenced with government agency technology transfer reports, since [U.S. Code](#) (Title 15 Chapter 63 Sec. 3710(f)(2)b) requires federal agencies to report on their technology transfer programs’ patent output. This research dovetails with the NNI’s desire to show its direct impact on inventions and innovations in public use, with the goal being to move beyond benchmarks that depend on aggregate patent counts.



They have found the following: (1) overall rates of declaration of the Government's Interest fall well below an assumed level of ~28% (the approximate federal share of all R&D); (2) the 977 class declares a Government's Interest at far higher rates than co-occurring classes, e.g. classes 257 and 438 (correlated in our previous analysis with solar technology); (3) increased Class 977 declarations roughly correlate with the existence of the NNI. They speculate that the NNI may have created heightened awareness among patentees of nanoscale R&D's public status – of both public impacts and public participation via funding. On the other hand, data allowing confirmation of this or competing interpretations is not actually available. The group is currently preparing a paper on this topic, which will include recommendations for improved data collection and reporting.

The case study for this research – nanoscale photovoltaics-- is designed to complement standard patent studies: their evolving work on nano-enabled solar photovoltaics. This year they conducted a review of technical literature in order to develop boundaries around "nano"-enabled PV research, created an inventory of federal research programs in this domain, and developed an archive of commercial PV news which we are in 2010 starting to convert into a formal database that enables the correlation of publications, patents, and commercial information. This work has allowed them to confirm that PV applications of QD are lagging behind applications involving biological tagging and displays. This is because tagging and photovoltaics involve two classes of applications. The simpler class involves the manipulation of light by the quantum structure, e.g. emission of a photon from a bio-tag or the re-emission of absorbed light as found in recent image intensification innovations. The second class appears in PV applications, which must manage the decoupling of photogenerated excitons, move the electrons and holes to respective electrodes (managing resistivity) and also across the interface barriers into the electrodes. Building a material

that does all this and does it efficiently poses greater challenges than does a QD bio-tag. Such PV-QD materials are “active” nanostructures. While at least one recent study suggests that nanoscience is already transitioning from passive to active nanostructures, IRG 2-2’s case study domain suggests that most practical applications of active nanostructures remain at least five years in the future.

The group continues to monitor the case law and the company news that bears on the patent data of special interest to us, and to seek patent licensing information that is not systematically made public. While patent filings continue to suggest that important nanoscale solar energy research moves ahead in the United States, market developments operate independently of this R&D. China has grown its share of the California solar market from 2% to 46% percent in 3 years, while the US share has fallen 16%. Given the gaps between scientific research, patenting, and economic developments, it is important to monitor all three at once.

As noted, the group’s methodological findings are leading them to recommend the formation of a federal repository of research outcomes--discoveries, patents, licenses, products with commercial sale or use. Better federal records would improve the country’s understanding of the research process, and would enable accessible narratives of technology development that would increase public interest and support.

IRG 2-3: The *macro level--technology transfer policy* (Newfield, Mowery, Barnett, Scotchmer)

Since the passage of the Bayh-Dole Act and related legislation starting in 1980, US technology transfer from university to industrial contexts has been governed by the wish to support “use-directed” basic research via intellectual property rights. The NNI is very much part of this post-1980 trajectory in science policy. In recent years, economists have produced more mixed opinions as to the effects of “strong” IPR in our current “pro-patent” era, focusing on such issues as the heterogeneity of the quality, the cost, and the scarcity of ideas, and on conflicts between private and social optimality (Mowery as a scholar and Barnett as a practitioner have played exemplary roles). This year, the group has continued its investigations of the optimality of tech transfer institutions and of the US innovation system on several fronts.

Mowery is reporting one paper this year. It discusses the relevance to renewable energy development of the R&D programs that produced major computer industries in the US after World War II. Mowery concludes that these precedents have limited relevance for alternative energy, where programs have tended to combine instability in R&D funding with little systematic effort to support demand for early versions of new technologies. Nanotechnology programs have not so far developed the kind of procurement policies that supported various parts of the computer industry, but should perhaps consider the implications of this precedent. Another in preparation argues that nanotechnology’s emergence from mission-directed federal programs is not a novel feature; nanotechnology’s novelty is instead its emergence in the “pro-patent era of stronger intellectual property rights,” which may eventually impair research progress.

Newfield completed the final 8 of 33 interviews on nanoscale technology transfer policy. This series covers a three-year period, and a publication on the findings is in preparation. The 2006 and 2007 interviews had already suggested that neither technology transfer professionals nor principal investigators involved with NST felt that it required novel transfer mechanisms. Given the excitement around NST’s potential for science, society, and the economy, the team was somewhat surprised by a lack of excitement in the possibility of systemic reforms motivated by NST’s special features. The current system of “strong” IPR seemed adequate to nearly all interview subjects, in contrast to concerns raised by some legal analysts about early patenting in what is arguably a “general purpose technology.” However, the study does report interesting

findings on the implications of research consortia and related structures for academic research, particularly for younger researchers. These findings suggest the need for deeper analysis of the limitations of the current tech transfer system for promoting the kind of self-organized research relationships that have benefitted science in the past.

Barnett, a tech transfer practitioner and director of the Research Technology Enterprise Initiative at the University of Washington, continued to develop a “technology translation” model focused on developing research communities that would support NST as an early-stage technology. He co-wrote a “National Innovation Initiative” that targets young companies with federally supported technology under management, offering a hybrid debt/investment growth strategy and access to regional value chains. Barnett is also working with GreenXchange and Science Commons, as well as with a new initiative to create a super-regional “Pacific Northwest Center for Innovation” covering western Canada and the northwestern US, conducted workshops in Singapore, Malaysia, and various research centers in the U.S., and was tapped to help the University of Oregon School of Business sort out an entrepreneurship program.

In response to a request from the California Council on Science and Technology for information to present to the PCAST board reviewing the NNI in January 2010, Newfield and team performed a rough calculation of the employment base of “nanotech industry” in California. California has about 430 nanotech companies according to NSTI data) and the US has 1804 companies for the U.S. overall, meaning that California has just under 25% of all U.S. nano companies. The NNIN suggests that the US might have 900,000 nanotech jobs by 2015. If California retains its 10% share of US manufacturing employment, it would have about 90,000 nano-related jobs by 2015. If California’s share of nano-related employment is closer to the share of all industry-filed patents held by California-based companies (about 25%) then California might have as many as 200,000 jobs. Since California nonfarm employment currently stands at somewhat over 14,000,000, nanotech would supply between 0.6% and 1.4% of California nonfarm jobs in 2015 (using the 2010 base). Using Census data to get a defensible order of magnitude for 2007 data, the team estimates that California had between 4115 and 19,504 nano employees in California in 2007, between 0.02% and 0.14% of total employment in that year. There may be limits on NST’s job impact: biotechnology is a flagship California industry, and yet it employs only about 50,000 people in California (and 200,000 in the US overall). The group’s conclusions are, first, that NST has yet to have a significant impact on employment, and secondly, that simple growth in markets, when it does begin to occur, cannot be assumed to lead to major employment growth without more deliberate policy.

Sustaining nanoscale research funding in universities requires that universities are able to support that research, including substantial costs for “facilities and administration,” often known as “indirect costs.” This year, our study of nanoscale research arrangements indicated that NST is following existing extramural funding patterns. In an article in the *Chronicle of Higher Education*, Newfield and Barnett presented summary findings of large and systematic shortfalls between full costs and the actual direct and indirect cost payments universities receive. Their primary example was the campus match required by one of Arizona State University’s nanoscale research centers. This piece had an immediate impact, judging both from the volume of correspondence we received from research administrators and from the article’s appearance in a presentation on research funding given to the University of California Board of Regents by the University’s Vice-President for Research and Graduate Studies, Steven Beckwith. Recommendations similar to Newfield’s and Barnett’s—including immediate increases in indirect cost recovery rates to make up shortfalls—have appeared in the working groups for UC’s Commission on the Future. The team is continuing this research this year, and are optimistic that

the university research environment can be stabilized in a way that supports often costly NST work.

Newfield attended two meetings in Brussels in which senior US research officials told appreciative European audiences that “the U.S. is back” in terms of levels of R&D funding. This was true of the overall stimulus and for some overall agency budgets. The project began a study of the funding pipeline for nano-enabled solar photovoltaics to see if advanced research in renewables had been so fortunate. The percentage increase they have found so far (at DOE) is healthy but the base is very small. They will recommend that enthusiasm for the most ambitious NST research be accompanied by higher levels of funding, particularly for “3rd Generation” technologies that seek to go beyond the Shockley-Queissar limit.

Finally, Newfield is using his administrative position at a UC study center in France to start a comparative project on technology transfer practice. He began an association with Stéphanie Lacour last year, a legal academic posted with France’s CNRS unit in Ivry-sur-Seine and the leader of a unit studying IP standards in emerging technologies (“Normativités et nouvelles technologies”). They are initiating a comparative study of IP regimes in the US, France, Germany, and the UK, extending the case-study method we have been developing in the group. A parallel collaboration is underway with Dr. Shyama V. Ramani of the Department of Economics at the National Institute for Agricultural Research outside of Paris. Ramani is a specialist in innovation economics with experience on feasibility studies of low-cost technologies for everyday needs, including important work on the diffusion of toilets in the Indian countryside. Newfield’s article on elements of the US innovation system most relevant to middle- and low-income countries’ nanoscale development will appear in a volume on Developmental Nanotechnology edited by Ramani.

IRG 2-4: Cultures of innovation (Newfield).

This research stream takes off from the fact that research developments need to have a basis in everyday cultural practices and social innovation in order to have sustained social and economic impact. In a series of published papers, Newfield has analyzed NNI-related forms of reporting of R&D results in order to assess the effectiveness of their modes of public address. Policymakers are more interested than ever in public engagement, and they have some standard mechanisms that aim at creating partnerships between the public and the government. Government agencies try to communicate with society through procedures such as “public comment,” focus groups, town halls, and other mechanisms of structured feedback that involve up-front education. Though these can lay the groundwork for social partnerships, they are labor-intensive, highly localized, expensive, and not scalable to society as a whole (Pidgeon et al. 2009). These mechanisms are less common on technical subjects where most of the public lacks the background to participate equitably or even feel interested in the first place.

Using his skills as a narrative analyst, Newfield examined dozens of reports on nanoscale research from the NSF, DOE, DOD, and the NNI itself. The primary question was whether any of these agencies offer narratives of the trail “bench to bedside” that would inspire the kind of public interest in nanotechnology that fictional and non-fictional narratives alike are known to inspire. He was unable to find examples of descriptions of the actual trails of scientific development that the government makes possible. The world of the laboratory – its PIs, graduate students, staff, technicians, and private and public funders—was not articulated. Results were presented as isolated discoveries rather than as part of a collective enterprise that overcomes dramatic obstacles in order to make a better world. NST work is in fact as replete with conflict and excitement, success and tragedy, as any successful television series. These papers recommend the creation of *innovation narratives* tied to high-impact research as well as to application

development that tell great stories and get the public behind the funding and heroic effort of breakthrough NST. If we can't have moonshot funding, Newfield argues, the US should at least stir up moonshot exuberance.

Finally, it is worth pointing out that many of Newfield's publications are geared toward disseminating the results of NSF research to non-NSF communities in the human sciences, in order to improve communication across the "two cultures" divide that limits the broader impacts of the sciences and humanities alike.

Summary: as can be seen from this overview, IRG2 has a large volume of work at various stages in the publication pipeline. A compressed summary of findings runs as follows:

IRG2-1: Although NST depends on interdisciplinary collaboration, it is unlikely that this collaboration will in general move beyond information exchange toward "deep collaboration" without the deliberate creation of incentives for such practices within existing interdisciplinary centers.

IRG-2: Although class 977 patents report government interests at a far higher rate than do USPTO patents as a whole, patents neither record public investments in a traceable way nor literally and directly reflect innovation. Technological developments cannot be correctly interpreted without a richer mixture of data and interpretative practices.

IRG-3: Technology transfer institutions are not developing new practices specific to nanoscale R&D, but the status quo approach is unlikely to lead to the hoped-for societal impacts, either in terms of employment or accelerated social uptake.

IRG-4: Current federal agency presentations of NNI-related findings do not constitute effective public engagement. Richer reporting and narrative development should be put in place.

IRG 2: Publications and Presentations in 2009-2010

Publications

- 1) **Chris Newfield**, "L'Université et la revanche des 'élites' aux États-Unis," *La Revue internationale des livres & des idées* (Mai-Juin 2009): 28-29.
- 2) **Chris Newfield**, "Structure et Silence du Cognitariat," *Multitudes* 39:69-78 (October 2009). A differently edited English version (**3E**) is included as a PDF, and can be found at <http://www.eurozine.com/articles/2010-02-05-newfield-en.html>
- 3) **Chris Newfield**, "Why Public is Losing to Private in American Research," *Polygraph* 21 (October 2009): 77-95.
- 4) **Chris Newfield**, "Is the Corporation a Social Partner? The Case of Nanotechnology," Afterword in *Cultural Critique and the Global Corporation*, ed. Purnima Bose and Laura E. Lyons, pp. 215-224 (Indiana University Press, 2010).
- 5) **Chris Newfield** and **Gerald Barnett**. "The Federal Stimulus Should Support Research at Public Universities." *Chronicle of Higher Education* Jan 3, 2010. Available at: <http://chronicle.com/article/The-Federal-Stimulus-Should/63354/>
- 6) **Chris Newfield**, Review of: Steven Shapin. *The Scientific Life: A Moral History of A Late Modern Vocation, Technology and Culture* (forthcoming 2010).
- 7) **Chris Newfield**, "Science Out of the Shadows: Public Nanotechnology and Social Welfare," "States of Welfare" Special Issue, *Occasion* 1.2 (forthcoming 2010). (first issue available at <http://arcade.stanford.edu/journals/occasion/issues>)

- 8) **Chris Newfield**, "Avoiding Network Failure: the Case of the National Nanotechnology Initiative," in Fred Block and Matt Keller, *State of Innovation: U.S. Federal Technology Policies, 1969-2008* (New York: Paradigm Press, forthcoming 2010).
- 9) **David Mowery**, "Federal policy and the development of semiconductors, computer hardware, and computer software: A policy model for climate-change R&D?" In Rebecca Henderson and Richard G. Newell, "Accelerating Energy Innovation: Lessons from Multiple Sectors" (forthcoming NBER, 2010).
- 10) **Chris Newfield**, et al., "Is Nanotechnology Changing Scientific Collaboration? Survey Evidence from a Nano-oriented Campus." Under review at *Nature Nanotechnology*.

In Preparation:

- 1) **G. Barnett** and **C. Newfield**, "Is Nanotech Ending the Bayh-Dole Era": Interviews with Technology Managers and Nanoscale Investigators"
- 2) **C. Newfield** and J. Macala "Do Patents Measure Innovation? Lessons from a Quantum Dot Case Study"
- 3) **C. Newfield** and J. Macala, "Can Patents Tell a Public Interest Story? Rates of Reporting Government Interests in Nanotechnology Patents"
- 4) **C. Newfield** and **D. Mowery**, "Does Nanotechnology need Employment Policy?: the Case of California Nanotech"
- 5) **C. Newfield** and K. He, "What is the Federal Government's Commitment to Nanoscale Solar Energy: A Survey of Funding Changes in the Obama Administration"

IRG 2 Presentations 2009-2010

- 1) **Chris Newfield**, "Premonitions of Deliverance: The University and Global Science," Conference on the Global University, La Sapienza, Roma, June 2009.
- 2) **Chris Newfield**, "What is Open Innovation at the Nanoscale?" CNRS Meeting on Nanotechnology and Global Development, Ivry-sur-Seine, June 2009.
- 3) **Gerald Barnett**, "Small Company Perspectives," National Governors Association Best Practices Workshop, San Francisco, CA, June 2009
- 4) **David Mowery**, "Nanotechnology: A 'New Wave' for the U.S. National Innovation System?", keynote address, meeting of the Society for the Study of Nanoscience and Emerging Technologies, Seattle, WA, September 10, 2009.
- 5) **David Mowery**, "Federal policy and the development of semiconductors, computer hardware, and computer software: A policy model for climate-change R&D?" Accelerating Energy Innovation: Lessons from Multiple Sectors, NBER, Washington DC, October 2009.
- 6) **Gerald Barnett**, "Innovative IP Management and Licensing," Association of Independent Research Institutes Annual Conference, Seattle, WA, October 2009
- 7) **Gerald Barnett**, "Beyond Licensing: Maximizing the Impact of University Technologies," State Science and Technology Institute Annual Conference, Overland Park, KS, Oct 2009
- 8) **Chris Newfield**, "The End of the American Funding Model: What Comes Next," FOREDUC, University of Paris – X, Nanterre, December 2009.
- 9) **Chris Newfield**, "The U.S. Innovation System: Elements for Middle-Income Countries," CNRS Meeting on Nanotechnology and Global Development, Ivry-sur-Seine, January 2010.
- 10) **Harthorn, Barbara Herr** and **Chris Newfield**. Provided extensive testimony documents for PCAST/OSTP review of the NNI to CCST Director Susan Hackwood for her PCAST presentation. January 18-19, 2010. Washinton, D.C.
- 11) **David Mowery**, "Federal R&D and the Development of U.S. IT: A Model for Climate-Change R&D?" invited presentation, Breugel Institute, Brussels, Belgium, February 22, 2010.

Meetings attended

- 1) **Gerald Barnett**, Regional, State, and Local Initiatives in Nanotechnology, Oklahoma City, OK, April 2009
- 2) **Gerald Barnett**, Named Advisory Board Member, GreenXchange Launch Planning Meeting, Hillsboro, OR, Sept 2009

IRG 3: Nanotech Risk Perception and Social Response

B. Herr Harthorn , Leader	Anthropology	UC Santa Barbara
B. Bimber	Political Science	UC Santa Barbara
N. Pidgeon	Social Psychology	Cardiff University, UK
T. Satterfield	Environmental Risk	University of British Columbia, CA
M. Kandlikar	Science policy	University of British Columbia, CA

Affiliates

E. Barvosa	Chicana/o Studies	UC Santa Barbara
F. Bray	Anthropology	Edinburgh University, UK
K. Bryant	Sociology	SUNY New Paltz
J. Conti	Sociology, Law	University of Wisconsin, Madison
W. Freudenburg	Sociology	UC Santa Barbara
E. Gwinn	Physics	UC Santa Barbara
H. Haldane	Anthropology	Quinnipiac University
P. Holden	Microbiology	UC Santa Barbara
T. Rogers-Hayden	Environmental risk	University of East Anglia, UK
J. Summers	Physics, Engineering	MIT

1[+2] Postdocs, 9 [+6] Grads, and 2 Undergrads

<i>Post-doctoral researchers:</i>	*Jennifer Rogers, Sociology; *Gwen D'Arcangelis, Women's Studies, beg. Jan 10 <i>International:</i> Adam Corner, Social Psych (Cardiff UK)
<i>Graduate students:</i>	<i>Social science/humanities:</i> Meredith Conroy, Poli Sci Indy Hurt, Geography Christine Shearer, Sociology Silke Werth, E.Asian Lang & Cultural Studies Qian Yang, E.Asian Lang & Cultural Studies *Cassandra Engeman, Sociology, beg. May 2009 * Lynn Baumgartner, Env Sci & Mgt * Ben Carr, Env Sci & Mgt * Allison Fish Env Sci & Mgt * John Meyerhofer, Env Sci & Mgt <i>Nanoscience:</i> Erica Lively, Electrical Engineering Tyronne Martin, Chemistry <i>International:</i> Christian Beaudrie, Environmental Risk (U-BC) * Laura Devries, Environmental Risk (U-BC)] Adelaide Veyre, Sociology (EAP, France; intern)
<i>Undergraduate students:</i>	UCSB: Javier Martinez Community college: Ryan Shapiro *co-funded from another source

The IRG-3 risk perception group aims to use mixed qualitative and quantitative methods to study the views and beliefs about emerging nanotechnologies by multiple parties, by which we mean people in numerous social locations and positions—nanoscale scientists and engineers, nano risk assessment experts, regulators, industry, NGOs or other social action and special interest groups, and members of the public who differ by gender, race/ethnicity, class, occupation, education, and age, as well as nation. Quantitative methods used include standard, psychometric and experimental phone and web surveys of the US general public and experts including scientists and engineers, regulators, and industry leaders, and experimental research on factors

driving group polarization in emerging nanotech debate; qualitative methods provide a substantive basis for and validation of quantitative results and include mental models interviewing, expert interviews, and deliberative public engagement regarding the risks and benefits of specific applications of nanotechnologies. In the past year, researchers in this group in IRG-3 performed work in the main areas detailed below.

The Social Response team in IRG-3 has aimed at understanding the processes by which nanotechnologies come to be recognized by the public as an object of politics and societal relevance, with a focus on processes of framing and agenda-building. This group has focused in the past on how the media frame ideas about nano, and now in the past year they are turning to study how specific frames affect measurable attitudes in citizens.

The group also planned for and convened a Nano Risk Perception specialist meeting Jan 29-30, 2010 in Santa Barbara—Harthorn, Pidgeon & Satterfield worked together throughout the past year developing the aims for this meeting, recruiting key scholars, developing the program, and writing 2 white papers (Harthorn, Satterfield) and a synthetic overview by Pidgeon that will become the cornerstone for the planned special edition of *Risk Analysis* the 3 co-organizers plan to develop out of the meeting. The meeting convened over a dozen leading international scholars who prepared white papers for the sessions; IRG 3 collaborators Kandlikar, Haldane and Conti served as discussants; leading scholar Paul Slovic gave a concluding overview about the implications of the research presented for risk perception theory and knowledge, and for risk communication.

IRG 3-1: Expert Judgments about Nanotechnologies' Benefits and Risks Harthorn, Satterfield, Kandlikar (leaders); Beaudrie, Bryant, Conti, Gwinn, Haldane, Holden, Martin, Pidgeon, Summers.

IRG 3-1a: Expert Interviews-NSE & Regulators (Haldane-NSE; Conti-Regulators)

In 2009-10, the UCSB team continued analysis and write up of 90-minute NSE and Nanotox interviews conducted by Harthorn and Bryant in California (and Satterfield and Kandlikar in Canada) in 2006-08, and anthropologist Haldane piloted a new instrument to add a set of new respondents from the US upper northeast nano research world, work planned for summer 2010. There seem to be several different forms of expert risk attenuation in evidence in these earlier interviews, and although the upstream context and scientific uncertainty of near-term hazards make assessment complex, it is also potentially crucial as an interaction in any process of 'responsible development' of nanotechnologies. Over the same period, the UBC team has used these qualitative interviews in the development of a new survey instrument for use in a web survey of NSE and nanotoxicology experts (see below).

Haldane is focusing in her work on the **NSE interview** data on aspects of gender and scientific labor, from a cultural analytic perspective. She presented a paper on this at the AAA meetings in Dec 2009, and has been invited to revise this for submission as part of the CNS *Social Life of Nano* volume. She will conduct a series of interviews in summer 2010 with NSE women and men in the Northeastern US in centers of NSE intense research to extend the project database. Harthorn and Bryant continue involvement in this project and are planning joint paper production with Haldane. Key issues include gender differences among experts in risk attenuation, attitudes toward the public and media, direction of labor (tech development) toward social goals, and organizational aspects of laboratory practice.

Another component of expert study that will focus on **nano regulators and policymakers** has been in development over the past year and a half by former CNS fellow, Joe Conti, now an Asst

Prof. of Sociology and Law at UW Madison. Even though he is in his first year in a new tenure-track position and has been publishing a book on his dissertation on international regulation and disputes in the WTO, he has nonetheless gathered literature related to nano-regulation; attended web press conferences on nano-regulation; and made contact with nano-science and social studies of nano community at UW Madison in readiness for this work. In June 2010 he will relocate to Washington DC for an extended period and plans to initiate a series of interviews with US nano regulators to explore their comparative interagency views on issues of regulating nanomaterials and nano-enabled technologies. His prior work with IRG3 as a key collaborator on the 2008 public risk perception survey and the 2006 industry EHS survey has attuned him to the protocols and risk perception issues of interest, and his unique background as an expert on international governance provides an extremely useful comparative framework. Conti, Harthorn and Satterfield plan a brief policy-oriented paper on the regulation/regulator-relevant issues that have emerged in the 2008 public risk perception survey (and possibly the new 2010 industry survey). This work connects directly to the expert web survey project, and the teams have been coordinating closely.

This work also will interface well with the UBC team's analytic work on ***regulation across the life cycle*** and both studies link well to the UC CEIN's interests. In 2010, the UBC team completed a study of regulatory gaps across life cycle of nanomaterials, led by Christian Beaudrie under the supervision of Kandlikar and Satterfield; this is resulting in a commissioned report that the Chemical Heritage Foundation is currently readying for public release (April 2010).

IRG 3-1b: Expert Web Survey

The UBC team is taking the lead on a new expert study to be based on a large web survey of 3 pools of US experts: Nanoscale Scientists and Engineers (NSE), Nanotoxicologists and Regulators. In the past year this has involved working with the UCSB Social Science Survey Center, which will host the survey for us, gaining IRB clearance at both UCSB (Harthorn) and UCSB (Satterfield), and extensive protocol development in reference to the expert interview data (above). Extensive work has gone into sample frame design and construction for the 3 pools of experts. These samples are now complete and are being cleaned for upload to the web survey site at UCSB. The survey protocol for the expert survey is complete, has been uploaded at the survey center, and has been pilot tested. Revisions of protocol are complete and one more pilot will be conducted shortly, after which survey will be launched/data collection will commence by mid- to late-April 2010. This work links directly to the interview work above, allowing translation and testing of ideas that emerge initially in contextually rich interviews to determine their distribution across a broad array of respondents in different disciplines, institutions and with different demographic and experiential profiles. The study explores experts' views on physical or technological risks, societal risks and benefits, laboratory practices (where appropriate), and regulatory challenges for nanomaterials (NMs) and nanoenabled products.

We anticipate a number of synergistic activities of this work with our public perception work and with the UC CEIN, and in general anticipate this work will allow us to better understand disciplinary and other contextual differences among the emergent risk assessment community and their counterparts in basic and applied NSE. This work builds on the foundational work of Satterfield's collaborator, Paul Slovic, on comparative toxicological assumptions of experts and lay persons.

IRG 3-2: Public Participation in Nanotechnology R&D: Upstream Engagement and Deliberation Research (Harthorn, Pidgeon, Bryant, Rogers-Hayden, Satterfield, Rogers, Hurt, Martin, Shearer; Veyre)

The first set of CNS-UCSB comparative deliberations in California and the UK were completed in 2007, and extensive data analysis in NVivo was conducted over the remainder of the year and into 2008. The first publication on this work came out in *Nature Nanotechnology*, on-line in Dec 2008, and hard publication in Feb 2009. The group is still working on the longer companion piece to this study which will explore at greater length the application-based differences in attitudes they found so pronounced, the more subtle but important cross-national differences and surprising similarities, attitudes about trust, responsibility, and regulation, which also vary more intensely by application than by country in this study. In addition, the study allows us to explore cultural constructs of the domains of health and energy which form the backdrop for the views about nanotechnologies in those application areas. The project has the great advantage of reviewing these results in the context of the Cardiff and UEA group's extensive comparative experience with other nano and non-nano public engagement efforts in the UK. The team anticipates submitting this longer piece for review by summer 2010. This study also provides invaluable comparative data for the 2009-2010 study.

Co-Funding*: To extend this work and follow the very suggestive gender differences that emerged within all the groups in the 2007 workshops, Harthorn (and Bryant) sought and received additional funding from NSF for new research to explore these phenomena more systematically. Combining work on gender and risk perception with research on women in science and public attitudes to science and technology, the new study examines gender as a between group variable in 6 deliberative workshops plus one pilot, conducted in the US in summer and fall, 2009. Postdoctoral scholar feminist sociologist Jennifer Rogers joined this project in January 2009. The project has employed a modified version of the same protocol and a very similar approach to the 2007 workshops in a series of 6 deliberative workshops in California in Sept-Oct 2009, focused again on health and energy applications, and varying group composition by gender (a 2x3 design with all women, all men, and mixed gender groups). We conducted a 7th pilot workshop in summer 2009 to familiarize the team with facilitation practices and nano deliberation contexts. We also took the opportunity to explore in this pilot the effects of use of electronic polling devices in small group deliberation.

The workshops were completed on schedule in Santa Barbara, facilitated by Harthorn, Rogers, and Martin (and Hurt in the summer pilot). Work entailed extensive revision of the protocol, obtaining IRB clearance, piloting the new protocol (July 2009) at UCSB. Full transcription and attribution, that allows the team to follow individuals through the 5-hr workshop, from large group to small and back to large, has been extremely tedious, but full, cleaned transcripts were completed in March 2010, and data analysis in progress. The team has been active in dissemination: Harthorn prepared a commissioned paper on gender and risk perception for Center for Workforce Devt. at U Wash (Sept 2009), the team has given presentations drawing on this material at the Sept S.NET conference (Rogers et al.), 4S in Oct 2009 (Harthorn), NanoEquity in Nov 2009 (Harthorn), AAA Dec 2009 (Rogers et al.), at the Nano Risk Perception meeting Jan 2010 (Harthorn et al.), at the Society for Applied Anthropology, March 2010 (Rogers et al.), and the Pacific Sociological Assoc Apr 2010 (Rogers et al.), with a number others in the works. Plans include development of a series of papers and chapters for publication exploring the profound gender differences in technological attitudes revealed in surveys (our own included) and in this study.

The Cardiff team is taking on a key writing task for the *Social Life of Nano* edited volume, an overview/synthesis of nano public engagement provisionally entitled: "Nanotechnologies and upstream public engagement: dilemmas, debates and prospects?" Good progress has been made on the chapter so far – in particular, they have created a comprehensive and up-to-date

database of public engagement projects. The criteria for inclusion are that projects were documented by either peer-reviewed publications, or reports that reflected on data and methodology. This database will serve as part of the chapter, as an anchor for CNS discussions in the volume and other venues of the debates around upstream engagement.

In addition the Cardiff team was asked to submit a brief memorandum to the House of Commons Science & Technology Select Committee inquiry on the Regulation of Geoengineering. The Memorandum was submitted, arguing that any investment in the physical science of geoengineering should be pre-empted by investment in social science too – so that public engagement on geoengineering can be as upstream and effective as possible. The memorandum drew explicitly on CNS funded work (Pidgeon et al, 2009: *Nature Nanotechnology* publication) and the field of upstream engagement in nanotechnology more broadly. This work demonstrates the applicability of NNI-funded upstream nano research to other emerging technologies and its potential contributions to regulatory decision making.

IRG 3-3: Emergent Public Perceptions of Benefits and Risks (national survey) (Satterfield, Pidgeon, Harthorn, Kandlikar, Beaudrie, Conti, D’Arcangelis, Corner, Devries)

IRG 3-3a: Public perceptions, construction of preference

We developed and put in the field as a phone survey in summer 2008 a new national US survey of public perceptions of nanotech benefits and risks. The survey was based on a novel instrument we developed that included a number of experimental components using vignettes and brief narratives to examine the differential effects of provision of risk vs. benefit information on resultant risk judgments, and was designed to explore the effects of a number of theorized factors on risk (attitudinal variables re: science, worldviews & social vulnerability; sociodemographic variables--race & gender, religion, political orientation, cultural orientation; scales on vulnerability, stigma, trust; and more). The team has been analyzing data since Fall 2008. Unlike public opinion surveys on nano, this research is better characterized as experimental risk perception research that explores systematically the interactions of attributes of perceivers, several sets of factors (trust, affect, vulnerability, attitudes toward science), and contextual variables such as application domain (health, energy, food, etc), on nano risk and benefit judgments. Results indicate a robust set of findings that will add to the growing literature refining public attitudes and perception of risk in response to particular frames and conditions. The team is far along in preparing a series of papers from this work, focusing on key contextual, experiential, affective, and demographic factors that seem to be driving nanotech perceived risk, perceived benefit, reversals of judgments about risk vs. benefit, and construction of preference. The first of these is under review at *Risk Analysis* (Conti et al.), and 2 more will be submitted shortly. Additional analyses are in discussion in collaboration with Cardiff, UCSB, and U Wisc teams.

As a part of this work and to ensure the distinctiveness and comparative merit of our own work, Satterfield and her UBC team conducted a quantitative meta-analysis of survey research from 2002-2009 in the US, Canada, Europe, and Japan on nanotech attitudes and risk perception. This work was published as a full research paper in 2009 in *Nature Nanotechnology*, was the subject of additional commentary from several leading researchers in that volume, and has drawn considerable interest and attention. The work found familiarity low and benefit centric views dominating 3 to 1 over risk centric views. However, it also highlighted evidence of potential malleability of public concerns, with 44% of respondents on average saying they were ‘not sure’ about the benefits vs. risks of nanotechnologies. This ‘unsure’ response is mirrored in our deliberative research, where it is also highly gendered.

IRG 3 plans for the next 5 years include another national survey in the US, and experimental decision pathway analysis. The Cardiff team is already at work pursuing an application for funding in the UK to conduct a UK survey in 2011-2012 in parallel with CNS Phase II survey.

IRG 3-3b: Environmental Risk Perception Survey (Satterfield, Harthorn, D'Arcangelis, Devries)

Co: funding: Primarily funded through the UC CEIN IRG 7, the team is building on the 2008 CNS survey and currently developing a new, experimental web survey instrument to explore public perceptions of the risks posed to different environmental media (air, water, soil) by specific nanomaterials. Lack of available psychometric research on environmental risk perception has necessitated foundational mental models research in Canada and the US in preparation for instrument development, as well as a series of expert interviews with UCSB nanotoxicologists about key distinctions in the way they think about environmental toxicity. The new instrument will be completed and piloted in May 2010, put in the field shortly thereafter, and the team will be conducting data analysis in summer 2010.

IRG 3-4: Industry risk perception study (International survey) (Harthorn, Holden, Satterfield, Conti, Engeman, Baumgartner, Carr, Fish, Meyerhofer)

This project, also funded primarily through the UC CEIN IRG 7, aimed to assess changes since 2006 in industry EHS views and practices, studied in our 2006 international survey (Conti et al. 2008) and also add a new dimension of focused risk perception data on industry leaders in order to investigate links between perceived risk and behaviors such as company attention to and following of guidance documents for safe handling of nanomaterials, compliance with voluntary regulatory programs, attention to worker and environmental safety, waste management practices, and consumer safety. The project was run as a Bren School for Environmental Science and Management Masters Group Project, for the MSc degree, with Holden the Bren advisor, Harthorn the 'client' and PI, and sociology doctoral candidate Cassandra Engeman the project coordinator. As of Jan 2010, Phase 1 of data collection (Bren Group Project) completed a sample of 60 companies that synthesize or handle nanomaterials. Preliminary data analysis has been completed, and the Phase 1 report completed March 2010. Additional sample development is currently underway, and the team hopes to complete the data collection by Jun 1 2010. Satterfield has provided extensive consultation regarding the risk perception portion of the instrument and data analysis for those data. A set of publications on this work is planned for summer 2010.

The industry survey project is of significant interest to NSE, industry and regulators, as well as the public, and the team has already made a number of presentations to date (Baumgartner et al. Sept 2009 to ICEIN, Engeman Nov 2009 to the California Dept of Toxic Substance Control, Engeman to a major Japanese industry meeting in Feb 2010, Engeman and Baumgartner to an industry and academic consortium Mar 2010, Harthorn to an NNCO EHC Capstone meeting in Mar 2010), with more planned. The project anticipates preparing a policy brief on the main implications once the dataset is complete and the analyses updated to the full dataset.

IRG 3-5: Experimental research-Cultural cognition and attitude polarization (UK) (Pidgeon, Corner)

This group has now completed a second phase of experimental data collection exploring the cross-cultural validity of cultural cognition and attitude polarization effects, but the results have been difficult to reconcile with existing data. The Cardiff team has initiated discussion with Dan Kahan and his collaborators about developing new angles on the cultural worldview/attitude polarization approach. The team is not anticipating being able to publish the experimental data as it stands, although future work may allow them to produce a more coherent package of evidence

(possibly in collaboration with Kahan et al). The team is also contributing effort to the deliberation research, public attitude survey studies, and environmental risk perception survey research.

IRG 3-6: Variation in the Framing of Nano. (Bimber, Lively, Conroy)

In 2009, the group published (Weaver, Lively & Bimber 2009) an analysis of news trends over time in coverage of nanotechnology, focusing on the following questions. 1) How has news volume changed over time and in response to what events? 2) What are the most common news frames in stories about nano? 3) With which news outlets are these associated? They followed up on that project with continued news tracking of nano coverage through 2009, with more news outlets, and with an added analytic focus: which specific applications of nanotechnologies (e.g. energy, computing, medicine, consumer products) are associated in news coverage with which news frames. The analysis is complete and the team is preparing a chapter for the UCSB-CNS edited volume that will report the results of this project. They anticipate concluding this project this year.

IRG 3-7: Anchoring Effects in Judgments about Public Policy. (Bimber, Lively, Conroy)

Studying nanotechnology in the public sphere provides an unusual opportunity to observe the political system responding to a novel or apparently novel issue. Most important from the group's perspective is the hypothesis that no dominant frames and categories advanced by media have yet shaped how the public thinks about nano. This provides a useful opportunity to examine some theoretical questions regarding how people think about novel political objects, and how their thinking is shaped by framing. We have developed a theoretical framework combining research in psychology on cognitive biases with theories of framing in political science and communication. Our theory involves "anchoring effects," which are a well-known phenomenon by which an arbitrarily given number affects a recipient's judgment in a later quantitative task. We extrapolate to judgments about risk comparisons not involving explicit quantitative judgments, and we suspect that apparently innocuous comparisons between nano and other technological products may produce an anchoring effect in the ways that people judge nano, and well as how they reason among other comparisons of public issues.

The group will test their hypotheses using an experimental survey with 700 subjects, to be fielded in May 2010, using Knowledge Networks as a subcontractor. They conducted a pilot of their instrument in late 2009, after which they made modifications. The new final instrument is complete and data collection will begin as soon as contract details are completed by the UCSB business office. The group anticipates analyzing the data in June and July of 2010, preparing an article manuscript in the summer, and having it under review at a journal in Fall 2010.

***IRG 3 Co-funding:**

Leverage:

1) Harthorn (NSF SES-0824042), "Deliberating Nanotechnologies in the US: Gendered Beliefs about Benefits and Risks as Factors in Emerging Public Perception and Participation," 2008-2010. Rogers is the postdoc researcher; CNS fellows Shearer, Martin and Hurt and visiting graduate student Veyre all participate in this project.
2) Nel, Andre et al. (NSF EF-0830117), "UC Center for Environmental Implications of Nanotechnology," Harthorn is IRG 7 ("Environmental Risk Perception") leader, Co-PI of the UCSB subcontract, and member of the UC CEIN Research Executive Committee, 2008-2013; Satterfield, Freudenburg, and Kandlikar, are IRG 7 senior personnel. The IRG 7 UC CEIN funding allows CNS IRG 3 to extend its research on expert views and public perceptions to more specifically environmental issues, and to add to the team the expertise of UCSB environmental sociology and risk perception scholar, William Freudenburg. The IRG 7 funding in the UC CEIN

provides funds for the new public survey on nano environmental risk perception (postdoc D'Arcangelis; UBC research assistant Devries), and the 2009-2010 international industry survey (GSRs Engeman, Baumgartner, Carr, Fine, Meyerhofer) both of which build on prior CNS research and feed back into ongoing and future efforts; modest IRG 3 funding supplements both projects.

IRG 3: Publications and Presentations in 2009-2010

IRG 3's work is maturing into a rich publication portfolio of interlinked pieces, with many more in planning than are listed here. In 2009-2010 we have 12 published articles, 2 of them in the journal, *Nature Nanotechnology*, 4 forthcoming chapters, 2 white papers, 1 article under review, and over a dozen publications in preparation, 2 of which are book-length works. Publications reflect the group's aim to produce scholarly work of high quality within social science disciplines but also to reach out to NSE audiences and policymakers and others concerned with emerging nanotechnologies, risk communication, and responsible development.

The group has disseminated findings widely, to a range of disciplinary, NSE, industry and policy audiences. IRG 3 has a robust program of dissemination in scholarly disciplinary and interdisciplinary setting by all project participants, as reflected in the 38+ presentations listed below, and the leadership role taken in organizing and chairing panels and sessions at a number of venues (S.NET, AAA, NanoEquity, NSE PI, Nano2). Project senior personnel also increasingly draw across the different projects and research areas, synthesizing implications of the findings for interdisciplinary risk perception and public deliberation studies as well as more focused nanotechnology public response and debate issues. Harthorn presented some key findings from the metaanalysis and survey on perceived benefit and trust at her presentation to the US Congressional Nanotechnology Caucus on Mar 9, 2009, and Pidgeon presented a lengthier set of findings to the UK House of Lords in expert testimony on March 24, 2009, and again to the House of Commons in Jun 2009. More recently, in Dec, 2009, Pidgeon gave a presentation on the role of the public in S&T to a National Academies panel and in Jan 2010 gave evidence to the UK House of Commons Science and Technology Committee inquiry on the regulation of geoengineering, drawing extensively on examples from nanotechnology for public engagement and regulatory gaps analysis. Harthorn has made a series of national and international presentations and provided testimony and evidence incorporating findings from these studies, for example at the INC 5 meeting in May 2009, the NSE PI meeting in Dec 2009, on a panel of the PCAST working group reviewing the NNI in Feb 2010, the Nano 2 NNI Revisioning conference in Mar 2010, and most recently at the NNCO Capstone conference in Mar 2010.

Publications

- 1) Alexis D. Ostrowski, Tyronne Martin, **Joseph Conti**, Indy Hurt, **Barbara Herr Harthorn**. 2009. Nanotoxicology: characterizing the scientific literature, 2000–2007. *Journal of Nanoparticle Research* 11:251-257.
- 2) **Pidgeon, N, Harthorn, B., Bryant, K, Rogers-Hayden, T.** 2009. Deliberating the risks of nanotechnologies for energy and health applications in the United States and United Kingdom. *Nature Nanotechnology* 4:95-98.
- 3) **Satterfield, Theresa, Milind Kandlikar**, Christian Beaudrie, **Joseph Conti**, and **Barbara Herr Harthorn**. 2009. Anticipating the perceived risk of nanotechnologies. *Nature Nanotechnology* 4:752-758.

- 4) Godwin, H., K. Chopra, K. Bradley, Y. Cohen, **B. Harthorn**, E. Hoek, **P. Holden**, A. Keller, H. Lenihan, R. Nisbet, A. Nel. 2009. The University of California Center for the Environmental Implications of Nanotechnology. *Environmental Science & Technology*, 43 (17): 6453–6457.
- 5) **Pidgeon, N.** 2009. *A Beacon or Just a Landmark? Reflections on the 2004 Royal Society/Royal Academy of Engineering Report: Nanoscience and nanotechnologies: opportunities and uncertainties.* <http://www.responsiblenanoforum.org/publications/> 29 July (pp.32).
- 6) **B. H. Harthorn.** 2009. *A Beacon or Just a Landmark? Reflections on the 2004 Royal Society/Royal Academy of Engineering Report: Nanoscience and nanotechnologies: opportunities and uncertainties.* <http://www.responsiblenanoforum.org/publications/> 29 July (pp.43).
- 7) Jae-Young, C. Ramachandra, G, **Kandlikar, M.** 2009. The impact of toxicity testing costs on nanomaterial regulation. *Environmental Science & Technology* 43 (9):3030-3034.
- 8) Weaver, D., Lively, E., and **Bimber, B.** 2009. Searching for a frame: Media tell the Story of technological progress, risk, and regulation in the case of nanotechnology. *Science Communication*, 31(2): 139-166.
- 9) **Pidgeon, Nick, Barbara Harthorn, Terre Satterfield.** 2009. Nanotech: Good or Bad? *The Chemical Engineer Today* (Dec 2009/Jan 2010): 37-39.
- 10) Harthorn, Barbara, Nick Pidgeon, & Terre Satterfield. 2009. Risks and Benefits of Nanotechnology. <http://www.azonano.com/details.asp?ArticleId=2452AZoNano>.
- 11) **Barbara Herr Harthorn, Karl Bryant,** & Jennifer Rogers. 2009. Gendered risk beliefs about emerging nanotechnologies in the US." *Univ of Washington Center for Workforce Development*; on-line publication posted at <http://depts.washington.edu/ntethics/symposium/index.shtml>
- 12) Corner, A. & **Pidgeon, N.** 2010. Geoengineering the climate: The social and ethical implications. *Environment* 52 (1) 24-37.
- 13) Beaudrie, Christian. 2010. Emerging Nanotechnologies and Life Cycle Regulation: An Investigation of Rederal Regulatory Oversight from Nanomaterial Production to End-of-Life. Commissioned report. Philadelphia: Chemical Heritage Foundation. (forthcoming April 2010)
- 14) **Barbara Herr Harthorn.** Forthcoming. Methodological challenges posed by emergent nanotechnologies and cultural values. In *The Handbook of Emergent Technologies and Social Research*, Ed. Sharlene Nagy Hesse-Biber, Oxford University Press.
- 15) **B. Herr Harthorn.** Forthcoming. "Gender and nanotechnology," "Risk amplification," and Risk attenuation. Entries in *Encyclopedia of Nanotechnology and Society*, eds. David Guston and J. Geoffrey Golson. Thousand Oaks: Sage Publ.
- 16) Jennifer Rogers. Forthcoming. "iPod Nano," "Friends of the Earth," and "Center for Nanotechnology in Society--UC Santa Barbara." Entries in *Encyclopedia of Nanotechnology and Society*, eds. David Guston and J. Geoffrey Golson. Thousand Oaks: Sage Publ.
- 17) **Joseph Conti, Terre Satterfield, Barbara Herr Harthorn.** Under review. Vulnerability and social justice as factors in emergent US nanotechnology risk perceptions"(under review at *Risk Analysis*, 2010)
- 18) **Satterfield et al.** 2010. Designing for upstream risk perception research: Malleability and asymmetry in judgments about nanotechnologies. White paper for Nanotech Risk Perception Specialist Meeting, Santa Barbara, Jan 29-30, 2010.
- 19) **Harthorn, BH,** J Rogers, & C Shearer. 2010. Gender, application domain, and ethical dilemmas in nano-deliberation. White paper for Nanotech Risk Perception Specialist Meeting, Santa Barbara, Jan 29-30, 2010.

In preparation:

- 1) **Barbara Herr Harthorn, Karl Bryant, & Jennifer Rogers.** Differences that Matter in Public Participation: Gender and Race as Factors in Debating Nanotech Health Applications in the US. In preparation for submission to *Gender & Society*.
- 2) **Harthorn, Barbara Herr, Karl Bryant, Nick Pidgeon, & Tee Rogers-Hayden.** Deliberating Nanotechnologies: US and UK Perspectives on their Potential Roles for Health and Energy Futures. In preparation for submission to *Science Communication*.
- 3) **Satterfield, Conti, Pidgeon & Harthorn.** A Fine Balance – Risk, Trust, and the Potential for Stigma in Emerging Perceptions of Nanotechnology. In preparation.
- 4) **Terre Satterfield, Joseph Conti, Barbara Herr Harthorn, Nick Pidgeon.** Unpacking Benefit: Perceived Benefit, Real Benefit. In preparation.
- 5) **Barbara Herr Harthorn.** Constraints on Benefit of New Technologies for the World's Poor. In preparation for NanoEquity volume, ed. Rachel Parker and Rich Appelbaum, Routledge.
- 6) **Harthorn**, co-author of chapter in progress w/ NNI leader M. Roco and ASU/GA Tech colleagues Phil Shapira and Dave Guston on Past and Future of Societal Dimensions of Nanotechnology for volume from Nano2 conf., Mar 9-10, 2010, Evanston, IL.
- 7) **Harthorn** is editor, with John Mohr, of *Social Life of Nano* volume in preparation; the book will include 5 chapters by WG 3 contributors Pidgeon and Corner, Satterfield, Conti et al, Kandlikar and Beaudrie, Haldane et al., and Harthorn, Rogers et al.
- 8) WG3 leaders **Harthorn, Pidgeon** and **Satterfield** are preparing a special issue of *Risk Analysis* on the work from the Jan 2010 risk perception specialist meeting

IRG 3 Presentations 2009-10

- 1) **Nick Pidgeon**, testimony before the UK House of Lords, on public views of nanotechnology, March 24, 2009
- 2) **Barbara Herr Harthorn**, "Recap of US Congressional Nanotechnology Caucus testimony, Why Risk Perception Matters: Nanotechnology and Emerging Public Views, Mar 9, 2009." UCSB CEIN guest lecture, Bren School of Environmental Science & Management, April 6, 2009.
- 3) **Barbara Herr Harthorn**, Organizer, Chair, lead presenter. "CNS-UCSB Overview," "WG 3 Risk Perception Research," CNS National Advisory Board meeting, Upham Hotel, Santa Barbara, April 19-21, 2009.
- 4) **Barbara Herr Harthorn**, Organizer, Chair, lead presenter "CNS-UCSB Overview and Proposed Research 2011-2015," "WG 3: Nanotech Risk Perception Research," CNS External Site Review by the NSF and an external peer review panel, UCSB, May 14-15, 2009.
- 5) **Barbara Herr Harthorn**, "NSF's Network for Nanotechnology in Society." 5th International Conference on Nanotechnology (INC-5), UCLA, May 18-20, 2009
- 6) **Barbara Herr Harthorn, Karl Bryant**, and Jennifer Rogers, "Gender and Risk Beliefs about Emerging Nanotechnologies" Invited keynote address at the Univ of Washington Nano Ethics Workshop, held in conjunction with the inaugural meeting of the Society for Study of Nanoscience and Emerging Technologies, Seattle, Sept 9, 2009
- 7) Jennifer Rogers and **Barbara Herr Harthorn**, Co-organizers; Co-Chairs. "Tales of Progress and Cultural Beliefs: Risks, Perceptions, and Messages about Nanotechnology in the Upstream/Midstream Context." Session at the inaugural meeting of the Society for Study of Nanoscience and Emerging Technologies, Seattle, Sept 8-11, 2009
- 8) **Terre Satterfield, Joseph Conti, Nick Pidgeon & Barbara Herr Harthorn** "Emergent Public Risk Perceptions: Asymmetry in Judgments about Nanotechnologies" Paper presented at the inaugural meeting of the Society for Study of Nanoscience and Emerging Technologies, Seattle, Sept 8-11, 2009

- 9) Jennifer Rogers, **Barbara Herr Harthorn**, **Karl Bryant**, and Indy Hurt. "Investigating the Roles of Gender and Activism in Deliberative Dialogues about Nanotechnology Risk and Benefit" Paper presented at the inaugural meeting of the Society for Study of Nanoscience and Emerging Technologies, Seattle, Sept 8-11, 2009
- 10) Cassandra Engeman, Lynn Baumgartner, Ben Carr, Allison Fish, John Meyerhofer, **Patricia Holden**, and **Barbara Harthorn**. "Current Practices and Perceived Risks Related to Health, Safety and Environmental Stewardship in Nanomaterials Industries" Poster presented at the 1st International Center for Environmental Implications of Nanotechnology (ICEIN) Conference, Howard University, Sept 9-11, 2009
- 11) **Joe Conti**, "The Embeddedness of Technological Risk: Vulnerability and Justice in the Nanotechnology Enterprise." Economic Change and Development Speak Series, University of Wisconsin, Madison. October 26, 2009
- 12) **Barbara Herr Harthorn**, "Social Risk and Challenges to the Sustainability of Emerging Nanotechnologies" Paper presented in the session on Sustainability and Emerging Technologies, Society for Social Study of Science, Arlington VA Oct 28-31, 2009
- 13) **Barbara Herr Harthorn**, "Constraints on Benefit of New Technologies for the World's Poor" Panel: "Governing Emerging Technologies: Regulating Risk & Ethical Dimensions in Development." *Emerging Economies, Emerging Technologies: [Nano]technologies for Equitable Development*, Woodrow Wilson International Center, Wash DC Nov 4-6, 2009.
- 14) Jennifer Rogers. Rapporteur for "Food Security" Breakout Session. Emerging Technologies/Emerging Economies: (Nano)technology for Equitable Development. Conference. Washington D.C.: November 4-6, 2009.
- 15) Conroy, Meredith (rapporteur). "Water" breakout session, Emerging Technologies /Emerging Economies: (Nano)technology for Equitable Development conference, Washington D.C. November 4-6, 2009.
- 16) Lively, Erica (rapporteur). "Energy" breakout session, Emerging Technologies/Emerging Economies: (Nano)technology for Equitable Development conference, Washington D.C. November 4-6, 2009.
- 17) **Nick Pidgeon**, "Social Acceptance and Public Views" Talk presented at the Nuffield Council on Bioethics Meeting, 25th November 2009.
- 18) Cassandra Engeman, "Reported Practices and Perceived Risks Related to Health, Safety and Environmental Stewardship in Nanomaterials Industries" Poster presentation of research design to the California Groundwater Resources Association (GRA)/Department of Toxic Substance Control (DTSC) Nanosymposium; Sacramento, Nov 16, 2009
- 19) **Barbara Herr Harthorn**, Chair; Mikael Johansson, Organizer "Nanotechnology in Public and Expert Discourses," panel session at the American Anthropological Association annual meeting, Philadelphia, Dec 4, 2009.
- 20) **Hillary Haldane**, **Karl Bryant**, **Barbara Harthorn**, "Expertise and Expectations: The role of gender in expert perceptions of emergent nanotechnologies" Presentation at the American Anthropological Association meetings, Philadelphia Dec 4, 2009
- 21) Jennifer Rogers, **Barbara Herr Harthorn**, and Christine Shearer "Imagining Nanotech Futures: The Anthropology of Risk and Gender in Deliberative Settings," Paper presented at the American Anthropological Association Annual Meeting. Philadelphia. December 2-6, 2009.
- 22) **Terre Satterfield** (2009) "Reflections on Chasing the Elusive: Hope, Intention and Disruption in the Perception of Nanotechnologies," AAA Meetings, Philadelphia, PA Dec 4, 2009
- 23) **Nick Pidgeon**, "Lessons from the Past: Governance of Emerging Technologies" presentation at the National Academy of Sciences, Washington, 3rd-4th December, 2009.
- 24) Christian Beaudrie, **Milind Kandlikar**, and **Terre Satterfield** (2009) "Risk Ranking for Nanomaterials using hazard and intake fraction models." Presentation at the Society for Risk Analysis meetings, Baltimore, Dec 7-9, 2009.

- 25) **Barbara Herr Harthorn**, Co-Chair, 2009 NSF Nanoscale Science and Engineering Grantees Conference, Arlington, VA Dec 7-9, 2009.
- 26) **Barbara Herr Harthorn**, Panel Moderator, "The Present and Future of Nano-ELSI Research" NSF Nanoscale Science and Engineering Grantees Conference, Arlington, VA Dec 7-9, 2009.
- 27) **Barbara Herr Harthorn**, "NSEC Centers for Nanotechnology in Society: CNS-UCSB." NSF Nanoscale Science and Engineering Grantees Conference, Arlington, VA Dec 7-9, 2009.
- 28) **Nick Pidgeon** gave evidence to the House of Commons Science and Technology Committee inquiry on the regulation of geoengineering, and drew extensively on examples from nanotechnology for public engagement and regulatory gaps analysis (Jan 2010)
- 29) **Harthorn, Barbara, Nick Pidgeon, & Terre Satterfield**. Co-Organizers, Co-Chairs, CNS-UCSB Nanotech Risk Perception Specialist Meeting, Upham Hotel, Santa Barbara, Jan 29-30, 2010. Attended by leading researchers from US, Canada, UK, Austria, Switzerland, Germany, Portugal.
- 30) **Nick Pidgeon, Barbara Harthorn, & Terre Satterfield** "Nanotech Risk Perception – Issues and Challenges" Nanotechnology Risk Perception Specialist Meeting, Santa Barbara, January 29th-30th, 2010.
- 31) **Satterfield, Terre**. "Designing for Upstream Risk Perception Research: Malleability and Asymmetry in Judgments about Nanotechnologies," Nanotech Risk Perception Specialist Meeting, Santa Barbara, Jan 29-30, 2010.
- 32) **Harthorn, BH, J Rogers, & C Shearer**. "Gender, Application Domain, and Ethical Dilemmas in Nano-Deliberation." Presentation in Nanotech Risk Perception Specialist Meeting, Santa Barbara, Jan 29-30, 2010.
- 33) **Kandlikar, Milind**. Discussant, Nanotech Risk Perception Specialist Meeting, Santa Barbara, Jan 29-30, 2010.
- 34) **Haldane, Hillary**, Discussant, Nanotech Risk Perception Specialist Meeting, Santa Barbara, Jan 29-30, 2010.
- 35) **Conti, Joe**, Discussant, Nanotech Risk Perception Specialist Meeting, Santa Barbara, Jan 29-30, 2010.
- 36) **Satterfield, T.** (2010) "Rethinking Risk at the Intersection of Culture, Justice and Governance." Guest Lecture, February 3, 2010, University of Western Ontario, Centre for Environment and Sustainability
- 37) Cassandra Engeman, "Reported Practices and Perceived Risks Related to Health, Safety and Environmental Stewardship in Nanomaterials Industries" invited speaker, Nanotech 2010 Exhibition and Conference; invited by the strategic area of nanotechnology working group, National Institute of Advanced Industrial Science and Technology (AIST), Japan; Tokyo, Feb 19, 2010
- 38) Cassandra Engeman and Lynn Baumgartner. Video conference presentation of preliminary findings to the Nanotechnology Colloquium, a bi-weekly meeting of industry and academics on the issue of nanotechnology; invited to speak by Applied Nanotechnology, Inc. in Austin, TX; March 8, 2010
- 39) **Barbara Herr Harthorn**, "Societal Dimensions of Nanotechnology: Research for Responsible Development," Testimony to President's Council of Advisers on Science and Technology NNI Review, panel on environmental, ethical, societal, and legal concerns, Palo Alto, CA February 18, 2010.
- 40) **Terre Satterfield, C. Beaudrie, M. Kandlikar, et al.** "Reflections on Chasing the Elusive: Hope, Intention and Disruption in the Anticipation of Social Response to Nanotechnologies" presentation at the University of British Columbia, March 2, 2010
- 41) **Barbara Harthorn**, Rapporteur for Session 13, Societal Dimensions of Nanotechnology NNI Revisioning Nano2 conference, Mar 9-10, 2010, Evanston, IL, Mar 9-10, 2010;

- 42) **Barbara Harthorn**, "The Past and Future of Responsible Development for Nanotechnologies," invited presentation, Session 13, Societal Dimensions of Nanotechnology at NNI Revisioning Nano2 conference, Mar 9-10, 2010, Evanston, IL, Mar 9-10, 2010.
- 43) Jennifer Rogers, **Barbara Harthorn**, Christine Shearer, and Tyronne Martin, "Engaging the Citizenry: US Publics' Values and Perceptions Regarding Emerging Nanotechnologies for Energy and the Environment." Paper presented at the *Society for Applied Anthropology Annual Meeting*. Merida, Mexico. March 24-27, 2010.
- 44) **Barbara Herr Harthorn**, "How Nanotech Risk Perception Informs EHS Decision Making." Keynote address, NNCO EHS Capstone conference, Wash DC Mar 30-31 2010.
- 45) Jennifer Rogers, Christine Shearer, and **Barbara Herr Harthorn**, "GM and Nano in our Food: Public Perceptions, Reactions, and Movements." Paper presented at the *Pacific Sociological Association*. Oakland. April 8-11, 2010.

IRG Meetings/Outreach to industry, policymakers, publics/Engagement:

- 1) Rogers, Jennifer, Indy Hurt, & Tyronne Martin. Public Deliberation workshop on Nanotechnologies for Health. UCSB July, 2009.
- 2) **Harthorn, Barbara Herr**, Jennifer Rogers, Tyronne Martin, and Christine Shearer. 6 public deliberation workshops on nanotechnologies for energy and environment and nano for health and human enhancement, in Santa Barbara community Sept-Oct 2009.
- 3) Cassandra Engeman, "Reported Practices and Perceived Risks Related to Health, Safety and Environmental Stewardship in Nanomaterials Industries" Poster presentation of research design of industry survey to the California Groundwater Resources Association (GRA)/Department of Toxic Substance Control (DTSC) Nanosymposium; Sacramento, Nov 16, 2009
- 4) Planning for NanoDays 2010 at UCSB in collaboration w/ UCSB CEIN/CNS/UCSB CNSI
- 5) **Harthorn** met with EC commissioner re: funding opportunities. UCSB, Jan 13 2010
- 6) **Harthorn** provided extensive testimony documents for PCAST/OSTP review of the NNI to NNI leader Mihail Roco for Jan 18-19 Wash DC meeting
- 7) **Harthorn** and **Newfield** provided extensive testimony documents for PCAST/OSTP review of the NNI to CCST Director Susan Hackwood for Jan 18-19 Wash DC meeting
- 8) **Nick Pidgeon** gave evidence to the House of Commons Science and Technology Committee inquiry on the regulation of geoengineering, and drew extensively on examples from nanotechnology for public engagement and regulatory gaps analysis (Jan 2010)
- 9) Cassandra Engeman, "Reported Practices and Perceived Risks Related to Health, Safety and Environmental Stewardship in Nanomaterials Industries" invited speaker, Nanotech 2010 Exhibition and Conference; invited by the strategic area of nanotechnology working group, National Institute of Advanced Industrial Science and Technology (AIST), Japan; Tokyo, Feb 19, 2010
- 10) **Harthorn** phone meeting with Charles Geraci, NIOSH, re: incorporating risk perception into risk assessment framework, Feb 11, 2010.
- 11) **Harthorn** gave testimony for PCAST review of the NNI to PCAST working group, Feb 18, 2010, Palo Alto.
- 12) Cassandra Engeman and Lynn Baumgartner. Video conference presentation of preliminary findings to the Nanotechnology Colloquium, a bi-weekly meeting of industry and academics on the issue of nanotechnology; invited to speak by Applied Nanotechnology, Inc. in Austin, TX; March 8, 2010.
- 13) **Barbara Harthorn**, Rapporteur for Session 13, Societal Dimensions of Nanotechnology at NNI Revisioning Nano2 conference, Evanston, IL, Mar ; co-author chapter in progress w/ NNI leader M. Roco and ASU/GA Tech colleagues Phil Shapira and Dave Guston

- 14) **Barbara Harthorn**, keynote address at NNCO Capstone conf on EHS issues for nano, Wash DC, Mar 30-31, 2010; meeting w/ Tom Kalil, Office of the White House
- 15) **Barbara Harthorn** invited to give a keynote address at a NIOSH conf. July 21-23 2010, Keystone, CO

IRG 4: Globalization and Nanotechnology

R. Appelbaum , <i>Leader</i>	Sociology, Global & Int'l	UC Santa Barbara
G. Gereffi	Sociology	Duke University
T. Lenoir	History	Duke University
C. Cannady	Law	Private sector IPSEVA

Affiliates

C. Cao	Sociology	SUNY Levin Institute
B. Chmelka	Chemical Engineering	UC Santa Barbara
T. Cheng	Electrical & Computer Engin	UC Santa Barbara
P. Herron	Computer Sci	Duke University
G. Folodari	Sociology	Universidad Autónoma de Zacatecas

1 postdoc, 4 grads, 1 undergrad

<i>Postdoctoral scholar</i>	Yasuyuki Motoyama, Regional Planning
<i>Graduate students:</i>	Social Science: Rachel Parker, Sociology; James Walsh, Sociology; Claron Ridge, Chemistry/Biochemistry Collaborating: Stacey Frederick (NC State)
<i>Undergraduate Student</i>	Andrea Tran

IRG 4-1: China's Developmental State: Becoming a 21st Century Nanotech Leader
([Appelbaum](#), Parker, [Cao](#), [Gereffi](#))

This research stream aims at understanding where China stands in terms of innovation, R&D, and commercialization of nanotechnology, examining the degree to which China has a more centralized approach to funding for nanotechnology along the value chain, particularly towards the commercialization end. China is convinced that manufacturing prowess alone is insufficient to becoming a leading economic power in the 21st century. China's overarching goal is to become an "innovation-oriented" society by the year 2020. Since the Third National Conference on Science and Technology in 1995 when "The Decision on Accelerating Scientific and Technological Progress" was announced, "indigenous innovation" (or *zizhu chuangxin*) has been heralded as the source of China's future development, and science, technology and education were identified as the tools that will create national prosperity and reduce the inequality that currently threatens China's rapid development. Our research examines the ways in which the debate over innovation is shaping national development in China, with nanotechnology providing a case study. We seek to better understand whether China's relatively government-centered approach toward science and technology policy can succeed in creating the bases for genuine innovation, in light of its distinctive approach to technological leapfrogging, the institutional features of its innovation system, and nanotechnology's status as an early stage emerging technology. This far this research stream has focused on the research end of the research-development-commercialization process; in a May 2010 trip to China we plan to visit with firms and policy-makers to get a better sense of how effectively China is commercialization its advances in nanotechnology. A September 2010 trip is planned to South Korea as a first step in extending our analysis to other East Asian countries.

IRG 4-2: Comparative Study of State Nanotechnology Policy: U.S., China, Japan
([Appelbaum](#), Parker, Ridge, Motoyama)

One central theme of our research is the role of public investment as a driver for nanotechnology. To what extent do government-funded national nanotechnology initiatives constitute industrial policy? What are the results of different governmental approaches, in terms of publications,

patents, and commercialization? Much of our research to date has focused on China, where government efforts appear to reach further into the commercial end of the value chain than in the U.S. Our China research concludes that China's substantial investment in nanotechnology – one of four “science megaprojects” under the Medium and Long-Term Plan (for high technology) – has paid large dividends at the research stage, but has yet to result in significant commercial payoff. While this is true in other countries as well, China faces the additional challenges of having a risk-averse state sector, an SME sector that is growing but undeveloped, and a university and science academy-based research sector that lacks entrepreneurial experience.

This research stream builds on the previous research done in China, and seeks to better understand the role of state policy as a driver of nanotechnology R&D and commercialization. We have developed a comparative methodology that uses similar kinds of data (for example, public documents, published reports and studies, differences in IP protection law, analysis of patent and publication data). The first step has been to focus on the U.S. NNI in an effort to better understand funding allocations across agencies, especially programs such as SBIR and STTR that are more directly focused on commercialization. This study of the US NNI concludes that while the NNI can be seen as an example of industrial policy (it was initiated within NSF and OSTP, rather than resulting from “grassroots” pressure from scientists or business people), most of the funding has been at the research end (to universities and government labs), with only a small portion directed to support businesses.

The project post-doc, Yasuyuki Motoyama, is using this framework for one of his projects, a comparative study of nanotechnology policy in the U.S. and Japan (his hypothesis is that, contrary to conventional thinking, the U.S. has a more aggressive industrial policy in this area than Japan). Appelbaum, Parker, and Cao will provide a comparative analysis of the U.S. and China.

IRG 4-3: Case Study of a Nanotechnology Start-Up Company (Parker, Appelbaum)

Rachel Parker received funding from the Chemical Heritage Foundation to conduct a case study of Seldon Technologies, a US start-up working on a nano-enabled water filtration technology. Seldon is currently expanding to many emerging markets, where there is considerable need for low-cost, low-energy (the Seldon media runs on gravity) solutions to the country's water crisis. The project examined Seldon's efforts to commercialize its innovative ideas – to make the transition from new materials innovation to new product innovation.

IRG 4-4: Drivers of Nanotechnology Commercialization in China: Patent Analysis (Parker, Appelbaum, Motoyama, Lenoir, Herron, Ridge, Cannady)

We have acquired a dataset of Chinese nanotech patent data from Donghua ZHU, Vice Dean, School of Management and Economics, and Director, Laboratory of Knowledge Discovery and Data Analysis at Beijing Institute of Technology (his lab is the lead agency in China analyzing such data). Our purpose is to better understand the prospects for commercialization in China, and possibly to identify particular firms or researchers for follow-up interviews. The data-set of Chinese nanotechnology patents based on a random sample, and would additionally includes the abstracts of all nanotech patents issued in China for the period 1985-2008. In addition to the raw data, we were provided with a 74 page “Analysis Report of Nanotechnology Chinese Patents,” as well as the complete patents (in Chinese) in four areas: thin films, quantum dots, carbon nanotubes, and nanoporous filtration. Cynthia Cannady (technology lawyer and former Director of the Intellectual Property and New Technologies Division at the World Intellectual Property Organization, WIPO. in Geneva, Switzerland) has provided a preliminary analysis of the report.

The team has subsequently conducted its own analysis of this data. One key finding is that while the number of nanotechnology patent applications in China has grown markedly in recent years, most patents come from the country's research institutions such as major universities and the Chinese Academy of Science, and not the private sector. (Many patents also "sleep in the safe," most likely taken out primarily to justify funding. They also found that Chinese nanotechnology patent applications are more successful than patent applications to SIPO in other technological areas, while the reverse appears to be true for foreign firms, which are more successful in obtaining SIPO patents in technology areas other than nanotechnology. They speculate that this may be the case because nanotechnology has become an area of specialization for Chinese research and development, while foreign patent applications may come from firms seeking to protect commercial innovations rather than the more basic research that still characterizes innovation in nanotechnology.

Next steps include identifying key firms in China for this coming summer's research (which will focus on the commercial end of the value chain), and further analyzing the acquired patent data, including a detailed analysis of selected nanotech areas (for example: filtration, energy, CNTs, quantum dots; biopharma). The team has also begun a spatial analysis of Chinese patents, examining how the spatial concentration of nanotechnology has increased over time, in an effort to see whether selected regions are emerging as "nanodistricts."

IRG 4-5: Comparative Statistical Analysis of Nano in China, South Korea, Japan, India, and Singapore (Lenoir, Herron)

This is in a preliminary stage. The team has been exploring the most cost-effective ways to acquire the large required datasets, including ISI web of science, EPO, USPTO, and trade data. The research will be directed at characterizing the changing nature of global nanotechnology in terms of intellectual property, publications, actors, firms, states, policies, manufacturing, and trade. They are in the process currently of acquiring the data.

IRG 4-6: Emerging Technologies/Emerging Economies: [Nano]Technology for Equitable Development, conference held in Washington, D.C. November 4-6, 2009 (Parker, Appelbaum)

IRG 4 researchers believe that nanotechnology (and other emerging technologies) hold the promise of solving some of the world's most critical problems related to energy scarcity, finite clean water sources, diminished availability of sustainable food resources, and pandemic diseases. Increased international collaboration on technological innovation can help advance progress in these four areas, while also reducing inequality between the global North and South. In a 1st step toward such collaborative innovation, IRG-4 (and CNS) hosted an international conference in Washington, D.C. November 4-6, 2009 to explore these possibilities. The conference was a collaborative effort of CNS-UCSB which organized the conference with the Woodrow Wilson International Center for Scholars (the host organization), and Rice University's Center for Biological and Environmental Nanotechnology. The roughly 85 participants came from the US and Europe; China, India, and Brazil, the world's three largest emerging economies; and Mexico, South Africa, Uganda, and Zimbabwe, and included leading scientists and engineers, government employees and NGO activists, social scientists and new technology business entrepreneurs. Discussion and dialogue were facilitated by the Meridian Institute, an organization committed to increasing more equitable North/South dialogue. A central concern of the conference was how to best manage global science and technology development to ensure that the benefits of technological advancement contribute to equitable development.

Mihail Roco, Senior Advisor for Nanotechnology at the U.S. National Science Foundation, launched the conference with a talk on the anticipated contribution of nanotechnology to solving critical needs. The importance of government support for science and technology was emphasized in a keynote address at the National Press Club by Aneesh Chopra, recently appointed to the newly-created position of U.S. Chief Technology Officer. Todd Osman, Executive Director of the 17,000 member Materials Research Society, also gave a keynote address in which he argued that to successfully address societal challenges such as alternative energy sources and access to clean water, the scientific and engineering communities must “bridge global and disciplinary boundaries.” The conference also participated in a “Wilson Center on the Hill event, attended by Congressional staff, introduced by Oregon Senator Ron Wyden, in which three conference participants laid out some basic issues for Congressional staff: David Irvine Halliday, founder and CEO of the NGO *Light Up The World*; Chen Wang, who heads up China’s National Center for Nanoscience and Technology; and Kalpana Sastry, Head of the Agriculture Research Systems, Management & Policy Division at India’s National Academy of Agricultural Research Management, where she is a Senior Scientist.

As part of the meeting follow-up, the group is planning several different new media outreach methods, including a Facebook page where conference participants can exchange information and introduce their networks and peers to other like-minded people around the world. They have also secured a book contract with Routledge, and are currently aiming for a March 2011 publication date.

In addition to IRG 4 collaboration with IRG 1 (Choi) on Korean nano development, another outcome of the NanoEquity workshop is a new collaboration between IRG 4 (Appelbaum, Parker), IRG 3 (Rogers) and Mexican nanotech scholar G. Folodari (pending, UC MEXUS, see section 20: Leverage).

Conference presentations and program details can be found on the conference website: <http://www.nanoequity2009.cns.ucsb.edu>.

IRG 4: Publications and Presentations in 2009-2010

Publications

- 1) **Appelbaum**, Parker, **Cao**, and **Gereffi**, “China’s (Not So Hidden) Developmental State: Becoming a Leading Nanotechnology Innovator in the 21st Century,” to appear in Fred Block and Matthew Keller (eds.), *State of Innovation: Technology Policy in the United States*. Paradigm, forthcoming 2010.
- 2) Parker, Ridge, **Cao**, and **Appelbaum**, “China’s Nanotechnology Patent Landscape: An Analysis of Invention Patents Filed With the State Intellectual Property Office,” accepted for publication in *Nanotechnology Law and Business* 524 (winter 2009)
- 3) Motoyama, **Appelbaum**, and Parker, “The National Nanotechnology Initiative: Federal Support for Science and Technology, or Hidden Industrial Policy?” under review at *Research Policy*
- 4) Parker and **Appelbaum**, “Multi-Walled Carbon Nanotubes in Water Filtration Systems: From New Material Innovation to New Product Innovation,” Gore “New Materials and Innovation” Series, Chemical Heritage Foundation, Philadelphia, PA.

- 5) **Appelbaum** and Parker, "China's Developmental State," in Khalid Nadvi, for a special issue of *Global Networks* (forthcoming 2011)
- 6) **Appelbaum** and Parker, "Promise and Prospects of Nanotechnology," in Denis Simon (ed.), *The Evolving Role of Science and Technology in Foreign Relations: Implications for International Affairs in the 21st Century* (publisher, date unknown; the paper will be based on a conference presentation at Penn State by that title)
- 7) Herron and **Lenoir**, "Mapping the Recent Rise of Chinese Bio/pharma Nanotechnology," *Journal of Biomedical Discovery and Innovation*, 4:8: October 14, 2009

In Preparation

- 1) Parker and **Appelbaum**, eds. *Emerging Economies, Emerging Technologies: Can Technology Make a Difference in Development?* Under contract to Routledge for 2011 publication.
- 2) **Appelbaum** and Parker, "Emerging Technologies / Emerging Economies: Prospects for Equitable Development." Introductory chapter in Parker and Appelbaum eds, *Emerging Economies, Emerging Technologies: Can Technology Make a Difference in Development?* Routledge.
- 3) Parker, **Appelbaum** et al. "Introduction to Emerging Technologies." Chapter 2 in Parker and Appelbaum eds, *Emerging Economies, Emerging Technologies: Can Technology Make a Difference in Development?* Routledge.
- 4) Parker, **Appelbaum** et al. "Looking Ahead—Collaborating for Equitable Development." Chapter 26 in Parker and Appelbaum, eds, *Emerging Economies, Emerging Technologies: Can Technology Make a Difference in Development?* Routledge.
- 5) Motoyama, Hurt, Parker, **Appelbaum**, "Regional Geography of Nanotechnology Patents in China"

Presentations

- 1) **Appelbaum**, "China's Move to Become a Technology Leader," testimony before the U.S.-China Economic and Security Commission, Russell Senate Office Building, Washington, D.C. (March 24, 2009)
- 2) **Cao**, Participation in ChinaNano 2009 in Beijing (August 2009)
- 3) **Appelbaum** and Parker, "Comparing the Developmental State Policies of China and the U.S. in the Race to Advance Nanotechnology in the 21st Century," S-Net, Seattle (Sept 8-11, 2009)
- 4) Motoyama, "Developmental States and Nanotechnology: Comparison of U.S. and Japanese Governments and Technology Performance," S-Net, Seattle (September 8-11, 2009)
- 5) Parker and **Appelbaum**, "Chinese Nanotechnology Policy: A Developmental State," Atlanta Conference on Innovation, Atlanta (October 2-3)
- 6) Motoyama, "The Nanotechnology Cluster in Kyoto: The Cluster Theory and Gap with Practice: In Investment Regionalism: Economic Development and Sector Strategies," Association of Collegiate School of Planners, Washington, D.C. (Oct. 2009)
- 7) **Appelbaum** and Parker, "Promise and Prospects of Nanotechnology," Penn State (October 22-25, 2009)
- 8) **Appelbaum**, "Emerging Economies Emerging Technologies: Prospects for Equitable Development," Wilson Center, Washington, D.C. (November 4-6, 2009)
- 9) **Parker**, Closing address, Emerging Economies/Emerging Technology: [Nano]technologies for Equitable Development, Wilson Center, Washington, D.C. (November 4-6, 2009)
- 10) **Appelbaum** and **Chmelka**, Nano-Meeter presentations, Santa Barbara, CA, March 11, 2010
- 11) Parker and **Appelbaum**, "Multi-Walled Carbon Nanotubes in Water Filtration Systems: From New Material Innovation to New Product Innovation," Transatlantic Workshop on Nanotechnology Innovation & Policy, Atlanta, March 25, 2010

Meetings attended:

Cao, Participation in ChinaNano 2009 in Beijing (August 2009).

10. CNS-UCSB DIVERSITY PLAN

CNS-UCSB recognizes from experience that diversity strengthens the quality of research and the capacity to disseminate to a wide range of community audiences. Our diversity mission is focused on creating a diverse Center of outstanding researchers, staff, and advisors of different gender, racial, ethnic and disciplinary and family educational backgrounds that represent/reflect the communities we serve in our research mission.

(i) Current status and progress this reporting year and since 2006

Undergraduates

Undergraduate interns were recruited through a broad, campus-wide call, through email announcements and fliers to all majors. Announcements were also sent specifically to our contacts in SACNAS and Los Ingenieros student organizations, to distribute to students. For the current reporting year, summer undergraduate interns included 3 male and 1 female students, 1 Asian female, and 1 Latino male. Cumulatively since 2006, students from underrepresented groups are noted in Table 10-1. In addition, at least 5 of the twenty interns were first in their family to graduate college, and one intern was disabled. Half (n=10) of our interns have been from California community colleges (a partnership with the UCSB California NanoSystems Institute's (CNSI) INSET (REU) program, and half (n=10) from UCSB. Interns also contribute to the academic diversity of CNS, with majors or minors in social science, humanities and science departments that have in the past included Anthropology, Biology, Economics, Literature, Mathematics, Microbiology, Philosophy, Physics, and Sociology.

Table 10-1: Diversity information, n=20 Summer Undergraduate Interns, 2006-2009

Female	African-American*	Asian*	Latino*	Mixed racial origins*
8	1	3	2	3

*this type of data not available for all INSET community college students

[Current reporting year: summer 2009: We received applications from 15 students, for 2 intramural internship positions. Applicant pool statistics: 10 female, 5 Caucasian, 2 Pacific Islander, 3 Asian, 4 Latino/a, 1 African-American. Applicants represented 12 different majors. Applicant information is not available from CNSI for the extramural INSET program applicants, of whom we selected 2 for internship positions, for a total of 4.]

Graduates

The Graduate Research Fellowship program recruits participants through an open, competitive application process. Diversity data for the complete cohort of 10 graduate fellows active during the current reporting year (7 Social Sciences/Humanities and 3 Science and Engineering Fellows) is as follows: 6 Female, 2 African-American, 2 Latina; 4 are first in their family to graduate college, and 5 will be first to receive a graduate degree.

Table 10-2: Diversity information, n=22 Graduate Research Fellows, 2006-2009

Female	African-American	Asian	Latino/a	Mixed racial origins
10	2	1	2	1

[Current reporting year: Application data for the 2009-2010 Fellows in the Social Sciences and Humanities. Eleven graduate students submitted applications for two positions. Statistics on the

applicant pool: 5 male, 6 female; 6 Caucasian, 1 African-American, 1 Latino, 1 Asian/Caucasian; 3 are first in their family to graduate from college and 6 are first to receive a graduate degree.]

Postdoctoral Scholars

CNS began its postdoctoral program in Fall 2008. Like our other programs, we strive for a diverse and excellent applicant pool through an open, competitive recruitment process. Positions are broadly advertised to achieve this aim; one example is sending announcements to professional society specialty groups that are geared toward diversity. The 3 CNS-funded postdocs are all international and have included one Asian, one Canadian, and one N. European participant. Two additional postdoctoral scholars affiliated with CNS through co-funded projects to director Harthorn are female.

Leadership: Pls, Advisory Board, Senior Personnel

At all junctures in its development, the CNS has recruited staff and participants with attention to diversity of ethnicity, gender, and experience. The Center Director and PI is a woman, a professor of Feminist Studies, a past member of the governing boards of the UCSB Institute for Chicano Studies and the UCSB Center for Black Studies, a current member of the Advisory Committee for the new Center for Latina/o Health, Education & Research as well as the AAAS' Committee on Opportunities in Science (COOS) whose role is to enhance the participation nationally in Science and Engineering of women, people of color, and people with diverse disabilities, sexual orientations, and other needs. The CNS Executive Committee has a record of gender balance (3 out of 7 members were women) and some ethnic diversity. With changes in the Committee during the last reporting year, however, we have lost some of the gender and diversity balance, and are cognizant of this issue. The additions of Education Director Dillemath and Assistant Director Gilkes, both women, as *ex officio* members restores gender balance; the CNS will seek to add ethnic diversity at this management level.

The CNS staff also reflects a commitment to diversity. The previous CNS Office Manager (through Aug 2009) was a 1st generation Latina of Mexican origin, our previous Financial Administrative Analyst (through June 2009) was South American, and our Education Director is a woman with an advanced degree in geography (a field predominated by men).

In addition to racial, ethnic and gender diversity, disciplinary diversity is a hallmark of CNS, as noted above in our student participants. CNS participants represent a wide breadth of educational background and disciplinary experience. Including department affiliations, the CNS Executive Committee bring expertise and perspectives from Anthropology, Chemistry/Biochemistry and Materials, Communication, English, Feminist Studies, Global and International Studies, History, Political Science, and Sociology. Senior Personnel at UCSB expand that list to include: Engineering, Environmental Studies, Geography, Microbiology, and Physics. And our collaborators at other universities and settings add Asian Studies, Business, Economics, Law, Social Psychology, Science Policy, and Visual Studies.

The CNS National Advisory Board was recruited with attention to diversity by gender, ethnicity, and interest in the equity issues that are likely to accompany emerging nanotechnologies. The Board is nearly 50% women, including the Board Co-Chair who is associate professor and associate dean for research at Evans School of Public Affairs, University of Washington (Ann Bostrom), a Chemistry professor and the executive director of the Center for Biological and Environmental Nanotechnology at Rice University (Vicki Colvin), the executive director of the California Council on Science and Technology (Susan Hackwood), and a professor in the History and Sociology of Science department at the University of Pennsylvania (Ruth Schwartz Cowan) who is a leading scholar on the gendered history of science and technology. Board member Willie

Pearson is African-American, a very active participant in NSF EHR and also contributes strongly to CNS goals of improving diversity.

Senior personnel from CNS-UCSB's collaborating institutions, many of them international, have contributed to the cultural diversity of the CNS; fewer contribute to gender/ethnic/racial diversity, although 4 collaborators count Asian heritage and 4 are female. Leveling this imbalance has been a goal in recruiting new participants for the renewal period, years 6-10 of the Center.

Connections to national organizations committed to diversity goals

This program appears to be highly effective in attracting women and minority STEM students who are particularly interested in the kinds of social and equity issues research in the CNS portfolio. The program drew particular praise from visiting SBES AGEP program leaders in 2008 and seems likely to become a model for others. As a direct result of this presentation, Harthorn was invited to become a member of the AAAS Committee on Opportunities in Science, which she joined for a 3-year term in 2009. This national service provides CNS with direct access to many of the leading programs in the country for expanding opportunities for women, minorities, and persons with disabilities; it also provides a venue for CNS to contribute to national level discussions, initiatives and dialogue on these all important issues.

(ii) Plans for the next reporting period

Undergraduate and Graduate Participants

One primary strategy for maintaining if not improving diversity is to start with a diverse pool of strong applicants for our programs. Therefore, a current and future goal to recruit as large and diverse a pool of students as we can enables us to create a diverse community of outstanding young scholars in our programs. The following strategies reflect those we have used with success over the past 4.25 years, as well as new or anticipated strategies for enhancing diversity. Fortunately, UCSB and the central coastal California area in which it is located, are highly diverse, particularly reflecting the growing Latino population, but also have notable Native American, Asian American, and African American population bases. As a rising Research 1 campus in a beautiful coastal setting, UCSB is successful in recruiting a diverse student body and is an emerging Hispanic Serving Institution (HSI). California currently has 73 HSI schools in the community college and state university system, and CNS is drawing from such neighboring organizations in its popular undergraduate intern recruitment program.

Strategies:

- Open recruitment process

A competitive, open recruitment process for our undergraduate, graduate and postdoctoral programs has allowed us to attract a broad range of applicants. For internal programs (graduate and UCSB undergrad internships), program opportunities have been advertised by email and fliers to all pertinent UCSB departments to disseminate to students, augmented by announcements to the UCSB Women's Center, campus organizations including Women in Science and Engineering (WiSE), SACNAS (Society for the Advancement of Chicanos and Native Americans in Science) and Los Ingenieros, to ensure that students from underrepresented groups find out about our opportunities. For community college interns, CNS works closely with campus partners and established networks in area community colleges to recruit a diverse, talented pool of applicants.

- Collaborating with NSF diversity programs and campus organizations

From its inception to dissolution last year, CNS collaborated with the AGEP (Alliance for Graduate Education in the Professoriate) program, including a very well received invited talk on the CNS Education program by CNS Director Harthorn at the NSF SBES AGEP meeting (May 2008) at UCSB. CNS has one NSE fellow who is a veteran of the AGEP program.

The UC-DIGSS program (Diversity Internships for Graduate Study in the Social Sciences) supports UC recruitment of minority students in the social sciences, and this collaboration allowed us to successfully recruit a new incoming Latina sociology student who worked with us throughout the 2007-2008 year as an Associate Fellow and is now in her 2nd year as a CNS Social Science Graduate Research Fellow.

A new NSF Bridges to the Doctorate program has begun in CNSI, with the goal of connecting students to NSF funded opportunities. CNS participates in this network of programs that seek to recruit and retain excellent scholars from underserved populations.

In addition, CNS researchers and Education staff have developed ties with student organizations that serve underrepresented groups, including Los Ingenieros, SACNAS, and Women in Science and Engineering (WiSE). These groups address a wide variety of interests within the student community, and CNS research that focuses on environmental and social impacts has resonated with these groups' members. Presentations to these organizations by education staff, graduate research fellows and postdocs have informed participants about nanotechnology and society issues and current research, as well as described opportunities for students in CNS. CNS will seek to collaborate with new diversity programs that may begin at UCSB and is in close communication with key administrators in L&S, Graduate Division, and the Graduate School of Education.

- Partnering with California Nanosystems Institute (CNSI) Internships in Nanosystems Science, Engineering and Technology (INSET) REU program for recruiting California community college students

INSET is a unique REU program in that it is specifically designed for community college students, a high percentage of whom are from underrepresented racial and ethnic groups. Since 2006, half of all of our undergraduate summer interns (10 out of 20) have been in the INSET program. In 2006 and 2007, the entire group of CNSI INSET interns was 55% minority, 37% female and 3% disabled (diversity data not available for individuals).

CNS believes that diversity reproduces itself. Diversity in our CNS graduate fellows program helps to make CNS a welcoming context for undergraduates of diverse backgrounds as well. In a regional program such as ours, word of mouth and reputation are important factors in successful recruitment and retention, as is leadership dedicated to achieving a diverse organization that welcomes and supports a wide range of talents, experiences, and interests. We believe CNS has created a climate of cross-cultural and cross-ethnic acceptance at all levels.

We are continuing to seek innovative ways to disseminate the undergraduate curriculum (INSCITES) so that we can create a network of faculty who teach at higher education institutions that serve significant numbers of underrepresented students. CNS faculty and Education staff have partnered with CNSI and Santa Barbara City College (SBCC) in a successful NSF STS award to introduce an INSCITES course to the community college (PI, CNS Education Director Dr. Julie Dilleuth). UCSB graduate students are involved in starting to

build this network through teacher training and support. In addition, the same INSCITES course has been adopted in the UCSB Gevirtz Graduate School of Education's new Science and Math Initiative (SMI) undergraduate minor program, and will be co-taught by CNS Education staff in Spring 2011.

Postdoctoral Researchers

Our postdoctoral program remains modest due to funding constraints. All CNS postdoctoral positions are recruited in an open, competitive process. For postdoc recruitment CNS aims at a national and international audience through extensive advertising in topical nano, STS, disciplinary, and other listserves, professional organizations, bulletin boards and other avenues. In recruiting for open or new positions, we have worked with the UCSB Office of Equal Opportunity, and in addition to the traditional networks, listservs, and professional organizations (above) we have sent our advertisement to specialty groups serving women and minorities. Going forward, we will continue to broaden our reach to connect with as diverse a group of potential applicants as we can.

Leadership: Pls, Advisory Board, Senior Personnel

To enhance diversity on the faculty level, we have been mindful of our commitment to diversity, recognizing its contribution to research excellence and the broader impact a diverse group can have on the climate and culture of our Center. Senior personnel have included those of Asian and mixed Asian and White racial identities. In planning for renewal for years 6-10, diversity at the Senior Personnel level has been enhanced with the addition of 5 new female senior personnel. One of the proposed additions is a disability research expert. We also have expressly sought to include faculty earlier in their careers and are adding two assistant professors at UCSB and another at Univ of Wisconsin. Disciplinary diversity continues as we will add at UCSB: Chicana and Chicano studies, communication, economics, and environmental studies; including collaborators we add in science journalism and law.

Virtually all the current Advisory Board members have committed to continued service for the next reporting period, and going into the next five-year funding period. It is not expected that the same Board will serve all ten years, and thus in replacing those roles over time we will continue to pursue diversity goals in recruitment.

Engaging a Diverse Public

In order to ensure that all groups in the Santa Barbara area are aware of CNS activities, we will continue to plan and organize our community events, including speakers and NanoMeeters, in order to reach and represent the interests of the wide range of diverse groups in the population in Southern California. In research, we have recruited and will continue to recruit public deliberation participants in panels that reproduce the socio-demographic diversity of the communities in which we conduct them (Santa Barbara, Vancouver, and Cardiff, UK). Studying the effects of such diversity on public participation and group dynamics is an important component of the research.

11. EDUCATION

The CNS brings together researchers and students in the social sciences, humanities, engineering, and science to create new, critically-needed collaborative education programs. It sponsors graduate fellowships and undergraduate internships, and new undergraduate curriculum. Many of these events and activities take place in collaboration with the California NanoSystems Institute (CNSI).

The Education program is led by Dr. Julie Dillemath. As Education Director, Dr. Dillemath provides the day-to-day coordination of CNS educational and engagement activities as well as strategic planning for the education and public engagement programs.

CNS Education Program Objectives & Key Programs



Program Summary: Metrics

The following metrics reflect our primary program objectives, developed in conjunction with reviewers' advice at the 2009 site visit.

Training the next generation of interdisciplinary scholars

Metric	Met in current reporting year?
7-8 graduate research fellowships/year	Yes (9 in 2008/9; 8 in 2009/10)
4 undergrad internships/year, incl. comm. college students	Yes
6 postdoctoral scholars, total years 2006-10	Yes (5 this year (3 CNS-funded))
20 seminars per year	Yes
1-2 visiting speakers per quarter (3-6 per year)	Yes (4 Speaker Series and 2 CNS-only visitors)
Professional development in the areas of communication, teaching practices and job search strategies	Yes (see Postdoctoral, Graduate and Undergraduate report sections for details)
At least one major public engagement event annually where Fellows and Postdocs take the lead role	Yes (NanoDays)

Funding and professional preparation for conference travel for participants	Yes (travel funds for 18 confs.) conferences)
Ongoing formative and summative evaluation	Yes (annual survey)

Diversity – creating a diverse community of scholars within CNS

Metric	Met in current reporting year?
Continue to cultivate diversity among student participants, maintaining current levels: 45% women, 25% underrepresented groups, 50% first generation grads	Yes (50% women, 36% underrepresented groups, 42% first gen grads (fellows) or undergrads (interns))

Curricula Development and Dissemination:

Metric	Met in current reporting year?
Annually increase the number of new or modified courses incorporating CNS research	Yes (10 this year, 9 previous year)

Creating a community across the disciplines (SS, Hum, NSE)

Metric	Met in current reporting year?
Tracking the home departments of participants at CNS seminars	Yes
Tracking the participation of fellows that continue after their funding ends	Yes
Tracking the locations of guest speakers and guest lectures by CNS participants both on the UCSB campus and at professional meetings off campus	Yes
Tracking the background of participants who attend Nanomeeter events	Yes

Program Details

CNS Graduate Research Fellowships in Social Science and Humanities and Science and Engineering

CNS-UCSB awards fellowships to outstanding graduate students pursuing research in the social sciences and humanities and science and engineering. Graduate research fellows take lead roles in the Center's research and education initiatives, and are trained within the interdisciplinary research groups in a unique co-educational context of joint social science and nanoscale science and engineering research and training.

CNS Graduate Fellows for 2008/2009

Fellow	Department	Affiliation
Kasim Alimahomed	Communication	IRG-2
Meredith Conroy	Political Psychology	IRG-3
Summer Gray	Sociology	IRG-1
Indy Hurt	Geography	IRG-3
Erica Lively	Electrical & Computer Engineering	IRG-3
Tyronne Martin	Chemistry	IRG-3
Rachel Parker	Sociology	IRG-4
Claron Ridge	Chemistry	IRG-4

CNS Graduate Fellows for 2009/2010

Fellow	Department	Affiliation
Meredith Conroy	Political Psychology	IRG-3
Summer Gray	Sociology	IRG-1
Erica Lively	Electrical & Computer Engineering	IRG-3
Tyronne Martin	Chemistry	IRG-3
Rachel Parker	Sociology	IRG-4
Claron Ridge	Chemistry	IRG-4
Christine Shearer	Sociology	IRG-3
James Walsh	Sociology	IRG-4

The reporting period covers two fellowship years; the 2008/2009 Graduate Fellows participated from Sept. 2008 to Sept. 2009 and are discussed in detail in the Year 4 (2008-2009) Annual Report. The 2009/2010 fellows participated from Sept. 2009 through Sept. 2010, and are discussed here.

For 2009/2010, seven graduate research fellowships and one senior fellowship were awarded for a 12-month term beginning Fall quarter 2009; five graduate students in social sciences and three in science and engineering (listed in table above). Three social science Fellows and three science and engineering Fellows continued from the previous year (shaded in gray in the table above), a strong measure of the program's success in meeting essential career goals and professional training needs for grads. The Graduate Fellows program is a major component of CNS-UCSB's mission to produce and encourage excellent and innovative scholarship that addresses the intersection of nanotechnologies with society and to contribute to academic workforce development for future nanotechnology research. Fellows, in residence at UCSB, work directly with a faculty mentor in one of the IRGs, and IRG leaders in general have one social science and one science/engineering Graduate Fellow each. For 2009-2010, Fellows came from four different departments and disciplines.

Summary demographic information (out of 8 total):

- 5 Female
- 1 African-American
- 2 Latino/a
- 2 First in family to graduate college
- 3 Will be first in family to receive graduate degree

The Graduate Fellows contribute to the diversity of CNS. The group of eight includes 5 women, and Fellows who are African-American and Latino/a. Two are the first in their family to graduate from college, and three will be the first in their family to receive a graduate degree.

The fellowship term began with an orientation workshop for new fellows. Fellows continued to meet bi-weekly, year-round in a graduate seminar (Soc. 591 BH) with faculty researchers, visiting scholars, and other interested members of the campus community.

Evaluation

As part of ongoing formative and summative evaluation we collect feedback from fellows regarding their expectations and their general level of satisfaction and perceived benefits regarding their CNS research experience and progress. Responses identify particular strengths as well as areas for improvement in the Fellowship Program, and the feedback is used in planning programming that meets the needs of the participants. Education Director Dillemath

conducted the annual survey on the Graduate Fellows program in September 2009 (concerning total CNS experience), as CNS transitions between cohorts. Of the 20 fellows to date, current and alumni/ae, 15 responded to the 2009 survey.

The Fellow experience continues to be rated positively, with cited benefits that include quality mentoring from IRG leaders and research and publishing opportunities that would not have been available otherwise. The interdisciplinary aspects of the Graduate Fellow experience are seen as beneficial though challenging, and, particularly for the social science fellows, the experience is seen as valuable to future career goals (which are largely in academia, but include some government and industry/private sector career plans). In addition to survey responses, informal comments among students cite the importance of the collaborative research experiences in the IRGs for providing training and opportunities unavailable within their traditional disciplinary programs.

CNS-UCSB Postdoctoral Scholars Program

In Year 3 CNS-UCSB initiated an on-site Postdoctoral Scholar program, and over the past year and a quarter this has grown to a group of five scholars, listed in the table below. Two are funded through other NSF awards but maintain a significant presence in CNS and are considered part of CNS. Three postdocs are in their second year with CNS. In addition, CNS-UCSB has partially supported two postdoctoral researchers at Cardiff (Tee Rogers-Hayden, Adam Corner). CNS is committed to providing quality mentorship in research and professional skills towards postdocs' career and personal goals as an integral part of our plans to involve postdoctoral level scholars in our research, education, and outreach programs.

CNS Postdoctoral Scholars, 2009, 2010

Postdoc	PhD	Affiliation
Gwen D'Arcangelis*	Women's Studies, UCLA	IRG 3
Matthew Eisler	History, University of Alberta	IRG 1
Mikael Johansson	Social Anthropology, Univ. of Gothenburg	IRG 1 & 3
Yasuyuki Motoyama	City & Regional Planning, UC Berkeley	IRG 4
Jennifer Rogers*	Sociology, Women's Studies, UCSB	IRG 3

* indicates postdocs funded through other awards, but housed and collaborating in CNS

CNS provides a variety of mentoring and professional development opportunities for postdoctoral scholars at UCSB. On the academic side, our postdoctoral scholars give formal research presentations in the CNS Seminar, are encouraged to submit to and present at conferences, and prepare and present research posters for the annual CNS Research Summit and National Advisory Board meeting. At these meetings, they have the opportunity to engage with CNS external collaborators and elite board members, which develops and expands their networks. CNS provides postdocs with funding for research presentations at conferences as well as opportunities to represent the CNS at workshops, meetings and conferences (11 this year). The CNS Graduate Seminar (discussed below), attended by CNS faculty, postdocs and graduate fellows, includes academic and professional development discussions on various topics such as interdisciplinary collaboration; social science, humanities and science/engineering methodologies; publishing; training on oral and poster presentation design and communication; and other topics identified through regular evaluation surveys. As of Fall 2009, the postdoctoral scholars collaboratively plan one seminar meeting each quarter.

Postdoc participation has been instrumental in the following activities and programs over the last year: NanoDays, CNS's largest public engagement event around nanoscale science informal education; presentation to the summer undergraduate interns; mentoring a visiting graduate student from France in research methods; mentoring CNS graduate fellows; answering interview questions for a middle school student's report on nanotechnology as innovation; leadership role in the CNS NanoEquity Conference in 2009.

On a day-to-day level, postdoctoral scholars meet regularly with their mentors. The structure of the IRGs promotes close collaboration and mentorship with PIs, including interdisciplinary collaboration, at both the postdoc and graduate fellow level. Postdocs are also kept well-informed about events and activities in related departments and programs on UCSB campus. The Education Director forwards relevant lecture and visitor announcements from NSE departments, the Bren School of Environmental Science and Management, the UCSB Center for Information Technology and Society (CITS), as well as social science and humanities departments. In early 2010, we initiated a training workshop for postdocs on CNS policies and procedures, to help them utilize resources more effectively and to facilitate their taking leadership roles in the Center.

Apart from academic mentoring, CNS-UCSB supports postdoctoral scholars in personal development toward their career objectives. Postdocs and their mentors are provided and strongly encouraged to use the Individual Development Plan for Postdoctoral Fellows (IDP) developed by the Federation of American Societies for Experimental Biology (FASEB), a document utilized in many universities as an effective framework for identifying and meeting professional development needs and career objectives. Campus programs provide broader support: CNS postdocs have taken part in the new Professional Development Program for Postdoctoral Scholars, sponsored by the California Nanosystems Institute (CNSI), attending workshops on article writing and academic job applications. In addition, postdoc Johansson was president of the UCSB Society of Postdoctoral Scholars, which provides training, development, and social opportunities for campus postdocs. For support materials, articles, and guides on mentoring and career development, the UCSB Graduate Division provides an extensive online collection (<http://www.graddiv.ucsb.edu/postdoctoralscholars/careers.htm>, <http://www.graddiv.ucsb.edu/postdoctoralscholars/mentoring.htm>).

Evaluation

We evaluate the postdoctoral program on an annual basis with a Fall survey to our current and past postdoctoral participants, assessing their experience and rating of program components. From 2009, ratings of the quality of the CNS experience with respect to IRGs and IRG leader interaction averaged 3.3 (on a 1-4 scale, with 4 being 'excellent'). Interactions with other postdocs earned the highest ratings (3.7 avg), with ratings of interactions with graduate fellows, guest speakers and the seminar earning lower ratings (2.7 avg). These are ratings of the first year of our expanded postdoctoral scholars program, so it is not surprising that there is some room for improvement. Open-ended responses were positive overall, with mentoring, collaboration and network-building cited as particularly beneficial, and the interdisciplinary interactions both beneficial and challenging.

CNS-UCSB Undergraduate Summer Internship Program

CNS offers internships to UCSB undergraduate social science and humanities majors who are interested in gaining social science research experience. CNS also collaborates with the NSF funded Interns in Science, Engineering and Technology (INSET) REU program at the California Nanosystems Institute to recruit community college students to an 8-week summer research experience on the UCSB campus.

The four 2009 Interns gained first-hand experience investigating the societal issues relating to nanotechnology with our 'Traveling Nanotechnologies' Global Value Chain project. The students were matched individually with faculty and graduate fellow mentors and investigated research questions from their IRGs, but considered the research questions of their IRG in terms of a single nanomaterial, carbon nanotubes, and in that sense worked as a team. Their culminating research presentation, entitled, *Nanotechnology in the Global Marketplace: A Presentation Outlining the Innovation, Diffusion, Media Framing and Globalization of Carbon Nanotubes*, was a synthesis of their individual research into a unified story of their nanomaterial.

This project was modeled after a course taught by CNS collaborator Gary Gereffi (Duke University). Graduate student Stacey Frederick, who works with Dr. Gereffi and was involved in teaching the course after which this project was modeled, visited CNS at the beginning of the summer to provide training and guidance for both interns and mentors on the Traveling Nanotechnologies project. This was the second year of the Traveling Nanotechnologies project, and we now have an article in preparation and are preparing support materials to make available to others to adopt and adapt the project with their own interns.

The internship provided undergraduates training in societal implications research as well as ongoing mentoring, IRG participation and interaction, and professional development. In addition to research, the interns attended weekly CNS seminars, participated in group meetings, and developed communication and presentation skills. The culmination was an oral research presentation for CNS and research poster colloquium with all science and engineering summer interns. Following the summer program, intern Andrea Tran (IRG 4) became an intern with with IRG 2 during Fall quarter.

Summer 2009 CNS Summer Interns

Intern	University	Grad Mentor	PI	IRG
Sean Bronston-Wilson	SB City College	Kasim Alimahomed	Chris Newfield	2
Javier Martinez	UCSB	Indy Hurt	Barbara Herr Harthorn	3
Ryan Shapiro	SB City College	Meredith Conroy	Bruce Bimber	3
Andrea Tran	UCSB	Rachel Parker & Claron Ridge	Rich Appelbaum	4

Evaluation

Evaluations completed by both interns and mentors point to a successful summer and also specific ways to improve the project. Interns were very satisfied with the research they conducted, how much they learned, and the level of guidance and training they received. They reported increased confidence in their knowledge, research skills, and communication and presentation skills as a result of participating in the program. Particular challenges they reported included getting used to research not being a structured 'assignment', confidence in their own ability to conduct research, and dealing with a sometimes overwhelming amount of information. But the most enjoyable aspects cited were working and collaborating with their mentors and PIs, and benefiting from their expertise, learning about nanotechnology, and working with the other interns as a group and helping each other.

Mentors evaluated their experience positively, consistent with previous years. Reported challenges centered on communication and management, which underscores the importance of the mentoring experience for professional development, and the degree of contribution of the project to IRG research. At the end of the program graduate mentors reflected and provided

several suggestions for mitigating those issues in the future. Mentors particularly enjoyed seeing their interns' knowledge and confidence grow, feeling appreciated by their intern, and being challenged to improve their own mentoring skills.

Feedback has been incorporated into planning for summer 2010, to improve the program particularly to contribute more to current IRG research. Mentors for 2010 started planning for their intern research projects in the Fall, so that the additional lead time would allow plenty of time for thoughtful development. Fellows who have continued for another fellowship year will help provide guidance and continuity since they can draw on their experience to help new mentors this coming summer.

Curriculum

In September 2009, CNS held a one-day orientation workshop for new Graduate Fellows, which provided an in-depth introduction to CNS mission, activities and policies and procedures, as well as specific background on the IRG research programs from the co-PIs. A working lunch with all CNS was an effective way to regroup for a new academic year and introduce the new Fellows to the group.

The CNS Seminar Soc 591 is our focal point for graduate curriculum. The biweekly seminar meetings develop an interdisciplinary community of scholars with special expertise and, for participants, help develop their ability to communicate effectively across significant disciplinary boundaries. Seminars address a wide range of issues of emerging nanotechnologies and society including social science and NSE research methods, science and technology studies, professional development topics, and substantive research within the IRGs.

Highlights from the seminar during the reporting year include discussions led by CNS co-PIs on the history of technology as a discipline and nanotechnology and news media, a research presentation by Postdoctoral Scholar Matthew Eisler, a presentation by Fellow Indy Hurt on presentation skills, a discussion led by Postdoctoral Scholars on nanotechnology and development, a more informal lunch seminar with STS journal editor Michael Lynch, on the topic of peer-reviewed publishing, and an informal coffee discussion with visitor Richard Harris, a NPR Science Correspondent. The CNS Speakers Series, which is part of the seminar but opened up to a wide campus audience, hosted Michael Bess (professor in the History Dept, Vanderbilt Univ.) on "The Jetsons Fallacy: Science Fiction, Biotechnology, and the Future of the Human Species", Dominique Brossard (associate professor in the Department of Life Sciences Communication, UW Madison) on, "Of Misers, Google, and Technology: Audiences Use of New Information Environments to Make Sense of New Technology" and John Gastil (professor in the Communication Dept. at the Univ. of Washington) on, "One theory to rule them all: The cultural cognitive approach to public opinion on everything from abortion to nanotechnology."

Students in CNS have the opportunity to participate in an interdisciplinary doctoral emphasis program in Technology and Society, organized through the UCSB Center for Information Technology and Society (CITS). CNS faculty Bimber, Harthorn, and McCray are affiliated with CITS, and a close working relationship exists between the two Centers. The doctoral emphasis, which is of interest to some of our Fellows, requires coursework in the areas of culture and history and society and behavior, and a dissertation on a topic concerning technology and society. All CNS faculty and students are kept informed about upcoming events and speakers in the CITS seminar series.

New collaboration with community colleges around curriculum has begun in earnest with a new NSF STS award this year, *Bringing Nanotechnology and Society Courses to California Community Colleges*. This project, with Education Director Dillemath as PI and McCray is co-PI, redevelops one of the INSCITES (Insights on Science and Technology in Society) courses from UCSB with new nanotechnology content and a syllabus to fit the longer, 16-week semester of Santa Barbara City College (SBCC). An SBCC Chemistry instructor, the SBCC Dean of Educational Programs, and a new UCSB faculty member in History and Environmental Studies are co-PIs on the award, and two Graduate Teaching Scholars, from humanities and NSE disciplines, are closely involved in the redesign and teaching of *Green Works: Nanotechnology and the Search for Sustainability*.

CNS-UCSB faculty, external collaborators and Education staff incorporated Center research into 11 university courses during this reporting period:

Graduate level courses:

- Global 230 UCSB, *Global Political Economy* (Appelbaum)
- Soc 261, UCSB, *Sociology of Development* (Appelbaum)
- Soc 591 (BH), *CNS Graduate Seminar* (Harthorn)

Undergraduate level courses:

- Chem 235/Anth 235/Hist 237, Rice University, *Nanotechnology: Content and Context* [(Cyrus Mody (History, IRG1) and Kristen Kulinowski (Rice chemistry/CBEN/ICON))].
- FemSt 132, UCSB, *Gender, Science and New Technologies* (Harthorn)
- Eng 101, UCSB *Engineering Ethics*, Education Director Dillemath guest lecture
- Global 2, Introduction to Global Studies Politics and Economics (Appelbaum)
- Global 130, UCSB, *Global Political Economy* (Appelbaum)
- Hist/Elec 234, Rice University, *Technological Disasters*, co-taught by Cyrus Mody (History, IRG 1) and Kevin Kelly (Electrical and Computer Engineering) interdisciplinary intro-level engineering and humanities course
- Soc 125, U Wisc, *Contemporary American Society* (Conti)
- Mody, Cyrus. Guest telelecture in University of Virginia course on Societal Implications of Nanotechnology (Nathan Swami instructor), February 3, 2010

Reports to the National Advisory Board

CNS faculty and staff report on the evidence of progress towards completion of the objectives listed above at the annual meeting of the National Advisory Board. Specific questions raised by the evaluation data are discussed with a view to identifying problems and devising appropriate modifications. CNS convened a NAB meeting in Spring 2009 to review CNS issues and concerns going into the external review for the pending renewal proposal. In 2009-2010, the Exec Committee in conjunction with the NAB decided to have a 1-yr hiatus between NAB meetings, given the extensive work in the first half of 2009 devoted to the research integration and research summer, renewal proposal, and external site visit, and the board's participation in that process.

Evaluation Databases

CNS maintains a database of all participants in fellowship, internship and public outreach events so that we can provide evidence of the nature of the population who take an active part as well as those who express interest in learning more about this field. We will use the information gleaned from participants at conferences, public events and seminars to guide our future plans for both research and education.

The CNS website serves as an archive for all significant documents that are created by the Center faculty, staff and students. The web site also serves to inform that public about highlights in the field and to advertise future events that the center is hosting (see Outreach and Knowledge Transfer section for more information on the website).

Table 3a: Education Program Participants - All, irrespective of citizenship

Student Type	Total	Gender		Race Data								Ethnicity: Hispanic	Disabled
		Male	Female	AI/AN	NH/PI	B/AA	W	A	More than one race reported, AI/AN, B/AA, NH/PI	More than one race reported, W/A	Not Provided		
Enrolled in Full Degree Programs													
Subtotal	15	8	7	0	0	2	8	1	1	0	3	4	0
Undergraduate	4	3	1	0	0	0	2	1	0	0	1	2	0
Masters	0	0	0	0	0	0	0	0	0	0	0	0	0
Doctoral	11	5	6	0	0	2	6	0	1	0	2	2	0
Enrolled in NSEC Degree Minors													
Subtotal	0	0	0	0	0	0	0	0	0	0	0	0	0
Undergraduate	0	0	0	0	0	0	0	0	0	0	0	0	0
Masters	0	0	0	0	0	0	0	0	0	0	0	0	0
Doctoral	0	0	0	0	0	0	0	0	0	0	0	0	0
Enrolled in NSEC Certificate Programs													
Subtotal	0	0	0	0	0	0	0	0	0	0	0	0	0
Undergraduate	0	0	0	0	0	0	0	0	0	0	0	0	0
Masters	0	0	0	0	0	0	0	0	0	0	0	0	0
Doctoral	0	0	0	0	0	0	0	0	0	0	0	0	0
Practitioners taking courses	0	0	0	0	0	0	0	0	0	0	0	0	0
K-12 (Precollege) Education													
Subtotal	0	0	0	0	0	0	0	0	0	0	0	0	0
Teachers	0	0	0	0	0	0	0	0	0	0	0	0	0
Students	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	15	8	7	0	0	2	8	1	1	0	3	4	0

Table 3b: Education Program Participants - US Citizens and Permanent Resident

Student Type	Total	Gender		Race Data								Ethnicity: Hispanic	Disabled
		Male	Female	AI/AN	NH/PI	B/AA	W	A	More than one race reported, AI/AN, B/AA, NH/PI	More than one race reported, W/A	Not Provided		
Enrolled in Full Degree Programs													
Subtotal	15	8	7	0	0	2	8	1	1	0	3	4	0
Undergraduate	4	3	1	0	0	0	2	1	0	0	1	2	0
Masters	0	0	0	0	0	0	0	0	0	0	0	0	0
Doctoral	11	5	6	0	0	2	6	0	1	0	2	2	0
Enrolled in NSEC Degree Minors													
Subtotal	0	0	0	0	0	0	0	0	0	0	0	0	0
Undergraduate	0	0	0	0	0	0	0	0	0	0	0	0	0
Masters	0	0	0	0	0	0	0	0	0	0	0	0	0
Doctoral	0	0	0	0	0	0	0	0	0	0	0	0	0
Enrolled in NSEC Certificate Programs													
Subtotal	0	0	0	0	0	0	0	0	0	0	0	0	0
Undergraduate	0	0	0	0	0	0	0	0	0	0	0	0	0
Masters	0	0	0	0	0	0	0	0	0	0	0	0	0
Doctoral	0	0	0	0	0	0	0	0	0	0	0	0	0
Practitioners taking courses	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	15	8	7	0	0	2	8	1	1	0	3	4	0

12. OUTREACH & KNOWLEDGE TRANSFER

The CNS-UCSB pursues a multi-layered outreach and knowledge transfer program. Because of the novel work being pursued by CNS-UCSB, knowledge transfer is required at the levels of campus and academic communities as well as to general audiences, public policy makers and industry experts. In addition to initiating outreach activities and dialogue opportunities between the general public and nanoscale researchers (enumerated below), CNS-UCSB has been a connector for the growing nano in society community and is increasingly seen as a research hub and dissemination portal for that community. “Knowledge transfer” implies a one-way (and linear, top-down) process of knowledge deposition that is at odds with our views about the importance of two-way interaction between science and society. CNS aims rather to pursue processes for “engagement” with society, where “society” includes all interested social actors, as well as those who lack of familiarity with nanotechnologies. Ongoing low levels of public awareness of nanotechnologies (see Satterfield et al., 2009) challenge the project of engagement, and CNS is currently discussing new approaches as we move forward, including creation of a possible citizen advisory board.

In March 2009 CNS hired a science journalist to serve as a half-time Media Coordinator, filling a position vacated in December 2008. The position was intended to help disseminate CNS research and education results to the media and through the web portal, implement new media mechanisms for engagement, coordinate public events designed as engagement or education outreach, and coordinate these efforts with CNS staff and researchers as well as other partners on- and off-campus. After a 9-month trial period, the position was terminated in Dec 2009, and the CNS Executive Committee agreed with staff that a new approach is needed that will accomplish these different tasks by a number of means. In 2010, CNS plans to contract writing services from one or more professional writers on an as-needed basis, to use campus information services to write and disseminate press releases about CNS activities, to contract web services from a professional firm and web updating from a student assistant employee, and to contract a graphic designer to provide services as needed. Event coordination is reaffirmed as the purview of the CNS Administrator, in coordination with Education and Outreach Director Dillemath, and Assistant Director Gilkes. The initial administrative costs of setting up these different contracts and service agreements will be mitigated by having tailored professional services available but only on a cost effective as needed basis.

Public Engagement Objectives

CNS has pursued the following objectives through its initial 4.25 years of funding.

- To host visiting speakers to UCSB who will raise interest and participate in collaborative scholarship about critical issues related to the impact of nanotechnologies in society.
- To create a series of events that engage members of the general public in discussion and debate about the societal implications of nanotechnologies and issues concerning their responsible development.
- To create new contexts for “3-way” science-social science-public interaction that will serve to provide informal science education, to familiarize nanoscale scientists and social scientists with the public’s concerns, and to situate societal knowledge within ISE.
- To maintain a presence on the Web and, increasingly in the next funding cycle, in new media, that informs about the above objectives and serves to update the public and special interest groups such as industry, government, media, labor, and NGOs about significant research and policy findings.

- To disseminate policy-relevant research findings and recommendations about nanotechnologies' development and societal interactions to appropriate local, state, national, and international policy makers.

Program Summary: Metrics

Visiting Speakers Metric	Met in current reporting year?
Host 3-6 visiting speakers per year who will raise interest on campus and participate in collab. scholarship	Yes (3 Speaker Series events)

Event Series Metric	Met in current reporting year?
3-4 NanoMeeters per year	No (1 NanoMeeter this year)
1 NanoDays event per year	Yes
10 public presentations per year by CNS faculty, postdocs, students (ex: high school, community groups, campus organizations)	Almost (9 general public presentations)

Web presence	Met in current reporting year?
Maintain #1 google position, "nanotechnology, society"	No (3 rd as of 4/13/10)
Determine appropriate metrics (taking into account data availability) for measuring visitor engagement with website	In development

Policymaker Dissemination	Met in current reporting year?
Disseminate policy-relevant research findings to local, state, national, internat'l policymakers	Yes (19 presentations/reports)

Program Details

Nano-Meeter:

CNS (with CNSI, and the MRL) continued to utilize the informal nanoscale science discussion forum, the NanoMeeter (formerly called NanoCafé) to connect researchers with the public. NanoMeeters are held on weekday evenings for roughly 60-90 minutes, in the community in a publicly accessible site. Audiences range in size from approximately 25-50. UCSB CEIN is also a potential partner of future events.

In early March 2010, the topic was 'New Nanoscale Materials for the Future of Energy.' UCSB Professor of Chemical Engineering and Materials Research Lab researcher Bradley Chmelka presented his research on nanotechnology for fuel cells and batteries, with introduction and discussion moderation by CNS co-PI Rich Appelbaum. An enthusiastic audience of 25 people, ranging from college students to seniors, attended the free, Thursday evening event.

We plan to continue this series, which is popular with both audiences and speakers, on a roughly quarterly basis.

Speakers series/Visiting scholars or practitioners:

Speakers series: The CNS hosts at least 4 visiting speakers per year who present in the Graduate Seminar and to wider campus and public audiences on a range of topics. During the reporting year CNS hosted Michael Bess (Professor, Dept. of History, Vanderbilt Univ), Dominique Brossard (Associate Professor, Dept. of Life Sciences Communication, UW Madison), and John Gastil (Professor, Dept. Communication, Univ. of Washington), and co-hosted Peter Singer (Brookings Institute) and Richard Harris (National Public Radio).

These lectures were advertised to the wider campus community, across humanities, social science and engineering disciplines. Before moving into our new space with our own seminar room, CNS hosted these events on the Engineering side of campus to draw interested members of the College of Engineering community. The Center is making significant headway in gaining a supportive and interested constituency among Science and Engineering colleagues.

Visiting scholars and practitioners: In addition, CNS sponsors and co-sponsors a varied group of visitors to campus every year, providing extensive opportunities for CNS researchers and students to meet with and exchange views on a range of issues on the societal dimensions of nanotechnologies. Visitors in the reporting period include: Michael Lynch, Cornell in April 2009, Stacy Frederick, NCST in June 2009; UC CEIN legal and regulatory scholars, Tim Malloy and Hilary Godwin, July 2009; two different visitors from the Japanese Government's AIST nano organization, Mizuki Sekiya and Masafumi Ata, both in Nov 2009; EC Commissioner Laurent Bocherreau, in Jan 2010; Katherine McComas (Cornell), Wandu Bruine de Bruine (CMU), Sharon Friedman (Lehigh), Robin Gregory and Paul Slovic (Decision Research), Susanna Priest (UNLV), Michael Siegrist (Zurich), and Peter Wiedemann (Julich), all in Jan 2010; and representatives from the state's Dept of Toxic Substance Control, Feb 2010.

Public Presentations:

CNS researchers and graduate students also make numerous public presentations to campus, local, regional, and wider audiences about the work of the CNS-UCSB. In the reporting year these presentations totaled 121 and included 54 presentations in education and outreach and 67 in social science and humanities research contexts. See full listing at the end of this section (12).

Former CNS Science and Engineering Graduate Fellows (Ferguson, Ostrowski, Rowe) continue to participate in CNS engagement events. Former Fellow Ostrowski provided significant effort in the planning and running of the NanoEquity conference.

Weekly Clips:

Another popular continuing outreach effort is the CNS-UCSB Weekly Clips. Leading breaking news stories on nanotechnology and societal issues are tracked and circulated electronically. Fifteen Weekly Clips compilations were sent out during the reporting period to a growing list of nearly 500 interested colleagues, students, government and policy people, industry contacts, NGO leaders and members of the general public. This program depends on talented but necessarily transitory effort by student employees. The program experienced a hiatus during 2009 as one student graduated, and staff turnover limited CNS time and ability to replace. It has recently been reinstated, and CNS hopes to continue with as little disruption as possible in the future. UC CEIN has asked us to partner with them in disseminating environmental toxicity news as a part of this program.

Biannual Newsletter:

CNS-UCSB has aimed to distribute an electronic newsletter on a regular basis, including research items, education program highlights, past event recaps, upcoming event teasers, and a

student spotlight. Distribution is intended to include interested colleagues, students, government leaders and policy makers, industry contacts, nongovernmental organizations and members of the general public. Media position staff turnover has prevented realization of this aim in the past year, and lack of dedicated staff position to perform this work means CNS is reassessing this goal in 2010.

Conferences:

In November 2009, following 2 years of preparatory work, CNS hosted a major international conference entitled *Emerging Technologies/Emerging Economies: (Nano)technologies for Equitable Development*, held in Washington DC, to examine nanotechnology applications for solving intractable human problems (for clean water, safe energy, sustainable food, and health) and their implementation in the developing world. The conference organizing team was led by IRG 4 leader, Rich Appelbaum and Senior Fellow Rachel Parker; PIs Harthorn and Bimber as well as CNS Assistant Director Gilkes also served on the planning committee. Former NSE Fellow Alexis Ostrowski worked closely with Rachel Parker on many aspects of planning and implementation, and additional fellows and postdoc Jennifer Rogers participated in the event. The group recruited the Woodrow Wilson International Center to co-host the event, raised funding from several sources at UCSB, Rice Univ, and from NSF in the form of a supplement to support the conference. Meridian Institute, an international NGO that has facilitated other workshops on issues of nanotechnology development in the developing world, partnered with CNS and provided expert facilitation and planning to ensure full involvement of the developing world participants. The event brought approximately 85 participants to the intensive 3-day workshop, hosted media and policymaker engagement events at the National Press Club and on Capitol Hill, and was deemed a resounding success by all participants. Follow up activities include exploration of social media (Facebook) modes to maintain and build the network of participants and other interested people who were unable to attend, and the production of a volume, to be published by Routledge, that will further disseminate the conference's ideas on the opportunities and challenges to equitable global development of nanotechnologies. Key among the conclusions was the importance of development of open source technologies for humanitarian purposes in the developing world. More information is available at: nanoequity2009.cns.ucsb.edu

Specialist Meetings

In Jan 2010 IRG 3 also organized and convened a Nanotechnology Risk Perception Specialist Meeting. The meeting was held for two days Jan 29-30, 2010 at the Upham Hotel in Santa Barbara. IRG 3 co-leaders Harthorn, Pidgeon & Satterfield worked together throughout the past year developing the aims for this meeting, recruiting key scholars from around the world, developing the program, and writing 2 white papers (Harthorn, Satterfield) and a synthetic overview by Pidgeon that will become the cornerstone for the proposed special edition of the leading journal, *Risk Analysis*, the 3 co-organizers plan to develop out of the meeting. The meeting convened over a dozen leading international scholars from the US, Canada, the UK, Germany, Austria, Switzerland, the Netherlands, and Portugal who prepared white papers for the sessions; IRG 3 collaborators Kandlikar, Haldane and Conti served as discussants; leading scholar Paul Slovic gave a concluding overview about the implications of the research presented for risk perception theory and knowledge, and for risk communication. Key issues discussed at the workshop included: the applicability to mental models approaches in the upstream nanotechnology context, implications for the social amplification of risk framework, social risks such as fairness as critical drivers of emergent perception, effects of product labeling regarding NM content on public perceptions, cultural cognition, deliberations as public perception research, the role of expert perceptions in emerging public debate about risks, construction of preference, and, throughout, the methodological challenges of upstream work and the political challenges of navigating between demands for risk perception work to either socially engineer the public or as

market research. The meeting agenda is available at: <http://www.cns.ucsb.edu/conference-program/past/riskperception>.

IRG 2 has also taken the lead in planning a workshop on the Nanotechnology Innovation System, to be held in Lyon, France April 29-30, 2010. Co-led by Newfield, Mowery, Barnett and Boudreaux, this workshop, too, convenes an interdisciplinary group of leading international specialists to discuss the effects of state investment policies and programs, IP and Tech Transfer issues, and impediments to rapid development of critical renewable energy applications as planned and hoped for. The meeting agenda is available at: <http://www.cns.ucsb.edu/conference-program/innovation>.

NanoDays:

For the past three years CNS has hosted “NanoDays” events, the annual national education effort of the Nanoscale Informal Science Education (NISE) Network. On Friday, April 3rd and Saturday, April 4th, 2009, CNS and CNSI co-hosted NanoDays. Friday was on the UCSB campus at the UCen (student center) during lunch time, a time of peak traffic. Saturday’s event was in downtown Santa Barbara at the Farmers Market. Hands-on activities designed to engage and promote understanding of the nanoscale and nanotechnology were led by CNS Graduate Fellows, Postdoctoral Scholars, and additional student volunteers. Our total audience was approximately 200 people over both days.

In 2010 we took NanoDays to a new level, expanding our partnerships and audience. Together with UCSB’s National Nanotechnology Infrastructure Network (NNIN), UC CEIN, and CNSI, and the Santa Barbara Museum of Natural History, we held a NanoDay at the museum on Saturday, March 26, 2010, engaging nearly 500 visitors.

These events are popular with the public, science students, and social science students, and we anticipate continuing to participate in them.

Public Policy Presentations:

As the research agenda from the CNS has begun to develop a consolidated set of research results on the *global innovation system* for nanotechnologies (IRGs 1, 2 and 4) and issues regarding the *responsible development* of nanotechnologies (IRG 3 and 4), CNS is increasingly being called upon and initiating opportunities to disseminate findings to key national (NNI, NNCO, NIOSH, EPA, NSF, US Congressional organizations, UK governmental organizations) and state level organizations (CCST, DTSC).

Web Site:

The CNS Web site (www.cns.ucsb.edu) serves as the main portal for information dissemination to and contact with the various constituencies the CNS aims to serve and as such requires continual updating. Through this portal we aim to share the tools and resources generated for our own research, education and public outreach programs to a wider audience. Such resources include: identification and links to other researchers and their interests; sharing of emergent publications and bibliographies in annotated and/or classified format; clipping service of public media coverage; all CNS reports and products; and educational resources from UC Santa Barbara and elsewhere, with necessary permissions, such as syllabi of nano-society courses.

The web is very useful for planning, organizing, and hosting key events. For example, a web presence for the Nov 2009 NanoEquity conference (nanoequity2009.cns.ucsb.edu) was critical in informing and recruiting participants, linking it clearly to wider CNS audiences, and now in

continued use and development for conference follow-up, augmented by a Facebook networking site.

The CNS Web site is mounted on our host server in the UC Santa Barbara Institute for Social, Behavioral, and Economic Research (ISBER), which provides a secure and stable backbone for maintenance of our system. Computer and network support from ISBER have enabled us to incorporate new functionalities and information so far, and we have achieved significant economies and efficiencies through this partnership. As data collection increases and collaborations become more extensive around the globe, the need will increase for the CNS to serve as a “collaboratory.” We will continue to review and modify the formats, functionalities and capacities of the Web site to meet its mandate as a clearinghouse. The website links to a blog as well, hosted in the past primarily by PIs McCray and Newfield. Activity has diminished from modest to miniscule in the past year. CNS efforts have been redirected on the advice of our Board to following and contributing to blogs that are already well established (e.g., *Science Progress*, to which McCray has successfully contributed twice in the past year).

Staffing the full web services needed for a NSF national center working on strategic issues in emerging technologies is a challenge both budgetarily and in terms of human resources. The skills and tools needed rarely reside in a single individual, and the centers scale and operational resources do not permit hiring multiple different positions. CNS is redirecting its effort in 2010 to meet this needs not through permanent staff positions but through strategic use of on- and off-campus consulting, student employees, and other approaches that will leverage our resources and location.

Media program:

CNS has an active media objective of translating academic results to a general audience, using media contacts and dissemination processes. In the past the Media Coordinator position took the lead on pursuing these goals on behalf of CNS. CNS is currently in transition in this area of operation and in the process of redesigning our approach and the assignment of tasks across staff, researchers, and outside contractors.

Publicity:

With each event, publication, or major announcement, CNS-UCSB launches a publicity campaign. This campaign includes wide distribution of a press release to local and trade media; national science editors and reporters; CNS-UCSB collaborators; UC Santa Barbara deans and affiliated faculty; community, business and government leaders; INSN; and the CNS-UCSB National Advisory Board. Efforts are currently being explored to include industry within a wider distribution. Additionally, CNS-UCSB generates occasional podcasts, available on iTunes. These podcasts may be CNS faculty researchers or graduate fellows discussing research, or audio from visiting speakers or public events. CNS researchers also contribute op-ed pieces to various local, regional and national newspapers and blogs.

CNS Media Plan for 2010

The primary steps we plan to pursue in the coming year are:

- Increased networking with regional and national media to secure better placement, promotion of CNS news items.
- Continue efforts to post CNS op eds and opinion pieces to other prominent blogs (e.g., *Science Progress*).
- More opportunistic launching and placing of press releases, in a context of rapidly changing news publishing.

- Improving the CNS-UCSB website for more effective interaction and information retrieval, including showcasing CNS research, and developing a rotating segment on student activities.
- Review of the CNS Blog to either revitalize or redirect efforts elsewhere.
- Continue utilizing analytical tools to track traffic patterns to specific areas of our website.
- Podcasts of CNS events of interest to different groups; short interview video clips of CNS visitors by CNS researchers.
- Continue to assess requirements for implementing new media tools for engagement (e.g., short video clips on research findings of interest to different audiences).
- Develop aims consistent with the resources available and changing media contexts for dissemination and engagement.

CNS Engagement with Nanoscientists and Engineers

Engagement with nanoscientists and engineers is a central and distinctive aim of the CNS-UCSB. The reasons for engagement are multiple. CNS aims: to understand the nano enterprise from its participants' points of view; to foster new opportunities for dialogue and engagement between nano scientists and social scientists for mutual benefit; to develop innovative methods to train a new generation of society-minded scientists and science-minded social scientists; to use the research findings of the CNS to enhance two-way communication between nano-science and society, and 3-way communication between nano-science, social science, and society. We have pursued this mission in a number of ways:

- **Executive Committee:** In December 2008 CNS Executive Committee added UCSB MRSEC Director Craig Hawker, a leading nanoscale researcher (former CNSI Director Evelyn Hu preceded Hawker in this role). Hawker is a full participant in decisions and planning for the CNS.
- **National Advisory Board (NAB):** The NAB of the CNS-UCSB was chaired until Dec 2008 by Tom Kalil, UC Berkeley, until he was drafted to join the Obama White House in science and technology policy. Current Board Co-Chair John Seely Brown is extensively involved in nanotech start ups and global nanotech development; the board also includes Rice University nanochemist and national center (CBEN) leader, Vicki Colvin, Harvard nanoscientist and NSEC director, Robert Westervelt, and Martin Moskovits, a leading nanoscience chemist with industry and academic ties. Engineer Susan Hackwood is an engineering professor and leading science policy expert in California as Director of the California Council on Science and Technology Policy.
- **Location and Proximity:** CNS-UCSB was until Nov 2009 partially located in the CNSI building, where our education staff interacted closely with theirs. In spite of current relocation out of the CNSI and into badly needed contiguous working and research space, our ties to CNSI continue, with partnering on undergrad intern program, the new curriculum development program, event publicity, and many other instances. CNS will continue to have full use of the CNSI, and MRL Director Hawker has also been generous in offering us space in his building as needed.
- **Research Program:** All four IRGs of the CNS involve plans for fine grained social science research with nanoscientists and engineers at UCSB and elsewhere. We have collaborative ties with a number of researchers on campus, and we are successfully drawing top science graduate students as applicants to our Research Fellows program; and they come with the endorsement of their advisors, and requests for renewals, all strong evidence of the estimation of the CNS by our colleagues in science and engineering fields.
- In all cases, the NSE community has been receptive to our working with them on this research, has made significant commitments of their time, their students', and their knowledge in support of our work, and the numbers of interactions continue to grow over time. Support letters indicate the extent of this support and its importance to us.

- **Education Program:**

Our recruitment and summer internship programs are closely coordinated with CNSI's, providing a strong, deep interconnection between our two programs, and direct links as well to a number of other acclaimed science education and outreach programs on campus that involve nanoscientists and engineers, for example through the NNIN, of which UCSB is a member, through the MRSEC housed in the Materials Research Laboratory (MRL), and the UC CEIN, among numerous others.

More directly, and as a result of extensive consultation with campus nanoscientists, the CNS has an interdisciplinary program of CNS Graduate Research Fellowships that involves nanoscale science and engineering graduate students (3 in the reporting year) and social science graduate students (7 in the reporting year) directly in CNS IRG research programs. Fellows work alongside and in close contact with other Fellows and with faculty researchers. Disciplinary differences inform student approaches to the weekly fellows meetings and IRG meetings, and mechanisms to supersede those differences are developed in the collaborative atmosphere fostered by the Center. All CNS Graduate Fellows take an active role in the research, as evinced by the 8 papers or chapters (published or accepted for publication) that CNS graduate students co-authored with CNS senior researchers in the last year. CNS Fellows were first author on four of these publications.

There is increasing evidence that through their students, faculty scientists are gaining insight into our work, appreciation for our social scientific methods, and enhanced interest in engaging with us. Also nanoscale S&E Fellows demonstrate an ongoing commitment to CNS, as witnessed by ongoing participation in CNS events and activities (including former Fellows Ferguson, Macala, Ostrowski, Rowe) after the Fellowship term has ended for those who remain on campus. Ties are continuing even after NSE fellows leave campus, and future plans are to reconvene all fellows and postdocs in a culminating meeting.

CNS is also involved with CNSI in an innovative education program that gives the opportunity for graduate students in the science, engineering, and the social sciences to formulate a course for undergraduates that integrates nanoscience research (including labs) with the historical and social context in which this technology is being developed. INSCITES (Insights on Science and Technology for Society) funding was provided through an NSF Distinguished Teaching Scholar award to former CNSI Director and former CNS Associate Director for Nanoscience and Co-PI, Evelyn Hu. CNS Co-PI Patrick McCray co-taught the INSCITES course. Though this was the last year of funding for this program, an NSF STS award at CNS, with Education Director Dr. Julie Dillemath as PI, began in January 2010 to update the nanotechnology content of the *Green Works: Technology and the Search for Sustainability* course and bring INSCITES to community colleges in collaboration with Santa Barbara City College. Further, CNS is part of the NSF CCLI award at the UCSB Gevirtz School of Education to teach the same course as part of their new Science and Math Initiative minor.

CNS-UCSB Education Director Dillemath engaged with a national and international network of NSE educators during the NSF-funded Partnership for Nanoeducation Workshop in April 2009, the Society for the Study of Nanoscience and Emerging Technologies (S.NET) conference in September 2009, the Nanoscale Informal Science Education Network (NISE Net) Annual Meeting also in September, and the Materials Research Science and Engineering Centers Education Director's meeting in November 2009.

- **Research collaborations between CNS and nanoscientists and engineers:** CNS is a funded partner in the UC Center for Environmental Implications of Nanotechnology in which

Director Harthorn leads the only social science IRG and serves on the Executive Committee. In addition, Harthorn has again for the past year collaborated with Patricia Holden, an engineer and microbiologist in the Bren school of Environmental Science and Management to follow up on our 2006 survey by conducting a 2nd industry survey about safe handling practices for nano materials. This project has entailed a full year of close collaboration, weekly meetings and co-advising of the 5 graduate students on the project and represents a highly successful integration of social science and nanoscale science expertises and interests. CNS postdoc Johansson, listed in IRG 1 but really a cross-IRG appointment, is conducting lab ethnography in the NINN facility on campus—the ESB clean room---and CEIN toxicologists' labs. CNS has partnered with CNSI on several funding proposals to extend the educational mission. Director Harthorn is current senior personnel on a pending IGERT proposal to fund a new computer science and society program in conjunction with CITS. And Director Harthorn is also currently far along in discussion with researchers at Oak Ridge National Laboratory to collaborate in a project involving 8 DOE national centers for nanoscience and technology research and development.

- **CNS Nanotechnology in Society Network Activities:** In the first 3 years of the CNS, Harthorn regularly participated as CNS-UCSB PI in Nanotechnology in Society Network (NSN) conference calls with CNS-ASU and the 2 other funded projects at Harvard/UCLA and Univ of S. Carolina. CNS-UCSB through Dr. Harthorn's efforts has been directly and instrumentally involved in the launch of the new international professional society, S.NET, which held its inaugural meeting in Sept 2009 in Seattle. PI Harthorn is a founding executive committee member of S.NET, and served on the program committee for the 1st meeting, as well as the upcoming Sept 2010 meeting in Darmstadt, Germany. CNS-UCSB is taking the lead on fundraising in the US for that meeting, and CNS-UCSB and CNS-ASU anticipate co-hosting the 3rd meeting of the organization in 2011. The growing network offers many possibilities for dialogue. Harthorn was asked to co-chair the annual NSE PI meeting in Dec 2010, and, with CNS-ASU's director Guston, has played a prominent role in representing societal dimension issues in numerous meetings, conferences and sessions with the NSE community regarding values and mechanisms for fulfilling the aims of "responsible development" of nanotechnologies.

CNS-UCSB Presentations 2009 – 2010

A. Education and Outreach (to NSE, industry, government, media, public) (n=54):

1. **Pidgeon, Nick.** Testimony before the House of Lords on public views of nanotechnology, U.K. March 24, 2009.
2. **Appelbaum, Richard.** "China's Move to Become a Technology Leader," testimony before the U.S.-China Economic and Security Commission, Russell Senate Office Building, Washington, D.C. March 24, 2009.
3. **Choi, Hyungsub.** "Interdisciplinary Laboratories: The Institutional Origins of Materials Science," *Chemical Heritage Foundation Brown Bag Lecture*, Philadelphia, PA, March 24, 2009.
4. Alimahomed, Kassim. "Innovation and Collaboration in the Nanoscale Research Laboratory," paper presented on the panel, Emerging Fields and Technologies," Ninth Annual Science &

Technology in Society: An Interdisciplinary Graduate Student Conference, American Association for the Advancement of Science, Washington, D.C. March 28-29, 2009.

5. **Barbara Herr Harthorn**, "Recap of US Congressional Nanotechnology Caucus testimony, Why Risk Perception Matters: Nanotechnology and Emerging Public Views, Mar 9, 2009." UCSB CEIN guest lecture, Bren School of Environmental Science & Management, April 6, 2009.
6. Bunch, Sarah. "Innovation and Globalization: Growth of Solar Energy," poster presentation, research colloquium, UCSB, Santa Barbara, CA. April 20, 2009.
7. Meyer, Dayna. "Nano Silver: Is it a Product Before Its Time?" Poster presentation, Research Colloquium, UCSB, Santa Barbara, CA. April 20, 2009.
8. Mikael Johansson, Interview on Science Guys radio show, UCSB KSBY April 23, 2009.
9. **Harthorn, Barbara Herr**. "NSF's Network for Nanotechnology in Society," Fifth International Conference on Nanotechnology (INC-5), UCLA, Los Angeles, CA. May 18-20, 2009.
10. Johansson, Mikael. Presentation on risk perception and how it applies to nanotechnology and UC-CEIN, UCSB, Santa Barbara, CA, May 26, 2009.
11. Shah, Sonali, and **Cyrus Mody**. "Rick Smalley and the Commercialization of Nanotubes," presentation at Instruments in Manufacturing workshop, Houston, TX. June 18, 2009.
12. Shah, Sonali, and **Cyrus Mody**. "Innovation, Social Structure and the Creation of New Industries: User Communities as Paths from Innovation to Industry," presentation at Instruments in Manufacturing workshop, Houston, TX. June 18, 2009.
13. **Mody, Cyrus C.M.**, "Institutions as Stepping Stones: Rick Smalley and the Commercialization of Nanotubes," presentation at Instruments in Manufacturing workshop, Houston, TX. June 18, 2009.
14. Johansson, Mikael. "'Sexy', 'Hyped', and 'Dangerous': How Scientists Working on Nano Talk about Carbon Nanotubes," presented at CNS summer internship program orientation, UCSB, Santa Barbara, CA, June 22, 2009.
15. Lively, Erica. Presentation on nanotechnology and carbon nanotubes at CNS summer internship program orientation, UCSB, Santa Barbara, CA. June 22, 2009.
16. **Barnett, Gerald**. "Small Company Perspectives," presentation at National Governors Association Best Practices workshop, San Francisco, CA. June 2009.
17. **McCray, W. Patrick**, Invited commentator, "Instruments and Manufacturing," NSF sponsored workshop at Rice University, June 2009.
18. Rogers, Jennifer, Indy Hurt, and Tyronne Martin. Half-day public deliberation workshop on Nanotechnologies for Health, UCSB, Santa Barbara, CA. July 2009.

19. **Dillemuth, Julie**. Workshop presentation on poster presentations for UC Center for Environmental Impacts of Nanotechnology (UC-CEIN) student/postdoc group, UCSB, Santa Barbara, CA. July 16, 2009.
20. Dillemuth, Julie. Workshop presentation on ethics for CNS summer undergraduate internship program, UCSB, Santa Barbara, CA. August 4, 2009.
21. Corner, Adam. "Nanotechnology: Big Uncertainties about Small Things," presentation at the "Too Hot to Handle" session, British Festival of Science, University of Surrey, U.K. Summer 2009.
22. **Harthorn, Barbara Herr**, Jennifer Rogers, Tyronne Martin, and Christine Shearer. Six half-day long public deliberation workshops on nanotechnologies for energy and environment and nano for health and human enhancement, in Santa Barbara community Sept-Oct 2009.
23. Engeman, Cassandra, Lynn Baumgartner, Ben Carr, Allison Fish, John Meyerhofer, **Trish Holden**, and **Barbara Herr Harthorn**. "Current Practices and Perceived Risks Related to Health, Safety, and Environmental Stewardship in Nanomaterials Industries," poster presented at the First International Center for Environmental Implications of Nanotechnology (ICEIN) conference, Howard University, Washington, D.C. September 9-11, 2009.
24. **Choi, Hyungsub**, and David C. Brock. "Manufacturing Knowledge in Transit: A History of the Semiconductor Industry in the United States and Japan," presentation, School of Electrical Engineering seminar, College of Engineering, Seoul National University, Seoul, South Korea. September 11, 2009.
25. Shah, Sonali, and **Cyrus Mody**. "Innovation, Social Structure and the Creation of New Industries: User Communities as Paths from Innovation to Industry," presentation at West Coast Research Symposium, Seattle, WA. September 11, 2009.
26. **Mody, Cyrus**. "Microscience/Technology and Vietnam-Era Protest at Stanford," presentation at Mircoelectronics Research Center, Austin, TX. October 12, 2009.
27. **Barbara Herr Harthorn**, "Constraints on Benefit of New Technologies for the World's Poor" Panel: "Governing Emerging Technologies: Regulating Risk & Ethical Dimensions in Development." *Emerging Economies, Emerging Technologies: [Nano]technologies for Equitable Development*, Woodrow Wilson Center for International Scholars, Washington, D.C. November 4-6, 2009.
28. **Appelbaum, Richard**. Chair, "Wilson on the Hill" and National Press Club events, "Emerging Economies, Emerging Technologies: Prospects for Equitable Development," Woodrow Wilson Center for International Scholars, Washington, D.C. November 4-6, 2009.
29. **Parker, Rachel**, Closing address, Emerging Economies/Emerging Technology: [Nano]technologies for Equitable Development, Wilson Center, Washington, D.C. November 4-6, 2009.
30. Conroy, Meredith (rapporteur). "Water" breakout session, Emerging Technologies /Emerging Economies: (Nano)technology for Equitable Development conference, Washington D.C. November 4-6, 2009.

31. Lively, Erica (rapporteur). "Energy" breakout session, Emerging Technologies/Emerging Economies: (Nano)technology for Equitable Development conference, Washington D.C. November 4-6, 2009.
32. Rogers, Jennifer (rapporteur). "Food Security" breakout session, Emerging Technologies /Emerging Economies: (Nano)technology for Equitable Development conference, Washington, D.C. November 4-6, 2009.
33. Gray, Summer (rapporteur). "Health" breakout session, Emerging Technologies/Emerging Economies: (Nano)technology for Equitable Development conference, Washington, D.C. November 4-6, 2009.
34. Engeman, Cassandra, et al. "Reported Practices and Perceived Risks Related to Health, Safety and Environmental Stewardship in Nanomaterials Industries," poster presentation, California Groundwater Resources Association (GRA)/Department of Toxic Substance Control (DTSC) Nanosymposium, Sacramento, CA. November 16, 2009.
35. **Mody, Cyrus**. "Conversions: Sound to Picture, Military to Civilian," presentation, Sound Studies Handbook Workshop, Maastricht, Netherlands. November 21, 2009.
36. **Pidgeon, Nick**. "Social Acceptance and Public Views," presentation, Nuffield Council on Bioethics Meeting, U.K. November 25, 2009.
37. **McCray, W. Patrick**, "Hidden Histories of Nanotechnology," seminar talk, UCSB, December 2009.
38. **Pidgeon, Nick**. "Lessons from the Past: Governance of Emerging Technologies," National Academy of Sciences, Washington, D.C. December 3-4, 2009.
39. **Harthorn, Barbara Herr** (co-chair). 2009 NSF Nanoscale Science and Engineering Grantees Conference, Arlington, VA. December 7-9, 2009.
40. **Harthorn, Barbara Herr**. "NSEC Centers for Nanotechnology in Society: CNS-UCSB," NSF Nanoscale Science and Engineering Grantees Conference, Arlington, VA. December 7-9, 2009.
41. **Harthorn, Barbara Herr**, "The Present and Future of Nano-ELSI Research" (panel moderator), NSF Nanoscale Science and Engineering Grantees Conference, Arlington, VA. December 7-9, 2009.
42. **Harthorn, Barbara Herr**. Provided extensive testimony documents for PCAST/OSTP review of the NNI to NNI leader Mihail Roco's presentation. January 18-19, 2010. Washington, D.C.
43. **Harthorn, Barbara Herr** and **Chris Newfield**. Provided extensive testimony documents for PCAST/OSTP review of the NNI to CCST Director Susan Hackwood for her presentation. January 18-19, 2010. Washinton, D.C.
44. Eisler, Matthew. "Techno-Utopianism and Fuel Cell Research and Development," seminar presentation at Center for Nanotechnology in Society (CNS), UCSB, Santa Barbara, CA. January 20, 2010.

45. **Pidgeon, Nick.** Presentation to House of Commons Science and Technology Committee inquiry on the regulation of geoengineering. London, UK. January 2010.
46. **Barbara Herr Harthorn,** "Societal Dimensions of Nanotechnology: Research for Responsible Development," testimony to President's Council of Advisers on Science and Technology NNI Review, panel on environmental, ethical, societal, and legal concerns, Palo Alto, CA February 18, 2010.
47. **Mody, Cyrus.** "Fifty Years of Nanotechnology," testimony to President's Council of Advisers on Science and Technology NNI Review, panel on environmental, ethical, societal, and legal concerns, Palo Alto, CA. February 18, 2010.
48. Cassandra Engeman, "Reported Practices and Perceived Risks Related to Health, Safety and Environmental Stewardship in Nanomaterials Industries," invited speaker, Nanotech 2010 Exhibition and Conference, strategic area of nanotechnology working group, National Institute of Advanced Industrial Science and Technology (AIST), Tokyo, Japan. February 19, 2010.
49. Dilleuth, Julie. "Nanotechnology in Society," Presentation, "Engineering Ethics," Engr 101, University of California, Santa Barbara (UCSB), Santa Barbara, CA. March 8, 2010.
50. Engeman, Cassandra and Lynn Baumgartner. Video conference presentation of preliminary findings on industry views of EHS risks to the Nanotechnology Colloquium (invited by Applied Nanotechnology, Inc.), Austin, TX. March 8, 2010.
51. **Harthorn, Barbara Herr.** "The Past and Future of Responsible Development for Nanotechnologies," invited presentation, Societal Dimensions of Nanotechnology session at NNI Revisioning Nano2 conference, Evanston, IL. March 9-10, 2010.
52. **Harthorn, Barbara Herr** (rapporteur), Session 13 on Societal Dimensions of Nanotechnology, NNI Revisioning Nano2 conference, Evanston, IL. March 9-10, 2010.
53. **Appelbaum, Rich** and **Brad Chmelka,** Nano-Meeter presentations, Santa Barbara, CA, March 11, 2010.
54. **Barbara Herr Harthorn,** "How Nanotech Risk Perception Informs EHS Decision Making." Keynote address, NNCO EHS Capstone conference, Wash DC Mar 30-31 2010.

B. Research Presentations (n=67):

1. **Choi, Hyungsub.** "Manufacturing Knowledge in Transit: A Transnational History of the Semiconductor Industry in the U.S. and Japan," *Institute for Applied Economics and the Study of Business Enterprises*, Johns Hopkins University, Baltimore, MD, 31 March 2009.
2. **Harthorn, Barbara Herr.** "CNS-UCSB Overview" and "WG 3 Risk Perception Research," CNS National Advisory Board Meeting, Upham Hotel, Santa Barbara, CA. April 19-21, 2009.
3. **Harthorn, Barbara Herr.** "WG3: Nanotech Risk Perception Research," CNS External Site Review by the National Science Foundation and external peer review panel, UCSB, Santa Barbara, CA. May 14-15, 2009.

4. **McCray, W. Patrick**, "Of Fringes and Futures: Technological Enthusiasm, 1970-1990," talk at University of California, San Diego, May 2009.
5. **McCray, W. Patrick**, "Of Fringes and Futures: California's Technological Enthusiasts, 1970-1990," paper presented at *Mind and Matter: Technology in California and the West*, Pasadena, May 2009.
6. **Pidgeon, Nick**. "Deliberating the Risks of Nanotechnologies: A U.K.-U.S. Comparison," seminar presentation at Economic and Social Research Council's CESAGEN Genomics Research Centre, Cardiff/Lancaster, U.K. May 26, 2009.
7. **Choi, Hyungsub** and David C. Brock and (Brock presenting), "Semiconductor Technology Roadmapping: Origins, Functions, and Exemplary Status," *2009 Sloan Industry Studies Conference*, Chicago, IL, 28-29 May 2009.
8. **Choi, Hyungsub**. "Interdisciplinary Laboratories: The Spatiality of Materials Research in the 1960s," *The 5th Laboratory History Conference*, Baltimore, MD, 3-5 June 2009.
9. **Pidgeon, Nick**. "Discussing Potentials for Inter-Disciplinary Research on 'Public Engagement' in Science, Technology and Risk," conference at Cardiff University, U.K. June 8, 2009.
10. **Newfield, Chris**. "What is Open Innovation at the Nanoscale?" Presentation at the CNRS Meeting on Nanotechnology and Global Development, Ivry-sur-Seine, France. June 2009.
11. **Newfield, Chris**. "Premonitions of Deliverance: The University and the Global Science," presentation at the Conference on the Global University, La Sapienza, Rome, Italy. June 2009.
12. Herron, Patrick. "Tracking the Current Rise of Chinese Pharmaceutical Bionanotechnology," paper presented at the Fourth MedBio Conference, Dalian, China. August 7-11, 2009.
13. **Choi, Hyungsub**, and David C. Brock. "From the Laboratory to the Factory: An Early History of the Transistor in the United States and Japan," presentation at the History and Philosophy of Science colloquium, Seoul National University, Seoul, South Korea. September 4, 2009.
14. **Mowery, David C.** "Nanotechnology: A 'New Wave' for the U.S. National Innovation System?" Keynote presentation, inaugural meeting of the Society for the Study of Nanoscience and Emerging Technologies (S.NET), Seattle, WA. September 10, 2009.
15. **Choi, Hyungsub**. "Interdisciplinary Laboratories: Institutions, Communities, and Disciplines at Cornell University, 1960-2000," presentation at the Science and Technology Policy colloquium, Korea Advanced Institute for Science and Technology, Daejeon, Korea. September 7, 2009.
16. **Appelbaum, Richard**, and Rachel Parker. "Comparing the Developmental State Policies of China and the U.S. in the Race to Advance Nanotechnology in the 21st Century," presentation at S.NET, Seattle, WA. September 8-11, 2009.
17. Johansson, Mikael. "Nanoscientists and the media – a miniscule affair," presentation at S.NET, September 8-11, 2009.

18. Lively, Erica. Presentation at S.NET, Seattle, WA. September 8-11, 2009.
19. Motoyama, Yas. "Developmental States and Nanotechnology: Comparisons of U.S. and Japanese Governments and Technology Performance," presentation at S.NET, Seattle, WA. September 8-11, 2009.
20. Rogers, Jennifer, and **Barbara Herr Harthorn** (co-chairs/organizers). "Tales of Progress and Cultural Beliefs: Risks, Perceptions, and Messages about Nanotechnology in the Upstream/Midstream Context," session at S.NET, Seattle, WA. September 8-11, 2009.
21. Rogers, Jennifer, **Barbara Herr Harthorn**, Karl Bryant, and Indy Hurt. "Investigating the Roles of Gender and Activism in Deliberative Dialogues about Nanotechnology Risk and Benefit," paper presented at S.NET, Seattle, WA. September 8-11, 2009.
22. **Satterfield, Terre, Conti, Joseph, Pidgeon, Nick, and Barbara Herr Harthorn**. "Emergent Public Risk Perceptions: Asymmetry in Judgments about Nanotechnologies," paper presented at S.NET, Seattle, WA. September 8-11, 2009.
23. **Harthorn, Barbara Herr**, Karl Bryant, and Jennifer Rogers. "Gender and Risk Beliefs about Emerging Nanotechnologies," invited keynote address at the University of Washington Nano Ethics Workshop (in conjunction with S.NET), Seattle, WA. September 9, 2009.
24. **Mody, Cyrus**. "Institutions as Stepping Stones: Rick Smalley and the Commercialization of Nanotubes," presentation at S.NET, Seattle, WA. September 9, 2009.
25. **Dilleuth, Julie**. "Travels of a Carbon Nanotube: A Model for an Undergraduate Research Internship," presentation at S.NET, Seattle, WA. September 9, 2009.
26. **Newfield, Chris**. "Structure and Silence of the Cognotariat," presentation at meeting on the "Perils and Opportunities of the Internationalisation of Higher Education," Université de Lausanne, France. September 2009.
27. Parker, Rachel and **Richard Appelbaum**. "Chinese Nanotechnology Policy: A Developmental State," presentation at Atlanta Conference on Innovation, Atlanta, GA. October 2-3, 2009.
28. **Hyungsub Choi**, "The Long Tail of the Third Industrial Revolution: Technology Platform and Supply Chain Relationships at SEMATECH," *Society for the History of Technology*, Pittsburgh, PA, 15-18 October 2009 (presenter and co-organizer, with Andrew L. Russell, of the session "Technological History of the Third Industrial Revolution").
29. **Mody, Cyrus**. "Conversions: Sound to Picture, Military to Civilian," presentation at annual meeting of the Society for the History of Technology, Pittsburgh, PA. October 16, 2009.
30. **Mody, Cyrus C.M.**, "Conversions: Sound to Picture, Military to Civilian" (Pittsburgh: annual meeting of the Society for the History of Technology, October 16, 2009).
31. Corner, Adam. "(Na)no Consensus? Environmental Risk and Attitude Polarisation," presentation, Cardiff University School of Psychology seminar series, U.K. October 16, 2009.
32. **Appelbaum, Richard** and Rachel Parker. "Promise and Prospects of Nanotechnology," presentation at Pennsylvania State University, State College, PA. October 22-25, 2009.

33. Boudreaux, Daryl. "Impact of Innovation History for DOE Planning," briefing, National Bureau of Economic Research, Washington, D.C. October 23, 2009.
34. **Conti, Joseph**. "The Embeddedness of Technological Risk: Vulnerability and Justice in the Nanotechnology Enterprise," presentation in Economic Change and Development speaker series, University of Wisconsin, Madison. October 26, 2009.
35. **Harthorn, Barbara Herr**. "Social Risk and Challenges to Sustainability of Emerging Nanotechnologies," paper presented in the session on "Sustainability and Emerging Technologies," Society for Social Study of Science (4S), Arlington, VA. October 28-31, 2009.
36. Johansson, Mikael. "Our culture consists of being international and speaking English – How nanoscientists in Sweden form a global place by excluding the local community," paper presentation on "STS and Space" panel at 4S, Arlington, VA. October 28-31, 2009.
37. Motoyama, Yas. "The Nanotechnology Cluster in Kyoto: The Cluster Theory and Gap with Practice," presentation on "In Investment Regionalism: Economic Development and Sector Strategies" panel, Association of Collegiate School of Planners, Washington, D.C. October 2009.
38. **Mowery, David**. "Federal policy and the development of semiconductors, computer hardware, and computer software: A policy model for climate-change R&D?" Accelerating Energy Innovation: Lessons from Multiple Sectors, NBER, Washington DC, October 2009.
39. **Barnett, Gerald**. "Innovative IP Management and Licensing," Association of Independent Research Institutes Annual Conference, Seattle, WA, October 2009.
40. **Barnett, Gerald**. "Beyond Licensing: Maximizing the Impact of University Technologies," presentation, annual conference of the State Science and Technology Institute, Overland Park, KS. October 2009.
41. **Harthorn, Barbara Herr** (chair), and Mikael Johansson (organizer). "Nanotechnology in Public and Expert Discourses," panel session at the American Anthropological Association annual meeting, Philadelphia, PA. December 4, 2009.
42. **Haldane, Hillary, Karl Bryant, and Barbara Herr Harthorn**. "Expertise and Expectations: The Role of Gender in Expert Perceptions of Emergent Nanotechnologies." Presentation at the American Anthropological Association meetings, Philadelphia, PA. December 4, 2009.
43. **Satterfield, Terre**. "Reflections on Chasing the Elusive: Hope, Intention and Disruption in the Perception of Nanotechnologies," American Anthropological Association, Philadelphia, PA. December 4, 2009.
44. Johansson, Mikael. "The dose makes the poison – How Nano-toxicologists reason about risk and danger," paper presentation in "Nanotechnology in Public and Expert Discourses" panel, American Anthropological Association, Philadelphia, PA. December 4, 2009.
45. Rogers, Jennifer, **Barbara Herr Harthorn**, and Christine Shearer. "Imagining Nanotech Futures: The Anthropology of Risk and Gender in Deliberative Settings," paper presented at

- the American Anthropological Association annual meeting, Philadelphia, PA. December 2-6, 2009.
46. **Mody, Cyrus.** "Context in the Classroom: Co-Teaching Our Way to Societal Dimensions of Nano," annual meeting of the American Anthropological Association, Philadelphia, PA. December 4, 2009.
 47. Beaudrie, Christian, **Milind Kandlikar**, and **Terre Satterfield.** "Risk Ranking for Nanomaterials Using Hazard and Intake Fraction Models," presentation at the Society for Risk Analysis, Baltimore, MD. December 7-9, 2009.
 48. **Chris Newfield,** "The End of the American Funding Model: What Comes Next," FOREDOC, University of Paris – X, Nanterre, December 2009.
 49. **Chris Newfield,** "The U.S. Innovation System: Elements for Middle-Income Countries," CNRS Meeting on Nanotechnology and Global Development, Ivry-sur-Seine, January 2010.
 50. **Harthorn, Barbara Herr,** Nick Pidgeon, & Terre Satterfield (co-organizers, co-chairs). CNS-UCSB Nanotech Risk Perception Specialist Meeting, Upham Hotel, Santa Barbara, January 29-30, 2010.
 51. **Pidgeon, Nick.** "Nanotech Risk Perception – Issues and Challenges," Nanotechnology Risk Perception Specialist Meeting, Upham Hotel, Santa Barbara, CA. January 29-30, 2010.
 52. **Satterfield, Terre.** "Designing for Upstream Risk Perception Research: Malleability and Asymmetry in Judgments about Nanotechnologies," Nanotech Risk Perception Specialist Meeting, Upham Hotel, Santa Barbara, CA. January 29-30, 2010.
 53. **Harthorn, Barbara Herr,** Jennifer Rogers, and Christine Shearer. "Gender, Application Domain, and Ethical Dilemmas in Nano-Deliberation," presentation at Nanotech Risk Perception Specialist Meeting, Upham Hotel, Santa Barbara, CA. January 29-30, 2010.
 54. **Conti, Joe** (discussant). Nanotech Risk Perception Specialist Meeting, Upham Hotel, Santa Barbara, CA. January 29-30, 2010.
 55. **Haldane, Hillary** (discussant). Nanotech Risk Perception Specialist Meeting, Upham Hotel, Santa Barbara, CA. January 29-30, 2010.
 56. **Kandlikar, Milind** (discussant). Nanotech Risk Perception Specialist Meeting, Upham Hotel, Santa Barbara, CA. January 29-30, 2010.
 57. **Choi, Hyungsub.** "Institutional Origins of Materials Science at Cornell University, 1958-1972," Tuesday Seminar presentation in History of Science (Ka-Zemi), Tokyo Institute of Technology, Tokyo, Japan. Feb. 2, 2010.
 58. **Satterfield, Terre.** "Rethinking Risk at the Intersection of Culture, Justice and Governance," guest lecture, Centre for Environment and Sustainability, University of Western Ontario, Canada. February 3, 2010.
 59. **Mody, Cyrus.** "Fifty Years of Nanotechnology," Feynman Anniversary Symposium, Columbia, SC. February 13, 2010.

60. **Mody, Cyrus.** "From Microscience to Nanotechnology, 1970-2000," Feynman Anniversary Symposium, Columbia, SC. February 14, 2010.
61. **Mowery, David C.** "Federal R&D and the Development of U.S. IT: A Model for Climate-Change R&D?" Presentation at the Breugel Institute, Brussels, Belgium. February 28, 2010.
62. **Satterfield, Terre,** Christine Beaudrie, Milind Kandlikar, *et al.* "Reflections on Chasing the Elusive: Hope, Intention and Disruption in the Anticipation of Social Response to Nanotechnologies," presentation at the University of British Columbia, BC, Canada. March 2, 2010.
63. **Choi, Hyungsub.** "Semiconductor Technology Licensing in the 1950s," presentation, Forum on Innovation Studies, Hitotsubashi University, Tokyo, Japan. March 9, 2010.
64. Jennifer Rogers, **Barbara Harthorn,** Christine Shearer, and Tyronne Martin, "Engaging the Citizenry: US Publics' Values and Perceptions Regarding Emerging Nanotechnologies for Energy and the Environment." Paper presented at the *Society for Applied Anthropology Annual Meeting*. Merida, Mexico. March 24-27, 2010.
65. Mikael Johansson. "Working for Next to Nothing: Labor in the Global Nanoscientific Community." Paper presented in the panel, "Labor and Morality in the Global Economy," at the *Society for Applied Anthropology Annual Meeting*. Merida, Mexico. March 24-27, 2010.
66. Parker, Rachel and **Appelbaum,** "Multi-Walled Carbon Nanotubes in Water Filtration Systems: From New Material Innovation to New Product Innovation," Transatlantic Workshop on Nanotechnology Innovation & Policy, Atlanta, March 25, 2010
67. Jennifer Rogers, Christine Shearer, and **Barbara Herr Harthorn,** "GM and Nano in our Food: Public Perceptions, Reactions, and Movements." Paper presented at the *Pacific Sociological Association*. Oakland. April 8-11, 2010.

13. SHARED AND OTHER RESEARCH FACILITIES

The infrastructure needs for the societal implications research of CNS-UCSB are well met through UCSB and partner organizations.

1) CNS-UCSB

The main facility for CNS in the first period was been a set of research and administration offices at UCSB in North Hall and the California NanoSystems Institute. The dispersed nature of these offices was not ideal for running a collaborative interdisciplinary center. Beginning in late Nov 2009, the CNS relocated into a suite of contiguous offices, for all CNS personnel, providing proximity of researchers with staff and infrastructure and a suitable conference and meeting space. The new CNS site is in a centrally located building on campus that will allow more effective coordination and communication among all participants. This commitment of space by the Executive Vice Chancellor, Vice Chancellor for Research, and Dean of Social Sciences to the CNS on our very space-constrained campus is a strong mark of support for our interdisciplinary research and education efforts. We will continue to have shared access to space for meetings, conferences, seminars, and other gatherings in shared use spaces within the Institute for Social, Behavioral & Economic Research (ISBER) in North Hall. ISBER additionally provides the computing network infrastructure for our offices and our work, secure sites on the server for our collaborative sharing of project data, and many forms of research administration support that augment our capacity.

2) California NanoSystems Institute (CNSI)

The UCSB CNSI offers a unique set of resources that will contribute to the collaborative, interdisciplinary nature of the Center. Completed early in the first 5 years of CNS support, CNSI is a dedicated Institute building that serves as a state-of-the-art laboratory facility and hub for the many nanoscientists working on campus. It includes a consolidated Nanostructures Imaging and Characterization Laboratory, equipped with NMR, electron microscopes, scanning probe tools, optical and electrical characterization and surface analysis capability. A BioNanofabrication facility will complement the existing NNIN facility --11,000 sq. ft. cleanroom (see below) by focusing on new chemical and biologically-templated means of forming nanostructured devices. The CNSI building also houses the Allosphere, a 360 degree, 3-story data-visualization space, and extensive exhibition space that accomodates travelling nano science education exhibitions and public engagement events. These spaces are important sites for CNS's partnered education programs with CNSI. Although CNS no longer occupies office space in the CNSI building, the foundation created by our residence there for several years will endure, and we will continue to use CNSI conference and meeting spaces for seminars, lectures, and other events to increase our visibility and engagement with the NSE community. More information on CNSI, the MRL, and UCSB nanoscale shared research facilities can be found at www.cnsi.ucsb.edu.

3) Materials Research Laboratory (MRL) (UCSB)

MRL was established in September 1992 with funding from the National Science Foundation (NSF), and became an NSF Materials Research Science & Engineering Center (MRSEC) in 1996. The research, scientific and engineering activities of the Materials Research Laboratory focus on educational outreach and four major interdisciplinary research groups (IRGs), as well as six laboratories. MRL also runs the IGERT program ConvEne — Conversion of Energy Through Molecular Platforms, an interdisciplinary approach to graduate education aimed at providing a new generation of Chemical Scientists and Engineers with the technical skills, environmental awareness, business expertise, and teamwork approaches that will be required to address fundamental and applied issues in the generation and conversion of energy in efficient and environmentally-sustainable ways. The Director of MRL, Craig Hawker, is a member of the CNS

Executive Committee. MRL Education staff coordinate a campus-wide summer Undergraduate Research Intern Seminar Series, which CNS interns attend and in which CNS Education staff and faculty have presented. <http://www.mrl.ucsb.edu>

4) Nanotech: The UCSB Nanofabrication Facility, National Nanotechnology Infrastructure Network (NNIN) (UCSB)

UCSB has extensive facilities and research in nanotechnology. Specific UCSB strengths include leading expertise in compound semiconductors, photonics, quantum structures, and expertise with non-standard materials and fabrication processes. The nanofabrication facility has comprehensive and advanced semiconductor and thin film processing equipment and provides access and professional consultation to industrial and internal and external academic users. The facility currently consists of 12,700 sq ft of clean space. Both on-site and remote support of users (including equipment training, process consultation, and remote job processing) is provided by a staff of six engineers supporting facilities and three Ph.D.-trained engineers supporting process. The Nanofabrication Facility has been a resource for CNS ethnographic research of laboratory culture, and new partnerships with Education staff that bring CNS expertise to NNIN Societal and Ethical Issues education programs are expanding our reach to new audiences. <http://www.nanotech.ucsb.edu/>

5) Center for Spatial Studies (spatial@ucsb)/National Center for Geographic Information and Analysis (NCGIA)/Center for Spatially Integrated Social Science (CSISS) (UCSB)

The Center for Spatial Studies, NCGIA, and CSISS (housed within NCGIA) together form a cluster of internationally renowned knowledge, mapping resources and personnel for spatial analytic scientific work. Given the global scope of CNS' research, the interest in tracking flows (such as the movement of goods services, and ideas through the global value chain), and the attraction of spatial data visualizations as a means of enhancing participation and knowledge exchange, the spatial resources at UCSB, and CNS's close connection to them constitute significant resources. CNS PIs Harthorn and Appelbaum are former executive committee members of CSISS (a NSF-funded social science infrastructure center), and the new spatial center's director, Michael Goodchild, is a key advisor and resource for the CNS. In its new configuration, spatial@ucsb, the center provides free consulting services on GIS, cartographic and other spatial research. CNS has drawn GSRs (Glennon, Hurt) and fellow (Hurt) from CSS, and CNS has a firm commitment to incorporating cartographic and spatial analysis in the data analysis and data visualization phases of our research. In the renewal period, as CNS generates more databases adequate for spatial statistics we anticipate even closer ties with this cutting edge resource and the tools it provides. A supplement from NSF will allow us to initiate a spatial postdoc program in 2010 that will then carry on throughout the next 5 years of CNS operation. (See <http://www.spatial.ucsb.edu>; www.ncgia.ucsb.edu and www.csiss.org.)

6) Social Science Survey Center (SSSC) (ISBER, UCSB)

The SSSC/Benton Survey Research Laboratory at UCSB enhances interdisciplinary collaboration on theoretical and methodological planes. The SSSC is directed by sociologist John Mohr, a senior researcher in the CNS who has worked with both IRG 3 and IRG 2, and Associate Director, sociologist Paolo Gardinali. It is now housed in a generous space in the new social science building on campus and administered by ISBER and includes equipment and resources to conduct state-of-the art computer assisted interviewing system (CATI) telephone surveys, sophisticated web-based surveys, and mail and multi-mode surveys on local, regional, or national populations in several languages. The SSSC works in extending traditional data collection methods with the use of online-based questionnaires for quantitative and qualitative data collection, in survey and experimental settings. The SSSC has also pioneered a cutting edge use of mixed data collection modes, using telephone, mail and web for maximum effectiveness.

Extensive consulting is available on survey instrument design and development, programming, and data analysis and interpretation, and the SSSC is developing full GIS capability. Data security is a top priority, and multiple backups ensure stable system performance. SSSC provides support services for CNS deliberative workshops, web and phone survey, and data analysis consulting. Campus research services infrastructure greatly reduce the cost of such data acquisition while providing a reliable and IRB-safe mode. CNS has used SSSC services for components of several projects, and IRG 3 currently has a web survey on expert risk perception in the field with them. For more information see <http://www.survey.ucsb.edu>

7) Center for Information and Technology (CITS) (UCSB)

CITS is dedicated to research and education about the cultural transitions and social innovations associated with technology, particularly in the highly dynamic environments that seem so pervasive in organizations and societies today. They also work to improve engineering through infusing social insights into the innovative process. CITS was founded at UC Santa Barbara in 1999, on the thirtieth anniversary of the birth of the Internet, through the efforts of founding director Bruce Bimber, also a principal in the CNS. CITS research initiatives range from ground-breaking research on social computing, to the role and effectiveness of technology in the classroom, to the role of technology in organizing community events. In addition to research, CITS also supports an optional Technology and Society Ph.D. emphasis, which is available to students in participating doctoral programs at UCSB from the College of Engineering, the Social Sciences, and the Humanities. The emphasis provides interdisciplinary training on the relationships between new media and society with intensive faculty involvement. CITS serves as a close partner on graduate recruiting, shared programming, and other interests in common. CNS PIs Harthorn, Bimber and McCray are all affiliated faculty in CITS. If funded, the pending Social Computing IGERT proposal would draw both Harthorn and Bimber, and through them the CNS, into closer involvement. <http://cits.ucsb.edu/>

8) Bren School of Environmental Science and Management (UCSB)

The Bren School is among a handful of schools in the United States and the only one in the West that integrate science, management, law, economics, and policy as part of an interdisciplinary approach to environmental problem-solving. The school is housed in what was the "greenest" laboratory facility in the United States when it was completed in 2002 and in 2009, it became the first building to receive a second LEED Platinum certification, this time in recognition of maintenance and operations of an existing building. Bren Hall is home to a collection of superbly equipped laboratories, computer centers, lecture halls, and other teaching and meeting places that support instruction, research, interaction, and the development of tomorrow's most capable scientists and environmental managers. Bren School faculty and colleagues at UCSB (including CNS researchers), UCLA, and other universities have begun a 5-year, \$24 million nanotechnology risk-assessment project funded by the National Science Foundation (NSF) and the U.S. Environmental Protection Agency (EPA), in which CNS IRG 3 researchers have an active, funded role. The UC Center for the Environmental Implications of Nanotechnology (UC CEIN) is the nation's first such large-scale study of the potential ecological effects of nanomaterial forms. <http://www.bren.ucsb.edu>

9) Center on Globalization, Governance, and Competitiveness (CGGC) (Duke University)

This Center, led by CNS IRG 4 collaborator, Gary Gereffi, was created to address one of the key challenges of the contemporary era: to harness the potential advantages of globalization to benefit firms, countries, and organizations of all kinds that are trying to maintain or improve their position in the international arena. It does so by creating a comprehensive research framework that links the global, national, and local levels of analysis, translating research into appropriate organizational strategies and government policies. Its goal is to draw on a widespread,

interdisciplinary network of scholars to formulate creative solutions for firms, countries, and organizations that want to improve their competitiveness or forge better development policies. It draws on the experience and expertise of the Rockefeller Foundation's Global Value Chains Initiative, assembling interdisciplinary, international groups of researchers with deep expertise on a broad range of industries affected by globalization. The Center's first three priority areas are China, India, and Mexico. The Center provides essential intellectual contributions to IRG 4's work on nanotechnology, globalization and E. Asia, as well as to the CNS undergraduate education program's project of the Global Value Chain. See <http://www.cgqc.duke.edu/>

10) Chemical Heritage Foundation (CHF), Philadelphia

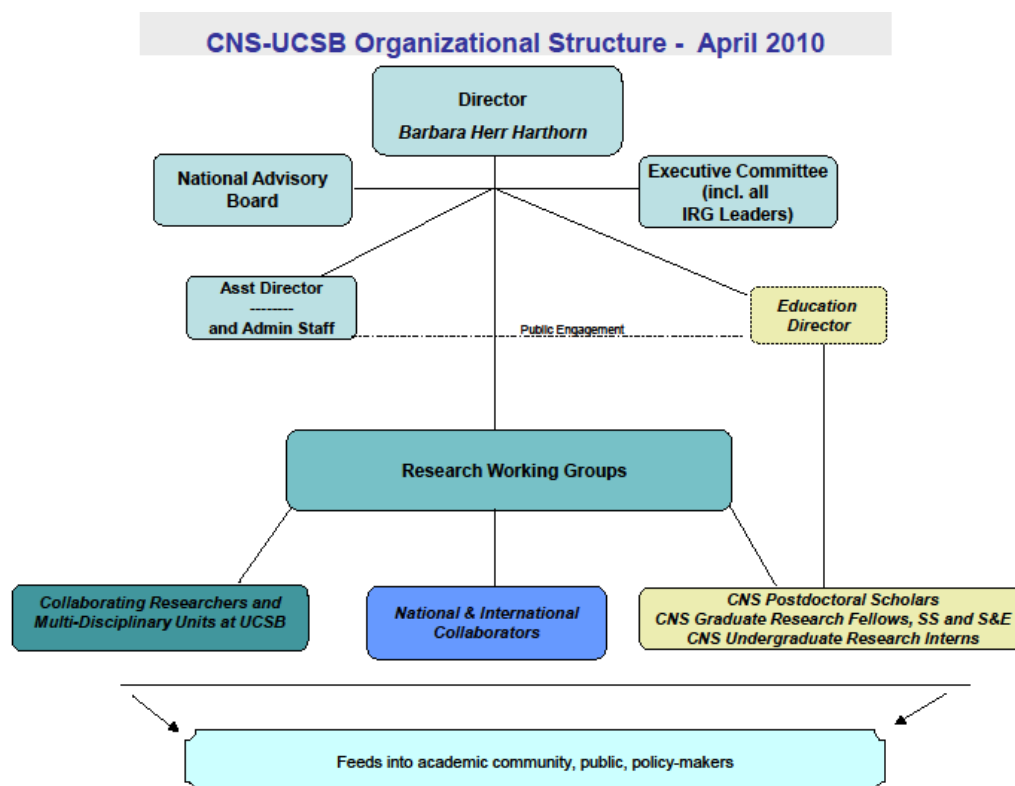
The Chemical Heritage Foundation is a library, museum, and center for scholars. Located in Philadelphia, CHF maintains world-class collections, including instruments and apparatus, rare books, fine art, and the personal papers of prominent scientists, all related to the chemical and molecular sciences. CHF also hosts conferences and lectures, supports research, offers fellowships, and produces educational materials. Their programs and publications provide insight on subjects ranging from the social impact of nanotechnology to alchemy's influence on modern science. CHF is the former base of CNS IRG 1 collaborator, Cyrus Mody, and current home to IRG 1 collaborator Hyungsub Choi. CHF is a generous partner in CNS's production of *oral histories* of leading nanoscientists, hosts key nano in society workshops and conferences, in which CNS has been a welcome participant, and currently partners with CNS in the publication of a series of commissioned research briefs, including some involving CNS researchers (Beaudrie, forthcoming 2010; Parker, forthcoming 2010). <http://www.chemheritage.org/>

11) The Jenkins Collaboratory, Duke University (Tim Lenoir) is a laboratory for developing technologies in contemporary science, engineering, and medicine, and their social and ethical implications. Their work focuses particularly on the current fusion of biotechnology, nanotechnology, and information technologies, and the transformative possibilities of this fusion for biomedicine, human-machine engineering, cultural production, and civic engagement. The Jenkins Collaboratory has several computer lab spaces and offices/workspaces as well as dedicated server space on the Duke campus. <http://www.jhfc.duke.edu/jenkins/>

14. PERSONNEL

CNS-UCSB is a single campus center, based firmly at University of California at Santa Barbara, taking full advantage of its renowned reputation for interdisciplinarity, its stellar materials science and engineering capabilities (MRSEC, top ranking Engineering College, California NanoSystems Institute, NNIN site, 2 Nobel laureates in the field), dedicated institutional commitment to diversity at all levels of leadership, and a strong team of interdisciplinary social science and humanities scholars to provide the core for CNS. CNS-UCSB Director Barbara Herr Harthorn is assisted by an Assistant Director (1.0 FTE), an Education Director (.65 FTE), a Financial Analyst/Events Coordinator (1.0 FTE), a Travel and Purchasing Administrative Assistant (.5 FTE) and a Computing Specialist (.25 FTE); until Dec 2009, CNS also employed a Media Coordinator (0.5 FTE). Harthorn is assisted by 4 additional co-PIs (Appelbaum, Bimber, McCray, Newfield) and MRL Director Hawker on the CNS Executive Committee, on which the CNS Assistant Director and Education Director serve *ex officio*. Three of the 4 IRG leaders (McCray, Harthorn, and Appelbaum) are located on the UCSB campus and meet frequently with their IRG research teams, so IRG leaders can integrate their research issues and needs through the Exec and senior researcher meetings and seminars; co-PI Newfield has been located in France for the past two years. Contact is maintained through regular Skype calls, executive committee meetings, and frequent correspondence.

Dr. Harthorn is responsible for all official agency contact with the CNS-UCSB, for adherence to campus and agency policies regarding fiscal controls, IRB, and the oversight of all CNS business. She is the primary contact for the CNS to the UCSB upper administration and the CNS' administrative unit, the Institute for Social, Behavioral, and Economic Research. In these capacities, she is responsible for oversight of fiscal management, campus matching funds, CNS subcontractors, space allocation, and compliance with UC and UCSB campus policies. As PI, Dr. Harthorn also represents the CNS in NSF Nanotechnology in Society Network and NSEC interaction. The Executive Committee meets monthly or more often on a face to face basis, dialing in those who may be off site, and communication takes place on an almost daily basis on matters practical and intellectual.



CNS leverages NSF resources in a number of ways to achieve savings without sacrificing capability. UCSB cash contribution to the CNS covers a significant portion of staff salaries and fringe benefits. CNS staff draws regularly on the expertise of the staff of CNS' immediate control point, the Institute for Social, Behavioral, and Economic Research, for assistance in all aspects of extramural award submissions and administration, accounts management, personnel action, travel accounting, purchasing, and computer network administration. ISBER's support has enabled CNS to achieve efficiencies in a number of areas, providing backup to CNS' smaller, more specialized staff. In addition, the CNS shares computer technology staffing with ISBER, which gives the CNS access to versatile skills when needed, without having to commit full-time salary expenditures.

National Advisory Board

CNS has had since inception an excellent National Advisory Board comprised of leading STS and social science scholars and members from industry, NSE, NGOs, policy, and others (see the full list in Section 4B). Previous CNS Board Chair, **Tom Kalil**, stepped down in Dec 2008 to take up a new high ranking post for Obama's White House. Board members **John Seely Brown** and **Julia Moore** agreed to take over as Board Co-Chairs in January 2009. In response to Julia's subsequent move from Woodrow Wilson to the Pew Foundation in spring 2009 and reluctant resignation from the CNS NAB, the Board asked member **Ann Bostrom** to take her place as Co-Chair. The board meets annually in Santa Barbara with CNS Executive Committee members, staff, researchers, and students to discuss CNS research, education and outreach efforts, assess new opportunities, and consider possible course adjustments in response to them. The board serves as an informal evaluation mechanism, as a sounding board for brainstorming new ideas and new directions, as a means to elicit elite views from a range of stakeholders in

nanotechnology's societal impacts. This has been highly successful to date, and CNS plans no changes to this basic approach. In the aftermath of the 2009 board meeting and site visit, the CNS Exec decided to let the Board have a break from these duties in 2010, so no board meeting has been scheduled this year. Board members are willing and available for consultation by phone and e-mail, Co-Chair **Bostrom** was in Santa Barbara in January 2010 to attend the CNS Nano Risk Perception meeting, and Director Harthorn will convene a teleconference if needed for consultation on any matters. CNS plans to combine the next Board meeting with the CNS Research Summit planned for Dec 2001 or Jan 2011.

Center as Infrastructure for Societal Implications Researchers

CNS-UCSB co-hosted with the NSF the Nano in Society Pls meetings in Arlington, Mar 15-16, 2007 and Jul 28-29, 2008. This has entailed submission of supplement requests by PI Harthorn for the funds to hold the meetings, coordination with NSF staff for the hosting of the event, and reimbursement processing by CNS staff of all travel expenses for the approximately 30 participants in each meeting. Thus the infrastructure investment by NSF in the CNS-UCSB is benefiting a wider community of scholars and researchers, and the multi-agency NNI as well. CNS-UCSB will be submitting the supplement request for funds for US participants in the 2010 S.NET meeting in Germany. And, along with CNS-ASU, CNS-UCSB is taking a leading role in many structured interactions among NSE and societal dimensions researchers (e.g., Nano 2 NNI revisioning meeting Mar 2010).

Management and operation of Research Program

CNS has established an effective infrastructure for managing the collaborative research efforts of the CNS. CNS' base on a single campus and now conjoint space arrangements simplify these processes.

- Executive Committee meetings on a monthly basis allow reporting to the group of both administration and research issues
- IRG meetings take place on a roughly weekly basis at UCSB, often dialing in collaborators for teleconference participation.
- The CNS Graduate Seminar meets weekly or bi-weekly and provides an established forum for sharing of research issues, regular rotating presentations by senior personnel and grads, for discussion and training on research methods, IRB issues, as well as informal interaction
- Grad Fellows work together in common space, which facilitates information sharing across the groups
- Postdoctoral Fellows work in shared and adjacent space, which also serves to promote interactions; since the move to the new space in Nov 2009, the postdocs have taken the lead in instituting regular weekly gatherings for tea that include all CNS researchers and staff in informal exchange
- Visiting Scholar/Lecture Series brings together CNS researchers with extramural visitors for formal and informal interactions, sharing; visitors are selected by grads, researchers, and education program
- Annual Research Summit meets for 2 full days and allows free flow of ideas among all CNS collaborators, students, and personnel.
- Management of projects—CNS requires semi-annual reporting and invoicing from all subcontractors, IRGs, and education.
- IRB—CNS operates under a blanket human subjects protocol in PI Harthorn's name and individual project approvals for all projects involving human subjects, at UCSB and other campuses as appropriate. Staff maintain a centralized database to ensure full compliance,

upcoming expirations of existing protocols. PI Harthorn provides annual training on research ethics and individual consultation on specific projects.

- Annual process for IRG budget review and allocation—CNS Director Harthorn solicits annual budget proposals from IRGs, allocates funds based on performance, unexpended funds carried forward, and competing needs. Budgets are then discussed in Executive Committee. Budgets are gauged to different research methods and needs.
- New postdocs are required to submit a research proposal to the CNS Exec within a month of their arrival and to provide milestones for assessing progress
- Funder required annual reporting and site visits provide significant impetus to aggregate and synthesize data within and between research groups
- Annual retreats of the Executive Committee and staff to discuss NSF review results have facilitated group assessment through SWOT analysis and other mechanisms and collective decision making

Clear and regular communication is essential to the management of any organization. To achieve this end, CNS-UCSB researchers and staff are in regular communication with one another, and this process is greatly facilitated in our new space. Members of the executive committee meet on a regular basis and those not physically present join via conference call. Email provides another forum for the exchange of ideas and information. Finally, the CNS website is continuing development to increase the means for more complex databases to be created, stored, and shared internally with adequate security maintenance and externally when desired and appropriate. We have been successfully using secure sites on the ISBER server for sharing data and resources with collaborators around the world. We hope in the future to increase the cyberinfrastructure of the CNS for more effective data sharing and project report generation.

B. Evaluation plan for CNS-UCSB

The evaluation plan for the CNS-UCSB is to evaluate performance against our goals in the main functional areas--research, education and public outreach, the network with other nanotechnology in society programs, international collaboration, and the clearinghouse. We evaluate work formatively and summatively at several levels of aggregation: within each working group on a regular, semi-annual basis (some groups do this quarterly), at the steering committee level also on a regular basis, and at the level of the National Advisory Board on an annual basis. Annual reporting on established metrics provides an important set of data on the accomplishments of the CNS and any problematic areas.

Seek continuous feedback

We begin with efforts to solicit and incorporate continuous feedback. This type of formative evaluation involves a continual quest for information about all areas of our functioning. In the research working groups, the mechanism for this is now standardized 6-month progress reports by the working group project leaders that are available for review by the full CNS executive committee. All subcontractors are required to submit such reports as well. Monthly face-to-face meetings of the Executive Committee have proven invaluable for appraising progress toward goals and identifying areas of concern. Additional meetings among working group personnel are also ongoing, both to coordinate research within groups and to integrate efforts between groups. The education and outreach program is also providing monthly updates, meeting weekly or bi-weekly with all graduate fellows, and provides extensive programmatic support to undergraduate

interns. (See Education and Outreach Program section for specific education program evaluation methods, goals, and metrics.)

The CNS Executive Committee is the main formal mechanism through which such formative evaluation takes place, with on-going discussion of possible problems, necessary adjustments to plans or activities, and communication. The meetings are largely face to face (although traveling members may be on conference call) and take place on a monthly basis. The Director maintains oversight of this process. The National Advisory Board (NAB) members are available for consultation on an as needed basis as well, and we confer with them when additional advice is needed. There is a high level of intercommunication among the principals of the CNS, and a very significant circulation of scholarly and practical advice, references, articles, and other knowledge sources among the Executive Committee members, staff, postdocs, and students, primarily by electronic media. We are using on-line methods to facilitate this process, and we will be conducting ongoing analysis of their effectiveness.

The CNS Assistant Director and Education Director are involved in the monthly Executive Committee meetings and report to the Director. CNS staff have recourse for advice and assistance to the experienced and knowledgeable professional staff of the Institute for Social, Behavioral, and Economic Research (and, in the case of the Education Coordinator, the CNSI). Regular work performance evaluation is mandated for all UCSB employees.

Budgetary controls within the University of California are very rigorous, and budget oversight of the CNS is maintained by ISBER and the Office of Research. The CNS Assistant Director and Director are in near daily consultation about budget matters, and, as needed, with all personnel, subcontractors, and service providers.

Semi-annual reporting is required from all CNS research teams, UCSB and extramural subcontractors. This is a requirement in conjunction with invoicing for subcontractor payments, and these documents are circulated to all CNS principals. The Education program also reports semi-annually on accomplishments and any issues of concern. These written records provide detail that our face-to-face meetings cannot cover, and serve to inform everyone about ongoing work of the CNS.

Achieve aims

This kind of summative evaluation takes place primarily on an annual basis. The main mechanisms for achieving this are: annual reporting (for the CNS and for the NSF) and annual meetings with the NAB. Annual reporting is required for all components of the CNS, and such cumulative records are the subject of focused meeting and discussion. The NAB, in addition, meets annually in Santa Barbara and is asked to provide detailed commentary, advice, and criticism both in person and in a written report. A key aspect of the NAB process is an executive session without CNS leadership, aimed at producing candid discussion and appraisal by this distinguished body of people outside CNS but familiar with us. NSF visitors are invited to attend these meetings as observers, and, if the NAB is willing, are free to provide commentary.

NSF annual reviews provide an opportunity for summative evaluation. Annual day-long retreats of the CNS Executive Committee and staff have followed the NSF site review process every year since inception in 2009.

Additional summative measures are drawn at any natural junctures, for example, the completion of a particular research program, or the completion of an iteration of the summer intern program. Entry and exit interviews are conducted with all summer interns and graduate mentors at the start

and end of the program, respectively. The annual survey to graduate fellows, both current and past, is conducted in the Fall, after the fellowship year has concluded. More details about these measures are available in the Education section (section 11) of this report.

Prepare to meet changing conditions, emerging issues

This challenge of meeting changing conditions is particularly great in the context of studying nanotechnology in society, as the issues are far ranging and many of them still in development—it is a dynamic system that is under study. Uncertainty about both the technical risks and public reception to these emerging technologies complicates this picture. We are tracking changes, in both the nanoscience and the social worlds, and we will address these issues as they emerge. In particular, IRG 3 is tracking social response and participation in a number of ways (media studies, public perception studies). These data do provide empirical data about the changing economic, political and social worlds in which nanotechnologies are unfolding. The annual rotation of (some) grad fellows provides one mechanism to respond to new research opportunities. The CNS postdoctoral researcher program also brings in new scholars and new ideas. The annual National Advisory Board meeting is a particularly important context for discussing, brainstorming, and troubleshooting new ideas and new directions for the CNS.

Table 4a: NSEC Personnel - All, irrespective of Citizenship														
Personnel Type	Total	Gender		Race Data							Ethnicity: Hispanic	Disabled		
		Male	Female	A/IAN	NH/PI	B/AA	W	A	More than one race reported, A/IAN, B/AA, NH/PI	More than one race reported, WIA			Not Provided	
Leadership, Administration/Management														
Subtotal	0	6	10	0	0	0	11	1	1	1	2	4	0	0
Director(s) 1	0	0	1	0	0	0	1	0	0	0	0	0	0	0
Thrust Leaders 1	0	4	1	0	0	0	5	0	0	0	0	0	0	0
Administrative Director and Support Staff	0	2	8	0	0	0	5	1	1	1	2	4	0	0
Research														
Subtotal	0	38	28	0	0	0	2	26	6	2	2	28	3	0
Senior Faculty 1	0	12	3	0	0	0	5	1	0	0	0	9	0	0
Junior Faculty 1	0	5	2	0	0	0	1	1	0	0	1	4	0	0
Research Staff	0	4	0	0	0	0	0	1	0	0	0	3	0	0
Visiting Faculty 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Industry Researchers	0	1	1	0	0	0	0	0	0	1	0	1	0	0
Post Docs 1	0	4	2	0	0	0	3	1	0	0	0	2	0	0
Doctoral Students 1	0	10	15	0	0	0	2	12	2	1	1	7	3	0
Master's Students 1	0	2	2	0	0	0	3	0	0	0	0	1	0	0
Undergraduate Students (non-REU) 1	0	0	3	0	0	0	0	2	0	0	0	1	0	0
High School Students	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Curriculum Development and Outreach														
Subtotal	0	0	2	0	0	0	0	1	0	0	0	1	0	0
Senior Faculty 1	0	0	1	0	0	0	0	0	0	0	0	1	0	0
Junior Faculty 1	0	0	1	0	0	0	1	0	0	0	0	0	0	0
Research Staff	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Visiting Faculty 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Industry Researchers	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Post Docs 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Doctoral Students 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Master's Students 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Undergraduate Students (non-REU) 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
High School Students	0	0	0	0	0	0	0	0	0	0	0	0	0	0
REU Students														
Subtotal	0	3	1	0	0	0	0	2	1	0	0	1	1	0
REU students participating in NSEC Research 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NSEC Funded REU Students	0	3	1	0	0	0	0	2	1	0	0	1	1	0
Precollege (K-12)														
Subtotal	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Students	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Teachers—RET	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Teachers—Non-RET	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	47	41	0	0	0	2	40	8	3	3	32	8	0

Table 4b: NSEC Personnel - US Citizens and Permanent Residents														
Personnel Type	Total	Gender		Race Data									Ethnicity: Hispanic	Disabled
		Male	Female	A/IAN	NH/PI	B/AA	W	A	More than one race reported, AI/AN, B/AA, NH/PI	More than one race reported, W/A	Not Provided			
Leadership, Administration/Management														
Subtotal	0	6	10	0	0	0	11	1	1	1	2	4	0	0
Director(s) 1	0	0	1	0	0	0	1	0	0	0	0	0	0	0
Thrust Leaders 1	0	4	1	0	0	0	5	0	0	0	0	0	0	0
Administrative Director and Support Staff	0	2	8	0	0	0	5	1	1	1	2	4	0	0
Research														
Subtotal	0	32	21	0	0	2	22	3	4	2	20	3	0	0
Senior Faculty 1	0	11	2	0	0	0	4	1	0	0	8	0	0	0
Junior Faculty 1	0	5	1	0	0	0	1	1	3	1	0	0	0	0
Research Staff	0	3	0	0	0	0	0	0	0	0	3	0	0	0
Visiting Faculty 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Industry Researchers	0	1	1	0	0	0	1	0	0	0	1	0	0	0
Post Docs 1	0	1	2	0	0	0	1	1	0	0	1	0	0	0
Doctoral Students 1	0	9	11	0	0	2	10	0	1	1	6	3	0	0
Master's Students 1	0	2	2	0	0	0	3	0	0	0	1	0	0	0
Undergraduate Students (non-REU) 1	0	0	2	0	0	0	2	0	0	0	0	0	0	0
High School Students	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Curriculum Development and Outreach														
Subtotal	0	0	2	0	0	0	1	0	0	0	1	0	0	0
Senior Faculty 1	0	0	1	0	0	0	0	0	0	0	1	0	0	0
Junior Faculty 1	0	0	1	0	0	0	1	0	0	0	0	0	0	0
Research Staff	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Visiting Faculty 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Industry Researchers	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Post Docs 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Doctoral Students 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Master's Students 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Undergraduate Students (non-REU) 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
High School Students	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total 1	0	38	33	0	0	2	34	4	5	3	23	7	0	0

15. PUBLICATIONS

2009-2010

Papers in journals: 19 published; 5 forthcoming; 4 under review

Chapters in books/books: 3 published; 13 forthcoming; 1 under review

Other: 6

15-A: PAPERS IN JOURNALS

Mody, Cyrus C.M. 2009. Introduction [to special issue on the history of nanotechnology]. *Perspectives on Science* 17.2: 111-122.

Ostrowski, Alexis D., Tyronne Martin, Joseph Conti, Indy Hurt, **Barbara Herr Harthorn**. 2009. Nanotoxicology: characterizing the scientific literature, 2000–2007. *Journal of Nanoparticle Research* 11:251-257.

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

Newfield, Chris. L'Université et la revanche des 'élites' aux États-Unis. *La Revue internationale des livres & des idées* (Mai-Juin 2009): 28-29.

Satterfield, Theresa, Milind Kandlikar, Christian Beaudrie, Joseph Conti, and Barbara Herr Harthorn. 2009. Anticipating the perceived risk of nanotechnologies. *Nature Nanotechnology* 4:752-758.

Newfield, Chris. 2009. "Structure et silence du cognitariat," *Multitudes* 39 (October): 69-78. An English version (3E) available at <http://www.eurozine.com/articles/2010-02-05-newfield-en.html>

Godwin, H., K. Chopra, K. Bradley, Y. Cohen, **B. Harthorn**, E. Hoek, **P. Holden**, A. Keller, H. Lenihan, R. Nisbet, A. Nel. 2009. The University of California Center for the Environmental Implications of Nanotechnology. *Environmental Science & Technology*, 43 (17): 6453–6457.

Jae-Young, C. Ramachandra, G. **Kandlikar, M.** 2009. The impact of toxicity testing costs on nanomaterial regulation. *Environmental Science & Technology* 43 (9):3030-3034.

Newfield, Chris, "Why public is losing to private in American research," *Polygraph* 21 (October 2009) 77-95.

Weaver, D., Lively, E., and **Bimber, B.** 2009. Searching for a frame: Media tell the Story of technological progress, risk, and regulation in the case of nanotechnology. *Science Communication*, 31(2): 139-166.

Harthorn, Barbara, Nick Pidgeon, & Terre Satterfield. 2009. Risks and Benefits of Nanotechnology. <http://www.azonano.com/details.asp?ArticleId=2452AZoNano>.

Barbara Herr Harthorn, Karl Bryant, & Jennifer Rogers. 2009. Gendered risk beliefs about emerging nanotechnologies in the US. *Univ of Washington Center for WorkforceDevelopment*; on-line publication posted at <http://depts.washington.edu/ntethics/symposium/index.shtml>

Herron, P. and **T. Lenoir.** 2009. Mapping the recent rise of Chinese bio/pharma Nanotechnology. *Journal of Biomedical Discovery and Innovation* 4:8: October 14.

Pidgeon, Nick, Barbara Harthorn, Terre Satterfield. 2009. Nanotech: Good or Bad? *The Chemical Engineer Today* (Dec 2009/Jan 2010): 37-39.

Corner, A. & **Pidgeon, N.** 2010. Geoengineering the climate: The social and ethical implications. *Environment* 52 (1) 24-37.

Parker, R., C. Ridge, **C. Cao, and R. Appelbaum.** 2009. China's nanotechnology patent landscape: An analysis of invention patents filed with the State Intellectual Property Office. *Nanotechnology Law and Business* (6):524-539 (winter).

Mody, Cyrus C.M. and Michael Lynch, "Test Objects and Other Epistemic Things: A History of

a Nanoscale Object,” *British Journal for the History of Science* 42 (on-line edition; printed version forthcoming).

Satterfield, T., et al. 2010. Designing for upstream risk perception research: Malleability and asymmetry in judgments about nanotechnologies. White paper for Nanotech Risk Perception Specialist Meeting, Santa Barbara, Jan 29-30, 2010.

Harthorn, BH, J Rogers, & C Shearer. 2010. Gender, application domain, and ethical dilemmas in nano-deliberation. White paper for Nanotech Risk Perception Specialist Meeting, Santa Barbara, Jan 29-30, 2010.

Forthcoming, 2010 or 2011

Parker, Rachel and **Rich Appelbaum**. *Multi-Walled Carbon Nanotubes in Water Filtration Systems: From New Material Innovation to New Product Innovation*. Gore New Materials and Innovation Series. Philadelphia, PA: Chemical Heritage Foundation, forthcoming early 2010.

Beaudrie, Christian. 2010. *Emerging Nanotechnologies and Life Cycle Regulation: An Investigation of Rederal Regulatory Oversight from Nanomaterial Production to End-of-Life*. Commissioned report. Philadelphia: Chemical Heritage Foundation, forthcoming early 2010.

Newfield, Chris, Review of: Steven Shapin. *The Scientific Life: A Moral History of a Late Modern Vocation. Technology and Culture* (forthcoming 2010).

Newfield, Chris, “Science out of the shadows: Public nanotechnology and social welfare,” “States of Welfare” Special Issue, *Occasion* 1.2 (forthcoming 2010). (Available at <http://arcade.stanford.edu/journals/occasion/issues>)

Appelbaum, R. and R. Parker. China’s developmental state. In Khalid Nadvi, ed., special issue of *Global Networks* (forthcoming 2011).

Under Review, 2010

Choi, Hyungsub and Christophe Lecuyer. How did semiconductor firms manage technological uncertainties? Under review at *Revue d'Histoire Moderne et Contemporaine*.

Conti, Joseph, Terre Satterfield, Barbara Herr Harthorn. Vulnerability and social justice as factors in emergent US nanotechnology risk perceptions. Under review at *Risk Analysis*.

Newfield, Chris, et al. Is nanotechnology changing scientific collaboration? Survey evidence from a nano-oriented campus. Under review at *Nature Nanotechnology*.

Motoyama, Y., **R. Appelbaum**, and R. Parker. The National Nanotechnology Initiative: Federal support for science and technology, or hidden industrial policy? Under review at *Research Policy*.

15-B: CHAPTERS IN BOOKS AND BOOKS

Mikael Johansson. 2009. *Next to nothing: A study of nanoscientists and their cosmology at a Swedish research laboratory*. ACTA-series, Gothenburg studies in Social Anthropology. Gothenburg University: Sweden. (monograph)

Mody, Cyrus C.M. 2009. Instruments of commerce and knowledge: Probe microscopy, 1980-2000. In *Science and Engineering Careers in the United States: An Analysis of Markets and Employment*, ed. Richard Freeman and Daniel Goroff, pp. 291-319. Chicago: University of Chicago Press.

Chris Newfield. 2010. Is the corporation a social partner? The case of nanotechnology. Afterword in *Cultural Critique and the Global Corporation*, ed. Purnima Bose and Laura E. Lyons, pp. 215-224. Bloomington: Indiana University Press.

Forthcoming, 2010

- Mody, Cyrus C.M.** Conversions: Sound and sight, military and civilian. In *Sound Studies Handbook: New Directions*, ed. Trevor Pinch and Karin Bijsterveld. Oxford: Oxford University Press, accepted/in revision.
- Newfield, Chris**, Avoiding network failure: The case of the National Nanotechnology Initiative. In *State of Innovation: U.S. Federal Technology Policies, 1969-2008*, ed. Fred Block and Matt Keller. New York: Paradigm Press, forthcoming 2010.
- Mowery, David**. Federal policy and the development of semiconductors, computer hardware, and computer software: A policy model for climate-change R&D? In *Accelerating Energy Innovation: Lessons from Multiple Sectors*, eds. Rebecca Henderson and Richard G. Newell. NBER, forthcoming 2010.
- Harthorn, Barbara Herr**. Methodological challenges posed by emergent nanotechnologies and cultural values. In *The Handbook of Emergent Technologies and Social Research*, Ed. Sharlene Nagy Hesse-Biber. New York: Oxford University Press, forthcoming.
- Appelbaum, R., R. Parker, C. Cao, and G. Gereffi**. China's (not so hidden) developmental state: Becoming a leading nanotechnology innovator in the 21st Century. In *State of Innovation: U.S. Federal Technology Policies, 1969-2008*, eds., Fred Block and Matt Keller. New York: Paradigm Press, forthcoming 2010.
- McCray, W. Patrick**. From L-5 to X-Prize. Book chapter for edited collection on California aerospace history, ed. Peter J. Westwick. Los Angeles: University of California Press, forthcoming, early 2011.
- McCray, W. Patrick**, Faith in futures: California and radical technological optimism, 1970-1990. In *Minds and Matters: Technology in California and the West*, ed. Volker Janssen. University of California Press, forthcoming, early 2011.
- Appelbaum, R.** and R. Parker. Promise and prospects of nanotechnology. In *The Evolving Role of Science and Technology in Foreign Relations: Implications for International Affairs in the 21st Century*, ed. Denis Simon. (Publisher, date unknown; the paper will be based on a conference presentation at Penn State by that title)
- Mody, Cyrus C.M.** Atomic Force Microscopy; Center for Biological and Environmental Nanotechnology; Electron Microscopy; Exotic Microscopies; IBM; International Council on Nanotechnology; Interdisciplinary Research Centers; Optical Microscopy; Scanning Probe Microscopy; Scanning Tunneling Microscopy; Timeline of Nanotechnology. Entries in *Encyclopedia of Nanotechnology and Society*, ed. David Guston and J. Geoffrey Golson. Thousand Oaks: Sage, forthcoming, Nov 2010.
- Eisler, Matthew N. Department of Energy. Entry in *Encyclopedia of Nanotechnology and Society*, eds. David Guston and J. Geoffrey Golson. Thousand Oaks: Sage, under review.
- Harthorn, B. Herr**. Gender and nanotechnology; Risk amplification; Risk attenuation. Entries in *Encyclopedia of Nanotechnology and Society*, eds. David Guston and J. Geoffrey Golson. Thousand Oaks: Sage, forthcoming, Nov 2010.
- Rogers, Jennifer. iPod Nano; Friends of the Earth; Center for Nanotechnology in Society--UC Santa Barbara. Entries in *Encyclopedia of Nanotechnology and Society*, eds. David Guston and J. Geoffrey Golson. Thousand Oaks: Sage, forthcoming, Nov 2010.
- Mikael Johansson. 2010. Nano Culture. Entry in *Encyclopedia of Nanoscience and Society*. Thousand Oaks: Sage, forthcoming, Nov 2010.

Under review, 2010

Mikael Johansson. "Vi är dina provexemplar"– om etnografiskt fältarbete i laboratoriemiljö (We are your samples-On ethnographic fieldwork in laboratory environments). Book chapter in

anthology “*Att tänka genom kulturer*” (*To think through cultures*), Bärmark, Jan (ed.). Under review by Carlssons förlag.

Other: commentary, opinion pieces, oral histories

Mody, Cyrus C.M. and McCray, W. Patrick, Big Whig history and nano narratives: Effective innovation policy needs the historical dimension. *Science Progress* April 6, 2009. Available at: <http://www.scienceprogress.org/2009/04/big-whig-history-and-nano-narratives/>

Pidgeon, N. 2009. *A Beacon or Just a Landmark? Reflections on the 2004 Royal Society/Royal Academy of Engineering Report: Nanoscience and nanotechnologies: opportunities and uncertainties*. London: Responsible Nano Forum 29 July (pp.32). Available at: <http://www.responsiblenanoforum.org/publications/>

B. H. Harthorn. 2009. *A Beacon or Just a Landmark? Reflections on the 2004 Royal Society/Royal Academy of Engineering Report: Nanoscience and nanotechnologies: opportunities and uncertainties*. London: Responsible Nano Forum 29 July (pp.43). Available at: <http://www.responsiblenanoforum.org/publications/>

Maddin, Robert. 2008. *Oral History Interview* by **Hyungsub Choi**. April 22, 2008. Philadelphia: Chemical Heritage Foundation. (Not previously reported)

Chris Newfield and Gerald Barnett. 2010. The federal stimulus should support research at public universities. *Chronicle of Higher Education* Jan 3, 2010. Available at: <http://chronicle.com/article/The-Federal-Stimulus-Should/63354/>

McCray, W. Patrick. 2010. Unintended consequences. *Science Progress* Mar 22, 2010. Available at: <http://www.scienceprogress.org/2010/03/unintended-consequences/>

16. BIOGRAPHICAL INFORMATION, New Senior Personnel

BIOGRAPHICAL SKETCH

JOSEPH A. CONTI

Sociology and Law Department
University of Wisconsin, Madison
Madison, WI 53706-1391

Professional Preparation

Regis University, Denver, Colorado	Philosophy	Bachelor of Arts 1996
University of California, Santa Barbara	Sociology	Master of Arts 2003
University of California, Santa Barbara	Sociology	Ph.D. 2008

Areas of Professional Expertise

Law and Society; Globalization; Sociology of Development; Economic Sociology

Appointments / Professional Experience

2009 Assistant Professor of Sociology and Law, University of Wisconsin, Madison.

2009 Collaborator, National Science Foundation Center for Nanotechnology and Society, UCSB

2008-2009 Post-Doctoral Fellow, American Bar Foundation, Chicago.

Publications

(i)

Conti, Joseph A, Teresa Satterfield, Barbara Herr Harthorn. "Vulnerability and Social Justice as Factors in Emergent US Nanotechnology Risk Perceptions." Under review. Likely publication: fall 2010

Satterfield, Theresa, Milind Kandilkar, Christian Beaudrie, Joseph Conti, Barbara Herr-Harthorn. (2009) "Anticipating the Perceived Risk of Nanotechnologies: Will They Be Like Other Controversial Technologies?" *Nature Nanotechnology* 4: 752-8.

Ostrowski, Alexis, Tyronne Martin, Joseph Conti, Indy Hurt, and Barbara Harthorn. (2009) "Nanotoxicology: characterizing the scientific literature, 2000–2007." *Journal of Nanoparticle Research* 11:2, 251-257.

Conti, Joseph A., Keith Killpack, Gina Gerritzen, Leia Huang, Maria Mircheva, Magali Delmas, Barbara Herr Harthorn, Richard P. Appelbaum, and Patricia A. Holden. 2008. "Health and Safety Practices in the Nanomaterials Workplace: Results from an International Survey." *Environmental Science & Technology* 42:3155-3162.

(ii)

Conti, Joseph. "Between Law and Diplomacy: Disputing at the World Trade Organization in its Social Contexts." Forthcoming. Stanford University Press.

Conti, Joseph A. "Legal Experience and Dispute Processing at the World Trade Organization: How the "Haves" Come Out Ahead in International Disputing." (forthcoming, *Law and Social Inquiry*).

Conti, Joseph A. (2010). "Producing Legitimacy at the World Trade Organization: the Role of Expertise and Legal Capacity." *Socio-Economic Review* 8: 1, 131-55.

Conti, Joseph A. 2008. "The Good Case: Decisions to Litigate at the World Trade Organization." *Law & Society Review* 42:1, 145-182.

Conti, Joseph A. and Moira O'Neil. 2007. "Studying Power: Qualitative Methods and the Global Elite." *Qualitative Research* 7:1, 63-82.

Collaborators

Barbara Herr Harthorn, UCSB
Terre Satterfield, UBC
Milind Kandlikar, UBC
Christian Beaudrie, UBC
Nick Pidgeon, Cardiff Univ.

Graduate Advisors

Richard Appelbaum, UCSB
John R. Sutton, UCSB
John Foran, UCSB
Jennifer Earl, UCSB

Postdoctoral Sponsor

American Bar Foundation

17. HONORS AND AWARDS

2009

Appelbaum, Richard. Invited testimony on “China’s investment in Nanotechnology and Its Likely Impact on the U.S.,” US-China Economic Security Commission hearing, Washington, DC. March 24, 2009.

Pidgeon, Nick. Invited Expert Witness, UK House of Lords Science and Technology Committee, Nanotechnologies and Food Inquiry. March 2009.

Hawker, Craig. PMSE (Division of Polymeric Materials: Science and Engineering) Fellow, American Chemical Society. March 2009.

Hurt, Indy. UCSB AGEP (Alliance for Graduate Education and the Professoriate) Travel Grant to attend the Association of American Geographers (AAG) Annual Meeting. March 22-27, 2009.

Hurt, Indy. UCSB Academic Senate Outstanding Teaching Assistant Award. April 2009.

Pidgeon, Nick. Presented Oral Evidence, UK House of Lords Science and Technology Committee, Nanotechnologies and Food Inquiry. June 9, 2009.

Beaudrie, Christian. Summer Research Internship at the Environmental History and Policy Program (EHP), Chemical Heritage Foundation. July 2009.

Parker, Rachel. Gore New Materials Program grant and commissioned paper, Chemical Heritage Foundation. Summer 2009

Hurt, Indy. Dangermond Travel Grant to attend the ESRI User Conference July 11-17, 2009.

Martin, Tyrone. PIRE ECCI funding for Technology Transfer Tour to China, sponsored by Technology Management Program, UCSB. Summer 2009.

Mody, Cyrus and Summer Gray. Research Grant from the Center for Biological and Environmental Nanotechnology, Rice University. Summer 2009.

Mody, Cyrus, Summer Gray, and W. Patrick McCray. NNIN Research grant from the Social and Ethical Issues program of the National Nanotechnology Infrastructure Network, Cornell University. Summer, 2009.

McCray, Patrick. Awarded Albert & Elaine Borchard Foundation grant for “The Merging of French Politics and Culture in a Contemporary Mega-Science Project.” August 2009-July 2010.

Choi, Hyungsub. JSPS-SSRC Japan Society for the Promotion of Science- Social Studies Research Council Postdoctoral Fellowship. September 2009 to March 2010.

Mowery, David. Keynote presentation at inaugural conference, Society for the Study of Nanoscience and Emerging Technologies (S.Net), Seattle, WA. September 10, 2009.

Conroy, Meredith. One of four recipients of a Graduate Research Award for Social Science Surveys (GRASSS) from UCSB's Institute for Social, Behavioral, and Economic Research (ISBER). Fall 2009.

Choi, Hyungsub. Brooke Hindle Postdoctoral Fellowship, Society for the History of Technology. October 2009.

Harthorn, Barbara. Co-Chair, NSF NSE annual PI meeting, Arlington, VA, December 8-10, 2009.

Martin, Tyrone. NSF Alliance for Graduate Education and the Professoriate (AGEP) Fellow. 2009-2010.

Johansson, Mikael. Elected President, UCSB Postdoctoral Scholar Society, 2009-10

2010

Dillemath, Julie, W. Patrick McCray, Meredith Murr, Eric Bullock, **Peter Alagona,** Marilyn Spavent. NSF STS Collaborative Grant, Bringing Nanotechnology and Society Courses to California Community Colleges. January-December 2010.

Pidgeon, Nick. Presented Oral Evidence, UK House of Commons Science and Technology Committee Inquiry on Regulation of Geoengineering. January 2010.

Hawker, Craig. Macro Group UK International Medal for Outstanding Achievement. 2010.

Hawker, Craig. Polymer Division Fellow, American Chemical Society. 2010.

Harthorn, Barbara. Invited testimony to the President's Council of Advisors on Science and Technology (PCAST/OSTP) panel for review of the National Nanotechnology Initiative. Palo Alto, CA. Feb 18 2010.

Mody, Cyrus. Invited testimony to the President's Council of Advisors on Science and Technology (PCAST/OSTP) panel for review of the National Nanotechnology Initiative. Palo Alto, CA. Feb 18 2010.

Mody, Cyrus, Mara Mills, and **Patrick McCray.** American Council of Learned Societies, collaborative grant, "Micro-Histories and Nano-Futures: The Co-Production of Miniaturization and Futurism," 2010, for work in 2011.

Table 6: Partnering Institutions

Institution Type	Name of Institution	Receives Financial Support From Center	Contributes Financial Support To Center	Minority Serving Institution Partner	Female Serving Institution Partner	National Lab/ Other Govt. Partner	Industry Partner	Museum Partner	International Partner
I. Academic Partnering Institution(s)	Allan Hancock			Y					
	Arizona State University								
	Australia National University								Y
	Beijing Institute of Technology	Y							Y
	Cal Poly San Luis Obispo								
	Cardiff University	Y							Y
	CNRS - France								Y
	Cornell University							Y	
	Cuesta Community College								
	Duke University	Y							
	Ecole Polytechnique, Paris								Y
	Harvard University		Y						
	Howard University			Y					
	Jackson State University			Y					
	Massachusetts Institute of Technology								
	Michigan State University								
	Oxnard Community College			Y					
	Quinnipiac University								
	Rice University	Y	Y						
	Santa Barbara City College								
	SUNY Levin Institute								
	SUNY New Paltz								
	Sussex University								Y
	Universidad Autónoma de Zacatecas								Y
	Université de Lyon 3		Y						Y
	University of British Columbia, Canada	Y							Y
	University of California, Berkeley	Y							
	University of California, Los Angeles		Y						
	University of California, Santa Cruz	Y							
	University of East Anglia, Norwich, UK								Y
	University of Edinburgh, UK								Y
	University of South Carolina								
	University of Southern Florida								
	University of Washington	Y							
	University of Wisconsin-Madison	Y							
	Venice International University								Y
	Ventura College								
Total Number of Academic Partners	37	9	4	4	0	0	0	1	12
II. Non-academic Partnering Institution(s)	American Bar Foundation								
	American Institute of Physics Incorporated								
	Boudreaux and Associates								
	Chemical Heritage Foundation	Y					Y		
	Cynthia Cannady, Legal Services	Y							
	Decision Research	Y							
	Environmental Defense Fund								
	International Council on Nanotechnology (ICON), Rice University								
	International Risk Governance Council, Switzerland								
	Knowledge Networks, Inc.	Y							
	Meridian Institute	Y							
	Nanoholdings, LLC (NY)	Y							
	Nanoscale Informal Science Education (NISE) network							Y	
	Woodrow Wilson International Center								
Total Number of Non-academic Partners	14	6	0	0	0	0	1	1	0