Annual Report 2013

This document contains introductory descriptions of our project for our external advisory panel and text extracted from our web-based annual report to the National Science Foundation, submitted 4/20/13

LANGUAGE PLASTICITY

genes brain cognition computation

A National Science Foundation IGERT Ph.D. training program at the University of Connecticut

UCONN
UNIVERSITY OF CONNECTICUT

NATIONAL SCIENCE FOUNDATION

(((Haskins Laboratories)))

UConn IGERT on
Language Plasticity: Genes, Brain, Cognition, Computation
Report to the External Advisory Panel, April 26, 2013

Contents:

This report brings together some basic information about our vision, and extracts from our Year 1 progress report to NSF.

Other documents presented to the advisory panel:
- Funded proposal
- 2-page Progress Summary
- Slides from overview presentation by PI Magnuson
- External assessment report from consultant **Dr. Mariko Chang**

Abstract: On July 1, 2012, we launched a new interdisciplinary training program funded by a National Science Foundation IGERT (Integrative Graduate Education and Research Training) grant. The core idea behind our training program is that the time is ripe to unify research on language in cognitive disciplines (linguistics, psychology, communication disorders) with research in biological domains (behavioral and molecular neuroscience and genetics). Our IGERT training program will provide Ph.D. students from cognitive and biological disciplines with a core of five "Foundations" courses that given them sufficient familiarity with methods, assumptions, theories, and terminology from each participating domain, preparing them to work in collaborative teams who (a) can communicate across conventional disciplinary boundaries and (b) collectively have the sufficient breadth and depth to develop unified biological-cognitive approaches to language development.

Site visit. On April 26, 2013, four distinguished scientists will perform our first annual External Advisory Panel site visit. The panelists in attendance are:
- **Sheila Blumstein,** Albert D. Mead Professor of Cognitive, Linguistic and Psychological Sciences, Brown University
- **Albert M. Galaburda**, MD, Emily Fisher-Landau Professor of Neurology (Neuroscience), Harvard Medical School
- **Dianne Newbury,** MRC Career Development Fellow, Welcome Trust Centre for Human Genetics; Junior Research Fellow, St John's College, Oxford
- **Colin Phillips,** Professor of Linguistics & Distinguished Scholar-Teacher; Co-Director, Cognitive Neuroscience of Language Lab & Maryland MEG Center; Associate Director, Neuroscience and Cognitive Science Program

Advisors unable to visit this year:
- **BJ Casey**, Sackler Institute, Weill Medical College of Cornell
- **Simon Fisher**, Max Planck Institute for Psycholinguistics
- **Annette Karmiloff-Smith**, Birkbeck College

Our vision: Unifying cognitive and biological approaches to language

Language is a defining element of human experience. However, the scientific understanding of language is in its infancy. We have yet to understand the genetic and neurobiological foundations of language development, the mechanisms that allow humans to achieve robust, adaptive perception across incredible variation in signal and environment, the biological, environmental, and experiential factors that support or disrupt language development, or the nature and limits of plasticity evident in linguistic recovery from acquired disorders, such as traumatic brain injury. This basic-science understanding has the potential to address many societal challenges, including technological, educational, and clinical challenges. Achieving this understanding will require new methods and theoretical frameworks, and tools and knowledge of familiar cognitive-level approaches to language d molecular neuroscience. Enormous challenges must be overcome before a synthesis of these fields can be achieved: scientists must be able to communicate across disciplinary boundaries before they can collaborate; new methods and theories are required for cognitive-level domains to grapple with systematic individual differences; new methods and theories are required for all disciplines to grapple with the complex genetic, neural, cognitive, and environmental interactions on which language development depends; and a unifying theoretical framework is required to link cognitive and biological approaches to language.

Our IGERT training program is inspired by the realization that the necessary disciplinary elements for this synthesis have recently emerged, and that we have the necessary personnel, expertise, and theoretical vision at UConn and Haskins Labs to achieve it. We have assembled a team of faculty from 7 Ph.D. programs (Linguistics; Speech, Language & Hearing Sciences; Physiology & Neurobiology; and 4 programs in Psychology: Behavioral Neuroscience, Clinical Psychology, Developmental Psychology and Perception-Action-Cognition) and Haskins Labs with the necessary skills and methods needed to launch a new cognitive-biological synthesis approach to language. The missing element is a formal training program, and a critical mass of trainees eager to participate in this pioneering endeavor.

Our IGERT training program provides Ph.D. students from cognitive and biological disciplines with a core of five "Foundations" courses that given them sufficient familiarity with methods, assumptions, theories, and terminology from each participating domain, preparing them to work in collaborative teams who (a) can communicate across conventional disciplinary boundaries and (b) collectively have the sufficient breadth and depth to develop unified biological-cognitive approaches to language development. Home-department curricula, IGERT electives, and international interships at research centers with cutting-edge technology prepare IGERT trainees to become leaders within their fields, as well as in the emerging unification of biological and cognitive approaches to understanding language development.

Curriculum

IGERT Trainees complete the curricula in their home departments. In addition, they complete the IGERT **core curriculum**, which consists of five Foundations courses (described below), attend the weekly IGERT "Talk Shop" (where we talk shop and work on professional development skills, such as giving talks), and attend the many optional IGERT activities: elective courses, talks by and meals with invited speakers, and "J-Term Primers" (short courses available during January break on academic, professional development, and methodological topics).

1. **Foundations 1: Genomic Sciences, Brain, and Computation**. Introduction to themes that are most cross-cutting, most in need of technical background, and least likely for all trainees to have

been solidly trained in as undergraduates. This course in particular lays out the vision of the empirical-theoretical framework motivating our IGERT and provides the core knowledge needed to participate in that vision.

2. **Foundations 2: Language Structure and Psycholinguistics**. Students in this course gain an appreciation for the complexity of speakers' tacit grammatical knowledge, and for the feat of child language acquisition, by constructing explicit, testable theories of grammatical phenomena in unfamiliar languages (e.g., Navajo, Georgian, Mohawk), and testing them against additional data from the language. Emphasis is placed on using theory to answer the logical problem of language acquisition (How can learning reliably occur, given the seemingly impoverished input that even typically developing children receive?) to theories of atypical language development. Moreover, by reviewing relationships between linguistic models and brain-inspired psycholinguistic models, the course will provide a foundation for spanning the large gap between neural-level and grammar-level understanding of the world's languages.

3. **Foundations 3: Neurodevelopment and Plasticity**. Foundations in: neurodevelopmental processes (neurogenesis, migration, synaptogenesis, pruning, and the genetic mechanisms that regulate them); neuroembryology and phylogeny; developmental plasticity (sculpting of cortical circuits through intrinsic and extrinsic experience, teratology, deprivation and re-organization); cognitive neurodevelopment; and genetics of neurodevelopmental pathology (SLI, dyslexia, ASD, Williams syndrome). Such knowledge- sets are necessary for all students to achieve a systems perspective on language development.

4. **Foundations 4: Typical and atypical language development**. These comparisons will provide a window into mechanisms and processes of language development in 3 ways. (1) For content areas (e.g., lexical, syntactic, and pragmatic knowledge), we will interleave readings focusing on typical and atypical language profiles. (2) We will characterize linguistic knowledge using data drawn from naturalistic approaches, psycholinguistic experiments, clinical assessments, genotype/phenotype comparisons, and intervention/plasticity. (3) We will integrate research on underlying causes/mechanisms of atypical language outcomes with the cognitive and computational processes assumed to be operating in typical acquisition, and illustrate how atypical trajectories and outcomes inform fundamental theory.

5. **Foundations 5: Neurobiology of typical and atypical language**. The goal of this course is to provide students with the tools to critically evaluate primary literature on the neurobiology of language in both typical and atypical populations, filling important historical and bidirectional gaps between cognitive neuroscience and language impairment research, and emphasizing basic science insights that originated from observations in atypical populations. We begin with methodological challenges and contributions that neuroimaging, computational modeling, and impaired populations present, and complete the course by examining important case studies where data from clinical populations, computational modeling and neuroimaging evidence can be integrated to guide formation of more complete models of language function. Ultimately, students will be conversant with techniques necessary to create multi-disciplinary research programs that integrate the many sources of evidence available to language scientists.

IGERT electives include many existing courses within our Ph.D. programs. We have also begun developing several electives specifically integrated with the IGERT. Here is a partial list:

- Techniques for brain and language (neuroimaging), E. Mencl, Director of Neuroimaging, Haskins. Introduction to magnetic resonance imaging (MRI) with emphasis on language, covering the physics of MRI, and hands-on fMRI design, acquisition and analysis. Advantages and disadvantages of MRI, EEG/ERPs, and MEG will be discussed. Students will leave the

course with an enhanced ability to interpret neuroimaging findings in the context of linguistic and cognitive theory.

- Introduction to computational neuroscience, H. Read, BNS. Explores domain-specific and -general aspects of organization in sensory and motor cortices from a computational perspective.
- Sensory Neuroscience Laboratory. H. Read, BNS. Techniques employed in the experimental investigation of sensory neuroscience, hearing and sound discrimination of human and animals. Computer programming (Matlab) is used to synthesize and process sounds and analyze human psychophysics; human and animal auditory evoked brainstem potentials data. Read will retool this class to make it accessible to non-BNS students and integrate it with IGERT themes.
- Time course methods, J. Magnuson, PAC. Magnuson will retool this hands-on seminar in eye tracking and EEG/ERP developed for his current NSF CAREER award to be accessible to students from all Ph.D. programs. This course has a history of preparing students through hands-on training in service of team-based, real research projects (90% of student projects have led to national conference presentations and/or publications).

EXTRACTS FROM OUR NSF ANNUAL REPORT

KEY QUESTIONS FROM NSF ANNUAL REPORT (BOLD) AND OUR RESPONSES

Describe how the Competitive Innovation Incentive Fund (CIIF) was used, barriers to implementation of CIIF training activities, and notable CIIF training successes.
Our CIIF was used to start collaborations led by IGERT fellows bringing together faculty and students from multiple Ph.D. programs. Two projects in particular standout. First, Fellow Brian Castellucio started a collaboration with his advisor, Inge-Marie Eigsti (Clinical Psychology) and his breadth mentor, Holly Fitch (Behavioral Neuroscience). They are developing mouse models of the genetic and neurobiological basis of differential auditory sensitivity in Autism using specially bred mice to isolate candidate genes. The funds were used to purchase advanced audio equipment needed to conduct the study. Second, Fellow Katie Shaw started a collaboration with her advisor, Heather Bortfeld (Developmental Psychology) and Heather Read (Behavioral Neuroscience) to conduct comparative studies of auditory development in infants and mice using optical imaging. Funds were used to purchase advanced equipment needed to conduct the research. We hope to report results next year.

Research Achievements

First achievement:
IGERT Associate Kornilov is bridging cognitive neuroscience (Magnuson, PI) and behavior and molecular genetics (Grigorenko, Investigator). Grigorenko has been genotyping residents of a remote Russian village with high incidence of language impairment and absence of other cognitive deficits. Kornilov used Magnuson's electroencephalography rig to assess cognitive and linguistic abilities in impaired and unimpaired village children with 6 experimental tasks. So far, we have analyzed 3. Event-related potentials reveal normally detailed phonetic resolution in impaired children; deficits emerge in linguistic and nonlinguistic tasks requiring sustained attention, with intriguing differences in sensitivity to phonological overlap (e.g.,

impaired children show less sensitivity to rhyming). Grigorenko is training Kornilov in genetic techniques so he can lead genetic analyses of individual differences that could be linked to our experiments. One paper has been submitted.

Second achievement:
Through the impetus of the IGERT program, we have developed a collaborative research project that includes two IGERT faculty members (Fitch: Psych-neuroscience) and Eigsti: Psych-clinical), an IGERT Fellow (Castelluccio) and two IGERT Associates (Truong and Rendall [who will be a fellow 2014-2016]). The project is aimed at behavioral characterization of a knock-out mouse line, particularly to characterize language-related phenotypes. The knock-out gene of interest is Cntnap2, a gene that is in turn regulated by Foxp2. While Foxp2 is often considered a "language" gene, a homolog is found in non-human species. Our investigations are ongoing, data is being collected, and will be presented at the LanguageFest April 27, 2103. The project has resulted in the submission of 3 collaborative grant proposals.

Third achievement:
At the 2013 Linguistic Society of America meeting, Snyder, Naigles, Lillo-Martin, & Petroj presented results from the first study to apply Intermodal Preferential Looking (experimental technique from developmental psychology) to a test of a "parametric" hypothesis from theoretical linguistics, where grammatical information a child acquires is more abstract than surface structures it yields. Snyder (1995-2012) argues for "The Compounding Parameter" (±TCP), where [+TCP] is needed for particle constructions (pull the top off) and "creative" noun-noun compounding ('NNC', apple box lid). Two-year-olds viewed 2 side-by-side images, and heard audio matching only one, with items testing comprehension of particles ("She's kicking it up/down!"), and NNC ("Look at the hand chair / hand on the chair!"). As predicted, children who looked longer at matching images for particles also looked significantly longer and more quickly to NNC matches, indicating an abstract generalization to novel NNCs.

Education Achievements

First achievement:
Our "breadth mentorship" and team-based models of training are succeeding in opening new lines of trainee-led research. A partial list: [1] a mouse-model study investigating the genetic and neurobiological bases of Autism led by Fellow Castelluccio [Clinical Psych.], bringing together Associate Trainees Rendall and Truong [Behavioral Neuroscience (BNS)] and Investigators Fitch [BNS] and Eigsti [Clinical Psych.]; [2] comparative study of mouse and human infants with potential to yield new insights into genetic and neurobiological bases of the development of auditory sensitivity led by Fellow Shaw [Developmental Psych.] bringing together Investigators Bortfeld [Dev. Psych] and Read [BNS]; [3] electroencephalographic and genetic analyses of impaired and unimpaired children in a remote Russian village with high incidence of language impairment led by Associate Trainee Kornilov [Perception-Action-Cognition] and bringing together Investigators Magnuson [PAC] and Grigorenko [Yale/Haskins]

Second achievement:
We launched 2 of our 5-course "Foundations" sequence that provides students from diverse areas (from linguistics to neuroscience) with sufficient background in each other's fields to allow them to work in collaborative teams. Foundations 1 covered fundamentals of neuroscience, genetics, linguistics, psychology, and computation, with just enough depth to jump-start student interest and prepare them for subsequent Foundations and specialized courses. This was effective: in Foundations 3 (Neurodevelopment & Plasticity), students with backgrounds in linguistics, communication disorders, and psychology kept up with neuroscience students. Trainees report our training has "forced them to think outside" their home disciplines, leading them to "think more deeply" about their own work, and "draw connections [they] would not have otherwise". Faculty report that diversity in student backgrounds led to novel discussions and is changing the way they think about aspects of their home disciplines.

Third achievement:
We conducted our first "J-Term Primers" during winter semester break. We conducted 7 short courses: (1) Hands-on computational modeling, (2) Hands-on statistical modeling in R, (3) Genetics crash course, (4) Language sampling [methods for collecting & quantifying natural language behavior], (5) Speech analysis using Praat, (6) Assessment [approaches from neuropsychology & communication disorders], (7) Neurophysiology [principles of fMRI and EEG/ERP]. We had 3 Professional Development Brownbags covering topics like preparing for the job market, how to get the most from conferences, and ethics across our component disciplines. We had 2 special events: a "dinner talk" by Investigator Coppola and a movie night where we watched "Project Nim", which led to discussions of the ethics of research and communication in non-human species. The courses accelerated student and faculty learning in practical and theoretical domains, and the special events were effective in team- and morale-building.

Trainee Achievements
Our 4 first Fellows each started a new research collaboration inspired by IGERT. [1]] A mouse-model study investigating the genetic and neurobiological bases of Autism led by Fellow Castelluccio [Clinical Psych.], bringing together Associate Trainees Rendall and Truong [Behavioral Neuroscience (BNS)] and Investigators Fitch [BNS] and Eigsti [Clinical Psych.]; [2] A comparative study of mouse and human infants with the potential to yield new insights into genetic and neurobiological bases of the development of auditory sensitivity led by Fellow Shaw [Developmental Psych.] bringing together Investigators Bortfeld [Dev. Psych] and Read [BNS]; [3] A study of gesture's role in lexical access and implications for aphasic recovery led by Fellow Jenkins [SLHS] bring together Coelho [SLHS] and Coppola [Dev. Psych. & LING]; [4] An EEG study on the use of prosody in language comprehension in Autism led by Fellow Richie, bringing together Eigsti & Magnuson.

Barriers to Implementation

IGERT faculty do not have enough time to develop new collaborations inspired by our language plasticity themes. Response:

We will devote brownbag sessions to brainstorming for new collaborations. This is time faculty already plan to commit; devoting it to collaborations will both facilitate collaborations and demonstrate to trainees how collaborations can be launched.

Outreach Activities

Activity 1: Community meeting on Autism
Name of media outlet or organization for which outreach was done: Town of Mansfield, CT
Date of activity:12/15/2012
Type of activity: General public
Briefly describe this activity, including the type of the activity and the names of individuals within IGERT who were involved:
Investigator Eigsti met with 30 Special Education professionals and parents to discuss the latest research on ASD and her work with Investigator Fein on "optimal outcomes" (teens who appear to recover from ASD after years of intensive treatment).

Outreach Activity 2: Diversity recruiting
Name of media outlet or organization for which outreach was done: Brooklyn College
Date of activity: 11/15/2012
Type of activity: Undergraduate
Briefly describe this activity, including the type of the activity and the names of individuals within IGERT who were involved:
Investigator Naigles presented the content and structure of the UConn IGERT program, as part of a forum about applying to graduate school, to (mostly minority) undergraduates majoring in Psychology, Linguistics, or Communication Disorders.

Outreach Activity 3: Diversity teaching and mentoring
Name of media outlet or organization for which outreach was done: Compact for Faculty Diversity
Date of activity:10/25/2012
Type of activity: Preparing our personnel for diversity mentoring
Briefly describe this activity, including the type of the activity and the names of individuals within IGERT who were involved:
Associate Trainee **A. Shaw** attended. As an African-American woman, there was practical advice & support for her career planning. She received advice on recruiting for IGERT, and advertised it. She is developing a local workshop for faculty & students.

Outreach Activity 4: Language development for middle schoolers
Name of media outlet or organization for which outreach was done: Renzulli Academy, Hartford, CT
Date of activity:11/01/2012

Type of activity: K-12
Briefly describe this activity, including the type of the activity and the names of individuals within IGERT who were involved:
Investigator Naigles presented her research and described our IGERT when discussing brain development) to 60 mostly minority 7th graders, as part of the school's 'Type 1' presentation series.

Outreach Activity 5: Neuroplasticity for kids
Name of media outlet or organization for which outreach was done: Mansfield Monarchs Girls' Group
Date of activity: 03/10/2013 Type of activity: K-12
Briefly describe this activity, including the type of the activity and the names of individuals within IGERT who were involved:
Investigator Myers & Associate **Johns** talked to 2nd grade girls about "changes in your brain," developmental changes in neuroplasticity, and methods scientists use for studying the brain". The activity culminated with an ERP demonstration.

*Outreach Activity 6***:** Outreach to Deaf students
Name of media outlet or organization for which outreach was done: Gallaudet University
Date of activity: 02/15/2013
Type of activity: Undergraduate
Briefly describe this activity, including the type of the activity and the names of individuals within IGERT who were involved:
Investigator Coppola and Associate Trainee (to be a Fellow in the fall) **Gagne** described our IGERT, our goal of recruiting Deaf students, and talked more generally about Deaf issues related to grad school and the goal of joining the professoriate.

*Outreach Activity 7***:** Understanding Autism
Name of media outlet or organization for which outreach was done: New Hampshire Public Radio
Date of activity: 04/17/2013
Type of activity: Media
Briefly describe this activity, including the type of the activity and the names of individuals within IGERT who were involved:
Investigator Eigsti was a panelist on NH Public Radio program "The Exchange" to talk about her work with Investigator Fein on "optimal outcomes" in Autism - the fact that a small number of children no longer meet diagnostic criteria for ASD as teens.

IGERT Project Features - Trainee Preparation in Multidisciplinary/Interdisciplinary Research

Practice 1
Our weekly brownbags are a simple but effective mechanism. These bring people together, expose us to each other's research, and naturally leads to further collaborations. We also devote

some sessions to reviewing the IGERT themes and encouraging students and faculty to make new connections. This has been the origin of about half of our new collaborations.

Practice 2

Our Foundations courses culminate in team-based research projects and/or grant proposals (for internal or external funds). These team-based efforts have pushed students to design projects related to our IGERT goals, and to discover ways to bridge their home disciplines and those of other trainees.

Practice 3

Our Breadth Mentorship component has been even more successful than we had hoped. We explicitly opted against a formal lab rotation mechanism because students in some participating programs have heavy coursework or laboratory time constraints. Instead, trainees must identify a breadth mentor and meet with him/her on a regular but informal basis to discuss connections between their respective fields. Being required to do this has led each Fellow to launch a new collaboration including their breadth mentors, (often) their primary advisors, and (often) other relevant faculty and trainees.

Tactics for Recruitment and Broadening Participation

Do you have an overall, active plan with a specific set of goals and timelines for the recruitment and retention of trainees, including specifics for broadening participation of groups underrepresented in science and engineering?
Yes
Regardless of your response to the previous question, please describe up to three of the promising tactics and results for recruiting qualified trainees to your IGERT project during this reporting period.

Tactic 1

In our promotional materials (website, brochures, posters, emails to colleagues and student groups at a variety of institutions, but especially historically minority serving institutions) we have emphasized our commitment to mentoring all students, but with special attention to the needs of students from underrepresented groups. We have also stressed the diversity commitment of the UConn Graduate School and the support and mentoring programs it offers to diversity students.

Result 1

Our communication efforts have paid off. We have seen emails administrators at MSIs have sent on to students emphasizing what an opportunity our IGERT program is. More concretely, most of our participating PhD programs observed marked increases in the numbers of applications from members of underrepresented groups.

Tactic 2

We invited our strongest applicants to visit our campus, with special attention given to communication with members of underrepresented groups before, during, and after their visits. We told all students about our emphasis on mentoring, and discussed the mechanisms within

our program and the UConn Graduate School to address particular needs of students from underrepresented groups.

Result 2
We were remarkably successful at recruiting members of underrepresented groups: 5 of 8 new fellows in the fall come from underrepresented groups, and 4 of 8 are women.
Approval for public use: Yes

Tactic 3
We emphasize the need for strong mentorship by primary advisors and breadth mentors. We also work with students to make them planful in achieving their intellectual and practical skill goals, and to lay the groundwork for successfully launching independent research careers when they graduate.

Result 3
Our fellows have each become involved in multiple collaborations that extend beyond their home PhD boundaries. Our students report that they feel well-supported and well-mentored. As we are in Year 1, we cannot yet report on our students' success after training, but we have so far achieved 100% retention.

According to NSF records, this project has explicit funding for an international component.

Training Experience/Component 1
Our plans call for international experiences for trainees to begin in Year 2. In Year 1, IGERT faculty have reached out to partner institutions, meeting with their representatives on-site or here in Storrs, to lay the groundwork for trainee experiences. These have led to a few new collaborations between our faculty and faculty and students at partner institutions, which bodes well for the likely success of these partnerships once trainees take part.

Training Experience/Component 3 Research/Educational Achievement 1
Because our plans do not call for trainee international experiences until Year 2, we do not have any to report this year.

Activities with international partners
Activities for this partner/institution: Basque Center for Cognition, Brain and Language
Collaborative Research/Teaching: Partner organization's personnel work with IGERT project staff on collaborative research/teaching.
Activities for this partner/institution
Investigators Magnuson, Pugh, Rueckl, and Eigsti have visited the BCBL during conference trips to lay the groundwork for IGERT trainee experiences. This has led to collaborations between BCBL and UConn IGERT faculty.

Activities for this partner/institution: Université Aix-Marseille
Type of partner Ph.D.-granting institution
Funding arrangement for this partner
No funding/direct financial interaction is involved in this partnership.

Collaborative Research/Teaching: Partner organization's personnel work with IGERT project staff on collaborative research/teaching.

Activities for this partner/institution

PI Magnuson spent a sabbatical year at this institution, which led to multiple collaborations, and open invitations to IGERT trainees to come for research visits.

Do you have an overall plan with milestones and timelines for measuring progress toward attaining key IGERT project goals?

Yes

If your IGERT project paid for professional evaluation services external to the IGERT institution or used expertise internal to your institution to aid in the evaluation process, please share their contact information. Organization/individual name

Mariko Chang, http://www.mariko-chang.com/

Was this an external evaluation service provider?

Yes

Please describe a key insight, and your response to it, if any, that has been identified through assessment and evaluation during this reporting period.

Insight/Learning

(Executive summary written by Dr. Chang)

Interviews and survey data indicate high levels of satisfaction with the training program overall. 89% of students are "satisfied" or "very satisfied" with the IGERT program. Students report greater confidence and expertise in their primary domain than their secondary domain. In their primary domain, students are most confident of their ability to read and understand technical articles. Students feel least prepared to connect research with societal challenges. Students found the winter break mini-courses very useful. 94% of faculty "agree" or "strongly agree" that faculty are embracing the program goals. As a result of the IGERT program, faculty are more likely to conduct research with colleagues in other disciplines and they have been exposed to new ideas outside their area of knowledge. However, few faculty reported improved skills at mentoring students from underrepresented groups. For faculty, the biggest challenge to participating in the IGERT program is finding enough time.

Response

We are already taking steps to address the weaknesses identified in the Year 1 survey. On the one hand, it is unsurprising that Fellows remain tentative about their secondary research areas after just 1-2 semesters getting started with them. On the other, we can do better, and we will arrange for more formal, intensive lab experiences for fellows who would like them. We currently do not have Fellows from underrepresented groups, though there are a few Associates, including Ashlee Shaw, who has been working with our Graduate School Diversity Office and attending workshops on mentoring. She is working with PI Magnuson to develop mentoring workshops for faculty and trainees. This is especially needed since 5 of 8 incoming fellows are from underrepresented groups.

Please describe a demonstrable institutional change, if any, that has occurred during this reporting period due to IGERT

Thanks to our interdisciplinary course-based and bread-mentor-based training, our students are engaging in and leading new collaborations across Ph.D. programs consistent with the theoretical goals of our training program. These include (*=Fellow, +=Associate): [1] Mouse-model of Autism (**Castelluccio***, **Rendall**+, **Truong**+, Fitch, Eigsti); [2] Comparative imaging of auditory sensitivity development in mice and human infants (**K. Shaw***, Bortfeld, Read); [3] electroencephalographic and genetic analyses of language-impaired children in a remote Russian village (**Kornilov**+, Magnuson, Grigorenko); [4] Gesture's role in lexical access and implications for aphasic recovery (**Jenkins***, Coelho, Coppola); [5] Use of prosody in language comprehension in Autism (**Richie***, Eigsti, Magnuson). In addition, the clear impact of our team-based approach with students has convinced our administration to provide us with a larger "studio" space large enough for all trainees expected to be in residence in Year 4.

APPENDIX: IGERT-RELATED PUBLICATIONS AND PRESENTATIONS

JOURNAL ARTICLES

1. Bean, J. L., & Eigsti, I. M. (2012). Assessment of joint attention in school-age children and adolescents. *Research in Autism Spectrum Disorders, 6*, 1304-1310. doi: 10.1016/j.rasd.2012.04.003
2. Berk, Stephanie & Lillo-Martin, Diane (2012). The Two-Word Stage: Motivated by Linguistic or Cognitive Constraints? *Cognitive Psychology 65*, 118-140. **(PMCID: PMC3331892)**
3. Bortfeld, H., *Shaw, K., & Depowski, N. (2013). Disentangling the influence of salience and familiarity in infant word learning: methodological advances. Frontiers in Language Sciences, 4. doi:10.3389/fpsyg.2013.00175
4. Brentari, D., Coppola, M., Jung, A. and S. Goldin-Meadow. (2013). Acquiring word class distinctions in American Sign Language: Evidence from handshape. *Language Learning & Development 9*(2), 130-150.
5. Candan, A., Küntay, A., Yeh, Y., Cheung, H., Wagner, L., & Naigles, L. (2012) Age and language effects in children's processing of word order. *Cognitive Development 27*, 205-221.
6. Chen, C. Read, H.L., & Escabí, M. A. (2012) Precise feature based time-scales and frequency decorrelation lead to a sparse auditory code. J. Neuroscience. 32: 8454-68.
7. Chen, C., Rodríguez, F.A., Read, H.L., & Escabí, M. A. (2012) Spectrotemporal sound preferences of neighboring inferior colliculus neurons: implications for local circuitry and processing. Front Neural Circuits. 6: 62.
8. Eigsti, I.M., Schuh, J.M., Mencl, E., Schultz, R.T., & Paul, R. (2012). The neural underpinnings of prosody in autism. *Child Neuropsychology, 18*, 600-17.
9. Fein, D., Barton, M., Eigsti, I-M., Kelley, E., Naigles, L., Schultz, R., Stevens, M., Helt, M., Orinstein, A., Rosenthal, M., Troyb, E., & Tyson, K. (2013) Optimal Outcome in Individuals with a History of Autism. *Journal of Child Psychology and Psychiatry 54*, 195-205. doi: 10.1111/jcpp.12037
10. Landi, N., Frost, S.F., Mencl, W.E., Preston, J.L., Jacobsen, L.K., Lee, M., Yrigollen, C., Pugh, K.R. & Grigorenko, E.L. (2013). The COMT Val/Met polymorphism is associated with reading related skills and consistent patterns of functional neural activation. Developmental Science, 16, 13- 23. NIHMSID: NIHMS457785.
11. Mayo, J., & Eigsti, I.M. (2012). A comparison of statistical learning in school-aged children with high functioning autism and typically developing peers *Journal of Autism and Developmental Disorders, 42*, 2476-85.
12. Mayo, J., Chlebowski, C., Fein, D.A., & Eigsti, I. M. (2013). Age of first words predicts cognitive ability and adaptive skills in children with ASD. *Journal of Autism and Developmental Disorders, 43*(2), 253-264. doi: 10.1007/s10803-012-1558-0
13. Myers, E.B., and Swan, K.S. (2012). Effects of category learning on neural sensitivity to non-native phonetic categories. *Journal of Cognitive Neuroscience*, 24(8), 1695-708.
14. Naigles, L.R. & Bavin, E. (2013) Atypical language development: Introduction to the special issue. *Journal of Child Language 40*, 1-10.
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9. Magnuson, J. S., Mirman, D., & Harris, H. D. (2012). Computational models of spoken word recognition. In M. Spivey, K. McRae, & M. Joanisse (Eds.), The Cambridge Handbook of Psycholinguistics (pp. 76-103). Cambridge University Press.

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13. Svedova, J., Eigsti, I. M., & Masino, S. M. (2012). Adenosine and autism: Physiological symptoms and metabolic opportunities. In S. M. Masino & D. Boison (Eds.), *Adenosine: A key link between metabolism and central nervous system activity* (Chap. 24). New York: Springer.

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CONFERENCE PUBLICATIONS

1. Alexander, M.L., Smith, A., Rosenkrantz, T. & Fitch, R.H. (2012). The effects of P7 HI injury on visual attention in a rodent model, and therapeutic benefits of caffeine treatment. Society for Neuroscience Abstracts, 38.

2. Fanghella, Julia, Geer, Leah, Henner, Jonathan, Hochgesang, Julie, Lillo-Martin, Diane, Mathur, Gaurav, Mirus, Gene, and Pascual-Villanueva, Pedro (2012). Linking an ID-Gloss Database of ASL with Child Language Corpora. LREC Workshop on the Representation and Processing of Sign Languages (Interactions between Corpus and Lexicon). Published online at http://www.lrec-conf.org/proceedings/lrec2012/index.html.

3. Goodrich, Mary and William Snyder (2013) Atelic paths and the Compounding Parameter: Evidence from acquisition. In Nobu Goto, Koichi Otaki, Atsushi Sato, and Kensuke Takita (eds.), *Proceedings of GLOW in Asia IX 2012*. Mie, Japan: Mie University.

4. Lillo-Martin, Diane, Koulidobrova, Helen, Quadros, Ronice Müller de, and Chen Pichler, Deborah (2012). Bilingual Language Synthesis: Evidence from WH-Questions in Bimodal Bilinguals. In Alia K. Biller, Esther Y. Chung, and Amelia E. Kimball (Eds.), *Proceedings of the 36th Annual Boston University Conference on Language Development*, 302-314. Somerville, MA: Cascadilla Press.

5. *Richie, R., Fanghella, J., Coppola, M. (2013). Emergence of lexicons in family-based homesign systems in Nicaragua. In L. Geer (Ed.) Proceedings of the 13th annual Texas Linguistics Society Meeting, Austin, TX.

6. Smith, A.L., Alexander, M.L., Chrobak, J.J., & Fitch, R.H. (2012). Effects of neonatal hypoxic ischemic brain injury on rapid auditory processing and spatial working memory. Society for Neuroscience Abstracts, 38.

7. Szalkowski, C.E., Booker, A.B., Truong, D.T., Rosen, G.D., LoTurco, J.J. & Fitch, R.H. (2012). Behavioral effects of ventricular embryonic RNAi for Dyx1c1 in male and female rodents: Effects on complex auditory processing and visual attention. Society for Neuroscience Abstracts, 38.

8. Truong, D.T., Szalkowski, C.E., Rosen, G.D., & Fitch, R.H. (2012). A behavioral assessment of sex differences in a mouse model of severe neuronal migration anomalies. Society for Neuroscience Abstracts, 38.

CONFERENCE PRESENTATIONS

1. Bean, A., Fein, D. & Naigles, L. (2013, April) Categories of Young Children on the Autism Spectrum. Poster presented at the *Society for Research in Child Development Biennial Meeting*, Seattle, WA.
2. Bortfeld, H. (January, 2013). Infants will tune to (pretty much) anything: implications for cochlear implant users. Meeting of the Auditory Cognitive Neuroscience Society, Tucson, AZ.
3. Carrigan, E. & M. Coppola. (2012, July). Communication partners' comprehension of family-based homesign gesture systems in Nicaragua. Poster presented at the Cognitive Science Society, Sapporo, Japan.
4. Carrigan, E. & M. Coppola. (2013, January). Communication partners' comprehension of family-based homesign gesture systems in Nicaragua. Paper presented at the Annual Meeting of the Linguistic Society of America, Boston, MA.
5. Chin, I., Vosoughi, S., Potrzeba, E., Goodwin, M. S., Roy, D., & Naigles, L. (2013, April). Verb use in a child previously diagnosed with ASD: Dense recordings reveal typical and atypical development. Poster presented at the *Biennial Meeting of the Society for Research in Child Development*, Seattle, WA.
6. Coppola, M., and D. Gagne. (2013, April). Explaining (and improving!) deaf children's poor mathematical performance: Combining perspectives from cognitive psychology, language, and education research. Paper presented at the Society for Research in Child Language Preconference: Development of Deaf and Hard-of-Hearing Children, Seattle, WA.
7. Coppola, M., D. Gagne, and A. Senghas. (2012, November). WHO chased the bird? Narrative cohesion in an emerging language. Paper presented at the Boston University Conference on Language Development, Boston, MA.
8. Coppola, M., D. Gagne, and A. Senghas. (2013, April). WHO chased the bird? Narrative cohesion in an emerging language. Poster presented at the Society for Research in Child Language, Seattle, WA.
9. Coppola, M., D. Gagne, and A. Senghas. (2013, January). WHO chased the bird? Narrative cohesion in Nicaraguan signing. Paper presented at the Annual Meeting of the Linguistic Society of America, Boston, MA.
10. Davidson, Kathryn, Goodwin, Corina & Lillo-Martin, Diane (2012). Language Transfer in ASL/English Bimodal Bilingual Children with CI's. UConn/ UMass / Smith Language Acquisition Workshop; Northampton, MA; November 2012.
11. Del Tufo, S. Mesite, L, and Myers, E. (2013). Structural plasticity resulting from phonetic category training. Meeting of the 20th Annual Cognitive Neuroscience Society.
12. Dixon, E., & Spauding, T. (June, 2012). Differences in performance on nonverbal cognitive tests for children with SLI and their typically developing peers: A meta-analysis. Symposium on Research in Child Language Disorders, Madison, WI.
13. Eigsti, I. M. (2012, July). *Invited speaker: Optimal Outcomes in ASD*. Paper presented at the IACAPAP, Paris, France.
14. Eigsti, I. M. (2012, June). *Invited talk: Autism and language acquisition*. Paper presented at the Basque Center on Cognition, Brain and Language, San Sebastian, Spain.
15. Eigsti, I. M. (2012, November). *Invited talk: Implicit learning in autism: Implications for language acquisition*. Paper presented at the American Speech Hearing and Language Association Annual Convention, Atlanta, Georgia.
16. Eigsti, I. M. (2012, October). *Invited talk: Understanding the cognitive and neural basis of developmental trajectories in delay of gratification*. Paper presented at the Oesterreichische Forschungsgemeinschaft ceremony in honor of Walter Mischel, who is awarded the Ludwig Wittgenstein Prize 2012, Vienna, Austria.
17. Eigsti, I. M. (2013, July). Invited talk: Language and Mind in Autism*International Congress of Linguists* (Vol. On behalf of the organizing committee: Stephanie Durrleman (Univ Geneva), Hélène Delage (University of Geneva), Laurice Tuller (University of Tours), Philippe Prévost (University of Tours) and Ira Noveck (L2C2, CNRS, Lyon).). Geneva, Switzerland.
18. Eigsti, I. M., & Fein, D. A. (2012, July). Children with "Optimal Outcomes" from ASD: Psychiatric comorbidity, pragmatic language, growth patterns, and special skills*International Association for Child and Adolescent Psychiatry and Allied Professions (IACAPAP)*. Paris, France.

19. Eigsti, I. M., Col Cozzari, G., Rosset, D., Da Fonseca, D. , & Deruelle, C. (2012, June). Embodied effects on stimulus encoding in high-functioning autism*Innovative Research In Autism (IRIA 2012)*. Tours, France.

20. Eigsti, I. M., Stevens, M., Schultz, R., Naigles, L.R., Kelley, E., Orinstein, A., . . . Fein, D.A. (2013, May). Neural Activation to Sentences in Individuals with High-Functioning Autism, Typical Development, and Autism Spectrum Disorder Optimal Outcomes*International Meeting for Autism Research (IMFAR-13)*. San Sebastian, Spain.

21. Eigsti, I.M., Col-Cozzari, G., Rosset, D., Da Fonseca, D., & Deruelle, C. (2013, May). Lack of Embodied Effects On Stimulus Encoding in High-Functioning Autism*International Meeting for Autism Research (IMFAR-13)*. San Sebastian, Spain.

22. Eom, Soyoung and William Snyder (2012) Children's acquisition of English datives: Competing parametric accounts. In Yukio Otsu (ed.), *Proceedings of the 2012 Tokyo Conference on Psycholinguistics*. Tokyo: Hituzi Shobo.

23. Fitch, A., Fein, D.A., & Eigsti, I. M. (2013, May). Detail and Gestalt Focus in Spontaneous Descriptions by Individuals with Optimal Outcomes From ASD*International Meeting for Autism Research (IMFAR-13)*. San Sebastian, Spain.

24. Flaherty, M., S. Goldin-Meadow, A. Senghas, M. Coppola. (2013, January). Watching Minds Shape Language: The Emergence of Spatial Verb Agreement in Nicaraguan Sign Language. Poster presented at the Budapest CEU Conference on Cognitive Development, Budapest, Hungary.

25. Goodwin, Corina & Lillo-Martin, Diane (2012). Vocabulary composition in a bimodal bilingual child: Are all signers verb attenders? Poster presented at the conference on Generative Approaches to Language Acquisition – North America 5; Lawrence, Kansas; October 2012.

26. Henner, Jonathan, Geer, Leah & Lillo-Martin, Diane (2013). Calculating Frequency of Occurrence of ASL handshapes. Poster presented at the Linguistic Society of America Annual Meeting; Boston; January 2013.

27. Johns, A. R., van der Lely, H., & Magnuson, J. S. (2013, April). Structure-driven expectations for animacy drive early left event-related potential negativities that are not overridden by contextual expectations. Poster presented at the 20th Annual Meeting of the Cognitive Neuroscience Society, San Franciso, CA.

28. Kelty-Stephen, E., Fein, D., & Naigles, L. (2013, April). Language development in children with ASD: A longitudinal study of grammar and lexicon. Poster presented at the *Society for Research in Child Development*, Seattle, WA.

29. Kelty, E. & Naigles, L. (2012, November) Language Development in ASD: Longitudinal Growth Curves Support Subgroups of ASD. Poster presented at the *Annual Meeting of the Psychonomic Society*, Minneapolis, MN.

30. Kornilov, S., Landi, N., Rakhlin, N., Grigorenko, E. L. & Magnuson, J. S. (2012, November). Atypical simple tone discrimination and processing in children with developmental language impairment. Poster presented at the Society for the Neurobiology of Language, San Sebastian, Spain.

31. Kozak, L. Viola, Quadros, Ronice Müller de, Cruz, Carina Rebello, Pizzio Lemos, Aline, Chen Pichler, Deborah & Lillo-Martin, Diane (2013). Phonological development in bimodal bilingual children: Pseudoword repetition. Poster presented at the Linguistic Society of America Annual Meeting; Boston; January 2013.

32. Lillo-Martin, Diane (2013). More than the sum of the parts: Bimodal bilingual language acquisition - syntactic aspects. Invited keynote, 1st Symposium on Sign Language Acquisition; Universidade Católica Portuguesa, Lisboa; March 2013.

33. Lillo-Martin, Diane (2013). More than the sum of the parts: Bimodal bilingual language acquisition - syntactic aspects. Invited presentation, University of Iceland; April 2013.

34. Lillo-Martin, Diane (2013). Role Shift, Quotation, and Constructed Action in ASL. Invited presentation, University of Iceland; April 2013.

35. Lillo-Martin, Diane (2013). Sign Language Acquisition by Deaf and Hearing Children. Invited Presentation, Conference Inaugurating the Center for Gesture, Sign, and Language at the University of Chicago; Chicago; March 2013.

36. Lillo-Martin, Diane, Quadros, Ronice Müller de, Chen Pichler, Deborah, Koulidobrova, Elena (2012). WH-questions in bimodal bilinguals — Evidence for language synthesis. Formal and Experimental Advances in Sign Language Theory (FEAST) 2012; Warsaw, Poland; June 2012.

37. Matsuo, A., Naigles, L.R., Wood, G. & Kita, S. (2012, August) Japanese children's use of morphosyntax and argument structure to infer meaning of novel transitive and intransitive verbs. Paper presented at the *NINJAL Valency Conference,* Tokyo, Japan.

38. Mesite, L, Del Tufo, S, and Myers, E, (2013). Neural correlates of intensive non-native phonetic category training. Meeting of the 20th Annual Cognitive Neuroscience Society.

39. Myers, E, & L. Mesite. (2012). Neural systems underlying lexically-biased perceptual learning in speech." Paper presented at the Neurobiology of Language Meeting, San Sebastian, Spain.

40. Naigles, L., King, D. & Fein, D. (2013, April) Shifting attention during language processing in typically developing children and children with ASD. Poster presented at the *Society for Research in Child Development Biennial Meeting*, Seattle, WA.

41. Naigles, L., Lillo-Martin, D., Petroj, V., & Snyder, W. (2013, January) The Compounding Parameter: New Evidence from IPL. Paper presented at the *Linguistics Society of America*, Boston, MA.

42. Navarro-Torres, C., Tovar, A., Fein, D., Naigles, L. (2013, April). Is Negation a Productive Morphosyntactic Form for Children with ASD? Poster presented at the *Biennial Meeting of the Society for Research in Child Development*, Seattle, WA.

43. Park, J., Cho, S. W., Lee, S. J., Nam. M., & Naigles, L. (2013, April). Syntactic Bootstrapping in Korean: typically developing children and children with Autism. Poster presented at the *Biennial Meeting of the Society for Research in Child Development*, Seattle, WA.

44. Quadros, Ronice Müller de, Lillo-Martin, Diane, Koulidobrova, Helen, & Chen Pichler, Deborah (2012). Noun Phrases in Bimodal Bilingual Acquisition. Presented at the conference on Generative Approaches to Language Acquisition – North America 5; Lawrence, Kansas; October 2012.

45. Rhimzhim, A. & Naigles, L. (2013, April) Morphosyntactic Bootstrapping in Verb Acquisition in a Split-Ergative Language: Evidence from Hindi. Poster presented at the *Society for Research in Child Development Biennial Meeting*, Seattle, WA.

46. *Richie, R., Fanghella, J., Coppola, M. (2012, June). Emergence of lexicons in family-based homesign systems in Nicaragua. Paper presented at the 13th annual Texas Linguistics Society Meeting, Austin, TX.

47. Rueckl, J. G., Aicher, K., & Austen, A. (2012, May). The role of prior knowledge in word learning. *Second Language Acquisition: from Brain Plasticity to Cognition Scientific Program*. Jersusalem, Israel.

48. Rueckl, J. G., Zhao, J., & Li, T. (2013, May). Plasticity and the Organization of the Reading System: Variation Between and Within Linguistic Communities. *L1 reading across different languages and L2-literacy acquisition*. Taiwan.

49. Sadat, J., Martin, C.D., Magnuson, J., Alario, F.-X., & Costa, A. (2013, March). Breaking down the bilingual cost in speech production. Poster presented at the 11th International Symposium of Psycholinguistics, Tenerife, Canary Island, Spain.

50. Shaw, A., Demos, A. P., Arthur, D., & Magnuson, J. S. (2012, November). Individual differences in lexical quality of newly learned words. Poster presented at the Psychonomic Society, Minneapolis, MN.

51. Snyder, William, Lillo-Martin, Diane & Naigles, Letitia (2013). The Compounding Parameter: New Evidence from IPL. Presented at the Linguistic Society of America Annual Meeting; Boston; January 2013.

52. Spaulding, T. (June, 2012). Factors affecting the provision of language intervention services in preschool children with SLI: A preliminary investigation. Symposium on Research in Child Language Disorders, Madison, WI.

53. Tovar, A.T., Fein, D. A. & Naigles, L. (2013, April). How Integrated are Production and Comprehension of Tense/Aspect in Young Children with ASD? Poster presented at the *Society for Research in Child Development*, Seattle, WA.