UCONN | UNIVERSITY OF CONNECTICUT

Connecticut **Institute** for **the Brain** and **Cognitive Sciences**

UCONN

CONNECTICUT INSTITUTE FOR THE BRAIN AND COGNITIVE SCIENCES

Annual Report Year 1
2015-16

Contents:

EXECUTIVE SUMMARY (and main expenditure):

- 15 **seed grants** awarded, across 10 departments; 9 collaborating external institutions: $235,000
- 23 **Graduate fellowships** awarded, across 7 departments: $107,000
- **Equipment**: High density in-scanner EEG and tDCS, housed at BIRC: $100,000 (through additional CLAS funds)
- 16 **External grant applications** submitted, supported by IBACS through seed or fellowship funding, totaling $24M+. (excludes 9+ additional grants to be submitted through seed funding and ~20 graduate fellowship applications)
- **Laboratory support:** *UConn K.I.D.S*; *UConn Logic Group*; *Murine Behavioral Neurogenetics Facility*; *BIRC* & *Cognitive Science Shared Electrophysiology labs* (the latter two through funds for lab manager/post doc hires)
- **Workshop support:** 5 sponsored workshops/meetings + IBACS 2-day inaugural *Meet-and-Greet*
- **Space renovation:** graduate workspace in Arjona (in progress): $25,000

2. INSTITUTE MISSION

The mission of the **Connecticut Institute for the Brain and Cognitive Sciences** (CT IBACS) is to serve as both a beacon and 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. It will enable new research and educational opportunities for graduate students, postdoctoral researchers, and faculty to extend their intellectual reach beyond traditional disciplinary boundaries, as well as enabling undergraduates to receive laboratory-based training in neuroscientific, behavioral, and theoretical research in the brain and cognitive sciences. It aims to provide the physical, financial, administrative, technical, intellectual, and educational infrastructure to enable UConn's extensive but distributed neuroscience and cognitive science community to realize its full potential for disciplinary and interdisciplinary innovation in the brain and cognitive sciences

3. INSTITUTE TIMELINE

IBACS was given a budget effective from July 1st 2015. On August 7th we hired a 50% admin assistant. Less than three months later, at our first deadline for receiving applications for seed grants, our website (ibacs.uconn.edu) was up-and-running, with forms available for online submission of seed grants and online application for affiliate membership. Since then, we have focused on disbursing monies for seed grants, graduate fellowships, small workshops, research and lab support. We have also developed research collaborations with UConn Health (specifically, Center for Aging and Department of Urology) and generated an Institute community through, among other things, the inaugural meeting of Institute affiliates (the "Meet-and-Greet" event), the IBACS listserv. Throughout, our aim is to encourage and incubate research that crosses traditional disciplinary boundaries, generating new research ideas and collaborations which have the potential, in turn, to generate new income streams.

4. GOVERNANCE

The Institute is managed by a **Director** (Altmann, *Psych Sciences*) and two **Associate Directors** (Magnuson, *Psych Sciences*; LoTurco, *PNB*). They meet with an **Executive Committee** of 10 other faculty drawn from 7 different departments (including Neuroscience at UConn Health, Farmington). The executive meets in person three times per year, although day-to-day issues are brought to their attention, and advice sought, via ad-hoc emails throughout the year.

In 2016/17 a **UConn-internal Advisory Board** will be constituted (advising on shorter- and longer-term issues of strategic importance, in respect of both Institute-internal matters and issues that may impact externally on the Institute). An **External Advisory Board** will also be constituted (to provide different perspectives on the Institute's mission, activities, and successes, and to advise on best practice based on their experience at their own Institutes, Centers, and other organizations). We delayed initiating these advisory boards in order to focus on setting up the Institute according to the transition plan formulated with help from the Provost's office, the VPR's office, CLAS, and the committee constituted approximately three years ago to oversee the setting up of an Institute for the Brain and Cognitive Sciences (which transitioned into the current Executive Committee). Throughout the year we have solicited and received advice from CLAS, the Offices of the Provost and the Vice President for Research, as well as from the Director of InChip, and the heads of the various departments we interact with (with particular support from Psychological Sciences, which provides also administrative and financial support).

5. INSTITUTE ACTIVITIES 2015/16:

Facts and Figures:

1. **Seed grants**: We had two calls for seed grants (November and February) and received 31 applications of which **16 were funded** (16 PIs *across 10 UConn departments, with 9 co-PIs at external institutions*). Applications were reviewed by one of two panels (depending on topic). No member of a panel was a PI or co-PI on any application in that round. Approximately half the dollar amount was awarded to more "cognitive" or behavioral grants, and the remainder to bench or animal neuroscience grants (including genomics). Six of the grants directly support research at the Behavioral Imaging Research Center (BIRC), and two support research at the new (Tier 2) Murine Behavioral Neurogenetics facility. All awards are described on the IBACS website (ibacs.uconn.edu/research/). A condition of award of a seed grant is that, in the event of a successful outcome (e.g. data suitable for publication or inclusion as pilot data in a grant) the PI will submit an application for external funding. We shall track and follow-up each funded grant to ensure this condition is met. **Total amount awarded: $255,000**.
2. **Graduate Fellowships**: These pay up to $5,500 in summer funding to graduate students. A condition of award is that students apply for a pre- or post-doctoral award (e.g. NRSA or GRF) in the Fall. To this end, recipients have taken a 4-day grant-writing workshop hosted by the Institute. For non-US citizens, their advisor had to commit to writing an application for external funding. We shall follow up on each fellowship. The IGERT on Language Plasticity had funds for summer payments and we joined forces to enable a larger number of total fellowships (in these cases, IBACS topped up the IGERT funds to a total of $5,500 per student). We funded **23 students, at a cost of $106,000**. Funding decisions were made by a committee comprising the Director and Associate Directors (COIs were avoided by ensuring that no advisor scored their own student, and conflicts were registered and explicitly considered by non-conflicted members).
3. **Equipment**: With an **additional grant to the Institute of $100,000**, we were able to upgrade the EEG system at BIRC to enable high-definition source localization and delivery of tDCS (targeted neuromodulation). Pilot data collected from the new system formed the basis for an **NIH R01 grant submission** (PI at MGH, Boston) with UConn as collaborators, providing 4.5 months salary support and scanning costs. A second **grant application, to the NSF component of the BRAIN initiative**, was submitted by Altmann et al. (UConn, Director IBACS), for $992,000 and is predicated on this equipment. Both grants are for development of new imaging and analysis techniques using combined fMRI/EEG.
4. **Research Support:**
   a. **UCONN K.I.D.S**. (**$11,000**). This is jointly supported by Psychological Sciences and CLAS and serves to recruit child participants in studies of both typical and atypical development (e.g. autism, SLI, etc). The monies will pay for a server, database software satisfying NIH regulations, and travel and misc. expenses for the recruiter.
   b. **UConn Logic Group** (**$5,000**). To support colloquia, visits, and other activities of the Logic Group – a group of logicians across the departments of Mathematics, Philosophy, and Linguistics.
   c. **Murine Behavioral Neurogenetics Facility** (MBNF)**:** Post-doctoral scientist / lab manager. MBNF is a Tier 2 facility. The lab manager will support Institute-funded and affiliated research with mouse models (linking cognitive behavior to neuroscience and genetics). The search is ongoing.
   d. **Cognitive Science Shared Electrophysiology Labs** (CSSERL) / **BIRC**: Lab manager. CSSERL supports the electrophysiological (EEG) research of faculty in SLHS, Linguistics, and Psychological Sciences, and will potentially house a new tDCS (neuromodulation) system (a

decision at CLAS is pending). The lab manager will support Institute-funded and affiliated research at CSSERL as well as at BIRC. The search is ongoing.

5. **Workshop support**. The Institute supported five workshops/conferences: (i) Evolution of Communication (ii) Life and Sciences of Complexity (iii) Theory of Mind (internal workshop) (iv) IGERT Diversity Workshop (v) LangFest. **Total outlay: $5,300**
6. **Inaugural Meet-and-Greet**. We held a 2-day meeting with 30 10-min speakers from both Storrs and UConn Health. We anticipate a similar meeting in 2017 with presentations from the recipients of seed grants.
7. **Outreach and related activities**. The Institute took over from the IGERT the publication of a Research Digest edited by one of our graduate students (Oliver Sawi). This is similar to a "glossy brochure" and will be sent in electronic form to the state legislature (as approved by CLAS and University Governmental relations). This first issue highlights UConn's work on language and its disorders. It is included as an appendix.
8. **Affiliate membership**. Excluding the Director, 2 Associate Directors, and 10 Executive Committee members, we have **47 affiliated faculty** and **32 affiliated graduate students** from across 17 UConn departments. All are listed on the Institute website (photograph, research description). Affiliation is dependent on demonstrating research expertise relevant to the research mission of the Institute. We anticipate growing this number each year.

6. External Grant Applications: July 1st 2015 – June 30th 2016

In this first year, we have funded work that has or is contributing to ***15 applications for external funding, totaling $24M+.*** This is before the seed grants and fellowships "kick in" (each PI is committed to submitting an external application, as is each graduate fellow or their advisor). The breakdown (in terms of kind of support) is as follows:

Grant applications by **Altmann** (*Psych Sciences*), **Large** (*Psych Sciences*), **Gow/Molfese** (*MGH, Boston & BIRC, UConn*), and **Smith*** (*Center for Aging & Dept. of Urology x3*) were or will be submitted (by June 30th) that were directly supported by IBACS funding (either through *pilot data*, *equipment*, or *fellowship contributions* directly funded by IBACS and identified in the grant proposal).

Grant applications by **Naigles and Skoe** (*Psych Sciences* & *SLHS* respectively), **Nishiyama** (*PNB x2*), **Conover** (*PNB x 3*), **Theodore** (*SLHS*), **Landi** (*Psych Sciences*), **O'Neill** (*MCB*), **Dzhafarov** (*Math*) were applied for which include research that is currently being funded by IBACS. This work will generate pilot data that will be included when the applications are revised. (*NB – some of these PIs have applied for other grants also, but unless supported by IBACS funds, those applications are not included here*).

***NOTE:** The submitted **Smith** (Urology, UConn Health) application includes collaboration with **Mulkey** (PNB, Storrs). They will also submit a collaborative grant shortly based on this same collaboration, and an R21 will be submitted in June. See below for further information about the Institute's involvement in this collaboration.

7. Deviations from 2015 Forward Plan

A. Activities budgeted for 2015-16 (Year 1) but which were postponed to future years. The saved monies were diverted into graduate fellowships and seed grants:

- **Cluster lectures** (cross-disciplinary educational' lectures) and internal workshops were replaced by the 2-day Meet-and-Greet.

- **Internet conferencing facility**: experience with UConn Health suggests this is unnecessary (see Case Studies, below)
- **Visiting Institute fellowships**: there was no time in which to organize these – they require a long lead-in. They will be advertised in 2016/17.
- **UConn Inquiry fellowships**: course buyouts for UConn faculty to facilitate grant preparation and research; we decided these were not cost-effective at present, and that the monies were better spent on seed grants.
- **Undergraduate fellowships**: These are planned but now postponed until 2016/17 to fit in with the SURF timetable. They will take the form of small grants to enable undergraduates to join a research group either during the school year or over the summer.
- **International workshop**: The first of these is planned to take place in 2016/17, with a focus on "brain-storming" research programs on specific themes and with the goal of generating applications for external funding.
- **Colloquium series**: starting in 2016/17.

B. Activities beyond those budgeted for in 2015-16:

- **Workshop support**: we supported 5 workshops – a useful and important mechanism for building the community
- **Research support**: supporting UConn K.I.D.S. and the Logic Group fits our original goal of supporting both research infrastructure and "enquiry clusters".
- The 2-day **Meet-and-Greet** replaced the internal workshops and cluster lectures.
- **Grant-writing workshop** for IBACS graduate fellows (3 days of instruction and 1 day of review). We compensated the faculty leaders of this course with a seed grant to pay a total of 20 hours scan time at BIRC. Their "teaching load" included both delivery of the lecture/seminars and also review of each student's proposals. Whereas few graduate students at the Storrs campus apply for pre-doctoral fellowships, we hope that the graduate fellowships will change this ethos, to the point where it will become the norm to apply for such fellowships, thereby freeing up TA hours to further build up the graduate community.
- **Space Renovation**. The Institute does not have its own space, but cohabits with individual faculty research labs and the IGERT teaching space in Arjona. We identified a need to turn a part of this teaching space into graduate workspace to provide a focus for graduate student / faculty activities. The Director of the Institute is giving up one of his research labs to turn it into small meeting space.

8. GOING FORWARD INTO 2017 & BEYOND

New activities planned for 2016/17 include an international research ("brain-storming") workshop, the launch of the undergraduate fellowship scheme and the colloquium series, completion of the conversion of the Arjona graduate workspace, and the launch of an internal peer-review process for affiliate's external grant applications. We shall also introduce 'targeted' seed grant opportunities joint with BIRC, combining BIRC seed grants (scan time) with IBACS seed grants (participant and other expenses).

Challenges facing the Institute: In this first year, we diverted an additional $145,000 to the seed grant mechanism in order to rapidly kick-start the Institute's presence and support. We anticipate seed funds of around $150,000 in 2016/17 – a cut of close to $100,000 to fund the other activities originally planned for the Institute. The seed grant mechanism (and the future brain-storming workshops) are an effective way of generating applications for external funding.

It became apparent that a half-time administrative support position is insufficient. We are currently exploring, with CLAS, the options for turning this into a full-time position.

A longer-term challenge remains the lack of a physical focus for the Institute. While the Institute is successfully funding research activities distributed throughout and across the Storrs and UConn Health campuses, and encouraging new lines of research (and applications for its external funding), the vision of a physical hub housing graduate students and research labs from across the Brain and Cognitive Sciences is yet to take shape. We believe, nonetheless, that the current activities are a necessary first step towards building an intellectual environment in which a physical Institute could take shape, and we shall continue to work towards this goal.

Finally, the Director has a 50% lab manager / postdoc who manages his lab (3 graduate students, 5 undergraduates). She is funded for one more year (to August 2017). She has spent significant and growing time at BIRC managing activities there. Together with BIRC, we have identified a need for increasing involvement in Institute-related co-ordination/training of "simultaneous imaging methods" (e.g. combined fMRI/eye-tracking, fMRI/dEEG, EEG/eye-tracking, etc). There would be some considerable advantage to ensuring continuity of 'cover' for these activities, especially as the demand for BIRC facilities increases (in part, through Institute support). A contribution towards her salary would provide continued support for this Institute/BIRC activity (although grants with simultaneous imaging would request a contribution to her hours).

9. BUDGET SUMMARY

The Appendix contains a summary of expenditure and commitments made. These figures may differ slightly from current account balances, due to unpaid commitments. To summarize here (all figures rounded to nearest $1K):

Initial budget, July 1st 2015 – June 30th 2016:
- $300,000 from Tier 1 funding
- $150,000 from VPR
- $117,000 from CLAS (excl. additional $100,000 equipment grant)
- $567,000 total

Expenditure:
- $405,000 (excluding additional $100,000 paid for by CLAS)

Commitments by end of Summer 2016[1]:
- $75,000

To carry forward into AY 2016/17[2]:
- $87,000

We anticipate for FY 2016/17 the same level of funding from Tier 1, VPR, and CLAS funds.

[1]*Commitments include summer salary ($50,000) split between the Director and Associate Directors, and the Arjona graduate workspace conversion ($25,000).*

[2]*The carry-forward represents unspent monies originally budgeted for the 2 lab manager/post-doc positions, the undergraduate fellowships, and a $20,000 contingency margin (this margin is included in all forward planning). Some of the personnel monies were rolled into other expenditure for this year (primarily seed grants) once it was clear that their hiring would be delayed.*

10. CASE STUDIES: INSTITUTE-SUPPORTED COLLABORATIONS

Here, we briefly outline 2 case studies.

1. Mind-Brain-Viscera. This first case study describes a growing collaboration between the Institute and the departments of Physiology and Neurobiology (PNB) and UConn Health (Center for Aging and Department of Urology). It highlights the Institute's commitment and ability to foster cross-campus research and to integrate with UConn Health. One grant application has already been submitted, and two others will be submitted by the end of June.
2. Brain Dynamics. The second describes an Institute-driven collaboration between BIRC, Massachusetts General Hospital (MGH), and the departments of Psychological Sciences and Biomedical Engineering. This highlights the Institute's ability to foster external collaborations in support of UConn initiatives (in this case, BIRC-related activities), with one grant submitted by MGH/Salem State which includes UConn as a collaborating site, and one grant submitted by UConn with collaboration from MGH/Salem State.

Mind-Brain-Viscera. In the Fall of 2014 a meeting was held with members of PNB to discuss the proposal to create the Institute. During discussion, Dr. Daniel Mulkey asked, as a challenge, how his work on respiratory control could be made relevant to the Institute's mission. Interestingly, there is a cognitive component to respiration (one can take conscious control of one's breathing, or leave it to operate autonomously). After the Institute was announced in July 2015, Dr. Phil Smith M.D. asked whether his work on bladder control could be construed as relevant. Smith argues that overactive bladder (or bladder urgency) is due to miscalibration of signals in the brain, rather than a problem at the bladder. And like respiration, there is a conscious layer that can take control of the bladder. We recommended that Smith and Mulkey talk to one another. Mulkey suspected that there was little in common between their respective domains of research, but Smith pointed out, after reading Mulkey's work, that they were in fact studying the same control circuitry! Since then, Mulkey has become a consultant on Smith's K76 application, and they are currently in discussion on how to manage a joint grant application (given the Storrs/Farmington nature of the collaboration). They have also received seed funding.

This project has become the focus for a continuing dialogue with Dr. George Kuchel, Director of the Center for Aging at UConn Health. Altmann will, in October, attend a conference at Bethesda on translational research into urinary incontinence (UI) in the elderly, to gain an understanding of how the Institute could best facilitate related research at UConn. Altmann has met with Dr. Amy Gorin (Associate Director, InChip) to discuss how to leverage InChip expertise, and an in-house workshop is planned for later in the year that will bring together different expertise that could develop cognitive (and possibly neuromodulatory) interventions to alleviate UI. This is an issue that affects millions, and there is enormous scope translational research that could have a very significant impact on quality-of-life in a very large population. In turn, this means there is considerable potential for new funding streams, from both federal and private sources.

We are using this particular project as an initial focus for future collaborations with the Center for Aging and the Department of Psychiatry (through Dr. David Steffens).

Brain Dynamics. Through a generous additional grant from CLAS, we were able to purchase an upgrade to the BIRC's EEG systems to allow us, in principle, to map activation in different areas of the brain, across time (with millisecond resolution), as the brain engages in cognitive tasks such as language or visual processing. The high-density (256 channel) "dEEG" system can be used during fMRI scans. This equipment has become the focus for a collaborative effort to develop new methods for analyzing the dynamics of brain activity. Drs. Kevin Brown and Sabato Santaniello (BME) will work with Dr. Pete Molfese (BIRC) to work on methods for analyzing integrated fMRI/EEG. They will also work with Dr. David Gow (Salem State & MGH) and Dr. Seppo Ahlfors (MGH): Gow has experience of "Granger causality" modeling – a method for determining how activation in one part of the brain *causes* activation in others; Ahlfors is the Technical Director for the Magnetoencephalography (MEG) core at MGH and has implemented Gow's methods into a toolbox they have available at the Martinos Imaging Center. The idea is that Gow and Ahlfors can identify sources of activation and how each source is dependent on other sources across space and time, and Brown and Santaniello will use "graph theoretic tools" to develop ways of analyzing these dependencies. Dr. Gerry Altmann (Psych Sciences) is coordinating this effort and has applied to the NSF component of the BRAIN Initiative for funding.

Gow and Ahlfors' interest is twofold: (1) they believe that the combined fMRI/dEEG system we have, and which they do not have access to at the Martino Imaging Center, may be an accessible alternative to using MEG (which has 306 channels). While dEEG does not have the same spatial resolution as MEG (in part because of "smearing" of electrical current across the scalp), its combination with fMRI may compensate for that (MEG cannot be run concurrently with fMRI, unlike EEG). Gow and Ahlfors applied for an NIH R01 (with UConn as collaborator) to explore this question. If it turns out that our system is functionally similar to having MEG, we will have a very considerable impact on the neuroimaging community (making high spatiotemporal resolution of brain activity available to almost any center that has an MRI scanner – the dEEG system costs less than 10% of the cost of MEG and does not require the same maintenance or technical expertise). (2) Regardless of whether combined fMRI/dEEG is functionally similar to MEG, Gow and Ahlfors have a practical interest in this collaboration: Their tools only go so far, and the link-up with Molfese, Brown and Santaniello will allow the creation of a toolbox that essentially implements the entire workflow from data collection to a description of the brain's *causal* dynamics. This is a toolbox that we (the entire neuroimaging community) need. There is a commitment among all concerned, in the event that NSF funding is not forthcoming, to find alternative means for resourcing this program of work. Development of this toolbox will have very significant impact on neuroimaging research nationally and internationally.

These are just two of the 15+ projects that the Institute has supported in its first year of operation. The Appendices describe very briefly the other seeded projects. But these two exemplify the success of the Institute in its mission to bring together researchers who would not otherwise have met, and to spawn new research activities that will contribute to the intellectual ethos and financial sustainability of the Brain and Cognitive Sciences community here at UConn.

APPENDICES

1. Budget Summary
2. Recipients and topics of IBACS Seed Grants
3. Recipients of IBACS Graduate Summer Fellowships
4. Journal articles describing IBACS-supported research
5. Brain, Cognition, and Language Research Digest

APPENDIX 1
BUDGET SUMMARY

STARTING BUDGET	$567,000	
Expenditure and Commitments		*notes*
meetings		
ECOM meeting	$1,000	
Complexity workshop	$1,500	
ToM series	$1,600	
Meet n Greet	$3,000	
group support		
KIDS Server	$6,500	
UConn KIDS	$5,000	
LOGIC group	$5,000	
seed grants & fellowships		
1st round of grants Fall 2015	$130,487	
2nd round of grants Spring 2016	$104,674	
23 grad fellowships	$105,500	
Grant workshop seed grant	$10,000	
UG fellowships/grants	$25,000	to carry forward
space		
ARJ 311	$25,000	committed
personnel		
50% admin	$31,000	
post-doc/lab manager (x2)	$44,000	to carry forward
Director and Associate Directors' summer salaries:	$50,000	committed
TOTAL spend to date	$405,261	
TOTAL spend (incl. commitments & carry forward)	$549,261	
TOTAL uncommitted	$17,739	– to carry forward
TOTAL carry forward	$144,000	– includes funds committed for Summer 2016

APPENDIX 2
IBACS SEED GRANTS

Only the lead PI is listed, although in all cases there were one or more collaborators and Co-PIs. Details of each can be found at http://ibacs.uconn.edu/research/

Lead PI	Dept.	Title	Award Amount
Gerry Altmann	PSY	At the interface of episodic and semantic memory: hippocampal connectivity during language comprehension	$7,249
Kevin Brown	BME	Phonological and Semantic Dynamics	$15,100
Joanne Conover	PNB	Spatiotemporal mapping of stem cell fate in the normal and hydrocephalic developing brain	$22,295
Inge-Marie Eigsti	PSY	Hyperlexia: A window on reward circuitry in Autism Spectrum Disorders	$8,960
R. Holly Fitch	PSY	Development of new assessments of cognitive function in mouse models	$12,500
Joseph LoTurco	PNB	A Technology for Imaging Neuron Type Specific Activity Patterns Across Cerebral Cortex	$26,189
Akiko Nishiyama	PNB	How do NG2 glial cells modulate neuronal function in the mouse brain?	$12,128
Michael J. O'Neill	MCB	X-linked Imprinted Genes in Maternal Immune Activated (MIA) mice, a Model for Autism Spectrum Disorder	$22,758
John Salamone	PSY	Development of Chemogenetic (DREADD) Methods for Assessment of the Effort-Related Motivational Functions of Mesolimbic Dopamine	$9,643
Erika Skoe	SLHS	Brain Correlates and Early Predictors to School Age Language in Children with ASD	$7,518
Phillip Smith	UCHC	HCN - Interstitial Cell Interactions in the Autonomic Control of Bladder Muscle	$24,130
William Snyder	LING	Setting a Child's Linguistic Parameters	$19,118
Tammie J. Spaulding	SLHS	Prosody as a window on Specific Language Impairment	$19,273
Rachel Theodore	SLHS	Determinants of phonetic category structure in bilingual, infant, and language impaired populations	$19,900
Eiling Yee	PSY	Inhibition in Biologically-Plausible Models of Semantic Processing: Causal Studies using tDCS	$8,400

APPENDIX 3
IBACS GRADUATE SUMMER FELLOWSHIPS

Name	Department	Advisor
Boshans, Linda	Physiology & Neurobiology	Akiko Nishiyama
Brooks, Thomas	Psychology	James Dixon
Chin, Iris	Psychology	Letty Naigles
Coletti, Amanda	Psychology	Joanne Conover
*Davis, Charles	Psychology	Eiling Yee
Drouin, Julia	Speech, Language & Hearing Sciences	Rachel Theodore
Ekves, Zac	Psychology	Gerry Altmann
Gettens, Katelyn	Psychology	Amy Gorin
Goz, Roman	Psychology	Joe LoTurco
Harrison, Henry	Psychology	Till Frank
*Kannan, Kavitha	Molecular & Cell Biology	Ping Zhang
Lang, Martin	Anthropology	Dimitrios Xygalatas
*Lee, Tommy	Psychology	Etan Markus
Marrouch, Natasza	Psychology	Blair T. Johnson
*Martinez-Vera, Gabriel	Linguistics	Jon Gajewski
Michaels, Timothy	Psychology	Chi-Ming Chen
Milton, Glenn	Molecular & Cell Biology	Michael O'Neill
*Prystauka, Yanina	Psychology	Gerry Altmann
Richie, Russell	Psychology	Marie Coppola
Rourke, Brenda	Communication	Kristine Nowak
*Ryherd, Kayleigh	Psychology	Nicole Landi
*Sawi, Oliver	Psychology	Jay Rueckl
Smith, Garrett	Psychology	Whitney Tabor

* student had other summer funding (e.g. IGERT) and IBACS topped up to a maximum cap of $5,500

APPENDIX 4
PUBLICATIONS:
July 1st 2015 – June 30th 2016

Recipients of seed grants, and affiliate members, were asked to submit articles and book chapters published since July 1st 2015 that were supported directly or indirectly by IBACS. This is not a list of all articles published by the 58 IBACS affiliates who were contacted. There are many of those, but only these received IBACS support. Names in bold indicate IBACS affiliates.

Peer-Review Articles published, in press, or under review

Altmann, G.T.M. Abstraction and Generalization in Statistical Learning: Implications for the relationship between episodic and semantic knowledge. *Philosophical Transactions of the Royal Society B*. (under review).

Rebecca Acabchuk, Denise I. Briggs, Mariana Angoa-Pérez, Meghan Powers, Richard Wolferz Jr., Melanie Soloway, Mai Stern, Lillian R Talbot, Donald M Kuhn, **Joanne C Conover** (2016) Repeated Mild Traumatic Brain Injury Causes Focal Response In Lateral Septum And Hippocampus. *Concussion* (in press)

Kadam, M. A., Orena, A. J., **Theodore, R. M**., & Polka, L. (2016). Reading ability influences native and non-native voice recognition, even for unimpaired readers. *Journal of the Acoustical Society of America, 139,* EL6-EL12.

Drouin, J. R., Theodore, R. M., & **Myers, E. B**. (Under review). Lexically-guided perceptual tuning of internal category structure. *Journal of the Acoustical Society of America.*

Landi, N. & **Ryherd, K**. (under revision). Understanding specific comprehension impairment: A review. *Language and Linguistics Compass*.

Myers, E. B., & **Theodore, R. M**. (Under review). Voice sensitive brain networks encode talker-specific phonetic detail. *Brain and Language*.

Skoe, E., Brody, L., & **Theodore, R. M**. (Revision under review). Reading ability reflects individual differences in auditory system function, even into adulthood. *Brain and Language*.

Theodore, R. M., Myers, E. B., & Lomibao, J. A. (2015). Talker-specific influences on phonetic category structure. *Journal of the Acoustical Society of America, 138,* 1068-1078.

Xie, X., **Theodore, R. M**., & **Myers, E. B**. (Revision under review). More than a boundary shift: Perceptual adaptation to foreign-accented speech reshapes the internal structure of phonetic categories. *Journal of Experimental Psychology: Human Perception and Performance*.

Book

Lidz, Jeffrey, **William Snyder** & Joseph Pater, editors. (2016) *The Oxford Handbook of Developmental Linguistics*. Oxford: Oxford University Press.

Book chapters published or in press

Joanne C Conover, and Krysti L Todd 2016 Chapter 6: Neuronal Stem Cell Niches of the Brain, in *Biology and Engineering of Stem Cell Niches*, eds Vishwakarma & Karp, Publishers: Elsevier Inc. (in press)

Snyder, W. (2016) Compound word formation. In J. Lidz, W. Snyder & J. Pater (eds.) *The Oxford Handbook of Developmental Linguistics*, 89-110. Oxford: Oxford University Press.

Peer-Review Articles ready to submit

Monto, N. R., Graham, S., & **Theodore, R. M**. (to be submitted by June 1st). Attention modulates lexically-informed letter perception. *Attention, Perception, & Psychophysics*.

Theodore, R. M., Monto, N. R., Orena, A. J., & Polka, L. (to be submitted by June 1st). Examining the locus of the language familiarity effect for talker identification: Contributions from time-reversed speech and associative learning. *Psychological Science*.

Theodore, R. M., Marmon, S., & Salvador, K. (to be submitted by June 1st). Reading ability influences talker-specific perceptual learning for speech. *Language & Speech*.

Spring 2016 Vol 1, Issue 1

UCONN
UNIVERSITY OF CONNECTICUT

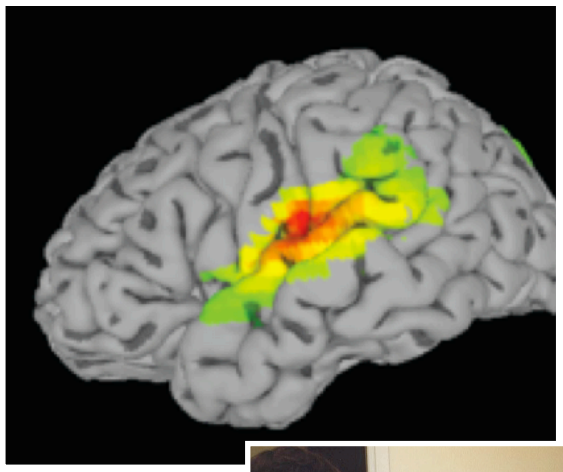
BRAIN, COGNITION & LANGUAGE

A Publication of the
CT Institute for the Brain and Cognitive Sciences

ATYPICAL LANGUAGE DEVELOPMENT

Disorders in the development of language

IN THIS ISSUE



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 was conceived through cross-department discussion and collaboration fostered by the IGERT training program (see http://igert.psy.uconn.edu for more information) and the Cognitive Science Program. It has since grown to encompass a broad scientific community across the UConn campuses.

What do we do?

Our goal is to further the scientific understanding of the mind and its biological instantiation through a cooperative and integrative approach. This requires that new methods and frameworks be developed and that the tools and knowledge of familiar cognitive-level

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Science & The Public Good: Evidence Based Practice

Advances in scientific understanding proceed as a continuous interplay between current theories which drive the development of testable hypotheses, and careful analysis of empirical data resulting from experimental tests of hypotheses. The extent to which scientists trust experimental results depends on two factors: reliability (roughly, the stability of findings over time), and validity, (does an experiment measure what it purports to measure). Since scientists depend on the criteria of reliability and validity to interpret their findings, they can provide valuable tools to decision makers in many different spheres of the public arena. For example, empirical research on the effects of learning approaches, environments and materials, can help inform education policy.

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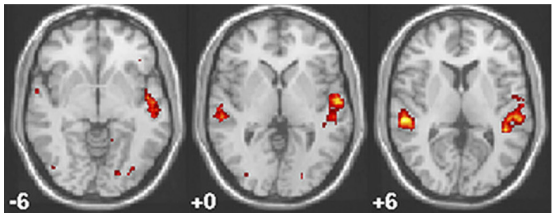

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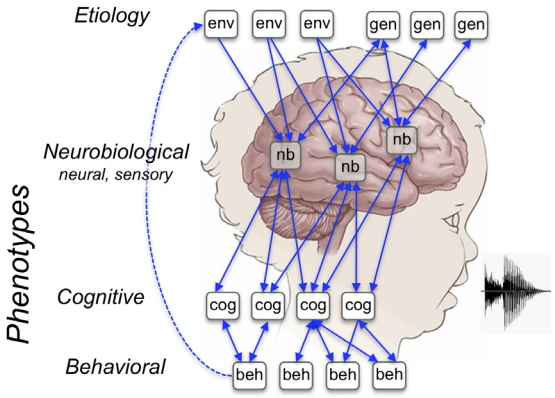
our research community

approaches to language be combined with biological and computational ones so that researchers may learn and become familiar with the theories and methodologies of their peers from other disciplines. These methods include computational and linguistic modeling, behavioral studies, electrophysiology, behavioral and bench neuroscience, genetics, and animal models.

A key area of Brain & Cognitive Sciences research at UConn is language development. There are still a lot of unanswered questions about how children acquire language, whether they are typically developing or are affected by a developmental disorder. Thus, our students and faculty do work on both typical and atypical language development, aiming to build a comprehensive picture of language development as a whole through studies spanning genetic, neural, theoretical, and behavioral aspects of language development. Below is a small selection of our research findings concerning ASD (Autism Spectrum Disorder), Dyslexia, and Specific Language Impairment.



Definitions of Disorders

Dyslexia, Developmental Language Disorder/Specific Language Impairment, and Autism Spectrum Disorder are disorders that affect language and communication. Symptoms are present from early development and persist through the lifespan, except in rare cases.

Developmental Language Disorder (DLD) or Specific Language Impairment (SLI)

Developmental language disorder (DLD) or language delay, also known as Specific language impairment (SLI), is a language disorder that delays the mastery of language skills in children who have no hearing loss or other disorders that could explain why they are struggling with language. It is one of the most common childhood learning disabilities, affecting approximately 7 percent of children in kindergarten. It is a lifelong disorder, and it is associated with a host of outcomes that range from academic achievement to socio-emotional functioning to behavioral adaptation to occupational success.

Did You Know?

Specific Language Impairment (SLI), Developmental Language Disorder (DLD)

Did you know Specific Language Impairment (SLI), also known as Developmental Language Disorder, affects 7-8% of children in kindergarten (NIDCD, 2013) and is one of the most common childhood learning disabilities.

FACT CHECK: Children with SLI take longer than their age- matched peers to produce their rst words. While most children produce their first words by age 1, children with SLI may not produce any words until age 2. Children with SLI may also show marked difficulty using verb phrases in their language and reading.

Did you know individuals with SLI are often late talkers and have special difficulty with verbs?

FACT CHECK: Children with SLI are often late to talk and may not produce any words until they are 2 years old. At age 3, they may talk, but may not be understood. As they grow older, children with SLI will struggle to learn new words and make conversation. Having difficulty using verbs is a hallmark of SLI. Typical errors include dropping the "s" from the end of present-tense verbs, dropping past tense, and asking questions without the usual "be" or "do" verbs.

Dyslexia/Reading Disability

Dyslexia is a brain-based learning disability that specifically impairs a person's ability to read despite having typical intelligence. A common characteristic among people with dyslexia is difficulty with phonological processing. Phonological processing includes skills that let people manipulate the individual sounds of words, such as saying the word cat without the first /k/ sound or saying words that rhyme with cat. Individuals with dyslexia also often have difficulty with spelling and with rapid visual-verbal responses.

Did You Know?

Dyslexia/Reading Disability

Did you know dyslexia reflects an underlying deficit in Phonological Processing, it is NOT a visual disorder (e.g., switching letters)?
FACT CHECK: It is often believed that individuals with dyslexia simply switch letters and that is the cause of the reading deficit. However, research indicates that the reading impairment is not linked to visual deficits; rather, it reflects underlying problems in phonological awareness.

Did you know that dyslexia is a lifelong condition, it is NOT a simply a phase children grow out of?
FACT CHECK: While many people with dyslexia may develop effective strategies for dealing with their reading problems, dyslexia is a lifelong condition.

Did you know dyslexia and intelligence (e.g., IQ) are SEPARATE?
FACT CHECK: Dyslexia is defined as a learning difficulty in the absence of other intellectual deficits. Dyslexia is a learning difficulty characterized by specific deficits to reading and reading fluency, which can also affect reading comprehension. With proper support mechanisms, individuals with dyslexia can learn to become good readers and writers.

Did you know there are clues BEFORE school that a child may have dyslexia?
FACT CHECK: Children with dyslexia often have delayed speech in addition to difficulty with rhyming.

Want to learn more about how neuroscience research has helped to debunk dyslexia myths? This blog post from the Cognitive Neuroscience Society can tell you more: http://www.cogneurosociety.org/dyslexia_myths/

Autism Spectrum Disorder (ASD)

Autism spectrum disorder (ASD) is a neurodevelopmental disorder characterized by deficits in social communication and social interaction as well as the presence of restricted, repetitive patterns of behavior, interests, and activities (National Institute of Mental Health).

Did You Know?

Austism Spectrum Disorder (ASD)

Did you know while language impairment is not a criterion for ASD, deficits in language are often found?
FACT CHECK: While some children with ASD acquire language comparable to typically developing peers, about 25% remain nonverbal. Trajectories of language acquisition also vary, some with typical but delayed development. The language domain in which deficits are found (e.g. sounds, words, sentences, conversation) can differ. Impairment in pragmatics (conversation) is most characteristic (Naigles & Chin, 2015).

Did you know children with autism benefit from early intensive behavioral intervention?
FACT CHECK: Children with ASD benefit significantly from behavioral intervention, particularly early in life. This intervention, "Applied Behavior Analysis", is the most effective way to strengthen verbal and nonverbal communication skills, such as making eye contact. Research at UConn shows the earlier this intervention is provided, the better.

Did you know that childhood vaccination and ASD diagnosis are completely SEPARATE?
FACT CHECK: Child vaccinations are an important component of early health care, helping to protect children from infectious diseases some of which can be fatal. Some may have heard rumors that ASD might be linked to childhood vaccines, as suggested by Andrew Wakefield in 1998. Wakefield speculated that the measles-mumps-rubella (MMR) might cause ASD or other neurodevelopmental disorders. Wakefield has since lost his medical license because of unethical behavior, and his ideas have been refuted. Over 20 studies, including millions of subjects, have looked for a relationship between the ASD and vaccines, and the verdict is in: vaccines do not cause autism (Gerber & Offit, 2009). Vaccines do provide essential disease prevention for children.

RESEARCH SUMMARIES

SLI/DLD

Dr. Tammie Spaulding's lab focuses on assessment of language disorders and the factors involved in identifying children with **SLI**. Current research examines cognitive abilities of children with **SLI** and how skills not related to language, including executive functioning and IQ, may differ in children with **SLI**. Research aims to examine long term outcomes of kids with **SLI**, and how this impairment may have an impact on other important life skills including understanding a driving test and the Miranda Rights. One reason why it is so important to focus research efforts on SLI is because it affects a large number of children, around 7-8% (NIDCD, 2013). Given that **SLI** may result in significant impairments, it is important to have a better understanding of the functional long term impacts of these deficits.

SLI/DLD

Dr. Sergey Kornilov's work focused on identifying the neurobiological sources of children's **speech and language difficulties**. He and his team worked with a very special geographically isolated population in rural Russia. A large proportion of children and adults in the population exhibit significant speech and language problems. Their goal was to use this unique population to find genes that could be responsible for the development of brain systems that support language development. Using DNA samples provided by ~400 individuals from the population, they were able to identify a novel candidate gene for language development difficulties *(SETBP1)*. In addition, they are developing a better characterization of the role of this gene in children's development in general, neural development in particular, by also obtaining recordings of electrical brain activity for linguistic and non-linguistic tasks.

AUTISM SPECTRUM DISORDER

Typically developing children's joint attention skills have been consistently linked to advanced language later in development. Before the current study, joint attention skills in children with **ASD** were only examined in formal tests, not in "regular" parent-child interactions. The research team coded joint attention and language from play sessions and found that typically developing children *and* children with **ASD** who participated in more joint attention episodes with their parents at earlier visits were the ones who consistently showed steeper language growth over time. The presence of joint attention at early visits had the strongest effect on low verbal children; that is, the ones who engaged in joint attention were the ones who showed steady increases in nouns over time (**Kelty-Stephen et al. 2014**).

AUTISM SPECTRUM DISORDER

The development of spoken language may rely upon the calibration of auditory processing abilities for speech. Some people with **autism spectrum disorder (ASD)** have superior auditory perceptual abilities. In fact, research by **Eigsti and Fein (2013)** shows that people with **ASD** are able to discriminate between auditory frequencies that typically developing people are unable to discriminate. Their research also showed that better auditory discrimination abilities are related to more difficulties in the acquisition of first words. Greater **ASD** symptom severity was also related to better auditory discrimination. This work suggests that heightened auditory processing abilities may contribute to deficits in language abilities in **ASD**.

DYSLEXIA/READING DISABILITY

Dr. Holly Fitch's lab examines the underlying biological and genetic causes of **Dyslexia**. There have been 14 candidate risk genes identified, however there are varying degrees of supporting evidence, and the functional roles of these genes remain poorly understood. One of these genes, dyslexia susceptibility 1 candidate 1 *(DYX1C1)* has been shown to be associated with deficits in short-term memory and non-word reading. Current studies further examine these deficits utilizing a mouse model with a knockout (i.e., the gene is made inactive) of *Dyx1c1*. Mice with the gene knockout showed deficits on memory and learning but not on any auditory processing or motor tasks, suggesting *DYX1C1* may play an underlying role in the development of neural systems important to learning and memory. Disruption of this function could explain the learning deficits seen in **individuals with dyslexia**.

DYSLEXIA/READING DISABILITY

While the structure and function of brain networks involved in **typical and atypical reading** are increasingly better understood, the underlying neurochemical bases of differences in reading development are mostly unknown. **Pugh et al. (2014)** is the first study to examine neurochemistry in children during the critical period in which the neurocircuits that support skilled reading are still developing. In a longitudinal study of emergent readers (ranging from **impaired** to superior), the relationship between reading and reading-related skills and concentrations of neurometabolites was examined. Higher concentrations of glutamate and choline were associated with poorer performance. Higher glutamate concentrations may affect networks involved in learning and consolidation. Higher choline might reflect excessive connectivity or abnormal myelination. These findings point to new directions for research on gene-brain-behavior pathways in human studies of reading disability. (**Pugh et al., 2014**).

UConn has taken delivery of a brand-new MRI scanner that promises to give researchers their clearest pictures yet of the inner workings of the human brain.

The scanner will be the centerpiece of the new Brain Imaging Research Center (BIRC) at the University of Connecticut, and marks an important milestone in UConn's continuing rise to prominence in the cognitive and brain sciences.

The scanner, made by the Siemens engineering company, is the company's newest and most advanced model, and will offer UConn researchers one of the most advanced imaging platforms available anywhere in the world.

"This is huge," said Emily Myers, an assistant professor of Speech, Language, and Hearing Sciences whose work makes heavy use of MRI brain scans. For more than three years she has been traveling to Brown University to use the MRI scanner there, but she will now have a more advanced instrument just steps from her office. "It's going to bring all of us who are already doing imaging research on campus to the same hub. That's where the cross-pollination of ideas happens."

Projects currently planned for the center include work on the nature of language, the origin of speech, and recovery from traumatic brain injuries. "I'm particularly excited by the new lines of research," said Jay Rueckl, professor of psychology and director the the new center. "Many of them involve new and often interdisciplinary collaborations." Joining Rueckl is Peter Molfese, director of MRI operations, who came to UConn from Yale University. The scanner was officially declared 'open for business' in the Fall.

UConn Brain Imaging Research Center (BIRC)

Inge-Marie Eigsti with the new FMRI at the Philips Communications Sciences Building on Sept. 28, 2015. *(Peter Morenus/UConn Photo)*

STATE OF UCONN

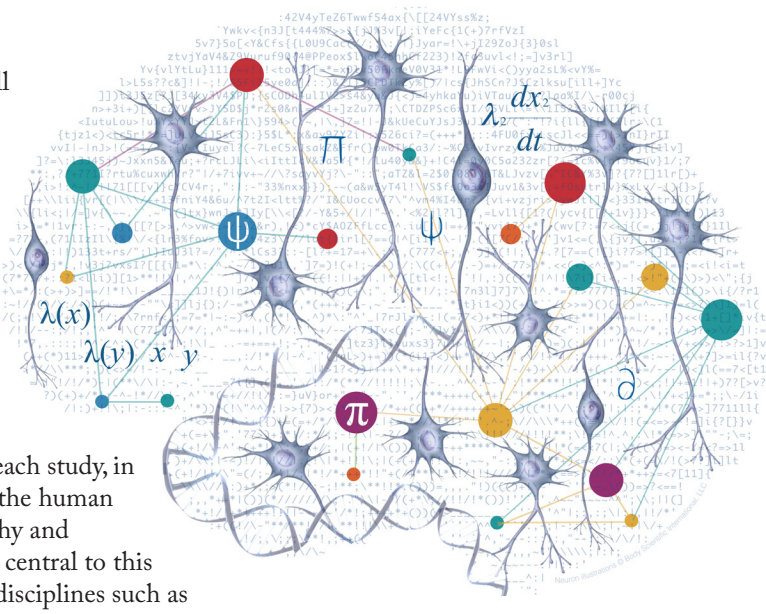
UCONN

CONNECTICUT INSTITUTE FOR THE BRAIN AND COGNITIVE SCIENCES

Also opened for business during the Fall of 2015 was the new Connecticut Institute for the Brain and Cognitive Sciences (IBACS), funded by the University's Academic Plan. The Institute's mission is to promote and support the interdisciplinary science of the mind and its realization in biological and artificial systems. It will enable new research and educational opportunities for students, postdoctoral researchers, and faculty to extend their intellectual reach beyond traditional disciplinary boundaries.

"UConn has world-class but distributed expertise in the brain and cognitive sciences" said Gerry Altmann, director of the new institute, "and the Institute's mission is to bring this expertise together to push the science forward into new territory."

The Institute will be disbursing seed money and student fellowships to encourage research that crosses the traditional boundaries that separate the individual disciplines that each study, in their own ways, the human mind. "Philosophy and linguistics are as central to this endeavor as are disciplines such as neuroscience and psychology. What is so unusual at UConn is that people working in such different disciplines are already talking to one another; the Institute is a reaction to this groundswell of discussion and collaboration already taking place across the different communities at UConn".



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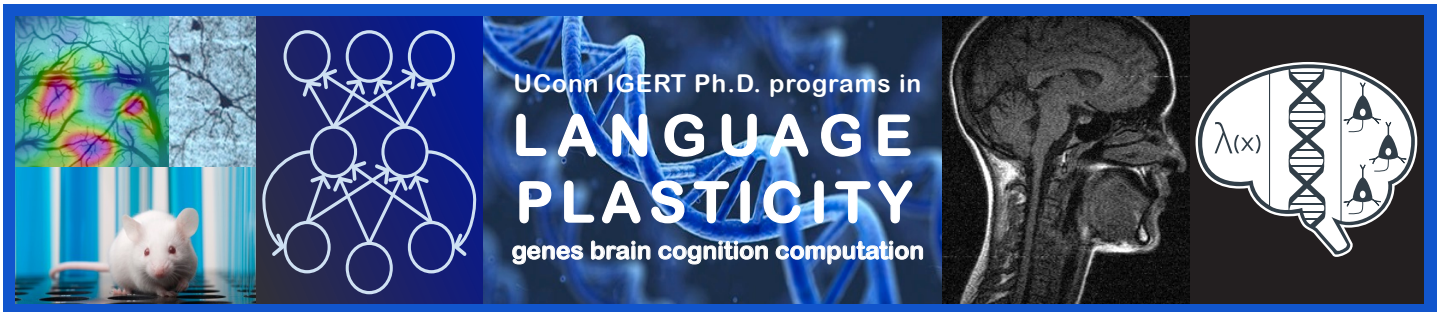


Meet Our Graduate Students

UConn is home to cutting-edge, state-of-the-art research that is integrative, interdisciplinary, and innovative. The new cognitive-biological synthesis approach requires expertise from a wide variety of disciplines. Collaboration is encouraged, helping foster strong interdisciplinary connections. This is most evident in our wonderful graduate student population. Grad students are an important element in academic research: our programs attract diverse and talented students from near and far. We are pleased to introduce graduate students whose research exemplifies this approach and is intimately related to the theme of this issue.

Amanda Rendall

Psychological Sciences: Behavioral Neuroscience

Research Focus: *Rodent models of neurodevelopment disorders, Genetic disruption of early neural development, Autism, Dyslexia, Specific Language Impairment*

Advisor: Holly Fitch

Emma Nguyen

Linguistics

Research Focus: *First Language Acquisition, Theory of Mind Development, Psycholinguistics*

Advisor: William Snyder

Julia Drouin

Speech, Language, and Hearing Sciences

Research Focus: *Speech Perception, Perceptual Learning, Auditory Processing, Neuroimaging Techniques (fMRI) and Electrophysiology*

Advisor: Rachel Theodore

Iliana Meza-Gonzalez

Psychological Sciences: Perception, Action, and Cognition

Research Focus: *Speech Perception; Perceptual Learning in Speech*

Advisor: Emily Myers

Oliver Sawi

Psychological Sciences: Perception, Action, and Cognition

Research Focus: *Language acquisition and development in typically and atypically developing populations, Bilingual Education, Biliteracy, Visual Word Recognition, Dyslexia*

Advisor: Jay Rueckl

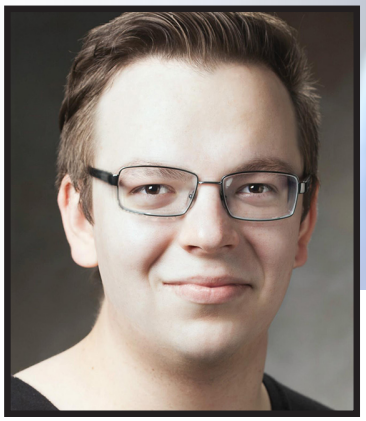
Kacie Wittke

Speech, Language, and Hearing Sciences

Research Focus: *Specific Language Impairment, Autism, Executive Functioning*

Advisor: Tammie Spaulding

Alumni Feature



Dr. Sergey Kornilov

Dr. Sergey Kornilov received his specialist diploma (MA/MSc equivalent) from Moscow State University with a focus on Educational Psychology and Psychometrics. In 2014, He received his PhD from UConn in Experimental Psychology, with a concentration in Language and Cognition, under the mentorship of Dr. James S. Magnuson. Sergey currently works as a Postdoctoral Associate at the Yale University Child Study Center. In this position Sergey is able to work on multiple projects that directly relate to his research interests. Sergey works as a project director on helping to develop a standardized assessment for language in Arabic language. Additionally, Sergey is examining the molecular underpinnings of complex developmental traits and disorders and is the primary bioinformatician working on a set of genome-wide and candidate gene association studies on reading, language, and intelligence. Sergey also supervises the EEG/ERP portions of a large scale study which tracks children's development in different contexts including foster care and biological families. Sergey credits much of his academic success to the amazing research community at UConn and Haskins Laboratories. As a graduate student, Sergey was able to begin a highly interdisciplinary line of research through the mechanism of the IGERT. This has allowed him to begin to bridge some of the gaps of communication across major research disciplines, such as molecular genetics and psycholinguistics. The workshops, coursework, and support from the IGERT faculty have been essential for his success as both a graduate student and a scientist. These experiences has allowed Sergey to develop skills and methodological approaches which he has begun to implement in his postdoctoral work and plans to continue throughout his career.

"The students who produced this digest are all members of the Neurobiology of Language training program at UConn. This program is funded by a $3,000,000 grant from the National Science Foundation (entitled "Language Plasticity: Genes, Brain, Cognition, Computation"). The program brings together students and faculty from 7 PhD programs at UConn, including Linguistics, Neuroscience, several programs in Psychological Sciences, and Speech, Language & Hearing Sciences. Our aim is to develop a comprehensive understanding of language development throughout the lifespan, as well as how the brain adapts in the face of developmental language disorders (such as dyslexia or autism spectrum disorders) or acquired disorders (such as aphasia following a stroke or traumatic brain injury)."

— Prof. Jim Magnuson, Director of the Neurobiology of Language PhD Training Program

Faculty Feature

Dr. R. Holly Fitch

Dr. Fitch is a Professor at the University of Connecticut in the Behavioral Neuroscience Division of Psychology. She also holds the position of UConn Animal Care and Use Committee Chair, as well as serves as a member on the following committees University Scholar/Award & Summer Research Fellowship Committee, Cognitive Science Steering Committee and Institute for Systems Genomics. Her research interests include neurodevelopmental disruption of cognitive/sensory processing deficits as well as neurodevelopmental genetics and modulators (e.g. hormone, experience, stress and enrichment).

Dr. Fitch's primary contributions have been in the areas of behavioral and developmental neuroscience. She is one of the first neuroscientists to investigate behavioral phenotypes of language disorders risk genes in animal models. Recently, her lab investigated the genetic modulation of developmental neural features in mice that may, in humans, impact on language. Interestingly, the language gap between humans and non-lingual rodents can be bridged by the examination of "intermediate language phenotypes," such as complex acoustic processing, and working memory. In fact, Dr. Fitch developed the modified pre-pulse inhibition paradigm that is used to assess rapid and complex auditory processing abilities in rodents in her lab. The most recent models that have been studied in Dr. Fitch's lab include mice genetically engineered for mutations in the Dyx1c1 gene (rodent homolog of DYX1C1, a dyslexia risk gene) and the Cntnap2 gene (an autism risk gene). The results from these studies indicate both of these genes may impact on the development of language-relevant features (i.e., mutations are associated with complex acoustic processing impairments and working memory impairments, respectively).

Dr. Fitch's research is both translational and influential due to the fact that these specific genes can be tied to the developmental emergence of different foundational aspects of language function, which opens a new door to the study of genetic modulation of the neural basis for language development in humans. Furthermore, these studies may provide useful information for early screening that could allow for optimal intervention strategies on an individual basis. research and thinking in these areas.

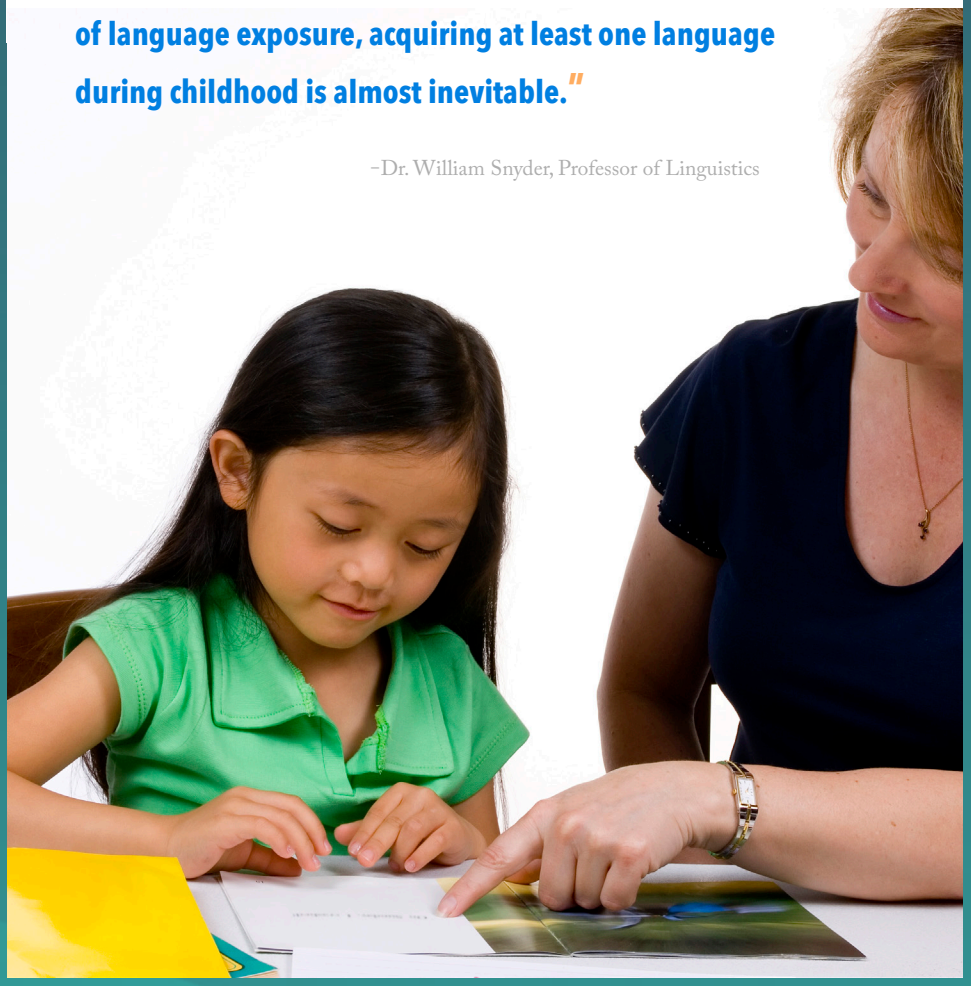
Continued from page 1

Science and the Public Good

Many brain and cognitive scientists examine problems that apply to the public good, including the areas of health, education, and human services. They study how people use language, read, remember things, solve problems, and behave socially. They investigate how the symphony of activity in the brain supports these mental processes. They also attempt to answer questions about how brain functions can become disrupted. Their work connects to public policy in a variety of ways. For example, when scientific studies reveal that a new reading intervention for children is more effective than existing interventions, education leaders could implement the new approach in order to increase the benefit for students. This exemplifies the concept of evidence based practice. Science informs best practices and policies for education, health, and related areas. Our practices must be founded upon scientific evidence of effectiveness, rather than conventional wisdom. History holds various instances of the damaging effects of reliance on practices that were not supported by research. With each new development in the field of brain and cognitive science, society gains a better foundation for promoting the public good.

"Many people believe that children acquire language because their parents TEACH it to them, but the reality is that children acquire language because they JUST CAN'T HELP it. Language is a biological characteristic of our species. Unless the child is somehow deprived of language exposure, acquiring at least one language during childhood is almost inevitable."

–Dr. William Snyder, Professor of Linguistics



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CT Institute for the Brain and Cognitive Sciences Research Digest is Published for the purposes of Community Outreach. This issue has particular input from Psychological Sciences, Linguistics, and Speech, Language, Hearing Sciences for the purposes of community outreach.

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