

Emerging Areas of Research Abstracts

June 2017

**College of
Arts +
Sciences**



IU BLOOMINGTON

EMERGING AREAS OF RESEARCH

Abstract Template -- Due June 30, 2017

Title of initiative to be proposed:

Mediated Consciousness: A Cognitive Humanities Approach

Name of lead PI, with title, department/school:

Fritz Breithaupt, Germanic Studies

Key team member names and departments/schools (up to 10 names):

Peter M. Todd, Cognitive Science and Psychology (co-PI); Marco Arnaudo, French & Italian Studies; M. Elizabeth Grabe, The Media School; Allen Hahn, Theatre, Drama & Contemporary Dance; Sandra Kuebler, Linguistics; Robert F. Potter, The Media School; Aina Puce, Psychological & Brain Sciences; Bret Rothstein, Art History; Eliot Smith, Psychological & Brain Sciences; Joan Linton, English

Description of area to be proposed. What constitutes this area of research or creative activity as emerging?
(Word limit=500)

By some accounts, many people use media for more than half of their waking hours each day, from written/spoken/visual storytelling including film and television, to digital or analog games and aesthetic (e.g. sound, taste, tactile) experiences. This barrage of mediated experience shapes our mediated consciousness, our ongoing simulation of the subjective experiences of others that we engage in as part of constructing our own experience. Mediated consciousness strongly impacts our individual and group identities, moral reasoning, strategic planning in social contexts, and experiences of the environment. It shapes our ability to empathize with select individuals and creates an "empathy deficit" in our dealings with many others, limiting our acceptance of other people's perspectives across ideological, political, or cultural lines. New technology, social media, and augmented reality will continue to stretch and challenge our mediated consciousness. To understand and properly channel these emergent impacts, we must study how mediated consciousness is constructed, what role technology plays in creating these experiences, and how we can control the consequences of these new interactions.

We wish to study this new consciousness and examine how it shapes social and moral behavior, collective identities and animosities, and political and religious commitments. To do so, we propose to establish a Center for the study of cognitive arts and humanities. The Center will support the integration of the arts, humanities, media research, and cognitive science to foster novel emerging research that IU is ideally placed to tackle, with mediated consciousness as its first main target. Our large group includes artists, scientists and researchers from more than a dozen departments. By combining tools and sensibilities from humanities disciplines such as narrative studies, discourse analysis, and hermeneutics with approaches from cognitive science including communication analysis, computer simulation, and psychological experimentation, we are able to base our enquiry on contemporary explanations of how consciousness is constructed while integrating effects of aesthetics, media, and historical context into that process. The Center will include space and the development of special infrastructure to enable virtual and analog simulations of mediated human experience, which in turn will foster experimental studies, teaching, art, and product development (with the aim of sparking industry connections).

Our interdisciplinary approach leads to a number of distinct projects under the initial umbrella topic of mediated consciousness. Each project will iterate between developing new theory of mediated consciousness and empirically testing the resulting ideas, including:

- How mediated narratives can be constructed to increase empathy toward marginalized groups.
- How traditional therapies like role playing can be implemented in virtual reality to increase perspective taking during conflict resolution scenarios or dating situations prone to relationship violence.
- How film, virtual reality, performances, narratives, and games can engage people in situations they are unlikely to experience (solitary confinement, poverty, environmental disaster) and produce lasting positive carry-over effects.
- How attempting to maintain concurrent presence in mediated and physical worlds can affect individuals' relationship quality, attention depth and span, and anxiety level.

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IU BLOOMINGTON

EMERGING AREAS OF RESEARCH

Abstract Template -- Due June 30, 2017

Title of initiative to be proposed:

Forced Migration: Origins, Effects, and Solutions

Name of lead PI, with title, department/school:

Elizabeth Cullen Dunn, Associate Professor, Geography and International Studies

Key team member names and departments/schools (up to 10 names):

Elizabeth Cullen Dunn (Geography/International Studies); Michelle Moyd (History); Stephen Macekura (International Studies); Ishan Ashutosh (Geography); Clemence Pinaud (International Studies); Abdulkader Sinno (Political Science and Middle Eastern Studies); Christine Glaser (SPEA); Dina Okamoto (Sociology); Lilian Yahng (Center for Survey Research)

Description of area to be proposed. What constitutes this area of research or creative activity as emerging?
(Word limit=500)

More than 65 million people around the world are forced migrants--refugees, internally displaced people or asylum seekers. This population, which has increased by over 33% in the last decade, will continue to grow well into the 21st century. With hundreds of millions who will be affected by climate change and armed conflict, and an international system for managing migration that has become completely dysfunctional, forced migration will remain a politically charged topic for the foreseeable future. Yet, although the US is the world's largest donor of aid to displaced people, few research centers in the US can offer evidence-based insight on the origins of the crisis and the effects of forced migration and humanitarian aid on displaced people themselves, or offer novel ideas for resolving it. The Indiana Center for the Study of Forced migration will be a research hub addressing these urgent questions. Focusing on people displaced by conflict, development or disaster, and the institutions that aid them or regulate their movements, the Center will be an authoritative public voice on forced migration. In addition to academic research, it will also be a place where academic researchers, aid agencies, charitable foundations and displaced people themselves can address problems and hash out solutions, as well as a respected source of policy advice for governments, foundations, multilateral institutions and NGOs.

Indiana University is the ideal home for this Center. IU's School for Global and International Studies, including IU's long area studies tradition and robust language programs, provide a strong basis for research on questions of migration. Individual IU faculty members in the College of Arts and Sciences and the School of Global and International Studies have developed strong research initiatives into topics including humanitarian assistance and displacement, and war economies and refugee dislocation. The Center will build on these endeavors by promoting cross-disciplinary, team-based research to support and expand faculty and graduate student research. In particular, the Center will focus on three key aspects of the forced migration crisis: (1) the origins of mass displacement, including political, historical, and environmental factors; (2) humanitarian response, including transnational aid institutions, donor nations, international NGOs and local aid agencies, and peacekeeping operations; and (3) the lived experiences of displaced people, including their experiences with emergency aid. We will focus not only on resettlement in North America or Europe--which, despite the controversy in the United States, affects less than 1% of the world's displaced population—but on the effects of protracted displacement, voluntary and involuntary repatriation, and social integration in developing countries.

The multidisciplinary group at IU includes scholars whose work has gained national and international attention, and has already begun creating partnerships with international agencies, corporate foundations, and resettlement agencies in Indiana to make IU a center for thinking about long-term solutions outside the current dysfunctional international system. With strategic funding, the Indiana Center for the Study of Forced Migration will be a center of innovative research aimed at developing long-term solutions to the global crisis of mobility.

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EMERGING AREAS OF RESEARCH

Abstract Template -- Due June 30, 2017

Title of initiative to be proposed:

Integrative Approaches to Cognitive Hearing Science

Name of lead PI, with title, department/school:

Laura Hurley, Associate Professor, Biology/COAS

Key team member names and departments/schools (up to 10 names):

Jennifer Lentz, Larry Humes, Yi Shen, Nancy Nelson, Department of Speech and Hearing Sciences/ COAS; Donald Williamson, School of Informatics and Computing; Minje Kim, Department of Intelligent Systems Engineering/School of Informatics and Computing; Gary Kidd, Cognitive Science Program/COAS; David Pisoni, Department of Psychological and Brain Sciences/COAS; Daniel Maki, Department of Mathematics/COAS, Communication Disorders Technologies

Description of area to be proposed. What constitutes this area of research or creative activity as emerging? (Word limit=500)

Hearing loss is a significant health problem across the lifespan. Although hearing loss negatively affects intellectual development and quality of life, this area of research has been seriously neglected in the biomedical research agenda because hearing loss is not fatal. There is an emerging consensus that hearing loss in humans is not just an ear problem but a brain problem related to multisensory and cognitive processing of information. These types of interactions are exemplified in phenomena such as the association of relatively normal auditory thresholds with profound difficulty in understanding speech in noise, or in emotional contributions to disorders like tinnitus. Just as their origins involve much more than a simple loss of hearing, these disorders can impose severe social and societal costs by contributing to isolation, loss of productivity, and cognitive decline and dementia. This situation presents an important opportunity for audiologically based integrative approaches to research and treatment. We propose a cross-disciplinary coalition among IUB faculty to address this challenge. We will leverage existing expertise at IUB in hearing and cognitive science, in computer science and signal processing, and in basic research, to achieve the following goals.

- Developing innovative hearing technology: We are on the cusp of a new generation of hearing aid technology. 'Smart' hearing aids pre-process sound to focus on meaningful inputs like speech. These devices require novel data-driven algorithms for speech recognition, in conjunction with new approaches to streamlining the neural processing needs for these small, wearable devices. IUB faculty are authorities in these areas.
- Creating new models for auditory cognition: Central neural circuits underlie auditory cognition, but there is little understanding of how these contribute to disordered hearing. Neurochemical pathways may serve as a source of feedback from limbic to auditory regions, transforming the representation of auditory stimuli. Research on such systems could contribute to pharmacological strategies for hearing disorders.
- Clinical research in cognitive hearing science: There is a profound need for greater understanding of the historical or cognitive factors associated with hearing loss, and for the value of intervention through novel technological or pharmacological strategies. IUB faculty have a strong history of collaboration in cognitive hearing science, including in the development of clinical assessments such as PRESTO, which assesses speech-based recognition and cognition. In this area, we will collaborate with Communication Disorders Technology (CDT), a Bloomington-based company responsible for the National Hearing Test.

Leadership at IUB: Major resources that we have identified as important to achieving these goals and coalescing our group are 1-2 faculty who would bolster or provide a bridge between different domains of our existing expertise. These could include a faculty expert in cognitive hearing science, or with experience in uniting animal and human auditory research in our areas of interest. To bring attention to IUB's work in this area, we would leverage the reputations of several prominent IUB faculty members to initiate a conference in Cognitive Hearing Science. As a group, we are excited to serve Hoosiers and lead internationally in this rapidly emerging area.

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EMERGING AREAS OF RESEARCH

Abstract Template -- Due June 30, 2017

Title of initiative to be proposed:

EAR: Environmental and Materials Chemistry Modeling Consortium [E-MC2]

Name of lead PI, with title, department/school:

Srinivasan S. Iyengar, Associate Professor, Department of Chemistry, Adjunct in Physics, COAS

Key team member names and departments/schools (up to 10 names):

coPIs: Krishnan Raghavachari (Chemistry), Peter Ortoleva (Chemistry, Informatics (Adjunct)),
Vikram Jadhao (Intelligent Systems Engineering, Informatics)
Senior Personnel: Chemistry: Phil Stevens (SPEA), Liang-shi Li (Chemistry), Caroline Jarrold (Chemistry), Sara Skrabalak (Chemistry), Amar Flood (Chemistry), Jeremy Smith (Chemistry)

Description of area to be proposed. What constitutes this area of research or creative activity as emerging?
(Word limit=500)

Rationale and Strength

Theoretical and computational chemistry is central to the materials genome initiative and impacts the design of new catalysts, vaccines, nanoparticle therapeutic delivery systems, and understanding environmental chemistry. The complexity of the systems requires sophisticated approaches in theoretical chemistry. True advances are limited by lack of quantitative predictive models because accurate treatment of such systems is an exponential scaling high-performance computing problem.

Since the 1960s, through efforts from Harrison Shull, Donald McQuarrie, and Ernest Davidson, (all IU Bloomington) has been prominent in the development and application of new computational methods. Examples of IU's influence include (a) the Quantum Chemistry Program Exchange that allowed storage of, and global access to, a repository of computer programs and chemical information, and (b) state-of-the-art computing facilities that have been a constant resource and support for the community.

Targeted Outcomes

This initiative will allow fundamental developments and new predictive technologies that harness our existing and proven capabilities in (a) quantum mechanical computations, (b) multiscale theoretical quantum dynamical theory and multistate computational statistical mechanics, (c) continuum electrostatics and its interface with atomistic simulations, (d) new algorithm development, and (e) deciphering patterns in large data-sets generated from our studies through interfacing with machine learning.

The new methods we develop will, in collaboration with listed senior personnel, deliver new insights and paradigm shifts in environmental, nanomedical, and materials science. These will include the following: (a) novel custom synthetic solutions to artificial nitrogen fixation, (b) molecular-level understanding of chemical drivers of climate change, air pollution, and nutrient cycling, (c) electron transport in photovoltaic devices, organic and optoelectronic devices, OLEDs and sensors, (d) nanoparticle vaccine design and therapeutic delivery systems, (e) nanoparticle nucleation, self-assembly and plasmonics.

Future Directions

The investigators listed have a track record of external funding (NSF, NIH, DOE). This initiative will build on existing strengths, produce new directions and lead to external grants in support of center activities.

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EMERGING AREAS OF RESEARCH

Abstract Template -- Due June 30, 2017

Title of initiative to be proposed:

Human-in-the-loop Natural Language Processing for Low Resource Languages Spoken in Indiana

Name of lead PI, with title, department/school:

Professor Sandra Kübler, Department of Linguistics, COAS



Key team member names and departments/schools (up to 10 names):

Matthew Anderson, School of Informatics and Computing
Kelly Harper Berkson, Department of Linguistics, COAS
Timur Gilmanov, School of Informatics and Computing
Donald Williamson, School of Informatics and Computing



Description of area to be proposed. What constitutes this area of research or creative activity as emerging?
(Word limit=500)

Indiana now has one of the largest Burmese refugee populations in the United States, with more than 13,000 people living in Indianapolis alone and nearly 20,000 in total. These refugees come from poverty abroad into poverty in Indiana, and access to basic services is complicated by language barriers. The language barrier is daily manifested in Indianapolis-area hospitals, which have near-constant needs for Laiholh (Chin) and Burmese translation capability. We will develop novel methodologies for automatic speech recognition (ASR) systems and machine translation (MT) (potentially speech synthesis) for low-resource languages and develop deployable systems for medical professionals and first responders supporting key low-resource languages spoken in Indiana including Burmese, Laiholh, Karen, Karenni, Kachin, and Mon. Standard approaches to ASR and MT, based on machine learning techniques, require large sets of language examples accompanied by correct transcriptions or translations. Thus for every language for which we need to develop these technologies we are forced to adjust analytical techniques based on language characteristics and to invest considerable effort (in the range of hundreds of thousands of hours) into creating data sets with which to train the machine learners. Acoustic models typically need thousands of hours of transcribed recordings, and machine translation requires hundreds of thousands of translated sentences. A trained linguist can need between 100 and 1000 seconds to transcribe 10 seconds of speaker recordings. Translating is only marginally faster. The problem is compounded if we need speech tools for specific language domains, such as the medical field, which require annotated data for domain-specific examples. Such efforts are deeply valuable, but are only feasible if there is a commercial interest in a language. For a wide range of languages, then—even those with millions of speakers—it is simply impossible to develop ASR and MT resources given current technologies and resources.

We propose to create a center for developing human-in-the-loop approaches to natural language processing applications for low-resource languages, with a specific focus on languages spoken by refugees in Indiana. We will create approaches that combine novel machine learning techniques for small data sets (e.g., one-shot learning, active learning) with novel methods for graph computing that allow us to integrate syntactic and semantic graphs (i.e., knowledge about sentence structure and meaning), along with knowledge- or grammar-driven approaches that extract knowledge/rules about a language from linguistically naïve speakers. We have access to native speakers, including 30 IU students, who can provide information about how the language works if we ask the right questions, and we have access to linguists who can provide knowledge about how to exploit similarities between languages. We will develop novel methods for partially automating such linguistic fieldwork so that the involvement of trained specialists (linguists and machine learning experts) is kept at a minimum.

The team consists of professionals with expertise in audio processing, speech recognition, fieldwork and linguistics, computational linguistics, machine learning, high performance computing graphs, and in Burmese and Laiholh. Potential funding can come from NSF, ONR, iARPA, DARPA, and from companies such as Amazon, Google, Microsoft, or Nuance.



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EMERGING AREAS OF RESEARCH

Abstract Template -- Due June 30, 2017

Title of initiative to be proposed:

Uncertainty and Strategic Interaction in Economic Networks

Name of lead PI, with title, department/school:

Dr. Emerson Melo, Department of Economics, College of Arts and Sciences

Key team member names and departments/schools (up to 10 names):

Description of area to be proposed. What constitutes this area of research or creative activity as emerging?
(Word limit=500)

Network structures play a fundamental role in the modern economy. Examples vary from communication and transportation networks to supply chains and financial networks. In all of these markets, economic agents face two types of uncertainty: Strategic uncertainty and Systemic uncertainty. Strategic uncertainty refers to situations where economic agents make decisions in strategic environments. To study this class of uncertainty, the theoretical and applied literature have adapted ideas from traditional game theory to understand how strategic interaction is determined by network structures. Systemic uncertainty refers to situations where all the agents in a given network make decisions with incomplete information about the realization of some fundamental variables that affect the entire system (network). To fix ideas, consider the case of a financial system, where the interrelation amongst banks is captured by a financial network. In this environment all banks face uncertainty about the realization of some financial shock or about the realization of some relevant economic variable. Because the realization of these exogenous shocks affect all the banks in the network, this uncertainty is referred as systemic uncertainty. A real world example that fits into this description is the 2008 sub-prime crises: All the economic agents faced uncertainty about the situation of the real state market. Most of the theoretical (and empirical) literature in Economics has been focused on strategic uncertainty, omitting the role of systemic uncertainty. In this project we study the role of systemic uncertainty in economic networks. In doing so, we built upon the literature of network games, including explicitly the role of risk measures, which allow us to capture the relevance of systematic uncertainty in agents' decisions.

We make three main contributions:

1. We develop a model of strategic interaction in networks, in which agents are risk-averse. This in sharp contrast with all previous literature on network games which has assume that agents are risk-neutral. As a consequence we are able to characterize agents behavior not only in terms of network structures but also in terms of the role of systemic uncertainty.
2. Based on point 1, we develop numerical methods to compute and simulate large network problems. A direct application of these methods is the counterfactual analysis of different economic policies.
3. Finally, we characterize the type of networks that are robust to systemic uncertainty.

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EMERGING AREAS OF RESEARCH

Abstract Template -- Due June 30, 2017

Title of initiative to be proposed:

Center for Quantum Science and Engineering

Name of lead PI, with title, department/school:

Gerardo Ortiz, Professor, Physics/College of Arts and Science

Key team member names and departments/schools (up to 10 names):

David Baxter, Roger Pynn, Phil Richerme, Mike Snow: Physics/College of Arts and Science
Alexander Gummenik: Intelligent Systems Engineering/School of Informatics and Computing
Amr Sabry: Computer Science/School of Informatics and Computing

Description of area to be proposed. What constitutes this area of research or creative activity as emerging?
(Word limit=500)

Quantum mechanics governs the properties of atomic scale systems, and understanding its details is fundamental to most of modern technologies (from mechanistic understanding of synthetic chemistry and nuclear physics, to the foundations of the semiconductor and magnetic storage industries, to name but a few examples). Taming the most unique aspect of quantum phenomena, entanglement, is key to achieving critical progress in future technologies. Entanglement lies at the heart of some of the most perplexing problems in materials physics, and it has also led to burgeoning revolutions in computing, cryptography, and other fields. Recently, the promise for entanglement to open major new technical horizons as our ability to control and understand this most unique aspect of the quantum universe has been described as the second quantum revolution. So-called quantum computers promise to provide exponential speed-up in solving problems that are fundamentally beyond the capabilities of conventional computers, and entanglement is believed to be the key distinguishing factor separating quantum from conventional computation. This is an area in which the National Science Foundation envisions making major investments over the upcoming decades, and it is also an area that has seen increased funding from the Defense agencies over the last decade. Technology companies, such as Microsoft, IBM and Google, have also identified this as a key area for future development and have devoted significant resources to the field recently.

IU Bloomington has a core group of faculty with overlapping interests in this field, and we are seeking to broaden and link more effectively these efforts through the EAR initiative. Physics has three distinct experimental groups developing novel approaches to control and characterize entanglement in systems of many particles, and faculty members in both Physics and Informatics are exploring ways to recast conventional theories of computation in light of these new developments. Furthermore, the Intelligent Systems Engineering (ISE) Department brings in prototyping, characterization, and system integration capabilities in a number of application areas, such as quantum sensing, devices, cloning, cryptography, and data routing. A small number of hires in areas complementary to our existing efforts (such as large-scale (conventional) computational approaches to simulating several-body quantum systems, studies of trapped atom systems, and quantum measurement techniques) would provide a significant boost to the international profile of our group while also providing enhanced connections to the wider Quantum Information Technology community for our future graduates. Funding of this EAR proposal will result in IU Bloomington becoming an internationally recognized leader in Quantum Simulation and the use of entangled states as a probe of quantum systems. Such funding will also greatly enhance ties between the College and ISE in this emerging area of quantum technology, and put the campus in a strong position to lead a burgeoning Midwest effort in Quantum Engineering that could involve partners such as IUPUI, U. Chicago, U. Illinois at Chicago, Argonne National Lab, and others.

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EMERGING AREAS OF RESEARCH

Abstract Template -- Due June 30, 2017

Title of initiative to be proposed:

Rebalancing the Nitrogen Cycle

Name of lead PI, with title, department/school:

Jeremy M. Smith, Associate Professor, Department of Chemistry

Key team member names and departments/schools (up to 10 names):

Kenneth G. Caulton, Department of Chemistry
Jeffrey M. Zaleski, Department of Chemistry

Description of area to be proposed. What constitutes this area of research or creative activity as emerging?
(Word limit=500)

The pollution of lakes and coastal bays by agricultural nitrogen fertilizer runoff, causing eutrophic algal growth, is a societal problem on a global scale that is superseded only by the buildup of carbon dioxide and other greenhouse gases in the atmosphere. The ability to deliver pure water (e.g. for residential use), and remediate the planet's soil and atmosphere by transformative catalytic science is recognized as an emerging area of chemical research at the most fundamental level, but one that is currently neglected by skilled observers of a dying planet. We currently lack chemically and energetically effective methods to respond to the needed recycling of agricultural nitrogen waste, which is essential for fertilizing planetary food production.

We will invent economical catalysts that use solar power to convert nitrogen-containing field runoff into value-added products, including the recycling of these pollutants back into agrochemicals. Sustainability will be built into the construction and operation of these new catalysts by building on the scientific breakthroughs in other catalyst-based environmental remediation processes, such as carbon dioxide recycling. We will pursue two strategies in catalyst design: (1) Molecular catalysts based on sustainable, inexpensive and nontoxic elements (e.g. iron) that are encased in a bioinspired, enzyme-like periphery will efficiently use energy harvested from sunlight (sourced from existing and developing photovoltaic technologies) for selective catalysis; and (2) Nanoparticle catalysts will capture solar energy, use their sharply pointed surface features to both concentrate this energy as well as create unique reactive sites for agricultural nitrogen waste conversion.

The long term goal of our research is the development of new technologies for nitrogen waste conversion that can be "deployed and forgotten," including in developing countries that have minimal infrastructure but abundant solar energy flux. By solving societal environmental problems, we will impact quality of life on a worldwide scale, deliver pure water and diminish the current cost of environmental remediation. The global impact of this emerging area forms a platform for innovative hiring and attracting long-term funding from the federal government and agrochemical companies, and will make Indiana the pioneering center for research towards a goal which is currently neglected around the world.

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IU BLOOMINGTON

EMERGING AREAS OF RESEARCH

Abstract Template -- Due June 30, 2017

Title of initiative to be proposed:

Comparative Ethics, Political Theory, and Political Philosophy

Name of lead PI, with title, department/school:

Aaron Stalnaker
Associate Professor, Dept. of Religious Studies, College of Arts and Sciences

Key team member names and departments/schools (up to 10 names):

Hussein Banai, International Studies; Kate Abramson, Philosophy; Marcia Baron, Philosophy; Sandra Shapshay, Philosophy; Allen Wood, Philosophy; Aurelian Craiutu, Political Science; Russell Hanson, Political Science; Jeffrey Isaac, Political Science; William Scheuerman, Political Science; Michael Ing, Religious Studies; R. Kevin Jaques, Religious Studies; Winni Sullivan, Religious Studies

Description of area to be proposed. What constitutes this area of research or creative activity as emerging?
(Word limit=500)

Western scholars who study ethics and political thought have over the last decade become increasingly fascinated by the intellectual implications of the current decentered global situation. Political theorists and ethicists realize they must engage writings on their subjects from outside Europe and the Anglo-American world more deeply, and in so doing see thinkers from other traditions and regions as philosophical interlocutors, and not merely as representatives of formerly subject peoples. By "comparative" ethics, political theory, and political philosophy we mean research in these disciplines that brings "mainstream" Western theorizing about ethics and political theory into explicit dialogue with philosophical and religious traditions and current debates from outside the European-influenced West. We aim to construct a "fusion of horizons" sufficient to enable productive philosophical debate about significant ethical and political issues, while explicitly raising the question of standards for judgment, argument, and relevance, in order to address deep differences without capitulating to either relativism or ignorant cultural chauvinism. We hope to shed fresh light on pressing normative issues regarding war, populism, global development and trade, liberalism and its discontents, and ethical universalism, as well as basic questions about the nature of norms, authority, solidarity, obligation, and virtue, among other topics. We are presently witnessing a dramatic upsurge in interdisciplinary attention to global and comparative normative theorizing in Political Science, Political Philosophy, and Religious Studies. This trend is visible in changing publishing patterns in flagship journals and elite university presses, as well as changing emphases in faculty hiring in these areas.

Luckily, Indiana University is perfectly positioned to seize a position of preeminence in these emerging fields. We already have strong faculty in political theory and ethics spread across Philosophy, Political Science, and Religious Studies, among other departments, and have two current faculty whose research centers on comparative ethics (Stalnaker) and political theory (Banai). IU's strength in global and international studies, including cultural and historical studies and a wide range of language training, also gives us essential supporting infrastructure that many elite competitors in these fields lack (e.g., Princeton).

We propose to found the IU Center for Comparative Ethics, Political Theory, and Political Philosophy. This center would be anchored by present IU faculty, and augmented by three new faculty hires, one in each of the three departments. The center would encourage robust intellectual exchange and cohort formation at the graduate level across the three primary departments, to allow IU faculty to take a leading role in shaping this new approach to normative theorizing, and place a generation of IU PhDs in positions of academic leadership. It would also dovetail with IU Press's new book series on World Philosophies. The EAR program would aid the work of interested faculty by supporting graduate students, post-docs, and visiting speakers and fellows; underwriting conferences and publishing projects; and providing a base and target for future grant writing. We think the proposed center would appeal strongly to outside foundations such as the Carnegie Endowment for International Peace, the Luce Foundation, and the Berggruen Institute.

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EMERGING AREAS OF RESEARCH

Abstract Template -- Due June 30, 2017

Title of initiative to be proposed:

Accelerating evolution with CRISPR gene drives

Name of lead PI, with title, department/school:

Michael Wade, Distinguished Professor of Biology

Key team member names and departments/schools (up to 10 names):

Andrew Zelhof, Associate Professor of Biology
Gabriel Zentner, Assistant Professor of Biology

Description of area to be proposed. What constitutes this area of research or creative activity as emerging?
(Word limit=500)

Genome editing technology based on clustered regularly interspersed palindromic repeats (CRISPR) has revolutionized biological research. In the lab, CRISPR is used to introduce genetic modifications that permit fine-scale dissection of gene function. Beyond the lab, the potential of CRISPR is apparent in many areas, particularly human health and agriculture, where CRISPR might be used to correct genetic defects underlying human diseases and engineer crops that resist pests and drought while producing additional nutrients. An additional potential application of CRISPR that has received increased attention is the idea of 'gene drives,' which could address key issues in public health, conservation, and agriculture.

What is a gene drive? In nature, there are genetic elements that bias their own transmission, ensuring that they are present in a population at a greater than expected frequency. Gene drives are thus considered 'selfish,' in that they cheat to ensure their own propagation. Notably, gene drives persist even though they may cause harm to their host. Drawing inspiration from naturally occurring gene drives, researchers have proposed CRISPR-based gene drives as a means by which to control populations of disease-vectoring insects, particularly mosquitoes, which transmit malaria, dengue, zika, chikungunya, and many other diseases. Diseases transmitted by mosquitoes and other insects account for ~17% infectious diseases and cause over 1 million deaths annually.

A handful of CRISPR drives have been successfully implemented in the lab, demonstrating the promise of this approach. However, there are factors that complicate their use in wild populations. We have found that genetic variation and inbreeding, which commonly occurs in populations of disease-vectoring insects, present substantial obstacles to propagation of a CRISPR gene drive. Such impediments will slow and eventually remove a CRISPR gene drive from a population of interest unless they are taken into account when designing the drive.

We propose to build a research group focused on applied genome editing, with a particular interest in designing and testing CRISPR gene drives. Such a group will capitalize on existing faculty strengths (Zelhof, Zentner, Wade) and focus on three immediate research goals: 1) expand the genome editing toolkit for the red flour beetle, *Tribolium castaneum*, a model organism in insect development and a major pest of stored food products; 2) design and construct novel approaches to CRISPR gene drives and effective reversal-of-drive mechanisms; 3) address the flaws we have identified in currently implemented CRISPR gene drives by drawing on our understanding of naturally occurring gene drives.

We propose to recruit 1-2 faculty with expertise in novel applications of genome editing technology, particularly in organisms of relevance to gene drive research. Combined with our existing strengths in molecular and population biology, these new faculty will transform IU Bloomington into a leader in CRISPR gene drive research. In the end, we anticipate that the technologies developed and insights gained, especially with respect to gene drives systems for both medical and agricultural insect vectors, will form a foundation for further public-private cooperation.

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EMERGING AREAS OF RESEARCH

Abstract Template -- Due June 30, 2017

Title of initiative to be proposed:

Building the Future of Structural Biology at Indiana University

Name of lead PI, with title, department/school:

Adam Zlotnick, Professor of Molecular and Cellular Biochemistry/College of Arts and Sciences

Key team member names and departments/schools (up to 10 names):

Suchetana Mukhopadhyay (co-PI, Biology); Carl Bauer (MCB); Steven Bell (MCB/Biology); Yves Brun (Biology); Bogdan Dragnea (Chemistry); Daniel Kearns (Biology); John Patton (Biology); Craig Pikaard (Biology/MCB/HHMI)

Description of area to be proposed. What constitutes this area of research or creative activity as emerging?
(Word limit=500)

Structure is the basis of function at scales from molecular to monumental. Flexibility and heterogeneity have limited our ability to determine structures relevant to biological function. However, the ongoing hardware and software "resolution revolution" in cryo-electron microscopy (cryo-EM) now enables us to reach molecular resolution of virtually any biological material.

Many scientists at IU are heavily invested in the use of cryo-EM for structure determination. Highly funded research on this campus that depends on EM includes the study of viral, bacterial, and eukaryotic ultrastructure, nucleic acid replication/repair machinery, and artificial nanostructures. These researchers have a common need: better structural resolution. To achieve this goal, it is imperative that researchers have state of the art EM equipment on this campus as sample optimization and data collection are iterative processes that are practical and effective only when performed on site.

Enhancing cryo-electron microscopy on this campus will have an immediate impact on IU's world renowned strengths in physical virology and nucleic acid biochemistry. We propose to use EAR funds to purchase a state of the art Talos Arctica electron microscope. Biochemistry will be opening a search for a cryo-microscopist at the Assistant Professor level this year with start up funds supported by the GC Precision Health Initiative. Combining GC and EAR resources will support our strengths and enable us to recruit world class structural biology faculty. Consider two IU-Bloomington examples that highlight our expertise and the need for on-site cryo-EM:

In the Zlotnick lab, structure-function studies of Hepatitis B Virus have led to development of antiviral compounds that dysregulate the viral lifecycle which has directly lead to a high visibility IU-industry partnership. A recent not-yet-published series of cryo-EM structures have shown that these compounds also distort and disrupt intact virus particles, identifying a new mechanism of antiviral action. Our ability to see molecular detail will contribute to the design of new antivirals.

The Pikaard lab uses electron microscopy to study RNA-directed DNA methylation, a process required for genome stability and gene regulation. Misregulation of DNA methylation occurs frequently in human cancers. The pathway is initiated by RNA polymerase IV, a 12-subunit enzyme that converts DNA into a strand of RNA that is then copied by a second enzyme. Preliminary studies have provided an envelope of the complex. To make a huge step forward, the Pikaard lab now needs high-resolution structures to derive function and mechanism. High resolution structures require "ideal" samples and the ability to take thousands of images. The Talos Arctica complements and dramatically expands IU's current electron microscopy infrastructure because Talos has enhanced stability, hardware, and software needed to support automated data collection on multiple samples (autoloading). This upgrade will allow rapidly screening of individual samples necessary to optimize sample conditions to achieve high resolution. Onsite automated cryo-EM will be necessary to competitively recruit outstanding structural biology faculty to this campus. Just a few key hires will make IU -Bloomington a pre-eminent center for the structural biology of supramolecular complexes.

Please submit to earprogram@indiana.edu

The Media School



IU BLOOMINGTON

EMERGING AREAS OF RESEARCH

Abstract Template -- Due June 30, 2017

Title of initiative to be proposed:

The Indiana Social Simulation Platform (ISSP)

Name of lead PI, with title, department/school:

Edward Castronova, Media School

Key team member names and departments/schools (up to 10 names):

Diane Henshel, Coady Wing, Justin Ross, Alexander Alexeev (SPEA); Bennett Berthental, Psychological and Brain Science; Sandra Kuebler (Department of Linguistics); Patricia Mabry, Xiaoran Yan (Indiana Network Science Institute); Xiaozhong Liu (SOIC)

Description of area to be proposed. What constitutes this area of research or creative activity as emerging?
(Word limit=500)

We aim to build a virtual platform for hosting human societies, much as a petri dish is used to host colonies of microscopic organisms. We will use existing game technology to build a virtual environment. Users will see themselves as players of a game much like any other. There will be puzzles, dangerous animals, quests, communication, travel, trade, crafting, and so on. But in playing this game, the users will form a simulated human society. Research has shown that the societies that emerge in virtual spaces like this emulate many relevant real-world behaviors, such as markets, reputations, and leadership. As a result, this simulated society can be used to conduct controlled experiments that are relevant to real world phenomena.

The platform, being a computer app, can be copied and replicated easily. With random assignment of users, the different copies of the world, the "shards," constitute control and experimental environments. Policy interventions can be inserted into different shards, allowing direct causal inference: "Policy X was attempted in World 3, 4, and 5, and Outcome Variable A fell in each one compared to the control environments 1 and 2." We would use EAR funding to build a small platform, then prove the concept using two research projects. Once proven, the platform would be leased to other researchers doing grant-funded work.

The first research project involves communication and malicious behavior: How and when do people switch from talking about a malicious act to doing it? And, what is the best way to respond to clues in communication streams? The second project involves economic growth: Why do countries blessed with natural resources have lower economic growth? And, what is the best way to encourage growth in these environments? (We may also team up with Fritz Breithaupt and Peter Todd to run experiments on consciousness.)

Building a large social experiment platform is now feasible. The game industry has been building worlds like this for more than a decade. Costs have fallen dramatically and know-how has spread outward. What is needed now is an adaption of this technology toward research. Not easy, but possible with the right team. Our initial team reflects the broad range of disciplines necessary for success. We have media producers, database specialists, big data analysts, modelers, linguists, biologists, psychologists, and economists.

We see a medium-term future in which the ISSP could host hundreds of thousands of users in complex social arrangements that persist for years. This social-macro level is where the thorniest human problems live. Controlled experiment at this level, which has never before been possible, could provide important new insights. The Indiana Social Simulation Platform has the potential to ignite a revolution in the study of human society.

Please submit to earprogram@indiana.edu

School of Optometry



IU BLOOMINGTON

EMERGING AREAS OF RESEARCH

Abstract Template -- Due June 30, 2017

Title of initiative to be proposed:

Concussion Research Core: Unraveling the Neuroscience of Traumatic Brain Injury

Name of lead PI, with title, department/school:

Nicholas Port, PhD, Associate Professor, School of Optometry
nport@indiana.edu 812-856-0124

Key team member names and departments/schools (up to 10 names):

Nicholas Port (School of Optometry)
Sharlene Newman, Franco Pestilli, Tom Busey, Bill Hetrick (Dept of Psychological and Brain Science/ College of Arts and Sciences)
Keisuke Kawata, Carrie Docherty (Dept of Kinesiology & Graduate Program in Athletic Training / School of Public Health)

Description of area to be proposed. What constitutes this area of research or creative activity as emerging?
(Word limit=500)

Research on mild traumatic brain injury (mTBI) / concussion has been increasing rapidly in importance and urgency as awareness grows of the widespread occurrence and potentially serious long term consequences of this injury. This has led to major research initiatives at the NIH, DOD, and other research funding sources. The goal of this proposal is to recruit three faculty members with expertise in concussion. Our focus will be on researchers working toward better diagnosis and treatment, as well as basic research into its pathophysiology and prevention. These new hires will have the option to be housed in the planned Sports Sciences Institute (SSI), the new laboratory space under construction in the south end zone edition of Memorial Stadium. In addition to athletes, high rates of concussion are seen among first responders, military personnel, and accident victims. The job advertisement will therefore be written broadly. Potential recruits could include basic and clinical neuroscientists, as well as scientists in neuroimaging, athletic training / sports medicine, speech and hearing, neuroengineering, and kinesiology. Those employing both human and animal research models will be encouraged to apply. With the support of the Emerging Areas of Research fund program (EAR) and the IU SSI, we are confident that we will be able to hire the best scientists in this emerging and exciting field, creating a world class research program for the highly visible and widely relevant study of concussion. This proposal capitalizes and builds upon IU's growing reputation in concussion research. With the support of EAR and IU SSI, we are confident that we will be able to hire the best scientists in the emerging and exciting field, creating a world class research program for the highly visible and widely relevant study of concussion.

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**Office of the
Vice
President for
Information
Technology**



IU BLOOMINGTON

EMERGING AREAS OF RESEARCH

Abstract Template -- Due June 30, 2017

Title of initiative to be proposed:

Enhancing Digital Supply Chain Assurance

Name of lead PI, with title, department/school:

Von Welch, Director, Center for Applied Cybersecurity Research, Pervasive Technology Institute, OVPIT
vwelch@iu.edu, 812-856-0363

Key team member names and departments/schools (up to 10 names):

Prof. Mark D. Janis, Robert A. Lucas Chair and Director of the Center for Intellectual Property, Research, Maurer School of Law; Prof. Michael Mattioli, Associate Professor, Maurer School of Law; Prof. Steve Myers, Associate Professor and Director of Secure Computing Programs, School of Informatics and Computing; Prof. Scott Shackelford, Chair, IUBloomington, Cybersecurity Program, Director, Ostrom Workshop Program on Cybersecurity and Internet Governance, Associate Professor, Kelley School of Business

Description of area to be proposed. What constitutes this area of research or creative activity as emerging?
(Word limit=500)

The Internet and the IT infrastructure of every organization originates from supply chains that include a variety of sources: commercial, open source, domestic, and foreign. Even large agencies such as the U.S. Department of Defense no longer build their own IT infrastructure and instead rely on complex supply chains. Since IT systems control everything from phones to factories, ensuring these systems are secure is of vital importance to the global economy. Yet this is a daunting proposition given varying sources of insecurity, from malicious — a 2012 Microsoft report found malware being installed in PCs at factories in China — to conflicting commercial incentives, such as Lenovo's installation of advertising software that weaken security in 2015. Our overarching research question is how to enhance cybersecurity in the context of modern supply chains, a key challenge to both public and private sectors with a grand scope impacting a variety of IT systems, voting systems, vehicles, medical devices, and other "Internet of Things" applications. We will focus on a particular use case, with a particular medical device the leading contender. Research will address the development of technical countermeasures, analytics, and the crafting of appropriate incentive structures through empirical studies, technical innovation, and groundbreaking governance research. Current participants are the School of Informatics and Computing, the Kelley School of Business (including the Operations and Decision Technologies Department), the Maurer School of Law, the Center for Applied Cybersecurity Research (CACR), and the Ostrom Workshop.

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**School of
Global &
International
Studies**



IU BLOOMINGTON

EMERGING AREAS OF RESEARCH

Abstract Template -- Due June 30, 2017

Title of initiative to be proposed:

International Aid and Development: Risk, Context, and Learning

Name of lead PI, with title, department/school:

Dr. Nick Cullather, Executive Associate Dean, SGIS, Professor, Departments of International Studies & History;

Key team member names and departments/schools (up to 10 names):

Dr. Jessica Steinberg, Assistant Professor, Department of International Studies, SGIS; Dr Sarah Bauerle Danzman, Assistant Professor, Department of International Studies, SGIS; Dr. Stephen Macekura, Assistant Professor, Department of International Studies, SGIS; Dr. William K. Winecoff, Assistant Professor, Department of Political Science, COAS

Description of area to be proposed. What constitutes this area of research or creative activity as emerging?
(Word limit=500)

SGIS has launched a program to support research and teaching in the area of international development, aid, and foreign investment. Building on this initiative, we propose an ambitious, multi-disciplinary program to position IU at the forefront of development research and practice by reshaping the ways in which international development projects are designed, implemented, measured, and assessed.

Owing to the limited success of aid transfers to national governments, the development community increasingly recognizes the importance of small-scale, context-specific projects. However, most of our analytic tools for predicting and assessing the effectiveness of development interventions remain at the national, rather than local level. Development assistance organizations have struggled to learn from past interventions that foundered either by failing to account for multi-dimensional risk, or adjusting too slowly to changing circumstances.

Our project bridges this gap with three inter-related research endeavors. First, we will create a Local Correlates of Aid Effectiveness (LOCAE) metric. This metric will provide the first set of multi-dimensional, comparable, and subnational measures of the local factors that shape effectiveness of development projects. Second, we will develop a new conceptual framework to evaluate aid effectiveness that spotlights the importance of projects' adaptive capacity. We will focus on a specific sector of aid project implementation to calibrate our LOCAE metric and provide an assessment of the barriers to flexible and responsive implementation of development assistance. Finally, we will analyze how and when assistance agencies and organizations learn by assimilating their own historical experiences into practice. By interrogating in particular how aid agencies have relied upon various metrics in the past, we will investigate the possibilities and limitations of relying on quantitative indicators as effective tools for narrating the success or failure of aid interventions.

Our research program will make IU a leader in multi-disciplinary, contextual, and historical research related to international development. The LOCAE measure has the potential to be widely used among academic and practitioner communities, making IU the fulcrum for development policy discussion and innovation. IU can build upon existing strengths in qualitative historical research and area studies with a series of strategic hires in experimental developmental economics, networks and complexity science, and field research in international development program implementation. The resulting research team will further enable IU faculty to be at the forefront of worldwide debates on the challenges of poverty reduction, inequality, and sustainability.

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IU BLOOMINGTON

EMERGING AREAS OF RESEARCH

Abstract Template -- Due June 30, 2017

Title of initiative to be proposed:

New Media and Global Africa

Name of lead PI, with title, department/school:

John H. Hanson, Director, African Studies Program, School of Global and International Studies, and Associate Professor, History, College of Arts and Sciences

Key team member names and departments/schools (up to 10 names):

Akin Adesokan, Media School and Comparative Literature; Vincent Bouchard, French & Italian; Beth Buggenhagen, Anthropology; Jane Goodman, Anthropology; Marissa Moorman, Media School and History; Michelle Moyd, History; Daniel Reed, Folklore & Ethnomusicology

Description of area to be proposed. What constitutes this area of research or creative activity as emerging?
(Word limit=500)

New Media and Global Africa is a research initiative that analyzes how new media transforms African cultural expressions and how these expressions shape the contemporary world. New media includes recent advances in digital formats but also earlier technologies associated with cinema, music, photography, and radio. The focus is global because African artists, on the continent and beyond, engage the world, shape political debates and economic affairs, and influence religious and social movements. It is an emerging area because new media productions by Africans are a growing influence on and off the continent. This project is collaborative and cross-disciplinary, moving beyond standard formulations of "traditional" and "modern" and area studies paradigms to analyze global expressions of exchange, elaboration, and innovation in a new conceptualization of African artistic expressions. We will achieve this goal of reshaping African Studies in the direction of the global by producing new scholarly publications, writing grants to secure external funding, documenting African cultural expressions digitally and archiving on an IU website, and hiring strategically in key disciplines that will further this new research agenda. The project taps IU's extensive and unique Africana resources in the Archives of Traditional Music, the Black Film Center/Archive, the Eskenazi Museum of Art, the Lilly Library, the Mathers Museum, the Wells Library, and other repositories. It builds on a series of workshops organized by members of the team, including an international symposium at the IU Berlin Global Gateway in June 2017. Our project will extend the internationally-recognized research of current faculty and add new members to propel IU, already a leader in African Studies and in research on new media and global Africa, to the top ranks internationally.

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IU BLOOMINGTON

EMERGING AREAS OF RESEARCH

Abstract Template -- Due June 30, 2017

Title of initiative to be proposed:

The Center for the Social History of Central Eurasia (CSHCE)

Name of lead PI, with title, department/school:

Edward J. Lazzerini
Director, Sinor Research Institute for Inner Asian Studies, School for Global & International Studies

Key team member names and departments/schools (up to 10 names):

Kate Graber, Dept. of Anthropology; Dov-Ber Kerler, Jewish Studies; Tatiana Saburova, Dept. of History; Jeffrey Holdeman, Slavics; Weihua An, Sociology (Network Analysis); Damir Cavar, Linguistics (Natural Language Processing); Arthur Alderson, Sociology (Comparative & Historical); Funda Ergun, Informatics (Algorithms for Big Data); Tassie Gniady, Informatics (Digital Mapping); Beth Plale, Informatics (Data Mining & Science)

Description of area to be proposed. What constitutes this area of research or creative activity as emerging?
(Word limit=500)

The Sinor Research Institute for Inner Asian Studies seeks EAR funding to create and manage a Center for the Social History of Central Eurasia. By bringing together the resources of IU and select partners elsewhere in the US and abroad, the Center will serve as a unique hub coordinating long-term collaborative research projects that apply innovative methodologies and tools to rewrite the social history of the region between the sixteenth and twenty-first centuries.

The first endeavor that the CSHCE will support is a big-data project—"The Central Eurasian Muslim Population Project (CEMPP)"—under the direction of Edward J. Lazzerini and currently funded by an IU FRSP External Resubmission grant and an NEH Digital Start-Up grant. In AY 2017-2018, we plan to seek additional funding from NEH through its Digital Humanities Advancement program as well as support from the National Archives of the Republics of Tatarstan and of Bashkortostan, both in the Russian Federation. If our proposal to the EAR program is successful, we will leverage its support to seek a future multi-million dollar grant from NSF.

To appreciate the purposes of the CSHCE, the place to begin is with CEMPP, which serves as the first phase in the creation of a massive database of longitudinal vital statistics and social information gathered from the so-called metrical books (parish registers) compiled, in the first instance, for Muslim subjects of the Russian Empire between 1828 and 1918. More generally, the metrical books represent an empire-wide effort to gather similar information on all imperial subjects down to the personal level based upon confession—e.g., Muslims, Buddhists, Rabbinical & Karaite Jews, Georgian Orthodox, Old Believers and other Sectarians, and Animists, etc. Within the context of the CSHCE, we will create a unique set of non-aggregated data on persons, families, and household covering, for the first time, the bulk of the Russian Empire's population when it was in the throes of dramatic change, unexpected domestic and international stress, and a rising tide of disorder and revolution that brought it to a downfall in 1917. By gathering tens of millions of discrete records on historical populations in the central portion of the vast Eurasian continent, we will be able to fill a huge gap with data never before examined and without which historical demographers and social historians working on the western or eastern ends of Eurasia are prevented from engaging in large-scale comparative study.

By means of this and other projects, the Center will produce broadly usable datasets that will be stored, preserved, and served globally. It will generate publishable products from local, regional, and state data, as well as others rich in comparative results. The historical demography and social history of the Eurasian continent as a whole will be revealed as never before. Likewise, the Central Eurasian zone, that witnessed perennial migrations of peoples as well as the near constant interplay between nomadic and surrounding imperial centers will, for once, receive significant attention in dramatic ways.

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IU BLOOMINGTON

EMERGING AREAS OF RESEARCH

Abstract Template -- Due June 30, 2017

Title of initiative to be proposed:

The Crisis of Religious Authority in Islam

Name of lead PI, with title, department/school:

Ron Sela, Director, Islamic Studies Program; Associate Professor, Central Eurasian & International Studies; School of Global & International Studies

Key team member names and departments/schools (up to 10 names):

Asma Afsaruddin, Near Eastern Languages & Cultures, SGIS; Asaad Alsaleh, NELC, SGIS; Beth Buggenhagen, Anthropology, COLL; Hussein Banai, International Studies, SGIS; Devin DeWeese, Central Eurasian Studies, SGIS; Seema Golestaneh, CEUS, SGIS; John Hanson, History/African Studies, COLL/SGIS; Nur Amali Ibrahim, International Studies/Religious Studies, SGIS/COLL; Nazif Shahrani, Anthropology/NELC/CEUS, COLL/SGIS; Winnifred Sullivan, Religious Studies, COLL; Timothy Waters, LAW



Description of area to be proposed. What constitutes this area of research or creative activity as emerging? (Word limit=500)

The crisis of religious authority in Islam, manifested in the fragmentation, plurality and exclusivity of religious authority, has been among the most fiercely contested phenomena among Muslims in both Muslim-minority and – majority societies. Despite its significant implications for Muslims and non-Muslims alike, implications that range from the ability to perform mundane religious activities to embracing radicalized positions or even religious terrorism, this subject also has been among the least studied in the West. Recognizing and decoding this complex topic has proven particularly confusing for outside observers and policy makers who are often assigned to identify concrete leaders or leaderships and distinct sources of inspiration for particular types of religious or religion-sanctioned behavior. But in recent decades, it seems, such observers (academics and professionals) typically come up short. Perceptions of a crisis of religious authority in Islam have been exacerbated by intensifying (and often unsuccessful) efforts by anxious religious functionaries, judges and other 'ulamā' – widely regarded as the guardians, transmitters and interpreters of religious knowledge, doctrine and law – to regulate Islam in a religious climate that many 'ulamā' characterize in terms of *fawḍā*, that is, chaos or anarchy. It appears that there is a wide agreement about the existence of a "crisis," but the roots of the crisis, or suggested avenues for its analysis, are typically attributed to alleged challenges that Muslims face in coping with modernity in a post-colonial world, or to a more general identity crisis in a global age. This identity crisis, it is claimed, has also led to confusion, self-doubt, and breakdown of the sense of community, the weakening of states and nations, radicalization, and to anti-establishment sentiments.

In this initiative, we propose to create an original, pragmatic and multi-lingual framework for analyzing the causes, spectra, and consequences of the (seemingly) increasingly diverse, decentralized and disjointed practices of Islamic religious authority, both regionally and comparatively. With our interdisciplinary team, we introduce a novel, wide-ranging and multi-lingual research agenda that historicizes debates about religious authority in Islam and moves away from misleading periodization; distinguishes the reality of decentralized and multivalent authority from the appearance of fragmentation that globalization and modernity amplify; critically examines the popular view among scholars and policy makers that takes as given state monopoly over the definition and exercise of religious authority and that also understands the plurality of religious authority to be an expression of opposition to the state and its servants; and also examines the diffusion of authority vis-à-vis themes of governance, polycentrism, transnational movements, and the emergence of increasingly networked peoples and societies. By engaging policy-related issues, we also aim to challenge a misleading and damaging national discourse about Islam. In this initiative we pay close attention to regions of the world that are not as widely studied through an Islamic studies lens and we plan to translate all the work we produce into multiple "Islamic" languages and disseminate it throughout our regions of inquiry.

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School of
Art +
Design



IU BLOOMINGTON

EMERGING AREAS OF RESEARCH

Abstract Template -- Due June 30, 2017

Title of initiative to be proposed:

1 + 1 = 3: Integrated Design and it's Power to Connect and Expand the Impact of Individual Disciplines

Name of lead PI, with title, department/school:

Peg Faimon, Founding Dean and Professor, School of Art + Design

Key team member names and departments/schools (up to 10 names):

Erik Stolterman, Senior Executive Associate Dean and Professor, School of Informatics and Computing; Eli Bleviss, Professor, School of Informatics and Computing; Elizabeth Boling, Interim Executive Associate Dean, School of Education; Kate Rowold, Fashion Design, Professor and Associate Dean, School of Art + Design; Jon Racek, Senior Lecturer, Interior Design, School of Art + Design; Minjeong Kim, Associate Professor, Merchandising, School of Art + Design; We plan to add others in the future.

Description of area to be proposed. What constitutes this area of research or creative activity as emerging?
(Word limit=500)

Humans have always been involved in designing their world. Over the last decade, the idea of design as a distinct process of inquiry and implementation has become a rich and influential approach to innovation and change management in both industry and academia (often under the name of design thinking or human centered design). Design is now at the center of organizational decision-making and strategic thinking about everything from how people learn and work to how we can optimize and best engage with our living environments.

Design as an approach offers a distinct alternative to the various traditional "discipline specific" approaches dominating academia, such as scientific, engineering or artistic approaches. As an alternative, the design approach seeks to be overarching and transdisciplinary, leading to creative outcomes in a rapidly changing environment while responding to people's needs and desires. Today there is a growing understanding that "design" can be and is applied in many academic disciplines and fields. In addition, many of the challenges and opportunities of the modern world cannot be solved by any one discipline and require collaboration and multiple perspectives. Design allows for a common process/approach for these disciplines to come together.

But, what is "designing", how can it be understood, explained and what is it good for? How are the different variations of the design process from discipline to discipline related to one another and how are they different? What is the common core language/process? There is today a rapidly growing academic field of design studies, design theory and philosophy of design that we wish to build upon with a stronger, more transdisciplinary approach.

Today, the study of design as an approach to innovation is widely studied, however, there are few attempts on a large scale including an entire campus with ALL relevant disciplines coming together to research this approach and its consequences. Indiana University Bloomington is unusually well situated to engage with this challenge and cultivate "integrated design". Few other organizations have the core strength in design represented in almost every School and the College.

Our vision is to establish IUB, already known for many independent design initiatives (i.e. IU Center for Art + Design, the new School of Art + Design, Human Centered Interaction Design in Informatics, design focused courses in almost every School, past work with the Design Thinking Forum), as a connected and interdependent NETWORK of exceptional and distinctive design activity that makes significant and lasting contributions to our global society.

To achieve this, the proposed research would focus on examining and developing a unified understanding of design in its different forms and its pragmatic consequences in an academic environment and in the extension how it can support the campus educational and research mission.

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IU BLOOMINGTON

EMERGING AREAS OF RESEARCH

Abstract Template -- Due June 30, 2017

Title of initiative to be proposed:

Understanding Creativity: Drawing and the Brain

Name of lead PI, with title, department/school:

PI: T. Kelly Wilson, Associate Professor/Director of IUCA+D, SOAD (School of Art and Design)
wilsontk@indiana.edu/(812) 375-7588

Key team member names and departments/schools (up to 10 names):

Co-PI: Sharlene Newman, Associate Professor/Director of Imaging Research Facility, Department of Psychological & Brain Sciences; Team Members: Robert Goldstone, Chancellor's Professor of Psychological and Brain Sciences, Department of Psychological & Brain Sciences; Karin James, Associate Professor, Department of Psychological & Brain Sciences; Marleen Newman, Sr. Lecturer, Associate Director of IUCA+D, SOAD (School of Art and Design); Caleb Weintraub, Associate Professor of Painting, SOAD (School of Art and Design)

Description of area to be proposed. What constitutes this area of research or creative activity as emerging?
(Word limit=500)

Creativity is a highly sought-after attribute, yet it is hard to define or teach. Recent breakthroughs in brain science may throw light on this elusive quality. This proposal seeks to address this issue by leveraging IUB's significant strengths in Cognitive and Brain Science and Art and Design, thus leading the university to become an innovator in both the science and the pedagogy of creativity.

As an emerging area of research, the study of creativity in its simultaneous relationship to drawing and to developments in understanding brain function is generating surprising results. In 2015, the d. School at Stanford (Hasso Plattner Institute of Design) completed a study of drawing and creativity, showing that the cerebellum, usually thought to be limited to coordinating muscular function, and not the cerebrum, generally associated with high level thinking, is responsible for creative activity. Activation of the "... brain's executive-control centers — the parts of the brain that enable you to plan, organize and manage your activities — is negatively associated with creative task performance," says Allan Reiss, Howard C. Robbins Professorship in Psychiatry and the Behavioral Sciences. His team found that "the more you think about it (being creative) the more you mess it up." The study's findings represent advancement because it established baseline information on creativity's underlying neuro-physiological processes.

Similarly, a recent study in the American Society for Cell Biology's Life Sciences Education journal argues that learning to draw promotes model-based reasoning among science students. IUB is ideally situated to build on the current research linking drawing with basic learning and conceptualization. With the establishment of a new School of Art and Design and a new and innovative professional graduate program in architecture, IUB is emerging as a force in the area of art, design, and architecture. Linked with IUB's established reputation in Cognitive and Brain Sciences, this creates a perfect synergistic environment for ground breaking studies in creativity and the brain.

An example of the possibilities at IU may be found in the recent and highly successful conference "Drawing and the Brain" held in the spring of 2016 at the IUCA+D (Indiana University Center for Art and Design). The conference attracted a national and international field of scientists, engineers and designers. It sparked a powerful dialogue about the linkages between creativity, drawing and the brain, further establishing IUB as a potential leader in the field.

Studies:

- Randomization of curriculum/comparison of results from classes with and without drawing.
- Use brain imaging to determine neural activities related to intelligence and creativity.
- Can information about brain function and structure increase successes in learning to be creative?

Outcomes:

- Understand creativity and learning with respect to drawing.
- Understand what the brain is doing while the hand is moving.
- Understand the value of creativity and drawing in the curriculum.
- Understand drawing as a function of learning and of creative thinking.
- What curricular changes should be instituted to keep IUB current with recent developments in the understanding of creativity with respect to learning to draw?

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**School of
Informatics
and
Computing**



IU BLOOMINGTON

EMERGING AREAS OF RESEARCH

Abstract Template -- Due June 30, 2017

Title of initiative to be proposed:

Educational Data Science: Precision Learning, Teaching, and Leadership

Name of lead PI, with title, department/school:

Katy Borner, Victor H. Yngve Distinguished Professor of Information Science, Departments of Intelligent Systems Engineering & Information and Library Science, School of Informatics and Computing, Indiana University

Key team member names and departments/schools (up to 10 names):

• Raymond Burke, E.W. Kelley Prof of Marketing, Kelley School of Business • Robert L. Goldstone, Chancellor's Prof, Psychological and Brain Sciences, COAS • Dennis Groth, Vice Provost for Undergraduate Education, IUB • Daniel Hickey, Prof., Learning Sciences Program, School of Education • Michael Kaganovich, Prof of Economics, Department of Economics, COAS • George Rehrey, Director, Indiana University's Center for Learning Analytics and Success • Jennifer M. Robinson, Prof of Practice, Department of Anthropology, COAS • Linda Shepard,

Description of area to be proposed. What constitutes this area of research or creative activity as emerging? (Word limit=500)

This project pioneers a new interdisciplinary field of study, Educational Data Science (EDS). EDS performs research using big data, data modeling, and visual analytics to advance our understanding of the complex, high-stakes environment of higher education. Such scholarship is timely for addressing the dramatic social, financial, and technological challenges confronting the higher education system. The proposed research will position IU as a leader in research of scientific, technological, social, behavioral and ethical aspects of higher education and its practical application to the benefit of students in and after college. Resulting models will support data-driven decision making by students, teachers, and leadership with the overall goal of improved student engagement and performance.

Our ambitious research agenda is made possible by recent advances in educational information systems, data collection, experimental methods, analysis, modeling, and visualization techniques that provide researchers with new tools for studying the student's educational journey and identifying the factors that drive student learning and success in school and in life. IU is well positioned to lead this new research area by capitalizing on existing research strengths, multidisciplinary faculty collaborations, corporate collaborations, superb learning analytic data collections, and new commitments by IU administrative offices, e.g., Office of the Vice Provost for Undergraduate Education (OVPU), Bloomington Assessment & Research (BAR), and Center for Learning Analytics and Success (CLASS).

Specifically, the EDS team will design and build a secure, unique federated data infrastructure of precision data that captures student engagement and performance before, during, and after IU; inside and outside of the classroom. Custom code and tools will be developed to validate and optimize models; analyze data returns; study the utility of different data sources; and understand the impact of policies and interventions. Using this unique infrastructure, we will perform research at the intersection of cognitive science, learning science, data science, economics, and management. While novel research results are anticipated in each of the four research areas, key breakthroughs are expected at the intersection of these areas. "Cognitive Science: Classroom Experiments" research will investigate the cognitive and social variables, patterns, and leverage points in teaching and learning. "Learning Science: Student Support" will investigate the impact of curricular interventions on student success at IU and in life. The "Economics and Management of Higher Education" line of work will investigate the impact of incentives, information sources, and educational product offerings on short-term and long-term student decision making and outcomes. The research will focus on identifying combinations of courses, activities, and individual student characteristics affecting the range of career options available to diverse populations of undergraduates. Research on "Data Science: Learning Analytics" will advance and validate novel methods and tools that render large-scale data into actionable insights and improve the data (visualization) literacy of tool users.

A collaboratory will ensure timely dissemination of results and support close collaboration between faculty, students, staff, and industry partners. Last but not least, EDS will develop academic and corporate partnerships that expand the impact of the proposed R&D.

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IU BLOOMINGTON

EMERGING AREAS OF RESEARCH

Abstract Template -- Due June 30, 2017

Title of initiative to be proposed:

Probabilistic Approaches to Computational Problems

Name of lead PI, with title, department/school:

Funda Ergun, Professor, Department of Computer Science/School of Informatics and Computing
(fergun@indiana.edu)

Key team member names and departments/schools (up to 10 names):

Michael Trosset - Department of Statistics, College of Arts and Sciences; Qin Zhang - Department of Computer Science, School of Informatics and Computing; Yuan Zhou - Department of Computer Science, School of Informatics and Computing; Russell Lyons - Department of Mathematics, College of Arts and Sciences; David Fisher - Department of Mathematics, College of Arts and Sciences; Michael Larsen - Department of Mathematics, College of Arts and Sciences; Ciprian Demeter - Department of Mathematics, College of Arts and Sciences

Description of area to be proposed. What constitutes this area of research or creative activity as emerging?
(Word limit=500)

With the ever-increasing ability to collect and store massive amounts of complex data comes the need for efficient algorithms to process and analyze that data. The data can be whole genomes of many species, streaming sound or video or text data, multidimensional data with missing values, etc. The desired object may be a network rather than a simple numerical summary. Using probability cleverly often improves the computation in addition to measuring the chances an approximate algorithm gives the correct answer. This proposal builds a connection between existing areas of expertise on campus in order to improve probabilistic approaches to computational problems. The collaboration will lead to increased opportunities for external funding and for patentable algorithms and will position Indiana University to become a world leader in this interdisciplinary area. The research questions to be investigated initially include the development of probabilistic methods for communication-efficient algorithms for distributed optimization across a network of computers, for metric embeddings and manifold learning (reducing a problem in a complicated space to a problem in a simpler space in order to facilitate its solution or visualization), and for generating random graphs that more accurately model real-world networks for use in computational algorithms.

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EMERGING AREAS OF RESEARCH

Abstract Template -- Due June 30, 2017

Title of initiative to be proposed:

From science fiction to science fact: informatics-driven cell reprogramming to create multicellular biodevices

Name of lead PI, with title, department/school:

Paul Macklin, Associate Professor, Intelligent Systems Engineering/SOIC

Key team member names and departments/schools (up to 10 names):

1. James Glazier (Intelligent Systems Engineering/SOIC),
2. Katy Borner (ISE/SOIC)
3. Geoffrey Fox (ISE/SOIC)
4. Luis Rocha (Computer Science/SOIC, CNetS)
5. James Sluka (ISE/SOIC)

Description of area to be proposed. What constitutes this area of research or creative activity as emerging?
(Word limit=500)

In the past decade, we have seen advances in manipulating cells at a molecular level that were previously in the realm of science fiction. New technologies such as CRISPR/Cas9, antibody-nanoparticle systems, and synthetic genes are emerging to change cell behaviors—to reprogram them—at a molecular level. In this emerging area of research, scientists are increasingly focusing on what to do with these new tools, and whether reprogrammed cells can solve problems in health, the environment, and society. Can cancer cells be reprogrammed to be less aggressive? Can we program stem cells to grow micro-organs that digest new toxins? Can we engineer bacterial colonies to fight pollution? Can we build multicellular biorobots that shuttle molecular cargo or repair damaged tissues?

Unfortunately, work to date has focused on developing individual technologies for single-cell manipulation, and not on overarching design principles for creating multicellular biodevices such as artificial tissues, complex microbial systems, or biorobots. There is a lack of knowledge on how to robustly reprogram single-cell behavior with molecular manipulations. There is a lack of insight on how systems of many reprogrammed cells (often of different types) interact to form small tissues, functional microbial communities, or simple organisms. And we lack design tools to choose multicellular functional design goals—and work backwards to single-cell programs to reach these design goals. Until we solve these problems, multicellular biodevices will remain science fiction.

IU is uniquely positioned to help resolve these outstanding needs and perform cutting-edge work at the forefront of this emerging area of research. Our faculty have leading expertise in bioinformatics and data mining (Wild), multicellular simulations (Macklin, Glazier, Sluka), high-performance and distributed computing (Fox), complex systems, machine learning, and bio-inspired computing (Rocha), single-cell microfluidic and mechano-acoustic manipulation (Guo), microbial environmental engineering (Picardal), visualization (Borner), and collaborative science (Borner, Fox). We have strong experimental collaborations at IU and other leading institutions. This EAR proposal would leverage our strengths to nucleate a new Center for Multicellular Design: a cross-cutting program to create and validate robust computational tools to reprogram cells, assemble them into multicellular biodevices, test their functions, and iteratively improve our cell programming choices to create useful and safe multicellular biodevices.

The team will develop:

- (1) bioinformatics tools to quantitatively map molecular-level reprogramming to cell behavior; [Wild, Hire1]
- (2) computational tools to virtually assemble and simulate multicellular biodevices in complex environments; [Macklin, Glazier, Sluka]
- (3) a language to quantify multicellular device form and function; [Macklin, Glazier, Sluka]
- (4) supercomputing techniques to test competing design choices; [Fox]
- (5) multicellular biodevices to validate the designs; [Guo, Hire2], and
- (6) a collaborative framework to work with domain experts across IU and beyond [Fox, Borner, Macklin].

With our collaborators in biological science and environmental microbiology (Picardal), we will test the tools on targeted problems in tumor-stromal dynamics, synthetic micro-livers that filter xenobiotics, and aquifer remediation. We anticipate new collaborations with COAS, SPEA, SPH, and SOIC to investigate the ethics and socioeconomic impact of engineered multicellular biodevices, and to control the security of multicellular biodevices.

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IU BLOOMINGTON

EMERGING AREAS OF RESEARCH

Abstract Template -- Due June 30, 2017

Title of initiative to be proposed:

Music Tutoring Systems

Name of lead PI, with title, department/school:

Prof. Christopher Raphael, School of Informatics and Computing

Key team member names and departments/schools (up to 10 names):

Prof. Gretchen Horlacher, Jacobs School of Music; Assoc. Prof. David Crandall, School of Informatics and Computing; Assoc. Prof. David Cartledge, Jacobs School of Music; Assoc. Prof. Pete Miksza, Jacobs School of Music; Asst. Prof. Minje Kim, School of Informatics and Computing

Description of area to be proposed. What constitutes this area of research or creative activity as emerging?
(Word limit=500)

Online technology has brought education to the masses in an unprecedented way, with services like Coursera and Udacity reaching hundreds of thousands of people. These services give people in even the most remote areas access to the world's great universities and professors, and dramatically extend the reach of educational institutions across the globe. Unfortunately, while current online education technologies work well for subjects like computer science, it is not obvious how to effectively teach skills like music and art where even beginning instruction requires regular and immediate interaction with a human expert. As a consequence, rural and other disadvantaged populations cannot receive instruction proven to increase learning, persistence, creativity, and quality of life. Additionally, education institutions with premiere expertise in arts and humanities (notably Indiana University) cannot extend their outreach via online technologies. We need to develop advanced new technology that can monitor a student's progress in learning a skill in real time, using minimal equipment (e.g. a simple laptop or smartphone) to do the observation, and automatically give feedback without constant manual effort of a human instructor. The proposed project would take a first but important step in this direction, developing the technology required to automatically monitor a student's progress in learning to play a musical instrument. It leverages IU's unique combination of interdisciplinary strengths in Music and Computer Science to develop ambitious new technology that could transform music instruction, dramatically extending the potential impact of the Jacobs School to millions of people online.

Our specific focus is a Music Tutoring System -- a program designed to teach a musical instrument. The challenge involves marrying the two disparate realms of recognition and music pedagogy. To succeed we must first sense the student's playing, detecting when the pitches, intonation, rhythm, fingerings, etc. are correct (we will limit our domain to scenarios where "correctness" is meaningful). Our approach will fuse both audio and video data since instrumental teaching usually involves aspects that must be heard, such as dynamics, and those that must be seen, such as the choice of fingering. Here we

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EMERGING AREAS OF RESEARCH

Abstract Template -- Due June 30, 2017

Title of initiative to be proposed:

The Nest: An Incubator for Co-Design of Technology, Spaces, and Media for Aging in the Community

Name of lead PI, with title, department/school:

Selma Sabanovic, Associate Professor, Department of Informatics, School of Informatics and Computing

Key team member names and departments/schools (up to 10 names):

Kay Connelly (School of Informatics and Computing); Jennifer Piatt (School of Public Health); Lesa Huber (School of Public Health); Jiangmei Wu (School of Art and Design); Jonathan Racek (School of Art and Design); Phillip Stafford (Department of Anthropology, Center on Aging and Community)

Description of area to be proposed. What constitutes this area of research or creative activity as emerging?
(Word limit=500)

This proposal seeks to establish an interdisciplinary, campus-community research network and incubator – The NEST -- that will demonstrate the individual and socio-economic benefits of co-design with older adults of new spaces, technologies, and media to address the social, cognitive, and physical challenges of aging. By 2050, one fifth of the world's population will be over 60 years of age. 38% of households in counties adjacent to Monroe already have one or more persons over age 60. These population shifts produce both challenges and opportunities; our initiative employs co-design to address the former and take advantage of the latter in collaboration with local communities.

Co-design is a participatory form of design practice equalizing the roles of expert designers and end-users as co-creators of environments, technologies, and media. It is increasingly recognized as necessary for the rapid and societally beneficial implementation of new digital and physical artifacts and spaces, particularly for marginalized populations such as older adults. It privileges local knowledge in a way that can re-define the university/community relationship with rural Indiana communities dominated by a global system, and aligns with the rapidly growing social economy by redefining humans as producers rather than users, consumers, and spectators (Ostrom, Manzini 2013). As a model for collaboration and participation, co-design mirrors major transformations occurring in other social domains, which are moving from centralized to distributed systems to create sustainable solutions, and takes into account the need to “design for change and transition within complex systems” (Irwin et al: 2015).

Projects undertaken through the NEST incubator will reflect diverse local needs and research and design priorities at IUB, focusing on three areas of co-design research: (1) The development of a robust and self-sustaining university-community network for soliciting participation in and supporting co-design activities; (2) The identification and evaluation of appropriate co-design methods to enable inclusion of diverse stakeholders affected by aging; and (3) The ideation, development, and testing of co-designed technologies and digital and physical spaces among NEST participants and the broader Indiana community.

The NEST will draw upon the social research, design, architecture, and engineering capabilities of the School of Informatics, the School of Public Health, the School of Art and Design, and the Indiana Institute on Disability and Community to create a vibrant, creative space in which users, researchers and developers can innovate, test, and launch new products, services, and environments to the growing aging population while developing productive relationships among designers, developers, and users. Users in the NEST will include younger, older, healthy, and frail older adults, their caregivers, and community members invested in age and dementia-friendly communities. This co-design initiative will provide a significant opportunity for IUB to re-define its relationship with surrounding communities, and will serve as a hub, spawning an active program of outreach and participatory research and development within south central Indiana. It would also be one of only a few co-design projects in the US, as well as among the first in the nation to emphasize the needs and design capabilities of older adults.

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EMERGING AREAS OF RESEARCH

Abstract Template -- Due June 30, 2017

Title of initiative to be proposed:

Towards Collective Intelligence from IoT Edge Devices to Cloud Data Centers

Name of lead PI, with title, department/school:

Martin Swamy, Professor, Dept. of Intelligent Systems Engineering, School of Informatics and Computing

Key team member names and departments/schools (up to 10 names):

Judy Qiu (Associate Professor, ISE, SoIC), Minje Kim (Assistant Professor, ISE SoIC), Lei Jiang (Assistant Professor, ISE SoIC), Alexander Gummenik (Assistant Professor, ISE SoIC), Feng Guo (Assistant Professor, ISE SoIC), Lantao Liu (Assistant Professor, ISE SoIC), Greg Lewis (Assistant Professor, ISE SoIC)

Description of area to be proposed. What constitutes this area of research or creative activity as emerging?
(Word limit=500)

Integration of Artificial Intelligence (AI), Internet-of-Things (IoT) and Cloud Computing (CC) is a promising emerging area that will profoundly change the approach to science and society with an impact on applications such as surveillance systems, autonomous driving and intelligent transportation, precision health and environments, etc. It turns big data into actions through an integrated system with new capabilities, richer experiences, and unprecedented economic opportunities. However, the diversity of the computing resources and the different application-specific needs across the networked devices raise challenges. For example, a state-of-the-art AI model (e.g. a deep neural network) often resides in the cloud, since CC supplies the required high-level intelligence by enabling access to a centralized pool of powerful computing resources and big data. However, the unpredictable network latency, expensive bandwidth, and privacy concerns hinder CC from meeting the stringent requirements of real-time applications. Therefore, sometimes the IoT edge devices could be better off running the intelligent tasks, while complex AI models are not affordable due to the limited resources. To this end, the initiative tackles the heterogeneity of the networked computing units and the way the AI applications are decomposed across them.

An Example Scenario:

A distributed ecosystem adaptively controls a variety of intelligent tasks by pushing some of them towards the IoT edge devices. On the edge side, various wearable sensors of varying levels of fidelity run a lightweight AI task to detect an event of interest in real time (e.g. an irregular heartbeat). This lower-end device fires up the communication channel only if an event is detected, reducing communication costs. Then, a mid-level AI engine, implemented in a larger device with more resources available (often called the fog), conducts an advanced activity such as predicting the context (e.g. the user is working out). Eventually, the comprehensive AI in the cloud analyzes big data collected from many users and makes a final decision (e.g. calling 911). Likewise, this initiative is to balance the load of the AI tasks across the wearables, coordinated robots, biomedical/environmental sensors and data centers, so that the whole infrastructure works as a collective intelligence.

The Team:

We see this emerging area of research in a holistic way. First, we fabricate smart sensors for various applications. Then, we invent extremely efficient computing architectures as a low-power brain of the IoT edge devices and robots. Our research on edge computing systematically balances the job loads in-between the edge and the cloud. The CC part innovates the parallelization technologies tailored for training and running the massive AI models. The glue of the project is our expertise in machine learning theories, specialized with the hardware-friendly binarized arithmetic. With the efficient machine learning techniques, we can add an additional flexibility to those AI engines so that they can be freely deployed not only in the cloud with its full functionality, but in the embedded systems in its resource-saving form. On top of this expertise of the team, examples above also point out the breadth of potential interest across IU.

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IU BLOOMINGTON

EMERGING AREAS OF RESEARCH

Abstract Template -- Due June 30, 2017

Title of initiative to be proposed:

Empowered Democracy in Communities: Collaborative Systems for Local Self-Governance in the 21st Century

Name of lead PI, with title, department/school:

Lisa Blomgren Amsler, Keller-Runden Professor of Public Service
Indiana University School of Public and Environmental Affairs (SPEA)

Key team member names and departments/schools (up to 10 names):

David Audretsch, Professor and Ameritech Chair, SPEA and IU Network Science Institute Affiliated Faculty; Claudia Avellaneda, Associate Professor, SPEA Local Governance Initiative Affiliated Faculty and Ostrom Workshop Affiliated Faculty; Robert Kravchuk, Professor, SPEA Local Governance Initiative; Sean Nicholson-Crotty, Professor, SPEA Local Governance Initiative Affiliated Faculty; Barry Rubin, Professor Emeritus, SPEA Local Governance Initiative Affiliated Faculty; Terry Amsler, Adjunct Lecturer, SPEA and former Director,

Description of area to be proposed. What constitutes this area of research or creative activity as emerging? (Word limit=500)

Commentators say U.S. democracy is at risk. Trust in government is at an all-time low; adversarial partisanship is high. National legal and institutional structures enabled capital to create extreme wealth -- and extreme inequality in distribution. The press is under attack and faces an unprecedented challenge building a national consensus on what facts are true. Electoral districts for both state legislatures and the U.S. House of Representatives are so badly gerrymandered that citizens are losing faith in the power of voting. Millennial surveys report low support for democracy.

The Federalist Papers' authors argued for dividing society and government into smaller and smaller parts and interests to avoid the tyranny of the majority. They believed separation of powers provided a structure to elicit voluntary collaboration in the interest of the common good; change requires broad consensus.

Scholars observe that effective governance involves all sectors, public, private, nonprofit, and civic, in agreeing on collective action. Increasingly, communities need to engage in collaboration with cross-sector stakeholders to address common goals for solving 'wicked' problems across policy arenas including public finance, sustainability, transportation, economic development, land use, poverty, social services, and health care. For example, local governments need assistance with place-based research on economic and community development, leading to better jobs and incomes.

To make collaboration work, scholars point to leadership in tackling a difficult problem; stakeholders seeing advantages in collaborating; a situation that needs to improve; a shared mission, shared goals, and trust; and bringing a positive attitude to the table. Yet, other scholars see the local democratic participation and self-organization that de Tocqueville described as now diminishing and hyper-pluralism growing. What practical steps can the academy take to support the health of our democracy?

Citizens and stakeholders need collaborative governance. This means public engagement, cross-sector collaboration, and information systems to help communities build shared knowledge for problem-identification and problem-solving. Communities need systematic access to big data for making policy decisions. Communities may lack infrastructure for collaborative governance in the form of a portal, convening organization, or lead organization in a network to bring together cross-sector organizations and convene public deliberation. Imagine a 21st Century infrastructure for democratic collaborative governance. What would it look like? How would it work?

IU has faculty who could support communities by building systems for democratic and collaborative self-governance involving citizens, residents, and stakeholders from the public, private, and nonprofit sectors.

Together, faculty can develop and pilot systems thinking and collaborative governance infrastructure for communities in Indiana, providing the basis for outside funding applications to expand to communities in other states.

The team will build connections to centers on campus, within the state, and nationally. One team member is reaching out to AIM, formerly the Indiana Association of Cities and Towns. The team has affiliations with SPEA's Local Governance Initiative, the Ostrom Workshop on Political Theory and Policy Analysis, COAS, and the Indiana University Network Science Institute. The team would seek future funding from foundations that are members of Philanthropy for Active Civic Engagement (PACE), an affinity group.

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EMERGING AREAS OF RESEARCH

Abstract Template -- Due June 30, 2017

Title of initiative to be proposed:

Manufacturing Policy Initiative

Name of lead PI, with title, department/school:

Sanya Carley, Associate Professor, School of Public & Environmental Affairs

Key team member names and departments/schools (up to 10 names):

David Audretsch, Sanya Carley, Sameeksha Desai, Denvil Duncan, John D. Graham, Bradley Heim, David Konisky, Kerry Krutilla, Justin Ross, John Rupp
School of Public and Environmental Affairs

Description of area to be proposed. What constitutes this area of research or creative activity as emerging?
(Word limit=500)

The wellbeing of the manufacturing sector is crucial to the future of the State of Indiana and the United States. In 1792 Secretary of Treasury Alexander Hamilton observed that: "Not only the wealth, but the independence and security of a country, appear to be connected to the prosperity of manufacturers." In the last ten years, both Indiana and the US have lost a substantial number of jobs in the manufacturing sector. Nonetheless, Indiana has the highest manufacturing employment share in the nation, while the US continues to rank as one of the largest manufacturing countries in the world. There is also some recent evidence of a renaissance in US manufacturing, driven by factors such as innovation, low energy prices, and a relatively favorable regulatory environment. This emerging area of research will investigate steps that federal, state and local policy makers can take to strengthen the manufacturing sector in Indiana and the United States.

SPEA launched the Manufacturing Policy Initiative (MPI) (<https://spea.indiana.edu/mpp/home.html>) in 2015 as a source of objective information for policy makers and stakeholders interested in US manufacturing. MPI is the first and only university program in the country dedicated to studying public policy issues related to the future of US manufacturing. An external advisory committee has been established to identify issues and assist in fundraising for the Initiative. Priority issues include growth in employment and earnings, workforce education and training, international trade and globalization, productivity and innovation, advanced/sustainable manufacturing, national security, tax policy, and regulatory reform. Projects under this Initiative will have significant external funding potential, as projects related to this initiative have already started to attract support from the private sector (e.g., applied studies of regulatory issues in the automotive and chemicals industries as well as dissertations on unconventional methods of oil and natural gas development). Potential sources of government support include the National Science Foundation, the Department of Commerce, the Department of Energy, and the Environmental Protection Agency. The State of Indiana has already provided seed funds to help launch the MPI.

The primary operational objectives of this initiative are to: 1) organize a multidisciplinary team of faculty, fellows, and students at IUB to focus on the study of manufacturing and public policy; 2) establish the MPI as the go-to source of national expertise and information on U.S. manufacturing policy; and 3) transform the MPI into a sustainable university Center for long-term activity as well as near-term projects.

To supplement SPEA's existing expertise on this emerging issue, this proposal calls for recruitment of three new sources of faculty expertise on the Bloomington campus: one (likely in collaboration with Economics or Kelley) on international trade policy, one (likely in collaboration with Informatics) on engineering and sustainable/advanced manufacturing, and one (likely in SPEA) on energy and environmental policy. SPEA has already hired a full-time staff director to lead the MPI and has raised significant philanthropic support to assist in the startup.

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EMERGING AREAS OF RESEARCH

Abstract Template -- Due June 30, 2017

Title of initiative to be proposed:

The Center for Advanced Chemical Safety, Toxicology, and Risk Prediction

Name of lead PI, with title, department/school:

Joseph R. Shaw, PI, Associate professor, School of Public and Environmental Affairs

Key team member names and departments/schools (up to 10 names):

Joseph Shaw, PI, School of Public and Environmental Affairs (SPEA); James E. Klaunig, co-PI, Environmental Health, School of Public Health (EH-SPH); Stephen Jacobson, Chemistry; Maria Bondesson, Intelligent Systems Engineering, School of Informatics and Computing (ISE-SOIC); John Graham, SPEA; Zemin Wang, EH-SPH.

Other potential key participants include James Glazier, ISE-SOIC.



Description of area to be proposed. What constitutes this area of research or creative activity as emerging? (Word limit=500)

Worldwide, we are increasingly exposed to chemicals through our indoor and outdoor environments, producing a "chemosphere" in which we live. Many of these chemicals are potentially harmful to human health; the WHO finds that 8.3% of all deaths are directly attributable to just 14 chemicals, with pollution estimated to kill 1.7 million children per year. This issue is particularly relevant to Indiana, which the EPA identifies as the second largest contributor of toxic chemicals per square mile of the 50 states. These health crises are only the tip of the iceberg. Attempts to regulate chemicals in our environment have been difficult (costing 3% of GDP), because we lack basic scientific information needed for industry to comply with legislation intended to ensure human health and protect the ecosystems on which we rely. Fewer than 5% of the more than 100,000 chemicals used in consumer products have been evaluated for safety, because traditional methods of safety testing are slow (>5 years/compound) and costly (>\$5 million/compound).

Indiana University is ideally poised to lead in providing a solution to these problems, which requires emerging research that breaks from outdated, reactive methods, and is guided by a comprehensive and scalable project. By pooling the brainpower and capacity of our experts and facilities, and applying state-of-the-art methods and technology in analytical chemistry, toxicology, quantitative genetic, public health, environmental sciences, and predictive analytics we can dramatically decrease the time and cost of evaluating chemical risks.

We propose such a project that builds on important discoveries and technical advances of the past decade, particularly the: (1) ability to rapidly identify genes, metabolites and bio-molecular interactions that are altered by chemical challenges, (2) availability of genomes for many animals, (3) improved analytical methods that allow for detection of chemicals in exceedingly small quantities, (4) exponential increases in computational power to identify predictive patterns in massive data sets, and (5) many studies underscoring the similarity across animals of biological processes that are highly relevant to human toxicology. We will focus our initial studies on agrochemicals, because they represent an important sector of Indiana's chemical industry and are important for the state's economy. For a select group of pesticides, we will initiate studies in five thematic research areas: Alternative testing, Molecular and mechanistic studies, Predictive toxicology, Chemical analysis and exposure, and Integrative risk. These studies will move beyond traditional endpoints (e.g., mortality, growth, reproductive decline) to identify the mechanisms that underlie the toxic response, quantitatively link these mechanisms to chemical dose, develop computational tools for predicting chemical effects across the Tree of Life, and develop risk estimates that safeguard human health and protect the environment. This emerging approach allies with the Nation Research Council call for a complete redesign and update of the field.

We have three goals for these studies: develop our emerging approach and demonstrate that it is sound; prove the independent research areas can work together to tackle large problems, and establish a sustainable multidisciplinary research program that is positioned to scale to meet global needs.



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EMERGING AREAS OF RESEARCH

Abstract Template -- Due June 30, 2017

Title of initiative to be proposed:

Arts and Cultural Investments: Measuring the Social and Economic Impact

Name of lead PI, with title, department/school:

Joanna Woronkowicz, Assistant Professor, School of Public and Environmental Affairs (SPEA)

Key team member names and departments/schools (up to 10 names):

Michael Rushton (SPEA), David Audretsch (SPEA), Matthew Baggetta (SPEA), Jeffrey Bardzell (Informatics), Shaowen Bardzell (Informatics), Brad Fulton (SPEA), Amy Gonzales (Media School), Craig Johnson (SPEA), Jill Nicholson-Crotty (SPEA), Anya Peterson Royce (Anthropology)

Description of area to be proposed. What constitutes this area of research or creative activity as emerging?
(Word limit=500)

Investments in the arts and culture are often supported by an array of potential instrumental impacts, effects that go beyond the public enjoyment of art for its own sake, such as fueling economic growth, improving citizen well-being, and reducing neighborhood poverty and crime. Often, assumptions about the instrumental impacts of arts and culture help to justify expenditures; however, the lack of systematic evaluation prevents us from understanding any subsequent investment returns. As such, representatives of government, business, and private philanthropy struggle with articulating a broad-base rationale for future investments in arts and culture. The need for evaluation is particularly dire in an era when governments and foundations are deprioritizing arts and cultural funding.

That said, there is existing research across various disciplines focusing on arts and cultural investments. For example: economists examine artist employment behavior, the role of cultural infrastructure in economic development, and the efficacy of public sector spending on the arts; historians study patterns of cultural development and artistic patronage, and cultural heritage preservation; sociologists study the arts' relationship with civic engagement, and class, gender, and racial inequities in the arts; and psychologists and humanists have been investigating the influence of the arts on the empathy of readers, and how arts and cultural experiences can help bridge across social and political divides.

With scholars in siloed disciplines studying issues related to arts and cultural investments, the area as a whole remains underdeveloped. In particular, the fragmentation of the area prevents its movement forward with respect to understanding the socioeconomic impact of arts and cultural investments. For example, while economists focus on measuring the economic effects of cultural facility investments in neighborhoods, sociologists work on understanding the consequences with regard to racial and social equity, and historians are documenting the provenance of neighborhood sociocultural dynamics. Each line of research is equally relevant, and in tandem could inform policies related to investments in cultural infrastructure. In other words, policymakers could have the information they need to design policies that further the economic development goals of arts and cultural investments, at the same as protecting the most vulnerable populations and preserving a neighborhood's authenticity. Furthermore, each discipline's methodological approach provides a unique perspective on a similar topic and could be combined in order to enhance our understanding of arts and cultural investments more broadly.

By combining the theoretical frameworks and methodological strengths of an interdisciplinary group of researchers, this proposal seeks to develop a research program in measuring the social and economic impact of arts and cultural investments. The program will build upon existing research in this area; however, the focus will be to generate research that identifies cause-and-effect relationships between investments in arts and culture and socioeconomic outcomes. The program will leverage on the existing strengths of faculty in the School of Public and Environmental Affairs (ranked top in the nation amongst schools of public affairs) in program and policy evaluation, and faculty in the arts and humanities, in understanding the role of the arts and culture in public life.

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School of Public Health



IU BLOOMINGTON

EMERGING AREAS OF RESEARCH

Abstract Template -- Due June 30, 2017

Title of initiative to be proposed:

Sustainable Food Systems Science

Name of lead PI, with title, department/school:

James Farmer, Assistant Professor, Department of Recreation, Park, and Tourism Studies, SPH-B

Key team member names and departments/schools (up to 10 names):

Dan Knudsen, Professor, Department of Geography, College; Peter Todd, Professor, Cognitive Science Program, College ; Tom Evans, Professor, Department of Geography, College ; Alyce Fly, Associate Professor, Department of Applied Health Science, SPH-B ; Sarah Osterhoudt, Assistant Professor, Department of Anthropology, College; Jennifer Robinson, Professor of Practice, Department of Anthropology, College ; Analena Bruce, Postdoctoral Fellow, Department of Recreation, Park, and Tourism Studies, SPH-B; Angela Babb, Visiting Assistant Professor, +

Description of area to be proposed. What constitutes this area of research or creative activity as emerging? (Word limit=500)

The 20th Century produced a homogenized, petroleum-based industrial food system that is not environmentally sound, culturally just, nor particularly healthy. The American Public Health Association (2007) proclaimed that "the US industrial food system provides plentiful, relatively inexpensive food, but much of it is unhealthy, and the system is not sustainable." Indiana exemplifies this disconnect. Our state is part of the world's bread basket, very agriculturally productive, and yet our health statistics are among the poorest in the nation. Two-thirds of Hoosiers are overweight or obese and one-third have high blood pressure (ISDH 2011). 25% of Indiana residents do not have access to adequate food and nearly 1/6 of the state's population relies on the federal Supplemental Nutrition Assistance Program (FRAC 2015; US Census 2015; Meter 2012). These rates are statewide, higher in less privileged communities. Research increasingly attributes rising obesity, diabetes, cardiovascular disease, and some forms of cancer to the U.S. agricultural and food system (Franck et al. 2013; ISDH 2013; CDC 2012). In the midst of agricultural bounty, want and ill health abounds.

Juxtaposed with the predominant industrial food system is the growing, broad-based demand for food from sustainable, "permanent" agricultural systems centered on resilient ecological, social, and economic models working collectively to enhance a community or region and its people (APHA 2007; USDA 1990). Sustainable food (and its many off-shoots) has transitioned from a niche trend to a mainstream driver. Six of the "Top 10 Concept Trends" of the National Restaurant Association address how and where food is produced and minimizing waste along the supply chain (NRA 2016). Amazon is buying Whole Foods®, urban farms are beginning to supply food insecure places, and Walmart has become the largest organic food retailer in North America.

The emergence of Sustainable Food Systems Science comes at a time that providing healthy, fair, and sustainable food both globally and regionally is at the crux of world conflicts, political battles, public health epidemics and initiatives, alongside un-paralleled popular demand for changes to our agri-food system. Meeting the challenge to provide populations with sustainable and just food requires that scholars move beyond the limits of traditional disciplines and technical solutions to study food systems through the interdisciplinary, community-participatory, and action-oriented contexts in which they exist. This proposal will couple field, lab-based, and big-data research between IU's accomplished food, nutrition, agro-ecological, brain science, and systems scholars to forge a networked effort that will nationally and internationally lead Sustainable Food Systems Science throughout the 21st Century. This combination will create an integrated approach for understanding sustainable food system development, from farm to fork, proposing theoretical and applied solutions and interventions to current and emerging dilemmas and wicked problems. Strategic investments that link existing scholars, units, centers, and infrastructure will catalyze Indiana University's contributions and efforts for better understanding and shepherding food system development, evolution, and achievement across Hoosier communities and beyond.

Please submit to earprogram@indiana.edu