



2020 - 2021

# IBACS BRAIN DIGEST

## FACULTY SPOTLIGHT



## DR. ALEXANDRA PAXTON

### From conflict resolution to open science

As you pass by an ongoing conversation at a coffee shop, you might be able to tell a bit about the interaction occurring: if the conversation is serious or light-hearted, if it's regarding business or pleasure, and potentially what relationship these individuals share. However, if you're Dr. Alex Paxton, you're probably thinking about how myriad multi-scale factors and contexts shape the interaction.

Dr. Paxton, a professor at the University of Connecticut Storrs, received her PhD in Cognitive and Information Sciences from the University of California, Merced. Dr. Paxton's work treats interpersonal interaction as an emergent dyad-level system jointly shaped by separate individuals. Within this perspective, conversation is a context-dependent, multimodal, dynamical system, shaped by a variety of contributions including context, individual histories, and even body movements. What are the backgrounds of these individuals? What is their relation? How are their motions and mannerisms changing throughout the conversation? These and many more properties shape conversation into a dynamic, evolving event.

Using this multi-faceted approach, Dr. Paxton believes we can find ways to better navigate conflict as groups and individuals. While traditional wisdom would suggest similarity across individuals leads to the most effective conflict resolution, Dr. Paxton's work highlights the role of dissimilarity in shaping interactions. Such results suggest that our prescriptions for conflict resolution should not necessarily strive for homogeneity, but rather preserve the constructive role of variability. Dr. Paxton points out that given the rich

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## DR. ALEXANDRA PAXTON

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range of factors contributing to conversation, there is a need for thorough basic science research on interpersonal dynamics to better understand the role of such factors and their interactions.

In addition to her novel work in the lab, Dr. Paxton is a champion of the move to open science methodologies. Providing broad public access to publications, as well as ensuring the availability of methods, data, and data-processing code for researchers will serve to build a transparent scientific framework. These practices not only promote public trust and understanding in the scientific process, but also support the reliability and replicability of research results.

Just as the factors that shape conversations are multitudinous, so is the scope of Dr. Paxton's research interests; she studies collective behaviors in bees with one of her students (Megan Chiovaro), she is outlining the new ethics required for science using big data, and she is even partnering with IBACS, fellow researcher Dr. Dimitris Xygalatas, and another one of her students (Cat Hall) to study the virtual Burning Man festival! The interdisciplinary and multifaceted nature of her research coupled with modern methodological and analytical tools promises pioneering insight on a variety of topics.



## ROBERT ASTUR

**Exercise builds resilient memories**

The preservation of memory throughout life is a crucial part of the human experience. With aging, the prevalence of disorders

of memory drastically increases, contributing to decreased quality of life for the individuals affected and impaired connections with loved ones. Dr. Robert Astur, a behavioral neuroscientist and professor at UConn Storrs, studies how small interventions can have a big impact on maintaining our memories in old age—as well as prevent memory loss in the first place. The hippocampus is the region of the brain responsible for processing and storing memories and the first region impacted by Alzheimer's disease (AD) and dementia. Dr. Astur studies how exercise impacts memory and the generation of new hippocampal brain cells—neurogenesis—in individuals with increased genetic risk of AD based on the presence or absence of a specific variation of a gene called APOE4. Weekly exercise routines are linked to increase neurogenesis in the hippocampus and memory function. Although having APOE4 may increase your risk of getting AD, Dr. Astur and his

collaborators have found that it also increases the benefits of exercise in improving memory—a silver lining for those with this risk factor.

A promising therapy to facilitate resilient memory relies on promoting hippocampal neurogenesis. Spatial memory, or the ability to use memory to navigate through space effectively, is negatively impacted in AD patients as well, and depends on the hippocampus. By retraining this part of the brain through virtual reality games that train spatial memory, Dr. Astur has shown an effective means of improving cognitive function. However, he cautions that looking for a quick fix through games is not necessarily guaranteed to improve function. Although the games are widely available, the financial incentive for these companies seems to outweigh the science behind them: currently, studies do not support the claims many of these products offer. Regulation on the unsupported claims made by these companies will help protect older adults from falling victim to scams while simultaneously requiring comprehensive studies to determine the veracity of these products. Functional brain imaging, he argues, will parse out if these puzzles are just for fun or if they can be beneficial off the screen.

Like many 'brain games', Dr. Astur's research promises an engaging and easily distributable tool for individuals to maintain cognitive resilience. While brain games are not subject to consistent regulation to validate their therapeutic claims, Dr. Astur's research has the benefit of being backed by empirical results and sophisticated methodologies.



## STEPHEN CROCKER

**Stem cell research into Multiple Sclerosis**

Multiple Sclerosis (MS) is a degenerative disease of the brain and spinal cord that impacts

affected individuals' quality of life and independence. MS is not often thought of as a disease of aging, as diagnoses usually occur in early adulthood. However, advances in medicine have drastically increased the lifespan of these patients, though no therapies exist to slow or stop the progression of MS. The work of Dr. Stephen Crocker, neuroscientist and professor at UConn Health, seeks to better understand the disease process and help regenerate the nervous systems of MS patients. Although the brain and spinal cord are thought to be unable to regenerate, recent work by Dr. Crocker and his colleagues have challenged that notion. Using stem cells derived from a skin or blood sample from MS patients and healthy controls (usually a spouse or sibling), Dr. Crocker's team creates brain cells to test

why the brains and spinal cords of MS patients behave so much differently than someone without MS. He has found that the cells from young patients act more like those of older individuals without MS—alluding to MS as a disease of premature aging which could explain why many drug therapies aren't effective.

Aside from his work in the laboratory, Dr. Crocker is active in the MS community: reviewing grants for the National Multiple Sclerosis Society, actively advocating for patients, and lobbying for issues they feel are most important. Some of their priorities include transparency in drug pricing and 'surprise billing'—paying for procedures out of pocket that patients were unaware of or were unable to consent to. "The cost of living for MS patients increases exponentially with aging," Dr. Crocker explains, "with little improvement in the efficacy of therapies available [to them]."

"More research," he argues, "will be required to find an intervention to slow or stop disease progression that actually benefits patients long-term."



## GEORGE KUCHEL

**Health and wellbeing in the aging population**

Dr. George Kuchel, a physician and researcher at UConn Health's Center on Aging,

studies the nervous system and its interface with a variety of age-related health factors. This work ranges from the traditional focus on dementia and cognitive faculties, to bladder control, physiological coordination and mobility, and immune system functioning. These functional domains interact with each other and with the cognitive system, relying heavily on the proper functioning of the nervous system. Dr. Kuchel is motivated by a desire to improve the lives of individuals as they age, especially by facilitating independence: one's abilities to be mobile, to control the bladder, and to remain resilient to infection are critical for maintaining autonomy as we age. In addition to the health and wellbeing of our aging populations, increased independence can reduce the load on social programs.

Given that aging is a core factor for so many aspects of health, it is no surprise that Dr. Kuchel's work would confront it head on; how can we treat and slow the process of aging itself? UConn Health and the Center on Aging will be the site of a pioneering study on aging – the first gero-science project of its kind – that will target the biological processes of aging. The study will consist of a clinical trial with patients receiving a drug called Metformin, that has been demonstrated to have

anti-aging effects. Aging, Dr. Kuchel reminds us, is ideally a universal experience, and tools for aging well will have universal benefits.



## KEVIN MANNING

**Neurodegenerative disease and mood disorders**

Depression symptoms are often identified as changes in mood or loss of interest in daily activities, but 'brain fog,' or changes in memory and concentration, are also frequently reported. Aging populations are at a higher risk for experiencing neurodegeneration, so how can we determine if cognitive or mood changes are the result of depression or something more?

Dr. Kevin Manning investigates the interaction between two important age-related factors that we may not typically associate: cognitive faculties and mood. How might one's ability to recall information interact with their levels of joy or sadness? Interestingly enough, the reported symptoms of both neurodegenerative diseases and mood disorders can overlap, especially when it comes to memory. Dr. Manning's research can differentiate whether memory issues derive from cognitive decline or an underlying mood disorder such as clinical depression. Appropriate diagnosis, aided by such diagnostic tests, will inform an appropriate treatment plan.

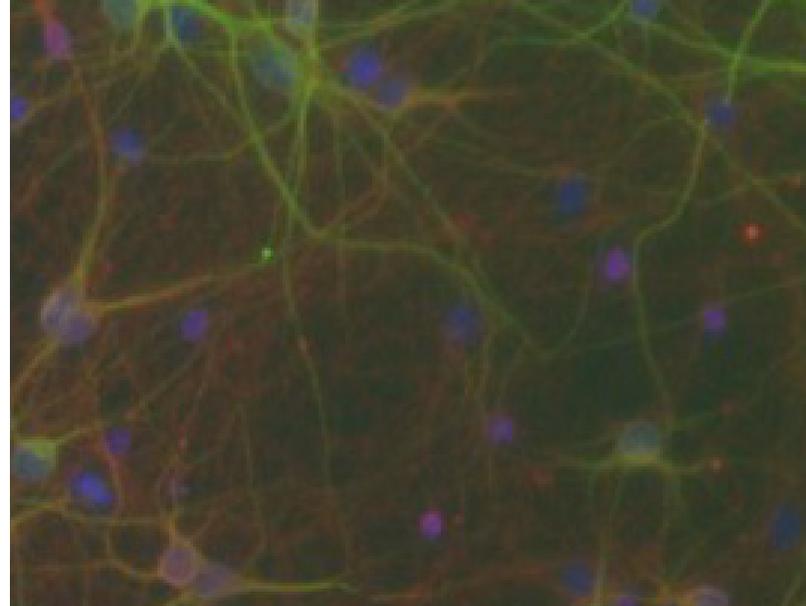
Dr. Manning is further exploring the relation between cognitive skills and mood regulation with a study investigating the efficacy of brain-training as a treatment for depression. While antidepressants are widely used and effective for many, many other patients are resistant to their effect. Digital games that train participants' cognitive skills (like memory recall) may also promote regulation of mood. Such a treatment plan offers a "two birds with one stone" promise to help patients with treatment-resistant depressive symptoms as well as improving cognitive faculties. Aided by Dr. Manning's Career Development Award from the National Institute of Mental Health (NIMH), future neuro-imaging studies will help to untangle the interaction of mood and cognition. Dr. Manning advises that understanding these properties, and increasing the availability of brain scans, will be critical for the early identification of neurodegenerative disease and mood disorders, thus allowing for more timely and effective treatment.



## JENNIFER MOZEIKO

### Rehabilitating language following brain damage

Language is one of the richest means of connection between people, making breakdowns in comprehension or production of language—known as aphasia—hugely impactful. Often aphasia results from damage to the left hemisphere of the brain, where much of our linguistic capabilities originate. Dr. Jennifer Mozeiko is a researcher working to develop treatment protocols to rehabilitate those language faculties, with a focus on naturalistic language contexts, often in a social setting. One such successful intervention has been to have aphasia patients play a game similar to “Go Fish”, wherein they must request cards by describing a depicted scene. The game facilitates practice of patients’ language production and comprehension in a fundamentally social context, providing both a challenge and, importantly, connection. Patients’ success is evident not only in their improved linguistic skills, but also in changes in their brains. Some patients displayed increased activation of brain areas surrounding the lesion, suggesting health and adaptation of the tissues, while some patients recruited new distal areas of the brain (i.e., areas further away) for linguistic acts. Dr. Mozeiko highlights that similar to how children’s acquisition of language depends on their interaction with many users, the maintenance of linguistic skills too depends on an individual’s opportunities for language. Group-based interventions and intensive one-on-one therapist sessions present critical naturalistic opportunities for training and rehabilitation of these linguistic capabilities, especially for individuals who may be socially isolated. Dr. Mozeiko’s work also highlights the need for increased insurance coverage of these intensive therapies, as current coverage seldom provides these proven interventions at affordable rates for patients.





## ALUMNI SPOTLIGHT

# ALEXANDRA NICAISE

## Reprogramming brain cells and cellular repair

Dr. Alexandra Nicaise ('19) received her PhD in Biomedical Sciences at UConn Health (Farmington, CT) in the laboratory of Dr. Stephen Crocker studying multiple sclerosis—a neurodegenerative disease characterized by a series of relapses and remissions while the disease progresses. While a student at UConn, Alex was highly productive: actively generating data, assisting in grant writing, and drafting manuscripts. Her work in the Crocker lab led to over half a dozen peer-reviewed publications and her thesis received the Henderson Award, an annual recognition of the most outstanding graduate thesis in the Biomedical Sciences Program.

Since graduating, Alex has continued her research across the pond at the University of Cambridge in England, through a postdoctoral fellowship in the laboratory of Dr. Stefano Pluchino. There, she continues to study multiple sclerosis using cells from patients called iNSCs (induced neural stem cells). These iNSCs are made by taking a skin or

blood sample from patients and reprogramming those cells to become a different cell type—in this case, brain cells. Her work has already led to several peer-reviewed publications and a competitive 2-year fellowship award through the European Committee for Treatment and Research in Multiple Sclerosis (ECTRIMS). This will allow her to continue her studies in the Pluchino laboratory.

Alex's work focuses on the progressive form of multiple sclerosis in which patients experience consistently worsening disease without remissions as they age. Current therapeutics are not effective for progressive multiple sclerosis, leaving many patients with few or no options. Using iNSCs derived

from primary progressive patients, she is learning how this disease impacts cellular function in the brain within the context of aging and why current therapies may be ineffective. Alex hopes that her research will improve our understanding of how aging influences multiple sclerosis and the mechanisms of cellular repair.





## MEGAN CHIOVARO

### Understanding the dynamics of collaboration

Megan Chiovaro is a third-year graduate student at the University of Connecticut Storrs

in the Perception-Action-Cognition branch of the Department of Psychological Sciences, working under her advisor Dr. Alexandra Paxton. Her work centers on the collective activity of individuals without a traditional hierarchical leadership structure, including both human and non-human collectives. Megan takes insights from the coordination dynamics of honey bee colonies and applies them to cooperative tasks conducted by humans in virtual spaces. Individuals play a virtual game with constrained communicative channels and varying task roles. Megan is interested in the different regimes of dynamics that emerge as people learn the game and change roles. Research on online collaboration is increasingly important as we continue to see more international collaboration as well as remote working opportunities. Megan received the IBACS Summer Grant Writing Fellowship in 2019 to support her work.



## BEN DE BARI

### The physics of self-organizing systems

Ben De Bari is a Doctoral Candidate in Experimental Psychology in the Ecological

division of the Perception-Action-Cognition group in UConn's Psychological Sciences department. His research asks us to consider behavior and psychology at its most fundamental; what is the minimal psychological repertoire of a living system, and what sorts of physics might instantiate these properties? Under his advisor, Dr. James Dixon, as well as mentor and renowned physicist Dilip Kondepudi, Ben investigates the behaviors of life-like, self-organizing, physical systems. These dissipative structures, systems that spontaneously self-organize when driven by a sustained flow of energy and matter, exhibit life-like behaviors including foraging for resources and inter-entity coordination. Contrary to some perspectives that reserve psychology for more sophisticated organisms, Ben's work offers that psychology may be generic to a broader class of systems, namely these dissipative structures.



## MARTIN FLAMENT FULTOT

### Dynamics and mechanics in posture control

Martin Flament Fultot recently received his PhD in Experimental Psychology from the University

of Connecticut Storrs. Dr. Fultot, while working under James Dixon in the Perception-Action-Cognition division of the Department of Psychological Sciences, investigated a minimal model of postural control. The simulations blended recurrent neural networks and physiological mechanics resulting in a rich virtual analogue of human postural control. Dr. Fultot plans to continue his work with virtual systems at Galvion, where he will focus on perception in augmented reality. Dr. Fultot received the IBACS Summer Grant Writing Fellowship in 2018, where much of his dissertation work germinated. Dr. Fultot thanks his subsequent interactions with IBACS and its affiliates for their contributions to his work.



## CARA HARDY

### Translational science and Alzheimer's disease

Cara Hardy, a Doctoral Candidate in Biomedical Sciences at UConn Health, investigates the

complex interaction between the nervous system and aging. Her work tackles Alzheimer's disease and its impacts on urinary function, both of which become increasingly common as individuals age. Utilizing mouse models, Cara's work simulates the neurodegenerative effects of Alzheimer's disease to quantify the impact on bladder control. Cara is passionate about translational science - bridging the basic knowledge derived from science and practical applications - especially given the potential therapies to be derived from her results.



## STUDENT SPOTLIGHT

# RAMALAKSHMI RAMASAMY

## Improving quality of life in MS

Ramalakshmi 'Rama' Ramasamy is a Doctoral Candidate in the Biomedical Sciences PhD program at UConn Health in the laboratory of Dr. Phillip Smith. Rama studies the association between multiple sclerosis (MS) lesions, called white matter lesions or 'plaques', and dysfunctional bladder control—a common complaint among MS patients. Just like in human MS, her mouse model develops lesions that vary in location. By studying how these lesions affect bladder function, Rama can understand how those lesions affect the autonomic (unconscious) nervous system. Aside from her primary appointment as a mother, Rama is a part of both the Center on Aging and Department of Neuroscience at UConn Health, as well as IBACS at Storrs. As an international student ineligible for government funding, she has appreciated the flexibility of the IBACS grant writing workshop in supporting a variety of funding mechanisms outside the NIH. "Through the hands-on experience IBACS provides," she explains, "international students can still learn essential grant writing skills while being able to apply for funding as more than just an exercise." Rama hopes that her research will contribute to improve treatments for MS patients experiencing this common problem that drastically affects their quality of life.

## The CT Institute for the Brain and Cognitive Sciences

publishes its Brain, Cognition & Language Research Digest for the purpose of community outreach. This issue includes research from Speech, Language and Hearing Sciences; Psychological Sciences; Biomedical Sciences (UCH); Psychiatry (UCH); the UConn Center on Aging (UCH); and Neuroscience (UCH).

### IBACS Stats Since Inception (July 2015)

# \$2.7 MILLION

in student fellowships, seed funding, group, and meeting support

# 252

affiliates across 34 departments

# 61

seed grants

# 103

Graduate fellowships

# 65

Undergraduate fellowships

# 12

Research Assistantships in Neuroimaging

In 2021 data collection, 61% of IBACS-affiliated applying PIs attributed their external grant applications almost entirely to IBACS support.

## OUR RESEARCH COMMUNITY

### WHO ARE WE?

The CT Institute for the Brain and Cognitive Sciences (CT IBACS) serves as an incubator for research across the brain and cognitive sciences at UConn and beyond, promoting and supporting the interdisciplinary science of the mind and its realization in biological and artificial systems. The Institute is a collaboration between multiple departments and campuses of the University of Connecticut. Educational seminars and workshops, community outreach, graduate and undergraduate fellowships, and pilot grant opportunities are available to our affiliates. Through these various mechanisms for fostering novel research across the biological and related physical, psychological, and computational sciences, IBACS provides support for the first steps in the many research programs that go on to receive subsequent federal funding from public agencies such as the National Institutes of Health (NIH) and the National Science Foundation (NSF).

### ABOUT THE DIGEST

Investing in research directly benefits the State of Connecticut and its residents; the IBACS Digest aims to disseminate some of the findings that Connecticut residents, and their legislature, have helped make possible. The Digest is an annual publication intended to highlight research conducted by IBACS-affiliated scientists across UConn. Each issue focuses on a different theme among the many that run through our research community. In this issue, we focused on translational science, much of which (but not all) is health-related. We talked to UConn scientists about their work and asked researchers to focus on those aspects of their research that had practical application to quality of life. Many of the examples described here have implications for policy makers and the communities they serve.

### To Learn More

**ONLINE:** [ibacs.uconn.edu](http://ibacs.uconn.edu)

**CALL US:** 860.486.4937

**EMAIL US:** [ibacs@uconn.edu](mailto:ibacs@uconn.edu)

CT Institute for the Brain and Cognitive Sciences  
University of Connecticut  
337 Mansfield Rd Unit 1272  
Storrs, CT 06269-106

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CONNECTICUT INSTITUTE  
FOR THE BRAIN AND  
COGNITIVE SCIENCES

