

National Science Foundation
Societal Implications of Nanotechnology
2007 Principal Investigators' Meeting

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**NSEC/Center for Nanotechnology in
Society at Arizona State University**

Arizona State University

University of Wisconsin-Madison

Georgia Institute of Technology

North Carolina State University

Rutgers, The State University of New Jersey

University of Colorado, Boulder



The Center for
Nanotechnology in Society
ARIZONA STATE UNIVERSITY

**Human identity, enhancement, and biology TRC:
Prospects and progress**

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Human identity, enhancement, and biology TRC

*Co-led by
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- Broad focus on ethical, societal, and institutional aspects of NSE-enabled research in biology, biotechnology, and biomedicine
- More specific initial focus on:
 - Nano-enabled neural interfaces
 - Animal (esp. primate) research
 - Motor, cognitive enhancement
 - Analogies with other transformative technologies

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One initial activity

- Needs assessment of SEIN research agendas
- 'Greedy' survey of the relevant literatures from ethics, policy, and NSE (including scholarly articles, books, reports, pamphlets, websites)
- Content analysis for: core and more peripheral societal and ethical issues; mention vs. discussion; generic vs. specific vs. TRC-specific; negative vs. positive vs. mixed presentation; source/ publication type; influence (citation trail) [eventually]
- Identification of opportunities for collaboration, resource sharing
- Priority setting for our TRC
- NB: Putative 'uniqueness' or 'novelty' of NSE is not our concern

| Issue | Description, source |
|---|--|
| Health and safety concerns | Spatial scale-dependent properties of nano-particles raise concerns about their potential toxicity. Will it be possible to protect the health of laboratory workers, employees of manufacturing facilities, patients, and consumers? |
| Regulatory issues | Spatial scale-dependent properties of NSE raise concerns about the ability to identify, monitor, and moderate potential risks; will current national and international regulatory regimes suffice? |
| Range of potential impact issues | Financial and spatial scale-dependent properties of NSE raise the potential for ‘revolutionary’ effects throughout society. Additionally, NSE is predicted to be part of a technological convergence with biotechnology, computing and information technology, and cognitive sciences, expected to profoundly alter the human condition. Will it be possible to anticipate, plan for, and cope with large-scale effects within and between societies? What are the opportunity costs associated with a significant focus on NSE, and how can these be moderated? |
| Research priorities, funding issues | There are industrial, military, medical, academic, and fundamental technological motivations for nanoscale science and engineering. What factors determine the research agenda for NSE? What factors <i>should</i> determine the research agenda? |
| Intellectual property (IP) issues | As with biotechnology, there are concerns about key patents for enabling technologies – who owns them, their breadth, their interrelationships, licensing considerations. Will the IP regime help or hinder research and commercial aspects of NSE? What IP strategies are being and should be pursued? (See also regulatory issues, range of potential impact considerations, and research priorities, funding issues.) |
| Equity and access considerations | As with technologies of all sorts, there is the potential for inequitable distribution of technologies within and between societies. Will NSE be different? (See also research priorities, funding issues, and intellectual property issues.) |
| Clinical translation concerns | In biomedicine, the path from bench to bedside is long and difficult. Will NSE be different? (See also health and safety concerns and regulatory issues.) |
| Privacy, confidentiality | Due to the spatial scale of NSE, nanotechnologies may enable unprecedented opportunities for detection, surveillance, and intervention into daily activities. Will it be possible to devise and enforce appropriate regulations? (See also regulatory issues.) |
| Potential dual-uses unintended consequences | As with technologies of all sorts, there is the potential for the ‘dual-use’ of nanotechnologies: originally developed for one purpose, a technology is adopted for adapted for malevolent ends. Additionally, technologies engender unintended consequences of many kinds. Will it be possible to devise and enforce appropriate safeguards to minimize risks? (See also regulatory issues, and privacy, confidentiality.) |

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Nanobiology,
nanobiotechnology,
nanobiomedicine

- Specific technologies
 - Initial focus: nano-enabled neural prosthetics for motor and visual repair, rehabilitation, or rerouting of signals
- Research methods
 - Empirical and conceptual methods from anthropology, philosophy, and history, along with collaborative consultation with scientists and engineers to:
 - develop case studies and scenarios;
 - normatively assess cases/scenarios;
 - generate analytical frameworks for cases/scenarios;
 - refine methods for participatory societal evaluation of cases/scenarios (anticipatory governance);
 - devise policy recommendations.

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NSE-neuroscience
convergence

- Controversial emerging S&T
- NSE-enabled development of small, physically non-invasive, flexible, reliable, chronic, multi-electrode recording and signaling methods for the brain
- Apparently fantastical technologies, poorly understood - yet long history and already in clinical use or clinical trials
- Potentially enormously beneficial
- Potentially socially, morally, politically dangerous, too.

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Our agenda



- NSE-neuro research
 - ◆ What are the relevant values (ethical, religious, scientific, political, economic) at stake?
 - ◆ What are some specific identity and enhancement concerns, and how should they be addressed?

- Controversy
 - ◆ How should scientists, engineers, and ethicists respond?

- Anticipatory deliberation
 - ◆ How can we, as citizens in a diverse, pluralistic society with competing visions of the good, begin to grapple with nano-enabled neural prosthetics?

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Activities – Hogle

Cross-fertilization
with DiNapoli, Pirtle

- Research supervision - CNS
 - Eun-Sung Kim – PDF – Synthetic nanobiology
 - Mary Moore, MDiv – Religious perspectives
- Research – articles
 - Hogle LF. Emerging medical technologies. In E Hackett et al. (eds). *The New Handbook of Science, Technology and Society*, in press.
 - Hogle LF. Enhancement technologies and the body. *Annual Review of Anthropology* 34: 695-716, 2005.
- Research – article in process
 - Hogle LF. “Sentinel beings: Humans and machines at the molecular level”, American Anthropological Association, Washington DC (December, 2005); in preparation for a themed issue of *BioSocieties*, ed. C. Waldby
- Research – 4S panel (2006)
 - Optimizing performance in the face of nature: Soldiers, civilians and productivity culture

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Activities – Robert

Cross-fertilization
with Kim, Moore

- Research supervision - CNS
 - Shannon DiNapoli – MS (Bio/Policy/Law)
 - Zach Pirtle – BS/MS (Eng), BA (HPS)
 - Jeremy Stoloff – MS (Bio/Policy/Law)
- Research cluster
 - ASU Bioethics and Bioengineering Interdisciplinary Research Cluster (Institute for Humanities Research)
- Research – articles in process
 - Controversial science, controversial scientists, and prospects for progress in a pluralistic polity
 - Neural prosthetics – from the lab to the human brain (with Prof. Steve Helms Tillery, Bioengineering)
 - Post Marketing Studies and FDA Approval of Medical Nanotechnology (with Stoloff)
 - Reassessing the SEIN research agenda: Beyond bioethics as usual (with DiNapoli)
- Research – book in process
 - *Chimeras, Cyborgs, and the Moral Limits of Science* (under contract with OneWorld)

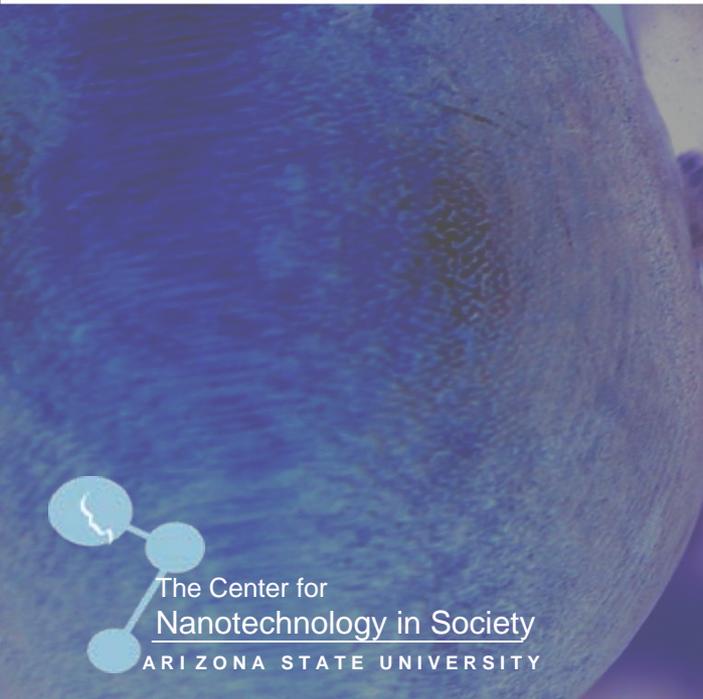
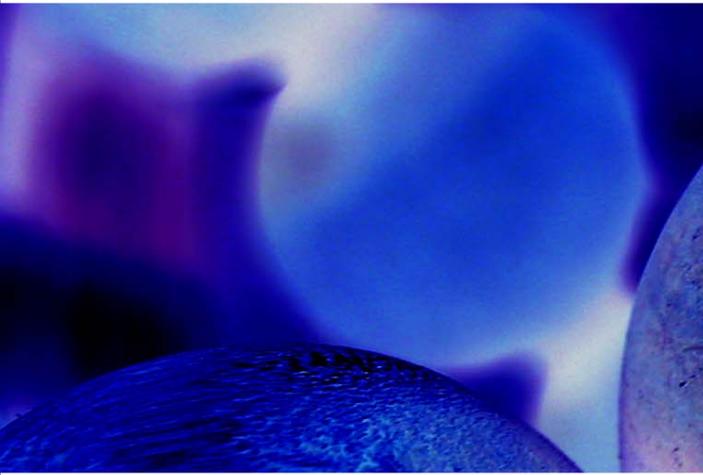
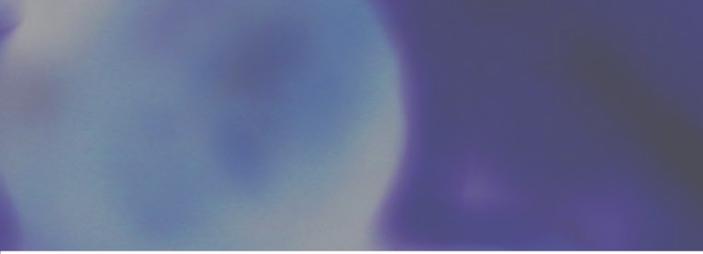
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Outstanding challenges

Promising prospects

- Shouldn't Guston pay for that?
- Travel for collaborations
- Backlash *re*: nano is old news vs. everything is new again

- Deeper, better SEIN literature than currently exists
- Connections with other literatures, audiences
- Real-time engagement with nanoscientists and engineers



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Identity

- Boundary crossing technologies
 - How are implanted NSE devices (or NSE-enabled devices) like (or not like) macro- or micro-mechanical technologies?
 - E.g., heart valves; LVADs; artificial hearts; pacemakers; insulin pumps; visual prosthetics
 - What can we learn from the literatures on mechanical technologies and the body that might speak to self/identity issues as we go to NSE indwelling devices?
 - What might we learn about how people adapt, work-around, foil, and/or reinterpret technologies as they negotiate new identities?
 - Will NSE devices (or NSE-enabled devices) raise any new issues of self/identity, especially re: the distinction between animate and inanimate matter?
 - What are the implications for how users or designers think about crossings and identity issues (how much/which parts are 'human-like' or 'biological-like') for regulatory and legal purposes?

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Enhancement



- Enhancement technologies
 - Enhancement is the amplification or extension of some capacity – but amplification or extension beyond what? Some candidate possibilities are current personal or cultural ability (as with cosmetic surgery or cognitive enrichment) and species-typical functioning or even ‘species limits’ (as with endogenous synthesis of vitamin C or lifespan extension beyond 150+ years).
 - What are the motivations for enhancement? To be fashionable? To gain a competitive advantage? To exercise one’s personal liberty? To meet the demands of justice?
 - Whatever the motivation and means, there are many modes of enhancement, whether physical, cognitive, psychological, or moral.
 - How may NSE or NSE-enabled devices, drugs, or products be used to improve (or impede) human performance?
 - Who cares? Why?