## COVER SHEET FOR PROPOSAL TO THE NATIONAL SCIENCE FOUNDATION

| PROGRAM ANNOUNCE  | PROGRAM ANNOUNCEMENT/SOLICITATION NO./CLOSING DATE/if not in response to a program announcement/solicitation enter NSF 07-140 FOR NSF USE ONLY |                         |                                      |                                |                          |                             |  |  |  |  |  |
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| Colin Phillips  |  | PhD                     |                                      | 1996                           | 301-405-3082             | 2 colin@ur                  | nd.edu                                 |  |  |  |  |
| CO-PI/PD  |  |                         |                                      | 100 4                          |                          |                             |  |  |  |  |  |
| Jeffrey L Lidz  |  | PhD                     |                                      | 1996                           | 301-405-8220             | ) jlidz@un                  | nd.edu                                 |  |  |  |  |
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|   |  | DPni                    | 1                                    | 1990                           | 301-405-0205             | miongs@                     | ama.eau                                |  |  |  |  |
| Amy S Weinber   | σ  | рн п                    |                                      | 1988                           | 301-405-403/             | 1 wainhara                  | wainharg@umiacs umd adu                |  |  |  |  |
| CO-PI/PD  | 5  | 1 11.D                  | •                                    | 1700                           | 501-405-475-             |                             | s annacs.uniu.                         | .uu  |  |  |  |
| Amanda L WoodwardPhD1992301-4   |  |                         |                                      |                                |                          | 3 awoodwa                   | rd@psyc.umd.                           | edu  |  |  |  |

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### Certification for Authorized Organizational Representative or Individual Applicant:

By signing and submitting this proposal, the Authorized Organizational Representative or Individual Applicant is: (1) certifying that statements made herein are true and complete to the best of his/her knowledge; and (2) agreeing to accept the obligation to comply with NSF award terms and conditions if an award is made as a result of this application. Further, the applicant is hereby providing certifications regarding debarment and suspension, drug-free workplace, and lobbying activities (see below), nondiscrimination, and flood hazard insurance (when applicable) as set forth in the NSF Proposal & Award Policies & Procedures Guide, Part I: the Grant Proposal Guide (GPG) (NSF 07-140). Willful provision of false information in this application and its supporting documents or in reports required under an ensuing award is a criminal offense (U. S. Code, Title 18, Section 1001).

#### **Conflict of Interest Certification**

In addition, if the applicant institution employs more than fifty persons, by electronically signing the NSF Proposal Cover Sheet, the Authorized Organizational Representative of the applicant institution is certifying that the institution has implemented a written and enforced conflict of interest policy that is consistent with the provisions of the NSF Proposal & Award Policies & Procedures Guide, Part II, Award & Administration Guide (AAG) Chapter IV.A; that to the best of his/her knowledge, all financial disclosures required by that conflict of interest policy have been made; and that all identified conflicts of interest will have been satisfactorily managed, reduced or eliminated prior to the institution's expenditure of any funds under the award, in accordance with the institution's conflict of interest policy. Conflicts which cannot be satisfactorily managed, reduced or eliminated must be dislosed to NSF.

#### **Drug Free Work Place Certification**

By electronically signing the NSF Proposal Cover Sheet, the Authorized Organizational Representative or Individual Applicant is providing the Drug Free Work Place Certification contained in Exhibit II-3 of the Grant Proposal Guide.

#### Debarment and Suspension Certification (If answer "yes", please provide explanation.)

Is the organization or its principals presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency?

By electronically signing the NSF Proposal Cover Sheet, the Authorized Organizational Representative or Individual Applicant is providing the Debarment and Suspension Certification contained in Exhibit II-4 of the Grant Proposal Guide.

#### **Certification Regarding Lobbying**

The following certification is required for an award of a Federal contract, grant, or cooperative agreement exceeding \$100,000 and for an award of a Federal loan or a commitment providing for the United States to insure or guarantee a loan exceeding \$150,000.

Yes 🗖

No 🛛

#### Certification for Contracts, Grants, Loans and Cooperative Agreements

The undersigned certifies, to the best of his or her knowledge and belief, that:

(1) No federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

(2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, "Disclosure of Lobbying Activities," in accordance with its instructions.

(3) The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements and that all subrecipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by section 1352, Title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than \$10,000 and not more than \$100,000 for each such failure.

#### **Certification Regarding Nondiscrimination**

By electronically signing the NSF Proposal Cover Sheet, the Authorized Organizational Representative is providing the Certification Regarding Nondiscrimination contained in Exhibit II-6 of the Grant Proposal Guide.

#### **Certification Regarding Flood Hazard Insurance**

Two sections of the National Flood Insurance Act of 1968 (42 USC §4012a and §4106) bar Federal agencies from giving financial assistance for acquisition or construction purposes in any area identified by the Federal Emergency Management Agency (FEMA) as having special flood hazards unless the:

community in which that area is located participates in the national flood insurance program; and
 building (and any related equipment) is covered by adequate flood insurance.

By electronically signing the NSF Proposal Cover Sheet, the Authorized Organizational Representative or Individual Applicant located in FEMA-designated special flood hazard areas is certifying that adequate flood insurance has been or will be obtained in the following situations:

(1) for NSF grants for the construction of a building or facility, regardless of the dollar amount of the grant; and

(2) for other NSF Grants when more than \$25,000 has been budgeted in the proposal for repair, alteration or improvement (construction) of a building or facility.

| AUTHORIZED ORGANIZATIONAL REP   | SIGNATURE               |  | DATE  |       |  |  |  |
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#### A. PROJECT SUMMARY

| 1. | Title              | IGERT: Biological and Computational Foundations of Language Diversity           |
|----|--------------------|---|
|    | PI                 | Colin Phillips  |
|    | Lead Institution   | University of Maryland  |
|    | Participating Inst | Central Institute for Indian Languages, Mysore, India; Hiroshima and Tohoku     |
|    |                    | Universities, Japan; Universidade Federal do Rio de Janeiro, Brazil; Center for |
|    |                    | Advanced Study of Language (UMd.); VL2 Science of Learning Center,              |
|    |                    | Gallaudet University; National Institute on Deafness and other Communication    |
|    |                    | Disorders.  |
|    |                    |   |

2. INTELLECTUAL MERIT. Human language is both universal within the species and highly variable across populations. This IGERT will train young scientists to understand language diversity by combining tools of behavioral, computational and biological research. The goal of the project is to create a model for sustainable change in the science of language. We argue that this requires change in the role of academic departments that focus on language, creating units that form the hub of a collaborative network, rather than attempting to simply remove traditional departmental boundaries. We also contend that sustainable change, i.e., change that will persist across time and across institutions, depends strongly on the pursuit of diversity, encompassing both language diversity and diversity of participation. The starting point for the project is a language research community at the University of Maryland that is perhaps uniquely well positioned to combine expertise from linguistic, computational, cognitive and neuroscientific approaches to language with clinical and pedagogical concerns, drawing upon an extensive network of existing connections that span nine departments in five colleges. The first goal of the IGERT is to build upon our existing interdisciplinary success to break down further barriers to collaboration and crosstraining. The second goal of the project is more outward-looking. The aim is to promote sustainable change through local and international collaborations and outreach efforts that will build infrastructure for interdisciplinary work on diverse languages, build awareness of the science of language among younger and underrepresented groups of students through high school and undergraduate partnerships, while also training IGERT students to be effective agents of change in their own future careers.

The training program will create a framework that allows students to translate broad foundational training into innovative interdisciplinary research. The training plan provides coursework, research training, and environment that are all geared towards the goal of preparing students for interdisciplinary research projects and equipping them to build similar collaborative networks at other institutions in their future careers. Preparation for interdisciplinary research projects will be provided by broad coursework in language and cognitive (neuro-)science, integrative pro-seminars and a post-candidacy lab rotation that pairs trainees with students from other disciplines. A central component of the IGERT is the *Winter Storm*, an intensive two-week workshop that provides foundational skills training, building student partnerships through research projects, review and updating of research goals, and professional development. In addition, the IGERT builds upon international connections that will advance interdisciplinary training in language in India, Japan, and Brazil, while providing IGERT trainees with access to broader multilingual perspectives. The IGERT will partner with an NSF-supported Science of Learning Center based at Gallaudet University, expanding local training opportunities for deaf students.

3. BROADER IMPACTS. This interdisciplinary training model developed in this IGERT will have a national and international impact. The project will create resources and train graduates that can promote the integration of psychological, neural, and computational tools with multi-lingual expertise at other institutions. The project will strengthen a series of international collaborations through which students can contribute to infrastructure for interdisciplinary research in countries where linguists have less ready access to experimental and computational expertise. The project will enhance the use of computational and neuroscientific techniques in studies of atypical language and second language learning. A program of outreach activities at the undergraduate and high school level, plus the partnership with Gallaudet University, will enhance participation of underrepresented groups in science.

4. KEYWORDS: Social Science: Behavioral and Cognitive Science; Computer Science/Information Technology; Biology; Linguistics

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Appendix Items:

\*Proposers may select any numbering mechanism for the proposal. The entire proposal however, must be paginated. Complete both columns only if the proposal is numbered consecutively.

# C. <u>PROJECT DESCRIPTION</u>1. <u>List of Participants</u>

| Participating Faculty and Key Partners |                                     |                                       |  |  |  |  |
|--|-------------------------------------|---------------------------------------|--|--|--|--|
| Tom Allen †                            | Professor, Gallaudet University     | PI, 'VL2' Science of Learning Center  |  |  |  |  |
| Allen Braun, MD †                      | Chief, Lang & Speech Unit, NIDCD    | cogn neurosci, aphasia, ASL           |  |  |  |  |
| Robert de Keyser                       | Professor, Second Lang Acq          | second language acquisition           |  |  |  |  |
| Bonnie Dorr                            | Professor, CompSci & UMIACS         | multilingual NLP, machine translation |  |  |  |  |
| Michael Dougherty                      | Assoc Prof, Psychology              | attention, memory, decision theory    |  |  |  |  |
| Fred Eckman                            | Res. Prof, SLA & CASL               | phonology & syntax in SLA             |  |  |  |  |
| Carol Espy-Wilson                      | Professor, Elec Eng & ISR           | digital speech processing             |  |  |  |  |
| Yasmeen Faroqi-Shah                    | Asst Prof, Hearing & Speech Sci     | aphasia, cognitive neuroscience       |  |  |  |  |
| Aniela Improta França †                | Assoc Prof., UFRJ, Brazil           | psycho/neuroling, indigenous langs    |  |  |  |  |
| Valentine Hacquard                     | Asst Prof, Linguistics              | semantics, psycholinguistics          |  |  |  |  |
| Mary Harper                            | Res. Prof, Elec Eng & CASL          | digital speech processing, NLP        |  |  |  |  |
| Norbert Hornstein                      | Professor & Chair, Linguistics      | syntax, semantics, philos of lang     |  |  |  |  |
| Bill Idsardi                           | Assoc Prof, Linguistics             | phonology, phonetics, comp models     |  |  |  |  |
| Greg Iverson                           | Res. Prof, CASL                     | speech perception, SLA                |  |  |  |  |
| Masatoshi Koizumi †                    | Assoc Prof, Tohoku Univ, Japan      | syntax, devel cogn neuro, psycholing  |  |  |  |  |
| Howard Lasnik                          | Disting Univ Prof, Linguistics      | syntax                                |  |  |  |  |
| Jeffrey Lidz *                         | Assoc Prof, Linguistics             | lang acq, psycholing, lang diversity  |  |  |  |  |
| Michael Long *                         | Professor & Chair, Sch of Langs     | SLA, cognitive development            |  |  |  |  |
| Marcus Maia †                          | Assoc Prof, Museu Nacional, Brazil  | psycholing, indigenous languages      |  |  |  |  |
| Carlos Montalvan, MEd †                | AP Psych teacher, Northwood HS      | psychology education                  |  |  |  |  |
| Rochelle Newman                        | Assoc Prof, Hearing & Speech        | infant and adult psycholinguistics    |  |  |  |  |
| Colin Phillips **                      | Assoc Prof, Linguistics             | psycho/neuroling, lang acquisition    |  |  |  |  |
| Paul Pietroski                         | Professor, Linguistics & Philosophy | semantics, logic, lang acquisition    |  |  |  |  |
| David Poeppel                          | Professor, Linguistics & Biology    | cogn neurosci, speech & hearing       |  |  |  |  |
| Nan Bernstein Ratner                   | Professor & Chair, Hearing/Speech   | lang. disorders, stuttering, infancy  |  |  |  |  |
| James Reggia, MD                       | Professor, CompSci & UMIACS         | comp modeling, neurology              |  |  |  |  |
| Philip Resnik                          | Assoc Prof, Linguistics & UMIACS    | comp ling, machine translation        |  |  |  |  |
| Hiromu Sakai †                         | Assoc Prof, Hiroshima Univ, Japan   | psycho/neurolinguistics, syntax, SLA  |  |  |  |  |
| Shihab Shamma                          | Professor, Elec Eng & ISR           | auditory neurosci, neuromorphic eng.  |  |  |  |  |
| Jonathan Simon                         | Asst Prof, Elec Eng & Biology       | biological signal processing          |  |  |  |  |
| Udaya Narayana Singh †                 | Director, CIIL, Mysore, India       | comp linguistics, Indian languages    |  |  |  |  |
| Juan Uriagereka                        | Professor, Linguistics              | syntax, lang diversity, evol of lang  |  |  |  |  |
| Amy Weinberg *                         | Assoc Prof, Linguistics & UMIACS    | comp linguistics, psycholinguistics   |  |  |  |  |
| Amanda Woodward *                      | Professor, Psychology               | cognitive development, infant lang    |  |  |  |  |
| Andrea Zukowski                        | Asst Res Scientist, Linguistics     | atypical language development         |  |  |  |  |

\*\* PI \* Co-PI † External partner CASL - Center for Adv Study of Lang; CIIL - Central Inst for Indian Langs; ISR - Inst for Systems Res; UFRJ - Universidade Federal do Rio de Janeiro; UMIACS - U of Maryland Inst for Adv Comp Studies

#### 2. Vision, Goals, and Thematic Basis

MOTIVE. Linguists have long been consumed by a search for common principles underlying all human languages, and by an interest in the scope of cross-language variation. This leads them to search for commonalities and for dimensions of variation, not just descriptions of lots of languages. But for a long time there seemed to be little reason for other scientists and professionals to pay much attention. There was a time when language professionals in the clinical, educational, and information sciences could get by with focused expertise in one or just a few languages. But this is rapidly changing.

The first wave of the 'global information economy' was fueled by remarkable advances in natural language technologies in a small number of languages. This created huge wealth in some places, but contrary to initial expectations, technology has widened the 'information divide' for speakers of minority languages. A second wave of natural language technologies based on 'portable' solutions that can be adapted to any language may begin to roll back the divide. Meanwhile, language analysts in the defense sector now need rapid ramp-up strategies aided by language-general expertise: traditional strategies based on a small number of 'critical' languages are now hopeless, since little-known languages can become critically important almost overnight. This has led to fundamental re-thinking of strategies. They require technologies to leverage resources from well-resourced languages to minority languages.

In the clinical domain, a great deal of effort and funding has been invested in building detailed phenotypes for developmental language disorders in English, leading to tests of effective therapies, and we increasingly see the importance of early intervention. But it is impractical to repeat this effort for each language individually, whether in the US or abroad. Language-general solutions could allow results from a small number of languages to drive rapid and cost-effective development of diagnostic tools and therapies for any language, including spoken and signed languages. In language education, teachers encounter learners from a vast array of language backgrounds, and require language-general understanding in order to tailor diagnoses and curricula to a diverse student body. A Korean immigrant child who mispronounces *van* as *ban* likely has a very different problem than a French-speaking immigrant from West Africa who makes an identical error (a speech pathology referral would be relevant in one case, not the other).

All of these considerations provide a clear motive for the language-general concerns of linguists to be exported to neighboring fields, but they require experts in these fields to gain a better understanding of the basic science of language. At the same time, there is a rapidly growing need for expertise from computational, psychological, neurobiological, and clinical areas to be imported into (psycho-)linguistics. Linguists have long assumed that their concern with language-general models is driven by the desire to understand children's prolific language learning ability (and adults' corresponding frustrations) and its underlying neuroscientific causes. But these links have often remained as promissory notes. More recently, rapid advances in surrounding fields has impacted the desired synthesis in opposing ways. On the one hand, advances in neuroscience, machine learning, and cognitive development (among others) have greatly improved the prospects for models of language learning and processing that are computationally explicit and cognitively and neurally plausible. On the other hand, these advances have spawned new specialized skills that have made it increasingly difficult for researchers to take advantage of progress in fields other than their own. How can one possibly be expected to both understand the statistics or modeling techniques needed to be a language engineer and to master techniques of experimental or linguistic analysis?

OPPORTUNITY. The language research community at the University of Maryland already possesses an unusually rich set of resources that allow it to import expertise from such fields as neuroscience and computer science into the basic science of language, and to export insights from the study of language diversity to clinical, educational, and engineering settings. We have a Linguistics Department that is unusually outward-looking, and a multi-department Neuroscience & Cognitive Science Program that provides a framework for interdisciplinary courses and degrees. We have an established network of close connections between faculty across many departments engaged in language research (School of Languages, Psychology, Hearing & Speech, Linguistics, Computer Science, ElecCompEng, Philosophy). The psycholinguistics and natural language engineering groups happen to share a focus on multi-lingual research. The campus and Washington DC/Maryland suburbs are host to a wide variety of institutions that can support links between basic science and real-world applications. The UMd campus hosts the *Center for Advanced Study of Language*, which is the core of the DoD's new language-general research strategy, and also the *National Foreign Language Center*, a center for language teaching expertise.

Nearby are the National Institutes of Health, and the Children's National Medical Center, plus the Headquarters of the American Speech-Language-Hearing Association. All of these have direct ties to UMd and to members of our IGERT team. We also are members of a local consortium of universities with Gallaudet University, the nation's preeminent university for the deaf, which provides the resources needed for Deaf students to participate in activities at UMd. With these foundations in place, it is perhaps not surprising that the U of Maryland President has designated language as a primary institutional focus area. We also have the benefit of being in an ethnically and linguistically vibrant metropolitan area.

MEANS. Although the motive and the opportunity are clear, putting them together is not as straightforward as one might imagine. Human language presents an easy-to-grasp unifying theme for an IGERT, and yet the challenges for interdisciplinary integration are unusually acute, because of the highly diverse skill-sets required for such projects as linguistic fieldwork, cognitive neuroscience, clinical interventions, automatic machine translation, and second language acquisition. The range of methods and data-types used in language-related research presents obstacles not just to individual researchers but also to collaboration, as the technical vocabularies of these different domains vary widely, often making it difficult for language scientists to collaborate even when working in related areas.

Therefore, our trainees must become language scientists who are equipped to be effective collaborators across multiple disciplines and across multiple research languages. This will require a rich understanding of the details of linguistic diversity in concert with awareness of techniques and results from research areas as diverse as machine learning, systems neuroscience, and cognitive development. While we cannot hope to provide trainees with expertise in all of the areas that may be useful in a career of language related research, we can give trainees the skills needed to recognize what methods are most appropriate to solving which kinds of problems, to know what languages provide the best research preparations for particular questions, and to know how to collaborate across disciplines and across oceans in order to realize their research potential.

Our plan is focused on 4 primary aims: (1) to develop collaborative and sustainable interdisciplinary graduate research opportunities; (2) to build on and enrich existing collaborative networks to foster sustainable multi-discipline research teams; (3) to implement a multi-national research and training network, enriching the trainees' perspectives on the challenges facing higher education and research; and, (4) to increase access to language science and technology for underrepresented populations.

#### What is missing from current approaches?

A MULTILINGUAL PERSPECTIVE. The rich multilingual perspective that has proven so important in standard linguistics research has had only limited impact on developments in other areas of language study, where English and a very few other languages have reigned supreme. An account of language learning must explain how a child is equipped to learn *any* language. In the neuroscience of language, a multilingual perspective is crucial for understanding the balance between invariant brain mechanisms and mechanisms that are shaped by experience with a specific language. Models based on findings from a small number of Western European languages may not be robust enough to tackle the full range of linguistic diversity. Our multilingual investigations involve more than simply casting a wide net. Rather, this research is driven by detailed models of linguistic diversity and by the understanding that languages with different structures highlight different parts of the problem. Progress in understanding how, for example, memory is accessed during language comprehension will depend on comparing languages whose structures make different demands on memory. Identifying appropriate languages for comparison requires an understanding of the dimensions of linguistic variation.

Effective use of data from diverse languages also requires advanced computational techniques. The focus on a small number of languages can be attributed in part to the availability of study participants and electronic resources, and to a lack of training and motivation for multilingual perspectives for non-linguists. The narrow focus on a small number of languages is also due to the limited access worldwide to the methodological and technical advances that have transformed language research in the US.

HUMANS AS A MODEL FOR COMPUTERS; COMPUTERS AS A MODEL FOR HUMANS. Current engineering approaches to language technology do not take advantage of insights into language structure, or from the most successful known language acquisition device: the human child. At the same time, models of human language learning are typically built on relatively small amounts of experimental data from small numbers of languages and do not take advantage of insights from machine learning or the potential contribution of computer modeling in constructing robust theories. Developing better theoretical models, improved second language acquisition methods and automated language understanding and support tools will

require educating researchers and engineers with an appreciation for the mutual informativity of computational, experimental and linguistic data.

A related limitation is that the demands of natural language engineering projects (and the availability of grants and contracts!) can make it difficult for computational students and faculty to devote time and resources to human modeling projects. Our project therefore emphasizes the use of natural language engineering skills in modeling human cognitive and neural processes, providing greater common-ground between experimentalists and computationalists, and creating opportunities for computational students that are less readily available otherwise.



ACCESS TO LANGUAGE SCIENCES AND TECHNOLOGY. Most students do not encounter the language sciences until late in their education, if at all. This misses a great opportunity to use language as a model domain that cuts across the curriculum, and likely contributes to the extremely low participation of underrepresented minorities in the language sciences. In addition, it has long been recognized that women and the deaf are underrepresented in technological areas of research. Language science provides a natural route into technological areas. For the deaf, there has been a rich and fruitful emphasis on American Sign Language, literacy issues and language studies due to the necessity of negotiating an English-dominated world Our integrated multidisciplinary approach can provide training in computational thinking and practice, without the requirement of enrollment in a traditionally technological department.

#### The Approach: What our IGERT has to offer

The solution to the problems identified above resides in a model of sustainable integration that outlives the individual trainees supported by this project, and extends beyond our own institution. We believe that sustainable change in this area requires redefining the role of a linguistics department as the hub of a collaborative network. For the foreseeable future, academic departments will continue to be the entities through which universities make long-term commitments (i.e., 'hard' budgets), and linguistics departments ought, in principle, to be best positioned to bring together linguistic, psychological, computational, clinical and neuroscientific expertise on language, whether through direct appointments or through collaborations. A neuroscience program will not recruit an expert on the African language Igbo, and a computer science department is unlikely to hire a clinician (although not without exception - our own Jim Reggia is a computational modeler and also a practicing neurologist).

We contend that the remedy for the 'inward-looking' nature of many traditional departments is not to eliminate department structures, as is sometimes suggested, but rather to create 'outward-looking' departments that take synergy as a primary responsibility and can serve as long-term advocates for language research in an institution. It is therefore unfortunate that no previous language-related IGERT project has been based in a linguistics department. We believe that this model stands the best chance of effecting long-term change.

Our IGERT will contribute to this model by providing an array of interdisciplinary research opportunities. Students will receive degrees from traditional departments and maintain disciplinary depth in their chosen fields. In addition to their disciplinary requirements, all students in our IGERT will benefit from the following activities: (1) participation in at least one of the 4 interdisciplinary thematic research clusters described below; (2) participation in a 2-week intensive *Winter Storm* workshop, focusing on expanding the technical skills of trainees while also providing concentrated exposure to the unifying research themes; (3) a required research rotation pairing students from different disciplinary backgrounds to work together to solve problems requiring multiple methodologies; (4) required participation in high-school or undergraduate training and mentorship; (5) on-going weekly IGERT proseminars and seminars; (6) a set of activities focused on career awareness, ethics, and professional development. Many trainees will also participate in international research and training activities.

These elements address the weaknesses in contemporary graduate education identified above in several ways. The intensely interdisciplinary character of the research themes breaks down barriers to cross-discipline communication by providing models of multi-scientist research projects and exposing trainees to the pragmatic difficulties of working across diverse methodologies. All students will be required to take courses from the Language Diversity track, ensuring that they acquire an appreciation for the full range of linguistic diversity and the challenges this diversity poses for neurobiological, cognitive, clinical, pedagogical and engineering approaches to language.

Our local and international collaborations also contribute to reaching our multilingual aims. These include a collaboration with the NSF-supported Science of Learning Center *Visual Language Visual Learning* ('VL2', Tom Allen, PI) at nearby Gallaudet University, which will provide access to sign language research for our IGERT students, while providing greater local training opportunities for deaf students involved in VL2 research projects. International activities export our expertise in and commitment to multilingual interdisciplinarity in the study of language to partners lacking access to recent technological and methodological advances. These activities also enrich our students' understanding of the need for international collaboration and the challenges it presents.

Diversity issues are addressed through our collaboration with Gallaudet, the increased emphasis on computational modeling in cognitive and neuroscientific research, and via our outreach activities with high school and undergraduate students.

An ambitious interdisciplinary research and training agenda requires substantial foundations. The University of Maryland has a unique arrangement of language scientists, putting us in position to implement the educational initiatives described here.

#### The Foundations.

This IGERT takes advantage of a language research community at the University of Maryland that provides the foundations for genuine integration. The Linguistics Department has been built with interdisciplinary research as its focus, and it stands in the unusual position of having led the development of cognitive neuroscience and computational linguistics on campus. The department is the hub of a

network of connections with neuroscience, computer science, hearing and speech sciences, electrical engineering, second language acquisition, psychology, and philosophy, and most of its graduate students include experimental or computational methods in their research. The IGERT draws on existing connections that span nine departments in five colleges at Maryland. In addition, the IGERT builds upon international connections that will advance interdisciplinary training in language in India, Japan, and Brazil, while also providing our IGERT trainees with access to broader multilingual perspectives.

|             | Braun | DeKeyser | Dorr | Dougherty | Eckman | Espy-Wilson | Faroqi-Shah | Harper | Hornstein | Idsardi | Lasnik | Lidz | Long | Newman | Phillips | Poeppel | Ratner | Reggia | Resnik | Shamma | Simon | Uriagereka | Weinberg | Woodward |
|-------------|-------|----------|------|-----------|--------|-------------|-------------|--------|-----------|---------|--------|------|------|--------|----------|---------|--------|--------|--------|--------|-------|------------|----------|----------|
| Braun       |       |          |      |           |        |             | Υ           |        |           | Υ       |        |      |      |        | Υ        | Υ       | Υ      |        |        |        |       |            |          |          |
| DeKeyser    |       |          |      |           | L      |             |             |        |           | L       |        |      | Υ    |        | Υ        |         |        |        |        |        |       |            |          |          |
| Dorr        |       |          |      |           |        |             |             | L      |           |         |        |      |      |        |          |         |        |        | Υ      |        |       |            | Υ        |          |
| Dougherty   |       |          |      |           |        |             |             |        |           |         |        | L    |      |        | L        |         |        |        |        |        |       |            |          | L        |
| Eckman      |       | L        |      |           |        | L           |             | L      |           | L       |        |      | Υ    | L      | L        |         |        |        |        |        |       |            | Υ        |          |
| Espy-Wilson |       |          |      |           | L      |             |             | Υ      |           | Υ       |        |      |      |        |          |         |        |        |        | Υ      | Υ     |            |          |          |
| Faroqi-Shah | Υ     |          |      |           |        |             |             |        |           |         |        | L    |      | L      | Υ        | Υ       |        |        |        |        |       |            |          |          |
| Harper      |       |          | L    |           | L      | Υ           |             |        |           |         |        |      |      |        |          |         |        |        |        |        |       |            | Υ        |          |
| Hornstein   |       |          |      |           |        |             |             |        |           | L       | Υ      | L    |      |        | Υ        | Υ       |        |        |        |        |       | Υ          | Υ        |          |
| Idsardi     | Υ     | L        |      |           | L      | Υ           |             |        | L         |         |        | Υ    |      | Υ      | Υ        | Υ       |        |        |        | L      |       |            |          |          |
| Lasnik      |       |          |      |           |        |             |             |        | Υ         |         |        | L    |      |        | Υ        |         |        |        |        |        |       | Υ          |          |          |
| Lidz        |       |          |      | L         |        |             | L           |        | L         | Υ       | L      |      |      | Υ      | Υ        | Υ       |        |        | L      |        |       | L          | Y        | Υ        |
| Long        |       | Υ        |      |           | Υ      |             |             |        |           |         |        |      |      |        |          |         |        |        |        |        |       |            | Υ        |          |
| Newman      |       |          |      |           | L      |             | L           |        |           | Υ       |        | Υ    |      |        | L        | Υ       | Υ      |        |        |        |       |            |          | Υ        |
| Phillips    | Υ     | Υ        |      | L         | L      |             | Υ           |        | Υ         | Υ       | Υ      | Υ    |      | L      |          | Υ       |        | Υ      | L      |        |       | Υ          | Υ        |          |
| Poeppel     | Υ     |          |      |           |        |             | Υ           |        | Υ         | Υ       |        | Υ    |      | Υ      | Υ        |         |        | Υ      |        | Υ      | Υ     | Υ          | Υ        |          |
| Ratner      | Υ     |          |      |           |        |             |             |        |           |         |        |      |      | Υ      |          |         |        |        |        |        |       |            |          | Υ        |
| Reggia      |       |          |      |           |        |             |             |        |           |         |        |      |      |        | Υ        | Υ       |        |        |        |        |       | Υ          | Υ        |          |
| Resnik      |       |          | Υ    |           |        |             |             |        |           |         |        | L    |      |        | L        |         |        |        |        |        |       | Υ          | Υ        |          |
| Shamma      |       |          |      |           |        | Υ           |             |        |           | L       |        |      |      |        |          | Υ       |        |        |        |        | Υ     |            |          |          |
| Simon       |       |          |      |           |        | Υ           |             |        |           |         |        |      |      |        |          | Υ       |        |        |        | Υ      |       |            |          |          |
| Uriagereka  |       |          |      |           |        |             |             |        | Y         |         | Y      | L    |      |        | Y        | Y       |        | Y      | Y      |        |       |            | Y        |          |
| Weinberg    |       |          | Y    |           | Y      |             |             | Υ      | Υ         |         |        | Υ    | Υ    |        | Υ        | Υ       |        | Y      | Y      |        |       | Y          |          |          |
| Woodward    |       |          |      | L         |        |             |             |        |           |         |        | Υ    |      | Υ      |          |         | Y      |        |        |        |       |            |          |          |

Y = existing collaborations: co-authorship, co-teaching, co-supervision, ongoing research, grant proposals L = likely collaborations (especially for recent hires)

**Table 2:** Matrix of collaborative connections among IGERT team members.

Maryland has arguably the best facilities in the US for psycholinguistic and neurolinguistic research with adults and children, and is a leader in cross-language approaches to language learning and processing. Recent experimental studies have covered Spanish, Japanese, Russian, Chinese, Korean, Basque, Portuguese, Kannada, Malayalam, Hindi, Gaelic, and American Sign Language (ASL), using a range of methods spanning traditional behavioral techniques to electrophysiology and functional brain imaging. Expertise in comparative linguistics is leveraged to identify particular languages that can be used to decide among competing hypotheses that are compatible with existing data. Our team of linguists, engineers, and computer scientists are also leaders in the development of automatic multilingual

tools for Automatic Speech Recognition and Machine Translation. Research has covered Chinese, Arabic, Hindi, Korean, and Cebuano, to name but a few. Collaboration between psychologists studying infant cognitive and linguistic development and developmental linguists provides the foundations for understanding human preparedness for language acquisition. Growing collaboration 1<sup>st</sup> and 2<sup>nd</sup> between language learning specialists is making Maryland a leading center for understanding language learning in adults children alike. The computational and neuroscience group, consisting of linguists, computer scientists. engineers, and psychologists. studies animal models of auditory processing that inform research on

human speech processing. Ties to NIH strengthen research in atypical language development and neurocognitive disorders. Our



**Figure 2:** Linguistics and the interdepartmental NACS program as the hub of a collaborative network.

expertise is enhanced by the new DoD-supported Center for the Advanced Study of Language (CASL), which is assembling a 100-strong team to investigate language learning and processing, language technologies, and expertise in less well-studied languages.

The groups that make up the IGERT team have the profile required to attract top students and to impact the development of the field. The Department of Linguistics is ranked #1 in the nation in the Faculty Scholarly Productivity Index (*Chronicle of Higher Ed.*, 1/12/07); the computational linguistics group recently won a Center of Excellence award for Human Language Technology (joint with Johns Hopkins); the Artificial Intelligence specialization in Computer Science has a top 10 ranking, the Electrical and Computer Engineering Dept has a top 15 ranking, and Hearing & Speech Sciences has a top 25 ranking (*US News & World Report*); the combined strength of the new second language acquisition PhD program and CASL make Maryland an emerging powerhouse for research in second language acquisition. Maryland graduates are especially sought after in universities that aim to build interdisciplinary strength in the language sciences. There is no question that Maryland can recruit IGERT-eligible students with the talent to become interdisciplinary leaders: the past 5 years have seen dramatic growth in the number of top-notch US students seeking interdisciplinary training in language at Maryland.

#### 3. Major Research Efforts

The research plan covers four themes that each combine expertise in comparative linguistics, computational modeling, and cognitive/neural sciences. The strength of the research lies in the close integration between researchers from diverse backgrounds. The integrative student projects associated with these themes could have transformative effects in a number of sub-fields.

**a.** Neurocomputational Models of Speech and Hearing: Poeppel (Bio/Ling); Idsardi, Phillips (Ling.); Newman, Ratner (HESP); Espy-Wilson, Shamma, Simon (ECE); Eckman, Iverson (SLLC, CASL), Harper (CASL), Braun (NIH).

A complete understanding of human speech perception will only be achieved when we are able to give a coherent explanation from basic auditory neural activity through to abstract mental representations. The UMD speech team is uniquely positioned to advance our understanding along this integrated research path, making a seamless connection from the study of phonological systems (including infant and adult language acquisition and speech disorders) through the cognitive neuroscience of speech perception to systems neuroscience research on auditory processing and automatic speech recognition. We accomplish this through overlapping interests between the sub-groups; the motto for these connections is "your black box is my mechanism." Even though the team spans several departments (Biology; Electrical and Computer Engineering; Hearing and Speech; Languages, Literatures and Cultures; Linguistics; and the Center for the Advanced Study of Language) across four colleges (Arts and Humanities, Behavioral and Social Sciences, Chemical and Life Sciences, and Engineering) the members

already have a strong record of active collaboration in both teaching and research. The step-by-step connections *From Neuron to Phoneme* are illustrated in the diagram of the group activities (Figure 3):



The unifying theme of the group is the search for the minimal units of speech perception and production: the phonetic features [1,2]. The collaboration between Shamma and Simon has led to a neuro-computationally plausible and experimentally verified model of the peripheral portions of the auditory system (the basic auditory features), and their connection into the primary auditory cortex (in which more complex features amalgamate information from throughout the auditory spectrum) [3-5]. This work exploring the detailed neuro-physiology of the mammalian auditory system is continuing with current students, including Donaldson (NACS). Connecting to this foundational work, Simon, Poeppel and Braun have conducted detailed neuro-physiological studies of basic human auditory abilities which underpin the speech functions (such as pitch and timbre) [6], and together with Phillips and Idsardi have connected basic auditory findings to the human perception of speech, discovering neural correlates of phonological features and phonological contrasts [7]. This is a particularly active area of current research, involving several collaborative studies with students in Biology, Linguistics and NACS. Newman, Idsardi, Eckman and lverson have shown the value of features and contrasts to the study of first and second language learning (including ASL) [8-12], and with the arrival of new faculty members Eckman and Iverson we are planning studies connecting neuro-physiological measures with the second language acquisition of featural contrasts (following up on [7]). Applying this approach to real-world problems, Ratner has shown that understanding crosslinguistic variation in phonological organization is crucial to correct diagnosis and remediation of speech disorders [13] and Espy-Wilson is the leading proponent of a feature-based approach to automatic speech recognition (ASR) [14,15], another lively area of current research. We envision several new connections between these areas, including neuro-physiological investigation of the computations identified in Espy-Wilson's ASR research, such as the cross-linguistic parameters for nasalization examined by Pruthi in his dissertation research (and in [15]).

Three recent graduates (Elhilali (ECE), Chait (NACS), and Kazanina (LING)) were each involved in specific research projects that illustrate both the interdisciplinary nature of the specific projects, and the kinds of contributions that can be made by IGERT trainees. All of these projects are still continuing, and we expect IGERT trainees to further integrate research across the labs throughout the IGERT period and beyond. Using data collected from single-unit recordings, Elhilali (working with Shamma and Simon) was able to map the precise timing and the spectro-temporal receptive fields of individual neurons in the primary auditory cortex. This painstaking, foundational work establishes the actions of the individual detectors at the very beginning of auditory cognition. Chait (working with Simon and Poeppel) has discovered more abstract auditory feature detectors, akin to the edge-detectors in visual neuro-cognition. They were able to identify clusters of neurons that respond to the change between coherent and incoherent auditory stimuli—the edges of coherent sounds. We plan to investigate the enormous potential that these auditory edge detectors have as the building blocks for the phonetic feature detectors in the language system. As an example, the transition between the consonant and vowel in a syllable like "saw" is itself signaled by the transition from broadband noise in the consonant to coherent timbre in the vowel.

A multilingual perspective lies at the heart of work by Kazanina (in collaboration with Phillips and Idsardi), who was able to find a neural correlate of the contrastive features in different languages. Although both Russian and Korean have the sound 'b', only in Russian is this sound contrasted with the sound 'p'; in Korean the two sounds form one category with positional variants: 'b' is used between vowels, 'p' is used in other positions. In a cross-group comparison, only the Russian speakers detected

(and showed a neural response to) a deviant 'b' in a stream of 'p's. This technique offers a more direct window into the process whereby speakers learn new speech sound feature contrasts in a second language, the question at the core of second-language feature research being conducted by Idsardi, Eckman and Iverson. Integrating the results obtained by these students, we see the beginnings of a coherent explanation (going from neurons to phonemes) of the perception of the transitions between consonants and vowels, which are the very building blocks of syllables.

**b.** Input, Uptake, and Output in Language Acquisition. Hacquard, Hornstein, Idsardi, Lasnik, Lidz, Phillips, Pietroski, Uriagereka, Zukowski (Ling.), Newman, Ratner (HESP), Resnik, Weinberg (UMIACS, Ling.); Dorr (CS); Woodward (Psyc.); DeKeyser, Long, Eckman, Iverson (SLLC/CASL), Allen (Gallaudet).

A theory of learning necessarily includes a model of the domain to be learned, an uptake function specifying how information is taken in and related to the model, and an update function indicating how new information is used to change the representation of the domain. Language acquisition research in linguistics typically focuses on the nature of the model, while research in psychology and computer science typically focuses on the update function. Because researchers in these fields tend to ask about different aspects of learning, there is a widespread perception that the approaches are incompatible. Nothing could be further from the truth. This research project mends this rift through collaborative research addressing all three aspects of the language learning problem, with a special emphasis on language variation. Computational modeling, merged with analysis of linguistic diversity and experimentation with infants and children, plays a critical role in exploring alternative perspectives on all three aspects of the learning theory, adding insights from engineering approaches. (See Figure 4)



The model of the domain must be provided by cross-linguistic comparisons of adult languages and child learners. In prior work, Lidz [16,17] and Phillips [18] have used typological generalizations to develop hypotheses about learners' initial syntactic and semantic representations and have shown that children approach very diverse languages with the same representational resources. Missing from this approach, however, is a clear specification of how the particular language being acquired leads to changes in these representations, and precisely what role the input plays in guiding development.

The representational space for language must also be informed by our understanding of the conceptual and cognitive resources that learners bring to the acquisition task. Work by Woodward [19], Pietroski [20], and Hacquard [21] addresses the relation between conceptual structure and linguistic semantics, though detailed models of how conceptual structure, in concert with linguistic experience, contributes to the acquisition of linguistic meaning remains unexplored. The role of conceptual structure in first language acquisition can also be examined through research on second language acquisition, where the cognitive limitations of early childhood are eliminated as a potential variable.

To address the interplay between input, uptake and output in language acquisition, trainees will focus on detailed 'model domains' rather than on coarse measures of overall development. Each linguistic preparation will include three features: (1) substantial, well-understood cross-linguistic variation, (2) a relevant adjacent cognitive domain, (3) a computational model of how experience can drive development.

One clear example domain comes from the interpretation of pronouns. Cross-linguistically, there are two kinds of pronouns: reflexives (*himself/herself*), which require antecedents in the same sentence, and non-reflexives (*him/her*), which do not. These can vary along morphological dimensions (mono vs. poly-

morphemic) as well as along syntactic dimensions determining the proper configurations for finding an antecedent. The two dimensions of variation interact, yielding a space of roughly 20 types of languages. This space is large enough to make learning non-trivial, but small enough to be modeled realistically, taking account of the linguistic and extra-linguistic contributions to learning.

A second preparation will involve the acquisition of speech sound categories in 6-12-month old infants. This is the age when infants transition from 'universal listeners' to showing only native language speech sensitivity [22]. Although it is understood what infants learn about sounds and when they learn it, it remains unclear how they do this, and why 8-10 months is a critical age. Two facts suggest that phonological learning depends on coordination of semantic and/or social knowledge. The onset of word-learning coincides with the acquisition of native phonological categories [23]; and, learners are more successful learning phonological contrasts in interactive experimental contexts than in non-interactive contexts [24]. Exploring and modeling this critical developmental change is an ideal challenge for our team (and a good candidate for an IGERT proseminar), since it brings together experts in infant speech (Newman) and word-learning (Woodward, Lidz), cross-linguistic phonological variation (Idsardi, Iverson), and computational analysis of speech (Resnik, Espy-Wilson). This research theme can also be related to work in second language acquisition, where phonological category learning is rather more difficult.

Work on language disorders can be used to examine the interplay of input and uptake in cases of arrested development [25]. Also, our group's finding that early measures are predictive of later learning disorders [26] can be modeled in order to determine the mechanisms of typical and atypical development.

A complete understanding of the relation between input, uptake and output across development will require computational analysis of the input, experimental data to determine how children represent that input, and theoretical models of how representations can change over time, with results in one area guiding the construction of new hypotheses in the other. With this many variables, computational modeling may be the most effective tool for generating hypotheses and possible learning trajectories. We will also investigate the profound implications of this approach for language learning in machines, replacing direct statistical learning of output parameters with techniques that favor succinct representation of underlying grammatical descriptions, such as Minimal Description Length in the sense of [27]. These techniques will be applied to syntactic and morphological modeling needed for improved automatic stemming and parser development.

**c. Temporal Dynamics of Language Processing**. Collaborators: Phillips, Lasnik, Lidz, Hornstein, Resnik, Uriagereka, Zukowski (Ling.); Weinberg, Resnik (Ling./UMIACS); Poeppel (Ling./Bio.); Braun (NIH/NACS); Faroqi-Shah (HESP), Reggia (CS); DeKeyser, Eckman (SLLC); Dougherty (PSYC).

Successful language processing requires speaker/hearers to dynamically create richly structured representations within a few hundred milliseconds of encountering each new word. Our team asks how this feat is achieved, whether it is achieved in the same fashion across languages with varying word order and morphological markers, what are the possible neural encoding mechanisms for richly structured information, and how the dynamics of language processing differ in adult language learners or in atypical learners or stroke patients. The unusual features of the Maryland group include its expertise in cross-language research (e.g., recent studies on Japanese, Hindi, Portuguese, Basque, Russian, ASL, and Spanish; [28,29]); its use of diverse tools in the tracking of language-related processes (reading time, eye-movement measures, EEG and MEG measures of millisecond-grain brain activity, and fMRI measures of brain localization); and its work linking neuro-computational modeling of language processing and studies of developmental and atypical populations ([30]).

The connections between investigators make it feasible to try to seamlessly align insights from formal grammars with findings from psycho/neurolinguistics and computational neuroscience (Figure 5), something that we could not have imagined a few years ago.

Languages like English, Japanese, and ASL vary greatly in the order and the manner in which information is packaged for communication. A rich psycholinguistic tradition on English-type languages emphasizes the value of verbs [31], which canonically appear early in the sentence in these languages. But in Japanese all verbs must appear in sentence-final position. In spoken languages information is organized in a linear sequence, due to constraints on acoustic transmission, but in signed languages information may be organized spatially. This variation raises questions about the uniformity vs diversity of language processing mechanisms across languages. Phillips and Weinberg and their students have devoted much effort in recent years to investigating the impact of word order variation on language comprehension, and have found striking evidence for shared processing mechanisms across languages:

For example, experiments confirmed our prediction that a mechanism proposed to account for interpretation biases in English sentences with non-canonical word order ('filler-gap dependencies') would elicit the opposite interpretation biases in corresponding sentences in Japanese [32]. Poeppel and his student Diogo Almeida have begun to investigate related issues in the electrophysiology of word recognition in English and ASL, in collaboration with Gallaudet team member Deborah Chen-Pichler. These lines of work provide many opportunities for future student projects, particularly involving work with the local and international partners. Another promising direction for integrative research explores parallels between cross-language comprehension mechanisms and the concerns of the attention/memory group in psychology. In the area of decision-making, Dougherty's group investigates the role of rough-and-ready heuristic strategies vs. more knowledge-intensive mechanisms [33]. This closely tracks controversies in language processing [34], although the literatures rarely overlap.



A core understanding of language processing by adult native speakers can provide a basis for interpretation findings from aphasic patients (Shah, Braun), children with delayed or arrested language development (Ratner, Newman, Zukowski), or second language learners (Eckman, DeKeyser). Agrammatic aphasics have long been known to show deficits in the production of tense information in English, but Shah's work has shown striking asymmetries that provide clues to the source of the deficit. When asked to complete a sentence containing a past-tense adverb (e.g., vesterday), patients fail to select an appropriate verb form (e.g., ate vs. will eat), but perform well in the opposite task, appropriately selecting a past tense adverb when presented with a past tense verb [35]. A student with clinical research interests could study the source and time-course of this contrast together with faculty and students in psychology and/or linguistics. In this way the collaborations will guide the development of new therapies. In the area of second language acquisition the use of fine-grained language processing measures may help to sharpen the question of whether there is a 'critical period' for language learning studies that test how information uptake in adult learners specifically impacts their learning abilities. This type of approach has the potential to have a transformative impact upon SLA research, and it is an area where the UMd program is well-positioned to attract highly talented students. Trainees from SLA and developmental science who gain expertise in dynamic processes are in great demand in the current job market.

Our efforts in human language processing have natural links to the team's expertise in resources and algorithms for multilingual natural language technology models [36], and an important goal for this project will be to seek closer connections between these two areas of strength. A related area that offers rich opportunities for collaboration between students with cognitive (neuro-)science and computer science skills involves the deployment of existing neuro-computational models of low level linguistic processes for use in understanding the dynamics of syntactic and other higher level computation at the neuro-biological level. Work by trainee Whitney (in collaboration with Reggia and Weinberg) has already shown parallels between models of letter position encoding and models of syntactic comprehension [37,38].

**d.** Multi-domain Investigations of Action-Perception Relations. Collaborators: Woodward (Psych.); Idsardi, Lidz, Phillips (Ling.); Poeppel (Bio./Ling.); Newman, Ratner (HESP); Reggia (CS); Espy-Wilson, Simon, Shamma (ECE); Weinberg (CASL, Ling.); Allen (Gallaudet).

Questions about the relation between perception and action lie at the very root of psychology, the neurosciences, and especially the cognitive neuroscience of language. In one of the core historical documents of neurobiology [39] Sherrington in 1906 discussed mechanisms that may be shared between

perception and action. And, even more strikingly, the origins of neurolinguistic research derive explicitly from the attempt to account for the intuitively compelling link between speaking and hearing. Carl Wernicke's 1874 work [40], in particular, anticipated many of the issues now at the forefront of experimental and theoretical research in psycho- and neurolinguistics.

Notwithstanding such prominent historical precedents, perception and action (in language research as well as in other domains) have been studied more or less independently. But recent efforts in psychology to explain aspects of human behavior in the context of *embodied cognition*, on the one hand, and recent neurophysiological findings concerning *mirror neurons*, on the other, have reignited interest in investigating the links between doing and observing (e.g. 41-3). While our team is also enthusiastic about the prospects for considering close action-perception connections, we take a more circumspect approach, on the view that the popular notion of single neuron solutions to linking perception and action fails to do justice to the complexity of relating these foundational domains of experience. In the research program pursued across different UMd labs, we build on the important insight that action-perception links must be viewed as critical, but aim to explore this idea by designing experiments and models that incorporate more abstract concepts, going beyond the simple sensory-neuron-to-motor-neuron links as the basis for explanation in cognition. In particular, neuronal mechanisms such as predictive coding, algorithms such as analysis-by-synthesis, and Bayesian statistical-probabilistic approaches are employed to test how internal forward models may form the basis for the computations linking perception and action. There is, in this perspective, not an unmediated connection between sensory and motor activity that lies at the basis of cognition, but intermediate stages of computation that operate on internal representations.

This research focus for the IGERT is in many ways a (conceptual and methodological) synthesis of projects developed independently by our constituent groups that approach action-perception relations using diverse tools at multiple levels of analysis. The cross cutting focus of this theme research involves deploying methods and techniques developed in the other thematic sections to these issues, and in enriching work in the other thematic areas with computational models developed to address these issues directly. The speech and audition group [theme (a)] is interested in action-perception relations due to their search for basic representational units that putatively underlie both speech articulation and perception in the brain, due to their interest in audio-visual integration processes that implicate analysis-by-synthesis in AV speech, and due to their investigation of Bavesian models of native and non-native phonological learning [44]. The language learning group [theme (b)] is interested in productionperception relations because forward models



**Figure 6.** ERP studies of audio-visual integration and the McGurk illusion [visual /pa/ + auditory /ka/ = perceptual /ta/]. Visual cues prime auditory ERP responses. [Poeppel group, related audiovisual studies on 2-month olds by Lidz & Idsardi.]

(based on learners' knowledge of language at a given state) may allow learners to extract more informative data from the language input. Moreover, important work on pre-linguistic infants investigates how babies' developing motor skills impact their understanding of events and intentions in the world around them, providing a critical precursor to language learning [45]. The *language processing group* [theme (c)] approaches action-perception relations from the perspective of predictive models of language comprehension, which may play a crucial role in explaining the speed of normal language understanding [46], and the challenges of non-native comprehension. Action-perception relations also play a key role in explaining why language impairments that more transparently impact language production (non-fluent aphasia, stuttering [47]) are also associated with specific comprehension deficits.

These investigations of perception-action relations in language learning and processing will be informed by a broader research focus across campus on perception-action relations in motor learning and development. Woodward's group investigates the role of self-produced actions in the development of infants' action perception. Using visual habituation, eye-tracking and imitative learning techniques, this group has discovered that the acquisition of a new motor skill influences infants' perception of others'

goal-directed actions. For example, 3-month-old infants trained to apprehend objects with Velcrocovered mittens subsequently view others' mittened actions as goal-directed ([48]; see Figure 7). A broader collaborative project, including Woodward, Contreras-Vidal and Clark (in Kinesiology), Fox (Hum Devel) and Aloimonos (CompSci) investigates perception-action relations in motor skill learning throughout the lifespan, using both behavioral and electrophysiological techniques. In addition to providing a parallel line of investigation for comparison with work in language, the IGERT team will investigate the interaction between acquired knowledge in these domains and the development of event representations, a critical foundation for verb learning, and into intention concepts, a foundation for acquiring linguistic symbols.

STUDENT PROJECTS. (i) Recent work in auditory cognition has focused on audiovisual speech perception, and it is now widely accepted that visual information from the face/articulators has a facilitative effect on perception (e.g. 49). In a series



**Figure 7.** 3-month old infant training with velcro 'sticky mittens'. The mittens allow younger infants to grasp objects, leading to concomitant changes in their ability to understand observed actions as goal-directed. [Woodward lab, psyc]

of experiments combining psychophysics and EEG recording, a former trainee (NACS), Virginie van Wassenhove (now post-doc at Caltech), was able to show a precise, articulator-specific predictive relation between the information contained in the face (visemes) and the auditory evoked signals elicited by speech. She was able to show that the more predictive a viseme is, the more temporal savings one observes in auditory cortex ([50], see Figure 6). These data are most naturally interpreted as supporting an analysis-by-synthesis operation in audiovisual speech perception. We intend to investigate the numerous new experimental, computational, and theoretical questions, for example about ecologically natural AV speech. Moreover, this will allow us to link to our colleagues, as incorporation of data on visual signals provides a natural link to studies in ASL, where it is possible to explore the predictive value of hand and face information for online comprehension. (ii) Work by current trainee Ellen Lau (LING) grounds internal forward models and perception-comprehension processes at the level of sentence processing. By recording EEG data while participants read English sentences with carefully crafted ellipsis constructions, Lau et al. [46] showed that readers generate nuanced structural (grammatical) expectations that are tested against the input so rapidly that very early (~200 ms latency) brain responses provide an index of whether such structural predictions are met or not. Because of the extreme rapidity, the most plausible account assumes that an internal forward model of the grammar/parser continuously updates its forward expectations. This research, central to the aims of theme (c), opens a host of new possibilities to study how listeners/viewers/readers construct moment-by-moment representations by generating forward models. This work also provides an example of how theoretical linguistics, cognitive neuroscience, and computational modeling can converge to yield fuller descriptions of online language processing. (iii) A more explicitly computational project is exemplified by the work of a current trainee Hyuk Oh (NACS). Current functional-anatomic models of speech (e.g. [51]) suggest that there must be an intermediate stage in which coordinate transformations are computed that translate between auditory (time-frequency) and motor (time-articulator joint space) coordinate systems. To tackle this issue from a computational perspective. Oh is merging a computational model of auditory cortical neurons and their contribution in the analysis of speech sounds [52] with a detailed model of speech production [53]. Each model provides a sophisticated account of how perception or production may be mediated, but neither engages in detail how the information is transformed to permit effective recoding of information, as is typical in human cortex. By testing computational hypotheses about coordinate transformations and what representational primitives lie at their basis, this type of project directly addresses the question of how perception and production may be linked in the vocabulary of the brain.

Cumulatively, this research theme provides a foundation for merging insights from the different research themes of the IGERT, while also drawing upon the varied experimental and computational tools that trainees will learn to use.

#### 4. Education and Training

EDUCATIONAL VISION. WHY MARYLAND? Our training program aims to prepare our students for their future based on lessons learned from our past. Many of us have had the privilege of training in multiple disciplines through graduate or postdoctoral work, and have trained students with multiple backgrounds. We know what it is like to try to master multiple paths related to the study of language. We have discussed at length the skill-sets required to solve the problems discussed in the previous sections. We have also discussed with groups of students the structural or psychological barriers that we or they have had to overcome, with the goal of providing a more programmatic and long-lasting solution.

Our IGERT will stretch the boundaries of our multidisciplinary approach to training. We have already created an environment in which it is second nature for some students to combine theoretical, behavioral, and neuroscientific research. We have experience in offering courses to diverse audiences through teaching in the Neuroscience & Cognitive Science (NACS) Program, which provides foundational coursework in cellular, systems, computational and cognitive neuroscience to students from 14 feeder departments. And, since we have already trained many students in this model, we know how to translate this approach into terms that can be understood by traditional conference committees, journal editors, and department hiring committees, and by industry. Our experience, however, has also provided us with an understanding of the remaining challenges, which the current IGERT plan addresses. We have identified 4 key challenges that our training program aims to overcome.

(1) <u>Linking computational and linguistic expertise</u>. To date, we have had good success in pairing experimental and theoretical training. Students in our program routinely merge analytic techniques used in cross-linguistic description and theory construction with those of the behavioral sciences. Training in <u>thinking computationally</u>, for students with formal aptitude but limited background is far less attested. Conversely, expertise in <u>analyzing diverse human languages</u> demands knowledge-intensive training, and is often underestimated by students with computational or experimental backgrounds. <u>Action Items</u>: Winter Storm; new and modified coursework; integrative seminars. (see below)

(2) <u>Interdisciplinary communication</u>. We and our students have dealt with the difficulty of getting multidisciplinary work into single-focused venues, but these venues are still the norm. Our plan emphasizes writing and communicating across disciplines, especially crafting research proposals and writing for journals and reviewers that retain a primarily disciplinary focus, and presenting work to broad, possibly non-expert audiences. <u>Action Items</u>: co-mentoring; IGERT fellowship application; writing and speaking workshops; outreach and international partnerships; IGERT pro-seminar.

(3) <u>Building effective collaborators</u>. No-one can realistically have independent expertise in all of these disciplines. We want our trainees to attain a rich enough understanding of the modes of inquiry and ways of problem solving to know when they need help and who to get it from. <u>Action Items</u>: Winter Storm; courses emphasizing collaborative projects; advanced rotations.

(4) <u>Finding frontiers</u>. Our students must be prepared not just to address the substantial challenges that we have targeted, but to tackle the challenges they will face in 10 years. Students must therefore be experienced in stepping outside their comfort zones to forge new connections across departmental, disciplinary and political borders. How does one become a secure neophyte after working hard to be "the expert" in a home discipline? <u>Action Items</u>: Outreach and international partnerships; advanced rotations. Collaboration with Gallaudet colleagues.

WHAT TYPES OF STUDENTS WILL WE PRODUCE? We consider three possible successes for our program. The first is the **savant**: a student who gains sufficiently deep expertise in more than one area of the IGERT to be an independent investigator in multiple fields. For example, we could expect a student with previous programming experience to leave UMd with sufficient expertise to be hired as a computationalist, or a theoretician in a linguistics or CS department, or in a research institute or industrial setting. The second type of student is the **broad collaborator**; a student with primary expertise in one area and sufficiently deep multidisciplinary experience to engage in diverse collaborative research. These students will be well suited to building their own collaborative networks after graduation, leading to sustainability of our goals. The third type of student is the **broadened collaborator**; a student with attributes of the broad collaborator, perhaps to a lesser degree. We want to be flexible enough to attract the best students from departments where recruitment and employment variables militate against tackling all of the skills offered.

#### Our Plan

The program is geared towards preparing students for interdisciplinary dissertation projects and for building similar collaborative networks at other institutions in their future careers. These new initiatives build upon a number of pieces that are already in place.

FOUNDATIONS: APPLICATION. Students' applications for IGERT support will be a part of their training. Our students have benefited from working closely with mentors on NSF Graduate Research Fellowship proposals, and we will extend this to the IGERT program. Applications will be open to UMd PhD students, not only those working with faculty listed in C1. Applicants will be strongly encouraged to specify comentors from diverse departments in their application. Sponsoring faculty will be expected to outline their own contributions to IGERT training activities as a part of the application, and should describe how comentoring the student will move their own research in new directions. (Additional details in C5, C7.)

FOUNDATIONS: WINTER STORM. There will be a highly intensive (morning to late-night) two-week Winter Storm every January for all new IGERT participants, along with other trainees and faculty. The Winter Storm focuses on hands-on skill building, interdisciplinary communication, and collaborative teambuilding. The Winter Storm is inspired by a successful 'Boot Camp' initiative in a computer vision IGERT at UCSD. What is distinctive in our plan is the great diversity in skill-sets represented by the students and faculty at this event.

The Winter Storm will include intensive workshops for developing key foundational skills, e.g., computing with MATLAB, statistical analysis with *R*, speech analysis with *Praat*, simple linguistic problem solving, or electrophysiological data acquisition. "Hands first" learning enables students to step outside of their comfort zones to build an appreciation for diverse methods and data-types. An SLA student may be encouraged to take a computational course following success with basic statistical analysis, or may benefit simply from using "proxy" off the shelf tools with expert guidance. A student with no background in formal linguistics will gain the skills and confidence for the language diversity track. The workshops also allow basic foundational courses to concentrate on content, rather than teaching basic tools of the trade.

A second activity of the Winter Storm is a set of presentations of research by IGERT groups, with a focus on relating specific projects to the big-picture challenges. These provide models of interdisciplinary communication. These are not progress reports, however. Presenters will also identify manageable problems of their research agenda for other students to work on collaboratively. The aim will not be for students to solve the problems, but to propose detailed approaches, identifying methods and data-analysis techniques. These exercises help to build student relationships across disciplines.

Winter Storm will also include social activities for 'decompression' and team-building. This activity and the proseminar (below) will also serve as an "icebreaker" for our collaborators from Gallaudet and their students. It provides an intensive response to the question of "what's in this for you". It also puts Gallaudet students in the same position as others; entering new territory, feeling less like outsiders.

Our key faculty have already signed on to contribute to the Winter Storm, and a number have also expressed enthusiasm in participating as learners. In addition, when we presented this plan to student groups, they enthusiastically supported expanding the role of students as peer instructors in these events. We expect the Winter Storm to be exhilarating for students, and to play a pivotal role in IGERT activities. This and participation in foundational courses and obligatory seminars serves to build a student cohort.

FOUNDATIONS: COURSEWORK. Coursework that takes a student away from his/her home department sets the stage for subsequent interdisciplinary research projects. The default 'tracks' shown in the table below provide guidelines, but students may design individualized tracks in the application process. Students must take at least one track outside their home department. Students can receive formal recognition for the additional coursework through the new Certificate Program in NACS that the PI helped to develop (approved summer 2007). Importantly, a Washington area consortium allows Gallaudet students to take our courses with ASL interpretation or other services provided free of charge (see attached letter from Ms Evalyn Hamilton of UMd Disability Support Services).

The Language Structure and Diversity track provides students with essential background for multilingual studies. We will continue the ongoing modification of linguistics courses to better serve non-linguistics students. In particular, after taking Syntax I (Lasnik) students can take a new IGERT course on language diversity and language learning (Hornstein/Lidz). This course emphasizes multilingual linguistic analysis and relates these results to research questions in first and second language acquisition.

The Phonology sequence relates formal linguistic analysis to problems of categorization in learning, speech recognition, and the neural encoding of speech. The unifying research theme, the search for the minimal units of speech perception and production also serves as the unifying principle of the phonology

course sequence. The phonology sequence emphasizes the importance of drawing on data from multiple disciplines and the interdisciplinary consequences of any one data type. The course will help students to understand phonetic features as the phonological primitives of human languages, to demonstrate their connection to the neural coding of auditory signals in humans and other mammals, and to explicate how features inform models of automatic speech recognition and speech disorders.

The Semantics sequence (Pietroski, Hacquard) will emphasize multidisciplinary perspectives. Both semanticists are experienced experimentalists, and they will integrate formal approaches to meaning with novel experimental approaches. Because the semantic content of linguistic expressions partly derives from independently existing cognitive systems, semanticists must find points of contact with cognitive psychology. For example, we can expect that an understanding of infants' representations of events can provide important boundary conditions on how they learn the meanings of words referring to events. By contextualizing traditional semantic theory with adjacent areas of cognition, the semantics curriculum can be made more meaningful students coming from other departments (e.g., psychology) and can help students in linguistics to see how to turn formal questions into psychological and neuroscientific ones.

The Cognition and Neuroscience track includes courses that already have substantial hands-on and teamwork components and that have spawned a number of successful cross-cutting research projects in recent years. Students will take foundational courses offered by two programs (LING, NACS), with electives from other departments. Psycholinguistics I & II offer a focused introduction on using behavioral methods to answer questions posed by linguistics. What is the trade-off between statistical tuning from data and the deployment of innate knowledge? How is language comprehension impacted by linguistic variation? Lectures are reinforced with labs (many designed by the PI as part of an NSF CAREER award) that allow students to "get their hands dirty". These courses have prepared many linguistics and SLA students with no background to be effective experimentalists. A notable feature of the Cognitive Neuroscience course (Poeppel) is that it has built cross-discipline student partnerships by pairing students from different fields for hands-on research projects, some of which have led to publications.

The Computational/Neural/Cognitive Modeling track spans two areas of computational research relevant to language. The computational linguistics courses focus on application areas such as multilingual search and summarization, machine translation, or development of machine-aided language tutoring applications. The neural modeling courses emphasize the link between computer models and testable neuroscientific predictions. The biological signal processing course (Simon) is already highly popular among students from NACS, Linguistics, Kinesiology etc. who seek a deeper understanding of data analysis techniques. Courses for each track are currently taught by IGERT faculty (e.g., Reggia, Simon, Dorr, Resnik, Weinberg). In addition (see letters by Deans Harris and Montgomery), the University is committed to hiring an additional computational modeler who specializes in modeling language and other higher cognitive processes.

Experience has taught us that computational training often presents a real challenge for students who enter graduate school with technical aptitude but a traditional language/psychology/clinical background. Nonetheless, Weinberg and Resnik have trained linguists to become successful computational researchers: Reggia has combined his talents as a computational modeler and practicing neurologist to develop computational training for MDs. Based on our experience, we see the keys to success in this area as: (i) preparatory training (via the Winter Storm); (ii) a new "gateway" course to introduce students with limited programming expertise to underlying computational methods and modes of inquiry. This course will discuss suitable language application (e.g., "parsing") designed to introduce basic concepts such as search, constraint satisfaction, problem reduction, and the use of first order predicate logic. We will combine this with a language learning application to introduce concepts from basic statistics and machine learning (rule induction, decision trees), elementary linear algebra and the corresponding basic 'neural' learning models. We intend to illustrate these basic concepts with "off the shelf" tools in order to divorce computational thinking from extensive programming, while presenting students with lab exercises. We have experimented with this technique in our current signal processing course. (iii) Cross-discipline student partnerships will be modeled on our current LING647/CMSC723 where we have designed problems that require the combined skills of linguists and computer scientists.

ETHICS TRAINING: We are fortunate to be able to offer programs staffed by experienced scientific ethics educators to our faculty and students. Ethics education for science and engineering was initiated more 12 years ago at UMd by our colleagues Robert Dooling (Psych/NACS), Arthur Popper (Biology/NACS) and Sandra Greer (ChemEng). Using funds provided through an NSF-EESE special solicitation "Ethics Education in Science and Engineering" (SES-062929), our colleagues are revising their courses

to produce a single three-hour/week course for graduate students and postdocs entitled *Research Ethics*. The course will address bias, use of human and animal subjects, attribution, plagiarism, intellectual property and the issue of under-represented groups in science; using domain specific material in relevant disciplines. We will require this course for IGERT fellows. Our colleagues are also developing a 4-6 hour Research Ethics Workshop, to be part of the orientation of newly appointed Assistant Professors. Our faculty plans to attend the course and share our personal experiences.

The program is intentionally flexible and allows multiple navigation paths. For example, in order to become a savant capable of advancing the state of the art in linguistics and computation, a linguistics student with basic programming experience might supplement our computational modeling track with additional computer science courses. The new gateway course makes it possible for a broad collaborator without programming background to eventually take a machine learning course. Finally, a student not interested in adding a computational component could refrain from taking the courses in Track 3, while still being exposed to computational thinking through Winter Storm and the proseminar activities.

| Students complete two of the three tracks; all students must take courses from the Lang. Diversity Track; |                                 |                                 |  |  |  |  |  |  |
|---|---------------------------------|---------------------------------|--|--|--|--|--|--|
| students may petition to substitute courses that better serve their interdisciplinary preparation         |                                 |                                 |  |  |  |  |  |  |
| Language Diversity Track  | Cognition & Neurosci. Track     | Comp./Neural Modeling Track     |  |  |  |  |  |  |
| Three of:   | Two of:                         | Both of (neural modeling):      |  |  |  |  |  |  |
| Syntax I/II (LING 610-611)  | Psycholing. I/II (LING 640-641) | Intro. Neuroscience (NACS 641)  |  |  |  |  |  |  |
| Phonology I/II (LING 620-621;   | Cogn. Neurosci (NACS 642)       | Comp. Neuroscience (NACS 643)   |  |  |  |  |  |  |
| modified course)  | Cogn. Science (NACS 644)        | Or both of (comp. linguistics)  |  |  |  |  |  |  |
| Semantics I/II (LING 660-661;   | Plus one of:                    | Comp. Linguistics (CMSC 726-7)  |  |  |  |  |  |  |
| modified courses)   | Cogn. Devel. (PSYC 679)         | Or Intro Comp Models            |  |  |  |  |  |  |
| Language Diversity and Learning   | Attention/Memory (PSYC 778)     | of Higher Order Processes (new) |  |  |  |  |  |  |
| (new course)  | Research Design (HESP 724)      | And one of:                     |  |  |  |  |  |  |
|   | Second Lang. Acq. (SLAA 649)    | Neural Computation (CMSC 727)   |  |  |  |  |  |  |
|   |                                 | Signal Processing (NACS 728b)   |  |  |  |  |  |  |
|   |                                 | Machine Learning (CMSC 726)     |  |  |  |  |  |  |
|   | All students also enroll in:    |                                 |  |  |  |  |  |  |

Proseminar: Biological & Computational Foundations of Language Diversity (new course) IGERT Lunch Seminar (new 1-credit course, continuing participation) Research Ethics (NACS 600 - revised course)

RESEARCH INTEGRATION: TRANSLATIONAL ACTIVITIES. At the core of the IGERT are four components that help students with the crucial step from foundational training into innovative research programs.

TRANSLATIONAL ACTIVITIES: PROSEMINAR. A team-taught IGERT pro-seminar will focus on questions in cross-language research that require a convergence of theoretical, experimental and computational tools. For example, From Ferrets to Phonemes will relate research on the neurophysiological encoding of complex acoustic spectra to the task of representing the sound systems of individual languages. Another pro-seminar, From Cells to Semantics, will engage computational modelers, linguists, and psycholinguists in the problem of encoding richly structured representations. Co-PI Lidz piloted such a seminar in Spring 2007 along with a developmental psychologist and a philosopher, focusing on number and quantification. This course drew on research from animal behavior, cognitive development, cognitive neuroscience. linguistic theory, logic and mathematics, psycholinguistics and psychophysics, addressing the question of how cognitive mechanisms for representing quantity shape the lexical representation of quantification in natural language. Because the mechanisms for representing quantity are evolutionarily ancient (found in insects and primates), their role in linguistic representations can be assessed from an evolutionary and developmental perspective. Second, findings about the neuroanatomical structures implicated in quantity representations offer an initial foothold on the problem of neural encoding of semantic representations. The course was a success, serving as a springboard for several new research projects and illustrating how to integrate research from different disciplines. Critically, some of the students in that course, while not explicitly working on number and quantification, have begun projects that use techniques learned in that course, illustrating the benefit of having students step outside their methodological comfort zones.

TRANSLATIONAL ACTIVITIES: RESEARCH PROPOSAL. By the end of the first year of IGERT support students will develop a formal interdisciplinary research proposal, building upon the experience gained through the IGERT fellowship proposal, and drawing on the interdisciplinary coursework. The proposal will be developed under the close supervision of the primary advisor and the co-advisor, and will be evaluated like a research grant proposal. We require the integration of ideas from multiple disciplines and a clear communication of how the multidisciplinary approach will enable the proposer to solve questions that are not addressable from a single disciplinary perspective. The process of proposal development will build the trainee's ability to communicate across disciplines and also strengthens research ties among the faculty, providing the basis for sustainable research projects and future training opportunities.

TRANSLATIONAL ACTIVITIES: ADVANCED ROTATION. Following advancement to PhD candidacy the student will carry out the research project in a non-home department host group for at least half a year. In contrast to traditional lab rotations in physical sciences, where beginning students carry out assigned research in similar lab environments, our trainees will be 'advanced rotators' who take primary responsibility for developing their project and will use the rotation to shape their dissertation research. Advanced rotators will be paired with beginning students in the host lab, providing experience to both students in cross-disciplinary collaboration and providing valuable mentoring experience to the trainee.

TRANSLATIONAL ACTIVITIES: RESEARCH SEMINAR. A lunchtime IGERT Research Seminar will focus on student research presentations to the whole IGERT group. The research seminar will alternate 'background' and 'news' weeks, and will develop students' ability to move comfortably between the details of their specific projects and the broader issues that they bear on. As an antidote to internal parochialism we expect students to present a seminar explaining why "their field" considers a problem to be important. Presentations also serve as models for students writing their initial IGERT admission or research proposals and will develop the skill of pitching a talk to the interests of different fields; this is a key component of tailoring a body of research to a specific journal audience as discussed above.

BROADER IMPACTS: OUTREACH. The undergraduate and high school outreach activities already underway or being developed (see C7 for details) serve multiple goals. They address acute minority under-representation in cognitive science research at an earlier level (i.e., the PhD application stage is recognized as too late); they provide models of 'problem solving across the curriculum' for high school students. In addition, they will provide IGERT trainees with experience in developing broadly accessible instructional materials and in mentoring students from diverse backgrounds. For example, in collaboration with Northwood High School, a 60%-minority population high-school in Silver Spring, MD, the IGERT trainees will participate in bringing their cutting edge research on language to students who would otherwise not be exposed to the language sciences. Interactions with the AP psychology class will consist of laboratory demonstrations coupled with problem-based learning sessions. Trainees will develop interactive instructional materials which help students to pair appropriate research methods to problems (see attached letter from Mr Carlos Montalvan of Northwood HS).

In addition to the diversity-focused outreach activities (see C7), many undergraduate students already gain research experience in the participating laboratories. For example, in just the 3 labs in the Infant Studies Consortium (Woodward, PSYC; Newman, HESP; Lidz, LING) around 40 undergraduates are engaged in research each semester.

We also envision significant outreach to the Deaf community in partnership with colleagues at the NSF sponsored Science of Learning Center 'VL2' ('Visual Language and Visual Learning'). This center is devoted to understanding visual languages such as ASL from neural, developmental, behavioral and instructional perspectives. The Center is staffed by researchers from across the country, but the focal campus is Gallaudet University in Washington DC. Gallaudet currently does not have programs in either cognitive psychology or in computational areas that can support the VL2 program. In collaboration with the PI of VL2, we plan to make our course offerings, Winter Storm, and the other translational offerings of the IGERT available to Gallaudet students. (See supporting letter from Dr. Thomas Allen)

BROADER IMPACTS: INTERNATIONAL PARTNERSHIPS. The international partnerships with India, Brazil, and Japan play an important role in expanding the reach of interdisciplinary research on language to underrepresented and low-density languages. These partnerships also allow trainees to develop valuable skills in building new connections and working in unfamiliar environments. The different partnerships present different kinds of challenges to collaboration, but all offer the same potential for building international communication skills across disciplines.

The particular language groups chosen reflect a reasonable sample of the variability in human languages and a cline of similarity to English and to each other. Brazilian Portuguese (BP) is a Romance language, which is relatively similar to English. The particular differences between English and BP in morphological structure and in morphosyntax enable examination of relatively fine-grained differences across languages. Japanese and the Dravidian languages spoken in South India represent the other

extreme. These languages are globally quite different from English, but are about as similar to each other as English is to BP. Hence, research here enables us to identify the psychological consequences of large scale differences (from English and BP) in addition to fine-grained differences (e.g., between Japanese and Kannada). The North Indian languages are more closely related to English (they are Indo-European) and so can provide another dimension along which small scale differences can be manipulated. In addition, these languages differ along a scale of documentation and availability for computational tools. Whereas Japanese is both well studied and well represented in electronic media, BP and the Indian languages are considerably less well understood. While there is, of course, a rich tradition of grammatical description on Indian languages, there is virtually nothing reflecting the cognitive science perspective on these languages (other than what we ourselves have produced). With respect to electronic representation, materials in Indian languages are considerably less available on the Internet. Consequently, there is a significant need for tools that can build corpora, translation tools, electronic dictionaries, etc. from small amounts of data, presenting a clear and addressable challenge (see C9).

BROADER IMPACTS: MULTI-INSTITUTION IMPACT. Our goal of sustainable change in the science of language across institutions is supported in a number of ways. (i) Students and faculty from other universities will be invited to IGERT activities, as discussed above in reference to our collaboration with the VL2 Center. (ii) There is high demand for graduates with the hybrid skills provided by this IGERT, especially in SLA, speech pathology, and linguistics departments. Trainees will be well prepared to extend our strategies to their new employers. (iii) The Maryland language community already enjoys high visibility, due to its reorganization of the role of the Linguistics Department and the growth of CASL and the SLA PhD. We will use the IGERT to further publicize "the Maryland model" by presenting a series of 4 interdisciplinary symposia at major professional meetings, related to the topics of our proseminars. We will also make teaching materials and course syllabi available through our web portal.

*ENVIRONMENT.* The success of a project like this depends on a conducive intellectual and physical environment. There is a vibrant intellectual community with collaborations across five colleges. We already have space for multidisciplinary proseminars and the Winter Storm. The physical environment has been designed with collaboration in mind. For example, the Cognitive Neuroscience of Language Laboratory (LING) is a 5000 sq. ft. facility where all resources are shared across 6 faculty members. Students are mixed across specialties, with generous space for small meetings that is in constant use, and space is explicitly set aside for researchers from other departments who come to work with the brain recording facilities. The Computational Linguistics Laboratory is a state of the art computing facility that already co-locates students from Arts and Humanities and the Computational and Information Sciences. These spaces have extra capacity for collaborators from other departments. We are requesting funds for an SLA laboratory, equipped for behavioral experimentation and a variety of analysis methods, which will allow these colleagues to supplement the facilities already afforded by the infant and child language development laboratories in the Linguistics and Psychology departments.

#### 5. Organization, Management, and Institutional Commitment

PI AND STAFF. The organizational structure of the project is outlined above in Figure 1 (p. 4). Dr Colin Phillips will direct the project. His responsibilities include liaison with NSF, coordinating student, faculty and staff activity, and supervising recruitment. He will coordinate with each student's home department to report on student progress, and to ensure a smooth funding stream during each student's career. He is also the primary point of contact for the evaluation consultant, who will also report to the Executive Committee. Dr Phillips has extensive administrative experience as the co-director of the Cognitive Neuroscience of Language Laboratory, which houses approximately 40 students, faculty, and research staff. He is also well placed within relevant administrative units, serving on the Executive Committee and chairing the Curriculum Committee of the NACS Program, and serving on the UMd Research Council. The PI will be assisted by staff support, consisting of an administrator, a lab technician, a post bachelor fellow, and our evaluation consultant. The administrator is responsible for student record keeping, course, seminar, rotation and meeting scheduling, and financial management. The post BA student supervises general IRB accounting as well as serving as a 'roving' technical support person, while the lab technician is primarily responsible for supporting our major research instruments. Information coordination and collaborative management will be supported by an on-line portal for the project (through Blackboard). which we have successfully piloted during the development of this proposal.

EXECUTIVE COMMITTEE. The PI will be supported by an Executive Committee (EC) consisting of 8 members: the PI, 1 further Linguistics co-PI, 1 SLLC co-PI, 1 Psychology co-PI, 1 member for CompSci or

ElecCompEng, 1 member for HESP, and 2 students in rotation across departments. The composition of the committee ensures inclusion and fair distribution of resources. The EC will meet monthly. Each member of the EC will also be assigned responsibility for the smooth functioning of specific aspects of the program. The PI will be the point of contact between the NSF, and relevant UMd departmental and upper administrative bodies. One member will head the Recruitment and Admissions Committee. One EC member will be responsible for ensuring adequate staffing for the proposed courses. A faculty/student dyad will be responsible for coordinating topics and student/faculty leaders for the Winter Storm. The final format of Winter Storm will be approved by the entire EC. One EC member will ensure the smooth running of laboratory rotations and adequate outreach participation, and another faculty/student dyad will be responsible for the proseminar. The international partnerships will initially be coordinated by the primary initial contacts for each country, but the aim is to broaden responsibility as the partnerships develop. The EC members will coordinate activities with team-leaders for the individual research themes, who will be chosen annually.

RECRUITMENT & ADMISSIONS. A 5-member committee representing multiple disciplines will be responsible for recruitment and admissions activities. This committee is charged with implementing the general and unit-specific recruitment plans (see C7 and C10 for details), securing ever-improving pools of applicants to the participating programs, and fairly allocating IGERT stipend support. This committee will aim for departmental and ethnic diversity among IGERT trainees, weighing these factors in funding decisions, in combination with the other ways in which a student contributes to the project's goals.

STUDENT COMMITTEE: a representative committee of 6 students will assist in the planning of major project activities, including outreach, Winter Storm, and symposia, and will provide student input on potential obstacles to the success of the project.

STUDENT PROGRESS. Two mentors will agree to supervise each IGERT student from the proposal writing stage through laboratory rotation, at which point they may be joined by the head of the non-host laboratory, if different. The PI and the home advisor will ensure consistency between IGERT progress and the requirements of each student's home department. Student progress for all IGERT fellows will be tracked semi-annually against a series of milestones, and continued IGERT support will depend on successful attainment of milestones (e.g., complete rotation research proposal prior to 2nd year of IGERT support). Student progress will be reviewed annually at faculty meetings that are open to all faculty, but must be attended by the Executive Committee and the student's IGERT advisors. This yields evenhanded oversight and provides a general picture of how all students are doing which can lead to retrofitting the program to better serve student needs.

An IGERT-wide council will meet at the beginning of each semester to discuss policy and the ongoing progress of the project. One meeting will be held after the Winter Storm, with another at the beginning of the academic year. The Winter Storm meeting is devoted to evaluating the last season's courses and the Winter Storm, setting the topic for the next year's proseminar, proposing and ratifying the course roster, and reviewing evaluation tasks for the coming semester. The beginning of academic year meeting will address recruitment goals and action plans, will discuss topics for the upcoming Winter Storm, and will review program objectives for the year. We will invite the PI and faculty from Gallaudet's VL2 Science of Learning Center to participate in these semi-annual meetings (and we have budgeted funds for sign language interpreters.)

ADVISORY BOARD. In addition to our internal management, we have formed an Advisory Board that will meet once per year in the spring. The team will be furnished with written research materials including publications, and results from all internal assessment activities. They will listen to a morning's worth of research presentations and then spend the afternoon interviewing students, faculty, and our executive committee. They will write report to be presented to the executive committee and shared with the UMd senior administration. The following distinguished scientists from across our disciplines have all agreed to serve: (i) Mark Johnson (Professor, Brown U), a computational linguist who has directed an IGERT; (ii) Susan Gass (Univ Distinguished Professor, Michigan St U), an expert on cognitive aspects of SLA; (iii) Greg Hickok (Professor, UC Irvine), a cognitive neuroscientist with expertise in sign language research; (iv) Maria Polinsky (Professor, Harvard U), an expert on language diversity and fieldwork, with additional expertise in psycholinguistics and heritage languages; (v) Mabel Rice (Distinguished Professor, U Kansas), a leading figure in research on neuro-cognitive disorders and language acquisition.

INSTITUTIONAL COMMITMENT: The U of Maryland has a strong record of supporting interdisciplinary research on language, and has made language and cognition an institutional priority at the highest level. The President of the University has designated *Language, Cognition, & Culture* as one of the University's

strategic priorities, the Vice President of Research has appointed co-PI Weinberg to lead the effort to translate this strategic plan into additional programs and centers, and this IGERT is seen as part of this effort. In addition to targeted faculty appointments, the College of Arts and Humanities (ARHU) and the Graduate School have supported a series of facilities enhancements and reconfigurations that have fostered far greater collaboration among research groups. Dean Harris has committed to securing space enhancements for the personnel and research activities of the IGERT, and will also support a new crossdepartmental faculty line in computational modeling in connection with the IGERT, in addition to existing commitments to new positions in Second Language Acquisition and a new Language and Logic focus area that spans Linguistics and Philosophy. Dean Montgomery of the College of Behavioral and Social Sciences has committed to fund at least 50% of a computational neuroscience position (the other 50% will come from a NACS member department). He is supporting vigorous growth in the Psychology Department, with resources already committed for 6 new hires this year, and strong support of continued aggressive hiring (adding up to 12 more faculty) over the next 5 years. Among these, 2 in the coming year and likely more in future will be dedicated to the cognitive or neural sciences. He has also allowed the program in Neuroscience and Cognitive Science to hire a half-time administrator to support group initiatives involving faculty members from the program. The University will additionally support two new graduate student lines for non-citizens who will are ineligible for NSF support. More specifics can be found in the Deans' attached support letters.

POTENTIAL OBSTACLES. Faculty in this IGERT are well funded and busy, and their home departments make many demands on their time. Although the project is based upon a network of connections that has been developed over a number of years, we recognize that full commitment from all participants cannot be taken for granted. Two main features of our plan address this concern. (i) As we have done throughout the planning of this project, the PI and other project leaders will devote much effort to fostering personal connections with all participating units and individuals, emphasizing *two-way* communication: we are advocates for the project's benefits to individuals and departments, but we have also learned much by listening, e.g., leading to unit-specific variants on our recruitment plan. (ii) In order to maximize the impact of IGERT funds, no funds will be committed to individuals, units, or projects in advance. Requests for funds will be tied to commitments to contribute to project activities. These efforts set the stage for the continued feasibility of the program at the departmental level, and for the development of future initiatives. This is why we have specified departmental relations as one of the major duties of the PI and EC.

A second potential obstacle is that the IGERT has so many moving pieces. Our antidote to this problem is an active executive committee, with each member having a specific coordinating assignment and regular opportunities for advice and monitoring in terms of monthly meetings.

#### 6. <u>Performance Assessment/Project Evaluation</u>

OBJECTIVES. The assessment plan stems directly from the goals of this proposal. We claim that we can train students capable of high-quality multidisciplinary research through a combination of new and revised courses and proseminars plus hands-on experiences supervised by researchers from multiple disciplines. A further claim is that this type of training will fill an obvious need and be appealing to both students and employers from inside and outside of academia, enhancing recruitment and job placement. Three levels of evaluation are required. We need to monitor whether we did what we promised in terms of implementing the required elements of the program, e.g., offering courses, organizing rotations. This is documented by a quantitative evaluation. We must also document the impact of our programs. An external measure of success at producing students trained across the disciplines could be the number of papers presented at conferences or papers written for journals in multiple fields by a given student. We also want to document correlation or causation between what we are doing and these outcomes. For example, did students benefit from the multidisciplinary courses? Were the courses accessible to a diverse population, without diluting the experience for specialists? Were these courses helpful in preparing for hands-on work or did students only "get it" once they had had these experiences? Understanding these factors will help us to more finely tune the program. In order to enhance prospects for sustainability, we will also make these evaluations available as part of a yearly report to our upper administration, to keep them aware of and excited about our accomplishments. We will use both qualitative and quantitative methods as discussed below.

IMPLEMENTATION. The evaluation will be carried out by a 7-member evaluation committee consisting of the PI, 2 co-PIs (rotating), 2 non co-PI faculty on the project, and 2 students. This committee will be supported by Ms. Sharon La Voy and a graduate student in her office. Ms. La Voy is the Director of

Assessment in the University's Office of Institutional Research, Planning & Assessment (OIRPA), and has extensive experience in designing assessment projects in higher education settings. She has designed numerous surveys and focus group protocols, and has implemented them in diverse settings. We have selected an evaluation practitioner rather than a faculty member whose focus is in advancing the theory of evaluation. We also want someone with university-wide standing, again with an eye to the sustainability of the program. The evaluator will compile independent reports to the evaluation committee. Results of the report with additional recommendations by the evaluator and the evaluation committee will be disseminated to the IGERT groups as a whole on a semester-by-semester basis. These evaluations will also form the basis for reports to NSF, and will be used by the Advisory Board. The first step in the evaluation, at the very beginning of the project, will involve creation of a <u>baseline dataset</u>, that can be used as a point of comparison for subsequent evaluations.

#### I. <u>Documenting Implementation: Doing what we promised</u>

- a. Did we provide activities to prepare students for multidisciplinary thinking and collaboration?
- Which multidisciplinary courses did we offer?
- How broad was participation in proseminars? Did the instructors reflect disciplinary diversity?
- Did we track formulation, acceptance, or completion of projects for advanced rotations?
- Did students participate in seminars beyond their home departments?
- What was offered during each Winter Storm? Who participated and how?
- How many international collaborations were formed and completed?
- b. Did we recruit a cohort of diverse, highly talented students to the program?
- How does the caliber of incoming students (GPA, GRE, etc.) compare to baseline data?
- Are numbers of IGERT-relevant applicants increasing in participating programs?
- What specific outcomes resulted from targeted recruiting efforts, e.g., minority recruitment? Have our deaf colleagues remained with us?
- Are students reaching project milestones on time? Are students productive (presentations and caliber of venues; papers submitted or published, a more delayed measure)?

DATA SOURCES: Implementation evaluations force researchers to think about measurable outcomes from the outset and to document those outcomes as the projects proceed. EC members will provide the team members with lists of specific plans with milestones to be met on a semester-by-semester basis. Much data collection and tracking will be done using our web portal.

ANALYSIS STRATEGY: Data will be compared to the planned and scheduled activities. The outside evaluator will compile a comparison report to be distributed to the evaluation team and project administrators. They will also compile recruitment and productivity tables.

#### II. Documenting Impact

a. Did we produce researchers with multidisciplinary focus?

- Does student and faculty work cite papers from multiple disciplines?
- Are students and faculty presenting or publishing in multiple fields?
- Do IGERT participants publish with faculty outside their home department?
- b. Does our program fulfill a recognized need inside and outside academia?
- How is our program affecting recruitment? (see above)
- Who is hiring our students? Is placement positively influenced by students' training?

c. Are we training international citizens?

- What types of activities did students engage in while partnering in foreign labs?
- Did lasting collaborations follow these experiences (e.g., papers co-authored)?
- Did the project broaden the scope of cross-language research among team members?
- Did foreign students apply to, visit, or join departments in the US?
- d. Are we changing models of "business as usual" at Maryland and across the nation?
- Did the IGERT encourage further university investment in similar projects? (E.g., investment in faculty, seed money for center proposals, changes in departmental requirements.)
- Do we see hiring trends related to IGERT goals. (e.g., Linguistics departments now commonly seek candidates with both experimental and theoretical linguistics training. This was not the case 15 years ago. Will we see calls for natural language engineers with linguistics training?)

#### III. Correlating Impacts with Programmatic Features

Given the small number of students and relatively small number of faculty participants, we have been advised that we can draw a richer picture from focus groups, exit interviews, and other qualitative measures. These will consist of questions like the following:

- a. Assessments of transformational aspects of the program (for both students and faculty)
- Were innovations introduced into classroom and lab offerings? Present evidence that students were thinking in different ways, that proposals were translational.
- Did students feel prepared for the challenges of the program? Could they follow the courses outside the home department? Was the sequencing of activities appropriate?
- How was the task of producing challenging courses for a mixed audience met?
- Did faculty provide models for collaboration? Was new collaborative research undertaken?
- Where are the knowledge gaps?
- Were students able to absorb/provide expertise from areas outside their home discipline when working on advanced rotations or overseas on extramural projects?

Qualitative data from these methods will be analyzed for common themes across participants, and reported in a narrative. Special attention will be paid to themes that cut across participants (faculty, students) and that diverge among participants. For example, has the program had a strong impact on the students in the program, but little impact with faculty? Or did it impact certain programs more directly than others? We will use the results of both the quantitative and qualitative data provided to refocus the program as needed as well as to report on success. This will be facilitated by the expectation that the co-PIs serve on the evaluation committee, and that evaluation lessons will guide program planning.

#### 7. Recruitment, Mentoring, and Retention

GENERAL RECRUITMENT - PROMOTING 'LANGUAGE AT MARYLAND'. Recruitment is an important component of the plan for our IGERT, both because of the need to attract talented US students to all participating programs, and also because of the goal of promoting our model for integration in the language sciences. In our experience, most of our students and also our colleagues at other institutions are aware of a part of the language community at Maryland, but have less awareness of the breadth of connections among areas. In order to address this shortcoming we will devote particular attention at the start of the IGERT project to developing unified recruitment materials (electronic and print) that promote 'Language at Maryland' and can be used across all participating units to leverage the strengths of other units. At the same time, extensive discussions during the planning of this project have shown us that the different participating units each face different recruiting challenges that require variations on the unified strategy. The specific contexts in each unit are discussed in the recruitment history pages in C10 below. The *Baggett Fellowship Program*, an endowment from a satisfied former undergraduate that the Linguistics Department has designated entirely for supporting intensive undergraduate and post-baccalaureate research training, also supports undergraduate research involvement as a recruiting tool.

In addition to our overall graduate recruitment strategy and our efforts to engage younger students (below), we have an opportunity for targeted recruitment of minority students through the recently developed *Atlanta Recruitment Day* organized for the College of Arts & Humanities (ARHU) by Prof. Heather Nathans, in conjunction with the Atlanta University Center (a consortium of Clark, Morehouse, and Spelman). Prof Nathans' team makes literally hundreds of individual phone calls to AUC faculty and students each fall in advance of this event, which takes a dozen UMd faculty to Atlanta. The event has yielded tangible recruitment results for a number of ARHU departments, and we aim to extend this to cover additional IGERT-associated departments. The university also provides matching funds to support recruitment of minority graduate students.

At the undergraduate level the University of Maryland has a large pool of talented minority students, which provides a valuable opportunity to inspire students to pursue STEM careers. In recent years more minority PhD recipients earned their bachelor's degree at Maryland than at almost any other non-HBCU in the nation (#1 Harvard, #2 Maryland, NSF-data). The program will benefit from a partnership being developed with Maryland's McNair Scholars Program, which prepares highly qualified minority students for doctoral education, in programs lasting from one summer to 2 years (Director, Dr Wallace Southerland). A number of IGERT team members already participate in summer internship programs targeted at minority students, such as one that is under the auspices of the Atlantic Coast AGEP program in the College of Behavioral & Social Sciences, and another organized by the NACS program. IGERT

team members will also participate in UMd's annual Graduate Preview Day, an event designed to educate sophomores and juniors from underrepresented groups about preparing for graduate school.

Our team has taken the goal of minority recruitment very seriously. For example, we recruited two African American and one Hispanic PhD student to the CNL Lab in the past two years. Additionally, four of the senior personnel listed in C1 are from underrepresented minorities. Through the partnership with Gallaudet University the IGERT will benefit deaf students from the VL2 Science of Learning Center who participate as project affiliates. We have discussed with the university's Disability Support Services (DSS) office the process for obtaining ASL interpreting support for Gallaudet students who participate in IGERT activities (see attached support letter), and we have also set aside funds in the IGERT budget to pay for interpreting services at events not covered by DSS.

ADMISSION TO AND RETENTION IN THE PROGRAM. All IGERT students will have a home PhD program, from which they will have received admission and a full funding commitment *before* they apply to the IGERT program. We anticipate that most trainees will come from the Departments of Linguistics, Psychology, Hearing & Speech Sciences (HESP), Computer Science (CS), or Electrical and Computer Engineering (ECE), or from the Programs in Second Language Acquisition (SLA) or Neuroscience and Cognitive Science (NACS). Recruitment and retention histories for all of these programs can be found in C10 below, together with discussion of the varied recruiting contexts in each field. We have discussed our general monitoring structure in the previous section.

After much discussion we have decided that IGERT stipends will not be offered as a recruitment incentive to new students, except in exceptional circumstances (e.g., addressing disciplinary or ethnic diversity). Although promises of IGERT support might help us to 'land' a couple of recruits that we might otherwise lose, we have determined that this does not maximize the impact of IGERT funds. Therefore, most students who apply to receive IGERT support will have already participated in some IGERT-related activities such as courses, lunch talks, or the Winter Storm, and hence they will have some familiarity with the program before they seek IGERT support. By having students submit a separate application in the 2nd-6th semester of study, we can ask students (and their mentors) to commit to specific contributions to the IGERT program (e.g., teaching in *Winter Storm*), students receive the additional training value of planning a research program and preparing a proposal, and we avoid the possibility of departmental and student friction resulting from 'quotas' or premature funding decisions. It will also be easier to have students self-affiliate with IGERT activities before it is determined whether they receive IGERT stipend support. The steps considerably enhance retention prospects.

We plan to offer students 2-years of direct IGERT support, thereby releasing individual departments or mentors from 2-years of a 5-year funding commitment. We expect to support 23 students over the life of the project. Most students will receive an IGERT stipend in two of Years 2-4 of their program, although they may opt to use some IGERT research or travel support after the period of stipend support, e.g., if they present IGERT-related research at a conference in the 5th year of study. Funding for students' remaining 3 years of study varies dramatically across the participating units, reflecting national trends in the respective fields. Standard stipends range from \$15,000-\$18,000 (including any summer support) in the Humanities units to the high \$20s in engineering. Also, standard responsibilities vary substantially, between fellowships, grant-funded assistantships, and daily teaching responsibilities. Consequently, the value of a \$30,000 IGERT stipend varies substantially across departments.

Students may be affiliated with the IGERT program and participate in IGERT activities even if they are ineligible (non-citizens) or narrowly miss out on selection for IGERT funding. We consider this to be essential to the success of the program, and we are mindful of the need to avoid creating a 'class divide' among students in programs where IGERT support could amount to a 70% funding increase. We have secured a commitment from the University to contribute some additional funding for students who are not supported by IGERT funds (see support letters from Deans Harris and Montgomery). Also, we do not want our international students to miss out on the benefits of a well-integrated program. In fact, the PI of this project owes his own interdisciplinary training to the fact that he was able to participate in an IGERT-precursor at MIT, thanks to institutional support for international students.

Once minority students are at Maryland they have access to a broad range of programs and events designed to further their professional development. The university hosts two NSF-supported AGEP programs. The PROMISE AGEP spans 3 U of Maryland campuses and was recently renewed for 2007-2012. It provides peer mentoring by advanced students, a 'PhD House' summer workshop for proposal development, and other workshops. The Atlantic Coast SBE-AGEP focuses on the social, behavioral, and economic sciences and spans Howard, Miami, Florida, UNC and UMd. Particularly relevant to this IGERT

is a summer statistics workshop held at U of N Carolina. In addition, the Office of Recruitment, Retention and Diversity in the Graduate School (see attached letter from Assoc Dean Davis) sponsors *PhD Completion Project* events for all graduate students, which present bi-monthly workshops to up to 300 students on various aspects of thesis writing and professional development.

MORE ON OUTREACH AND DIVERSITY. Our team has begun to implement a series of undergraduate and high school outreach activities that are designed to address the acute underrepresentation of minorities in cognitive science. We recognize that by the time students reach their senior year of college it is likely too late to excite them about a career in science, and so we are targeting students at an earlier stage.

At the high school level, IGERT team members are already extending existing UMd partnerships with two local high schools with 60-70% minority enrollments (Northwood HS, Silver Spring; Eleanor Roosevelt HS, Greenbelt), providing curriculum enhancement and internships. Team members have designed outreach activities with Ms Asewe Onyango and Mr Carlos Montalvan of Northwood HS (see attached letter), aimed initially at integrating language science into the AP Psychology curriculum, including field trips in Spring and Fall '07 and school visits starting in Fall '07. In the longer term, the aim is to use language as a model of 'teaching across the curriculum', as an antidote to the fractionation of much high school learning. Student interns from Roosevelt HS have begun yearlong internships in a number of IGERT labs, following initial successes in co-PI Woodward's lab in 2006-2007. Graduate trainees have played critical leadership roles in all of these activities, which we have used to provide valuable experience in teaching and mentoring. Numerous team members are also involved in community outreach activities through UMd's annual *Maryland Day*, which attracts up to 70,000 visitors to campus each spring, such as through a *Hear the Turtle!* tent that showcased research in hearing and speech.

#### 8. Recent Traineeship and Results from Prior NSF Support

This IGERT project does not attempt to create a rich training environment from scratch. Rather, it builds upon two major initiatives that have been a decade in the making, and upon some more recently arrived faculty with rich training experience from other institutions.

(i) A number of the IGERT faculty in sound/speech are also members of the *Center for Comparative and Evolutionary Biology of Hearing* (C-CEBH), an auditory neuroscience research center that has been supported by an NIH training grant since 1994 (PI, A. Popper, *Biology*) and by an NIH P30 'core' award since 1997 (PI, R. Dooling, *Psychology*). C-CEBH not only provides a fine model for collaborative training, it also led the creation of the interdepartmental NACS program. NACS provides many valuable components for this IGERT, in a sustainable fashion: a flexible PhD program, a series of core courses, an innovative ethics training program, frequent talks and workshops, increased opportunities for faculty interaction, and more recently a Certificate Program that provides IGERT trainees with official recognition of their additional coursework. NACS has also demonstrated the importance of individual partnerships at the student level, such as a recent project comparing word and face perception involving students from linguistics, engineering and psychology.

(ii) Maryland's Linguistics PhD program is an experiment in reorganizing a traditional program to focus on interdisciplinary training and outward-looking collaboration, with changes ranging from course requirements to office space configurations. This reorganization was viewed with a mix of enthusiasm and skepticism around the country, but it has led to dramatic gains in recruitment, retention, productivity, and placement among students (see C10), and has also coincided with a growing demand for graduates with the broad training provided here. It has also fostered the growth of language research groups in other departments, and the formation of the *Center for Advanced Study of Language*. An important lesson from these efforts is the value of creating support networks for students who are relative newcomers to computational or experimental research. A number of the program's recent PhDs are students who entered with minimal background in experimentation or computation and went on to become successful independent scientists in those areas.

(iii) Two co-PIs of this project are relatively recent senior appointments who have substantial experience in training or program building at their previous institutions. Mike Long heads the School of Languages and created the SLA PhD program at Maryland. Prior to this he was a founder and chair of the SLA program at Hawaii, which has long been recognized as the leading program in that field. Amanda Woodward is the Graduate Director for NACS and is the creator of the interdepartmental Developmental Science Field Committee at Maryland. In her previous position at the U of Chicago she trained a cadre of highly successful PhDs who now hold positions in leading research universities.

#### 9. International Collaboration

The team has strong international partnerships with groups in India (Central Institute for Indian Languages, Mysore: CIIL), Brazil (Universidade Federal do Rio de Janeiro: UFRJ, Museu Nacional), and Japan (Hiroshima and Tohoku Universities). These partnerships fulfill a number of important goals for the project. (i) They provide students with access to the wealth of linguistic diversity represented by these partners, with languages varying in different dimensions and to different degrees from English. This allows students to provide a broad linguistic context for generalizations that they might reach about learning or processing mechanisms. (ii) They serve the important goal of broadening the worldwide reach of integrative research on language. It is essential to expand interdisciplinary research on language to countries with limited access to relevant expertise (India, Brazil) or more rigid institutional structures (Japan). Our research problems cannot be solved in the US alone, due to the importance of cross-language testing. (iii) Students will be directly involved in training faculty and students at the partner sites, providing valuable experience of working outside one's comfort zone, and of developing interdisciplinary links. These skills will serve them well after graduation, when they will be responsible for creating their own integrative networks. Team members have experience with each of these components, which the current project aims to expand.

INDIA. The partnership with CIIL in Mysore, India, is especially well suited for the IGERT. Indians speak hundreds of languages, with 24 spoken by more than 1 million people. CIIL is charged by the Indian government to coordinate scientific research on the many languages of India and to promote interdisciplinary research on language. It is engaged in documenting major, minority, and tribal languages, teaching 15 languages to non-native learners, creating content and corpora, and developing machine translation tools for all 23 official languages of India. Co-PI Lidz has worked with CIIL researchers for ten years on first language acquisition in Kannada. Kannada has proven to be an excellent testing ground for hypotheses about language acquisition because it appears on the surface to be highly distinct from English, yet has provided a variety of evidence for parallel learning mechanisms across these diverse languages. Other recent student research projects have involved the Indian languages Hindi (Indo-European) and Malayalam (Dravidian family). Expanded collaboration through this IGERT presents rich opportunities for new infrastructure and psycholinguistic training in India.

An important target for new collaboration with CIIL involves bringing together UMd expertise in computational linguistics with the specific linguistic challenges found in India. Current efforts at CIIL in creating dictionaries, tutoring systems, and machine translation tools could be rapidly advanced by drawing on UMd innovations in these areas. UMd is a leader in Machine Translation and its team has a particular focus on using a technique ('annotation projection') that allows for migration of resources (e.g., morphological analyzers, parsers) developed on well studied, 'high density' languages like English to less well-resourced languages, given a corpus of direct translations (parallel texts) [54,55]. An IGERT student and either Amy Weinberg or Philip Resnik will visit India to give a mini-course in foundations of statistical language processing, emphasizing applications to any of the above areas. The UMd team also hopes to engage in joint research on cross-dialectal annotation projection using the extensive corpus resources developed by CIIL. Taken together, these efforts could help to advance computational linguistics research in India, while providing a fertile testing ground for flexible multilingual tools for low-density languages, a major current research interest in UMIACS and CASL.

BRAZIL. Our partners at UFRJ are engaged in two very interesting initiatives. The Linguistics program at UFRJ has partnered with the Biomedical Engineering Dept (with help from UMd's David Poeppel, see attached support letter) to establish neurophysiological studies on language in Brazil. Second, our partners are leaders in Brazil both in experimental psycholinguistics and in research and outreach involving members of Brazil's many indigenous language communities, particularly in Amazonia. Marcus Maia (see biosketch) has long-standing connections to these communities, and now through the *Museu Nacional* at UFRJ he is involved in a project that provides college education to members of these groups who have completed high-school level education within their communities. These efforts have already led to a series of undergraduate theses by indigenous students that document their own native languages.

The connection between UMd and UFRJ has developed over a number of years, since one of the UFRJ team leaders was a visiting scholar at Maryland in 2000. UMd researchers and their students have continued to provide guidance as the UFRJ has built its psycho/neurolinguistics research program. In 2006 a group of 6 Maryland students visited UFRJ, where they led an intensive 1-week workshop on topics in linguistics, psychology and cognitive neuroscience together with the UFRJ team. We view this as a model for the kind of training activity that IGERT students will help to lead at our other partner sites. In

the future, we anticipate that IGERT students will travel to UFRJ to conduct experimental research on Brazilian Portuguese, and we also envision that students will be able to gain valuable experience in linguistic fieldwork from UFRJ experts. Students who take advantage of both of these lines of inquiry into their research will have an enviable skill-set that will make them attractive candidates for faculty positions.

JAPAN. Our two partner groups in Japan, at Hiroshima University and at Tohoku University (in Sendai City) are led by linguists who are attempting to create the same kind of collaborative networks in Japan that our team has built in Maryland. Although Japan has strong infrastructure in STEM disciplines, the language sciences have not traditionally been a part of this (a large proportion of Japanese linguists earn their keep by teaching English), and our partners face institutional and cultural challenges to interdisciplinary work that make their task more difficult than ours. Nevertheless, our partners Hiromu Sakai and Masatoshi Koizumi have made impressive progress, and have been very active in organizing interdisciplinary workshops on language that bring together researchers from diverse fields, and in writing grant proposals to support collaborative research. They are emerging as leaders in psycho/neurolinguistics in Japan. Our group has built ties with Japan over a number of years, has supported student exchanges and collaborative research, and Maryland students have contributed to the training of Japanese researchers. In one example, UMd student Robert Fiorentino (now an Asst Prof at U of Kansas) spent a summer at Hiroshima U, supported by a small grant from NSF's EAPSI program. where he developed a series of studies that contributed to his PhD thesis. In another recent example, UMd student Takuya Goro spent much of 2006-2007 at Tohoku U, supported in part by an NSF doctoral dissertation improvement grant, where he conducted ground-breaking studies on cross-language semantic development, while also working to build infrastructure for language acquisition research in Sendai, in the form of close partnerships with preschools and methods training for Tohoku U students and research staff. In the context of this IGERT project we are keen to broaden the scope of the collaborations with Japan to include more UMd research groups, particularly the Second Language Acquisition group. Both Japanese partners provide an environment where our students will be well supported (see support letters).

A notable feature of the Japanese partnerships is that both groups are actively seeking funding for reciprocal support, through the Japanese counterpart of IGERT awards. The Hiroshima group already submitted a proposal this year, which narrowly missed out on funding, and will try again next year.

PREPARATION. One faculty member will visit each partner in the first year of the project (2 to India - 1 experimentalist, 1 computationalist), to lay the groundwork for subsequent student visits, which will include preparatory and longer visits (details in Budget Justification). IGERT trainees will compete for the opportunity to visit foreign partner sites. Trainees will write a 3-4 page proposal describing the particular research they hope to conduct. This proposal must include a discussion of how the project meets the broader goals of the IGERT, especially what expertise will be exported and what new scientific knowledge will be imported, and must also describe the educational benefit to the trainee and to collaborators at the partner institution. Finally, the proposal must include a discussion of the Broader Impact of the proposal, using NSF's criteria for this category. The application must also include a letter of support for the project from the US and Foreign mentor, detailing how the project can be feasibly completed in the time allotted. Proposals will be selected for funding by the IGERT Executive Committee.

All IGERT trainees will be strongly encouraged to apply for international research experience, and students will be encouraged to articulate ideas conducive to international research and training experiences in their initial application to the IGERT program. As such, interest in the international partnerships will be taken into consideration in admissions decisions. Because all aspects of the program are focused on finding solutions that are robust to cross-linguistic variation, we do not anticipate difficulty in finding trainees who are interested in participating in these experiences.

Students will be well prepared for international visits. On the cultural side, trainees will be encouraged to consult with faculty and students who are from or have visited the relevant countries (such people are in abundance in the Maryland language community), and we will help to locate language tutors for trainees whenever possible. Because we are located in the Washington D.C. metropolitan area, this should not be difficult (the Amazonian languages of Brazil are an obvious exception). On the logistical side, all experiments will undergo piloting or role-playing simulations in the US, prior to the trainees' departure for the host institution. Back-up plans will be formulated in case of equipment failure or other logistical difficulties.

#### **Recruitment and Retention History - LINGUISTICS**

| Totals for 2005-2007 (3 years)<br>All / US-only | Women    | Minorities | Other    | Total     |
|---|----------|------------|----------|-----------|
| # applicants                                    | 152 / 72 | 15         | 133 / 56 | 289 / 132 |
| # applicants accepted                           | 14 / 11  | 2          | 24 / 13  | 39 / 25   |
| # applicants matriculated                       | 9/6      | 2          | 11 / 5   | 21 / 12   |
| # students who withdrew                         | 2 / 1    | 0          | 3/2      | 5/3       |
| # PhDs awarded                                  | 11/4     | 0          | 9/3      | 20 / 7    |
| # currently enrolled (Sep 07)                   | 17 / 10  | 2          | 15 / 7   | 33 / 18   |

CONTEXT STATEMENT: The Dept of Linguistics underwent major changes in faculty, facilities, and program organization in 1998-2005, which led to dramatic gains in the number and quality of PhD applicants starting around 2001, and equally dramatic improvements in the placement of graduates starting around 2006. The changing profile of the department also led to substantial increases in the number of top-notch US applicants. The student body had 10% US citizens in 2001, and currently has 55% US citizens. The department currently competes for the very best PhD applicants in Linguistics, and is most successful in attracting students who seek interdisciplinary training in linguistics, cognitive (neuro-)science, or computer science.

Placement Data for US Citizens & Permanent Residents:

| Stephan Greene    | 2007 | ATG Inc. (Reston, VA)   | Natural Lang. Tech. Engineer              |
|-------------------|------|-------------------------|---|
| Lisa Pearl        | 2007 | UC Irvine               | Assistant Professor (Cognitive Science)   |
| Jon Sprouse       | 2007 | UC Irvine               | Assistant Professor (Cognitive Science)   |
| Robert Fiorentino | 2006 | U Kansas                | Assistant Professor (Linguistics)         |
| Scott Fults       | 2006 | U Maryland              | Postdoc (Computer Science)                |
| Yeongmi Jeong     | 2006 | Harvard U.              | Visiting Scientist (Linguistics)          |
| Utako Minai       | 2006 | RIKEN Brain Sci (Japan) | Research Scientist (Psychology)           |
| Ilhan Cagri       | 2005 | U Maryland              | Research Scientist (Middle Eastern Langs) |
| John Drury        | 2005 | McGill U (Canada)       | Postdoc (Communication Sci & Disorders)   |

Placement data for non-US citizens is also relevant for this department, since most recent graduates were foreign students who entered the program in 2000-2002. Four students obtained tenure-track faculty positions (at Northwestern U., Baylor U., Middlebury College, U. of Ottawa), five obtained research scientist or postdoc positions at research universities in the UK and Japan, including a *Marie Curie* fellowship at UC London, and two took non-permanent teaching positions at Pusan National U in Korea and Nehru University in Delhi, India.

In comparison to NSF's national data on Linguistics PhDs, the UMd program has a more even gender balance (US average: 65% female), a more even balance of US/international students (US average: 29% foreign), and a similar percentage of minority enrollment (US black/Hispanic average: 7%). Retention rate is 75-80%, and median time to degree is 5.0 years, which is significantly better than national averages.

EVIDENCE OF SUCCESS IN GRADUATE TRAINING: Students in the Linguistics Dept have become prolific in research, in 2003-2006 generating 220 refereed and invited presentations, 50 published or submitted journal articles, and 85 chapters and proceedings papers. Many students pursue interdisciplinary training, e.g., 10 are currently pursuing the new Certificate in Neuroscience & Cognitive Science, which requires additional coursework outside the department. Many graduates are employed in positions where they are expected to bridge different areas or departments.

EVIDENCE OF POTENTIAL IGERT APPLICANTS: The department attracts a large and highly qualified pool of potential IGERT trainees. In recent years a majority of the ~30 finalists for admission have been US students who are specifically attracted by Maryland's interdisciplinary strengths and by the possibility of additional training through the NACS Program. Among US students entering the program in the past 3 years median GRE scores are 710/750/5.5, and median undergraduate GPA is 3.90.

MAIN CHALLENGES AND ACTION PLAN: The main recruiting and retention challenges for the Dept of Linguistics are: (i) attracting well-qualified minority applicants; (ii) competing successfully with traditional linguistics program with long-standing cachet; (iii) fuller integration of computational efforts with other focus areas. Plans for addressing these challenges are integral features of the IGERT project.

| Totals for 2005-2007 (3 years)<br>All / US-only | Women  | Minorities | Other  | Total   |
|---|--------|------------|--------|---------|
| # applicants                                    | 127/77 | 17         | 112/67 | 248/151 |
| # applicants accepted                           | 21/17  | 5          | 23/19  | 48/40   |
| # applicants matriculated                       | 8/8    | 3          | 10/6   | 19/16   |
| # students who withdrew                         | 3/1    | 1          | 4/3    | 8/5     |
| # PhDs awarded                                  | 7/3    | 1          | 4/3    | 12/7    |
| # currently enrolled (Sep 07)                   | 21/9   | 3          | 19/12  | 41/22   |

CONTEXT STATEMENT: NACS is a cross-disciplinary doctoral program involving 81 faculty from 14 U Maryland departments as well as affiliated faculty at NIH and Children's National Medical Center. NACS offers interdisciplinary training in several broad areas: systems neuroscience, molecular and cellular neuroscience, computational and cognitive neuroscience, and cognitive science. Within and across these areas are faculty with internationally renowned research programs in vision, audition, sensorimotor integration, synaptic plasticity, language and communication, learning, memory and decision making, and neuromorphic engineering. NACS is a relatively new program, having granted its first degree in 1999. Current students represent 9 diverse disciplines (Psychology, Linguistics, Computer Science, Biology, Kinesiology, Animal Science, Electrical & Computer Engineering, English, and Human Development).

Each student has a home disciplinary department (generally the department of their mentor), but each student completes the NACS curriculum and earns a NACS degree. Students take a series of core courses designed to provide broad training in neuroscience, cognitive science, and computational neuroscience so that they learn to appreciate the breadth of the field, as well as specialized training required to pursue their research interests. The NACS curriculum would dovetail readily with the proposed IGERT training program.

NACS also serves as scientific community for faculty, fostering collaborative research as well as collaborative graduate training. The NACS community meets weekly for a colloquium and lunch, works together at an annual faculty and student retreat, and hosts an annual research day at which students present their work to the broader community.

| Recent Placement Data for US Citize | ens & Permanent Residents: |
|-------------------------------------|----------------------------|
|-------------------------------------|----------------------------|

| Kelvin Oie    | 2006 | Kinesiology  | US Army Research Lab           | Post Doc            |
|---------------|------|--------------|--------------------------------|---------------------|
| Mary Howard   | 2005 | Comp. Sci.   | U Maryland                     | Post Doc            |
| Shiva Sinha   | 2005 | Psychology   | Indiana University             | Post Doc            |
| Kyle Vick     | 2005 | Biology      | Shawnee State University       | Assistant Professor |
| Brenda Benson | 2005 | Biology      | NIH                            | Psychologist        |
| Lewis Wheaton | 2005 | Biology      | Johns Hopkins University       | Post Doc            |
| Carol Whitney | 2004 | Comp. Neuro. | Computational neuroscience res | search              |

Placement data for non-US citizens is also relevant for this department, since a significant proportion of recent graduates were foreign students. These students were placed in post docs at major research universities (Boston U, University College London, Harvard Medical School, U Michigan, and Cal Tech).

EVIDENCE OF POTENTIAL IGERT APPLICANTS: There is a strong faculty and student presence in NACS from the cognitive, developmental and linguistic sciences. Current students include 10 in Psychology, 2 in Linguistics, 1 in Human Development, 1 in English, and 1 in Computer Science. Faculty and students from these disciplines benefit from the opportunity to integrate this work into the broader context of both cognitive science and neuroscience. Given their cross-disciplinary focus, NACS students would be natural candidates for the IGERT training program, and the NACS training program is a natural complement to the IGERT program.

MAIN CHALLENGES AND ACTION PLAN: Challenges for NACS include (1) continuing to recruit wellqualified minority students, (2) increasing representation of students in the cognitive, developmental and linguistic sciences; (3) retaining students and supporting their training despite the distributed nature of the program. The IGERT contributes to each of these needs. IGERT staff will assist in recruiting to NACS strong students with interests in cognition and language, as well as providing focused recruitment for minority students. Some IGERT students will find that NACS offers the flexibility to take best advantage of the IGERT. The IGERT program would also provide a center of mass in fostering a cohort of students, many of whom will likely be in NACS, and thereby contribute to cohesion in the training program.

| Totals for 2005-2007 (3<br>years)<br>All / US-only | Women  | Minorities | Other     | Total    |  |
|--|--|------------|-----------|----------|--|
| # applicants                                       | 300/58   | 75         | 1184 /248 | 1556/373 |  |
| # applicants accepted                              | 51/27  | 23         | 198/90    | 268/136  |  |
| # applicants matriculated                          | 17/4   | 6          | 72/32     | 95/42    |  |
| # students who withdrew                            | UMd data unavailable; minimal AI Group attrition |            |           |          |  |
| # PhDs awarded                                     | 15/5   | 4          | 75/14     | 95 / 24  |  |
| # currently enrolled (Sep 07)                      | 32/12  | 14         | 150/58    | 198/86   |  |

CONTEXT STATEMENT: The UMd Computer Science Department is ranked 13th in the country by US News and World Report, and the Artificial Intelligence Group 9<sup>th</sup>. The Department thus competes for the very top candidates nationally and internationally. Figures are for the total department. The AI group is 16% of the department and is the most likely recruitment pool. As is the norm, UMd CS students have to take a substantial load of additional courses, many of which may have minimal relevance to their training in computational modeling. However, the focus of this IGERT is supported by the department's affiliation with the Institute for Advanced Computer Studies (UMIACS) and with the Program in Neuroscience and Cognitive Science. The NACS program serves a crucial role: students with a "cognitive science" leaning can enroll in NACS and receive a NACS degree, choosing an affiliated advisor from the CS department. This allows them to take a core of cog/neuro courses, including computational neuroscience. They then add a significant component of additional computer science courses and work in the advisor's laboratory. An alternative is CS affiliation with work on projects through UMIACS. Since its inception, UMIACS was formed to build strong interdisciplinary research programs and cutting-edge infrastructure. UMIACS houses 10 interdisciplinary labs. 3 students listed here are affiliated with the NACS program or UMIACS.

Placement Data for US Citizens & Permanent Residents: (Students of Dorr and Reggia)

|                  |      | <b>\</b>                              | 00 /                       |
|------------------|------|---------------------------------------|----------------------------|
| Rebecca Green    | 2005 | University of Maryland (Inf. Science) | Assistant Professor        |
| Mary Howard      | 2005 | University of Maryland                | Postdoc (Linguistics)      |
| Stacey P. Hobson | 2007 | IBM                                   | Research Scientist         |
| Shaun Gittens    | 2007 | Auburn University                     | Postdoc (Computer Science) |
| Ransom Winder    | 2007 | MITRE                                 | Technical Position         |
| David Zajic      | 2007 | U of Maryland/Ctr Adv Study Lang      | Asst. Res. Scientist       |
|                  |      |                                       |                            |

It is of note that half of these graduating students are women, which is unusual for a CS program. We also note that Gittens and Hobson are African American. Recruitment rates for both women (42%) and African Americans (9.5%) are above the NSF-reported national averages of 16.7% and 3% respectively.

EVIDENCE OF SUCCESS IN GRADUATE TRAINING: The department has graduated approximately 95 PhD students in the last 3 years. 8 AI students are working in language at companies such as Google and SRI. Another works on computational modeling at the new Howard Hughes Center at Janelia Farms.

EVIDENCE OF POTENTIAL IGERT APPLICANTS: IGERT faculty already have a history of training US students with interest in relevant subjects. For example, Dr. Howard completed a dissertation on brain lateralization and now works on lateralization in auditory processing. Gittens worked on computational models of the development of speech perception. Reggia and Weinberg (Linguistics/UMIACS) co-advised Dr. Suzanne Stevenson who is currently an Associate Professor at the U. of Toronto working on linguistic variables in computational modeling. Among US students entering the program in the past 3 years median GRE scores are (V) 534, (Q) 784, (A) 4.35, and median graduate GPA is 3.63. Students from multiple backgrounds (Linguistics, Computer and Information Science) regularly apply to the Computational Linguistics and Information Processing (CLIP) laboratory in UMIACS and NACS.

MAIN CHALLENGES AND ACTION PLAN: The main recruiting and retention challenges for the Dept of Computer Science are: (i) attracting more well-qualified minority applicants; (ii) incorporating a cognitive science focus into the public profile of the department (iii) fuller integration of computational efforts with other focus areas. IGERT related work is a natural recruitment tool for minority populations. The recent addition of a bio-informatics group and publicity around the IGERT should help us to generalize the cognitive and biological focus beyond individual labs to the department as a whole.

| Totals* for 2005-2007 (3 years)<br>All / US-only | Women  | Minorities | Other      | Total      |
|--|--|------------|------------|------------|
| # applicants                                     | 839  | 198        | 3546 / 309 | 3744 / 507 |
| # applicants accepted                            | 187  | 81         | 910 / 188  | 991 / 269  |
| # applicants matriculated                        | 97   | 81         | 478 / 184  | 559 / 265  |
| # withdrew                                       | Data not available; no significant attrition in IGERT-related labs |            |            |            |
| # PhDs awarded                                   | 12   | 6          | 79 / 10    | 85 / 16    |
| # currently enrolled (Sep 07)                    | 62   | 35         | 329 / 84   | 364 / 119  |

\* includes both doctoral and masters students in Electrical and Computer Engineering

CONTEXT STATEMENT: The close involvement in this IGERT of faculty from the Clark School of Engineering links the project to one of the University of Maryland's main areas of strength. UMd graduate programs in engineering collectively rank 16th in the nation and 10th among all public universities, according to the 2008 U.S. News & World Report study, and are ranked 6th in The Princeton Review's 2007 graduate rankings. The programs in electrical and computer engineering both rank among the top 10 among public universities nationwide and 1st among public universities in the Northeast. The Electrical and Computer Engineering program (unlike other participating IGERT departments) includes a substantial number of non-PhD graduate students, and across both masters and doctoral programs US students represent a small fraction of the total enrollment (e.g. 19% of PhD's awarded).

Students with a desire to do work in neuroscience and cognitive science can enroll in the NACS program but choose their advisor and receive their degree from the Electrical and Computer Engineering department. This arrangement allows such students to take a core of neuroscience and cognitive science courses, including computational neuroscience and signal processing. The students would add to this core a significant number of additional courses in Electrical and Computer Engineering and they would also work in the advisor's laboratory. Thus they have the benefit of a professionally recognized and accredited engineering degree while still actively pursuing research in neuroscience and cognitive science. One of the currently enrolled US PhD students (Donaldson) is in the NACS program.

EVIDENCE OF SUCCESS IN GRADUATE TRAINING: All of the PhD students supervised by Espy-Wilson, Shamma and Simon have been successfully placed as professors or postdocs or in industry.

Placement Data for US Citizens & Permanent Residents: (Students of Espy-Wilson, Shamma and Simon) Mounya Elhilali Ph.D. (2004), Assistant Professor, Johns Hopkins U (woman and minority)

Placement Data for International Students (Students of Espy-Wilson, Shamma and Simon)Maria ChaitPh.D. (2006), Postdoc, CNRS/Ecole Normale Supérieure, Paris. (woman)Amit JunejaPhD, (2004). Senior Scientific Programmer, Think-A-Move, Ltd.Om DeshmukhPhD (2006). Senior Research Engineer, IBM India Research,Tarun PruthiPhD, (2007). Senior Research Engineer, Think-A-Move, Ltd.

EVIDENCE OF POTENTIAL IGERT APPLICANTS: The IGERT faculty in ECE (Espy-Wilson, Shamma, Simon) have a strong track record of training students with interest in relevant subjects. Elhilali and Chait work on auditory encoding in neurons and neuronal assemblies; Juneja, Deshmukh and Pruthi developed computational models for the computer recognition of speech features and landmarks. Thus, there are, and will continue to be, students with relevant interests in the ECE program, although the vast majority of these students are not US citizens. Therefore, the main potential source of relevant IGERT applicants will come (as with Donaldson) from non-traditional sources—students interested in combining computational and systems neuroscience, an important and unusual feature of the UMD ECE group. The international students who will work and study alongside the IGERT trainees will also be an important resource for the IGERT trainees, enlarging and enriching the experience for the trainees and for the international students.

MAIN CHALLENGES AND ACTION PLAN: The main recruiting and retention challenges for Electrical and Computer Engineering are: (i) increasing the number of well-qualified US applicants, and (ii) increasing the number of well-qualified women and minority applicants. The IGERT faculty have a strong record of working with women and minority students, and NACS provides an excellent forum through which to recruit non-traditional engineering students from the U.S—a novel source of graduate students in engineering. One current NACS/ECE student (Donaldson) is an excellent example of this kind of recruitment, his NACS advisors include two IGERT faculty (Shamma, Idsardi). The IGERT admissions group will identify likely sources of crossover students and inform and entice potential applicants into the ECE IGERT group, building on the existing successful model of the NIH-UMd C-CEBH training grant.

| Totals for 2005-7           | Women | Minorities | Other | Disabled | Total |
|-----------------------------|-------|------------|-------|----------|-------|
| All/US-only                 |       |            |       |          |       |
| # applicants                | 32/16 | 7/6        | 4/2   |          | 37/19 |
| # applicants accepted       | 7/3   | 0/0        | 3/2   |          | 10/5  |
| # applicants matriculated + | 8/6   | 1/1        | 1/1   | 2/2      | 10/8  |
| # students who withdrew     | 0     | 0          | 0     | 1/1      | 1     |
| # PhDs awarded              | 1     | 0          | 0     |          | 1     |
| # currently enrolled        | 10/8  | 1/1        | 1/7   | 1/1      | 11/9  |

† Matriculated students also include transfers from the clinically-oriented AuD (Doctor of Audiology) degree to the research PhD; these students are not admitted through an additional application process. This is why there are more matriculated students than accepted students.

CONTEXT STATEMENT: Hearing and Speech Sciences (HESP) has 8 tenure track faculty members, and a large cadre of stable adjunct faculty at local research institutions such as the NIH and National Children's Medical Center. It serves approximately 200 undergraduates, 80 graduate students in clinical education programs (MA in speech-language pathology, AuD in clinical audiology) and 11 PhD candidates. PhD students come through one of three tracks: a traditional PhD program, a clinical PhD program for students who wish to gain a research PhD in addition to a clinical AuD, and the program in NACS. Its last PhD graduate was Celia Bassich, now an Assistant Professor at Towson University.

EVIDENCE OF POTENTIAL IGERT APPLICANTS: HESP programs are ranked by US News; HESP at Maryland ranks within the top 10% of programs nationwide. Like communication sciences and disorders (CSD) programs nationwide, HESP is experiencing a shortfall in applications to the research doctorate. This decline in doctoral applications has been identified as a targeted focus of strategic planning by the NIH, the American Speech-Language and Hearing Association, and the Council of Graduate Programs in CSD (see http://www.capcsd.org/reports/JointAdHocCmteFinalReport.pdf). This shortage has emerged in part, through the increased attractiveness of salaries and positions for clinically-oriented students. However, HESP at UMCP has seen a resurgence of interest in the research PhD in recent years (in 2004 there were only 4 doctoral students in HESP), and the focused research mentoring efforts have led a number of students who entered clinical programs to transfer to research degree programs. Despite the success in attracting such students, many talented, admitted students did not choose to enroll in HESP over the time frame surveyed, in large part due to a lack of attractive and sufficient long-term funding for doctoral students. Thus, the IGERT offers an important means of attracting more talented students to the field, and helping to solve this critical shortage. It is important to note that other ventures that support doctoral students in HESP, such as the NIH-supported training program in Comparative and Evolutionary Biology of Hearing (C-CEBH), have successfully attracted candidates to the department. Finally, faculty position prospects for graduates of HESP are exceptionally promising, given both the program's reputation and the critical nationwide shortage. We note that HESP attracts a large number of female applicants, and thus IGERT support is likely to result in an increase in the proportion of women in the language sciences. Student research productivity at all levels of training in HESP is high, given its clinical focus. In the past five years, students have authored more than two dozen publications and national conference presentations. Productivity of students even within the clinical education tracks is at a level that exceeds that typically seen in research doctoral programs elsewhere. Thus, with appropriate funding, it is likely that HESP could "grow its own" doctoral candidates with excellent further research potential.

MAIN CHALLENGES AND ACTION PLAN: Previous experience shows that the strongest PhD applicants in HESP tend to be students who are mentored through research experiences during clinical programs; the roughly two dozen programs nationwide with visible student research productivity are easily identified. We will therefore target recruitment efforts at these institutions to identify a large pool of potential applicants. Clearly, a targeted need is an increase in the diversity of talented applicants. The department is currently developing and implementing an action plan to attract a broader as well as larger applicant base. We will continue to use HESP's active and growing participation in diversity initiatives such as the summer research institute for minority students supported by the SBE-AGEP to identify and foster applications from historically under-represented populations. In sum, the integrated *Language at Maryland* recruitment strategy plus the prospect of attractive IGERT support promises to have a substantial impact upon PhD recruitment in HESP.
| Developmental and Cognitive<br>Psychology Programs<br>Totals for 2005-2007 (3 years)<br>All / US-only | Women | Minorities | Other | Total  |
|---|-------|------------|-------|--------|
| # applicants  | 95/66 | 14         | 28/24 | 124/90 |
| # applicants accepted   | 10/10 | 1          | 1/0   | 11/10  |
| # applicants matriculated   | 6/6   | 0          | 0/0   | 6/6    |
| # students who withdrew   | 1/1   | 0          | 0     | 1/1    |
| # PhDs awarded  | 5/3   | 0          | 3/3   | 8/6    |
| # currently enrolled (Sep 07)   | 8/7   | 0          | 2/1   | 10/8   |

Recent Placement Data for US Citizens & Permanent Residents:

| Amber Sprenger  | 2007 | Johns Hopkins Univ.           | Post Doc                     |
|-----------------|------|-------------------------------|------------------------------|
| Matthew Dykas   | 2006 | SUNY Oswego                   | Assistant Professor          |
| Lisa Murphy     | 2006 | York Comm. Coll. (Maine)      | Faculty                      |
| Petra Sheck     | 2006 | Center for Adv St of Language | Assistant Research Scientist |
| Ty Boyer        | 2005 | Indiana U                     | Post Doc                     |
| Timothy Pleskac | 2004 | U Basel, Switzerland          | Post Doc                     |

The two non-US students earning PhDs in 2005-07 also took scientific jobs, one as a post doc at NIH, the other as post doc at UC San Diego. More recently, recruitment of talented students in the Cognitive area has been augmented by Michael Dougherty's NSF CAREER Award. Amanda Woodward joined the Psychology Dept. in 2005 and has not yet graduated PhD students at UMD. However, her prior record at U Chicago indicates successful placements. Of her 6 doctoral and post-doctoral students (5 women, 1 minority), 3 are now Assistant Professors at research-intensive universities (U Washington, U Illinois, U Minnesota), 1 is a post doc (U Chicago), and 2 have research positions in the corporate sector.

CONTEXT STATEMENT: In the years reported here, The Psychology Dept. was comprised of 8 diverse doctoral programs. Data are reported for the two that are most relevant to the proposal. Developmental and Cognitive. These programs have been small, with 3 active faculty in Cognitive, and 2 in Developmental. However, strength in these areas is slated to grow along with a vigorous program of rebuilding in the department following a change of leadership. In the past year, the department has undergone a thorough reorganization, and with the strong support of the dean it has embarked on an aggressive initiative to rebuild strength in core areas and interdisciplinary integration alike. As part of this, the department anticipates growing dramatically in size. The department has just hired a developmental cognitive neuroscientist and has 6 additional faculty searches in 2007-2008. A further 12 hires are anticipated in the next five years. Among the current 6 searches are two in cognitive science and neuroscience. In addition, Psychology is active in the search for a shared NACS hire in computational neuroscience, a position that is is integral to both the Psychology Dept. and the IGERT proposal. There is focused interest in building in ways that strengthen the department's connections to the strong existing cognitive science and language communities on campus. The foundations of this initiative are already well established. All of the faculty and many of the students in the cognitive and developmental programs participate in the interdisciplinary NACS graduate program, and engage in collaborations across campus that will both support and benefit from this IGERT.

EVIDENCE OF POTENTIAL IGERT APPLICANTS. Students currently working with Psychology faculty have strong interdisciplinary interests and would be attracted by this IGERT training program. Indeed, 10 current students in the interdisciplinary NACS Program work with Psychology faculty. Woodward trained students at U Chicago in a program intensive in language and cognition, and, given the presence of an IGERT training program, would attract such students at Maryland.

MAIN CHALLENGES AND ACTION PLAN: As the department grows, the challenge will be to recruit increasing numbers of students in cognitive, developmental and neural sciences. As part of this, it will be critical to increase recruitment of students from underrepresented minorities. Targeted recruitment efforts will include publicizing the departmental transformation and cross-disciplinary training opportunities, as well as leveraging the broader cognitive and linguistic strengths on campus. The IGERT administrator will provide support for recruitment in these areas, working with program faculty to effectively draw on their professional connections in identifying and recruiting talented doctoral students.

| Total for 2005-2007 (3 years) | Women       | Minorities | Other       | Total       |
|-------------------------------|-------------|------------|-------------|-------------|
| All/US-only                   | All/US-only |            | All/US-only | All/Us-only |
| #applicants                   | 82/17       | 3          | 28/8        | 110/25      |
| #accepted                     | 18/6        | 1          | 5/4         | 23/10       |
| #applicants matriculated      | 13/5        | 1          | 3/3         | 16/8        |
| #students who withdrew        | 0           | 0          | 0           | 0           |
| #PhDs awarded                 |             |            |             |             |
| #currently enrolled (9/07)    | 11/4        | 1          | 3/3         | 14/7        |

CONTEXT STATEMENT: The new PhD program in Second Language Acquisition (SLA) is psycholinguistically and experimentally oriented, its faculty and students focusing primarily on theory and research in adult language learning from a cognitive science perspective. The program aims to produce graduates who are equipped for faculty and research positions in leading universities, research institutes, and government language facilities. The first students were admitted in Fall 2005, just weeks after the program's approval. Numbers of applicants have risen steadily ever since, totaling 49 for Fall, 2007, of whom six were accepted, four of them US citizens, with four of the six entering the program, two of them US citizens. As the table shows, while applications run approximately 4:1 non-US/US, of the total of 14 students now enrolled, a healthy 50% are US citizens, with an overall 3:1 ratio of women to men. Based on current trends and data from peer programs, total applications are expected to top out at 80-100 per year by 2010, with acceptances still limited to 6-8 per year, i.e., under 10% of applicants, and roughly equal numbers of US and non-US citizens, for a steady state total of 20-25 full-time students in residence.

Despite its brief history, the Maryland program already has a high profile and is attracting applications from the best students within the US and overseas. Those admitted are mostly those also accepted at the current leading program in SLA at the University of Hawai'i, with roughly half of that subset already opting for Maryland. The Maryland program continues to add tenure-line faculty and relative to its peers it is unusually well placed to leverage close connections with neighboring fields, as reflected in the number of affiliate faculty drawn from Linguistics, Psychology, Philosophy, Hearing and Speech Sciences, Communication, and Evaluation, Measurement and Statistics (EMS), as well as from two major research centers, the Center for Advanced Study of Language (CASL) and the National Foreign Language Center (NFLC). No placement data exist as yet, but second and third-year students are already receiving attractive offers from surrounding institutions. The program anticipates close to 100% placement in research-active universities and in government programs. SLA is a field where the demand for well-trained PhDs currently far exceeds supply, and Maryland graduates are expected to be sought-after.

EVIDENCE OF SUCCESS IN GRADUATE TRAINING: Once again, the newness of the program means that few data are available. However, second and third-year students are already presenting empirical papers at international conferences and starting to submit papers to books and journals. The primary indicators of success will be placement, publication, and research prizes. Current hiring trends indicate high and increasing demand for SLA experts with strong interdisciplinary training in such areas as psycholinguistics or cognitive science, which bodes well for the program's success.

EVIDENCE OF POTENTIAL IGERT APPLICANTS: Largely due to its research and cognitive science orientation, plus the encouragement provided for students to take coursework in other departments (Linguistics, EMS, and Philosophy being especially popular so far) the program currently has at least four potential IGERT trainees in residence. A steady supply of qualified new IGERT applicants should be readily available. Median GRE scores for US students currently in the program are 655/625/50; the median undergraduate GPA is 3.78.

MAIN CHALLENGES AND ACTION PLAN: The main weakness in the program's recruitment efforts to date (retention has not been a problem) is its relative failure to attract suitably qualified minority applicants. It is hoped that the coordinated recruitment efforts planned by the IGERT will address this concern, including the comprehensive plan for involving minority students in research internships and participation in targeted recruitment efforts (see section C7 and the letter from Assoc Dean Johnetta Davis). The SLA lab that the IGERT will help to build will lead to more opportunities for internships in SLA for undergraduates and high-schoolers. More broadly, the *Language at Maryland* recruitment strategy will further leverage the strengths of the SLA program's interdisciplinary connections, driving continued growth in applications.

### **D. References Cited**

| Boldface | IGERT team member                       |
|----------|---|
| Italics  | Trainee supervised by IGERT team member |

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#### **Thomas E. Allen** Biographical Sketch

# (i) **Professional Preparation**

| Kenyon College                        | Psychology             | A.B., 1973  |
|---------------------------------------|------------------------|-------------|
| University of Minnesota               | Educational Psychology | Ph.D., 1979 |
| · · · · · · · · · · · · · · · · · · · |                        | ,           |

# (ii) **Professional Appointments**

| Gallaudet University               | Education, Assistant Professor            | 1980-1984    |
|------------------------------------|---|--------------|
| Gallaudet University               | Researcher, GU Research Institute         | 1980-1985    |
| Gallaudet University               | Education, Associate Professor            | 1984-1988    |
| Ctr for Assessment and Demogr. St. | Director                                  | 1985-1986    |
| Gallaudet University               | Education, Professor                      | 1988-present |
| Gallaudet University               | Director, GU Research Institute           | 1996-1998    |
| Gallaudet University               | Dean, Grad Sch & Research                 | 1998-2001    |
| Gallaudet University               | Dean, Grad Sch & Prof Progs               | 2001-2007    |
| Gallaudet University               | Professor, PI of VL2 Sci. of Learning Ctr | 2007-present |

(iii) Selected Publications (selected from 214 publications)

# 5 recent publications related to the current proposal:

- Woodward, J. & Allen, T. (1987). Two analyses of the ASL to English continuum. In S. Delancey and R. Tomlin (Eds.), *Proceedings of the Second Annual Pacific Linguistics Conference*. Eugene, OR: University of Oregon, Department of Linguistics.
- Allen, T.E. & Woodward, J. (1987). Teacher characteristics and the degree to which teachers incorporate features of English in their sign communication with hearing impaired students. *American Annals of the Deaf, 132*, 61-67.
- Woodward, J., Allen, T.E., & Schildroth, A. (1987). Linguistic and cultural role models for hearing impaired children in elementary school programs. In M.Strong (Ed.), *Language Learning and Deafness* (pp. 184-191). Cambridge: Cambridge University Press.
- Allen, T.E. (1989) Handicapped youth and the outcomes of their schooling: Recent research advances in the United States (Special Issue). *The International Journal of Educational Research*.
- Karchmer, M.A., & Allen, T.E. (1999). Functional assessment of deaf and hard of hearing students, *American Annals of the Deaf, 144*, 68-77

# 5 Additional recent publications:

- Allen, T.E. (1986). Patterns of academic achievement among hearing impaired students: 1974 and 1983. In A.N. Schildroth & M.A. Karchmer (Eds.), *Deaf Children in America* (pp. 161-206). San Diego: College Hill Press.
- Allen, T.E., Rawlings, B.W., & Schildroth, A.N. (1989). *Deaf students and the school-to-work transition*. Baltimore: Paul H. Brooks.
- Allen, T.E. & Sligar, S. (1994). Assessment of hearing impaired individuals in the context of vocational rehabilitation. In R. Nowell & L. Marshak (Eds.), *Understanding Deafness and the Rehabilitation Process*. Needham Heights, MA: Allyn and Bacon.
- Braden, J.P., Wolack, J.A., & Allen, T.E. (1996) A reply to Kishor: Choosing the right metric. *Journal of Psychoeducational Assessment.*
- Allen, T.E. (1992). Subgroup differences in educational placement for deaf and hard of hearing students in the United States. *American Annals of the Deaf, 138,* 381-388.

# (iv) Synergistic Activities

• Principal Investigator of NSF funded Science of Learning Center on Visual Language and Visual Learning (VL2). VL2 brings together an international team of researchers and educators to study the acquisition of visual languages among individuals who are deaf, the development of English

literacy for individuals who have no access to auditory input, and the mapping of visual languages to print language. This interdisciplinary research effort is organized around three disciplinary strands: cognitive neuroscience, language structure and the visual modality, and developmental and social processes of language acquisition.

- As Dean of graduate programs at Gallaudet University, oversaw the expansion of graduate degree and certificate programs, including the implementation of new Ph.D. programs in Linguistics and Audiology, new Masters programs in Deaf Studies, Education, and International Development, and new graduate certificate programs in Deaf History, Multiculturalism for Human Service providers, and International Development.
- Led 2 national achievement-testing projects with the population of deaf and hard of hearing students to develop national achievement norms with the Stanford Achievement Test (7<sup>th</sup> and 8<sup>th</sup> editions). The development of norms, based on administering a standardized test to a large national sample of deaf and hard of hearing students enables educators to make appropriate comparisons for their students within a national context.
- For 11 years, directed the Annual Survey of Deaf and Hard of Hearing Children and Youth, a project that has contributed to educational policies at the national, state, and local levels regarding educational policy for deaf and hard of hearing students. Since 1968, the Annual Survey has been the only nationally conducted survey that focuses on the educational needs of a subgroup of students with a particular disability.
- Directed a national longitudinal study of deaf students and their school-to-work transitions. This
  study led to a broader understanding of the difficulties faced by deaf and hard of hearing students
  as they make the transition from school to work, and described the kinds of services and interagency collaborations that facilitated effective transitions.
- Conducted over 50 workshops with teachers, discussing the proper interpretation of standardized test scores for their deaf and hard of hearing children. These workshops presented concepts of validity and reliability to users of achievement test data, and better enabled teachers to understand the limitations of standardized test results for their deaf and hard of hearing students.

# (v) Collaborators

# a. Collaborators in Past 48 months:

| David Corina        | UC Davis, Linguistics/Ctr for Mind & Brain (VL2 Scientific Management Team) |
|---------------------|---|
| Guinevere Eden      | Georgetown Univ., Neuroscience (VL2 Scientific Management Team)             |
| Peter Hauser        | Natl Tech Inst Deaf, Rochester, NY (VL2 Scientific Management Team)         |
| Marlon Kuntze       | San Jose State U (VL2 Scientific Management Team)                           |
| Jenny Singleton     | U of Illinois, Urbana-Champaign (VL2 Scientific Management Team)            |
| Jill Morford        | U of New Mexico (VL2 Scientific Management Team)                            |
| Paul Dudis          | Gallaudet Univ. (VL2 Scientific Management Team)                            |
| John McLaughlin     | Managing for Results Inc. (VL2 Scientific Management Team)                  |
| Diane Clark         | Gallaudet University (VL2 Scientific Management Team)                       |
| Corine Bickley      | Gallaudet University (VL2 Scientific Management Team)                       |
| David Boen          | Delmarva Foundation   |
| Jeffrey Braden      | University of Wisconsin   |
| Michael A. Karchmer | Gallaudet University  |

# b. Own Graduate Advisors

| David W. Johnson | University of Minnesota |
|------------------|-------------------------|
| Gregory Maruyama | University of Minnesota |

# c. Advisees:

None. As a faculty member in the Department of Educational Foundations and Research, Dr. Allen's dissertation advisement was limited to providing methodology advice, and he has never served as thesis advisor. As Dean, by University policy, he does not serve as a member of dissertation committees.

#### Allen Braun Biographical Sketch

#### (i) **Professional Preparation**

| Washington University | English/Biology | B.A., 1968           |
|-----------------------|-----------------|----------------------|
| Rush Medical College  | Medicine        | M.D., 1980           |
| Rush, Pres St. Luke's | Neurology       | Residency, 1981-1984 |
| NIH Clinical Center   | Nuclear Med.    | Residency, 1986-1988 |
|                       |                 |                      |

# (ii) **Professional Appointments**

| (                      |                  |                                   |
|------------------------|------------------|-----------------------------------|
| NIH                    | Therapeutics     | Medical Staff Fellow, 1984-1986   |
| NIH                    | Nuclear Medicine | Senior Staff Fellow, 1986-1988    |
| NIMH                   | Nuclear Medicine | Head, Nuclear Medicine, 1988-1991 |
| NIDCD                  | Voice/Speech     | Medical Officer, 1991-1994        |
| NIDCD                  | Language         | Acting Chief, Language, 1994-2003 |
| NIDCD                  | Language         | Chief, Language, 2003-            |
| University of Maryland | Neuroscience     | Adjunct Professor, 2003-          |
|                        |                  |                                   |

(iii) Selected Publications (selected from 75 publications):

# 5 recent publications related to the current proposal:

- Gil-da-Costa R., Martin A., Lopes, M., Monica Munoz, M., Fritz, J., **Braun, A.R.** (2006). Species-specific calls activate homologues of Broca's and Wernicke's areas in the macaque. *Nature Neuroscience 9*, 1064-70.
- Boemio, A., Fromm, S., **Braun, A**., Poeppel, D. (2005). Symmetry and asymmetry in human auditory cortex response to temporal structure studied with fMRI. *Nature Neurosci, 8*, 389-95.
- Braun, A.R., Guillemin, A., Hosey, L. Varga, M. (2001). The neural organization of discourse: A PET study of English and ASL production. *Brain*, 124, 2028-2044.
- Braun, A. R. Balkin, T.J., Wesensten, N.J., Gwadry, F., Varga, M., Baldwin, P., Carson, R.E., Belenky, G. and Herscovitch, P. (1998). Dissociated pattern of activity in visual cortices and their projections during human rapid eye movement sleep. *Science*, *279*, 91-95.
- Gannon, P.J., Holloway, R.L., Broadfield, D.C., **Braun, A.R**. (1998). Asymmetry of chimpanzee Planum Temporale: humanlike pattern of Wernicke's brain language area homolog. *Science*, 279, 220-222.

# 5 Additional recent publications:

- Kemeny, S., Xu, J., Park, G., Hosey, L., **Braun, A.R**. (2006). Temporal dissociation of early lexical access and articulation using a delayed naming task: An fMRI Study. *Cerebral Cortex, 16*, 587-595.
- Poeppel, D., Guillemin, A., Tompson, J., Fritz, J., Bavelier, D., Braun, A.R. (2004). Auditory lexical decision, categorical perception, and FM direction discrimination differentially engage left and right auditory cortex. *Neuropsychologia* 42, 183-200.
- Corina D.P., San Jose-Robertson L., Guillemin A, High, J., Braun, A.R. (2003). Language Lateralization in a Bimanual Language. *Journal of Cognitive Neuroscience* 15, 718-730.
- Neville, H.J., Bavelier, D., Cornia, D., Rauschecker, J., Karni, A., Lalwani, A., Braun, A., Clark, V.P., Jezzard, P., Turner, R. (1998). Cerebral organization for language in deaf and hearing subjects: biological constraints and effects of experience. *Proc Natl Acad Sci USA*, *95*, 922-929.
- Braun, A.R., Varga, M., Stager, S., Shulz, G., Selbie, S., Maisog, J.M., Carson, R.E., and Ludlow, C. L. (1997). Altered patterns of cerebral activity during speech and language production in developmental stuttering: An H2O-15 Positron Emission Tomography Study. *Brain, 120*:761-784.

# (iv) Synergistic Activities

 Conducting translational research evaluating pharmacological augmentation of neuroplastic changes in a rodent model of stroke, stroke recovery. Developed a program for MRI imaging of a rodent model for stroke in which patterns of BOLD activity are correlated with immunocytochemical indices of neuronal repair.

- Conducting ongoing studies of American Sign Language processing in deaf subjects and in hearing offspring of deaf parents.
- Language Section provides scientific liaison and support to patient advocacy/stroke recovery groups.
- Conducted neuroimaging research evaluating responses to auditory stimuli in awake behaving monkeys.
- Reviewer: Brain, Science, NeuroImage, Human Brain Mapping, Brain & Language, etc.
- Editorial Board: Neuropsychoanalysis.

# (v) Collaborators

### a. Collaborators in the last 48 months (selected)

| Jose Contreras-Vidal | University of Maryland    |
|----------------------|---------------------------|
| David Corina         | UC Davis                  |
| Alex Dromerick       | Georgetown U              |
| Guinevere Eden       | Georgetown U              |
| Karen Emmorey        | Salk Inst./San Diego St U |
| Yasmeen Faroqi-Shah  | University of Maryland    |
| Susan Goldin-Meadow  | U. Chicago                |
| Mark Hauser          | Harvard                   |
| Peter Herscovitch    | NIH                       |
| Alan Koretsky        | NIH                       |
| Husseini Manji       | NIH                       |
| Alex Martin          | NIH                       |
| Colin Phillips       | University of Maryland    |
| David Poeppel        | University of Maryland    |
| Betsy Quinlan        | University of Maryland    |
| Nan Ratner           | University of Maryland    |
| Lalith Talagala      | NIH                       |
| Steven Warach        | NIH                       |

# b. Own graduate and postdoctoral advisors

Harold L Klawans, MDNeurology Residency Director, Rush Medical Center, ChicagoThomas N Chase, MDNeuropharmacology Staff Fellowship, NINCDS, NIHRonald Neumann, MDPET/Nuclear Medicine Residency/Fellowship, DNM, CC, NIH

# c. Graduate thesis and postdoc supervision

# PhD Student Supervision:

| Michele Costanzo      | PhD Candidate, NACS, Kinesiology, U of Maryland                              |
|-----------------------|--|
| Trent Bradbery        | PhD Candidate, Kinesiology, Engineering, U of Maryland                       |
| Nuria AbdulSabur      | PhD Candidate, NACS, Linguistics, U of Maryland                              |
| Joe McArdle           | PhD 2006, Virginia Tech. Postdoc, Language Section, NIDCD                    |
| Bruce Swett           | Predoctoral Fellow 2005-2007. Postdoctoral fellow, Language Section, NIDCD   |
| Omar Ali, Ph.D.       | PhD 2004, Psychology, American U, Drug Devt Scientist, Cato Research, MD     |
| Lucila San Jose, M.A. | Predoctoral Fellow 2002-2004, Ph.D. Candidate, Psychology, Howard University |
|                       |  |

Postdoctoral Fellow Supervision:

| Jiang Xu, MD, PhD | Research Fellow (Visiting)   |
|-------------------|--|
| Jed Meltzer, PhD  | Postdoctoral IRTA Fellow   |
| Chunmao Wang, PhD | Research Fellow (Visiting)   |
| Bruce Swett, PhD  | Postdoctoral IRTA Fellow   |
| Joe McArdle, PhD  | Postdoctoral IRTA Fellow   |
| Charles Limb, MD  | Fellow (2003-2006), Asst Prof, Otolaryngology, Johns Hopkins Sch of Medicine |
| Stefan Kemeny, MD | Fellow (2001-2005), Resident, Neuroradiology, Aachen, Germany                |
| Vladimir Nechaev  | Fellow (2002-2004), Inst of the Hum Brain, Rus. Acad of Sci, St. Petersburg  |
| Grace Park        | Postdoc (2002-2005), Private practice (aphasiology), Rockville, MD           |
| Dennis MacLean    | Postdoc (2003-2004), Assistant Professor, Psychology, Cameron U              |
| Whitney Postman   | Postdoc (2004-2007), Staff Fellow, Comm Sci and Disorders, Temple U          |
|                   |  |

# Robert M. DeKeyser

**Biographical Sketch** 

### (i) **Professional Preparation**

| Katholieke Universiteit Leuven | Romance Philology          | B.A. 1979 |
|--------------------------------|----------------------------|-----------|
| Stanford University            | Foreign Language Education | MA 1982   |
| Stanford University            | Foreign Language Education | PhD 1986  |

# (ii) Academic Appointments

| University of Maryland   | Second Language Acquisition | Professor, 2005-               |
|--------------------------|-----------------------------|--------------------------------|
| University of Pittsburgh | Linguistics                 | Associate Professor, 1997-2005 |
| University of Pittsburgh | Linguistics                 | Assistant Professor, 1991-1997 |
| University of Pittsburgh | Linguistics                 | Visiting Asst Prof 1988-1991   |

# (iii) Selected Publications (selected from 40 publications)

### 5 recent publications related to the current proposal:

- DeKeyser, R. (2005). What makes learning second language grammar difficult? A review of issues. *Language Learning*, 55, Supplement 1, 1-25.
- DeKeyser, R. & Larson-Hall, J. (2005). What does the critical period really mean? In J. Kroll & A. M. B. de Groot (eds.), *Handbook of Bilingualism: Psycholinguistic Approaches*. Oxford: Oxford University Press, pp. 88-108.
- DeKeyser, R. (2003). Implicit and explicit learning. In C. Doughty & M. Long (eds.), Handbook of Second Language Acquisition. Oxford: Blackwell, pp. 313-348.
- Goldschneider, J. & DeKeyser, R. (2001). Explaining the 'natural order of L2 morpheme acquisition' in English: A meta-analysis of multiple determinants. *Language Learning*, *51*, 1-50.
- DeKeyser, R. (2000). The robustness of critical period effects in second language acquisition. *Studies in Second Language Acquisition, 22*, 499-533.

# 5 additional publications:

- DeKeyser, R. (2007). Skill acquisition theory. In J. Williams and B. VanPatten (eds.), *Theories in Second Language Acquisition: An introduction*. Mahwah, NJ: Erlbaum.
- DeKeyser, R. (2007). Revisiting the concept of practice. In R. DeKeyser (ed.), *Practicing in a second language: Perspectives from applied linguistics and cognitive psychology*.
- DeKeyser, R. (2007). Study abroad as foreign language practice. In R. DeKeyser (ed.), *Practicing in a second language: Perspectives from applied linguistics and cognitive psychology.*
- DeKeyser, R. M. (2006). A critique of recent arguments against the critical period hypothesis. In C. Abello-Contesse, R. Chacón-Beltrán, L.-J. M. D. & M. M. Torreblanca-López (Eds.), Age in L2 acquisition and teaching (pp. 49-58). Bern, Switzerland: Peter Lang.
- DeKeyser, R. & Juffs, A. (2005). Cognitive considerations in L2 learning. In E. Hinkel (ed.), *Handbook of Research in Second Language Teaching and Learning*. Mahwah, NJ: Erlbaum, pp. 437-454.

- Editor of the journal *Language Learning* (since May 2005). Language Learning is one of the premier journals in applied linguistics, founded in 1948.
- Frequent reviewer for 20+ journals (Journal of Memory and Language, Studies in Second Language Acquisition, Second Language Research, Modern Language Journal, Applied Linguistics, Psychological Reports, TESOL Quarterly, Language Learning, Language Teaching Research, Applied Psycholinguistics, Journal of Experimental Child Psychology, Canadian

Modern Language Review, ITL Review of Applied Linguistics ...), book series (Erlbaum, Benjamins), and grant agencies (NEH, NSF, agencies in the UK, Netherlands, Belgium, Canada)

- Organizer or co-organizer of conferences or conference symposia (SLRF, AAAL, PacSLRF); discussant at other symposia (AAAL, EUROSLA)
- Frequent external examiner for PhD dissertations at foreign universities
- Presentations on the science of language for high school career day events.

#### (v) Collaborators and other affiliations (past 48 months)

# a. Collaborators and co-editors

| Tel Aviv University             |
|---------------------------------|
| University of Queensland        |
| University of Pittsburgh        |
| University of North Texas       |
| Tel Aviv University             |
| Aoyama Gakuin University, Tokyo |
| Rice University                 |
|                                 |

### b. Graduate and postdoctoral advisors

| Robert Politzer     | (deceased)          |
|---------------------|---------------------|
| Shirley Bryce Heath | Stanford University |

#### c. Graduate Theses and Postdoctoral Supervision

Recent Graduate Supervision (total = 23):

| Marina Saiz                      | Ph.D, (2007) University of Pittsburgh; Hispanic Linguistics |
|----------------------------------|---|
| Sonia Lenk                       | Ph.D. (2007) University of Pittsburgh; Hispanic Linguistics |
| David Libber                     | M.A., University of Maryland (exp. 2008): French and SLA    |
| Tamar Bernfeldt                  | M.A , University of Pittsburgh (2004): Linguistics          |
| Nicole Garcia                    | M.A., University of Pittsburgh (2005): Linguistics          |
| Veronica Lifrieri                | M.A., University of Pittsburgh (2005): Linguistics          |
| Postdoctoral Supervision; (total | = 1):   |

Cornelia de Jong,

Post-doc at NSF Science of Learning Center (U of Pittsburgh/CMU) (PhD University of Amsterdam)

### **Bonnie J. Dorr** Biographical Sketch

# (i) Professional Preparation

| Boston University<br>Massachusetts Inst of Technology<br>Massachusetts Inst of Technology | Computer S<br>Computer S<br>Computer S | Science<br>Science<br>Science | B.A., 1984<br>S.M., 1987<br>Ph.D., 1990 |
|---|--|-------------------------------|---|
| (ii) Professional Appointments  |  |                               |   |
| University of Maryland  | UMIACS                                 | Research Associate            | 1990-1992                               |
| University of Maryland  | Comp Sci                               | Assistant Professor           | 1992-1998                               |
| University of Maryland  | Comp Sci                               | Co-director, CLIP lab         | 1995-present                            |
| University of Maryland  | Comp Sci                               | Associate Professor           | 1998-2005                               |
| University of Maryland  | Comp Sci                               | Professor                     | 2005-present                            |

(iii) Selected Publications (selected from 214 publications)

# 5 recent publications related to the current proposal

- **Dorr, BJ** & T Gaasterland. (2007). Exploiting Aspectual Features and Connecting Words for Temporal-Relation Extraction in Multi-Document Summarization. *Information Processing and Management 43*, 1681-1704.
- Hobson, SP, **BJ Dorr**, C Monz, & R Schwartz. (2007). Task-Based Evaluation of Text Summarization using Relevance Prediction. *Information Processing and Management, 43*, 1482-1499.
- Lin, J, GC Murray, **BJ Dorr**, P Pecina, & J Hajic. (2007). A Cost-effective Lexical Acquisition Process for Large-scale Ontology Translation. To appear in *Journal of Languages Resources and Evaluation*.
- Zajic, D, **BJ Dorr**, & J Lin. (2007). Single-Document and Multi-Document Summarization Techniques for Email Threads Using Sentence Compression. To appear in *Journal Information Processing and Management*.

Zajic, DM, **BJ Dorr**, J Lin, & R Schwartz. (2007). Multi-Candidate Reduction: Sentence Compression as a Tool for Document Summarization Tasks. *Information Processing and Management, 43*, 1549-1570.

# **5** Additional recent publications

- Ayan, NF & **BJ Dorr**. (2006). A Maximum Entropy Approach to Combining Word Alignments. *Proc. of Human Language Technology Conference, North American Chapter of Assoc for Computational Linguistics Annual Meeting*, New York, NY.
- Madnani, N, R Passonneau, J Conroy, N Fazil Ayan, **BJ Dorr**, J Klavans, D O'Leary, & J Schlesinger. (2007). Variability in Sentence Ordering across Multiple Subjects: An Argument for Multiple References in Evaluation. Proceedings of the 11th European Workshop on Natural Language Generation, Daghstuhl, Germany.
- Madnani, N, N Fazil Ayan, P Resnik & **BJ Dorr**. (2007). Using Paraphrases for Parameter Tuning in Statistical Machine Translation. ACL Workshop on Statistical Machine Translation, Prague.
- Murray, C, **BJ Dorr**, J Lin, J Hajic, & P Pecina. (2006). Leveraging Reusability: Cost-effective Lexical Acquisition for Large-scale Ontology Translation. *Proceedings of ACL*, Sydney, Australia.
- Rosti, Al, N Fazil Ayan, B Xiang, S Matsoukas, R Schwartz, & **BJ Dorr**. (2006). Combining Outputs from Multiple Machine Translation Systems. Proceedings of the North American Chapter of the Association for Computational Linguistics, Rochester, NY. **BEST PAPER AWARD.**

- President of the Association for Computational Linguistics, 2007-2008; Vice Pres. from 2006-2007.
- Editorial advisory board member of: Machine Translation, Journal of Artificial Intelligence Research. Member of the executive committee of: American Assoc. for Artificial Intelligence, Assoc. for Comp. Ling., Assoc. for Machine Translation in the Americas, FDA Advisory Board for Drug Safety and Risk Management. Program Committee Member: HLT-NAACL, 2006; EACL, 2006; ACL, 2005; AMTA, 2004; EMNLP, 2004; COLING, 2004; Document Understanding Conference, 2004, IJCNLP, 2004, MT-Summit Evaluation, 2003; MT-Summit, 2003; HLT-NAACL 2003.
- Active in promoting the interests of women in Computer Science: featured in Voice of America, Maryland Outlook Online, Washington Techway Magazine, Business Week Magazine, and various

workshops on the subject. Outreach work to middle school audiences: Briggs Chaney Middle School, "Melding Technology with History and Language".

 PI or co-PI in numerous current multi-institution or multi-investigator projects: Dept. of Defense Human Language Technology Center of Excellence, with Amy Weinberg, Mary Harper, David Doermann, Doug Oard, and Philip Resnik, awarded 2007-2017. (Joint with Johns Hopkins). "Rosetta: An Analyst Co-Pilot", Darpa GALE #W0550441 (Prime #HR0011-06-2-0001), with Doug Oard, Philip Resnik, and Amy Weinberg. (Collaboration among 7 sites: Brown, IBM, CMU, JHU, Pittsburgh, Stanford, UMD.) "Joint Institute for Knowledge Discovery", A center for massive knowledge management, learning from heterogeneous multilingual textual and other sources, as well as intelligent semantic inferences from such sources (with VS Subrahmanian, Rama Chellapa, Carol Espy Wilson, Jim Hendler, Doug Oard. 2005-2008). NSF-IIS: "iOPENER A Flexible Framework to Support Rapid Learning in Unfamiliar Research Domains," with Jimmy Lin, Judith Klavans, and Dragomir Radev. 2007-2010.

#### (v) Collaborators

#### a.Collaborators in Past 48 months (excluding students)

|                   |                    | <b>v</b> ,       |                 |
|-------------------|--------------------|------------------|-----------------|
| David Farwell     | New Mexico State U | Keith Miller     | MITRE           |
| Terry Gaasterland | UC San Diego       | Teruko Mitamura  | Carnegie Mellon |
| Rebecca Green     | U of Maryland      | Douglas Oard     | U of Maryland   |
| Steve Helmreich   | New Mexico State U | Martha Palmer    | U of Colorado   |
| Ed Hovy           | U of S California  | Owen Rambow      | Columbia        |
| Pamela Jordan     | U of Pittsburgh    | Florence Reeder  | MITRE           |
| Greg Kondrak      | U of Alberta       | Philip Resnik    | U of Maryland   |
| Lori Levin        | Carnegie Mellon    | Richard Schwartz | BBN             |
| Dekang Lin        | U of Alberta       | Amy Weinberg     | U of Maryland   |
| Antonia Marti     | U of Barcelona     |                  | -               |

#### b.Own Graduate Advisor

Robert C. Berwick

Massachusetts Institute of Technology

# c.Advisees:

| Graduate Supervision; to | otal = 14:   |
|--------------------------|--|
| Sungki Suh               | PhD (1994), Professor, Seoul National University                             |
| Yahui Chang              | PhD (1995), Assoc. Professor, National Chiao Tung University                 |
| Mine Ulku Sencan         | PhD (1996), Researcher   |
| Doug Oard                | PhD (1996), Assoc. Professor & Assoc. Dean for Research, U. Maryland         |
| Wade Shen                | PhD (1998), Research Scientist, MIT Lincoln Labs                             |
| Scott Thomas             | PhD (2002), Researcher, Naval Research Laboratory                            |
| Maria Katsova            | PhD (2002), Researcher, Microsoft Research                                   |
| Clare Voss               | PhD (2002), Researcher, Army Research Laboratory                             |
| Rebecca Green            | PhD (2004), Asst Professor of Library & Information Science, U. Maryland     |
| David Zajic              | PhD (2007), Asst Research Scientist, U of Maryland Ctr Adv Study of Language |
| Nate Waisbrot            | PhD candidate, Computer Science  |
| Stacy President          | PhD candidate, Neuroscience & Cognitive Science                              |
| Calandra Tate            | PhD candidate, Applied Mathematics   |
| Matt Snover              | PhD candidate, Computer Science  |
| Postdoc Supervision; to  | tal = 9  |
| Douglas Jones            | Postdoc. 1997, Senior Researcher, MIT Lincoln Labs                           |
| Mari Olsen               | Postdoc. 1999, Senior Researcher, Microsoft Natural Language Group           |
| David Traum              | Postdoc. 2000, Research Scientist, Inst. for Creative Technologies, USC      |
| Gina-Anne Levow          | Postdoc. 2001, Assistant Professor, U. of Chicago.                           |
| Rebecca Hwa              | Postdoc. 2003, Assistant Professor, U. of Pittsburgh.                        |
| Nizar Habash.            | Postdoc. 2004, Research Scientist, Columbia U.                               |
| Christof Monz            | Postdoc. 2005, Lecturer, Queen Mary, University of London, UK                |
| Necip Fazil Ayan         | Postdoc. U. Maryland. 2006-  |
| Saif Mohammad            | Postdoc. U. Maryland. 2007-  |

### Michael Dougherty Biographical Sketch

# (i) Professional Preparation

| Kansas State University | Psychology | BA, 1993  |
|-------------------------|------------|-----------|
| Oklahoma University     | Psychology | PhD, 1999 |
|                         |            |           |

# (ii) Academic Appointments

| University of Maryland | Psychology | Associate Professor, 2005-present |
|------------------------|------------|-----------------------------------|
| University of Maryland | Psychology | Assistant Professor, 1999-2005    |

(iii) Selected Publications (selected from 29 publications):

5 recent publications related to the current proposal:

- Thomas, R. P., **Dougherty**, M. R., Sprenger, A. & Harbison, J. I. (in press). Diagnostic hypothesis generation and human judgment. *Psychological Review.*
- **Dougherty**, M. R. & Harbison, J. I. (2007). Retrieval failure in memory: How long does one keep going back to the well when the well is dry? *Journal of Experimental Psychology: Learning, Memory & Cognition.* In press.
- Franco-Watkins, A. & **Dougherty**, M. R. (2006). Does context discrimination in recognition memory depend on the concreteness of the to-be-remembered items? *Memory and Cognition, 13,* 973–985.
- **Dougherty**, M. R., \*Scheck, P., Nelson, T. O. & Narens, L. (2005). Using the past to predict the future. *Memory & Cognition, 33,* 1096–1115.
- **Dougherty**, M. R. P. & \*Hunter, J. E. (2003). Hypothesis generation, probability judgment and individual differences in working memory capacity. *Acta Psychologica*, *113*, 263–282.

5 additional recent publications:

- **Dougherty**, M. R., Franco-Watkins, A., & Thomas, R. P. *(in press)*. The psychological plausibility of fast and frugal heuristics. *Psychological Review*.
- **Dougherty**, M. R. & Sprenger, A. (2006). The influence of improper sets of information on judgment: How irrelevant information can bias judged probability. *Journal of Experimental Psychology: General, 138,* 262-281.
- Dougherty, M. R. P., Gronlund, S. D., & Gettys, C. F. (2003). Memory as a fundamental heuristic for decision making. In S. L. Schneider & J. Shanteau's (Eds.) *Emerging Perspectives on Judgment and Decision Research* (pp. 125-164). Cambridge, MA: Cambridge University Press.
- **Dougherty**, M. R. P. (2001). Integration of the ecological and error models of overconfidence using a multiple-trace memory model. *Journal of Experimental Psychology: General*, 130, 579–599.
- **Dougherty**, M. R. P., Gettys, C. F., & Ogden, E. E. (1999). MINERVA-DM: A memory processes model for judgments of likelihood. *Psychological Review*, *106*, 180-209.

- As part of an NSF CAREER award, developed graduate seminars in Memory and Decision Making and Attention and Memory, and undergraduate courses in Experimental Methods. In addition, in the process of starting new professional society whose purpose is to disseminate knowledge on the emerging field of Cognitive Decision Theory.
- Served on 2007 NSF Committee of Visitors (COV) for the purposes of providing advice and recommendations concerning NSF science and education activities within the Directorate for Social and Economic Sciences.

- Editorial Board: Journal of Experimental Psychology, Learning Memory and Cognition. Reviewer for 10+ journals, funding agencies, and publishers in psychology. External reviewer for Israeli Science Foundation, National Science Foundation, and Air Force Office of Scientific Research.
- Frequently invited for new student and freshman orientations on the Maryland campus, for purposes of providing an overview of research in psychology.
- Served as Panel Discussant on "Building a CV", a graduate student seminar sponsored by Center for Teaching Excellence, 2005.
- Organizer of a weekly speaker series (Cognitive seminar) since 2001.

# (v) Collaborators and other Affiliations

a. Collaborators in Past 48 months (graduate students and postdocs are listed in (c) below)

| Psychology, University of London, Birkbeck                    |
|---|
| Center for Advanced Study of Language, University of Maryland |
| Psychology, U of California, San Diego                        |
| Psychology, U of Oklahoma                                     |
| Social and Decision Sciences, Carnegie Mellon                 |
| Psychology, University of Maryland                            |
| Psychology, Michigan State University                         |
|   |

# b. Own Graduate & Postdoctoral Advisor

Scott Gronlund University of Oklahoma

# c. Graduate Theses and Postdoc Supervision

Graduate Supervision (\*indicates co-advisor); total = 6:

| Ana Franco-Watkins<br>Jennifer Hunter | PhD, U of Maryland (2004). Assistant Professor, Au<br>MS, U of Maryland (2003). US Census Bureau | burn University       |
|---------------------------------------|--|-----------------------|
| Amber Sprenger                        | PhD, U of Maryland (2007). Post Doc, Johns Hopkin  | ns University         |
| Tracy Tomlinson                       | PhD, expected 2009, U of Maryland: Psychology  |                       |
| Sharona Atkins                        | PhD, expected 2011, U of Maryland: Neuroscience  | and Cognitive Science |
| Erika Hussey                          | PhD, expected 2012, U of Maryland: Neuroscience  | and Cognitive Science |
| Postdoc Supervision; to               | otal = 1:  |                       |
| J. Isaiah Harbison                    | Postdoc, U of Maryland (PhD, Louisville U.)  | 2005-2008             |

### Fred R. Eckman Biographical Sketch

### (i) **Professional Preparation**

| Johns Hopkins University      | Romance Languages | В.А., 1966<br>М.А. 1969 |
|-------------------------------|-------------------|-------------------------|
| Indiana University            | Linguistics       | Ph.D., 1972             |
| (ii) Professional Appointment | S                 |                         |

| Indiana University         | Linguistics       | Visiting Asst Prof  | 1972-1973    |
|----------------------------|-------------------|---------------------|--------------|
| Mass. Inst. of Technology  | Linguistics       | Visiting Scientist  | 1973-1974    |
| U Wisconsin–Milwaukee      | Linguistics       | Lecturer            | 1974-1977    |
| U Wisconsin–Milwaukee      | Linguistics       | Assistant Professor | 1977-1980    |
| U Wisconsin–Milwaukee      | Linguistics       | Associate Professor | 1980-1989    |
| U Wisconsin–Milwaukee      | Linguistics       | Professor           | 1989-Present |
| Heinrich Heine University, | Engl. Linguistics | Guest Professor     | Fall 1995    |
| Duesseldorf, Germany       | 0 0               |                     | Summer 2000  |
|                            |                   |                     | Fall 2002    |
|                            |                   |                     | Summer 2006  |

(iii) Selected Publications (selected from 59 publications):

#### 5 recent publications related to the current proposal:

- **Eckman, F. R**. Forthcoming. Language Typology and Second Language Acquisition. To appear in *Handbook of Language Typology* (ed.) Jae Song. Oxford: Oxford University Press.
- **Eckman, F. R**. Forthcoming. Typological Markedness and Second Language Phonology. To appear in *Second Language Phonology*, (ed.) by J. Hansen and M. Zampini. Amsterdam: John Benjamins.
- **Eckman, F. R**. 2007 Hypotheses and Methods in Second Language Acquisition: Testing the Noun Phrase Accessibility Hierarchy on Relative Clauses. *Studies in Second Language Acquisition, 29, 321 327.*
- **Eckman, F. R.** 2007. Universals, innateness and explanation in second language acquisition. In *What Counts as Evidence in Linguistics*, (ed.) by M. Penke & A. Rosenbach, pp. 217 239. Amsterdam: John Benjamins Publishing Co.
- **Eckman, F. R.** 2004. From phonemic differences to constraint rankings: Research on second language phonology. *Studies in Second Language Acquisition 26*, 513 549.

#### 5 Additional recent publications:

- **Eckman, F. R**. 2004. Optimality Theory, markedness, and second language syntax: The case of resumptive pronouns in relative clauses. *Studies in Phonetics, Phonology, Morphology 10,* 89-110.
- **Eckman, F. R**. 2004. From phonemic differences to constraint rankings: Research on second language phonology. *Studies in Second Language Acquisition 26*, 513 549.
- Eckman, F. R. 2004. 'External' universals and explanation in SLA. *Studies in Language 28,* 707 709.
- **Eckman, F. R.**, A. Elreyes and G. Iverson. 2003. Some principles of second language phonology. *Second Language Research* 19, 169-208, 2003.
- **Eckman, F. R**. A. Elreyes, and G. Iverson. 2001. Allophonic Splits in L2 Phonology: The Question of Learnability. *International Journal of English Studies*, 1, 21-51.

# (iv) Synergistic Activities

- Editorial advisory board member of Studies in Second Language Acquisition
- Referee/reviewer for: Applied Linguistics, International Review of Applied Linguistics, Language Learning, Linguistics, Studies in Second Language Acquisition; The Canadian Social Science Research Council; Several publishers.
- Principal Investigator, NIH Research Grant R01 HD46908-01A2 "Markedness and Learnability in Second Language Phonology", \$1,390,654, 2006-11, Co-investigators: Gregory Iverson, University of Wisconsin-Milwaukee; Robert Fox, The Ohio State University; Ewa Jacewicz, The Ohio State University
- Principal Investigator, NIH Academic Research Enhancement Award R15 HD34233-01, Learnability in Second Language Pronunciation, \$106,774, 1997 – 2000, Co-investigator: Gregory Iverson. (AREA grants are for conducting pilot studies for the purpose of applying for R01 funding)

# (v) Collaborators

#### a. Collaborators in Past 48 months (excluding students)

| Robert Fox       | The Ohio State University              |
|------------------|--|
| Ewa Jacewicz     | The Ohio State University              |
| Gregory Iverson  | University of Wisconsin–Milwaukee      |
| Abdulla El Reyes | Center for Documentation and Research, |
| -                | Abu Dhabi, United Arab Emirates        |

# b. Own Graduate Advisors

| M.A.: Andreas Koutsoudas  | Indiana University (deceased) |
|---------------------------|-------------------------------|
| Ph.D.: Andreas Koutsoudas | Indiana University (deceased) |

#### c. Graduate Supervision (previous ten years, all at U. of WI-Milwaukee)

### Ph.D Chair of Committee

| Fatemi Zohra Hilali (degree completed) | Mohammed V University, Rabat, Morocco  |
|--|--|
| Minsook Kim (degree completed)         | University of California, Berkeley     |
| Wendi Halstead (degree completed)      | Milwaukee Area Technical College       |
| Abdulla El Reyes                       | Center for Documentation and Research, |
|  | Abu Dhabi, United Arab Emirates        |
| Olesya Ostapenko (ongoing)             |  |

Olesya Ostapenko (ongoing) Sooho Song (ongoing)

# Ph.D. Member of committee

| Doreen Krueger (degree completed) | Concordia University, Mequon, Wisconsin |
|-----------------------------------|---|
| Emiko Kaneko (ongoing)            |   |
| Haeil Park (ongoing)              |   |
| Claire Hicks (ongoing)            |   |

# MA (degrees completed)

| Lindsey Butler     | Barbara Schulz |
|--------------------|----------------|
| Abigail Goelzer    | Hyowon Song    |
| Anastasia Kasprzyk | Brita Swenson  |
| Mijo Kim           | Hie-Jung You   |
| Ayumi Sawad        | Hyo-Seung You  |

#### Carol Y. Espy-Wilson Biographical Sketch

#### (i) Professional Preparation

| Stanford University | Electrical Engineering | BS, 1979  |
|---------------------|------------------------|-----------|
| MIT                 | Electrical Engineering | MS, 1981  |
| MIT                 | Electrical Engineering | EE, 1984  |
| MIT                 | Electrical Engineering | PhD, 1987 |
| MIT                 | Postdoctoral Fellow    | 1987-1988 |

#### (ii) Academic Appointments

| University of Maryland | Electrical Engineering | Professor, 2007-               |
|------------------------|------------------------|--------------------------------|
| University of Maryland | Electrical Engineering | Associate Professor, 2001-2007 |
| Boston University      | Electrical Engineering | Associate Professor, 1999-2001 |
| Boston University      | Electrical Engineering | Assistant Professor, 1990-1999 |

(iii) Selected Publications (selected from 147 publications):

# 5 recent publications related to the current proposal:

- Pruthi, T., **Espy-Wilson**, **C.** & Story. B. (2007) Simulation and analysis of nasalized vowels based on MRI data. *Journal of the Acoustical Society of America*, 121, 3858-3873.
- Salomon, A., **Espy-Wilson, C**., & Deskmukh, O. (2004). Detection of speech landmarks from temporal information. *Journal of the Acoustical Society of America*, 115, 1296-1305.
- Deshmukh, O., & **Espy-Wilson, C**. (2002). Acoustic-phonetic speech parameters for speaker-Independent speech recognition. Proc. IEEE Intern. Conf. On Acoust., Speech and Signal Proc., pp. 593-596.
- Deshmukh, O., **Espy-Wilson, C,** Salomon, A., and Singh, J. (2005). Use of temporal information: detection of the periodicity, aperiodicity and pitch in speech. *IEEE Transactions on Speech and Audio Processing*, 13, 776-786.
- **Espy-Wilson, C**. (2004). Articulatory strategies, Speech Acoustics and Variability. *From Sound to Sense:* 50+ Years of Discoveries in Speech Communication, MIT, Cambridge, MA, pp. B62–B76, **invited**.

# 5 additional publications:

- Deshmukh, O., **Espy-Wilson, C**. & Carney, L. (2007) Speech enhancement using the modified phase opponency model. *Journal of the Acoustical Society of America*, 121, 3886-3898.
- Pruthu, T., & **Espy-Wilson, C**. (2004). Acoustic parameters for automatic detection of nasal manner. *Speech Communication*, 43, 225-239.
- Juneja, A., & Espy-Wilson, C. (2004). Significance of invariant acoustic cues for phonetic features in a probabilistic framework for landmark-based speech recognition. *From Sound to Sense:* 50+ Years of Discoveries in Speech Communication. MIT, Cambridge, MA, pp. C151-C156.
- **Espy-Wilson, C**., Boyce, S., Jackson, M., Narayanan, S., & Alwan, A. (2000). Acoustic modeling of American English /r/. *Journal of the Acoustical Society of America*, 108, 343-356.
- Zhang, Z., and **Espy-Wilson, C**. (2004). A vocal tract model for American English /l/. Journal of the Acoustical Society of America, 115, 1274-1280.

- Developed a Digital Speech Processing course for advanced graduate students that includes lab work and requires that the students conduct a research project. A junior-level undergraduate engineering course "Signals and Systems" also includes many examples of how the techniques being taught in the class are applied in research in speech processing.
- Outreach activities include keynote addresses at high schools including Woodward Academy (2001), Newton North High School (1993), Southwest Dekalb High School (1996); served variously as a mentor, keynote speaker or workshop panel member in the New England Board of Higher Education Science and Engineering Network (1991-1999); other speeches for special programs include the Massachusetts Pre-Engineering Program (1991), MIT Minority Summer Research Program (1992), "Black Women in the Academy: Defending our Name, 1894-1994" Conference (1994), Alpha Kappa

Alpha Sorority for MIT and Wellesley students (2000) and Success in the Sciences Summer Institute at Rutgers University, 1993 & 1994) Washington, DC Chapter of the IEEE Women in Engineering Affinity Group (2002).

- Developed tools that have been made available to other researchers: (a) formant trackers used at Ohio State and MIT, and (b) a computer vocal tract modeling program (VTAR) available at <u>http://www.isr.umd.edu/Labs/SCL/vtar/index.html</u> and used by many colleages for teaching and research. Recent MRI data collected from 20 speakers (as part of an NIH grant) will be processed and put in a format that others can use (<u>http://lara.haskins.yale.edu</u>). Lead-PI on an NSF collaborative grant which will result in many tools being developed and shared with the larger community.
- Member of the Editorial Board for *Acoustics Today*, a publication by the Acoustical Society of America; external advisory board for the Next Generation Localisation Center between four universities and several companies in Dublin, Ireland; chair of the Speech Technical Committee of the Acoustical Society of America; member of the NIH Language and Communication Study Section, 2001-2004.
- Lab engages numerous undergraduate and women students in engineering research, including
  participants in summer internship programs. Graduate student Om Deshmukh won the Best Student
  Paper Award at ASA for presentations made in 2003 and 2004; undergraduate student Paul Young
  received the Best Presentation Award in the MERIT program at UMD, Summer 2003.
- PI or co-PI on several multi-institution or multi-investigator projects: "Landmark-based Robust Speech Recognition Using Prosody-Guided Models of Speech Variability", a joint effort between 5 sites: UMD, USC, UCLA, UIUC, BU (NSF, 2007-2010); "Joint Institute for Knowledge Discovery", A center for massive knowledge management (with VS Subrahmanian, Rama Chellapa, Jim Hendler, Doug Oard, Bonnie Dorr (DoD, 2005-2008) and an ONR grant: "Center for Auditory and Acoustics Research" between 10 faculty at Boston University and five at UMD (ONR, 1997-2000).

# (v) Collaborators and Other Affiliations:

a. Collaborators in Past 48 months (graduate students and postdocs are listed in (c) below):

| Dr. Suzanne Boyce<br>Laurel Carney<br>Mark Tiede<br>Zhaoyan Zhang<br>Shihab Shamma | University of Cincinnati<br>Syracuse University<br>MIT<br>UCLA Medical School<br>University of Maryland |
|--|---|
| William Idsardi  | University of Maryland  |
| Ray Liu  | University of Maryland  |
| Min Wu   | University of Maryland  |
| b. Own Graduate Advisor:   |   |
| Ken Stevens  | MIT   |
| c. Graduate Theses:  |   |
| Nabil Bitar  | Ph.D, (1997), Principal member of technical staff, Verizon Inc.   |
| Venkatesh Chari  | MS, (1992). Systems Applications Manager, Analog Devices Inc.   |
| Ariel Salomon  | MS, (2000).   |
| Thorvaldur Einarsson   | MS, (2004).   |
| Amit Juneja  | PhD, (2004). Senior Scientific Programmer, Think-A-Move, Ltd.   |
| Om Deshmukh  | PhD (2006). Senior Research Engineer, IBM India Research,   |
| Tarun Pruthi   | PhD, (2007). Senior Research Engineer, Think-A-Move, Ltd.   |
| Sandeep Manocha  | MS, (2007). Microsoft Research  |
| Xinhui Zhou  | PhD expected 2008, University of Maryland: Electrical & Computer Eng                                    |
| Shrikanth Vishnubhotla   | PhD expected 2009, University of Maryland: Electrical & Computer Eng                                    |
| Daniel Garcia-Romero   | PhD expected 2009, University of Maryland: Electrical & Computer Eng                                    |
| Vikramajit Mitra   | PhD expected 2010, University of Maryland: Electrical & Computer Eng                                    |
| Jaime Hernandez  | PhD expected 2011, University of Maryland: Electrical & Computer Eng                                    |

# Yasmeen Faroqi Shah

**Biographical Sketch** 

# (i) **Professional Preparation**

| All India Institute of Speech & Hearing, India | Speech & Hearing | B.S., 1995  |
|--|------------------|-------------|
| All India Institute of Speech & Hearing, India | Speech & Hearing | M.S., 1997  |
| Northwestern University                        | Comm. Sc. & Dis. | Ph.D., 2004 |

# (ii) Academic Appointments

University of Maryland

Asst Prof., Hearing & Speech Sciences 2005-

# (iii) Selected Publications

# 5 recent publications related to the current proposal:

- **Faroqi-Shah, Y.** (2007). Are regular and irregular verbs dissociated in nonfluent aphasia? A metaanalysis. *Brain Research Bulletin, 74,* 1-13.
- Faroqi-Shah, Y. & Thompson, C. K. (2007). Verb inflections in agrammatic aphasia: Encoding of tense features, *Journal of Memory and Language*, 56, 129-151.
- Marian, V., Shildkrot, Y., Blumenfeld, H.K., Kaushanskaya, M., **Faroqi-Shah, Y.,** & Hirsch, J. (2007). Cortical activation during word processing in late bilinguals: Similarities and differences as revealed by fMRI. *Journal of Clinical and Experimental Neuropsychology, 29,* 247-265.
- Faroqi-Shah, Y. & Thompson, C. K. (2004) Semantic, lexical, and phonological influences on the production of verb inflections in agrammatic aphasia, *Brain and Language 89, 484-498*.
- Faroqi-Shah, Y. & Thompson, C. K. (2003). Effect of lexical cues on the production of active and passive sentences in Broca's and Wernicke's aphasia. *Brain and Language, 85,* 409-426.

# 5 additional publications:

- Faroqi-Shah, Y. (2007). Cultural Diversity: the Asian Indian Contribution. *Perspectives* [Publication of the American Speech Language and Hearing Association's Division on Issues in Higher Education].
- Thompson, C. K. & Faroqi-Shah, Y. (2002). Models of sentence production. In Hillis, A. E. (ed.) Handbook of adult language disorders: Integrating cognitive neuropsychology, neurology, and rehabilitation (pp. 311-330). Philadelphia: Psychology Press, Taylor and Francis.
- Marian, V., Faroqi-Shah, Y., Sheng, L., Shildkrot, E., & Hirsch, J. (2002). One Brain, Two Languages: Cortical Similarities and Differences in Bilinguals. Proceedings of the American Psychological Association, Division 40. The Clinical Neuropsychologist, 16, p.195.
- Faroqi-Shah, Y. & Thompson, C. K. (2000). Effect of lexical cues on the production of passive sentences in Wernicke's aphasia. Abstract of the presentation at the Annual Meeting of the Academy of Aphasia. Brain & Language, 74, 535-538.
- **Faroqi, Y**. & Chengappa, S. (1998). Trace deletion hypothesis and its implications for intervention with a multilingual agrammatic aphasic patient [Special volume]. Osmania Papers in Linguistics, 23, 79-106.

- Invited member of the Multicultural Issues Board (MIB) of the American Speech-Language and Hearing Association (2008-2010). The MIB recommends and monitors policies related to linguistic and culturally diverse individuals with communication disorders, including bilinguals and English as a second language learners.
- President of the Asian Indian Caucus (AIC), one of the multicultural constituent groups of the American Speech-Language and Hearing Association (2007-2009). One of the future objectives of the AIC is to develop and compile language development norms, language tests and linguistic materials in Indian languages to be used for communication disorders assessment and intervention with speakers of Asian Indian languages residing in the United States. Some of these

activities will be conducted in collaboration with the All India Institute of Speech and Hearing in Mysore, India.

- Mentor for Speech-Language clinicians and students as part of the Maryland Speech-Language and Hearing Association's mentoring program (2005-2006).
- Member of the Maryland Speech-Language Hearing Association's Adult Service Delivery Committee involved in clinical service issues to adults with communication disorders.
- Invited panelist for a webinar on mentoring in the profession of Speech and Hearing, American Speech Language and Hearing Association (August 2006).
- Reviewer for conferences in adult language disorders
- Invited as speaker on topics related to neural plasticity and language rehabilitation:
  - Neural Plasticity in Aphasia Therapy (March 2006). Keynote speaker at the annual convention of the Maryland Speech-Language and Hearing Association
  - Neurobiological correlates of theoretically-driven aphasia therapy (January 2007). Invited talk at the All India Institute of Speech and Hearing, Mysore, India.
- As director of the Aphasia Research Center, research mentor for 29 undergraduate students.

# (v) Collaborators and other Affiliations

#### a. Collaborators in Past 48 months (excluding students):

| Michael Dickey | Northwestern University       |
|----------------|-------------------------------|
| Allen Braun    | National Institutes of Health |
| Arpita Bose    | University of Windsor, Canada |
| Colin Phillips | University of Maryland        |
| David Poeppel  | University of Maryland        |

#### b. Own Graduate Advisors:

| Cynthia K. Thompson | Northwestern University |
|---------------------|-------------------------|
| James Booth         | Northwestern University |
| Viorica Marian      | Northwestern University |

#### c. Graduate Supervision (chair of committee)

Monica Sampson PhD expected in 2009 (Area of study: aphasia and bilingualism)

#### **Norbert Hornstein** Biographical Sketch

# (i) Professional Preparation

| McGill University  | Philosophy | B.A., 1975  |
|--------------------|------------|-------------|
| Harvard University | Philosophy | Ph.D., 1979 |

# (ii) Professional Appointments

| Columbia University    | Assistant Professor, Philosophy  | 1979-1983 |
|------------------------|----------------------------------|-----------|
| University of Maryland | Assistant Professor, Linguistics | 1983-1986 |
| University of Maryland | Associate Professor, Linguistics | 1986-1990 |
| University of Maryland | Professor, Linguistics           | 1990-     |
| University of Maryland | Dept. Chair, Linguistics         | 2003-     |

(iii) Selected Publications (selected from 93 publications):

# 5 Recent publications related to the current proposal:

Hornstein, N. (1999). Movement and Chains. Syntax, 99-127.

- Hornstein, N., Aoun, J. and L. Choueri. (2001). Resumption, Movement and Derivational Economy. *Linguistic Inquiry*, 32, 371-403.
- Hornstein, N. and J. Nunes. (2002). On Asymmetries between Parasitic Gaps and Across-the-Board Constructions. *Syntax*, 5, 26-54.

Hornstein, N. and C. Boeckx. (2004). Movement under Control. *Linguistic Inquiry*, 35, 431-452.

Hornstein, N. and C. Boeckx. (2006). Control in Icelandic and Theories of Control. *Linguistic Inquiry*, 37, 591-606

# 5 Additional recent publications:

- Hornstein, N and D.W. Lightfoot. (1981). *Explanation in Linguistics*. Longman. (Japanese edition 1988).
- Hornstein, N. (1990). As Time Goes By: Tense and Universal Grammar. Bradford Books/MIT Press.

Hornstein, N. (1995). Logical Form: From GB to Minimalism. Blackwell, Oxford.

Hornstein, N. (2001). Move! A Minimalist Theory of Construal. Blackwell, Oxford.

Hornstein, N., Nunes, J. and K. Grohmann. (2006). *Understanding Minimalism*. Cambridge University Press, Cambridge.

- Founded (1998) and Coordinates (1998-to present) the Maryland-Blackwell Lectures in Language and Cognition. Speakers have included David Lightfoot, Noam Chomsky, Morris Halle, Lila Gleitman, Randy Gallistel, Mark Hauser, and Jerry Fodor.
- Co-founded (1992) the annual "Mayfest" at UMCP. This is a yearly spring two-day workshop that brings scholars in the world over to discuss topics of interest to the language and cognition community. The workshop generally includes both tutorials to educate the community as a whole on the accepted wisdom in each sub area and recent novel research that builds on this foundation. Topics have included: "Parameter Setting," "The acquisition of semantics," "Natural Language Parsing," "The empirical and conceptual bases of minimalism."
- Member of the editorial board of *Syntax* and *Linguistic Inquiry*. Reviewer for various presses including Oxford University Press, Cambridge University Press, Blackwell Publishers, MIT Press.

- Generated alumni contributions to fund 5 summer fellowships and two year-long post baccalaureate fellowships to allow students to pursue research in language and cognition. This is intended to allow undergraduates interested in linguistics, cognition and neuroscience to work with UMCP faculty in a collaborative fashion. The program will have a two-year pilot status in 2006-2008, with the intent of making it permanent if successful.
- Associate Director of Neuroscience and Cognitive Science (NACS) Program, 2005-8.
- PI of NSF-funded project "Islands and Linearization", with H. Lasnik & J. Uriagereka, 2007-2010, \$300,000.

# (v) Collaborators

# a. Collaborators in the last 48 months (Graduate students listed in (c) below):

| Cedric Boeckx   | Harvard University               |
|-----------------|----------------------------------|
| Howard Lasnik   | University of Maryland           |
| Andrew Nevins   | Harvard University               |
| Jairo Nunes     | Universidade de Campinas, Brazil |
| Paul Pietroski  | University of Maryland           |
| Juan Uriagereka | University of Maryland           |

# b. Own thesis advisor:

Hilary Putnam Harvard University

c. Graduate Supervision ; total = 31 supervised; 17 supervised as chair of committee:

| PhD (1993). Associate Professor, Michigan State University        |
|---|
| PhD (1994). Associate Professor, University of Rhodes, Greece     |
| PhD (1996). Lecturer, University of Maryland University College   |
| PhD (1999). Associate Professor, Yokohama City University, Japan  |
| PhD (2000). Assistant Professor, University of Cyprus             |
| PhD (2001). Assistant Professor, University of Michigan           |
| PhD (2004). Assistant Professor, Kyoto University                 |
| PhD (2004). Postdoc, Federal University, Brasilia                 |
| PhD (2005). Research Scientist, University of Maryland, Languages |
| PhD (2005). Assistant Professor, Pusan National University        |
| PhD expected 2008   |
| PhD expected 2009   |
| PhD expected 2012   |
|   |

### William J. Idsardi Biographical Sketch

### (i) **Professional Preparation**

| University of Toronto | Mathematical Linguistics | BA (Hons, w/ distinction), 1988 |
|-----------------------|--------------------------|---------------------------------|
| MIT                   | Linguistics              | PhD, 1992                       |

# (ii) Academic Appointments

| Linguistics             | Associate   |
|-------------------------|---|
| Languages, Lit. & Ling. | Fulbright D   |
| Linguistics             | Chair, 2002   |
| Linguistics             | Acting Cha  |
| Linguistics             | Visiting As   |
| Linguistics             | Associate   |
| Linguistics             | Assistant F   |
|                         | Linguistics<br>Languages, Lit. & Ling.<br>Linguistics<br>Linguistics<br>Linguistics<br>Linguistics<br>Linguistics |

Associate Professor, 2005-present Fulbright Distinguished Chair, 2006 Chair, 2002-2005 Acting Chair, 2000-2002 Visiting Associate Professor, 1999 Associate Professor, 1998-2005 Assistant Professor, 1992-1998

(iii) Selected Publications (selected from 45 publications)

# 5 recent publications related to the current proposal:

- Poeppel, D., **Idsardi, W**., & van Wassenhove, V. (2007, in press). Speech perception at the interface of neurobiology and linguistics. *Proceedings of the Royal Society of London*.
- Kabak, B. & Idsardi, W.J. (2007) Speech perception is not isomorphic to phonology: The case of perceptual epenthesis. *Language and Speech* 50: 23-52.
- Kazanina, N., Phillips, C. & Idsardi, W.J. (2006) The influence of meaning on the perception of speech sounds. *Proceedings of the National Academy of Sciences*, 103: 11381-11386.
- **Idsardi, W.J.** (2006). A simple proof that Optimality Theory is computationally intractable. *Linguistic Inquiry* 37: 271-275.
- Baker, S.A., **Idsardi, W.J**., Golinkoff, R.M. & Petitto, L. (2005) The perception of handshapes in American Sign Language. *Memory & Cognition*, 33: 887-904

# 5 additional recent publications:

- **Idsardi, W.J**. (2007, in press). Calculating metrical structure. In C. Cairns & E. Raimy (Eds.) *Contemporary Views on Architecture and Representations in Phonological Theory*, Cambridge: MIT Press.
- Idsardi, W.J. (2006). Canadian Raising, opacity and rephonemicization. *The Canadian Journal of Linguistics* 51: 119-126.
- Avery, P. & Idsardi, W.J. (2001). Laryngeal dimensions, completion and enhancement. In T.A. Hall & U. Kleinhenz (eds) *Studies in Distinctive Feature Theory.* Berlin: Mouton de Gruyter, pp. 41-70.
- Purnell, T.C., **Idsardi, W.J**. & Baugh, J. (1999). Perceptual and phonetic experiments on American English dialect identification. *Journal of Language and Social Psychology*, *18*, 10-30.
- Idsardi, W.J. (2000). Clarifying opacity. The Linguistic Review, 17: 337-350.

- Co-teach the core course in Cognitive Science for the interdisciplinary Neuroscience & Cognitive Science Program, joint with Rochelle Newman (Hearing & Speech Sci.)
- Dissertation committee member for graduate students throughout the indepartmental speech and hearing community at Maryland, including students in Neuroscience & Cognitive Science, and students in Electrical and Computer Engineering.
- Fulbright awards in 1999 and 2006

- Co-Editor: Oxford University Press monograph series Oxford Surveys in Phonology and Phonetics; Associate Editor: Phonology; Editorial Boards: Linguistic Inquiry, Korean Linguistics, Journal of Linguistics.
- Member of NSF Linguistics Panel, 2003-2006.
- Program committee: Linguistic Society of America 2001-2004; Program Committee Chair, 2003-2004.

# (v) Collaborators and other Affiliations

# a. Collaborators in Past 48 months (graduate students are listed in (c) below)

| Peter Avery       | York University                             |
|-------------------|---|
| Carol Espy-Wilson | University of Maryland                      |
| Roberta Golinkoff | University of Delaware                      |
| Nina Kazanina     | University of Bristol, UK                   |
| Jeffrey Lidz      | University of Maryland                      |
| Colin Phillips    | University of Maryland                      |
| Laura-Ann Petitto | Dartmouth College                           |
| David Poeppel     | University of Maryland                      |
| Jerzy Rubach      | University of Iowa and University of Warsaw |
| Bert Vaux         | University of Cambridge                     |
| Matthew Winn      | University of Maryland                      |
|                   |   |

# b. Own Graduate Advisor

Morris Halle Massachusetts Institute of Technology

# c. Graduate Theses Supervision

PhD Supervision (\*indicates co-advisor); total = 17:

| Yap, Ngeethai       | PhD, U. of Delaware, (2006) Assist. Prof., Universiti Putra Malaysia, Malaysia |
|---------------------|--|
| Son, Sun-Ah         | PhD, U. of Delaware, (2005) Lecturer, Chung-Ang University, Korea.             |
| Sung, Eun-Kyung*    | PhD, U. of Delaware. (2003) Researcher, Seoul National University, Korea.      |
| Kabak, Baris        | PhD, U. of Delaware. (2003) Juniorprofessor, University of Konstanz.           |
| Chang, Woohyeok     | PhD, U. of Delaware. (2003) Assist. Professor, Dankook University, Korea.      |
| Imsri, Patcharee    | PhD, U. of Delaware. (2003) Assist. Professor, Walailak University, Thailand.  |
| Baker, Stephanie*   | PhD, U. of Delaware. (2002) Post-doc, University of British Columbia           |
| Raimy, Eric         | PhD, U. of Delaware. (1999) Asst. Professor, U. of Wisconsin-Madison           |
| Kim, Sun-Hoi        | PhD, U. of Delaware. (1999) Asst. Professor, Chung-Ang University, Korea.      |
| Purnell, Thomas     | PhD, U. of Delaware. (1997) Asst. Professor, U. of Wisconsin- Madison.         |
| Zhang, Guangsheng*  | PhD, U. of Delaware. (1996)  |
| Durvasula, Karthik* | PhD expected 2008, U. of Delaware, Linguistics.                                |
| Monahan, Philip*    | PhD expected 2009, U. of Maryland, Linguistics                                 |
| Cogan, Gregory*     | PhD expected 2011, U. of Maryland, Neuroscience & Cognitive Science            |
| Rhone, Ariane*      | PhD expected 2011, U. of Maryland, Linguistics.                                |
| Riley, Joshua*      | PhD expected 2011, U. of Maryland, Linguistics.                                |

# **Gregory K. Iverson** Biographical Sketch

# (i) **Professional Preparation**

| Concordia College, Moorhead | Political Science, German | B.A., 1968  |
|-----------------------------|---------------------------|-------------|
| Rice University             | Germanics                 | M.A., 1970  |
| University of Minnesota     | Linguistics, Scandinavian | Ph.D., 1974 |

### (ii) **Professional Appointments**

| University of Minnesota | Linguistics      | Instructor/Asst Prof | 1974-1975 |
|-------------------------|------------------|----------------------|-----------|
| U Wisconsin-Milwaukee   | Linguistics      | Assistant Professor  | 1976-1978 |
| University of Iowa      | Linguistics      | Assistant Professor  | 1978-1979 |
| University of Iowa      | Linguistics      | Associate Professor  | 1979-1990 |
| U Wisconsin-Milwaukee   | Linguistics      | Associate Professor  | 1990-1991 |
| U Wisconsin–Milwaukee   | Linguistics      | Professor            | 1991-2007 |
| University of Maryland  | Linguistics/CASL | Research Professor   | 2007-     |

(iii) Selected Publications (selected from 126 publications):

### **5** recent publications related to the current proposal:

- **Iverson, Gregory K.** & Joseph C. Salmons. (2007). Domains and Directionality in the Evolution of German Final Fortition. *Phonology*, 24,1-25.
- **Iverson, Gregory K.** & Ahrong Lee. (2006). Perception of Contrast in Korean Loanword Adaptation. *Korean Linguistics*, 13, 49-87.
- Iverson, Gregory K. & Joseph C. Salmons. (2006). On the Typology of Final Laryngeal Neutralization: Evolutionary Phonology and Laryngeal Realism. *Theoretical Linguistics*, 32, 205-216.
- Iverson, Gregory K. (2005). The Principling Role of Korean in Phonological Adaptation. The 30<sup>th</sup> Anniversary Publication of the International Circle of Korean Linguistics, ed. by Sang-Oak Lee. Seoul: Pagijong Press, pp. 141-159.
- Ahn, Sang-Cheol & **Gregory K. Iverson**. (2004). Dimensions in Korean Laryngeal Phonology. *Journal of East Asian Linguistics*, 13, 345-379.

# 5 Additional recent publications:

- **Iverson, Gregory K.** & Sang-Cheol Ahn. (2007). English Voicing in Dimensional Theory. *Language Sciences*, 29, 247-269.
- **Iverson, Gregory K.** & Joseph C. Salmons. (2006). Fundamental Regularities in the Second Consonant Shift. *Journal of Germanic Linguistics*, 18, 45-71.
- **Iverson, Gregory K.** & Joseph C. Salmons. (2006). Filling the Gap: English Tense Vowel plus Final /j/. *Journal of English Linguistics*, 33, 1-15.
- **Iverson, Gregory K.** & Joseph C. Salmons. (2004). The Conundrum of Old Norse Umlaut: Sound Change versus Crisis Analogy. *Journal of Germanic Linguistics*, 16, 77-110.
- **Iverson, Gregory K.** (2004). Deriving the Derived Environment Constraint in Non-Derivational Phonology. *Studies in Phonetics, Phonology and Morphology*, 11, 1-23.

#### (iv) Synergistic Activities

• Editorial advisory board member of: *Phonology, Journal of English Linguistics, Journal of Germanic Linguistics, Korean Linguistics, Korean Journal of English Linguistics, Language Research, Journal of Linguistic Science, Studies in Phonetics, Phonology, and Morphology, Stanford Encyclopedia of Korean Linguistics, Journal of UAE Studies.* 

- Referee/reviewer for: Diachronica, Language, Linguistics, Journal of Linguistics, Studies in Second Language Research, Language Learning, NSF, NEH, numerous presses.
- Developed Integrated Linguistics Track M.A. Program between Ajou University, Suwon, Korea and University of Wisconsin–Milwaukee (trained and supported 30+ Korean students in past 5 years).
- Primary Collaborator with Fred Eckman (PI), NIH RO1 Research Grant ("Markedness and Learnability in Second Language Phonology"), \$1,390,654, 2006-11.
- Co-Investigator with Soyoung Lee (PI), University of Wisconsin–Milwaukee Research Growth Initiative Award ("Speech Production of English-Korean Bilingual Children"), \$115,729, 2006-07.
- Co-Investigator with Joseph Salmons (PI) and Thomas Purnell, Joan Hall, Luanne von Schneidemesser, UW–Madison, and Erica Benson, UW–Eau Claire, Wisconsin Humanities Council Follow-On Grant ("Wisconsin Englishes"), \$10,000, 2006-07.

# (v) Collaborators

# a. Collaborators in Past 48 months (excluding students)

| Robert Fox                | The Ohio State University                                |
|---------------------------|--|
| Ewa Jacewicz              | The Ohio State University                                |
| Fred R. Eckman            | University of Wisconsin–Milwaukee                        |
| Soyoung Lee               | University of Wisconsin–Milwaukee                        |
| Joseph C. Salmons         | University of Wisconsin–Madison                          |
| Thomas Purnell            | University of Wisconsin–Madison                          |
| Joan Hall                 | University of Wisconsin–Madison                          |
| Luanne von Schneidemesser | University of Wisconsin–Madison                          |
| Sang-Cheol Ahn            | Kyungee University, Seoul, Korea                         |
| Hae-Jeong Park            | Yonsei University, Seoul, Korea                          |
| Sang-Oak Lee              | Seoul National University, Seoul, Korea                  |
| Abdulla El Reyes          | Center for Documentation and Research,<br>Abu Dhabi, UAE |

# b. Own Graduate Advisors

| M.A.:  | James Copeland | Rice University         |
|--------|----------------|-------------------------|
| Ph.D.: | Gerald Sanders | University of Minnesota |

# c. Graduate Advisees (current)

- M.A.: Kyoung Ea Han, Songhee Lee, Sooyeon Lee, Haiyun Lu, Andrew Olson, John Olstad, Ryoko Osada, Ayumi Sawada, Moonyoung Son
- Ph.D.: Younghyon Heo, Emiko Kaneko, Ahrong Lee, Haeil Park

# d. Graduate Advisees (past 48 months)

- M.A.: Anastasia Kasprzyk, Sueyon Seo, Hyowon Song, Yeonsoo Kim, Eunsil Bae, Corrine Occhino, Matthew Boeke, Suyong Yi, Myunghee Kang, Kookhee Yang, Young Joo Yang, Jimi Kim, Byron Thigpen, Eiko Ishioka, Kasumi Kato, Min Sook Kim, Bouchra Kmihi, Jung-Eun Lee, Eun-Sun Park, Ji-Yeon Lee, Ho-Yeon Ihm, Eun-Hee Lee, Byung-Geun Kim, Mose Kim, Gi-Young Kim, Ju-Sung Kim, Young-Hyon Heo, Ahrong Lee, Eun-Ju Ma, Veronica Lundbäck, Rosemarie Rogers
- Ph.D. Committees: Min Sook Kim (English-Linguistics), Deborah Mulvaney (English-Linguistics), Hyowon Song (English-Linguistics), Beatte Damm (English-Linguistics), Wendy Halstead (English-Linguistics), Jeffrey Cooley (Psychology), Peter Lenz (Psychology), Eun-Kyung Sung (Linguistics-U. Delaware), Kyung-Ah Chung (Linguistics-U. Wisconsin-Madison)

# Howard Lasnik

# **Biographical Sketch**

# (i) Professional Preparation

| Carnegie Institute of Technology | Mathematics and English | B.S., 1967  |
|----------------------------------|-------------------------|-------------|
| Harvard University               | English                 | M.A., 1969  |
| MIT                              | Linguistics             | Ph.D., 1972 |

# (ii) Professional Appointments

| University of Connecticut | Linguistics | Assistant Professor, 1972-1976            |
|---------------------------|-------------|---|
| University of Connecticut | Linguistics | Associate Professor, 1976-1981            |
| University of Connecticut | Linguistics | Professor, 1981-2000                      |
| University of Connecticut | Linguistics | Distinguished Professor, 2000-2002        |
| University of Maryland    | Linguistics | Professor, 2002-2003                      |
| University of Maryland    | Linguistics | Distinguished University Professor, 2003- |

(iii) Selected Publications (selected from 123 publications):

# 5 recent publications related to the current proposal:

- Fox, D. and **H. Lasnik**. 2003. Successive cyclic movement and island repair: The difference between Sluicing and VP Ellipsis. *Linguistic Inquiry* 34:143-154.
- Boskovic, Z. and **H. Lasnik**. 2003. On the distribution of null complementizers. *Linguistic Inquiry* 34:527-546.
- Lasnik, H. 2005. Grammar, levels, and biology. In J. McGilvray (ed.) *The Cambridge Companion to Chomsky*. Cambridge University Press, pp. 60-83.
- Lasnik, H. 2006. Conceptions of the Cycle. In L. Cheng and N. Corver (eds.) *Wh-Movement: Moving On*. MIT Press, pp. 197-216.
- Hornstein, N., **H. Lasnik** and J. Uriagereka. 2007. The dynamics of islands: Speculations on the locality of movement. *Linguistic Analysis* 33:149-175.

# **5** Additional publications:

Lasnik, H. 1990. Essays on Restrictiveness and Learnability. Kluwer Academic Publishers.

- Lasnik, H. 2001. Derivation and representation in modern transformational syntax. In M. Baltin and C. Collins (eds.) *Handbook of Syntactic Theory*. Blackwell, pp. 62-88.
- Lasnik, H. 2002. The Minimalist Program in syntax. Trends in Cognitive Sciences 6:432-437.
- Lasnik, H. 2003. Minimalist Investigations in Linguistic Theory. Routledge Ltd.
- Lasnik, H. and J. Uriagereka. 2005. A Course in Minimalist Syntax: Foundations and Prospects. Blackwell.

- Reviewer for many journals in linguistics and cognitive science, and for proposals to granting agencies in these areas.
- Editorial board member: Languages and Linguistics, Journal of Generative Grammar, Language Acquisition, Linguistic Inquiry, Syntax, English Linguistics, Biolinguistics.
- On editorial board of the book series Studies in Theoretical Psycholinguistics, Studies in Natural Language and Linguistic Theory, Lincom Studies in Theoretical Linguistics.
- Author or co-author of 3 textbooks in syntactic theory; author of 15 encyclopedia and handbook entries making syntactic theory and/or specific portions of syntactic theory accessible to a broader audience, especially cognitive scientists.
- Major on camera and advisory role in the 3-hour PBS series *The Human Language*.

• NSF grant (with Norbert Hornstein and Juan Uriagereka) "Islands and Linearization" (a theoretical and cross-linguistic study of locality constraints on syntactic movement), 2007-2010, \$300,000.

# (v) Collaborators

# a. Collaborators in the last 48 months (Graduate students listed in (c) below)

| Harvard University           |
|------------------------------|
| University of Connecticut    |
| MIT                          |
| Princeton University         |
| University of North Carolina |
| University of Maryland       |
| UCLA                         |
| University of Maryland       |
| Dongguk University           |
| University of Maryland       |
|                              |

#### b. Own thesis advisor

Ilknur Oded

Alex Drummond

Noam Chomsky Massachusetts Institute of Technology

> PhD expected 2011 PhD expected 2012

# c. Graduate Supervision; total = 54:

| Sandra Stjepanovic | PhD, U of Connecticut (1999): Associate Professor, West Virginia University  |
|--------------------|--|
| Masao Ochi         | PhD, U of Connecticut (1999): Osaka University                               |
| Satoshi Oku        | PhD, U of Connecticut (1999): Hokkaido University                            |
| Marcela Depiante   | PhD, U of Connecticut (2000): U. Nacional del Comahue                        |
| Asako Uchibori     | PhD, U of Connecticut (2000): Nihon University                               |
| Adolfo Ausín       | PhD, U of Connecticut (2001): Assistant Professor, Michigan State University |
| Arthur Stepanov    | PhD, U of Connecticut (2002): Universität Potsdam                            |
| Sasa Vukic         | PhD, U of Connecticut (2003): U. Nacional del Comahue                        |
| Mariana Lambova    | PhD, U of Connecticut (2004): Assistant Professor, Central Conn. State U.    |
| Masashi Nomura     | PhD, U of Connecticut (2005): Chukyo University                              |
| Bum-Sik Park       | PhD, U of Connecticut (2005): Dongguk University                             |
| Lydia Grebenyova   | PhD, U of Maryland (2006): Assistant Professor, Baylor University            |
| Hajime Ono         | PhD, U of Maryland (2006): Postdoc, Hiroshima University                     |
| Tomohiro Fujii     | PhD, U of Maryland (2006): Postdoc, Nanzan University                        |
| Jon Sprouse        | PhD, U of Maryland (2007): Assistant Professor, UC Irvine                    |
| Chizuru Nakao      | PhD expected 2009  |
| Atakan Ince        | PhD expected 2010  |
| Shiti Malhotra     | PhD expected 2010  |
| Maki Kishida       | PhD expected 2011  |
| Ilknur Odod        | PhD expected 2011  |

# Jeffrey Lidz **Biographical Sketch**

### (i) **Professional Preparation**

| Northwestern University                      | Journalism        | B.S. 1990          |
|--|-------------------|--------------------|
| University of Delaware                       | Linguistics       | M.A. 1992          |
| University of Delaware                       | Linguistics       | Ph.D. 1996         |
| University of Pennsylvania                   | Psych/Linguistics | Postdoc, 1997-2000 |
| Centre National de la Recherche Scientifique | Psycholinguistics | Postdoc, 1999      |
| University of Pennsylvania                   | Psych/Linguistics | Postdoc1999-2000   |

#### (ii) Appointments

University of Maryland Centre National de la Recherche Scientifique. Northwestern University

Cognitive Science Linguistics

Linguistics/NACS Associate Professor, 2005-present Poste Rouge, 2004. Assistant Professor, 2000-05

(iii) Publications (selected from 55 publications)

5 Publications most closely related to current proposal:

- Han, C.H., J. Lidz, and J. Musolino. (2007) Verb-movement and Grammar Competition in Korean: Evidence from Quantification and Negation. Linguistic Inquiry 38-1-47.
- Lidz, J. (2006). The Grammar of Accusative Case in Kannada. Language 82:1-23.
- Lidz, J., S. Waxman and J. Freedman (2003) What Infants Know about Syntax but Couldn't Have Learned: Experimental Evidence for Syntactic Structure at 18-months. Cognition 89:B65-B73.
- Lidz, J., H. Gleitman and L. Gleitman (2003) Understanding How Input Matters: The Footprint of Universal Grammar on Verb Learning. Cognition 87:151-178.
- Lidz, J. and J. Musolino (2002). Children's command of quantification. Cognition 84:113-154.

5 Selected Additional Publications:

- Halberda, J., L. Taing, and J. Lidz (in press) The age of onset of "most" comprehension and its potential dependence on counting ability. Language Learning and Development.
- Lidz, J. (2007). The Abstract Nature of Syntactic Representations: Consequences for a Theory of Learning. in E. Hoff and M. Shatz (eds.) Handbook of Child Language. Blackwell.
- Lidz, J. and J. Musolino (2006). On the Quantificational Status of Indefinites: The View from Child Language. Language Acquisition.
- Waxman, S. and J. Lidz. (2006) Early Word Learning. in D. Kuhn and R. Siegler (eds.) Handbook of Child Psychology: Cognition, Perception and Language.Wiley:Hoboken, NJ.
- Lidz, J. and L. Gleitman (2004). Argument Structure and the Child's Contribution to Language Learning. Trends in Cognitive Science 8(4):157-161.

- Co-director, University of Maryland Infant Studies Consortium. 2005-. Collaborative effort between the departments of Linguistics, Psychology, and Speech and Hearing Sciences, towards the recruitment of infants to participate in experiments in cognitive and linguistic development. The consortium also publishes an annual newsletter, directed towards parents and nonacademic readers, that reports on its scientific acitivities.
- Extensive Fieldwork on Kannada from 1994 to the present. In affiliation with the Central Institute of Indian Languages, Mysore, India.
- Reviewer for 30+ journals, funding agencies, and publishers in linguistics and psychology. Editorial Board, Journal of South Asian Linguistics; Consulting Editor, Child Development; Brief Articles editor, Language Acquisition.
- Mentor, Eleanor Roosevelt High School Science and Technology Program, 2007-08. Working with two high school students on research projects in developmental linguistics.

• Panel Discussant. "The Acquisition of Language," *Odyssey: A Daily Talk Show of Ideas*. National Public Radio. December 19, 2001.

# (v) Collaborators and Other Affiliations

# a. Collaborators within the last 48 months

| Anne Christophe     | CNRS, Paris                      |
|---------------------|----------------------------------|
| Henry Gleitman      | University of Pennsylvania       |
| Lila Gleitman       | University of Pennsylvania       |
| Justin Halberda     | Johns Hopkins University         |
| Chung-hye Han       | Simon Fraser University          |
| William Idsardi     | University of Maryland           |
| Christopher Kennedy | University of Chicago            |
| Jessica Maye        | Northwestern University          |
| Julien Musolino     | Rutgers University               |
| Lisa Pearl          | University of California, Irvine |
| Colin Phillips      | University of Maryland           |
| Janet Pierrehumbert | Northwestern University          |
| Paul Pietroski      | University of Maryland           |
| Sandra Waxman       | Northwestern University          |
| Alexander Williams  | University of Maryland           |
|                     |                                  |

# b. Own Graduate and Postdoctoral Advisors

| Peter Cole      | University of Delaware  |
|-----------------|---|
| Lila Gleitman   | University of Pennsylvania  |
| Henry Gleitman  | University of Pennsylvania  |
| Emmanuel Dupoux | Laboratoire de Sciences Cognitives et Psycholinguistique, CNRS, Paris |

### c. Graduate Theses and Postdoc Supervision

Graduate Supervision (\*indicates co-advisor), total = 12:

| Steven Fix*     | PhD, Northwestern Univ. 2006. Postdoc, Northwestern Univ.                       |
|-----------------|---|
| Erin Leddon     | PhD, Northwestern Univ. 2006. Postdoc, Northwestern Univ.                       |
| Ann Bunger      | PhD, Northwestern Univ. 2006. Postdoc, Univ. of Pennsylvania                    |
| Jessica Hicks   | PhD, Northwestern Univ. 2006. Computational Linguist, Versay Speech Solutions   |
| Utako Minai     | PhD, Univ. of Maryland. 2006. Research Scientist, RIKEN Brain Institute, Tokyo. |
| Kristen Syrett  | PhD, Northwestern Univ. 2007. Postdoc, Rutgers Univ.                            |
| Joshua Viau     | PhD, Northwestern Univ. 2007. Postdoc, Johns Hopkins Univ.                      |
| Elisa Sneed     | PhD, Northwestern Univ. 2007. ESL Coordinator, Northwestern Univ.               |
| Chunyuan Jing   | PhD expected 2008, Univ. of Maryland: language acquisition                      |
| Stacey Conroy   | PhD expected 2009, Univ. of Maryland: language acquisition, psycholinguistics   |
| Eri Takahashi   | PhD expected 2009, Univ. of Maryland: language acquisition                      |
| Annie Gagliardi | PhD expected 2012, Univ. of Maryland: language acquisition, morphosyntax        |

# Michael H. Long Biographical Sketch

#### (i) **Professional Preparation**

University of Birmingham<br/>University of LondonLawLL.B. (honors), 1966<br/>P.G.C.E., 1970University of Essex<br/>UCLALinguisticsM.A. (distinction), 1974<br/>Ph.D., 1980(ii) AppointmentsKarlow

| University of Maryland     | Second Language Acquisition, Professor & Chai | r 2003-present |
|----------------------------|---|----------------|
| University of Hawai'i      | Second Language Acquisition, Professor,       | 1990-2003      |
| University of Hawai'i      | Second Language Acquisition, Assoc. Professor | 1985-1990      |
| University of Hawai'i      | Second Language Acquisition, Asst Professor   | 1982-1985      |
| University of Pennsylvania | Educational Linguistics, Asst Professor       | 1980-1982      |

(iii) Publications (selected from over 100)

# Five publications most closely related to the current proposal:

- Long, M. H. (1990). Maturational constraints on language development. *Studies in Second Language Acquisition* 12, 251-85.
- Long, M. H. (1993). Second language acquisition as a function of age: substantive findings and methodological issues. In Hyltenstam, K., & Viberg, V. (eds.), *Progression and regression in language* (pp. 196-221). Cambridge: Cambridge University Press.
- Long, M. H. (2003). Stabilization and fossilization in interlanguage development. In Doughty, C. J., & Long, M. H. (eds.), *Handbook of second language acquisition* (pp. 487-535). Oxford: Blackwell.
- Long, M. H. (2005). Problems with supposed counter-evidence to the Critical Period Hypothesis. International Review of Applied Linguistics, 43, 287-317.
- Long, M. H. (2007). Age differences and the sensitive periods controversy in SLA. In Long, M. H. (ed.), *Problems in SLA* (pp. 43-74). Mahwah, NJ: Lawrence Erlbaum Associates.

# Five additional recent publications:

- Doughty, C. J., & Long, M. H. (eds.) (2003). *Handbook of second language acquisition*. Oxford: Blackwell.
- Lee, Y-G., Kim, H-S. H., Kong, D-K., Hong, J-M., & Long, M. H. (2005). Variation in the linguistic profiles of advanced English-speaking learners of Korean. *Language Research*, *41*, 437-56.
- Long, M. H. (2005). Methodological issues in learner needs analysis. In Long, M. H. (ed.), Second language needs analysis. Cambridge: Cambridge University Press. (pp. 19-76)
- Kanno, K., Hasegawa, T., Ikeda, K., Ito, Y., & Long, M. H. (in press). Relationships between prior language-learning experience and variation in the linguistic profiles of advanced English-speaking learners of Japanese. In Brinton, D., & Kagan, O. (eds.), *Heritage Language: A New Field Emerging*. Mahwah, NJ: Lawrence Erlbaum.
- Long, M. H. (to appear). Second language acquisition. In Hogan, P.C. (ed.), *The Cambridge Encyclopedia of the Language Sciences*. Cambridge: Cambridge University Press.

- Founding member/designer and later chair of U. of Hawai'i Ph.D. program in Second Language Acquisition, recognized in three surveys between 1996 and 2002 as the world's leading SLA program (surveys organized by committee of chairs of SLA programs).
- Designer of new Second Language Acquisition PhD program at the U. of Maryland.

- Designer and original PI for three National Flagship Language programs, in Korean (at U of Hawaii) and Arabic and Persian (at U of Maryland). DoD (NSEP)-sponsored Flagship programs take leadership roles nationally for innovative curriculum design and teaching in the languages concerned, especially at advanced proficiency levels. PI for federally-sponsored research on the acquisition of advanced L2 abilities in four less commonly taught languages: Arabic, Korean, Persian (Farsi), and Russian.
- Co-editor, Cambridge Applied Linguistics Series. Cambridge University Press. 1983-present. Editorial Boards of several journals over past two decades, including TESOL Quarterly, JACET Bulletin, Porta Linguarium, Language Teaching Research, Estudios de Linguistica Aplicada, Revista Nebrija de Lingüística Aplicada a la Enseñanza de Lenguas, and Studies in Second Language Acquisition (1985-present). Regular reviewer for the past two decades for some 20 journals and funding agencies in the USA and overseas
- Plenary speaker at over 50 national and international conferences, and co-chair or organizer of three conferences (Second Language Research Forum in 1978 and 1988, and Pacific Second Language Research Forum in 1998)

# (v) Collaborators and other affiliations

### a. Collaborators in past 48 months

| University of Hawai'i               |
|-------------------------------------|
| University of Maryland              |
| Regional Language Center, Singapore |
| Aoyama Gakuin University, Tokyo     |
| University of Hawai'i               |
| University of Hawai'i               |
| University of Maryland              |
|                                     |

#### b. Own graduate and postdoctoral advisor

Evelyn Hatch (Emeritus, UCLA)

#### c. Graduate and Postdoctoral Supervision

Graduate Supervision; (total advisees = 40+):

| Seoul |
|-------|
| zona  |
|       |
|       |

#### **Rochelle Newman** Biographical Sketch

# (i) **Professional Preparation**

| Northwestern University | Communication Sci. & Dis. | BSS (BS in Speech, honors), 1991 |
|-------------------------|---------------------------|----------------------------------|
| SUNY at Buffalo         | Psychology                | M.A., 1995                       |
| SUNY at Buffalo         | Psychology                | Ph.D., 1997                      |

# (ii) Academic Appointments

| University of Maryland | Hearing & Speech Sciences | Associate Professor, 2007-present  |
|------------------------|---------------------------|------------------------------------|
| University of Maryland | Ctr. Adv. Study Language  | Research Asst. Prof., 2005-present |
| University of Maryland | Hearing & Speech Sciences | Assistant Professor, 2001-2007     |
| University of Iowa     | Psychology                | Assistant Professor, 1997-2001     |

(iii) Selected Publications (selected from 29 publications)

# 5 recent publications related to the current proposal:

- **Newman, R. S**. & German, D. J. (2002). Effects of lexical factors on word naming among normallearning children and children with word-finding disorders. *Language and Speech*, *43*(3), 285-317.
- **Newman, R. S.** (2003). Using links between speech perception and speech production to evaluate different acoustic metrics: A preliminary report. *The Journal of the Acoustical Society of America*, *113*(5), 2850-2860.
- **Newman, R. S.** (2005). The cocktail party effect in infants revisited: Listening to one's name in noise. *Developmental Psychology*, *41*(2), 352-362.
- Newman, R. S., Bernstein Ratner, N., Jusczyk, A. M., Jusczyk, P. W., & Dow, K. A. (2006). Infants' early ability to segment the conversational speech signal predicts later language development: a retrospective analysis. *Developmental Psychology*, 42(4), 643-655.
- Newman, R. S. (2006). Perceptual restoration in toddlers. Perception & Psychophysics, 68, 625-642.

# 5 additional recent publications:

- Hollich, G., **Newman, R. S.,** & Jusczyk, P. W. (2005). Infants' use of synchronized visual information to separate streams of speech. *Child Development*, *76*(3), 598-613.
- Newman, R. S., Sawusch, J. R., & Luce, P. A. (2005). Do post-onset segments define a lexical neighborhood? *Memory & Cognition*, 33(6), 941-960.
- Newman, R. S. & Hussain, I. (2006). Changes in infant preference for motherese across ages and listening environments. *Infancy*, *10*(1), 61-76.
- **Newman, R. S.** & Bernstein Ratner, N. (2007). The role of selected lexical factors on confrontation naming accuracy, speed and fluency in adults who do and do not stutter. To appear in *Journal of Speech, Language, and Hearing Research, 50*, 196-213.
- German, D. J. & **Newman, R. S.** (2007, in press). Oral reading skills of children with oral language (word finding) difficulties. To appear in *Reading Psychology*, 28(5).

- Associate editor for the *Journal of the Acoustical Society of America*, the leading journal on the general topic of sound, covering the entire range from physical acoustics, neural representations of sound, phonetic structure/speech perception, and human communication.
- Reviewer for 20 different journals and funding agencies in the past 5 years;
- Research mentor for over 75 undergraduate students (currently 15 per semester) through a variety of research experience programs and mentor for high school interns from local science magnet school

- Regular mentor for 3 different programs designed specifically to broaden the participation of groups underrepresented in science.
- Development of infant participant database used by a variety of researchers, and Co-director, University of Maryland Infant Studies Consortium, which includes researchers from three departments and two colleges (all involved in this IGERT proposal)

# (v) Collaborators and other Affiliations

a. Collaborators in Past 48 months (graduate students and postdocs are listed in (c) below)

| Anthony Boemio       | National Institutes of Health    |
|----------------------|----------------------------------|
| Kathryn Dow          | University of Maryland           |
| Diane German         | National-Louis University        |
| David Gow            | Massachusetts General Hospital   |
| Prahlad Gupta        | University of Iowa               |
| George Hollich       | Purdue University                |
| Ann Marie Jusczyk    | Johns Hopkins University         |
| Peter Jusczyk        | late of Johns Hopkins University |
| Nina Kazanina        | University of Bristol, UK        |
| Paul Luce            | SUNY at Buffalo                  |
| Nan Bernstein Ratner | University of Maryland           |
| Shannon Ross-Sheehy  | University of Iowa               |
| Froma Roth           | University of Maryland           |
| Larissa Samuelson    | University of Iowa               |
| Jim Sawusch          | SUNY at Buffalo                  |
| Ruth Tincoff         | Harvard University               |
| Bruce Tomblin        | University of Iowa               |
| Jane Tsay            | National Chung Cheng University  |
| Amanda Woodward      | University of Maryland           |
| Grace Yeni-Komshian  | University of Maryland           |

# b. Own Graduate Advisors

| Jim Sawusch (primary) | SUNY at Buffalo                  |
|-----------------------|----------------------------------|
| Peter Jusczyk         | late of Johns Hopkins University |
| Paul Luce             | SUNY at Buffalo                  |

# c. Graduate Thesis Supervision

| Brittan Barker     | MA, University of Iowa (1999), Asst Prof, Louisiana State Univ. |
|--------------------|---|
| Andrea Krecmar     | MA, 2006, University of Maryland                                |
| Lisa Loder         | MA 2006, University of Maryland                                 |
| Stephanie Weinberg | MA 2007, University of Maryland                                 |
| Peitzu Tsai        | MA 2007, University of Maryland                                 |
| Sofia Vallila      | MA expected, 2008, Georgetown University                        |
| Emily Singer       | MA expected 2008, University of Maryland                        |
| Sarah Haszko       | MA expected 2009, University of Maryland                        |
| Sarah Stimley      | MA expected 2009, University of Maryland                        |
| Elizabeth Blayney  | MA expected 2009, University of Maryland                        |
| Audry Singh        | MA expected 2009, University of Maryland                        |
| Sarah Michael      | MA expected 2009, University of Maryland                        |
| Jillian Parry      | MA expected 2009, University of Maryland                        |
| Jessica Bauman     | MA expected 2009, University of Maryland                        |

#### **Colin Phillips** Biographical Sketch

# (i) **Professional Preparation**

| Oxford University | Modern Languages                     | BA (Hons, 1 <sup>st</sup> class), 1990 |
|-------------------|--------------------------------------|--|
| MIT               | Linguistics                          | PhD, 1996                              |
| MIT               | Cognitive Neuroscience Postdoc, 1996 |  |

# (ii) Academic Appointments

| University of Maryland | Linguistics & NACS | Associate Professor, 2002-present |
|------------------------|--------------------|-----------------------------------|
| University of Maryland | Linguistics & NACS | Assistant Professor, 2000-2002    |
| University of Delaware | Linguistics        | Assistant Professor, 1997-2000    |

(iii) Selected Publications (selected from 58 publications):

5 recent publications related to the current proposal:

Phillips, C. (2003). Linear order and constituency. Linguistic Inquiry, 34, 37-90.

- Aoshima, S., **Phillips, C.**, & Weinberg, A. (2004). Processing filler-gap dependencies in a head-final language. *Journal of Memory and Language*, *51*, 23-54.
- Kazanina, N., **Phillips, C.**, & Idsardi, W. (2006). The influence of meaning on the perception of speech sound contrasts. *Proceedings of the National Academy of Sciences, 103*, 11381-11386.
- Phillips, C. (2006). The real-time status of island phenomena. Language, 82, 795-823.
- Kazanina, N. & **Phillips, C.** (2007). A developmental perspective on the imperfective paradox. *Cognition, 105*, 65-102.

5 additional recent publications:

- Phillips, C., Pellathy, T., Marantz, A., et al. (2000). Auditory cortex accesses phonological categories: an MEG study. *Journal of Cognitive Neuroscience*, *12*, 1038-1055.
- **Phillips, C.** (2001). Levels of representation in the electrophysiology of speech perception. *Cognitive Science*, *25*, 711-731.
- Phillips, C., Kazanina, N., & Abada, S. (2005). ERP effects of the processing of syntactic long-distance dependencies. *Cognitive Brain Research*, *22*, 407-428.
- Lau, E., Stroud, C., Plesch, S., & **Phillips, C.** (2006). The role of structural prediction in rapid syntactic analysis. *Brain and Language*, *98*, 74-88.
- **Phillips, C.** & Wagers, M. (2007). Relating structure and time in linguistics and psycholinguistics. In: M. G. Gaskell (ed.), *Oxford Handbook of Psycholinguistics*. Oxford University Press, pp. 739-756.

- As part of an NSF CAREER award, developed teaching materials for hands-on lab-based courses in psycholinguistics and introductory linguistics courses; freely available on the internet, and used at numerous other universities; on-line course materials named to "Top 100 Open Courseware Projects" in 2007 (Online Education Database, oedb.com)
- Reviewer for 40+ journals, agencies, and publishers in linguistics, psychology, cognitive neuroscience. Member of review panels and study sections at NIH and NSF (2003-2007). Editorial Board: Syntax, Language Acquisition, Journal of Linguistics; Brief Articles editor, Language Acquisition
- Frequently invited for 'synergistic' role as speaker/lecturer, for the purpose either of making psycholinguistics or cognitive neuroscience more accessible for linguists, or for representing linguistics to cognitive neuroscientists, including mini-courses in Japan, Spain, Norway and US.
- Organizer of numerous conferences and workshops (CUNY 2004 at Maryland; MEG symposium at Maryland, 2002; NELS at Delaware, 1998; Morphology-Syntax Connection at MIT, 1995; L2 Acquisition at MIT, 1993).
- In role as co-director of Cognitive Neuroscience of Language Lab at Maryland, frequently give presentations and demos of cognitive neuroscience for broader audience (undergraduates from other institutions, high school students, educators-in-training, media, e.g., BBC Radio 4's *Leading Edge* science documentary, 7/19/07).
- As part of a Human Frontiers Science Program award, worked with Japanese researchers on bridging linguistic and neuroscientific models of language.

#### (v) Collaborators and other Affiliations

a. Collaborators in Past 48 months (graduate students and postdocs are listed in (c) below)

| William Idsardi | University of Maryland |
|-----------------|------------------------|
| Jeffrey Lidz    | University of Maryland |
| Andrew Nevins   | Harvard University     |
| David Poeppel   | University of Maryland |
| Kuniyoshi Sakai | University of Tokyo    |
| Amy Weinberg    | University of Maryland |

#### b. Own Graduate & Postdoctoral Advisor

Alec Marantz New York University

## c. Graduate Theses and Postdoc Supervision

Graduate Supervision (\*indicates co-advisor); total = 17:

| David Schneider         | PhD, U. of Delaware (1999). Comp. Ling. at Cycorp Inc.                     | , Austin, TX               |  |
|-------------------------|--|----------------------------|--|
| Meesook Kim             | PhD, U. of Delaware (1999). Associate Professor, Sang                      | ji University, Korea       |  |
| Sachiko Aoshima*        | PhD, U. of Maryland (2003). Assistant Professor, Americ                    | can University             |  |
| Ana Gouvea*             | PhD, U. of Maryland (2003). Assistant Professor, Florida                   | a International University |  |
| Nina Kazanina           | PhD, U. of Maryland (2005). Lecturer, University of Brist                  | ol, UK                     |  |
| Leticia Pablos          | PhD, U. of Maryland (2006). Postdoc, University of Read                    | ding, UK                   |  |
| Masaya Yoshida          | PhD, U. of Maryland (2006). Assistant Professor, Northw                    | vestern University         |  |
| Chun-Chieh Hsu*         | PhD, U. of Delaware (2006). Postdoc, National Cheng K                      | (ung U., Taiwan            |  |
| Takuya Goro             | PhD, U. of Maryland (2007). Postdoc, Tohoku University                     | /, Sendai, Japan           |  |
| Douglas de Lorenzo      | MA, U. of Delaware (1999). Rhodes Scholarship, Oxford                      | l University               |  |
| Thomas Pellathy         | MA, U. of Delaware (2000). Rhodes Scholarship, Oxford                      | I University               |  |
| Matthew Wagers          | PhD expected 2008, U. of Maryland: psycholinguistics, of                   | comp. neuroscience         |  |
| Clare Stroud            | PhD expected 2008, U. of Maryland: cognitive neuroscie                     | ence                       |  |
| Ellen Lau               | PhD expected 2009, U. of Maryland: psycholinguistics, neurolinguistics     |                            |  |
| Akira Omaki             | PhD expected 2010, U. of Maryland: psycholinguistics, language acquisition |                            |  |
| Brian Dillon            | PhD expected 2012, U. of Maryland: neurolinguistics, co                    | omputational ling.         |  |
| Pedro Alcocer           | PhD expected 2012, U. of Maryland: psycholinguistics, r                    | neurolinguistics           |  |
| Postdoc Supervision; to | tal = 3:   |                            |  |
| Silke Urban             | Postdoc, U. of Maryland (PhD, U. of Leipzig)                               | 2002-2004                  |  |
| Ryuichiro Hashimoto     | Postdoc, U. of Maryland (PhD, U. of Tokyo)                                 | 2003-2004                  |  |
| Ming Xiang              | Postdoc, U. of Maryland (PhD, Michigan State U.)                           | 2005-2007                  |  |

#### **David Poeppel** Biographical Sketch

#### (i) **Professional Preparation**

| MIT              | Cognitive Science        | B.S., 1990     |
|------------------|--------------------------|----------------|
| MIT              | Cognitive Neuroscience   | Ph.D., 1995    |
| UC San Francisco | Functional brain imaging | Postdoc, 95-97 |

## (ii) **Professional Appointments**

UC San FranciscoRadiologyUniversity of MarylandLinguistics/BiologyUniversity of MarylandLinguistics/BiologyUniversity of MarylandLinguistics/BiologyKanazawa Inst. of Tech.Linguistics/BiologyInst. for Advanced Studies BerlinAmerican Academy BerlinEcole Normale Superieure, ParisParis

Adjunct Assistant Prof., 1997-1998 Assistant Professor, 1998-2002 Associate Professor, 2002-2006 Professor, 2006-Visiting Professor, 2001-Fellow, 2003-2004 Fellow, 2004 Guest Professor In Residence, 2006

(iii) Selected Publications (selected from over 80 publications):

5 recent publications related to the current proposal:

- van Wassenhove V, Grant K, **Poeppel D** (2005). Visual speech speeds up the neural processing of auditory speech. *Proc National Acad Sci* 102, 1181-1186.
- Boemio, A., Fromm, S., Braun, A., **Poeppel, D**. (2005). Hierarchical and asymmetric temporal sensitivity in human auditory cortices. *Nature Neuroscience* 8, 389-395.
- Hickok, G. & **Poeppel, D.** (2007). The cortical organization of speech processing. *Nature Reviews Neuroscience* 8: 393-402.
- Luo, H. & **Poeppel, D.** (2007). Phase patterns of neuronal responses reliably discriminate speech in human auditory cortex, *Neuron* 54, 1001-1010.
- Giraud, AL, Kleinschmidt, A, **Poeppel, D**, Lund, T, Frackowiak, R, Laufs, H. (in press). Endogenous cortical rhythms determine cerebral specialisation for speech perception and production. *Neuron*.

5 Additional recent publications:

- **Poeppel, D**. (2003). The analysis of speech in different temporal integration windows: cerebral lateralization as 'asymmetric sampling in time'. *Speech Communication* 41, 245-255.
- Hickok, G. and **Poeppel**, **D**. (2004). Dorsal and ventral streams: a framework for understanding aspects of the functional anatomy of language. *Cognition* 92, 67-99.
- van Wassenhove V, Grant K, and **Poeppel D** (2007). Temporal window of integration in auditory-visual speech perception. *Neuropsychologia* 45(3), 598-607.
- Chait, M., **Poeppel, D**., de Cheveigne, A, Simon, JZ (2007). Processing asymmetry of transitions between order and disorder in human auditory cortex. *Journal of Neuroscience* 27(19), 5207-5214.
- **Poeppel, D**., Idsardi, W. van Wassenhove, V. (in press). Speech perception at the interface of neurobiology and linguistics: prospects and problems. *Phil Trans Royal Soc London*.

- Development of new signal processing algorithms based on MEG auditory experiments, e.g. 1) Sekihara, K., Nagarajan, S., Poeppel, D., Miyauchi, S., Fujimaki, N., Koizumi, H., Miyashita, Y. Estimating Neural Sources from Each Time-Frequency Component of Magnetoencephalographic Data (2000 *IEEE Trans Biomed Eng* 47 (5): 642-653 and 2) Sekihara, K., Nagarajan, S., Poeppel, D., Marantz, A., Miyashita, Y. (2002). Application of an MEG eigenspace beamformer to reconstructing spatio-temporal activities of neural sources. *Human Brain Mapping* 15, 199-215.
- Organization of Workshop 2001 Annual Meeting of the Cognitive Neuroscience Society (New York) "Brain mechanisms of auditory language processing: from sounds to sentences".
- *Editor* of special section of journal *Cognitive Science*: "Neural basis of speech perception: contributions to cognitive science of speech" (vol 25 (5), September 2001).
- Co-editor (with G. Hickok) of special issue of journal Cognition "Towards a new functional

anatomy of language" (vol 92 May-June 2004).

• Development and teaching of new graduate courses on Cognitive Neuroscience that incorporates large-scale EEG/ERP and MEG practica for graduate and advanced undergraduate students.

## (v) Collaborators

## a. Collaborators in the last 48 months (Graduate students listed in (c) below)

| Alan Beretta     | Michigan State U                        |
|------------------|---|
| Allen Braun      | NIH-NIDCD                               |
| David Embick     | U Pennsylvania                          |
| Nathan Fox       | U Maryland ( <i>Human Development</i> ) |
| Anne-Lise Giraud | Ecole Normale Superieure, Paris         |
| Kenneth Grant    | Walter Reed Army Medical Center         |
| Brad Hatfield    | U Maryland (Kinesiology)                |
| Greg Hickok      | UC Irvine                               |
| Bill Idsardi     | U Maryland ( <i>Linguistics</i> )       |
| Alec Marantz     | NYU                                     |
| Sandeep Prasada  | Hunter College                          |
| Jonathan Simon   | U Maryland (Elec Comp Eng)              |
| Lutz Trahms      | PTB Berlin                              |
|                  |   |

#### b. Own graduate and postdoctoral advisors

| Alec Marantz    | MIT, now NYU Linguistics        |
|-----------------|---------------------------------|
| Kenneth Wexler  | MIT Brain & Cognitive Sciences  |
| Timothy Roberts | UCSF, now U Penn Medical School |

#### c. Graduate and Postdoc Supervision in the last five years

Graduate Supervision (\*indicates co-advisor); total = 17:

| Anthony Boemio         | PhD, U. of Maryland (2003). Post-doc, NIH (NIMH)                       |
|------------------------|--|
| Ana Gouvea*            | PhD, U. of Maryland (2003). Asst Professor, Florida International Univ |
| Virginie v. Wassenhove | PhD, U. of Maryland (2004). Post-doc, Caltech                          |
| Maria Chait            | PhD, U. of Maryland (2006). Marie Curie Fellow, Univ College London    |
| Robert Fiorentino      | PhD, U. of Maryland (2006). Asst Professor, Univ Kansas                |
| Huan Luo               | PhD, U. of Maryland (2006). Researcher, Chinese Acad Science Beijing   |
| Diogo Almeida          | PhD expected 2008, U. of Maryland, psycholinguistics, neurolinguistics |
| Philip Monahan*        | PhD expected 2009, U. of Maryland, psycholinguistics, neurolinguistics |
| Julian Jenkins         | PhD expected 2010, U. of Maryland, auditory neuroscience               |
| Greg Cogan*            | PhD expected 2011, U. of Maryland, speech, auditory neuroscience       |
| Joshua Riley*          | PhD expected 2011, U. of Maryland, speech, phonology, neuroscience     |
| Ariane Rhone*          | PhD expected 2011, U. of Maryland, speech, psycholinguistics           |
| Nuria Abdulsabur*      | PhD expected 2012, U. of Maryland, neurolinguistics                    |
| Yue Zhang              | PhD expected 2012, U. of Maryland, auditory neuroscience, computation  |

Postdoc Supervision; total = 8:

| Silvia Gennari | PhD Brown Univ, post-doc 2000-2002. Lecturer (Psychology), Univ of York, UK |
|----------------|---|
| Michael Gordon | PhD Univ of Rochester, post-doc 2000-2001. Clinician                        |
| Martin Hackl   | PhD MIT, post-doc 2000-2002. Asst Prof (Linguistics), Pomona College CA     |
| Lisa Sanders   | PhD Univ Oregon, post-doc 2002-2003. Asst Prof (Psychology), UMass Amherst  |
| Anita Bowles   | PhD Univ Colorado, post-doc 2003-2006. Researcher, CASL, UMD                |
| Yadong Wang    | PhD Univ Rhode Island, post-doc 2003-2006. Researcher, Industry.            |
| Mary Howard    | PhD Univ Maryland (computer science), post-doc 2006-                        |
| Minna Lehtonen | PhD Univ Turku, Finland, post-doc 2007                                      |

## Nan Bernstein Ratner

**Biographical Sketch** 

| (1) 1 101033101141 1 1004141011 |                           |        |      |
|---------------------------------|---------------------------|--------|------|
| Tufts University                | Child Studies             | B.A.,  | 1974 |
| Temple University               | Speech-Language Pathology | M.A.,  | 1976 |
| Boston University               | Applied Psycholinguistics | Ed.D., | 1982 |

#### (ii) Academic Appointments

(i) Professional Proparation

| University of Maryland | Hearing & Speech Sciences | Assistant Professor, 1983-1989     |
|------------------------|---------------------------|------------------------------------|
| University of Maryland | Hearing & Speech Sciences | Associate Professor, 1989-1992     |
| University of Maryland | Hearing & Speech Sciences | Associate Prof. & Chair, 1993-1999 |
| University of Maryland | Hearing & Speech Sciences | Professor & Chair, 1999-present    |

(iii) Selected Publications (selected from 79 publications):

#### 5 recent publications related to the current proposal:

- Berl, M., Moore, E., Vaidya, C., Gioia, G., Bernstein Ratner, N. & W. Gaillard (2006). Auditory comprehension of language in young children. In D. Riva, I. Rapin & G. Zardini (eds.) Language: normal and pathological development: Remembering Elizabeth Bates. Montrouge, FR: John Libbey Eurotext (pp 51-60).
- Newman, R., **N. Bernstein Ratner,** A.-M. Jusczyk, P. Jusczyk, & K. Dow (2006). Infants' early ability to segment the conversational speech signal predicts later language development. *Developmental Psychology*, *42*, 643-655.
- Newman, R. S. & **Bernstein Ratner**, **N**. (2007). The role of selected lexical factors on confrontation naming accuracy, speed and fluency in adults who do and do not stutter. *Journal of Speech, Language, and Hearing Research, 50,* 196-213.
- Bernstein Ratner, N. (2005). Is phonetic complexity a useful construct in stuttering? *Journal of Fluency Disorders*, 30, 337-341.
- Rescorla, L., N. Bernstein Ratner, P. Jusczyk & A.-M. Jusczyk (2005) Relationships between the Language Development Survey (LDS) and the MacArthur Communicative Development Inventory: Words and Sentences (CDI: WS). American Journal of Speech-Language Pathology, 14, 156-163.

#### 5 additional recent publications:

- Bloodstein, O. & **N. Bernstein Ratner** (in press). *A Handbook on Stuttering, 6<sup>th</sup> edition*. Vancouver: Thomson.
- Gaillard, W.D., Berl, M., Moore, E., **Bernstein Ratner, N.** et al. (in press). Atypical language in lesional and nonlesional complex partial epilepsy. *Neurology*.
- Hall, N., Wagovich, S., & **Bernstein Ratner**, **N.** (2007). Language considerations in developmental stuttering. In E. Conture & R. Curlee (eds.) *Stuttering and related disorders of fluency (3<sup>rd</sup> edition)*. NY: Thieme.
- Bernstein Ratner, N. & F. Wijnen. (2007). The Vicious Cycle: Linguistic encoding, self-monitoring and stuttering. In J. Au-Yeung (ed.) *Proceedings of the Fifth World Congress on Fluency Disorders*.
- Wagovich, S. & **N. Bernstein Ratner** (2007). Frequency of verb use in young children who stutter. *Journal of Fluency Disorders*, 32, 79-94.

- Co-editor-in-Chief, Seminars in Speech and Language
- Editorial Board, *Applied Psycholinguistics, Journal of Communication Disorders.* Member of study sections at NIH (1994-). Reviewer for more than 20 different journals and publishers in speech-language pathology, applied linguistics, acoustics and psychology.
- Founder of LEAP Program (Language-Learning Early Advantage Program), an innovative communication enrichment program for preschoolers at risk of speech/language delays. Program received a Distinguished Program award in 1997 from Maryland Higher Ed Assoc for

contributions to children and to student training; selected in 2002 as a model preschool reading program by the American Speech-Language-Hearing Association.

- Specialty area coordinator (fluency) American Speech-Language-Hearing Association (1995-2003).
- Educational consultant, University of Kuwait (2005) to establish speech-language pathology preparation program. Visiting Fellow, University of Sydney, Australia (2007). Visiting consultant, Curtin University, Perth, Australia (2006)
- Consultant to 2 recent interdisciplinary grants: RO1 NS44280-01 NINDS: Plasticity of Language Networks in Childhood Epilepsy (PI: William Gaillard, MD; 2002-7), and R41-DC006970 NIDCD: Virtual reality environments for stuttering treatment (PI: Shelley Brundage, PhD.; 2004-6)
- Frequently invited speaker (60 courses/workshops since 2000) on "synergy" among linguistic and fluency variables in typical and atypical children's speech production (e.g., NSF KidTalk workshop, October 2005, numerous national and international meetings; Distinguished Researcher award from International Fluency Association).
- Development of evidence-based practice assessment protocol for speech-language pathologists (with Barbara Nail-Chiwetalu U. of Maryland).

#### (v) Collaborators and other Affiliations

a. Collaborators in Past 48 months (graduate students are listed in (c) below):

| Jean Berko Gleason       | Boston University                           |
|--------------------------|---|
| Oliver Bloodstein        | Brooklyn College                            |
| Frank Wijnen             | University of Utrecht                       |
| Stacy Silverman Wagovich | University of Missouri, Columbia            |
| Nancy Hall               | University of Maine                         |
| William Gaillard         | Children's Hospital National Medical Center |
| Mark Onslow              | University of Sydney, Australia             |
| John Tetnowski           | University of Louisiana, Lafayette          |
| Barry Guitar             | University of Vermont                       |
| Leslie Rescorla          | Bryn Mawr College                           |
| Barbara Nail-Chiwetalu   | University of Maryland                      |
| Kathryn Dow              | University of Maryland                      |
| Ann Marie Jusczyk        | Johns Hopkins University                    |
| Peter Jusczyk            | late of Johns Hopkins University            |
| Rochelle Newman          | University of Maryland                      |
| Bruce Tomblin            | University of Iowa                          |
| Amanda Woodward          | University of Maryland                      |
| Grace Yeni-Komshian      | University of Maryland (emerita)            |

#### b. Own Graduate Advisors:

| Boston University (emerita)           |
|---------------------------------------|
| Boston University (emerita)           |
| Massachusetts Institute of Technology |
| University of Colorado                |
|                                       |

#### c. Graduate Thesis Supervision:

17 students, all thesis studies subsequently published in peer-reviewed journals, including (since 2000): Haya Berman Hakim (*J Fluency Disorders*, 2004), Brian Boscolo (*Am J Sp Lang Path*, 2002), Stephanie Miles (*J Sp Lang Hear Res*, 2001), Stacy Silverman/Wagovich (*J Sp Lang Hear Res*, 1997 & 2000), Maria Dixon and Phyllis Bonelli (*Clin Ling & Phon*, 2000), Aimee Pharr (Appl Psycholing, 2000). Supervised graduate training for large numbers of speech-language pathologists currently in clinical practice.

## James A. Reggia

**Biographical Sketch** 

#### (i) Professional Preparation

| University of Maryland, College Park | Physical Sciences | B.S., 1971           |
|--------------------------------------|-------------------|----------------------|
| University of Maryland, Baltimore    | Medicine          | M.D., 1975           |
| University of Maryland Hospital      | Neurology         | Residency, 1975-1978 |
| University of Maryland, College Park | Computer Science  | Ph.D., 1981          |

#### (ii) Academic Appointments

University of Maryland, BaltimoreNeurologyUniversity of Maryland, Coll. Pk.Comp. Sci.University of Maryland, BaltimoreNeurologyUniversity of Maryland, BaltimoreNeurologyUniversity of Maryland, Coll. Pk.Comp. SciUniversity of Maryland, Coll. Pk.Comp. SciUM Inst. for Advanced Computer StudiesCenter for the Advanced Study of Language

Assistant Professor, 1979-1984 Assistant Professor, 1982-1987 Associate Professor, 1984-1989 Research Assoc. Prof., 1989-1993 Associate Professor, 1987-1993 Professor, 1993-Professor, 1986-Research Professor, 2005-

(iii) Selected Publications (selected from approximately 240 publications)

#### Five recent publications related to the current proposal:

- Schulz R & **Reggia J**. (2004). Temporally Asymmetric Learning Supports Sequence Processing in Multi-Winner Self-Organizing Maps. *Neural Computation*, 16, 535-561.
- Weems S & **Reggia J**. (2004). Hemispheric Specialization and Independence for Word Recognition: A Comparison of Three Computational Models. *Brain and Language*, 89, 554-568.
- Grushin A. & **Reggia J**. (2005). Evolving Processing Speed Asymmetries and Hemispheric Interactions in a Neural Network Model. *Neurocomputing*, 65-66, 47-53.
- Wagner K & **Reggia J**. (2006). The Emergence of an Internally-Grounded Multi-referent Communication System. *Interaction Studies*, 7, 103-129.
- Weems S & **Reggia J**. (2006). Simulating Single Word Processing in the Classic Aphasia Syndromes Based on the Wernicke-Lichtheim-Geschwind Theory. *Brain and Language*, 98, 291-301.

#### Five additional recent publications:

- **Reggia J**. (2004). Neurocomputational Models of the Remote Effects of Focal Brain Damage. *Medical Engineering and Physics*, 26, 711-722.
- Schulz R & **Reggia J**. (2005). Mirror Symmetric Topographic Maps Can Arise from Activity-Dependent Synaptic Changes. *Neural Computation*, 17, 1059-1083.
- Jung J & **Reggia J**. (2006). Evolutionary Design of Neural Network Architectures Using a Descriptive Encoding Language. *IEEE Transactions on Evolutionary Computation*, 10, 676-688.
- Winder R, Cortex C, **Reggia J** & Tagamets M. (2007). Functional Connectivity in fMRI: A Modeling Approach for Estimation and for Relating to Local Circuits. *NeuroImage*, 34, 1093-1107.
- Howard M & **Reggia J**. (2007). A Theory of the Visual System Biology Underlying Development of Spatial Frequency Lateralization. *Brain and Cognition*, 64, 111-123.

## (iv) Synergistic Activities

- Design and introduction of three new courses into graduate computer science curriculum: CMSC 726: Machine Learning; CMSC 727: Neural Computation; CMSC 828: Artificial Life and Evolutionary Computation
- Primary organizer, First (1995) and Second (1998) International Workshops on Neural Models of Brain and Cognitive Disorders; supported by NIH, Whitaker Foundation, and several Universities.
- Mentor, Gemstone Group, 2002-2004: mentor to 14 honors undergraduates on a three year group research and thesis project using genetic programming.
- Mentor, several undergraduate computer science students, summer research internships.
- Mentor, several high school student projects in Computer Science (one a Finalist in Maryland Science and Humanities Symposium)
- Ongoing funded research projects on evolution of neural networks (NASA), neurocognitive models (CTNS STARS program), and self-organizing collective intelligence (NSF ITR).

## (v) Collaborators

#### a. Collaborators in the last 48 months (Graduate students listed in (c) below)

| Rita Berndt          | University of Maryland, Baltimore     |
|----------------------|---------------------------------------|
| Jose Contreras-Vidal | University of Maryland, College Park  |
| Judy Frels           | University of Maryland, College Park  |
| David Jacobs         | University of Maryland, College Park  |
| John Salasin         | University of Maryland, College Park  |
| Malle Tagamets       | University of Maryland, Baltimore     |
| Juan Uriagereka      | University of Maryland, College Park  |
| Jerry Wilkinson      | University of Maryland, College Park  |
| Eran Zaidel          | University of California, Los Angeles |

#### b. Own thesis advisor

Charles Rieger Currently in Industry; formerly of University of Maryland, CP

#### c. Graduate and Postdoc Supervision in the last five years

Graduate Supervision; total = 34:

| Yuri Shkuro         | PhD, 2001, Senior Software Developer, Morgan Stanley              |
|---------------------|---|
| Reiner Schulz       | PhD, 2004, Research Scientist, Kings College, London              |
| Mary Howard         | PhD, 2005, Postdoc (Linguistics), University of Maryland          |
| Alejandro Rodriguez | PhD, 2007, NIH Bioengineering Position                            |
| Shaun Gittens       | PhD, 2007, Postdoc, Computer Science, Auburn University           |
| Alex Grushin        | PhD, 2007, Research Scientist, Intelligent Automation Inc.        |
| Shaun Gittens       | PhD, 2007, Postdoc, Computer Science, Auburn University           |
| Alex Grushin        | PhD, 2007, Research Scientist, Intelligent Automation Inc.        |
| Ransom Winder       | PhD, 2007, Technical Position, MITRE                              |
| JaeYoon Jung        | PhD, 2007, Postdoc, Computer Science, Queen's University, Ontario |
| Ũ                   |   |

Postdoc Supervision in the last five years; total = 6:

Scott Weems U. of Maryland, (PhD, UCLA) 2003-2005

#### Philip Resnik Biographical Sketch

#### (i) **Professional Preparation**

| Harvard College            | Computer Science   | A.B. (magna cum laude), 1987 |
|----------------------------|--------------------|------------------------------|
| University of Pennsylvania | Comp and Inf. Sci. | M.S.E., 1990                 |
| University of Pennsylvania | Comp and Inf. Sci. | Ph.D., 1993                  |

#### (ii) **Professional Appointments**

| Bolt Beranek and Newman Inc.  |             | Associate Scientist, 1987-1989       |
|-------------------------------|-------------|--------------------------------------|
| IBM TJ Watson Research Ctr    |             | Graduate student intern, summer 1991 |
| Sun Microsystems Laboratories | ;           | Scientist, 1993-1996                 |
| University of Maryland        | Linguistics | Assistant Professor, 1996-2002       |
| University of Maryland        | Comp. Sci.  | Affiliate Assistant Prof., 2001-2002 |
| University of Maryland        | Linguistics | Associate Professor, 2002-           |
| University of Maryland        | Comp. Sci.  | Affiliate Associate Prof., 2002-     |
|                               |             |                                      |

#### (iii) Selected Publications (selected from 81 publications)

#### 5 recent publications related to the current proposal:

- David Chiang, Adam Lopez, Nitin Madnani, Christof Monz, **Philip Resnik**, & Michael Subotin. (2005). The Hiero machine translation system: extensions, evaluation, and analysis. Conference on Human Language Technology/Empirical Methods in Natural Language Processing 2005.
- **Philip Resnik**. (2007). Word sense disambiguation in NLP applications. In E. Agirre and P Edmonds (eds.), *Word Sense Disambiguation: Algorithms and Applications.* Kluwer.
- Rebecca Hwa, **Philip Resnik**, Amy Weinberg, Clara Cabezas, & Okan Kolak. (2005). Bootstrapping parsers via syntactic projection across parallel texts. *Natural Language Engineering*, 11, 311-325.
- Philip Resnik & Noah Smith. (2003). The web as a parallel corpus. *Computational Linguistics*, 29, 349-380.
- **Philip Resnik**. (1999). Semantic similarity in a taxonomy: An information-based measure and its application to problems of ambiguity in natural language. *Journal of Artificial Intelligence Research*, 11, 95–130.

#### 5 additional recent publications:

- Okan Kolak and **Philip Resnik**. (2005). OCR post-processing for low density languages. Conference on Human Language Technology/Empirical Methods in Natural Language Processing 2005.
- **Philip Resnik**, Aaron Elkiss, Ellen Lau, and Heather Taylor. (2005). The web in theoretical linguistics research: two case studies using the Linguist's Search Engine. 31<sup>st</sup> Meeting of the Berkeley Linguistics Society.
- Mona Diab & **Philip Resnik**. (2002). An unsupervised method for word sense tagging using parallel corpora. 40th Anniversary Meeting of the Association for Computational Linguistics (ACL-02).
- Judith Klavans & **Philip Resnik**, eds., *The Balancing Act: Combining Symbolic and Statistical Approaches to Language*. Cambridge, MA: MIT Press.
- **Philip Resnik**. (1996). Selectional constraints: An information-theoretic model and its computational realization. *Cognition* 61:127–159.

- Editorial Board member, Linguistics in Language Technology (July 2007 -- present), Open Cybernetics and Systemics Journal (June 2007 -- present), Cognitive Linguistics (January 2005 – January 2007), Cognition (November 1994 – February 2005), Computational Linguistics (1998-2000).
- DARPA TIDES program. UMD lead-PI in machine translation, collaborating with Dorr, Weinberg at UMD and colleagues at IBM, JHU, CMU, and Stanford (2005-2010, \$3,054,000). Supervising a team of computer scientists and linguists in developing a state-of-the-art system for automatic translation from Chinese and Arabic to English, combining linguistic analysis with statistical tools.
- As UMd's lead investigator for an ONR multi-university research initiative (MURI) project with Johns Hopkins U, supervised development of techniques to exploit parallel text, i.e., text in parallel translation

to acquire information about sentences in a second language from their English translations (2001-2006, \$1,829,970).

- Collaboration with new UMd/JHU Center of Excellence in Human Language Technology, focusing the development of a rich grammatical formalism to connect syntactic and ontological knowledge sources, to be applied in the problem of identifying when the same entity is being referred to using different descriptions, across multiple documents in multiple languages.
- Linguist's Search Engine (http://lse.umiacs.umd.edu). The LSE makes it possible for the "ordinary working linguist" to do sophisticated searches for naturally occurring data on the Web by specifying structural and lexical search criteria. Collaborated with Center for Advanced Study of Language to develop Chinese extension of LSE, in order to support CASL's efforts in Chinese language pedagogy.

## (v) Collaborators

#### a. Collaborators in the last 48 months (Graduate students listed in (c) below)

| Cambridge University     |
|--------------------------|
| Johns Hopkins University |
| University of Maryland   |
| University of Maryland   |
| Johns Hopkins University |
| University of Maryland   |
| Johns Hopkins University |
| University of Maryland   |
| Johns Hopkins University |
|                          |

#### b. Own thesis advisor

Aravind Joshi

University of Pennsylvania

#### c. Graduate and Postdoc Supervision in the last five years

| Graduate PhD Supervis   | ion, total = 9   |
|-------------------------|--|
| Mona Diab               | PhD, U of Maryland, Linguistics (2003). Columbia University            |
| Okan Kolak              | PhD, U of Maryland, Computer Science (2005). Google                    |
| Stephan Greene          | PhD, U of Maryland, Linguistics (2007). ATG Inc.                       |
| Adam Lopez              | PhD expected 2008, Computer Science                                    |
| Michael Subotin         | PhD expected 2009, Linguistics   |
| Yuval Marton            | PhD expected 2009, Linguistics   |
| Chris Dyer              | PhD expected 2010, Linguistics   |
| Tim Hunter              | PhD expected 2010, Linguistics   |
| Tim Hawes               | PhD expected 2011, Linguistics   |
| Postdoc Supervision, to | tal = 5  |
| Gina Levow              | U. of Maryland, (PhD, MIT) Asst. Prof, University of Chicago           |
| Rebecca Hwa             | U. of Maryland, (PhD, Harvard), Asst. Prof., U. Pittsburgh             |
| Smaranda Muresan        | U. of Maryland, (PhD, Columbia) Current postdoc                        |
| Mari Broman Olsen       | U. of Maryland, (PhD, Northwestern U.), Microsoft                      |
| Daniel Zeman            | U. of Maryland, (PhD, University of Prague) Charles University, Prague |
| Undergraduate supervis  | ion, total = 7   |
| Greg Marton             | 1999-2000 (now PhD student at MIT)                                     |
| Noah Smith              | 1999-2001 (PhD at JHU, now Asst. Prof. at CMU)                         |
| Jessica Stevens         | 2001 (now researcher at BBN)   |
| Aaron Elkiss            | 2001-2003 (now PhD student at Univ of Michigan);                       |
| Mohammed (Rafi) Khan    | 2001-2003; James Wren, 2003; Girish Joshi, 2003.                       |

#### Shihab A. Shamma Biographical Sketch

#### (i) **Professional Preparation**

| Imperial College, London | Electrical Engineering        | B.S. 1976  |
|--------------------------|-------------------------------|------------|
| Stanford University      | Electrical Engineering        | M.S. 1977  |
| Stanford University      | Slavic Languages & Literature | M.S. 1980  |
| Stanford University      | Electrical Engineering        | Ph.D. 1980 |

(ii) Academic Positions

| University of Maryland        | Professor, Electrical and Computer Engineering | 1995-     |
|-------------------------------|--|-----------|
| University of Maryland        | Joint Appointment, Inst for Systems Research   | 1990-     |
| University of Maryland        | Associate Professor, Electrical Engineering,   | 1989-1995 |
| University of Maryland        | Institute for Advanced Computer Studies        | 1987-1992 |
| University of Maryland        | Assistant Professor, Electrical Engineering    | 1984-1989 |
| National Institutes of Health | Res. Fellow, Mathematical Res. Br., NIADDK     | 1983-1984 |
| National Institutes of Health | Postdoc, Section on Brain and Behavior, NICHD  | 1981-1983 |
| Stanford University           | Research Associate, Electrical Engineering     | 1980-1981 |

(iii) Selected Publications (selected from over 70 journal publications)

## Five recent publications related to this proposal:

- Fritz J, **S. Shamma**, M. Elhiliali, & D. Klein. (2003). Rapid task-dependent plasticity of spectrotemporal receptive fields in primary auditory cortex. *Nature Neuroscience*, *6*, 1216-1223.
- Elhilali M., J. Fritz , D. Klein, J. Simon, & **S. Shamma**. (2004). Dynamics of precise spiking in primary auditory cortex. *Journal of Neuroscience*, 24, 1159-1172.
- Fritz J, **S. Shamma**, & M. Elhiliali. (2005). Differential dynamic plasticity of A1 receptive fields during multiple spectral tasks. *Journal of Neuroscience*, *25*, 7623-7635
- Chi, T, and **S. Shamma**. (2006) Spectrum restoration from multiscale auditory phase singularities by generalized projections. *IEEE Transactions on Audio and Speech*, *14*, 2006, 1179-1192.
- Simon J., D. Klein, J. Fritz, D. Depireux, and **S. Shamma**. (2007). Temporal symmetry in primary auditory cortex: Implications for cortical connectivity. *Neural Computation* 19, 583-638.

#### Five additional recent publications:

- Shamma S. (2001). On the Role of Space and Time in Auditory Processing. *Trends in Cognitive Sciences*, 5, 340-348.
- Klein D., J. Simon, D. Depireux, & **S. Shamma**. (2000). Robust Spectro-temporal Reverse-Correlation for the Auditory System: Optimal Stimulus Design. *Journal of Computational Neuroscience*, 9, 85-111.
- Kowalski, N., Depireux, D. & S. Shamma. (1996). Analysis of dynamic spectra in ferret primary auditory cortex: Characteristics of single unit responses to moving ripple spectra. *Journal of Neurophysiology*, 76, 3503-3523.
- Shamma, S. (1997). Auditory cortical representation of complex acoustic spectra as inferred from the ripple analysis method. *Network: Computation in Neural Systems, 7*, 439-476.
- Ru, P. & **S. Shamma**. (1997). Representation of Musical Timbre in the Auditory Cortex. *Journal of New Music Research*, *26*, 154-169.

- Fellow of the Acoustical Society of America, Senior Member of the Institute for Electrical and Electronic Engineers, Association for Research in Otolaryngology, and Society for Neuroscience.
- Associate Editor for *J* of Computational Neuroscience; reviewer for numerous journals including Journal of the Acoustical Society of America, Journal of Neuroscience, Journal of Neural Networks, Nature, Nature Neuroscience, Science, Journal of Neurophysiology, IEEE Biomedical Engineering, IEEE Information Theory, IEEE Signal Processing, Biological Cybernetics.
- Co-organizer and Director of numerous workshops and symposia, including most recently the Annual Telluride Workshops on Neuromorphic Engineering (1997-2012 and continuing, partially funded by NSF, ONR, DARPA, and the Whitaker and Gatsby Foundations), and NIPS workshops on Neural Mechanisms of Music Perception (1999), and Thalamocortical Processing (2002).

Current research support includes "Spectro-temporal plasticity in ferret auditory cortex" (NIH-R01, 2004-2008, \$1,764,310); "Auditory scene analysis and the cocktail problem" (NIH-CRCNS, 2005-2008, \$734,277), Annual Telluride Workshop for Neuromorphic Eng. (NSF, 2004-2009, \$500,000).

#### (v) Collaborators and other Affiliations

## a. Collaborators in the past 48 months (selected):

- R. Carlyon University of Cambridge
- C. Espy-Wilson Electrical & Computer Engineering, University of Maryland
- C. Michyel Department of Psychology, University of Minnesota
- A. Oxenham Department of Psychology, University of Minnesota
- D. Poeppel Linguistics Department, University of Maryland
- J. Z. Simon Department of Biology & ECE, University of Maryland
- C. Moss Department of Psychology, University of Maryland
- P. S. Krishnaprasad Electrical & Computer Engineering, University of Maryland
- Brian Zook Southwest Research Institute, TX.

## b. Own Graduate and Postdoctoral Advisors

| Robert White | Stanford University |
|--------------|---------------------|
| David Symmes | NIH                 |
| John Rinzel  | NIH                 |

## c. Graduate and Postdoctoral Advisor

| Completed PhD Superv    | ision; total = 12, 33 additional completed MS degrees supervised |
|-------------------------|--|
| X. Yang                 | Ph.D. (1988), Industry, MD                                       |
| A. Teolis               | Ph.D. (1991), Industry, DC                                       |
| D. Lin                  | Ph.D. (1992), Industry, CA                                       |
| W. Byrne                | Ph.D. (1992), Lecturer, Cambridge University, UK                 |
| S. Vranic               | Ph.D. (1993), Industry, IL                                       |
| K. Wang                 | Ph.D. (1995), Microsoft Research, WA                             |
| N. Kowalski             | Ph.D. (1996), Industry, MD                                       |
| T. Owens                | Ph.D. (1997), Industry, MD                                       |
| P. Ru                   | Ph.D. (1998), Industry, MD                                       |
| N. Kanlis               | Ph.D. (2000), Research Scientist, U. of Thessaloniki, Greece     |
| T. Chi                  | Ph.D. (2003), Assistant Professor, Taiwan                        |
| M. El-Hilali            | Ph.D. (2004), Assistant Professor, Johns Hopkins University      |
| Current Graduate Ph.D.  | Students: total = 4  |
| N. Mesgarani            | Ph.D. Expected 2008, Electrical and Computer Engineering         |
| S. Atiani               | Ph.D. Expected 2010, Neuroscience and Cognitive Science          |
| L. Ma                   | Ph.D. Expected 2011, Biomedical Engineering                      |
| K. Donaldson            | Ph.D. Expected 2011, Neuroscience and Cognitive Science          |
| PostDoc Supervision; to | otal = 16:   |
| J. Fleshman             | Postdoc, 1985-1988 (PhD University of Virginia)                  |
| X. Yang                 | Postdoc, 1988-1989 (PhD University of Maryland)                  |
| H. Versnel              | Postdoc, 1989-1993 (PhD University of Utrecht)                   |
| S. Vranic               | Postdoc, 1994-1995 (PhD University of Maryland)                  |
| J. Lin                  | Postdoc, 1994-1995 (PhD University of Maryland)                  |
| K. Wang                 | Postdoc, 1995-1997 (PhD University of Maryland)                  |
| P. Ru                   | Postdoc, 1998-1999 (PhD University of Maryland)                  |
| J. Simon                | Postdoc, 1999-2002 (PhD UC Santa Barbara)                        |
| D. Depireux             | Postdoc, 1998-2002 (PhD University of Liege, Belgium)            |
| E. Grassi               | Postdoc, 2000-2003 (PhD Boston University)                       |
| S. Kalluri              | Postdoc, 2002-2005 (PhD MIT)                                     |
| J. Fritz                | Postdoc, 2003-2007 (PhD Washington University)                   |
| T. Chi                  | Postdoc, 2003-2006 (PhD University of Maryland)                  |
| S. David                | Postdoc, 2005-2008 (PhD University of California Berkeley)       |
| P. Ying                 | Postdoc, 2004-2008 (PhD University of Beijing)                   |
| M. El-Hilali            | Postdoc, 2004-2007 (PhD University of Maryland)                  |

#### Jonathan Z. Simon Biographical Sketch

#### (i) **Professional Preparation**

| Princeton University                    | Physics               | A.B.    | 1985      |
|---|-----------------------|---------|-----------|
| University of California, Santa Barbara | Physics               | M.A.    | 1987      |
| University of California, Santa Barbara | Physics               | Ph.D.   | 1990      |
| University of Wisconsin, Milwaukee      | General Relativity    | Postdoc | 1990–1992 |
| University of Maryland                  | General Relativity    | Postdoc | 1992–1996 |
| University of Maryland                  | Auditory Neuroscience | Postdoc | 1996–2001 |
|   |                       |         |           |

#### (ii) Academic Appointments

| University of Maryland | Electrical & Computer Engineering (ECE) | Assistant Professor | 2001  |
|------------------------|---|---------------------|-------|
| University of Maryland | Biology (50%) / ECE (50%)               | Assistant Professor | 2002- |

(iii) Publications (selected from 44 publications)

## **5 Related Publications**

- de Cheveigné, A., and J. Z. Simon. (2007). Denoising based on time-shift PCA. J. Neuroscience Methods 165(2), 297-305.
- Chait, M., D. Poeppel, A. de Cheveigné and J. Z. Simon. (2007). Processing asymmetry of transitions between order and disorder in human auditory cortex. *J. Neuroscience* 27, 5207-5214.
- Luo, H., Y. Wang, D. Poeppel and **J.Z. Simon** (2006). Concurrent encoding of frequency and amplitude modulation in human auditory cortex, *J. Neurophysiology* 96, 2712-2723.
- Chait, M., D. Poeppel, A. de Cheveigné and J. Z. Simon. (2005). Human auditory cortical processing of changes in interaural correlation, *J. Neuroscience*, 25(37), 8518–8527.
- Simon, J. Z. and Y. Wang (2005) Fully complex magnetoencephalography. J. Neuroscience Methods, 149(1), 64-73.

## **5 Other Significant Publications**

Aytekin, M., C. F. Moss and J. Z. Simon. (in press). A sensorimotor approach to sound localization. *Neural Computation.* 

Simon, J.Z., D.A. Depireux, D.J. Klein, J.B. Fritz and S.A. Shamma. (2007). Temporal symmetry in primary auditory cortex: Implications for cortical connectivity. *Neural Computation* 19, 583-638.

- Chait, M., D. Poeppel and **J.Z. Simon.** (2006). Neural response correlates of detection of monaurally and binaurally created pitches in humans. *Cerebral Cortex*, 16(6), 835-848.
- Grau-Serrat V, C.E. Carr, and **J. Z. Simon.** (2003). Modeling coincidence detection in nucleus laminaris, *Biological Cybernetics*, 89, 388-96.
- **Simon**, **J.Z.** (1990). Higher derivative lagrangians, nonlocality, problems, and solutions. *Physical Review D*, 41, 3720.

- New Curriculum Development
  - Quantitative Analysis of Biological Data (Graduate Level Biology), 2002-present;
  - Mathematical Biology (Undergraduate Level Biology), 2005-present.
  - Data Analysis and Modeling component of Neural Systems & Behavior course, Marine Biological Laboratory, Woods Hole, 2001–present.
- Interdepartmental collaborations leading to peer-reviewed journal articles or shared federal grants
  - David Poeppel (Linguistics/Biology, UMCP)
  - Shihab Shamma (Electrical & Computer Engineering, UMCP)
  - Cynthia Moss (Psychology, UMCP)
  - Catherine Carr (Biology, UMCP)
- Curriculum Advisory Council, Exploration School, Inc. (Norwood, MA) 2007–present.

- Instructional videos for new teaching assistants
  - Getting Past Those First Quarter Blues: Interacting With Your Students.
  - Approaches to Problem Solving: The Good & Bad.

#### (v) Collaborators and other Affiliations

## a. Collaborators in past 48 months

| T. Arai         | Sophia U.                   |
|-----------------|-----------------------------|
| M. Aytekin      | U. Maryland                 |
| C. E. Carr      | U. Maryland                 |
| T. Chi          | U. Maryland                 |
| A. de Cheveigné | CNRS, Paris                 |
| D. A. Depireux  | U. Maryland, Baltimore      |
| G. Eden         | Georgetown U.               |
| M. Elhilali     | U. Maryland                 |
| D. L. Flowers   | Georgetown U.               |
| J. B. Fritz     | U. Maryland                 |
| S. Greenberg    | Silicon Speech              |
| D. F. Hill      | Georgetown U.               |
| S. lyer         | Johns Hopkins U.            |
| S. Kalluri      | Starkey Research            |
| D. J. Klein     | U. Maryland                 |
| J. Le Roux      | CNRS, Paris                 |
| H. Luo          | Chinese Academy of Sciences |
| L. Ma           | U. Maryland                 |
| K. MacLeod      | U. Maryland                 |
| C. Moss         | U. Maryland                 |
| D. Poeppel      | U. Maryland                 |
| S. A. Shamma    | U. Maryland                 |
| D. Soares       | U. Maryland                 |

## b. Own Graduate and Postdoctoral Advisors

| Ph.D.:  | J. B. Hartle   | U. California, Santa Barbara |
|---------|----------------|------------------------------|
| Postdoc | J. L. Friedman | U. Wisconsin, Milwaukee      |
|         | BL. Hu         | U. Maryland                  |
|         | S. A. Shamma   | U. Maryland                  |

#### c. Student and Postdoc Supervision

Graduate Students; total = 9; (\* indicates co-advisor)

| Raul Rodriguez-Esteban | MA, U. Maryland (2002). Neural Models of Coincidence Detection  |
|------------------------|---|
| Victor Grau-Serrat     | MA, U. Maryland (2003). Neural Models of Coincidence Detection  |
| Nayef Ahmar            | MA, U. Maryland (2005). Neural Signal Processing                |
| Maria Chait*           | PhD, U. Maryland (2006). Auditory Processing in the Human Brain |
| Juanjuan Xiang         | PhD expected 2007, Auditory Processing in the Human Brain       |
| Claudia Bonin*         | PhD expected 2009, Brain-Computer Interface                     |
| Jiachen Zhuo           | PhD expected 2010, Auditory Processing in the Human Brain       |
| Kim Drnec*             | PhD expected 2010, Somatosensory processing in awake animals    |
| Nai Ding               | PhD expected 2012, Auditory Processing in the Human Brain       |
|                        |   |

Postdocs Supervision; total = 1; (\* indicates co-advisor)

Yadong Wang\*

Postdoc, U. of Maryland (PhD, U. of Rhode Island) 2003-2006

#### Juan Uriagereka Biographical Sketch

## (i) Professional Preparation

| Universidad de Deusto (Bilbao, Spain)<br>University of Connecticut | Philology<br>Linguistics | <i>Licenciatura,</i> 1983 ( <i>magna cum laude</i> )<br>Ph.D., 1988 |
|--|--------------------------|---|
| (ii) Professional Appointments                                     |                          |   |
| University of Maryland   | Linguistics              | Assistant Professor, 1989-1994                                      |
| Georgetown University  | Linguistics              | Adjunct Professor, 1991-1994  |
| University of Maryland   | Linguistics              | Associate Professor, 1994-2000                                      |
| University of the Basque Country                                   | Philology                | Visiting Research Chair, 2002-2005                                  |
| University of Maryland   | Linguistics              | Professor, 2000-  |

(iii) Selected Publications (selected from 88 publications)

## 5 recent publications related to the current proposal:

- J. Reggia, R. Schultz and G. Wilkinson, **J. Uriagereka.** (2001). Conditions enabling the emergence of inter-agent signaling in an artificial world,' *Artificial Life*, 7, 3-32.
- J. Uriagereka. (2002). Cutting Derivational Options. Natural Language & Linguistic Theory, 19, 891-900.
- **J. Uriagereka** and D. Saddy. (2003). Language and Complexity: A tutorial. Special theme issue of the *International Journal of Bifurcation and Chaos* on 'Cognition and Complex Brain Dynamics'.
- M. Piattelli-Palmarini and **J. Uriagereka.** (2005). The Evolution of the Narrow Faculty of Language: The skeptical view and a Reasonable Conjecture. Theme issue of *Lingue e Linguaggio* on 'Language Evolution'.
- H. Lasnik, N. Hornstein and **J. Uriagereka**. (2006). The Dynamics of Islands. In K. Grohmann (ed.) special theme issue of *Linguistic Analysis* on *'Dynamic Interfaces'*.

## 5 Additional recent publications:

- **J. Uriagereka.** (1998). *Rhyme and Reason*, MIT Press, 720 pp. [Won the 1998 American Association of Publishers Award for Best New Professional Book on Language and Literature.]
- J. Uriagereka. (2002). Derivations. Routledge 'Leading Linguists' series, 361 pp.
- J. Uriagereka and H. Lasnik. (2005). A Course in Minimalist Syntax. Blackwell, 312 pp..
- J. Uriagereka. (in press). Syntactic Anchors (On Semantic Structuring). Cambridge University Press.
- **J. Uriagereka** (ed., with M. Piattelli-Palmarini and P. Salaburu) (in press). Of Minds and Language: The Basque Country Encounter with Noam Chomsky, Oxford University Press.

- Recipient of National Research Award of the Basque Country in 2001, and subsequently served as a Basque Country Senior Scientist in 2002-2005, organizing the Basque Observatory for Linguistic Research.
- Founding Member of the Basque Academy of Arts and Sciences (Jakiunde).
- Think-tanks: Member of the G2 Advisory Group to the Basque Presidency, Spain.
- Editorial Boards: Syntax, Probus, Biolinguistics, Linguistic Variation Yearbook, LICOM (Germany), Knowledge of Language Series (Spain), ReVEL (Brazil), Signos Linguisticos (Mexico), Anuario del Seminario Julio de Urkijo (Spain).
- Scientific Boards/Panels: Institució Catalana de Recerca i Estudis Avançats (Spain), Center for Complex Dynamic Systems (Postdam, Germany), Asymmetry Project (Université du Québec á Montreal, Canada), ASG Arbeitsstelle für Strukturelle Grammatik (Humboldt University, Berlin, Germany).
- Reviewer for (among others) Language, Lingua, Linguistic Analysis, Linguistic Inquiry, Natural Language and Linguistic Theory, Probus, The Journal of Linguistics, The Journal of Second Language Acquistion, the Linguistic Review, EvoLang, the Coloquio de Gramatica Generativa,

the Generative Linguistics of the Old World Symposium, the Hispanic Linguistic Society Symposium, the Linguistic Symposium of Romance Linguistics, the North Eastern Linguistic Symposium, the Western Confence on Linguistics, the West Coast Conference on Formal Linguistics, National Science Foundation, European Science Foundation, SSHRC (Canada), the Rockefeller Foundation, Blackwell, Cambridge, MIT Press, Oxford, etc.

- Co-PI in three team-based NSF awards at U of Maryland (1996-1999, 1999-2002, and 2007-2009, \$600,000 total), and two European collaborative projects in Spain (~\$150,000).
- Director of the Graduate Program in Linguistics (1999-2003) (recipient of Outstanding Graduate Director Award from U of Maryland in 2004).
- Organizer of several workshops on language/cognition in several countries, lectures on various topics ranging from biolinguistics to politics, several interviews in the media, collaborator of cultural ensemble )musica(aperta (Washington D.C.).

## (v) Collaborators

#### a. Collaborators in the last 48 months (Graduate students/post-docs listed in (c) below)

| Cedric Boeckx               | Harvard University                        |
|-----------------------------|---|
| Wolfram Hinzen              | University of Amsterdam                   |
| Norbert Hornstein           | University of Maryland                    |
| Howard Lasnik               | University of Maryland                    |
| Massimo Piattelli-Palmarini | University of Arizona                     |
| Eduardo Raposo              | University of California at Santa Barbara |
| Douglas Saddy               | University of Reading                     |

#### b. Own thesis advisor

Howard Lasnik

University of Maryland

#### c. Graduate and Post-doc Supervision

Doctoral Supervision (\* indicates co-advisor), total = 20, including:

| A. Martins*   | PhD, University of Lisbon (1994): University of Lisbon, Portugal        |
|---------------|---|
| J. Nunes      | PhD, University of Maryland (1995): University of Sao Paulo, Brazil     |
| C. Schmitt    | PhD, University of Maryland (1995): Michigan State University           |
| E. Thompson   | PhD, University of Maryland (1996): Florida International University    |
| R. Etxepare   | PhD, University of Maryland (1997): CNRS, France                        |
| K. Muromatsu  | PhD, University of Maryland (1998): Takushoku University, Japan         |
| J.C. Castillo | PhD, University of Maryland (2001): University of Northern Iowa         |
| E. Murgia*    | PhD, University of Maryland (2003): University of Toulouse, France      |
| M. Guimaraes  | PhD, University of Maryland (2004): Universidade do Parana, Brazil      |
| I. San Martin | PhD, University of Maryland (2004): University of Basque Country, Spain |
| J. Drury      | PhD, University of Maryland (2005): McGill University                   |
| L. Pablos*    | PhD, University of Maryland (2006): University of Reading               |
| A. Gallego*   | PhD, University of Barcelona (2007): University of Barcelona            |
| U. Soltan     | PhD, University of Maryland (2007): Middlebury College                  |
| I. Ortega     | PhD, expected 2008, University of Maryland                              |
| S. Hoerner    | PhD, expected 2012, University of Maryland                              |

Postdoc Supervision; total = 2:

| M. Camps     | Postdoc, University of Maryland (PhD Oxford, 2004)            |
|--------------|---|
| J. Gutierrez | Postdoc, University of Maryland (PhD U. Basque Country, 2005) |

#### Amy S. Weinberg Biographical Sketch

## (i) **Professional Preparation:**

| McGill University | Linguistics/Philosophy | BA 1976 (1 <sup>st</sup> cl., joint hons) |
|-------------------|------------------------|---|
| MIT               | Linguistics            | PhD, 1988                                 |

#### (ii) Academic Appointments:

| University of Maryland | Center for Adv. Study of Language | Area Director Technology  |
|------------------------|-----------------------------------|---------------------------|
| University of Maryland | Linguistics/UMIACS                | Associate Prof. 1992-     |
| University of Maryland | Linguistics/UMIACS                | Assistant Prof. 1987-1992 |
| University of Maryland | Linguistics                       | Lecturer 1984-1987        |

## (iii) Selected Publications

#### 5 recent publications related to the current proposal:

- Aoshima, S., C. Phillips, & **A. Weinberg.** (2004). Processing filler-gap dependencies in a head-final language. *Journal of Memory and Language 51*, 23-54.
- Aoshima, S., C. Phillips, & **A. Weinberg**. (2003). Processing of Japanese wh-scrambling constructions. In W. McClure (ed.), *Japanese/Korean Linguistics 12*. Stanford, CA: CSLI Publications.
- Hwa, R, P. Resnik, **A. Weinberg**, C. Cabezas, & O. Kolak (2005). Bootstrapping parsers via syntactic projection across parallel texts. *Natural Language Engineering 11*, 311-325.
- Hwa, R., P. Resnik, **A. Weinberg**, & O. Kolak. (2002). Evaluating translational correspondence using annotation projection. *Proceedings of the 40th Meeting of the Association for Computational Linguistics* (ACL-02).
- Olsen, M. A Weinberg, C. Van Ess-Dykema, & D. Traum, (2001). Implicit cues for explicit generation: using telicity as a cue for tense structure in a Chinese to English MT system. *Proceedings of the MT-Summit VIII*.

## 5 additional recent publications:

- Aoshima, S., Phillips, C., & Weinberg, A. (2003). Theoretical implications of the parsing of Japanese wh-scrambling constructions. In G. Garding & M. Tsujimura (eds.), *Proceedings of WCCFL 22*. Somerville, MA: Cascadilla Press.
- Hwa, R., P. Resnik & **A. Weinberg.** (2002). Breaking the resource bottleneck for multilingual parsing. *Proceedings of the Third International Conference on Language Resources and Evaluation* (LREC-2002).
- Weinberg, A. (2002). Semantics in the spin cycle. In S. Stevenson & P. Merlo (eds.), *Lexical Representation and Sentence Processing*. Amsterdam. John Benjamins.
- Weinberg, A. (1999). A minimalist theory of human sentence processing. In S. Epstein & N. Hornstein (eds.), *Working Minimalism*. Cambridge, MA: MIT Press, pp. 20-88
- Weinberg, A. & M. Olsen. (2000). Acquiring grammatical aspect via lexical aspect: the continuity hypothesis. In *Proceedings of the Boston Univ Conf on Language Acquisition*, Cascadilla Press.

## (iv) Synergistic Activities

 Area Director for Technology in the Center for Advanced Study of Language (2004-2007). Supervised technology and linguistics research at UMD's DoD funded University-Affiliated Research Center (UARC). Founded in 2003, CASL currently employs approximately 60 researchers in second language acquisition, language technology, psychology, anthropology and linguistics to improve performance of US government foreign language professionals.

- Leader for U of Maryland Initiative in Language, Cognition, and Culture: the U of Maryland has embarked on a university-wide initiative to enrich its research and teaching potential in this area. Currently working with the Vice President for Research to formulate university wide strategy and programs, and to assist individual groups in strategic planning and proposal development.
- University Lead Investigator in the DoD Center of Excellence in Human Language Technology. Subcontract from Johns Hopkins U provides funding for a jointly staffed research center to provide basic research to improve language technology for DoD applications.
- Associate Director, Neuroscience and Cognitive Science Program (2002-2004).
- Reviewer for 25 journals in psycholinguistics and computational linguistics.
- Co-organizer of CUNY Conference on Human Sentence Processing, University of Maryland, April 2004 (primary annual conference devoted to psycholinguistics; joint with Colin Phillips).
- Frequently asked to be panel expert for DoD on matters related to Human Language Technology
- Co- director, Language and Media Processing Laboratory and Co-director, Computational Linguistics and Information Processing Laboratory, both in UM Inst for Advanced Computer Studies.

#### (v) Collaborators and other Affiliations:

a. Collaborators in Past 48 months (graduate students are listed in (c) below):

| Sachiko Aoshima     | American University               |
|---------------------|-----------------------------------|
| Rebecca Hwa         | University of Pittsburgh          |
| Thomas Keenan       | Department of Defense             |
| Colin Phillips      | University of Maryland            |
| Mari Olsen          | Microsoft Corporation             |
| Philip Resnik       | University of Maryland            |
| David Traum         | University of Southern California |
| Carol VanEss Dykema | Department of Defense             |

#### b. Own Graduate & Postdoctoral Advisor

Noam Chomsky Massachusetts Institute of Technology

#### c. Graduate Theses and Postdoc Supervision

Postdoctoral Supervision; total =4:

| David Chiang | 2004-2005 (PhD, UPenn), Research Asst Prof., U of Southern California |
|--------------|---|
| Rebecca Hwa  | 2000-2003 (PhD, Harvard), Asst Prof, U of Pittsburgh.                 |
| Mari Olsen   | 1998-2000 (PhD, Northwestern), Senior scientist, Microsoft Research.  |
| David Traum  | 1998-2000 (PhD, Rochester), Research Sci., U of Southern California   |

Graduate Supervision; total = 10 (\* = co-advisor)

| Paola Merlo        | PhD, Linguistics (1993). Assoc. Professor, Universite de Geneve (Ling) |
|--------------------|--|
| Suzanne Stevenson  | PhD, Comp Sci (1994). Assoc. Professor, University of Toronto (CS)     |
| Margaret Antonisse | PhD, Linguistics (2000). Lecturer, University of Maryland (Ling)       |
| Sachiko Aoshima*   | PhD, Linguistics (2003). Asst. Professor, American University (Langs)  |
| Elixabete Murguia* | PhD, Linguistics (2003). Postdoc, University of Deusto (English)       |
| Carol Whitney      | PhD, Neurosci/CogSci (2004). Self employed.                            |
| Burcu Karagol-Ayan | PhD, Comp Sci (2006). Researcher SRI International, Palo Alto (CS).    |
| Lisa Pearl         | PhD, Linguistics (2007). Asst Professor UC Irvine (Cog Sci).           |
| Asad Saeed         | PhD expected 2009: Computer Science                                    |
| Yuval Marton*      | PhD expected 2009: Linguistics   |

## Amanda L. Woodward

Biographical Sketch

#### (i) Professional preparation

| Swarthmore College  | Psychology |
|---------------------|------------|
| Stanford University | Psychology |
| Cornell University  | Psychology |

BA, 1987 PhD,1992 Postdoctoral Researcher, 1992-1993

#### (ii) Academic Appointments

| University of Maryland | Psychology/NACS         | Professor, 2005-present          |
|------------------------|-------------------------|----------------------------------|
| University of Chicago  | Psychology/Human Devel. | Associate Professor, 2003-2005   |
| University of Chicago  | Psychology              | Assistant. Professor, 1993-2000. |

(iii) Publications (selected from 40 publications)

Five most closely related to the current proposal:

- Woodward, A. L. (2000). Constraining the problem space in early word learning. In R. Golinkoff, K. Hirsh-Pasek, L. Bloom, G. Hollich, L. Smith, A. L. Woodward, Akhtar, L., Tomasello, M., & Hollich, G. (Eds.) *Becoming a word learner: A debate on lexical acquisition*.(pp. 81-114). Oxford: Oxford University Press..
- Woodward, A. L. (2003). Infants' use of action knowledge to get a grasp on words. In D. G. Hall and S. R. Waxman (eds.) *Weaving a lexicon* (pp. 149-172). Cambridge, MA: MIT Press.
- Woodward, A. L. (2005). Infants' understanding of the actions involved in joint attention. In N. Eilan, C. Hoerl, T. McCormack and J. Roessler (eds.) *Joint attention: Communication and other minds* (pp. 110-128). Oxford University Press.
- Buresh, J., Wilson Brune, C., & Woodward, A. L. (2006). Prelinguistic action knowledge and the birth of verbs. In K. Hirsh-Pasek & R. Golinkoff (eds). *Action meets words* Oxford University Press.
- Koenig, M. A., & **Woodward, A. L**. (2007). Word learning. In M. G. Gaskell (Ed.) *The Oxford Handbook of Psycholinguistics*. Oxford: Oxford University Press.

Five other significant publications:

- Woodward, A. L. (in press). The infant origins of intentional understanding. In R. V. Kail (ed.) Advances in Child Development and Behavior, Volume 33. Oxford: Elsevier.
- Buresh, J. S. & **Woodward, A. L.** (in press). Infants track action goals within and across agents. *Cognition.*
- Sommerville, J. A., **Woodward, A. L.**, & Needham, A. (2005). Action experience alters 3-month-old infants' perception of others' actions. *Cognition*, *96*, B1–B11
- Brune, C. W., & **Woodward, A. L**. (in press). Social cognition and social responsiveness in 10-month-old infants. *Journal of Cognition and Development.*
- Woodward, A. L. (2003). Infants' developing understanding of the link between looker and object. *Developmental Science*, 6:3, 297-311.

- Extensive peer review and editorial service in experimental psychology, cognitive science, and general science. Current activities include Associate Editor of *Developmental Psychology (APA)*; editorial board member for the *Journal of Experimental Psychology:General (APA)* and *Language Learning and Development;* Reviewer for numerous journals in developmental and experimental psychology as well as cross-disciplinary outlets (e.g., *BBS, Science, TICS*); Standing member of the NIH Cognition and Perception Review Panel, College of Reviewers for the Canada Research Chairs Program, grant reviewer for the National Science Foundation.
- Development of cross-disciplinary doctoral training via academic leadership. Current activities include: founder and director of the Field Committee in Developmental Science (devsci.umd.edu); head of the graduate program in Developmental Psychology within the Psychology Department;

and Graduate Director for the interdisciplinary doctoral Program in Neuroscience and Cognitive Science (nacs.umd.edu).

- Activities to support synergistic communication among developmental scientists include: Coorganizer of an NSF sponsored conference on New Approaches to Infant Learning and Infant Cognition, 2005; Co-editor of the resulting book (to be published by Oxford University Press); and organizer of invited symposia at international meetings, including the International Society for Infant Studies, the American Psychological Association, and The Jean Piaget Society.
- Research mentor in programs to encourage the pursuit of scientific careers for high school and college students, including members of underrepresented minorities. Current activities include: mentor in the Research Practicum program at Eleanor Roosevelt High School, a public science magnet program in Prince George's County, MD (3 current students, 3 students in prior years); Mentor in the University of Maryland NACS Summer Internship Program for Undergraduates (http://nacs.umd.edu/program/summer.html) (2 students).
- Outreach activities to communicate the goals and achievements of developmental science include: Co-director of the UMD Infant Studies Consortium (infantstudies.umd.edu), appeared in the documentary television series *The Baby Human* (Discovery Health Channel); Interviews for parent-directed outlets (e.g. *Parenting Magazine*); appearances in local news programs.

#### (v) Collaborators and other affiliations

a. Collaborators in Past 48 months (graduate students and postdocs are listed in (c) below)

|                      | montile (graduate etadente and peetaeee are n |
|----------------------|---|
| Jane Clark           | University of Maryland                        |
| Jose Contreras-Vidal | University of Maryland                        |
| Nathan Fox           | University of Maryland                        |
| Jane Kiley Hamlin    | Yale University                               |
| Susan Levine         | University of Chicago                         |
| Jeff Lidz            | University of Maryland                        |
| Amy Needham          | Duke University                               |
| Rochelle Newman      | University of Maryland                        |
| Nan Ratner           | University of Maryland                        |
| Beate Sodian         | Ludwig Maximillian University of Munich       |
|                      | - ,   |

## b. Own Graduate and Postdoctoral advisors

| Ellen Markman    | Stanford University                            |
|------------------|--|
| Elizabeth Spelke | Cornell University (now at Harvard University) |
| Frank Keil       | Cornell University (now at Yale University)    |

#### c. Graduate Theses and Postdoctoral Supervision

| Jose Guajardo           | Ph.D, University of Chicago (2002): Researcher, Microsoft  |
|-------------------------|--|
| Jessica Sommerville     | PhD, University of Chicago (2002): Asst. Professor, Department of  |
|                         | Psychology University of Washington, Seattle   |
| Camille Wilson-Brune,   | PhD, University of Chicago (2004): Research Assistant Professor,   |
|                         | Department of Psychiatry, University of Illinois - Chicago   |
| Jessica Heineman Pieper | PhD, University of Chicago (2005).   |
| Amrisha Vaish,          | MA, University of Chicago (2006): doctoral student at the Max Planck<br>Institute for Cognitive Anthropology, Leipzig, Germany |
| Jennifer Buresh         | PhD, University of Chicago (2007), Post doctoral researcher, University  |
|                         | of Chicago, and instructor, Erickson Institute, Chicago  |
| Melissa Koenig          | post doctoral 2004-2007: Assistant Professor, Institute for Child  |
| -                       | Development, University of Minnesota   |
| Sarah Gerson            | PhD expected 2011, University of Maryland  |
|                         |  |

#### **Postdoctoral Supervision; total = 2:**

| Erin Cannon       | (PhD 2006, University of Mass., Amherst), 2006 - present |
|-------------------|--|
| Annette Henderson | (PhD 2007, Queens University, Canada), 2007 - present    |

## Aniela Improta França

Biographical Sketch

#### (i) Professional Preparation

| Faculdade da Cidade          | Language    | BA, 1992  |
|------------------------------|-------------|-----------|
| Federal U. of Rio de Janeiro | Linguistics | MA, 1994  |
| Federal U. of Rio de Janeiro | Linguistics | PhD, 2002 |

## (ii) Academic Appointments

| Federal U. of Rio de Janeiro | Linguistics                   | Assistant Professor, 1992-1994         |
|------------------------------|-------------------------------|--|
| Federal U. of Rio de Janeiro | Linguistics                   | Associate Professor, 1994-present      |
| Federal U. of Rio de Janeiro | Linguistics- Graduate School  | Core Professor, 1996-present           |
| Federal U. of Rio de Janeiro | Adv Neurosci. Prog (Med Sch.) | Researcher and Professor, 1995-present |

(iii) Selected Publications (selected from 24 publications) 5 recent publications related to the current proposal:

- **França, A.I.** (2006). Introduction to neurolinguistics. In: Ingrid Finger; Carmen Matzenauer. (eds.). TEP (Textos em Psicolingüística) [CD-ROM]. Pelotas: Educat, v. 1, pp. 1-52
- Cagy, M., Infantosi, A.F.C., **França, A.I.**, & Lemle, M. (2006). Statistical analysis of event-related potential elicited by verb-complement merge in Brazilian Portuguese. *Brazilian Journal of Medical and Biological Research*, 39, 1001-1008.
- **França, A.I.**, Cagy, M., Lemle, M., Constant, P., & Infantosi, A.F.C. (2004). Discriminating among different types of verb-complement merge in Brazilian Portuguese: An ERP study of morpho-syntactic sub-processes. *Journal of Neurolinguistics*, 17, 425-437.
- **França, A.I.** (2006). Estudo de diferentes módulos cognitivos na aquisição e no córtex. In: Ingrid Finger; Carmen Matzenauer. (Org.). TEP (Textos em Psicolingüística) [CD-ROM]. Pelotas: Educat, pp. 110-320.
- **França, A.I.** (2005). Neurofisiologia da linguagem: aspectos micromodulares. In M. Maia & I. Finger (eds.) Investigações em Psicolingüística GT de Psicolingüística da Anpoll. Pelotas: Educat, pp. 459-479.

5 additional recent publications:

- **França, A.I.**, Lemle, M., Infantosi, A.F.C., & Cagy, M. (2006). Conexões Conceptuais: um estudo de ERPs sobre a inescapável sintaxe na semântica. *Revista Letras*, 69, 35-49.
- França, A.I., Lemle, M., Pederneira, I.L., & Gomes, J.N. (2005). Conexões Conceptuais: um estudo psicolingüístico de priming encoberto. *Lingüística*, 1, 283-299.
- Lemle, M. & França, A.I. (2006). Arbitrariedade Saussureana em Foco. Revista Letras, 69, 31-64.
- França, A.I. (2006). A epistemologia lingüística e a neurofisiologia da linguagem. *Revista Brasileira de Cancerologia*, 52, 266-270.
- **França, A.I.** (2005). O léxico mental em ação: muitas tarefas em poucos milissegundos. *Lingüística* 1, 47-82.

- Head of Linguistics Department of the Federal University of Rio de Janeiro
- Editorial board: Revista Neurociencias, Revista Linguistica, Revista Psicologia Hoje, Revista Ciencia e Cognição, Revista Ciência Hoje.
- Vice Director: Linguistics Workgroup of ANPOLL (Language, Literature and Linguistic Society of Brazil).
- Organizer of numerous conferences and workshops (e.g. UFRJ-UMD Workshop on Neuroscience of Language; Laboratory Phonology; Interfaces of Syntax). Frequently invited

speaker (26 courses/workshops/conferences since 2002) on "synergy" among linguistics, psychology and neuroscience in several universities all over Brazil and in International events such as the 7<sup>th</sup> Sao Paulo Research Conference.

• Development and teaching of a new undergraduate course on Cognitive Neuroscience offered by the Advanced Program on Neuroscience from the Medical School of the Federal University of Rio de Janeiro.

#### (v) Collaborators and other Affiliations

#### a. Collaborators in Past 48 months (graduate students and postdocs are listed in (c) below)

| Miriam Lemle      | Linguistics, Federal University of Rio de Janeiro    |
|-------------------|--|
| Marcus Maia       | Linguistics, Federal University of Rio de Janeiro    |
| Leonardo Azevedo  | Fundação Oswaldo Cruz - Hospital Fernandes Figueira  |
| João da Franca    | Medical School, Federal University of Rio de Janeiro |
| Rogério Panizutti | Medical School, Federal University of Rio de Janeiro |

#### b. Own Graduate Advisor

Miriam Lemle Federal University of Rio de Janeiro

#### c. Graduate Thesis Supervision

| Juliana Novo Gomes  | Linguistics - MA, (started Aug, 2006) – Federal U. of Rio de Janeiro  |
|---------------------|---|
| Edna Maria de Souza | Linguistics - PhD, (started Aug, 2006) – Federal U. of Rio de Janeiro |
| Luiz de Carvalho    | Linguistics - MA, (started Mar, 2007) – Federal U. of Rio de Janeiro  |
| Fernanda Botinhao   | Medical School - PhD, (started Aug, 2007) - Federal U. of Rio Janeiro |
| Marije Soto         | Linguistics - MA, (started Aug, 2007) – Federal U. of Rio de Janeiro  |

## Masatoshi Koizumi

**Biographical Sketch** 

## (i) Professional Preparation

| International Christian U. | Linguistics           | BA, 1988  |
|----------------------------|-----------------------|-----------|
| Ohio State University      | East Asian Lang & Lit | MA, 1991  |
| MIT                        | Linguistics           | PhD, 1995 |

## (ii) Academic Appointments

| Tohoku Gakuin University | English     | Assistant Professor, 1995-1996    |
|--------------------------|-------------|-----------------------------------|
| Tohoku Gakuin University | English     | Associate Professor, 1996-2000    |
| Tohoku University        | Linguistics | Associate Professor, 2000-present |

(iii) Selected Publications (selected from 58 publications):

5 recent publications related to the current proposal:

- **Koizumi, M.**, & K. Tamaoka. (2004). Cognitive processing of Japanese sentences with ditransitive verbs. *Gengo Kenkyu (Journal of the Linguistic Society of Japan)* 125, 173-190.
- Tamaoka, K., Sakai, H., Kawahara, J., Miyaoka, Y., Lim, H., & Koizumi, M. (2005). Priority information used for the processing of Japanese sentences: Thematic roles, case particles or grammatical functions? *Journal of Psycholinguistic Research*, 34, 273-324.
- Kimura, N., Kim, J., & **Koizumi, M.** (2005). Sentence processing and phrase structural determinacy of aspect in Japanese. *Lexicon Forum* 1, 1-29.
- **Koizumi, M.**, & Tamaoka, K. (2006). Determination of basic word order of adverbs in Japanese by a sentence processing experiment [Bunkaisekijikken-niyoru nihongo-fukushirui-no gojyun-no hantei]. *Cognitive Studies* 13, 392-403.
- Sakai, Y., Iwata, K., Riera, J., Wan, X., Yokoyama, S., Shimoda, Y., Kawashima, R., Yoshimoto, K., &
  Koizumi, M. (2006). An ERP study of agreement between nouns and numeral classifiers in Japanese
  [Jishoukanrendeni-de miru meishi-to jyosushi-no shougou-purosesu]. *Cognitive Studies* 13, 301-315.

5 additional recent publications:

- Koizumi, M. (1998). Invisible Agr in Japanese. The Linguistic Review 15, 1-39.
- Koizumi, M. (2000). String vacuous overt verb raising. Journal of East Asian Linguistics 9, 227-285.
- **Koizumi, M.** (2002). The split VP hypothesis: Evidence from language acquisition. In Mengistu Amberber & Peter Collins (eds.) *Language Universals and Variation*, pp. 61-81. Praeger: New York.
- Koizumi, M. (2005). Syntactic structure of ditransitive constructions in Japanese: Behavioral and imaging studies. In Y. Otsu (ed.) *The Proceedings of the Sixth Tokyo Conference on Psycholinguistics*, pp. 1-25. Hituzi Shobo Publishing Company.
- Koizumi, M. (2006). The split VP hypothesis. In R. Freidin and H. Lasnik (eds.) Syntax: Critical Concepts in Linguistics, pp. 244-273. Routledge.

- Editorial board: *Journal of East Asian Linguistics*. Reviewer for many journals in linguistics and cognitive science, and for proposals to granting agencies in these areas.
- Member of the executive committee: Linguistic Society of Japan
- Frequently invited speaker (20 courses/workshops/conferences since 2000) on "synergy" among linguistics, psychology and neuroscience
- Unit leader in the Tohoku University 21st Century Center of Excellence Program in Humanities (2002-2007), a large training grant from the Japanese Ministry of Education, Culture, Sports, Science and Technology, which is a counterpart of NFS's IGERT program.

- Organizer of numerous conferences and workshops (e.g. CBL Seminar at Tohoku University, Japan, 2005; An International Workshop on Language, Brain and Cognition in Cambridge, UK, 2004; Formal Approaches to Japanese Linguistics 1 at MIT, 1993)
- Development and teaching of a new graduate course on Developmental Cognitive Neuroscience that incorporates a large-scale behavioral as well as ERP and NIRS practicum with preschoolers.

## (v) Collaborators and other Affiliations

a. Collaborators in Past 48 months (graduate students and postdocs are listed in (c) below)

| Jiro Gyoba        | Tohoku University                                |
|-------------------|--|
| Hiroko Hagiwara   | Tokyo Metropolitan University                    |
| Kaoru Horie       | Tohoku University                                |
| Miwa Isobe        | Tokyo National University of Fine Arts and Music |
| Jun'ichi Kawahara | Hiroshima University                             |
| Ryuta Kawashima   | Tohoku University                                |
| Yayoi Miyaoka     | Hiroshima University of Economics                |
| Hiromu Sakai      | Hiroshima University                             |
| Kuniyoshi Sakai   | University of Tokyo                              |
| Shigeru Sato      | Tohoku University                                |
| Koji Sugisaki     | Mie University                                   |
| Katsuo Tamaoka    | Hiroshima University                             |
| Kei Yoshimoto     | Tohoku University                                |
| Noriaki Yusa      | Miyagi Gakuin Women's University                 |
|                   |  |

#### b. Own Graduate & Postdoctoral Advisor

Noam Chomsky MIT

## c. Graduate Theses and Postdoc Supervision

Graduate Supervision:

| Masahiko Nose   | PhD, Tohoku U. (2002). Postdoc, Tohoku University                                |
|-----------------|--|
| Ken'ichi Mihara | PhD, Tohoku U. (2005). Professor, Osaka University of Foreign Studies            |
| Jungho Kim      | PhD, Tohoku U. (2006). Postdoc, Tohoku University                                |
| Eun-mi Song     | PhD, Tohoku U. (2007). Part-time Lecturer at several universities in South Korea |
| C C             |  |

Postdoc Supervision:

| Jungho Kim      | Postdoc (PhD, Tohoku U.), Tohoku U. & Japan Society for the Promotion of Science | 2006-present |
|-----------------|--|--------------|
| Mikihiro Tanaka | Postdoc (PhD, U. of Edinburgh), Tohoku U. & Japan Science and Technology Agency  | 2007-present |
| Takuya Goro     | Postdoc (PhD, U. of Maryland), Tohoku U. & Japan Science and Technology Agency   | 2007-present |

#### Marcus Maia Biographical Sketch

#### (i) **Professional Preparation**

University Gama Filho (Brazil) University of Southern California City University of New York

(ii) **Professional Appointments** 

The Indian Museum (Brazil) University of Southern California Federal University of Rio de Janeiro Federal University of Rio de Janeiro Linguistics Sentence Processing

Portuguese

Language Documentation Portuguese Linguistics Linguistics B.S., 1976 Ph.D., 1994 Visiting Scholar, 2003-2004

Researcher 1986 -1990 Teaching Assistant, 1992-1994 Assistant Professor 1994-1996 Associate Professor 1997-

(iii) Selected Publications (selected from over 50 publications):

5 recent publications related to the current proposal:

- Maia, M., Fernández, E., Costa, A., Lourenço-Gomes, M. Do C. (2007). Early and late preferences in relative clause attachment in Portuguese and Spanish. *Journal of Portuguese Linguistics*, 5/6, 227-250.
- Maia, M. (2007). Evidentiality Processes in Karaja. In Z. Guentcheva & J. Landaburu (eds.) L'énontiation mediatisée II. Louvain Paris: Peeters, pp.293-310.
- Maia, M. (2007). Manual de Lingüística: subsídios para a formação de professores indígenas na área de linguagem. Brasília: Ministério da Educação, Secretaria de Educação Continuada, Alfabetização e Diversidade; LACED/Museu Nacional.
- Maia, M., Lemle, M. & França, A. (in press). Efeito Stroop e Rastreamento Ocular no Processamento de Palavras. To appear in *Revista Ciência & Cognição*.
- Magalhães, J. O. De, **Maia, M. A. R.** (2006). Implicit prosodic cues in the resolution of syntactic ambiguities: An attribute adjunction case [Pistas prosódicas implícitas na resolução de ambiguidades sintáticas: um caso de adjunção de atributos]. *Journal of the Brazilian Linguistics Association [Revista da ABRALIN]*, 5, 143-168.

5 additional recent publications:

- Maia, M. A. R. (2006). Revitalizing indigenous languages and the challenges of inter-cultural bilingual education [A revitalização de línguas indígenas e seu desafio para a educação inter-cultural bilíngüe]. *Tellus*, 11, 61-76
- Maia, M. A. R., Vieira, M. D., Franchetto, B., Leite, Y. F., Soares, M. F. (1998). A comparison of different aspects of some Brazilian indigenous languages [Comparação de Aspectos da Gramática em Algumas Línguas Indígenas Brasileiras]. DELTA, 14(2), 349-375
- Maia, M. A. R. (1996). The Comprehension of Object Anaphora in Brazilian Portuguese. In: M. L. Zubizarreta & M. Saltarelli. (Ed.). Aspects of Romance Linguistics. Washington: Georgetown University Press, 293-311.
- Maia, M. A. R., Maia, J. M. (2004). Comprehension of relative clauses by monolingual and bilingual speakers of Portuguese and English [A Compreensão de Orações Relativas por Falantes Monolíngües e Bilíngües de Português e de Inglês]. *Revista Letra*, 1, p. 68-80
- Maia, M. A. R., Franchetto, B., Leite, Y. F., Soares, M. F., Vieira, M. D. (1999). Clausal structure in Brazilian indigenous languages [A Estrutura da Oração em Línguas Indígenas Brasileiras]. DELTA, 15(1), 1-26

## (iv) Synergistic Activities

 Currently one of the coordinators of the Linguistics Sector within the Anthropology Department of the National Museum (Museu Nacional/UFRJ), operating under the auspices of the Federal University of Rio de Janeiro. Active in research on Brazilian indigenous languages since 1981, and in the area of education for indigenous people since the mid 1980s. Affiliated with the Museu do Indio (Brazilian Indian Museum), which operates under the umbrella of the Brazilian Indian Foundation (FUNAI), where he investigated the educational situation of the Karaja people in central Brazil. Ongoing work in education initiatives of indigenous peoples, helping in the production of educational material such as dictionaries and school textbooks in different indigenous languages.

- Served since 2001 as a consultant and a professor in the Higher Education Project for Indigenous Peoples (Projeto do 3o Grau Indígena), where students of several indigenous groups that have been able to complete high school education within their communities are now seeking a university degree. In 2006 three students from two different groups (Kaingang and Karajá) completed undergraduate degrees under his supervision, with the following theses: Marcia Nascimento Kaingang. (2006). Yes/no interrogative sentences in the Kaingang language [Frases interrogativas Sim-Não na língua Kaingang]. Wadoi Karajá. (2006). Karajá Syntax [Sintaxe Karajá]. Woubedu Karajá. (2006). The linguistic invasion in the Hãwalo camp. [A invasão lingüística na aldeia Hãwalo].
- General Coordinator of the Psycholinguistics work group at ANPOLL (the Brazilian national association in graduate research on linguistics and literature). Established the first psycholinguistics lab to use eye-tracking technology in Brazil.
- Organizer of national conferences and workshops (e.g. 1st Language Processing Workshop at UFRJ, 2005 and the national meeting of the Psycholinguistics work group at ANPOLL, 2007).
- Co-editor (with Ingrid Finger) of the book Processamento da Linguagem. Porto Alegre: Educat, (2005) 535pp. Editorial board: Lingüística. Reviewer for many journals in linguistics, and for proposals to granting agencies in these areas.

## (v) Collaborators and other Affiliations

a. Collaborators in Past 48 months (graduate students and postdocs are listed in (c) below)

| Eva Fernandez          | CUNY Graduate Center                       |
|------------------------|--|
| Armanda Costa          | U. of Lisbon                               |
| José Olímpio Magalhães | Federal University of Minas Gerais, Brazil |
| Miriam Lemle           | Federal University of Rio de Janeiro       |
| Aniela Improta França  | Federal University of Rio de Janeiro       |
| João Moraes            | Federal University of Rio de Janeiro       |
| Filomena Sândalo       | Campinas State University                  |
| Bruna Franchetto       | Federal University of Rio de Janeiro       |
| Luciana Storto         | São Paulo State University                 |
|                        | 5  |

#### b. Own Graduate & Postdoctoral Advisors

| Yonne de Freitas Leite | Federal University of Rio de Janeiro                      |
|------------------------|---|
| Joseph Aoun            | USC, currently President, Northeastern University, Boston |
| Maryellen MacDonald    | USC, currently at U of Wisconsin/Madison                  |

#### c. Graduate Theses and Postdoc Supervision

Graduate Supervision (\*indicates co-advisor); total = 9:

| Maria de Fátima B. de Melo*            | PhD, UFRJ (2003). Asst Professor, Federal U. of Paraíba            |
|--|--|
| Marcio Leitão                          | PhD, UFRJ (2005). Asst Professor, Federal U. of Paraíba            |
| Paulo Antonio P. Correa                | PhD, UFRJ (2007). Asst Professor, Federal U. of Sergipe            |
| Rosana C. de Oliveira                  | PhD, UFRJ (2007). Visiting Professor, Mato Grosso State University |
| Cirineu C. Stein*                      | PhD expected 2008, UFRJ, psycholinguistics                         |
| Eduardo K. Areas                       | PhD expected 2008, UFRJ, psycholinguistics                         |
| Guiomar Albuquerque                    | PhD expected 2008, UFRJ, psycholinguistics                         |
| M <sup>a</sup> do Carmo Lourenço-Gomes | PhD expected 2008, UFRJ, psycholinguistics                         |
| Katia Abreu*                           | PhD expected 2010, UFRJ, linguistics                               |
| Postdoc Supervision; total = 1         |  |

José Olímpio Magalhães Postdoc (PhD, UFRJ), 2006-present

#### Hiromu Sakai Biographical Sketch

#### (i) **Professional Preparation**

| Kyoto University, Japan     | Linguistics    | BA, 1984                          |
|-----------------------------|----------------|-----------------------------------|
| Kyoto University, Japan     | Linguistics    | MA, 1988                          |
| UC Irvine                   | Social Science | PhD, 1996                         |
| (ii) Academic Appointments  |                |                                   |
| Hiroshima University, Japan | Linguistics    | Assistant Professor, 1995-2002    |
| Hiroshima University, Japan | Linguistics    | Associate Professor, 2002-present |

(iii) Selected Publications (selected from 34 publications):

5 recent publications related to the current proposal:

- Fukui, N. & **Sakai, H.** (2003). The visibility guideline for functional categories: Verb raising in Japanese and related issues, *Lingua*, 113, 321-375.
- Sakai, H., Ivana, A., & Zhang, C. (2004). The role of light verb projection in transitivity alternation, *English Linguistics*, 21, 348-375.
- Tamaoka, K., Sakai, H., Kawahara, J., Miyaoka, Y., Lim, H.-J., & Koizumi, M., (2005). Priority information used for the processing of Japanese sentences: thematic roles, case particles or grammatical functions?, *Journal of Psycholinguistic Research*, 34, 281-332.
- Ivana, A. & Sakai, H. (2007). Honorification and light verbs in Japanese, *Journal of East Asian Linguistics*, 16, 171-191.
- Tanaka, J., Tamaoka, K., & **Sakai, H.**, (2007). Syntactic priming effects on the processing of Japanese sentences with canonical and scrambled word orders, *Cognitive Studies*, 14, 173-191.

5 additional recent publications:

- Tamaoka, K., Lim, H.-J., & **Sakai, H.**, (2005). Entropy and redundancy of Japanese lexical and syntactic compounds, *Journal of Quantitative Linguistics*, 11, 233-250.
- Sakai, H., Yoshimura, M., Tanaka, J., Fiorentino, R., & Kazanina, N. (2005). Online processing of allomorphic alternation in compound words, *Proceeding of the 131st Meeting of Linguistics Society of Japan*, 372-377.
- Sakai, H., Miyatani, M. Tanaka, J., Yoshimura, M., Maruishi, M., Muranaka, H., Fiorentino, R., & Poeppel, D. (2006). Cortical structures for compound processing in auditory language comprehension: An fMRI investigation, *Proceeding of the 23rd National Conference of Cognitive Science Society of Japan*, 34-37.
- Tanaka, J., Tamaoka, K., & Sakai, H. (2007). Effects of syntactic priming and verb repetition in the comprehension of Japanese sentences, In Sakamoto, T. (ed.) *Communicating Skills of Intention*, Hitsuji Shoboo, pp. 213-237.
- Ono, H., Tanaka, J., & **Sakai, H.** (2007). Word order and clause boundary Insertion: Behavioral and ERP studies, *Japanese Institute of Electronics, Information and Communication Engineers Technical Report 107, (Proceedings of Mental Architecture of Processing and Learning of Language 2007), pp. 115-120.*

- Director of Project Center for Brain Science of Language Acquisition and Language Learning, Hiroshima University (2002-current)
- Board of Councilors: The Linguistic Society of Japan (2003-current), The English Linguistic Society of Japan (2007-current)
- Member of Editorial Board: Journal of East Asian Linguistics (2006-current), English Linguistics (2007-current), Journal of Japanese Grammar (2004-2006). Reviewer for linguistic journals: Linguistic Inquiry, Natural Language and Linguistic Theory, Lingua, Gengo-Kenkyu (Linguistic

Research), English Linguistics, etc. Reviewer for Japan Society for Promotion of Science Research Fellowship for Young Scientists (2005-2007).

- Conference Organizing Committee: The Linguistic Society of Japan (2001-2003), The English Linguistic Society of Japan (2001-2003). Local Organizer of many conferences and workshops: The Linguistic Society of Japan 131st National Meeting; Mental Architecture of Processing and Learning of Language 2007, etc.
- Member of the research group of Priority Areas <Higher-Order Brain Functions> by the Japanese Ministry of Education, Culture, Sports, Science and Technology; Unit leader of the RISTEX 'Brain Science and Education' Project (An Integrated study of language learning, brain development, and language education: Project Leader, Hiroko Hagiwara, Tokyo Metropolitan University) by the Japan Science and Technology Agency.
- PI for 'Cross-Border Training Program for Second Language Studies' in the Graduate School of Education, Hiroshima University. Submitted for the ITP (International Training Program for Younger Researchers) from the Japanese Society for Promotion of Science and Technology (counterpart of NFS's IGERT program), ranked as 'A (higest)' among unsuccessful programs in 2007. To be revised and resubmitted.

#### (v) Collaborators and other Affiliations

a. Collaborators in Past 48 months (graduate students and postdocs are listed in (c) below)

| Kuniyoshi Sakai   | Tokyo University, Japan     |
|-------------------|-----------------------------|
| Katsuo Tamaoka    | Hiroshima University, Japan |
| Makoto Miyatani   | Hiroshima University, Japan |
| David Poeppel     | University of Maryland      |
| Robert Fiorentino | University of Kansas        |
| Nina Kazanina     | University of Bristol, UK   |

## b. Own Graduate & Postdoctoral Advisor

| CT. James Huang | Harvard University       |
|-----------------|--------------------------|
| Naoki Fukui     | Sophia University, Japan |

# c. Graduate Theses and Postdoc Supervision

| Graduate Supervision, t | Ulai – To.  |
|-------------------------|---|
| Harold Kusters          | PhD, Hiroshima University (2003). Mazda Inc., Hiroshima, Japan                  |
| Chizuko Matsuoka        | PhD, Hiroshima University (2004). Lecturer., Pusan U. of Foreign Studies, Korea |
| Chao Zhang              | PhD, Hiroshima University (2005). Assistant Prof., Shanghai Maritime University |
| Adrian Ivana            | PhD, Hiroshima University (2006). Japanese Syntax, Syntactic Theory             |
| Marcia A. Kaida         | MA, Hiroshima University (2000). Japanese Syntax & Semantics                    |
| Soo-Min Lee             | MA, Hiroshima University (2000). Japanese Syntax & Semantics                    |
| Gundogdu Gengiz         | MA, Hiroshima University (2004). Sociolinguistics, Pragmatics                   |
| Naoko Kotake            | MA, Hiroshima University (2004). Japanese Syntax & Semantics                    |
| Jun-Ichi Tanaka         | MA, Hiroshima University (2005). Psycholinguistics, Cognitive Neuroscience      |
| Lai Chan                | MA, Hiroshima University (2005). Japanese Syntax & Semantics                    |
| Chiu Rosalynn S.        | PhD expected 2010, Hiroshima University, Psycholinguistics                      |
| Deng Ying               | PhD expected 2010, Hiroshima University, Psycholinguistics, L2 Acquisition      |
| Young-Jie Kim           | PhD expected 2010, Hiroshima University, Japanese Syntax & Semantics            |
| Baris Kahraman          | MA expected 2008, Hiroshima University, Psycholinguistics                       |
| Sheng-Yan Long          | MA expected 2008, Hiroshima University, Psycholinguistics                       |
| Luo Wei                 | MA expected 2008, Hiroshima University, Psycholinguistics                       |
| Atsushi Sato            | MA expected 2008, Hiroshima University, Psycholinguistics                       |
| Kyoko Sakamoto          | MA expected 2009, Hiroshima University, L2 Acquisition                          |
|                         |   |
|                         |   |

Postdoc/Research Fellow Supervision; total = 2:

| Hajime Ono       | Postdoc, Hiroshima University (PhD, U. of Maryland) | 2006-current |
|------------------|---|--------------|
| Megumi Yoshimura | Research Fellow, JST (MA, Kyushu University)        | 2005-current |

### Udaya Narayana Singh Biographical Sketch

#### (i) **Professional Preparation**

| University of Calcutta | Linguistics | B.A. 1972  |
|------------------------|-------------|------------|
| Delhi University       | Linguistics | M.A. 1975  |
| Delhi University       | Linguistics | Ph.D. 1979 |

### (ii) Appointments

| Central Institute of Indian Langs, Mysore, Inc | lia. Director.          | 2000-present |
|--|-------------------------|--------------|
| Centre for Applied Ling & Transl Studies, U d  | of Hyderabad. Professor | 1987-2000    |
| Dept of Linguistics, Delhi University          | Reader                  | 1985-1987    |
| Dept of Linguistics, South Gujarat U.          | Reader                  | 1981-1985    |
| Dept of Linguistics, U of Baroda               | Lecturer                | 1979-1981    |

(iii) Publications (selected from 150 publications)

5 Publications most closely related to current proposal

- **Singh, U.N**. (2007) <u>Translation as Growth. Towards a Theory of Language Development</u>. Pearson Education: Singapore.
- **Singh, U.N.** (2003) Life after Death: Patterns of Language Loss in South Asia. in J. Lindsay and T. Ying (eds). <u>Babel or Behemoth: Language Trends in Asia</u>. Asia Research Institute: Singapore.
- **Singh, U.N**. (1996) Code-switching in Lahanda Speech Community: A sociolinguistic survey. International Journal of Dravidian Linguistics 25:152-154.
- **Singh, U.N**. (1995) Standard language in education: The moltening effect. in I. Hasnain (ed.) <u>Standardization and Modernization: Dynamics of Language Planning</u>. Bahri Publications: Delhi.
- **Singh, U.N.** (1993) Some aspects of the Hindi-Maithili Divide: Evidence from syntax. <u>Bulletin of the</u> <u>Deccan College Research Institute</u> 51, 391-397.

5 Selected Additional Publications:

- Singh, U.N. (2006) India Writes: A Story of Linguistic and Literary Plurality. National Book Trust: New Delhi.
- **Singh, U.N.** (2001) Sociolinguistics thus far and further. <u>Journal of Social Science & Humanities</u>, Indian Institute of Advanced Study, Shimla.

**Singh, U.N.** (2000) Thoughts on transcreation of texts. In R.E. Asher & Roy Harris, (eds) Linguisticoliteracy. Delhi: Pilgrim Books. 462-487.

- Singh, U.N. & S. Padikkal (1998) <u>Suniti Kumar Chatterji: An End-centenary Tribute</u>. New Delhi: Sahitya Akademi
- **Singh, U.N.** (1993) Towards a historiography of Maithili language development. <u>Pondicherry Journal of</u> <u>Dravidic Studies</u> 2:205-26.

- Organized numerous conferences and summer institutes on machine translation, psycholinguistics, language policy and general linguistics.
- Director of Linguistic Survey of India, a national project to document all of the languages of India.
- Director of major project on documenting and promoting endangered and less well-documented languages of India.
- Past editor in chief: Indian Linguistics.
- Worked with UNESCO on global multilingualism policy.

- Director of Longman-CIIL Dictionaries project, geared towards creation of comprehensive dictionaries for Indian Languages.
- Director of Linguistic Data Consortium of Indian Languages, geared towards creating electronic corpora of Indian Languages.

## (v) Collaborators and Other Affiliations

### a. Collaborators within the last 48 months

| P. Mohanty      | University of Hyderabad               |
|-----------------|---------------------------------------|
| Probal Dasgupta | University of Hyderabad               |
| B.R. Bapuji     | University of Hyderabad               |
| P.P Giridhar    | Central Institute of Indian Languages |
| Rajiv Sangal    | Indian Institute of Technology        |
|                 |                                       |

## b. Own Graduate and Postdoctoral Advisors

P.B. Pandit

#### c. Graduate Theses and Postdoc Supervision

Graduate Supervision (\*indicates co-advisor), total PhD=12; total MPhil=21

| D. Gunasekaran.        | PhD, University of Hyderabad. 1992 |
|------------------------|------------------------------------|
| P. Rekha Abel*.        | PhD, University of Hyderabad. 1997 |
| Jayaraj Awasthi*       | PhD, University of Hyderabad. 1997 |
| S.K.Singh*             | PhD, University of Hyderabad. 1998 |
| M.K.Pandey*            | PhD, University of Hyderabad. 1998 |
| S.K. Pattanayak*       | PhD, University of Hyderabad. 1998 |
| K. Rajya Rama*         | PhD, University of Hyderabad. 1998 |
| G.P.Bhattarai          | PhD, University of Hyderabad. 1999 |
| Bal Mukund Bhandari    | PhD, University of Hyderabad. 2000 |
| G.V.K.S.Narayan Reddy* | PhD, University of Hyderabad. 2000 |
| Abdullah Al-Hamzii     | PhD, University of Hyderabad. 2001 |
| M. Radhika             | PhD, University of Hyderabad. 2001 |
| Aparupa Dasgupta       | PhD, University of Hyderabad. 2002 |
| Rifaat Ara-Awad        | PhD, University of Hyderabad. 2004 |

| SUMMARY  | Y                  | Æ <u>AR</u> | 1      |              |                     |                |  |
|--|--------------------|-------------|--------|--------------|---------------------|----------------|--|
| PROPOSAL BUDG  | PROPOSAL BUDGET FO |             |        | NSF USE ONLY |                     |                |  |
| GANIZATION PROPOSAI  |                    |             |        |              | DURATIC             | N (months)     |  |
| University of Maryland College Park  |                    | <u> </u>    |        | -            | Proposed            | Granted        |  |
| PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR  |                    |             | WARD N | NO.          |                     |                |  |
|  |                    | NSE Euro    | ed     |              | undo                | Funda          |  |
| A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates<br>(List each separately with title A.7, show number in brackets) | 0.41               | Person-mo   | iths   | Requ         | ested By            | granted by NSF |  |
| (List each separately with title, A.7. show humber in blackets)  |                    | ACAD        | SUMR   | pro          |                     | (if different) |  |
| 1. Colin Phillips - Associate Professor  | 0.00               | 0.00        | 1.00   | \$           | 12,000              | \$             |  |
| 2. Jellrey L Liuz - Associate Professor  | 0.00               |             | 1.00   |              | 12,000              |                |  |
| 3. Michael Luig - Fluidssui<br>4. Amy S Wainhara - Accordate Professor   | 0.00               |             | 1.00   |              | 12,000              |                |  |
| 5 Amanda I Woodward - Professor  | 0.00               |             | 1.00   |              | 12,000              |                |  |
| 6 ( <b>1</b> ) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)   | 0.00               |             | 0.00   |              | <u>12,000</u><br>N  |                |  |
| 7 (-5) TOTAL SENIOR PERSONNEL (1 - 6)  | 0.00               |             | 5.00   |              | 000 08              |                |  |
| B OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)   | 0.00               | 0.00        | 0.00   |              | 00,000              |                |  |
| 1. ( <b>1</b> ) POST DOCTOBAL SCHOLARS   | 0.00               | 0.00        | 0.00   |              | 0                   |                |  |
| 2. ( <b>2</b> ) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)   | 6.00               | 0.00        | 0.00   |              | 20.000              |                |  |
| 3. ( <b>0</b> ) GRADUATE STUDENTS  | 0.00               | 0.00        | 0.00   |              | 0                   |                |  |
| 4. ( <b>0</b> ) UNDERGRADUATE STUDENTS   |                    |             |        |              | 0                   |                |  |
| 5. ( 1) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)   |                    |             |        |              | 30.000              |                |  |
| 6. ( <b>0</b> ) OTHER  |                    |             |        |              | 0                   |                |  |
| TOTAL SALARIES AND WAGES (A + B)   |                    |             |        |              | 110,000             |                |  |
| C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)  |                    |             |        |              | 20,080              |                |  |
| TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)  |                    |             |        |              | 130,080             |                |  |
| D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEED   | ING \$5,           | 000.)       |        |              |                     |                |  |
| 7TB RAID storage (XServe)  |                    | \$          | 13,500 |              |                     |                |  |
| ERP Laboratory equipment (partial support)   |                    |             | 10.000 |              |                     |                |  |
| Hitachi EDG-4000 Near Infrared Spectroscopy device (part suppt)  |                    |             | 15.000 |              |                     |                |  |
| Others (See Budget Comments Page)  |                    |             | 45,000 |              |                     |                |  |
| TOTAL EQUIPMENT  |                    |             |        |              | 83,500              |                |  |
| E. TRAVEL 1. DOMESTIC (INCL. CANADA, MEXICO AND U.S. POSSE   | SSION              | 5)          |        |              | 0                   |                |  |
| 2. FOREIGN   |                    |             |        |              | 17,500              |                |  |
|  |                    |             |        |              |                     |                |  |
|  |                    |             |        | 4            |                     |                |  |
| F. PARTICIPANT SUPPORT COSTS   |                    |             |        |              |                     |                |  |
| 1. STIPENDS \$   |                    |             |        |              |                     |                |  |
| 2. TRAVEL0   |                    |             |        |              |                     |                |  |
| 3. SUBSISTENCE   |                    |             |        |              |                     |                |  |
| 4. OTHER   |                    |             |        |              |                     |                |  |
| TOTAL NUMBER OF PARTICIPANTS (11) TOTAL PAR  | TICIPAN            | NT COST     | 5      |              | 278,500             |                |  |
| G. OTHER DIRECT COSTS  |                    |             |        |              |                     |                |  |
| 1. MATERIALS AND SUPPLIES  |                    |             |        |              | 31,500              |                |  |
| 2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION   |                    |             |        |              | 10,000              |                |  |
| 3. CONSULTANT SERVICES   |                    |             |        |              | 15,000              |                |  |
| 4. COMPUTER SERVICES   |                    |             |        |              | <u> </u>            |                |  |
| 5. SUBAWARDS   |                    |             |        |              | <u> </u>            |                |  |
|  |                    |             |        |              |                     |                |  |
|  |                    |             |        |              | <u>50,500</u>       |                |  |
| H. TOTAL DIRECT COSTS (A THROUGH G)  |                    |             |        |              | 500,080             |                |  |
| I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE)   |                    |             |        |              |                     |                |  |
| AII ILEIIIS SUUJECI IU IJU (KALE: O.UUUU, BASE: 419380)  |                    |             |        |              | 22 566              |                |  |
|  |                    |             |        |              | 500 646             |                |  |
|  |                    |             |        |              | <u>599,040</u><br>N |                |  |
|  |                    |             |        | ¢            | U<br>500 646        | ¢              |  |
|  |                    |             | NT ¢   | Ψ            | 55,040              | Ψ              |  |
|  |                    |             | FOP    |              |                     | A 100.1        |  |
|  |                    | INIDIP      |        | ST RATI      |                     |                |  |
| ORG BEP NAME*  | п                  | ate Checker | Dat    | e Of Rate    | Sheet               | Initials - ORG |  |
|  | ľ                  |             |        |              | *                   |                |  |

\*\* D- Equipment SR Res. EyeLink 1000 eye-tracker (partial support) Tobii 1750 head-free eye-tracker (partial support)

(Amount: \$ 15000) (Amount: \$ 30000)

| SUMMARY  | <b></b> Y | E <u>AR</u> | 2      |                 |                  |                         |  |  |  |
|--|-----------|-------------|--------|-----------------|------------------|-------------------------|--|--|--|
| PROPOSAL BUDG  | EI        | _           | FOI    | DR NSF USE ONLY |                  |                         |  |  |  |
| ORGANIZATION   |           | PRO         | DPOSAL | NO.             | DN (months)      |                         |  |  |  |
| University of Maryland College Park                                      |           | _           |        |                 | Proposed         | Granted                 |  |  |  |
| PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR                                |           | A           | WARD N | 0.              |                  |                         |  |  |  |
| Colin Phillips   |           | NCE Euro    | od     | _               |                  |                         |  |  |  |
| A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates |           | Person-mo   | nths   | F<br>Requ       | unds<br>ested By | Funds<br>granted by NSF |  |  |  |
| (List each separately with title, A.7. show number in brackets)          | CAL       | ACAD        | SUMR   | pro             | oposer           | (if different)          |  |  |  |
| 1. Colin Phillips - Associate Professor                                  | 0.00      | 0.00        | 1.00   | \$              | 12,000           | \$                      |  |  |  |
| 2.   |           |             |        |                 |                  |                         |  |  |  |
| 3.   |           |             |        |                 |                  |                         |  |  |  |
| 4.   |           |             |        |                 |                  |                         |  |  |  |
| 5.   |           |             |        |                 |                  |                         |  |  |  |
| 6. ( 0) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)          | 0.00      | 0.00        | 0.00   |                 | 0                |                         |  |  |  |
| 7. ( <b>1</b> ) TOTAL SENIOR PERSONNEL (1 - 6)                           | 0.00      | 0.00        | 1.00   |                 | 12,000           |                         |  |  |  |
| B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)                            |           |             |        |                 |                  |                         |  |  |  |
| 1. ( 0) POST DOCTORAL SCHOLARS   | 0.00      | 0.00        | 0.00   |                 | 0                |                         |  |  |  |
| 2. ( 2) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)               | 6.00      | 0.00        | 0.00   |                 | 20,000           |                         |  |  |  |
| 3. ( <b>0</b> ) GRADUATE STUDENTS  |           |             |        |                 | 0                |                         |  |  |  |
| 4. ( 0) UNDERGRADUATE STUDENTS   |           |             |        |                 | 0                |                         |  |  |  |
| 5. ( 1) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)                     |           |             |        |                 | 30,000           |                         |  |  |  |
| 6. ( <b>0</b> ) OTHER  |           |             |        |                 | 0                |                         |  |  |  |
| TOTAL SALARIES AND WAGES (A + B)   |           |             |        |                 | 62.000           |                         |  |  |  |
| C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)                          |           |             |        |                 | 16.240           |                         |  |  |  |
| TOTAL SALARIES. WAGES AND FRINGE BENEFITS (A + B + C)                    |           |             |        |                 | 78,240           |                         |  |  |  |
|  |           |             |        |                 |                  |                         |  |  |  |
| TOTAL EQUIPMENT  |           |             |        |                 | 0                |                         |  |  |  |
| E. TRAVEL 1. DOMESTIC (INCL. CANADA, MEXICO AND U.S. POSSE               | SSIONS    | 5)          |        |                 | 1,000            |                         |  |  |  |
| 2. FOREIGN   |           |             |        |                 | 3,500            |                         |  |  |  |
|  |           |             |        |                 |                  |                         |  |  |  |
| F. PARTICIPANT SUPPORT COSTS   |           |             |        | 1               |                  |                         |  |  |  |
| 1. STIPENDS \$   |           |             |        |                 |                  |                         |  |  |  |
| 2. TRAVEL  |           |             |        |                 |                  |                         |  |  |  |
| 3. SUBSISTENCE 0   |           |             |        |                 |                  |                         |  |  |  |
| 4. OTHER120,000  |           |             |        |                 |                  |                         |  |  |  |
| TOTAL NUMBER OF PARTICIPANTS (15) TOTAL PAR                              | TICIPAN   | T COST      | S      |                 | 499,500          |                         |  |  |  |
| G. OTHER DIRECT COSTS  |           |             |        |                 |                  |                         |  |  |  |
| 1. MATERIALS AND SUPPLIES  |           |             |        |                 | 11,000           |                         |  |  |  |
| 2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION                         |           |             |        |                 | 500              |                         |  |  |  |
| 3. CONSULTANT SERVICES   |           |             |        |                 | 15,000           |                         |  |  |  |
| 4. COMPUTER SERVICES   |           |             |        |                 | 0                |                         |  |  |  |
| 5. SUBAWARDS   |           |             |        |                 | 0                |                         |  |  |  |
| 6. OTHER   |           |             |        |                 | 0                |                         |  |  |  |
| TOTAL OTHER DIRECT COSTS   |           |             |        |                 | 26,500           |                         |  |  |  |
| H. TOTAL DIRECT COSTS (A THROUGH G)                                      |           |             |        |                 | 608,740          |                         |  |  |  |
| I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE)                           |           |             |        |                 |                  |                         |  |  |  |
| All items subject to IDC (Rate: 8 0000, Base: 503740)                    |           |             |        |                 |                  |                         |  |  |  |
| TOTAL INDIRECT COSTS (F&A)   |           |             |        |                 | 40,299           |                         |  |  |  |
| J. TOTAL DIRECT AND INDIRECT COSTS (H + I)                               |           |             |        |                 | 649,039          |                         |  |  |  |
| K. BESIDUAL FUNDS  |           |             |        |                 | <u>,</u><br>N    |                         |  |  |  |
| L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)                             |           |             |        | \$              | 649 030          | \$                      |  |  |  |
|  |           |             | NT \$  | Ψ               | 5-10,003         | T                       |  |  |  |
|  |           |             | FOR    | NSF 119         |                  |                         |  |  |  |
| Colin Phillins   |           | INDIP       |        | ST RAT          |                  |                         |  |  |  |
| OBG BEP NAME*  | Da        | ate Checked | 1 Dat  | e Of Rate       | Sheet            | Initials - ORG          |  |  |  |
|  |           |             |        |                 |                  |                         |  |  |  |

|  | ET Y      | E <u>AR</u> | 3       |          |           |                |
|--|-----------|-------------|---------|----------|-----------|----------------|
|  |           |             | FOR     | KNSF     |           |                |
| ORGANIZATION   |           |             | POSAL   | NO.      | DURATIC   | DN (months)    |
| University of Maryland College Park                                      |           | <u> </u>    |         | -        | Proposed  | Granted        |
| PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR                                |           | A           | WARD N  | 0.       |           |                |
| Colin Phillips   |           | NSE Euro    | ed      |          |           | E              |
| A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates |           | Person-mo   | nths    | Req      | uested By | granted by NSF |
| (List each separately with title, A.7. show humber in brackets)          | CAL       | ACAD        | SUMR    | pi       | oposer    | (if different) |
| 1. Colin Phillips - Associate Professor                                  | 0.00      | 0.00        | 1.00    | \$       | 12,000    | \$             |
| 2.   |           |             |         |          |           |                |
| 3.   |           |             |         |          |           |                |
| 4.   |           |             |         |          |           |                |
| 5.   |           |             |         |          |           |                |
| 6. ( 0) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)          | 0.00      | 0.00        | 0.00    |          | 0         |                |
| 7. ( 1) TOTAL SENIOR PERSONNEL (1 - 6)                                   | 0.00      | 0.00        | 1.00    |          | 12,000    |                |
| B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)                            |           |             |         |          |           |                |
| 1. ( <b>0</b> ) POST DOCTORAL SCHOLARS                                   | 0.00      | 0.00        | 0.00    |          | 0         |                |
| 2. ( 2) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)               | 6.00      | 0.00        | 0.00    |          | 20,000    |                |
| 3. ( <b>0</b> ) GRADUATE STUDENTS  |           |             |         |          | 0         |                |
| 4. ( <b>0</b> ) UNDERGRADUATE STUDENTS                                   |           |             |         |          | 0         |                |
| 5. ( 1) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)                     |           |             |         |          | 30,000    |                |
| 6. ( <b>0</b> ) OTHER  |           |             |         |          | 0         |                |
| TOTAL SALARIES AND WAGES (A + B)   |           |             |         |          | 62,000    |                |
| C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)                          |           |             |         |          | 16,240    |                |
| TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)                    |           |             |         |          | 78,240    |                |
| D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEED           | ING \$5,0 | 000.)       |         |          |           |                |
|  |           |             |         |          |           |                |
|  |           |             |         |          |           |                |
|  |           |             |         |          |           |                |
|  |           |             |         |          |           |                |
| TOTAL EQUIPMENT  |           |             |         |          | 0         |                |
| E TRAVEL 1 DOMESTIC (INCL CANADA MEXICO AND U.S. POSSE                   | SSIONS    | 3)          |         |          | 1 000     |                |
| 2. FOREIGN   |           | /           |         |          | 3,500     |                |
|  |           |             |         |          |           |                |
|  |           |             |         |          |           |                |
| E PARTICIPANT SUPPORT COSTS  |           |             |         |          |           |                |
| 1 STIPENDS \$  |           |             |         |          |           |                |
| 2 TBAVEL76,500   |           |             |         |          |           |                |
|  |           |             |         |          |           |                |
| 4 OTHER120,000   |           |             |         |          |           |                |
| TOTAL NUMBER OF PARTICIPANTS ( 15) TOTAL PAR                             |           |             | 2       |          | 100 500   |                |
|  |           | 1 0001      | 5       |          | 455,000   |                |
|  |           |             |         |          | 11 000    |                |
|  |           |             |         |          | 11,000    |                |
|  |           |             |         |          |           |                |
| 3. CONSULTANT SERVICES   |           |             |         |          | 15,000    |                |
| 4. COMPUTER SERVICES   |           |             |         |          | <u> </u>  |                |
| 5. SUBAWARDS   |           |             |         |          | 0         |                |
| 6. OTHER   |           |             |         |          | 0         |                |
| TOTAL OTHER DIRECT COSTS   |           |             |         |          | 26,500    |                |
| H. TOTAL DIRECT COSTS (A THROUGH G)                                      |           |             |         |          | 608,740   |                |
| I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE)                           |           |             |         |          |           |                |
| All items subject to IDC (Rate: 8.0000, Base: 503740)                    |           |             |         |          |           |                |
| TOTAL INDIRECT COSTS (F&A)   |           |             |         |          | 40,299    |                |
| J. TOTAL DIRECT AND INDIRECT COSTS (H + I)                               |           |             |         |          | 649,039   |                |
| K. RESIDUAL FUNDS  |           |             |         |          | 0         |                |
| L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)                             |           |             |         | \$       | 649,039   | \$             |
| M. COST SHARING PROPOSED LEVEL \$ 0 AGREED LE                            | VEL IF I  | DIFFERE     | NT \$   |          |           |                |
| PI/PD NAME   | Γ         |             | FOR     | NSF US   | SE ONLY   |                |
| Colin Phillips   |           | INDIRI      | ECT COS | ST RAT   | E VERIFIC | CATION         |
| ORG. REP. NAME*  | Di        | ate Checked | Dat     | e Of Rat | e Sheet   | Initials - ORG |
|  |           |             |         |          |           |                |

|   | ET Y    | EAR         | 4      |           |                | ,                                |  |  |  |
|---|---------|-------------|--------|-----------|----------------|----------------------------------|--|--|--|
|   |         |             |        |           |                |                                  |  |  |  |
| University of Maryland College Park                                   |         |             | JFUSAL | NO.       | Bronosoc       | Granted                          |  |  |  |
|   |         |             |        |           |                |                                  |  |  |  |
| Colin Phillins  |         |             |        | 0.        | ĺ              |                                  |  |  |  |
| A SENIOR PERSONNEL: PI/PD Co-PI's Faculty and Other Senior Associates |         | NSF Fund    | ed     | F         | unds           | Funds                            |  |  |  |
| (List each separately with title, A.7. show number in brackets)       | CAL     | ACAD        | SUMB   | Requ      | lested By      | granted by NSF<br>(if different) |  |  |  |
| 1 Colin Phillins - Associate Professor                                | 0,00    | 0.00        | 1 00   | \$        | 12 000         | \$                               |  |  |  |
| 2   | 0.00    | 0.00        | 1.00   | Ψ         | 12,000         | Ψ                                |  |  |  |
| 3.  |         |             |        |           |                |                                  |  |  |  |
| 4   |         |             |        |           |                |                                  |  |  |  |
| 5   |         |             |        |           |                |                                  |  |  |  |
| 6. ( 1) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)       | 0.00    | 0.00        | 0.00   |           | 0              |                                  |  |  |  |
| 7 (1) TOTAL SENIOR PERSONNEL (1 - 6)                                  | 0.00    | 0.00        | 1 00   |           | 12 000         |                                  |  |  |  |
| B OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)                          | 0.00    | 0.00        | 1.00   |           | 12,000         |                                  |  |  |  |
|   | 0.00    | 0.00        | 0.00   |           | 0              |                                  |  |  |  |
| 2 ( 2) OTHER PROFESSIONALS (TECHNICIAN PROGRAMMER ETC.)               | 6.00    | 0.00        | 0.00   |           | 20 000         |                                  |  |  |  |
| 3( <b>0</b> ) GRADUATE STUDENTS                                       | 0.00    | 0.00        | 0.00   |           | 20,000         |                                  |  |  |  |
|   |         |             |        |           | 0              |                                  |  |  |  |
| 5. (1) SECRETARIAL - CLERICAL (IE CHARGED DIRECTLY)                   |         |             |        |           | 30 000         |                                  |  |  |  |
|   |         |             |        |           | <u> </u>       |                                  |  |  |  |
| TOTAL SALARIES AND WAGES (A + B)                                      |         |             |        |           | 62 000         |                                  |  |  |  |
|   |         |             |        |           | 16 2/0         |                                  |  |  |  |
| TOTAL SALARIES WAGES AND FRINGE RENEFITS (A + B + C)                  |         |             |        |           | 78 2/10        |                                  |  |  |  |
|   |         |             |        |           | 10,240         |                                  |  |  |  |
|   |         |             |        |           |                |                                  |  |  |  |
|   |         |             |        |           |                |                                  |  |  |  |
|   |         |             |        |           |                |                                  |  |  |  |
|   |         |             |        |           |                |                                  |  |  |  |
|   |         |             |        |           |                |                                  |  |  |  |
| TOTAL EQUIPMENT   |         |             |        |           | 0              |                                  |  |  |  |
| E. TRAVEL 1. DOMESTIC (INCL. CANADA, MEXICO AND U.S. POSSE            | SSIONS  | 6)          |        |           | 1,000          |                                  |  |  |  |
| 2. FOREIGN  |         |             |        |           | 3,500          |                                  |  |  |  |
|   |         |             |        |           |                |                                  |  |  |  |
|   |         |             |        | -         |                |                                  |  |  |  |
| F. PARTICIPANT SUPPORT COSTS  |         |             |        |           |                |                                  |  |  |  |
| 1. STIPENDS \$76 500  |         |             |        |           |                |                                  |  |  |  |
| 2. TRAVEL   |         |             |        |           |                |                                  |  |  |  |
| 3. SUBSISTENCE  |         |             |        |           |                |                                  |  |  |  |
| 4. OTHER  |         |             |        |           |                |                                  |  |  |  |
| TOTAL NUMBER OF PARTICIPANTS (15) TOTAL PAR                           | TICIPAN | IT COST     | S      |           | 499,500        |                                  |  |  |  |
| G. OTHER DIRECT COSTS   |         |             |        |           |                |                                  |  |  |  |
| 1. MATERIALS AND SUPPLIES   |         |             |        |           | 11,000         |                                  |  |  |  |
| 2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION                      |         |             |        |           | 500            |                                  |  |  |  |
| 3. CONSULTANT SERVICES  |         |             |        |           | 15,000         |                                  |  |  |  |
| 4. COMPUTER SERVICES  |         |             |        |           | 0              |                                  |  |  |  |
| 5. SUBAWARDS  |         |             |        |           | 0              |                                  |  |  |  |
| 6. OTHER  |         |             |        |           | 0              |                                  |  |  |  |
| TOTAL OTHER DIRECT COSTS  |         |             |        |           | 26,500         |                                  |  |  |  |
| H. TOTAL DIRECT COSTS (A THROUGH G)                                   |         |             |        |           | 608,740        |                                  |  |  |  |
| I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE)                        |         |             |        |           |                |                                  |  |  |  |
| All items subject to IDC (Rate: 8.0000, Base: 503740)                 |         |             |        |           |                |                                  |  |  |  |
| TOTAL INDIRECT COSTS (F&A)  |         |             |        |           | 40.299         |                                  |  |  |  |
| J. TOTAL DIRECT AND INDIRECT COSTS (H + I)                            |         |             |        |           | 649,039        |                                  |  |  |  |
| K RESIDUAL FUNDS  |         |             |        |           | <u>010,000</u> |                                  |  |  |  |
| AMOUNT OF THIS BEQUEST (J) OB (J MINUS K)                             |         |             |        | \$        | 649 039        | \$                               |  |  |  |
|   |         |             | NT \$  | Ŧ         | 010,000        | ¥                                |  |  |  |
|   |         |             | FORM   | NSF 119   |                |                                  |  |  |  |
| Colin Phillins  |         | INDIRE      |        | ST RAT    | E VERIEI       |                                  |  |  |  |
| OBG BEP NAME*   | Di      | ate Checked | 1 Dat  | e Of Rate | Sheet          | Initials - ORG                   |  |  |  |
|   |         |             | ~      |           |                |                                  |  |  |  |

|  | ET Y      | E <u>AR</u> | 5       |          |           |                |
|--|-----------|-------------|---------|----------|-----------|----------------|
|  |           |             | FOR     | KNSF     |           |                |
| ORGANIZATION   |           |             | POSAL   | NO.      | DURATIC   | DN (months)    |
| University of Maryland College Park                                      |           | <u> </u>    |         | -        | Proposed  | Granted        |
| PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR                                |           | A           | WARD N  | 0.       |           |                |
| Colin Phillips   |           | NSE Euro    | ed      |          |           | E              |
| A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates |           | Person-mo   | nths    | Req      | uested By | granted by NSF |
| (List each separately with title, A.7. show humber in brackets)          | CAL       | ACAD        | SUMR    | pi       | oposer    | (if different) |
| 1. Colin Phillips - Associate Professor                                  | 0.00      | 0.00        | 1.00    | \$       | 12,000    | \$             |
| 2.   |           |             |         |          |           |                |
| 3.   |           |             |         |          |           |                |
| 4.   |           |             |         |          |           |                |
| 5.   |           |             |         |          |           |                |
| 6. ( 0) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)          | 0.00      | 0.00        | 0.00    |          | 0         |                |
| 7. ( 1) TOTAL SENIOR PERSONNEL (1 - 6)                                   | 0.00      | 0.00        | 1.00    |          | 12,000    |                |
| B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)                            |           |             |         |          |           |                |
| 1. ( <b>0</b> ) POST DOCTORAL SCHOLARS                                   | 0.00      | 0.00        | 0.00    |          | 0         |                |
| 2. ( 2) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)               | 6.00      | 0.00        | 0.00    |          | 20,000    |                |
| 3. ( <b>0</b> ) GRADUATE STUDENTS  |           |             |         |          | 0         |                |
| 4. ( <b>0</b> ) UNDERGRADUATE STUDENTS                                   |           |             |         |          | 0         |                |
| 5. ( 1) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)                     |           |             |         |          | 30,000    |                |
| 6. ( <b>0</b> ) OTHER  |           |             |         |          | 0         |                |
| TOTAL SALARIES AND WAGES (A + B)   |           |             |         |          | 62,000    |                |
| C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)                          |           |             |         |          | 16,240    |                |
| TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)                    |           |             |         |          | 78,240    |                |
| D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEED           | ING \$5,0 | 000.)       |         |          |           |                |
|  |           |             |         |          |           |                |
|  |           |             |         |          |           |                |
|  |           |             |         |          |           |                |
|  |           |             |         |          |           |                |
| TOTAL EQUIPMENT  |           |             |         |          | 0         |                |
| E TRAVEL 1 DOMESTIC (INCL CANADA MEXICO AND U.S. POSSE                   | SSIONS    | 3)          |         |          | 1 000     |                |
| 2. FOREIGN   |           | /           |         |          | 3,500     |                |
|  |           |             |         |          |           |                |
|  |           |             |         |          |           |                |
| E PARTICIPANT SUPPORT COSTS  |           |             |         |          |           |                |
| 1 STIPENDS \$  |           |             |         |          |           |                |
| 2 TBAVEL76,500   |           |             |         |          |           |                |
|  |           |             |         |          |           |                |
| 4 OTHER120,000   |           |             |         |          |           |                |
| TOTAL NUMBER OF PARTICIPANTS ( 15) TOTAL PAR                             |           |             | 2       |          | 100 500   |                |
|  |           | 1 0001      | 5       |          | 455,000   |                |
|  |           |             |         |          | 11 000    |                |
|  |           |             |         |          | 11,000    |                |
| 2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION                         |           |             |         |          | 500       |                |
| 3. CONSULTANT SERVICES   |           |             |         |          | 15,000    |                |
| 4. COMPUTER SERVICES   |           |             |         |          | 0         |                |
| 5. SUBAWARDS   |           |             |         |          | 0         |                |
| 6. OTHER   |           |             |         |          | 0         |                |
| TOTAL OTHER DIRECT COSTS   |           |             |         |          | 26,500    |                |
| H. TOTAL DIRECT COSTS (A THROUGH G)                                      |           |             |         |          | 608,740   |                |
| I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE)                           |           |             |         |          |           |                |
| All items subject to IDC (Rate: 8.0000, Base: 503740)                    |           |             |         |          |           |                |
| TOTAL INDIRECT COSTS (F&A)   |           |             |         |          | 40,299    |                |
| J. TOTAL DIRECT AND INDIRECT COSTS (H + I)                               |           |             |         |          | 649,039   |                |
| K. RESIDUAL FUNDS  |           |             |         |          | 0         |                |
| L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)                             |           |             |         | \$       | 649.039   | \$             |
| M. COST SHARING PROPOSED LEVEL \$ 0 AGREED LE                            | VEL IF I  | DIFFERE     | NT \$   |          | ,         |                |
| PI/PD NAME   |           |             | FOR     | NSF US   | SE ONLY   |                |
| Colin Phillins   |           | INDIRI      | ECT COS | ST RAT   |           | CATION         |
| ORG. REP. NAME*  | Di        | ate Checked | Dat     | e Of Rat | e Sheet   | Initials - ORG |
|  |           |             |         |          |           |                |

| SUMMARY  | <b></b> C          | u <u>mulat</u> | ive          |             |              |                |  |  |
|--|--------------------|----------------|--------------|-------------|--------------|----------------|--|--|
| PROPOSAL BUDG  | PROPOSAL BUDGET FO |                |              |             | NSF USE ONLY |                |  |  |
| ORGANIZATION   |                    | PRC            | POSAL        | NO. [       | DURATIC      | N (months)     |  |  |
| University of Maryland College Park                                      |                    |                |              |             | Proposed     | Granted        |  |  |
| PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR                                |                    | A              | WARD N       | ID NO.      |              |                |  |  |
| Colin Phillips   |                    | NSE Fund       | ed           |             | ada          | Fundo          |  |  |
| A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates | 0.41               | Person-mor     | iths         | Reque       | sted By      | granted by NSF |  |  |
| (List Cachi Separately with title, A.Y. Show humber in brackets)         | CAL                | ACAD           | SUMR         | prop        |              | (if different) |  |  |
| 1. Colin Phillips - Associate Professor                                  | 0.00               | 0.00           | 5.00         | \$          |              | \$             |  |  |
| 2. Jelirey L Liuz - Associate Protessor                                  | 0.00               | 0.00           | 1.00         |             | 12,000       |                |  |  |
| 3. Michael Luiy - Fluiessui<br>4. Amy S Wainbarg - Associata Professor   | 0.00               | 0.00           | 1.00         |             | 12,000       |                |  |  |
| 5 Amanda I Woodward - Professor  | 0.00               | 0.00           | 1.00         |             | 12,000       |                |  |  |
| 6 ( ) OTHERS (I IST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)           | 0.00               | 0.00           | 0.00         |             | 12,000<br>N  |                |  |  |
| 7 (-5) TOTAL SENIOR PERSONNEL (1 - 6)                                    | 0.00               | 0.00           | 0.00<br>0 00 | 1           | 0 00         |                |  |  |
| B OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)                             | 0.00               | 0.00           | 3.00         | •           | 00,000       |                |  |  |
|  | 0.00               | 0.00           | 0.00         |             | 0            |                |  |  |
| 2 ( <b>10</b> ) OTHER PROFESSIONALS (TECHNICIAN PROGRAMMER ETC.)         | 30.00              | 0.00           | 0.00         | 1           |              |                |  |  |
| 3 ( ) GRADUATE STUDENTS  | 00.00              | 0.00           | 0.00         | •           | 00,000<br>N  |                |  |  |
| 4 ( <b>1</b> ) UNDERGRADUATE STUDENTS                                    |                    |                |              |             | 0            |                |  |  |
| 5. ( 5) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)                     |                    |                |              | 1           | 50,000       |                |  |  |
| 6. ( <b>0</b> ) OTHER  |                    |                |              | •           | 0            |                |  |  |
| TOTAL SALARIES AND WAGES (A + B)   |                    |                |              | 3           | 58.000       |                |  |  |
| C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)                          |                    |                |              |             | 85.040       |                |  |  |
| TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)                    |                    |                |              | 4           | 43.040       |                |  |  |
| D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEED           | ING \$5,0          | 000.)          |              |             |              |                |  |  |
|  |                    | \$             | 83,500       |             |              |                |  |  |
|  |                    |                |              |             |              |                |  |  |
|  |                    |                |              |             |              |                |  |  |
|  |                    |                |              |             |              |                |  |  |
|  |                    |                |              |             | 83,500       |                |  |  |
| E. TRAVEL 1. DOMESTIC (INCL. CANADA, MEXICO AND U.S. POSSE               | SSIONS             | 5)             |              |             | 4,000        |                |  |  |
|  |                    |                |              |             | 31,500       |                |  |  |
|  |                    |                |              |             |              |                |  |  |
|  |                    |                |              | -           |              |                |  |  |
| 1,395,000  |                    |                |              |             |              |                |  |  |
| 2 TRAVEL 329,500   |                    |                |              |             |              |                |  |  |
|  |                    |                |              |             |              |                |  |  |
| 4 OTHER 552,000  |                    |                |              |             |              |                |  |  |
| TOTAL NUMBER OF PARTICIPANTS ( <b>71</b> ) TOTAL PAR                     |                    |                | 3            | 2.2         | 76 500       |                |  |  |
| G OTHER DIBECT COSTS   |                    |                | ,<br>,       | ۲,۲         | 10,000       |                |  |  |
| 1 MATERIALS AND SUPPLIES   |                    |                |              |             | 75 500       |                |  |  |
| 2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION                         |                    |                |              |             | 12 000       |                |  |  |
| 3. CONSULTANT SERVICES   |                    |                |              |             | 75,000       |                |  |  |
| 4. COMPUTER SERVICES   |                    |                |              |             | 0            |                |  |  |
| 5. SUBAWARDS   |                    |                |              |             | 0            |                |  |  |
| 6. OTHER   |                    |                |              |             | 0            |                |  |  |
| TOTAL OTHER DIRECT COSTS   |                    |                |              | 1           | 62.500       |                |  |  |
| H. TOTAL DIRECT COSTS (A THROUGH G)                                      |                    |                |              | 3.0         | 01.040       |                |  |  |
| I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE)                           |                    |                |              | ; -         |              |                |  |  |
|  |                    |                |              |             |              |                |  |  |
| TOTAL INDIRECT COSTS (F&A)   |                    |                |              |             | 94,762       |                |  |  |
| J. TOTAL DIRECT AND INDIRECT COSTS (H + I)                               |                    |                |              |             | 95,802       |                |  |  |
| K. RESIDUAL FUNDS  |                    |                |              |             |              |                |  |  |
| L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)                             |                    |                |              | \$ 3,1      | 95,802       | \$             |  |  |
| M. COST SHARING PROPOSED LEVEL \$ 0 AGREED LE                            | VEL IF I           | DIFFERE        | NT \$        |             |              |                |  |  |
| PI/PD NAME   |                    |                | FOR          | NSF USE     | ONLY         | 1. Anno 1.     |  |  |
| Colin Phillips   |                    | INDIRE         | ECT COS      | ST RATE     | VERIFIC      | CATION         |  |  |
| ORG. REP. NAME*  | Da                 | ate Checked    | Dat          | e Of Rate S | Sheet        | Initials - ORG |  |  |
|  |                    |                |              |             |              |                |  |  |
#### **Budget Justification**

#### Senior Personnel

Funds are budgeted for 1 month of summer salary per year for the PI, who will be involved in all aspects of the management of the program (see C5 above). An additional 4 months of faculty salary support are budgeted in the first year of the project. These funds will be used over the first two years of the project to support the development of new courses for the IGERT, including coordination of the intensive Winter Storm course. These funds may be used for IGERT faculty other than the four co-PIs listed in the budget pages. Salaries are based upon average salaries of senior faculty in the IGERT team.

In this and all other budget categories no annual increases are included. This creates parity between senior personnel and students, whose stipends are fixed throughout the project. Any future increases in costs, such as rising travel or healthcare costs, will be absorbed by the participating departments.

#### **Other Personnel**

Annual funds are included for partial salary support for 3 individuals who will provide crucial support to the training program. By partially supporting a small group of highly qualified individuals we will have greater flexibility to respond to the ebb and flow of project tasks over the course of a year.

(i) A secretary/administrator for the project (50% effort, \$30,000), who will assist the PI and other team members in all aspects of the management of the program, but with particular emphasis on targeted recruitment efforts and the development of *Language at Maryland* recruitment materials, plus help in tracking student applications and student progress, and help in coordinating annual IGERT-related symposia. The administrator will also will help the project leadership in management of IGERT funds, coordinating disbursement across the numerous participating units across campus.

(ii) Partial support for a full-time research assistant (33% effort, \$10,000). This person will be a postbaccalaureate research fellow who will provide logistical support and technical assistance for researchers who are bringing new techniques into their research. This follows a model that we have tested and found to be very successful in recent years. For example, this model made it possible for Dr Shah's aphasia research group to implement experimental protocols for MEG brain recordings, and helped students in second language acquisition to conduct and analyze on-line behavioral studies. This person will also assist in IRB preparation for new projects (e.g., studies on human participants led by computer scientists) and maintenance and scheduling for shared lab equipment.

(iii) Partial support for Jeff Walker, the manager of the CNL Lab's shared brain-recording facilities (16% effort, \$10,000). In addition to maintenance of the facilities one of Mr Walker's key roles is to facilitate logistics and training for new users with limited experience in electrophysiological measures (MEG, EEG). This has greatly facilitated the use of our facilities by researchers from other units and other institutions. Mr Walker has led the development of apparatus for new experimental protocols, and has also been involved in outreach efforts at the high school and undergraduate level.

#### Fringe Benefits

Senior personnel summer salary: 8% of direct costs. Other personnel: 15% of direct costs + healthcare premiums, currently listed at \$7780/person-year. This request includes 1.0 units of healthcare coverage per year, pro-rated according to the percentage effort of the 3 staff persons.

#### Equipment

Equipment purchases in the first year of the IGERT project will be used to support collaborative research efforts. In most cases IGERT funds cover only part of the cost of the equipment; remaining funds will come from departmental or college funds, increasing the investment of the participating units in the use and success of the new equipment.

(i) RAID data storage array (XServe RAID 7TB, \$13,500 includes 3 years support). For data storage needs associated with IGERT research projects, particularly video archives for child and infant research and data storage for brain recordings.

(ii) Head-free eye-tracking device, primarily for use with infants and children (Tobii 1750, with infant and software development modules, one additional analysis license; contribution \$30,000 of \$40,000 total cost). Most useful for students from Hearing & Speech, Linguistics, CompSci. (A similar device is already in use in Dr Woodward's lab in psychology, but it is in almost constant use.)

(iii) EyeLink 1000 eye-tracking device, primarily for studies of reading in adults (contribution: \$15,000 of \$35,000 total cost). Most useful for students from Second Language Acquisition, Linguistics, Psychology, CompSci, also relevant to the literacy interests of the Gallaudet team.

(iv) Near infrared spectroscopy (NIRS) device for brain recording studies with infants and children (Hitachi EDG-4000, contribution \$15,000). This new technology will provide new opportunities for the extensive interdepartmental research efforts in early language development, and stimulate collaboration between existing focus areas in infant cognition, adult cognitive neuroscience, and biological signal processing. Implementation will be greatly facilitated by the newest member of the Psychology Dept, Dr Tracy deBoer, an expert in electrophysiological studies with young children (starts 2008) who has expressed enthusiasm for starting collaborations using NIRS.

(v) Refurbishment of core EEG Lab equipment to facilitate expanded user base (contribution \$10,000), including new Ag/AgCl electrode caps (ElectroCap Intl.) and one data analysis workstation.

#### Travel

Domestic: \$1000 per year in Years 2-5 for faculty participation in minority recruitment efforts such as the U of Maryland's fall event with the Atlanta University Center Consortium (Morehouse, Clark, Spelman), plus the IGERT awardees meeting. These costs will be covered in Y1 by U of Maryland funds.

International: Faculty visits of 8-10 days each for developing and sustaining the partnerships in India, Brazil, and Japan. For each partner site one visit in Y1 and one visit at some point during Y2-Y5, except for the India site where visits involve two faculty, an experimentalist and a computational expert, due to the scope of the planned collaboration, i.e., 5 person-trips in Y1, 1 person-trip per year in Y2-Y5. Average trip cost of \$3,500 based on \$1500/travel, \$1500/accommodation & subsistence, \$500 research materials and supplies. Total cost is \$17,500 in Y1, \$3,500 in Y2-Y5.

## **Participant Support**

STIPENDS AND RESEARCH SUPPORT. Most IGERT funds will be devoted to PhD students, who will be supported by the IGERT for 2 years each. 6 students will be supported in Y1, and 10 students in Y2-Y5, i.e., 46 person-years or 23 total trainees. All IGERT stipends will be \$30,000 as required by NSF, with students receiving university or departmental support (varying levels across participating units) in the remaining 3 years of study. \$10,500 per student/year is budgeted for tuition and health insurance. An additional \$1,500 per student-year is budgeted to partially defray students' IGERT-related research expenses, particularly relating to advanced lab rotations, e.g., payments for experimental participants.

STUDENT TRAVEL. Domestic travel support is budgeted at \$2000 per student-year, intended to cover the cost of travel, accommodation, and registration at two domestic meetings where the student gives a presentation, typically one in the student's 'home' area and one in an area related to the student's rotation. Some of this travel will occur in the year following the student's primary IGERT support. International travel support covers travel to the international partner sites in India, Brazil, and Japan. In Y2-Y5 funds are included for 6 student research trips per year of around 4 weeks each (\$1500 travel + \$3000 lodging & subsistence + \$500 materials and supplies = \$5000/trip), and 3 student trips of 1-2 weeks for training and planning activities (\$1500 travel + \$1500 lodging & subsistence = \$3000/trip). We also budget 3 x \$1000 per year for research expenses at the international partner sites, e.g., experimental participants. In our previous experience intensive data gathering in Japan can cost up to \$600/week.

ADVISORY BOARD. In each year \$7000 is budgeted for the annual visit of the 5-member advisory board: per person average \$400 flight+ground, \$100 expenses, \$400 hotel, \$500 honorarium. \$3000 of this cost is borne by UM funds in Y1 only.

SYMPOSIA. In each year of the project \$7500 is budgeted to cover the cost of participants in an IGERT-sponsored workshop or symposium. In the interest of promoting the project's vision to a broad audience across participating disciplines the IGERT will sponsor a series of 4 symposia at professional society meetings on specific interdisciplinary topics addressed by the IGERT. Targeted meetings include the Linguistic Society of America, American Speech and Hearing Association, Society for Research in Child Development, Second Language Research Forum, or the Association for Research in Otolaryngology. Each symposium will sponsor 5 external speakers, of which at least 3 should not be typical attendees at that meeting (\$500 travel + \$150 registration + \$600 3/nights hotel + \$250 4 days per diem = \$1500/person x 5; amounts based on federal rates for major US cities). Support for participating IGERT students will be drawn from the student travel category. In a 5th year the project will sponsor an internal 3-day workshop on IGERT-related research, on the weekend of the annual *Maryland Mayfest* language workshop. This workshop will feature 10 invited external speakers, plus presentations by IGERT faculty and students. The costs are kept low for this event by hosting most visiting speakers at the homes of participating faculty.

#### Other

MATERIALS AND SUPPLIES. Computer equipment is included in this category, but per U of Maryland policy computers priced \$1000-\$5000 are treated as equipment and excluded from indirect cost calculations. \$10,000/year is budgeted for student computer support, assuming a one-time expenditure of up to \$2000/student and an average of 5 new students per year. In Y2-Y5 \$1000/year is budgeted to cover materials and supplies associated with the administration of the project, including phone, mail, and printing, including supplies for the CNL Lab poster printer, which will be available to all IGERT students.

An additional \$21,500 is included in Y1 for computer equipment. \$2000 for the IGERT administrator, \$1500 for audio and video recording equipment, and a total of \$8000 to partially cover the cost of computer equipment in the various participating labs that will be hosting undergraduates and interns working with IGERT trainees. In addition, \$10,000 will be used to provide basic computer and experimental control equipment for the Second Language Acquisition Laboratory, housed in the School of Languages, which is significantly under-equipped.

PUBLICATION AND DISSEMINATION. Funds in this category are exclusively for materials associated with recruitment and promotion of the project's integrative activities. In Y1 \$10,000 is budgeted for initial creation of cross-departmental materials promoting *Language at Maryland* (\$5,000 for graphical/web support, \$5,000 for brochure printing/mailing, based on quotes for a 16-page color brochure). In Y2-Y5 just \$500 is budgeted for sustaining these efforts.

CONSULTANT SERVICES. \$10,000/year is budgeted for project evaluation activities, to be overseen by Sharon La Voy, MA, Director of Assessment at UM's Office of Institutional Research, Planning, and Assessment. \$5,000/year is budgeted for ASL interpreting services not already covered by UM's Disability Support Services under the Washington DC Consortium of Universities (see attached letter). Assuming \$100/hr for a two-person team of highly-qualified interpreters, these funds would cover around 12 half-day IGERT activities each year.

| Table 1: Year 1 Start-up Funds                         |           |
|--|-----------|
| Senior personnel - 4 months support for program devt   | \$48,000  |
| 8% Fringe benefits                                     | \$3,840   |
| Equipment  |           |
| XServe RAID server 7TB                                 | \$13,500  |
| Tobii 1750 head-free eye-tracker (partial support)     | \$30,000  |
| EyeLink 1000 eye-tracker (partial support)             | \$15,000  |
| Hitachi EDG-4000 NIRS device (partial support)         | \$15,000  |
| EEG Laboratory equipment                               | \$10,000  |
| Travel to international partner sites (5 person-trips) | \$17,500  |
| Computer Equipment/Supplies                            | \$31,500  |
| Recruitment/promotion materials & development          | \$10,000  |
| Indirect costs @ 8%                                    | \$5,547   |
| Total  | \$199,887 |

| Table 2: Internation                                       | nal Activities, Years 2-5   |          |
|--|-----------------------------|----------|
| International Travel - Senior Personn                      | el, one 8-10 day trip       | \$3,500  |
| Flight, ground transportation                              | \$1,500                     |          |
| Lodging, subsistence                                       | \$1,500                     |          |
| Research/teaching materials                                | \$ 500                      |          |
| International Travel - students, 6 research trips, 1 month |                             | \$30,000 |
| Flight, ground transportation                              | \$1,500                     |          |
| Lodging, subsistence                                       | \$3,000                     |          |
| Research materials & supplies                              | \$ 500                      |          |
| International Travel - students, 3 train                   | ning/planning trips, 1-2 wk | \$9,000  |
| Flight, ground transportation                              | \$1,500                     |          |
| Lodging, subsistence                                       | \$1,500                     |          |
| International Travel - students, addition                  | onal expenditures           | \$3,000  |
| 3 x \$1,000 for research costs, e.g                        | g., expt participants       |          |
| Indirect costs   |                             | \$3,640  |
| Total  |                             | \$49,140 |

Current and Pending Support (See GPG Section II.C.2.h for guidance on information to include on this form.)

| The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.   |  |  |
|--|--|--|
| Other agencies (including NSF) to which this proposal has been/will be submitted.  |  |  |
| Support: Current Pending Submission Planned in Near Future *Transfer of Support<br>Project/Proposal Title: Doctoral Dissertation Research: Language-Specific<br>Constraints on Scope Interpretation in First Language<br>Acquisition |  |  |
| Source of Support: NSF<br>Total Award Amount: \$ 11,506 Total Award Period Covered: 07/01/06 - 06/30/08<br>Location of Project: U of Maryland<br>Person-Months Per Year Committed to the Project. Cal:0.00 Acad:0.00 Sumr: 0.00      |  |  |
| Support:  Current  Pending  Submission Planned in Near Future  *Transfer of Support Project/Proposal Title: Structure Generation in Language Comprehension   |  |  |
| Source of Support: NSF<br>Total Award Amount: \$ 549,663 Total Award Period Covered: 01/01/08 - 12/31/10<br>Location of Project: U of Maryland<br>Person-Months Per Year Committed to the Project. Cal:0.00 Acad:0.00 Sumr: 1.00     |  |  |
| Support:  Current Project/Proposal Title: IGERT: Biological and Computational Foundations of Language Diversity  |  |  |
| Source of Support: NSF<br>Total Award Amount: \$ 3,195,802 Total Award Period Covered: 07/01/08 - 06/30/13<br>Location of Project: U of Maryland<br>Person-Months Per Year Committed to the Project. Cal:0.00 Acad: 0.00 Sumr: 1.00  |  |  |
| Support: Current Pending Submission Planned in Near Future *Transfer of Support Project/Proposal Title:  |  |  |
| Source of Support:<br>Total Award Amount: \$ Total Award Period Covered:<br>Location of Project:<br>Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:  |  |  |
| Support: Current Pending Submission Planned in Near Future *Transfer of Support Project/Proposal Title:  |  |  |
| Source of Support:<br>Total Award Amount: \$ Total Award Period Covered:<br>Location of Project:<br>Person-Months Per Year Committed to the Project Cal: Acad: Summ:   |  |  |
| *If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.   |  |  |

Current and Pending Support (See GPG Section II.C.2.h for guidance on information to include on this form.)

| The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.  |
|---|
| Other agencies (including NSF) to which this proposal has been/will be submitted. Investigator: Jeffrey Lidz  |
| Support: Current Pending Submission Planned in Near Future Transfer of Support<br>Project/Proposal Title: Quantification and the Syntactic Interfaces in Language<br>Acquisition  |
| Source of Support: NSF<br>Total Award Amount: \$ 240,000 Total Award Period Covered: 09/01/04 - 01/31/08<br>Location of Project: U of Maryland<br>Person-Months Per Year Committed to the Project. Cal:0.00 Acad: 1.00 Sumr: 1.00               |
| Support: Current Pending Submission Planned in Near Future *Transfer of Support<br>Project/Proposal Title: Linking Early Linguistic and Conceptual Development<br>(co-PI)   |
| Source of Support: NICHD<br>Total Award Amount: \$ 1,850,732 Total Award Period Covered: 06/01/03 - 05/31/08<br>Location of Project: Northwestern University<br>Person-Months Per Year Committed to the Project. Cal:0.00 Acad: 1.00 Sumr: 0.00 |
| Support: Current Pending Submission Planned in Near Future Transfer of Support<br>Project/Proposal Title: Doctoral Dissertation Research: Language Specific<br>Constraints on Scope Interpretation in First Language<br>Acquisition (co-PI)     |
| Source of Support: NSF<br>Total Award Amount: \$ 11,506 Total Award Period Covered: 07/01/06 - 06/30/08<br>Location of Project: U of Maryland<br>Person-Months Per Year Committed to the Project. Cal:0.00 Acad: 0.00 Sumr: 0.00                |
| Support: Current Pending Submission Planned in Near Future Transfer of Support<br>Project/Proposal Title: Grammar Learning from Minimal Evidence: A Psycholinguistic<br>Investigation   |
| Source of Support: NSF<br>Total Award Amount: \$ 394,322 Total Award Period Covered: 01/01/08 - 12/31/10<br>Location of Project: U of Maryland<br>Person-Months Per Year Committed to the Project. Cal:0.00 Acad: 1.00 Sumr: 1.00               |
| Support: Current Pending Submission Planned in Near Future Transfer of Support Project/Proposal Title: Lip-rounding: A Window onto Infant Phonological Knowledge  |
| Source of Support: NSF<br>Total Award Amount: \$ 275,014 Total Award Period Covered: 01/01/08 - 12/31/10<br>Location of Project: U of Maryland<br>Person-Months Per Year Committed to the Project. Cal:0.00 Acad: 1.00 Summ: 1.00               |

Current and Pending Support (See GPG Section II.C.2.h for guidance on information to include on this form.)

| The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.  |
|---|
| Other agencies (including NSF) to which this proposal has been/will be submitted. Investigator: Jeffrey Lidz  |
| Support:  Current  Project/Proposal Title: IGERT: Biological and Computational Foundations of Language Diversity  |
| Source of Support: NSF<br>Total Award Amount: \$ 3,195,802 Total Award Period Covered: 07/01/08 - 06/30/13<br>Location of Project: U of Maryland<br>Person-Months Per Year Committed to the Project. Cal:0.00 Acad: 0.00 Sumr: 0.00 |
| Support: Current Pending Submission Planned in Near Future *Transfer of Support Project/Proposal Title:   |
| Source of Support:<br>Total Award Amount: \$ Total Award Period Covered:<br>Location of Project:<br>Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:   |
| Support: Current Pending Submission Planned in Near Future *Transfer of Support Project/Proposal Title:   |
| Source of Support:<br>Total Award Amount: \$ Total Award Period Covered:<br>Location of Project:<br>Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:   |
| Support: Current Pending Submission Planned in Near Future *Transfer of Support Project/Proposal Title:   |
| Source of Support:<br>Total Award Amount: \$ Total Award Period Covered:<br>Location of Project:<br>Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:   |
| Support: Current Pending Submission Planned in Near Future Transfer of Support Project/Proposal Title:  |
| Source of Support:<br>Total Award Amount: \$ Total Award Period Covered:<br>Location of Project:<br>Person-Months Per Year Committed to the Project Cal: Acad: Summ:  |
| *If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period   |

# **Current and Pending Support**

(See GPG Section II.C.2.h for guidance on information to include on this form.) The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal. Other agencies (including NSF) to which this proposal has been/will be submitted. Investigator: Michael Long Support: Current □ Pending □ Submission Planned in Near Future □ \*Transfer of Support Project/Proposal Title: Linguistic Correlates of Proficiency Center for Advanced Study of Language Source of Support: Total Award Amount: \$ 2,499,280 Total Award Period Covered: 06/13/04 - 10/30/07 U of Maryland Location of Project: Person-Months Per Year Committed to the Project. Cal:1.50 Acad: 0.00 Sumr: 0.00 Current ■ Pending □ Submission Planned in Near Future □ \*Transfer of Support Support: Project/Proposal Title: IGERT: Biological and Computational Foundations of Language Diversity NSF Source of Support: Total Award Amount: \$ 3,195,802 Total Award Period Covered: 07/01/08 - 06/30/13 Location of Project: U of Maryland Person-Months Per Year Committed to the Project. Cal:0.00 Sumr: 0.00 Acad: 0.00 Support: Current □ Pending □ Submission Planned in Near Future □ \*Transfer of Support Project/Proposal Title: Source of Support: Total Award Amount: \$ Total Award Period Covered: Location of Project: Person-Months Per Year Committed to the Project. Cal: Acad: Sumr: Support: □ Current □ Pending □ Submission Planned in Near Future □ \*Transfer of Support Project/Proposal Title: Source of Support: Total Award Amount: \$ **Total Award Period Covered:** Location of Project: Person-Months Per Year Committed to the Project. Cal: Acad: Sumr: Support: Current Pending □ Submission Planned in Near Future □ \*Transfer of Support Project/Proposal Title: Source of Support: Total Award Amount: \$ **Total Award Period Covered:** Location of Project: Person-Months Per Year Committed to the Project. Acad: Summ: Cal: \*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.

# **Current and Pending Support**

(See GPG Section II.C.2.h for guidance on information to include on this form.) The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal. Other agencies (including NSF) to which this proposal has been/will be submitted. Investigator: Amy Weinberg Support: Current Pending □ Submission Planned in Near Future □\*Transfer of Support Project/Proposal Title: Global Autonomous Language Exploitation DARPA-DoD Source of Support: Total Award Amount: \$ 1,520,000 Total Award Period Covered: 11/01/06 - 12/31/07 University of Maryland Location of Project: Person-Months Per Year Committed to the Project. Cal:1.00 Acad: 0.00 Sumr: 0.00 Current Pending Submission Planned in Near Future □ \*Transfer of Support Support: Project/Proposal Title: Global Autonomous Language Exploitation DARPA-DoD Source of Support: Total Award Amount: \$ 2,296,931 Total Award Period Covered: 01/01/08 - 12/31/09 Location of Project: University of Maryland Person-Months Per Year Committed to the Project. Cal:1.00 Acad: 0.00 Sumr: 0.00 Support: Current □ Pending □ Submission Planned in Near Future □ \*Transfer of Support Project/Proposal Title: Human Language Technology Center of Excellence DoD Source of Support: Total Award Amount: \$ 2.500.000 Total Award Period Covered: 01/15/07 - 01/15/12 Location of Project: University of Maryland (w/ Johns Hopkins U) Person-Months Per Year Committed to the Project. Acad: 0.00 Cal:1.00 Sumr: 0.00 Support: ☑ Pending □ Submission Planned in Near Future □ \*Transfer of Support □ Current IGERT: Biological and Computational Foundations of Language Project/Proposal Title: Diversity NSF Source of Support: Total Award Amount: \$ 3,195,802 Total Award Period Covered: 07/01/08 - 06/30/13 Location of Project: University of Maryland Person-Months Per Year Committed to the Project. Cal:0.00 Acad: 0.00 Sumr: 0.00 Support: □ Current □ Pending □ Submission Planned in Near Future □ \*Transfer of Support Project/Proposal Title: Source of Support: Total Award Amount: \$ Total Award Period Covered: Location of Project: Person-Months Per Year Committed to the Project. Acad: Summ: Cal: \*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.

# **Current and Pending Support**

(See GPG Section II.C.2.h for guidance on information to include on this form.) The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal. Other agencies (including NSF) to which this proposal has been/will be submitted. Investigator: Amanda Woodward Support: Current □ Pending □ Submission Planned in Near Future □ \*Transfer of Support Project/Proposal Title: Infants' Understanding of Goal Directed Action NICHD Source of Support: Total Award Amount: \$ 1,181,531 Total Award Period Covered: 07/01/98 - 04/30/10 U of Maryland Location of Project: Person-Months Per Year Committed to the Project. Cal:3.00 Acad: 0.00 Sumr: 0.00 Current □ Pending □ Submission Planned in Near Future □ \*Transfer of Support Support: The Development of Infants' Action Knowledge Project/Proposal Title: NSF Source of Support: Total Award Amount: \$ 325.000 Total Award Period Covered: 03/01/05 - 02/28/08 Location of Project: U of Maryland Person-Months Per Year Committed to the Project. Acad: 0.00 Cal:0.00 Sumr: 2.00 Support: □ Current ☑ Pending □ Submission Planned in Near Future □ \*Transfer of Support Project/Proposal Title: IGERT: Biological and Computational Foundations of Language Diversity NSF Source of Support: Total Award Amount: \$ 3,195,802 Total Award Period Covered: 07/01/08 - 06/30/13 Location of Project: U of Maryland Person-Months Per Year Committed to the Project. Cal:0.00 Acad: 0.00 Sumr: 0.00 □ Pending □ Submission Planned in Near Future □\*Transfer of Support Support: □ Current Project/Proposal Title: Source of Support: Total Award Amount: \$ **Total Award Period Covered:** Location of Project: Person-Months Per Year Committed to the Project. Cal: Acad: Sumr: Support: □ Current Pending □ Submission Planned in Near Future □ \*Transfer of Support Project/Proposal Title: Source of Support: Total Award Amount: \$ Total Award Period Covered: Location of Project: Person-Months Per Year Committed to the Project. Acad: Summ: Cal: \*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.

### G. Facilities, Equipment and Other Resources

#### Laboratory

- (i) The Cognitive Neuroscience of Language Lab (CNL: Linguistics) is a central facility for this project, with 5000sf of office, laboratory and meeting space shared between 40 faculty, staff, and students.
- (ii) A consortium of 3 infant laboratories (Amanda Woodward, *Psychology*; Jeff Lidz, *Linguistics*; Rochelle Newman, *Hearing & Speech*) supports testing of infants aged 2-24 months, with coordinated recruitment efforts.
- (iii) 3 computational linguistics labs are housed in the U of Maryland Institute for Advanced Computer Studies (UMIACS), with close ties to computational labs at the Center for Advanced Study of Language (in the *M-Square* Research Park) and the Center of Excellence in Human Language Technology (Johns Hopkins U).
- (iv) The Institute for Systems Research (Elec. Comp. Eng.) has a cluster of labs for speech and hearing.
- (v) Hearing & Speech lab facilities include an anechoic chamber.
- (vi) Additional testing space is available in the Psychology department and the School of Languages.

#### Clinical

- (i) Drs Shah (UMd) and Braun (NIH-NIDCD) conduct research with aphasic patients. Braun's lab is in the main NIH Clinical Center in Bethesda, MD (~8 miles from UMd), and has access to a large regional patient population.
- (ii) Dr Ratner directs the LEAP preschool program for children with developmental language delays and works extensively with children who stutter.
- (iii) Dr Zukowski conducts basic research on children with Williams Syndrome, a rare genetic disorder characterized by fluent but arrested language development.

#### Animal

Dr Shamma's Neural Systems Laboratory (Elec. Comp. Eng.) conducts neurophysiological research on auditory cortex in the ferret.

#### Computer

All participating labs have computer equipment suitable for their research activities.

#### Office

In addition to faculty offices, most participating units provide office space for all doctoral students, and the CNL Lab has dedicated space for students visiting from other units or institutions. The NACS program also has central meeting space for graduate students.

#### Other

5 dedicated parking spaces for families and patients visiting for studies, and for visiting speakers.

#### Major Equipment

- (i) 160-channel magnetoencephalography (MEG) brain recording facility (Linguistics)
- (ii) 32-128 channel EEG brain recording facility (Neuroscan, Linguistics)
- (iii) Brain imaging using functional MRI, 1.5T and 3T scanners (NIH)
- (iv) PET brain imaging (NIH)
- (v) Free-head eye-tracker (Tobii, Psychology)
- (vi) Head-mounted eye-tracker (IScan, Linguistics)

#### **Other Resources**

Technician/manager in CNL MEG Lab. Technical support for imaging, computer and instrumentation through NIH-P30 'Core' facility in hearing and auditory neuroscience (funded 2002-7, renewal through 2012 pending). Secretarial support committed to the Developmental Science Field Committee and the Neuroscience & Cognitive Science Program. Long-standing relationship with Center for Young Children for research with preschoolers.



1102 Francis Scott Key Hall College Park, Maryland 20742-7311 301.405.2088 TEL 301.314.9148 FAX www.arhu.umd.edu

COLLEGE OF ARTS AND HUMANITIES Office of the Dean

September 25, 2007

To whom it may concern:

I am writing to express the strong support of the College of Arts and Humanities for the IGERT proposal "Biological and Computational Foundations of Language Diversity". This initiative is shared by five colleges: ARHU (Linguistics, School of Languages, Literatures, and Cultures); CMPS (Computer Science, UMIACS); BSOS (Psychology, NACS, Hearing & Speech); LFSC (Biology); and ENGR (Electrical Engineering). The project will train graduate students in interdisciplinary methods needed to pursue advanced research involving language, and will engage students in international and local outreach activities designed to enhance the diversity of languages and diversity of participation in the language sciences. The project builds upon dramatic changes in curricula, infrastructure, and cross-college connections that I have helped the language community to implement in recent years, and it is a part of a broader institutional priority to make the University of Maryland a leading center for research on language, culture, and cognition (articulated by President C.D. Mote, *Terp Magazine*, Winter 2007).

The College of Arts and Humanities (ARHU) will work with the Office of the Vice President for Research and other participating units to **support the goals of the IGERT** in a number of ways, including the following resources. (i) Two new faculty lines in language, both likely cross-departmental appointments: a computational modeling expert, ideally split between Linguistics and UMIACS or NACS; a semanticist, split between Philosophy and Linguistics. (ii) Space for the IGERT administrative assistant, students, and international visitors and collaborators. (iii) High-level support for removing administrative barriers to cross-college collaboration, such as teaching credit for co-taught courses, formation of cross-departmental PhD committees, etc.

ARHU is committed to the goal of **broadening participation** in research, and a number of its efforts are relevant to the IGERT. (i) Matching travel support for recruiting minority graduate students. (ii) ARHU initiated the partnership with Northwood High School that the Linguistics group is using as a model for integrating language research into the HS psychology curriculum. (iii) ARHU will work with participating units to secure two new fellowships to allow non-US citizens to be integrated into the IGERT program (since NSF funds only US citizens). (iv) Campus-level support for students with disabilities provides sign-language interpreting for deaf students from Gallaudet University who can register for IGERT-related courses.

The University of Maryland will help to **sustain the goals of the IGERT** after the award is ended. (i) The new faculty lines will be maintained. (ii) The IGERT-related space will continue to be available. (iii) University and college-level support for diversity and students with disabilities is ongoing, as is the commitment to outreach programs. (iv) The university and colleges will use the IGERT as a catalyst for their long-term development efforts related to language, including sustaining international partnerships.

In sum, ARHU commits to investing its own resources in this IGERT project. I believe strongly that this project will serve as a crucial step forward in the University's efforts to further enhance its existing strengths in the study of language.

Sincerely,

ames F. Hani

James F. Harris Dean, College of Arts and Humanities



COLLEGE OF BEHAVIORAL AND SOCIAL SCIENCES Office of the Dean October 2, 2007

To Whom It May Concern:

2141 Tydings Hall College Park, Maryland 20742 301.405.1679 TEL 301.314.9086 FAX www.bsos.umd.edu

As Dean of the College of Behavioral and Social Sciences (BSOS), I want to express my strongest support for the IGERT proposal: "Biological and Computational Foundations of Language Diversity." This initiative involves three BSOS units--the Department of Psychology, the Department of Hearing and Speech Sciences, and the Program in Neuroscience and Cognitive Science (NACS)--as well as units in four other colleges (ARHU, CMPS, LFSC and ENGR). This project will develop innovative interdisciplinary training for doctoral students across campus and it will engage students and faculty in new international collaborations and new outreach initiatives to increase diversity in language research. This proposal will become a key mechanism for furthering the University's and College's longstanding goal of promoting interdisciplinary research and training. The University has recently committed to becoming a leading national center for research on language, culture and cognition.

I look forward to working with the Office of the Vice President for Research and other campus units to support the goals of this IGERT. Here are some examples of the kind of support the College will provide:

- (1) An aggressive hiring plan currently underway in the Department of Psychology that will bring to campus new faculty in cognitive science, cognitive neuroscience and developmental science, areas that are integral to this IGERT. Two new faculty members in cognitive and neuroscience will be recruited in the coming year and I will work with the department to continue building in these areas over the next five years.
- (2) As lead Dean for the interdisciplinary NACS program, I have committed 50% of a faculty line for a position in Computational Neuroscience to be shared as a joint appointment by NACS and a NACS-participating department. The search for this position is now underway.
- (3) In coordination with the Vice-President for Research and the Provost, I have committed resources for a new staff position for NACS to assist specifically on extending and developing new interdisciplinary research initiatives in neuroscience. These efforts will help us fulfill our vision of this IGERT proposal as a catalyst for long-term enhancement of interdisciplinary research on this Campus which will lead to additional integrative research programs that intersect with the IGERT.
- (4) The College of BSOS is committed to maintaining and enlarging resources to support the scientific careers of minority students. A number of programs, such as the Summer Research Initiative (SRI) program, can function as an effective recruiting mechanism for IGERT program applicants.
- (5) BSOS recognizes the challenge that HESP faces in attracting strong students to research careers when the majority of applicants seek clinical training. As such BSOS will provide supplemental or matching fellowship support to doctoral students admitted to study in Hearing and Speech Sciences supported by this IGERT as part of our effort to increase the number of doctoral students in HESP.
- (6) Finally, I will work to eliminate administrative barriers to cross-college collaboration, for example by supporting mechanisms for teaching credit for co-taught courses, and facilitating funded collaborations with other colleges.

These activities will extend beyond the term of this IGERT because of our commitment to the type of cross disciplinary research embodied in the grant. BSOS is also committed to building and sustaining a diverse and high quality faculty and student body in the area of cognitive sciences and neurosciences. In closing, BSOS strongly supports this application for an IGERT and is happy to provide the above listed resources to further this project.

Sincerely, Edward Montgomery Professor and Dean



Center for Advanced Study of Language (CASL)

Box 25 College Park, Maryland 20742-0025 301.226.8806 TEL 301.226.8836 FAX

September 28, 2007

To Whom It May Concern:

I am writing this letter to express the support of the Center for Advanced Study of Language (CASL) for the research agenda to be pursued under the proposed IGERT entitled "Biological and Computational Foundations of Language Diversity." CASL is a Department of Defense research facility dedicated to improving the language training and on the job performance of United States Government professionals whose work involves foreign language. The Center conducts research relevant to many of the project areas identified in this IGERT, including the underpinnings of cross-linguistic language learning and processing using behavioral, neuro-cognitive, and computational methods, and the development of technologically enhanced tools for cross language applications such as Machine Translation, and Language and Dialect identification.

Concrete support from the Center will include participation by our researchers in training activities relevant to their areas of expertise and participation in seminars, colloquia, and other Center activities. The Center has developed a Fellowship program for U.S. citizens who are willing to apply their expertise to our problems during the course of their graduate career. The background of IGERT trainees makes them very attractive candidates for this fellowship program, and provides a venue for IGERT trainees to make very attractive job candidates for the Center at the end of their traineeships, and the relationships established through interaction with our researchers will serve to enhance this relationship.

This IGERT proposal has my very strong support. I believe it will enhance the University's already strong commitment to basic research in language and its dedication to application of this work to practical training and applications.

Sincerely,

Richard D. Brecht Executive Director



Language Section National Institute on Deafness and Other Communication Disorders Building: 10 Room: 8S-235A Bethesda, Maryland 20892 Tel: (301) 402-1497 Fax: (301) 451-5353 Email: brauna@nidcd.nih.gov

September 24, 2007

Colin Phillips Department of Linguistics 1401 Marie Mount Hall University of Maryland College Park, MD 20742

Dear Colin,

I'm writing to express my support for your training grant on "Biological and Computational Foundations of Language Diversity", and my hope that this initiative will help to strengthen the ties between NIDCD and the neuroscience and cognitive science community at the U of Maryland.

I am currently Chief of the Language Section at NIDCD, and my group is involved in cognitive neuroscience research with normal and clinical populations, with a particular interest in functional recovery in post-stroke aphasia. Our work combines neuropsychological studies using our extensive patient population with multi-modal brain imaging studies using hemodynamic methods (PET and fMRI) complemented by electrophysiological (EEG/MEG) and PET radiochemical tracer techniques.

Our group has ongoing collaborations with a number of members of your team (Poeppel, Shah, Phillips, Ratner, and their students), and the NACS PhD program at the U of Maryland provides a formal training framework for students in my lab that is not available at NIH. One recent outcome of this connection is that David Poeppel and I were able to jointly recruit Ms Nuria Abdulsabur to our labs, a talented African-American student who will divide her time between my lab at NIH and the NACS Program and CNL Lab at Maryland, supported in part by an NIH fellowship.

Previous student exchanges between our labs have been mutually beneficial: members of our group have consulted with U of Maryland researchers on linguistic issues and electrophysiological analyses, and U of Maryland students have gained experience with imaging methods that are not available to them in their home labs. Last week our group met with UMd students at NIH to discuss the set-up for a simultaneous MEG-EEG study of sentence comprehension. In the past UMd students such as Susannah Hoffman and Ellen Lau have benefited from fMRI workshops available at NIH. Your project's partnership with Gallaudet University also overlaps with my own interests, as my group is involved in ongoing brain imaging studies of ASL speakers in collaboration with Drs. Karen Emmorey and David Corina, both VL2 team members.

I hope that the IGERT project, if successful, will allow us to strengthen the collaborations between our labs, particularly through expanded opportunities for intensive student internships. Good luck with the proposal!

Sincerely,

Allen R. Braun, M.D. Chief, Language Section National Institute on Deafness and Other Communication Disorders National Institutes of Health GALLAUDET



SCIENCE OF LEARNING CENTER ON VISUAL LANGUAGE AND VISUAL LEARNING GRADUATE SCHOOL AND PROFESSIONAL PROGRAMS (202) 651-5866 (202) 448-7513 (FAX)

HALL MEMORIAL BUILDING N-205 800 FLORIDA AVENUE, NE WASHINGTON, DC 20002-3695

September 27, 2007

Dr. Colin Phillips Department of Linguistics 1401 Marie Mount Hall University of Maryland College Park, MD 20742

Dear Dr. Phillips:

I am writing this letter of support for your IGERT initiative at the University of Maryland. I am the Principal Investigator of our NSF sponsored Science of Learning Center (VL2) which conducts research on Visual Language and Visual Learning. VL2 is an international center uniting scholars from many disciplines working in locations around the US. Gallaudet is the focal campus for the center. We believe that the activities discussed in your proposal will enhance both our research and educational missions.

Independent collaborations (Chen-Pichler (Gallaudet)/Poeppel (UMd) and their students) already exist between researchers working on the neural underpinnings and parallels between lexical access in visual (ASL) and spoken language. There are also many points of contact for future synergy. Our work on "phonological awareness" in ASL speakers can benefit from contact with your research program that correlates phonological primitives with their neurobiological counterparts, and our efforts in the visual modality will help yours by teasing apart which features of the phonology are grounded in the auditory system, and which are matters of more abstract "segmentation" processes. Your multilingual work on both linguistic and nonlinguistic factors underlying online reading comprehension can inform our work, which aims at providing a baseline profile of a proficient ASL reader. In return, our comparative work can provide you with a richer basis for hypotheses about the relationship between "listening" and reading comprehension, and the influence of multilingual input on the development and final form of reading comprehension strategies. We see many other possible connections in other research threads, but as these are enumerated in your proposal, I will not repeat them here.

We expect to derive real benefit from your training opportunities. Our Center is dedicated to training a new cohort of deaf and hearing researchers who can sustain and advance progress in our Center's research areas, and we would like our current students to become full partners in center-wide research efforts. Gallaudet does not currently have programs in cognitive psychology, neuroscience, or the computational areas outlined in your proposal, and our students currently learn these integrative skills through training with individual researchers on our faculty. We believe that participation in the courses you plan to offer can be of great assistance to us in filling current gaps in our training program. In addition, opportunities like your "Winter Storm", your proseminar, and your weekly colloquia can reinforce our own educational aims by providing a graceful and "fear eliminating" introduction to the multiple disciplines currently deployed across our partner sites. We believe that providing opportunities for your students to work with ours on problems related to our respective research agendas will also help both groups to escape from their comfort zones, a goal that you mention in your proposal. The flexibility of your offerings will allow us to adapt your program to our research agenda and the educational background of our current cohort of students. We already have a mechanism for participation and support of our students in courses at UMd through the Washington area Consortium of Universities. Membership in the consortium allows students to take courses at other institutions and have the credits apply at their home universities. The consortium also provides services such as ASL interpretation. A small number of our linguistics students have used the consortium to take courses at UMd in recent years.

I look forward to the success of your proposal and to working closely with you on collaborations in the future.

Sincerely yours,

hans E.Ala

Thomas E. Allen, Ph.D. PI and Director, Science of Learning Center on Visual Language and Visual Learning



College Park, Maryland 20742-8111 TEL 301.314.7682 FAX 301.405.0813

September 26, 2007

Dr. Colin Phillips Linguistics Department University of Maryland College Park MD 20742

Dear Dr. Phillips:

I am writing to confirm that Gallaudet students participating in the training associated with your IGERT proposal would be eligible to receive support such as Deaf and Hard of Hearing Services, including Interpreting Services, and Captioning FM Systems needed to participate in UMD course offerings through Disability Support Services at the University of Maryland. As members of the Consortium of Universities of the Washington Metropolitan Area, Gallaudet students are entitled to the same range of services as our own students, which we supply as needed.

In order to be eligible to receive services through DSS, a student, faculty or staff person with a documented disability must make themselves known to DSS. This involves meeting with one of the staff members of DSS, providing appropriate medical or psychological documentation and completing the registration process. The type of documentation necessary will vary depending on the type of disability and accommodations being requested (please refer to our website at www.counseling.umd.edu/DSS). During the registration interview, students receive an accommodations letter (to give each of their instructors) detailing the services appropriate to their disability.

Sincerely yours,

Evalyn R. Hamilton

Evalyn Hamilton Coordinator, Disability Support Services



2122 Lee Building College Park, Maryland 20742-5121 301.405.4183 TEL 301.405.4185 FAX 1.800.245.GRAD TOLL FREE

THE GRADUATE SCHOOL Office of Recruitment, Retention and Diversity

September 25, 2007

Professor Colin Phillips Department of Linguistics 1401 Marie Mount Hall College Park, MD 20742

Dear Colin:

It was a pleasure to meet with you to discuss your plans for recruitment, retention, and diversity related to your IGERT proposal on *Biological and Computational Foundations of Language Diversity*. I am happy to provide this letter to confirm the many programs already in place at the University of Maryland that can support your efforts (most of which you appear to have already contacted before we met). This University has a long-standing commitment to recruitment and retention of <u>all</u> graduate students, including students from URM, and your team offers one of our most interconnected, cross-departmental research communities. Taken together, this bodes well for a successful integrative project.

UM has a number of programs in place that serve recruitment objectives. We recognize that the deadline for the graduate school application process is too late to start recruiting for fall 08, however, we have a number of programs designed to educate and cultivate interest in research among undergraduate students from URM groups. The McNair Scholars program offers a 2-year program of research and career development experience for first-generation college students already at UM. Programs such as this one contributes to UM's achievement of graduating more minority students who go on to take a Ph.D. than almost any non-HBCU in the nation (NSF data). The College of Behavioral & Social Sciences (in connection with one of our AGEP programs) offers the Summer Social Sciences Research Initiative and the NACS Program offers a Neuroscience Summer Internship Program, both targeted at members of URM groups. I was pleased to hear that members of your team have hosted a number of students from these programs in the past. Each fall my office organizes Graduate School Preview Day for 300 to 400 students from around the state and the country, targeted primarily at sophomores and juniors who are uncertain of what graduate school holds. For graduate school recruiting in the College of Arts & Humanities, Professor Heather Nathans coordinates an event in Atlanta each fall with the Atlanta University Center Consortium, targeted at HBCUs in the Atlanta area (e.g., Morehouse, Spelman, Clark-Atlanta). I gather that you have discussed including your project in with her most effective recruitment efforts.

Once students are at Maryland a number of programs are available to support their successful completion of the Ph.D. We have two NSF-supported AGEP programs for which I serve as Co-PI. One is the PROMISE -- Maryland's AGEP that spans three University System of Maryland campuses (UMB, UMBC and UMCP). This highly successful program has been in operation since 2002 and was recently renewed until 2012, and offers workshops, peer-mentoring, a Summer Success Institute (for new and continuing URM students), a Dissertation House for intensive work on developing dissertations, and currently involves several hundred students. The other is the Atlantic Coast AGEP for the Social, Behavioral and Economic Sciences that consists of five institutions (Howard, Florida, Miami, UNC and UMCP), was funded 2005-2007, and renewal is pending. A feature of that program that is particularly useful for your project is a summer workshop on analytical tools in the behavioral sciences held at the UNC, Chapel Hill. Our campus also hosts another NSF-funded program under the Louis Stokes Alliance for Minority Participation (LSAMP), including 'Bridge to the Doctorate' which may be most relevant for students in the computer science/engineering areas of your IGERT. Finally, my office has in place the Ph.D. Completion Project that consists, in part, of a series of bi-monthly student development and dissertation preparation workshops for graduate students across the campus. In 2006-2007, we sponsored 11 events on such topics as proposal writing, preparing for the academic job search, presenting at professional meetings, and writing for publication -- drawing more than 300 students per event. We wish you every success with your proposal, and look forward to working with your students.

Sincerely,

apretta

Johnetta Davis, Ph.D. Associate Dean of the Graduate School Director, Office of Recruitment, Retention and Diversity

Northwood High School 919 University Boulevard West Silver Spring, MD 20901

October 2nd 2007

Mr. Jeff Lidz,

I want to thank you for efforts in establishing an ongoing relationship with Northwood High School Social Studies Department and the Linguistics Department at the University of Maryland, College Park.

As a teacher of AP Psychology, I look forward to exposing my AP Psychology students (college bound juniors and seniors at Northwood HS) to the multitude of research conducted in your labs—in particular to your Cognitive Neuroscience of Language Lab, which will make unit 3 (Biological Bases of Behavior) more tangible for my AP students. In addition, our trip to Maryland's Project on Children's Language Learning Lab will also increase student's awareness in proper research methodology as well as developmental psychology. Furthermore, we greatly anticipate a guest lecture from you on language acquisition this upcoming academic year.

Northwood HS is demographically diverse—thus, our collaboration will expose a great deal of Northwood HS student body to higher education (that would not otherwise have access to such great academic opportunities). Through these opportunities, it is my hope that students will continue to pursue the fields of psycho-linguistics in their future.

Sincerely,

[signature on hardcopy]s

Carlos Montalvan, M.A.T Northwood High School Social Studies Department AP Psychology Instructor Honors Modern World History Instructor Class of 2009 Co-Sponsor Girls Varsity Soccer Head Coach



# HIROSHIMA UNIVERSITY FACULTY OF EDUCATION

Kagamiyama, 1-1-2 Higashi-Hiroshima, 724 Japan Tel. (0824) 22-7111

September 26th 2007

Dear Friends,

This is to confirm that our group at Hiroshima University enthusiastically supports its participation in the proposed training program in "Biological and Computational Foundations of Language Diversity" at the University of Maryland. Our group consists of Hiromu Sakai and colleagues and students of the Project Center for Brain Science of Language Acquisition and Language Learning and the Program in Language and Culture Education in Graduate School of Education at Hiroshima University. We have found our recent collaborations with University of Maryland faculty and students to be quite valuable, and we are eager to continue these collaborations. We have made a number of visits to the University of Maryland, and students from the University of Maryland have spent time conducting research at our university, such as the summer research program in 2005 by Robert Fiorentino (now an Assistant Professor at the University of Kansas) that was supported by an NSF-EAPSI award. As collaborators in your program, our group can provide opportunities for internships lasting from a week to a semester in duration. We can provide testing space and Japanese language expertise, with the possibility of access to eye-tracking and brain recording facilities. We will aim to pair students from Hiroshima with students from Maryland for collaborative projects on native and non-native speaking populations. In the past, visiting students have been housed in Hiroshima University residences, and we anticipate that this should continue to be possible.

It is fortunate that there is a pre-existing university-level partnership between Hiroshima University and the University of Maryland, which provides a framework for student exchanges. In addition, our group has already received a small grant from the Japan Society for the Promotion of Science that provides some support for Hiroshima/Maryland collaborations, and we are working to secure the JSPS International Training Program, a larger training grant from the Japan Society for Promotion of Science that is a counterpart of NSF's IGERT program. An important part of this project will be support for Hiroshima students to make reciprocal visits to Maryland for further training and collaboration. Our first submission to this program was unsuccessful, but since it was positioned in the highest rank among the unsuccessful proposals we plan to submit a revised proposal next year.

We have enjoyed having University of Maryland students as visitors in our lab, and we have appreciated the exchange of ideas that this has created. We hope that this new training grant will help to further our partnership.

Sincerely,

Stromn Sahar

Hiromu Sakai Associate Professor, Linguistics/Education (PhD, University of California Irvine, 1996)



# UFRJ - UNIVERSIDADE FEDERAL DO RIO DE JANEIRO Faculdade de Letras Departamento de Lingüística

Rio de Janeiro, September 17, 2007

Dear colleagues,

This is to confirm that the linguistics laboratories at the Federal University of Rio de Janeiro, Brazil, strongly support UMD's IGERT-related efforts to strengthen and extend graduate education and research cooperation between UMD and UFRJ. In fact, there is a long-standing relation between the two universities dating back to 2000, when I spent some months at the Cognitive Neuroscience of Language Lab-UMD under Professor David Poeppel's supervision, working on crucial aspects of the methodology and technology that made up my Doctoral Thesis' main experiment.

In 2001, David Poeppel gave a one-week course in Rio on neurolinguistics, attracting a good number of professors and graduate students from several departments at UFRJ, including medicine, biophysics, psychology and linguistics. Furthermore, Professor Poeppel took the right steps in helping us establish interface between the Linguistics and the Biomedical Engineering Departments, so that neurophysiology studies could start being conducted here at UFRJ.

In February 2002, UFRJ Professor Miriam Lemle visited UMD to obtain further expertise in language acquisition methodologies. With this knowledge, she reformatted undergraduate and graduate course syllabuses we offer. In 2003 and 2004 we had courses and lectures by Ana Cristina Gouvea, Acrísio Pires, Cilene Rodrigues and Max Guimarães, all UMD alumni. In 2005 we had the visit of UMD Professor Norbert Hornstein for syntax lectures. More recently, in January 2006, we organized the UMD-UFRJ Workshop on Theoretical and Experimental Linguistics. Twenty-one participants from both universities discussed topics from syntax to language acquisition, sentence processing and neurolinguistics. These efforts were led, in the main, by the two institution's Ph.D. students. UMD students also had the opportunity to follow work being done at our labs. It was an extremely beneficial exchange and we plan to make it into a regular event.

Important future possibilities of UMD-UFRJ partnerships are very much in the spirit of the IGERT grant - **Biological and Computational Foundations of Language Diversity**. Our group, which consists of four researchers and a good number of graduate students, is primarily focused on syntax, psycholinguistics and neuroscience of language research. We have a productive research line on morphology of Romance Languages. We are also conducting a series of ERP and eye-tracking studies on morphological and semantic lexical decomposition of Portuguese, some of which we presented at the Cognitive Neuroscience Meeting in 2007.

Finally, there are exciting perspectives related to Indigenous Languages. One of our most active researchers, Professor Marcus Maia, is also a professor in the first Indigenous College in Brazil, gathering students from over thirty Indigenous *nations*, and he is involved in providing high level graduate education to young Indian Linguists who graduate from this college. Maia is extremely excited about the possibility of sending some of these students to UMD and foresees the linguistic wealth it might bring to the linguistic community in Maryland. Maia is also interested in developing experimental field work which would consist in obtaining neuropsychological measurements related to linguistic stimuli being presented to Brazilian Indians. Thus, with the IGERT grant, students working here would have ampler access to the behavioral and ERP lab at UMD, and UMD students would have access to rich resources relating to Brazilian Indiagenous languages.

Considering the longstanding close cooperation we have established and the exciting perspectives we have for future work, we support UMD's IGERT proposal with great enthusiasm.

Suida Juquete França

Aniela Improta França Head of the Linguistics Department / Language School - UFRJ Researcher of the Advanced Program on Neuroscience / Medical School - UFRJ

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भारतीय भाषा संस्थान (मानव संसाधन विकास मंत्रालय, माध्यमिक और उच्च शिक्षा विभाग, भारत सरकार) मानसगंगोत्री, मैसूर - 570 006 CENTRAL INSTITUTE OF INDIAN LANGUAGES (Ministry of Human Resources Development, Dept. of Higher Education, Govt. of India) Manasagangotri, Mysore - 570 006

F.No.1-1/2007/UNS

## 3rd October 2007

## PROF.UDAYA NARAYANA SINGH DIRECTOR

Dear Colleagues,

This letter indicates the support of CIIL for the University of Maryland's efforts to improve graduate education and international collaboration in the cognitive science of language through the project "Biological and Computational Foundations of Language Diversity". CIIL welcomes continued collaboration with the UMD group in the areas of psycholinguistics and language acquisition in addition to new collaboration in the areas of machine translation and electronic language resource creation.

CIIL has assisted Professor Lidz in his research on the acquisition of Kannada by providing research assistants and infrastructure support during his 4 research visits to Mysore spanning the last 8 years. During these visits, Professor Lidz has given lectures on his research on language acquisition. We welcome a larger collaboration

in which UMD psycholinguists bring their methodological expertise together with CIIL researchers' language expertise to developing new research on language acquisition and processing in Indian languages.

CIIL is also charged by the Central Government of India with the goal of creating electronic resources and automatic translation tools for all 23 of the official languages of India. We recognize that UMD is a leader in the automatic creation of electronic language resources and in the field of Machine Translation. We also welcome a collaboration in which our language expertise can be combined with the technological and engineering insights coming from the UMD computational linguistics group.

We hope that this collaboration can come to fruition.

Sincerely Yours, age (UDAYA NARAYANA SINGH)

To Jeff Lidz jlidz@umd.edu Dept of Linguistics University of Maryland, 301-405-8220



# 東北大学 TOHOKU UNIVERSITY

Colin Phillips Department of Linguistics University of Maryland College Park, MD 20742 USA

Dear Colin:

I am happy to confirm my interest in being an international partner in your NSF-IGERT project on 'Biological and Computational Foundations of Language Diversity'. Our group at Tohoku University consists of myself and my colleagues and our students in the Departments of Linguistics, Psychology, and Applied Japanese Linguistics. Tohoku University is located in Sendai City and is one of the most prominent universities in Japan. Most relevant for the current project, we currently host a large training grant on cognition and language as a part of the 21st Century Center of Excellence Program of the Japanese Ministry of Education, Culture, Sports, and Technology. This program is a counterpart of NSF's IGERT program. We are currently preparing to apply for the successor of this program, the 'Global CoE' in the coming year. I am one of the team leaders of the program.

Our group has access to facilities for fMRI brain imaging with adults, NIRS imaging with children, and an infant testing suite equipped with EEG and an eye-tracker. We also have close ties with 3 preschools in Sendai City, which were strengthened by the efforts of Takuya Goro, a U of Maryland graduate student who spent 10 months in our group as part of his PhD research, funded in part by an NSF dissertation award and in part by a grant that I secured from the Japan Science and Technology Agency. Students from your project who visit our labs will be able to pair with students from Tohoku U for collaborative projects that use these and other facilities. Visiting students can receive additional mentoring through lab meetings and workshops in our lab and in the Cognitive Neuroscience Research Center. Tohoku University has 3 dormitories for international students, which may provide suitable housing for visiting students from your project. In addition, I have received a small grant from the Japan Society for the Promotion of Science that supports collaborations between Tohoku University and Hiroshima University, another partner in your project (our universities are at opposite ends of Japan's main island).

As somebody who was initially trained in theoretical linguistics and then later became involved in psychological and cognitive neuroscience approaches to language I am well-aware of the challenges that students face in learning to master techniques in diverse fields, and we are eager to create an environment that allows students to gain broad skills. In Fall 2006 I visited your group at the U of Maryland with a small group of my students and I very much enjoyed the interaction with your students. I hope that your project will allow us to expand this connection.

Best wishes.

Masatoshi Koizumi Associate Professor of Linguistics