RESEARCH REPORT

1. Name: Luke Barrington （ID No.: SP05001 ）

2. Current affiliation: Universtiy of California, San Diego

3. Research fields and specialties:

Humanities Social Sciences X Mathematical and Physical Sciences

Chemistry X Engineering Sciences Biological Sciences

Agricultural Sciences Medical, Dental and Pharmaceutical Sciences

Interdisciplinary and Frontier Sciences

4. Host institution: Advanced Telecommunications Research Institute International

5. Host researcher: Michael Lyons

6. Description of your current research

My current research is on cognitive models; using machines to model brain functions. My specific focus was on visual processing of faces; from the specific eye fixations that sample the visual data to the high-level conceptual cortical representation of facial identity. This research combines elements of neurobiology, machine learning and signal processing to amalgamate these diverse fields into a functioning entity – just as the brain does.

Based on the work that I did this summer in Japan, my research into cognitive models will now also be investigating the neural processes involved in the perception of sound and particularly music. I am now looking at similar machine learning techniques to apply to the analysis of music. I will also be trying to pursue my explorations in the field of ambient display and intelligent user interfaces.

7. Research implementation and results under the program

Title of your research plan:

Ambient Display using Musical Effects

Description of the research activities:

I worked with Dr. Lyons and another student in developing a novel approach to the peripheral display of information by applying audio effects to an arbitrary selection of music. This tied in with existing projects in the IRC group at ATR involving networked interaction projects for care and therapy of seniors. We examined a specific instance: the communication of information about human affect, and construct a functioning prototype which captures behavioral activity level from the face and maps it to musical effects. Several audio effects were empirically evaluated as to their suitability for ambient display. We reported measurements of the ambience, perceived affect, and pleasure of these effects for publication at a leading conference on human-computer interfaces. The findings supported the hypothesis that musical effects are a promising method for ambient informational display.

8. Please add your comments (if any):

This entire program was a wonderful experience. My best dreams about life and people in Japan were fulfilled. The work that I did with my colleagues in ATR was extremely interesting and satisfying and it has rejuvenated and inspired my PhD research in ways that I never expected. Thank you to everyone who made it possible for me to enjoy these fantastic 10 weeks.

RESEARCH REPORT

1. 1. Name: Dieldrich S Bermudez (ID No.: SP05002)

2. 2. Current affiliation: University of Florida

3. Research fields and specialties:

Humanities Social Sciences Mathematical and Physical Sciences
Chemistry Engineering Sciences XX Biological Sciences
Agricultural Sciences Medical, Dental and Pharmaceutical Sciences
Interdisciplinary and Frontier Sciences

4. Host institution: National Institutes of Natural Science, Okazaki Institute for Integrative Bioscience

5. Host researcher: Taisen Iguchi

6. Description of your current research

The thyroid/gonadal axis of the American alligator is being investigated. Two major areas of thyroid activity are examined, the poorly studied effect of thyroid hormones on the development of the ovary and testis and the 'permissive action' of thyroid hormones on sex steroid action. Specifically, the role (cooperative) the thyroid plays in the sexual differentiation of the gonads as well as its role in the development and functioning of the gonad during the neonatal and peripubertal periods is addressed. Additionally, gonadal differentiation and development following exposure to an antithyroid-agent (PTU, proplythiouracil) during the window of sexual differentiation as well as during neonatal development is investigated. Normal physiology and morphology of the thyroid/gonad axis as well as how these respective organs respond to hormonal challenges of FSH (follicle stimulating hormone), TSH (thyroid stimulating hormone), thyroxine (major thyroid pro-hormone) and estradiol-17ß (major estrogen) respectively in adolescent and neonatal alligators is also researched. The developmental and experimental studies will focus on the presence, distribution and concentration of thyroid receptors (TRs, α&ß), sex steroid receptors (ER- estrogen receptors, AR- androgen receptors), DI (deiodinase gene, type 1 & 3), TPO (thyroperoxidase), Tg (thyroglobulin), pendrin, NIS (sodium/iodide symporter) and PAX 8 (pair box gene).

Thyroid hormones affect differentiation, including growth, development, and metamorphosis. Thyrotoxicosis, Grave's disease, Hashimoto's disease, cretinism and juvenile myxedema in humans are examples of disorders in growth and development caused by altered thyroid hormone action. We also know that thyroid disorders are more prevalent in vertebrate females, including humans. Basic knowledge on the role the

thyroid plays in gonad development and function will aid in the prevention of related disorders. Moreover this study will provide insights on how the thyroid functions and how it is altered by describing aspects of its molecular physiology.

7. Research implementation and results under the program

(As much as possible, describe the contents and results of your research in a manner that is easily understandable to a non-specialist in your field.):

Title of your research plan: The effects of PTU on the thyroid/gonad axis during development and maturation of the American Alligator.

Description of the research activities:

The project proposed for work in Japan sought to clone out and designed primer sets for quantitative RT-PCR (method for measuring gene expression) from candidate genes related to thyroid physiology. These candidate genes included TSH-R (thyroid stimulating hormone receptor), DI (deiodinase gene, type 1 & 3), TPO (thyroperoxidase), Tg (thyroglobulin), pendrin (iodide/cloride symporter), NIS (sodium/iodide symporter) and PAX 8 (pair box gene). After the primer sets were designed, alligator thyroid samples from a previously performed PTU experiment would quantitative RT-PCR run to determine gene expression levels for said candidate genes. Unfortunately, time only permitted for the cloning and designing of primer sets for five out of eight of the candiate genes. They shown below:

Pendrin 780/2,349 bp (33.21 % of sequence)
Sodium/Iodide symporter 180/2,070 bp (8.70 % of sequence)
Thyroglobulin 561/8,322 bp (6.74% of sequence)
Thyroperoxidase 519/2,700 bp (19.22 % of sequence)
Thyroglobulin 561/8,322 bp (6.74% of sequence)

9. Advisor's remarks (if any):

Mr. Bermudez accomplished more than was expected for the time allotted. He was able to clone out several genes and learned some valuable laboratory techniques. The cloned out genes will serve to better understand thyroid physiology. I enjoyed the time we shared this summer.

RESEARCH REPORT

1. Name: Albert Bowers （ID No.: SP05003 ）

2. Current affiliation:

University of Illinois at Chicago

3. Research fields and specialties:

Humanities Social Sciences Mathematical and Physical Sciences

X Chemistry Engineering Sciences Biological Sciences

Agricultural Sciences Medical, Dental and Pharmaceutical Sciences

Interdisciplinary and Frontier Sciences

4. Host institution:

Dept. of Synthetic Chemistry and Biological Chemistry, Graduate School of Engineering, Kyoto U.

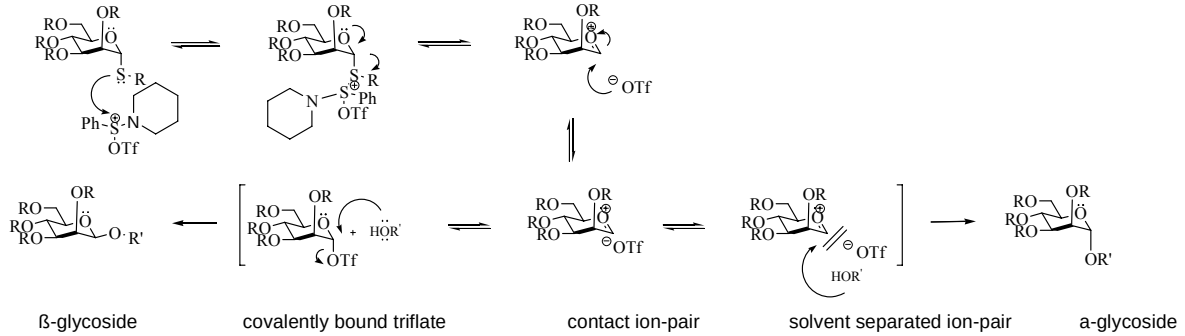
5. Host researcher:

Jun-Ichi Yoshida

6. Description of your current research

A major impediment in the chemistry of carbohydrates is controlling the three-dimensional geometries around linkages between monomer units, the so-called glycsidic bond. Thus, when linking two glucose subunits, if this linkage is up (β), we obtain the repeat unit of cellulose, whereas the opposite, down geometry (α) provides maltose, commonly known as starch. As biologically prevalent as glucose, but significantly more difficult to prepare chemically is the β-mannose linkage, this together with the similar β-rhamnose linkage has been the focus of my research in the U.S.

Our laboratory has reported the usage of a bridge group, the 4,6-*O*-benzylidene that can be used to protect a mannose monomer with subsequent high β-selectivity in a triflate mediated coupling reaction. As illustrated in the scheme below, due to a combination of physical and electronic stricture, this protecting group maintains the leaving group (a weakly bound triflate) on the α-face, so that when the new monomer is introduced it attacks and displaces the triflate from the β-face. The product is the β-mannoside.



Scheme 1: Mechanism of the BSP mediated glycosidation of thioglycosides.

I have extended this methodology to the rhamnosides, the 6-deoxy mannosides. Because these sugars have no oxygen on the last carbon of the chain, benzylidene can not be directly employed; there is no place to attach it. My chemistry has side-stepped this problem by altering benzylidene itself. Starting from the suitably protected mannose monomer, the modified benzylidene promotes formation of the β-linkage and then

allows, in a subsequent reaction, the removal of the terminal oxygen, unveiling the β-rhamnosides. These sugars are an important part of bacterial polysaccharides and by providing a method for their facile large scale laboratory preparation we have opened the door to a greater understanding of their roles in propagation of disease states. In course of these investigations we have seen many interesting results of altering the electronic identity of the 4,6-*O*-benzylidene and thus far my research has followed the ramifications.

7. Research implementation and results under the program

(As much as possible, describe the contents and results of your research in a manner that is easily understandable to a non-specialist in your field.):

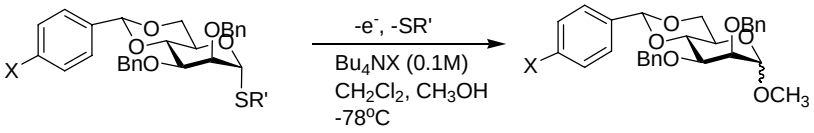
Title of your research plan:

Mechanism of β-Mannosylations via the "Cation Pool" Method.

Description of the research activities:

In general, modern glycosidation methods, methods for installing the intermonomeric linkage, follow direct chemical mediation of the bond formation. However, Ryoji Noyori has attempted to employ electrochemical methods and Jun-Ichi Yoshida at Kyoto University has picked up on this line of investigation. Yoshidas group has developed the "cation pool," a method for electrochemically generating and accumulating carbocations at low temperature. These highly reactive intermediates can then be combined with other building blocks to produce new target molecules. In extending Noyoris efforts, Yoshida had attempted with some success to couple carbohydrates via the cation pool. However, the character of the intermediates generated and the scope of the reaction conditions were not well understood at time of preparing the proposal. Therefore, we sought first to apply the 4,6-*O*-benzylidene protecting group in electrochemical couplings of the mannose monosaccharides and, second, proof of the structures of intermediates via low temperature NMR experiments.

The results of researches towards these goals are set out in the table below. In entries 1 through 4 it was observed that the protecting group itself was reacted instead of the sugar. Efforts to counteract this effect focused on increasing the oxidation potential of the protecting group, while decreasing that of the thioglycoside. In subsequent studies, the S-toluyl, *p*-chloro-benzylidene protected thiomannoside was identified as an adequate donor.



Results of electrooxidative couplings in the mannose series[1]

Entry	Y	-SR'	Bu4NX (equiv.)	Substrate conc.	F/mole	Recovered	% yield	(β:α)	Method
1	H	SEt	ClO_4 (6)	0.0167M	1.25	10	11	1.5:1	*in situ*
2	"	SEt	ClO_4 (6)	"	1.25	12	11	1.5:1	*in situ* (3 equ. TTBP)
3	"	SPh	ClO_4 (6)	"	1.25	12	43	1.5:1	*in situ*
4	"	"	OTf (6)	"	1.25	42	36	1.8:1	*in situ*

5	"	STol	ClO_4 (6)	"	1.25	39	26	1.5:1	*in situ*
6	Cl	SPh	ClO_4 (6)	"	1.25	41	35	1.2:1	*in situ*
7	"	STol	ClO_4 (6)	"	2.00	0	69	1.2:1	*in situ*
8	"	"	ClO_4 (6)	"	1.25	0	84	1.5:1	*in situ*
9	"	"	ClO_4 (6)	"	1.25	12	59	1.5:1	one pot
10	"	"	OTf (6)	"	1.25	5	69	2.5:1	one pot
11	"	"	TEBP (6)	"	1.25	41	0	--	one pot
12	"	"	OTf (3)	"	1.25	6	71	4.5:1	one pot
13	"	SAnis	OTf (3)	"	1.25	8	63	5.3:1	one pot
14	"	STol	ClO_4 (1.5)	0.05M	1.25	0	79	1.9:1	one pot
15	"	"	SbF_6 (1.5)	"	1.25	9	14	1.3:1	one pot
16	"	"	TEBP (1.5)	"	1.25		0	--	one pot
17	"	"	OTf (1.5)	"	1.25	5	75	4:01	one pot

[1]All yields refer to trapping of intermediate with 5 equivalents methanol. All reactions were carried out at -78ºC in CH_2Cl_2 in divided cell with carbon fiber anode and platinum cathode. Methanolysis was allowed to proceed for ~10 minutes at -78ºC, before quenching with Et3N and warming to rrom temperature.

Reasonable yields were obtained in the cation pool couplings of this donor, but selectivities were substantially less than those of similarly protected donors under standard coupling protocols. Reason for this discrepancy was sought through low temperature NMR characterization of intermediates. The amount of electrolyte was decreased to facilitate the NMR experiments and a corresponding increase in selectivity was observed. In entry 13, with 3 equivalents of Bu_4NOTf, a single, α-mannosyl triflate was observed in the low temperature NMR and selectivity showed approximate accord. With Bu_4NClO_4 at the same concentrations, selectivity remained poor and both α and β perchlorate esters were present in the low temp. NMR spectra.

Electrolytes are needed in electrochemical oxidations to aid the conductivity of the solution, to make it a better circuit and what we were observing was that the negatively charged anion from the electrolyte was associating with the oxidized sugar to form the reactive intermediate. The intermediates themselves turn out to be quite similar to those produced by chemical methods. Presumably, at higher electrolyte concentrations the α/β equilibrium of the intermediate was shifted (*in situ* anomerization), counteracting the selectivity of the standard triflate methods. This conclusion is substantiated by the facts that perchlorate anion is a stronger nucleophile and less electron withdrawing than the triflate, subject to a weaker anomeric effect (pKa, $HClO_4$: -9, pKa, HOTf: -12).

With benzylidene having been adapted to the cation pool couplings and the structure of the intermediate described, our initial goals had been satisfied. However, with time remaining, attention was turned towards further investigations of other putative intermediates. The naked glycosyl cation, unprotected by electrolyte counterions, ^-OTf, $^-ClO_4$, etc., has been postulated as intermediate in a great number of mechanisms, with no spectroscopic evidence; it is very reactive and readily decomposes or traps latent nucleophiles in whatever medium it is generated. The ability to adjust solvent conditions in cation pool with only prerequisite that it support the current necessary to oxidize the substrate suggested strongly

that the glycosyl cation can be isolated and observed by this method. Therefore, standard, selective, and somewhat covalent counterions, $^{-}$OTf and $^{-}ClO_4$, were exchanged for non-coordinating species, $^{-}SbF_6$ and $^{-}BR_4$, derived form George Olahs superacids (in these experiments we used R=aryl, as the intermediates were strong enough to rip fluorine from the more traditional $^{-}BF_4$). At present results of these experiments are not yet complete. A number of conditions were tried with promising results and a final solution has been set upon to be tested once the route to a substrate has been worked out.

RESEARCH REPORT

1. Name: Justin Brickell （ID No.: SP05004）

2. Current affiliation: The University of Texas at Austin

Department of Computer Sciences

3. Research fields and specialties:

Humanities Social Sciences X Mathematical and Physical Sciences
Chemistry Engineering Sciences Biological Sciences
Agricultural Sciences Medical, Dental and Pharmaceutical Sciences
Interdisciplinary and Frontier Sciences

4. Host institution: IBM Tokyo Research Laboratory

5. Host researcher: Dr. Mei Kobayashi

6. Description of your current research

Data Mining:

My current data mining research examines the access log that is automatically generated by most web server applications. The log contains information relating clients to the web pages they have visited. By carefully analyzing the log, we can determine relationships of the form “clients who visit page A are likely to later visit page B.” If there is no direct link between pages A and B, then it might be useful to automatically add one. Adding too many links is undesirable because they would clutter the page and make it difficult and awkward to use. I have developed a system that uses caching algorithms to select the best small set of “shortcut links” to add to pages in a website. Preliminary results indicate that the system is very fast and memory efficient, and that the links it suggests would be useful to clients visiting the website.

Privacy:

I am interested in *private computation*, also known as *secure multiparty computation*. Using cryptographic techniques, it is possible for multiple parties to perform a computation on their joint input without revealing their individual inputs to one other. There are general techniques that allow any polynomial-time algorithm to be transformed into a private protocol, but the protocols produced by these techniques tend to be inefficient. As a result, there has been interest in the privacy community in developing efficient private protocols to solve specific problems.

In a paper to be presented at the AsiaCrypt 2005 conference, I give secure multiparty protocols for several graph problems, such as all pairs shortest path, single source shortest path, and minimum spanning tree. Currently I am trying to apply my techniques to a more general class of problems.

7. Research implementation and results under the program

Title of your research plan:

"Defining Similarity in Medical Patients"

Description of the research activities:

My research was motivated by the design of a system to help doctors choose the best treatment for their patient from among many available options. My work was based on the premise that patients are likely to be best-served by the treatment that has best-served similar patients in the past.

Most of my research focused on developing a definition for patient similarity that could be used by an automated search system, and also corresponded well with the intuitive concept. I also developed a prototype for a user interface allowing doctors to perform queries for the best treatments. I produced the following reports and talks:

- Tokyo Research Lab Seminar: "Using Cache Algorithms to Choose Shortcut Links"
- Natural Language Group Informal Seminar: "Using Eclipse and SWT Designer to produce GUI prototypes"
- IBM Research Disclosure in Prior Art Database: "System and method for querying massive datasets using data object synopses" (with M. Kobayashi, S. Suzuki)
- IBM Research Report RT-5250: "A System for Querying Medical History Databases"
- Tokyo Research Lab Seminar: "Defining Similarity in Medical Patients"

8. Please add your comments (if any):

I would like to thank the NSF and JSPS for funding and organizing this exchange program. It has been very valuable for me to learn about conducting research in a corporate environment and to learn about Japanese culture. I would also like to thank my colleagues at IBM Tokyo Research Laboratory for accommodating my visit and answering all of my questions. Dr. Mei Kobayashi in particular was a gracious and helpful host.

9. Advisor's remarks (if any):

We were pleased that Justin Brickell actively participated in our informal and formal seminar series at IBM/TRL. The seminars he gave and attended provided a valuable opportunity for the employees and visitors of the lab to engage in meaningful academic dialog and to establish personal and professional friendships.

RESEARCH REPORT

1. Name: Rebecca Briggs （ID No.: SP05005 ）

2. Current affiliation:

University of Hawaii, Department of Oceanography

3. Research fields and specialties:

Humanities Social Sciences Mathematical and Physical Sciences
X Chemistry Engineering Sciences Biological Sciences
Agricultural Sciences Medical, Dental and Pharmaceutical Sciences
Interdisciplinary and Frontier Sciences X Environmental Sciences

4. Host institution:

AIST, National Advanced Industrial Science and Technology, Tsukuba Japan.

5. Host researcher:

Dr Masumi Yamamuro

6. Description of your current research

My study aims to assess the riverine flux of particulate and dissolved phosphorus to the oceans, focusing particularly on the changes of phosphorus speciation, reactivity, and bioavailability at the riverine-oceanic interface. Phosphorus is a nutrient essential for the growth of organisms and can act as a limiting nutrient in ocean environments. The phosphorus cycle is linked to the global carbon cycle through marine photosynthetic productivity. This cycle has influenced the chemistry of the oceans and atmosphere in both modern day, as well as throughout geologic time. The impact of phosphorus on oceanic primary productivity is not fully understood. In order to elucidate its role, one must look at the bioavailable fraction of phosphorus in the river and how much of this bioavailable phosphorus is released into the oceanic water column. This includes riverine dissolved phosphorus and the amount of phosphorus that will be released from river suspended sediment at the continent-ocean interface or after burial in coastal sediments. One method to determine the nature of phosphorus speciation in riverine particulate matter and bottom sediment is the sequential extraction method (SEDEX) outlined by Ruttenberg (1992). Using this method, phosphorus can be quantified into five reservoirs: loosely sorbed P; ferric iron-bound P; authigenic carbonate fluroapatite + biogenic apatite + $CaCO_3$-associated P; detrital apatite P; and organic P (Ruttenberg 1992). The SEDEX method can be used to analyze both riverine suspended particulate matter and benthic sediment samples from the

river and the coastal ocean. My research intends to utilize this method to analyze the phosphorus speciation in riverine and coastal ocean sediments and determine changes in P pools across the ocean-riverine interface. This project will enhance the understanding of the natural impacts of riverine phosphorus input to the ocean and provide boundary conditions for future modeling strategies.

7. Research implementation and results under the program

Title of your research plan:

The preferential separation of phosphorus bound in calcium carbonate and carbonate-fluoroapatite based on solubility properties in the solvent triammonium citrate: *An adaptation to step three of the SEDEX sequential extraction method for marine phosphorus*

Description of the research activities:

Currently the SEDEX method separates authigenic carbonate fluroapatite + biogenic apatite + $CaCO_3$-associated P; however a study by Silverman et al (1952) identified the organic acid triammonium citrate (TAC) as a possible solvent to preferentially separate calcium carbonate and carbonate-fluoroapatite (CFA), based on solubility. Utilizing this solvent could further separate these pools of bound inorganic phosphorus in marine sediments. My research in Japan was designed to fine-tune the previous work by Silverman and utilize TAC in step three of the SEDEX sequential extraction method for marine phosphorus. The project intended to dissolve pure end members of CFA and $CaCO_3$ in TAC and sample via the colorimetric phosphomolybdate blue method procedure of Koroleff; thus, testing the ability of TAC to fully separate these pools of inorganic phosphate.

IN the course of my research, I found it very difficult to analyze the amount of dissolved P in TAC. The most well known and simplest method for analyzing inorganic P in solution is to utilize the phophomolybdate blue; however, I observed that TAC interferes with the formation of the molybdate complex, similar to the problems found when working with the sodium bi-carbonate solution in step two of SEDEX.

Applying methods described by Dr. Masahiro Suzumura, at my host institute, a Sep-pak separation method was identified as a possible process for analyzing this solution. By utilizing the sep-pak method the inorganic P in solution can be separated from the interfering TAC and then analyzed via the colorimetric method. Further work needs to be conducted to determine whether this method of analysis will be applicable. Furthermore, if this process is applicable then additional work must be carried out to verify if TAC is preferentially separating apatite and $CaCO_3$

bound P. While in Japan I determined the necessary steps needed to apply this procedure and began analyzing standards using this method. My goal is to complete this research back at my home institute applying this new technique.

8. Additional Comments:

In addition to the work I completed for my project I was also very fortunate to work on other projects during my stay. I have begun analysis on a sediment core collected by Dr. Kou Harada off the coast of Japan to determine trends of P in deep sea sediments characterized by high productivity. Analysis of these samples will be completed at my home institute, and collaboration with researchers in Japan will continue while completing this project.

I have also been fortunate to learn two new laboratory techniques from the expertise of Dr. Masahiro Suzumura: the sep-pak separation technique, mentioned previously, and stirred celled ultrafiltration, a technique used to separate and characterize dissolved organic phosphorus. Both of these techniques will be very useful for further research and I will be setting up appropriate apparatus to run these techniques at my home institute.

Even through I could not fully answer the problems with my original research experiment, I have benefited greatly from my host and other colleagues in Japan and will be able to utilize much of what has been learned during my stay this summer. I would like to especially thank the researchers in Japan that helped me throughout my stay including: Masahiro Suzumura, Masumi Yamamuro, Nobuo Tsurushima, Osamu Oku, Kou Harada, and Hiroshi Ogawa.

RESEARCH REPORT

1. Name: Franklin Carrero-Martínez （**ID No.:** SP05006）

2. Current affiliation: University of Illinois at Urbana-Champaign

3. Research fields and specialties:

Humanities Social Sciences Mathematical and Physical Sciences
Chemistry Engineering Sciences X Biological Sciences
Agricultural Sciences Medical, Dental and Pharmaceutical Sciences
Interdisciplinary and Frontier Sciences

4. Host institution: National Institute of Genetics

5. Host researcher: Dr. Emiko Suzuki

6. Description of your current research:

Successful synaptogenesis requires collaboration of cellular and molecular dynamic events. Biochemical studies reveal that scaffolding family proteins such as PSD-95/Dlg coordinate postsynaptic molecular assembly at glutamatergic synapses. Genetic studies demonstrate their role during synaptic maintenance and plasticity. However, it is unclear whether initial synaptogenesis requires such proteins and, if so, how they function in the cell-specific matchmaking that precedes synaptogenesis. To investigate this problem, we chose the *Drosophila* neuromuscular synapse formation as a model system and its myopodia (post-synaptic filopodia) cluster. This muscle structure enables the interaction with neurites at the site of synaptogenesis. Our recent studies have shown that post-synaptic single-cell manipulations of myopodia clustering alter synapse formation. Myopodia cluster Also, disrupting post-synaptic PSD-95/Dlg function during this period aborts synaptogenesis without affecting myopodia cluster formation. These results support essential functions of postsynaptic PSD-95/Dlg and its collaboration with myopodia cluster at the onset of glutamatergic neuromuscular junction. However, visualization at higher resolution is desirable to gain additional insights into these processes as it occurs *in vivo*.

7. Research implementation and results under the program

(As much as possible, describe the contents and results of your research in a manner that is easily understandable to a non-specialist in your field.):

Title of your research plan:

High-resolution dissection of *in vivo* synaptogenesis

Description of the research activities:

I proposed to further assess PSD-95/Dlg implication in successful synaptogenesis by looking at this process *in vivo* at the ultra-structural level. The selection of the model system was based on the stereotypic neuromuscular synapses and availability of single, identifiable cells (**Fig 1c, 1d**). To gain insights into the ultrastructural changes induced by genetic manipulations we examined fillet-dissected *Drosophila* embryos at hour 14 of embryogenesis using scanning electron microscopy (SEM).

Targeted expression of dominant-negative PSD-95/Dlg (Dlg^{DN}) in all muscle cells (Nrv1'-Gal4/UAS-Dlg^{DN}) was used. Restricting expression of Dlg^{DN} to muscle12 ($Gal4^{M12}$/UAS-Dlg^{DN}) was also proposed. Previous results showed pan-muscle expression causes lethality prior to larvagenesis, while single-cell mutants develop into adult flies. Using these genetic backgrounds, I proposed to assess changes to the structural integrity of the synapse as it is formed *in vivo*.

At this higher resolution single-cell expression of Dlg^{DN} resulted in no appreciable effect on myopodia clustering. However, we observed abnormal neurofilopodia / myopodia interactions (compare **Fig 1c**, with **1b**). At a later stage, expression of this mutant protein resulted in no synapse formation (*not shown*). Similar results were observed when Dlg^{DN} was expressed in all 30 muscles; *not shown*). Ectopic synapse formation (as observed previously with confocal microscopy) onto muscles 21 and 22 remains to be elucidated at EM level. To that effect TEM (transmission electron microscopy) thin sections are being prepared and analyzed to assess this phenomenon. We conclude that Dlg plays a critical role during neuromuscular synaptogenesis.

Previously, we determined that expression of a dominant-negative form of Ezrin ($Ezrin^{DN}$) in a single post-synaptic cell results in the disruption of the myopodia cluster. At SEM level, we have observed that normal myopodia cluster (**Fig 1b**) failed to appear (**Fig 1d**). This resulted in the formation of an abnormally bigger

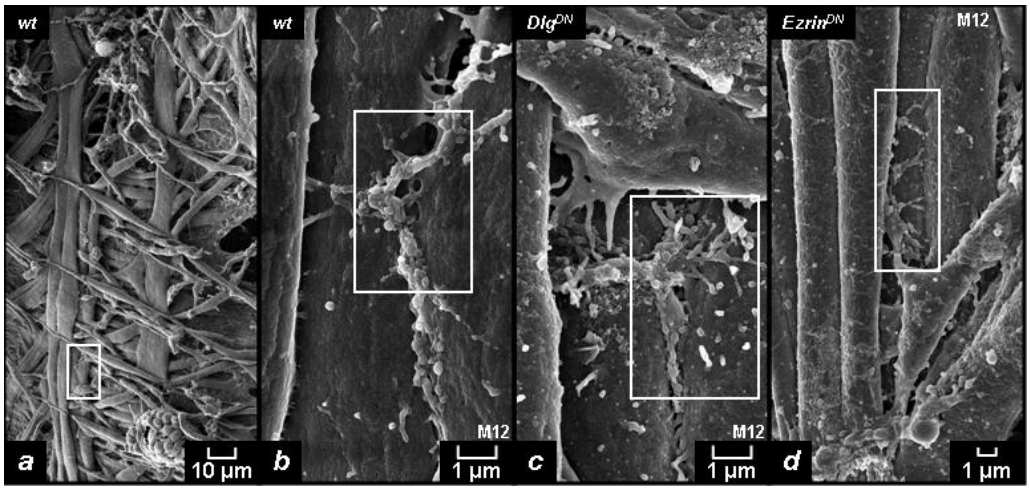


Figure 1: ***a***) SEM of a fillet-dissected wildtype *Drosophila* embryo at hour 14 after egg laying (AEL). In this system, muscle12 (m12) is our model postsynaptic cell (*box*) and its neuromuscular junction. ***b***) Wildtype m12 myopodia cluster (*box*). ***c***) Dlg^{DN} expression in muscle12 results in an abnormal neurofilopodia / myopodia interaction. ***d***) Expression of $Ezrin^{DN}$ in M12 disrupts myopodial cluster, resulting in increased surface interactions.

synaptic interaction onto muscle12 (**Fig 1d**). These results suggest that myopodia clustering plays an important role in shaping the synapse, presumably through stable interactions and recruitment of post-synaptic density proteins. Therefore, we propose that myopodia clustering, coupled to rapid remodeling of cytoskeletal and other subcellular components, is essential at the site of contact between synaptic partners for reliable synaptogenesis to proceed *in vivo*.

Taken together, these results suggest that myopodia cluster may serve as a "synaptic nucleation" site where the structural components of a synapse are recruited and assembled. One such protein is PSD-95/Dlg which we have shown to play a critical role, through its collaboration with myopodia cluster, to form the glutamatergic neuromuscular synapse.

8. Please add your comments (if any):

I am very happy with this summer experience. To me, this opportunity is of incalculable value, especially because I had the opportunity to work side by side with my sensei, a world-renown scientist. At the end of this program, I leave very satisfied: not only because I made a collaborator, but also a good friend. On top of all that, I leave with good results and the potential for publication in the near future.

9. Advisor's remarks (if any):

Our collaborative studies in this Summer program went very well. We could obtain concrete results on the implication of post-synaptic molecules in the dynamic interaction of pre- and post-synaptic cells at the early stages of synaptogenesis. I appreciate that Franklin contributed mainly to this project, much more than I expected.

RESEARCH REPORT

1. Name:Aditi Chandra （ID No.: SP05007 ）

2. Current affiliation: Stanford University

3. Research fields and specialties:

Humanities Social Sciences X Mathematical and Physical Sciences
Chemistry Engineering Sciences Biological Sciences
Agricultural Sciences Medical, Dental and Pharmaceutical Sciences
Interdisciplinary and Frontier Sciences

4. Host institution: Tokyo University

5. Host researcher: Dr. Fumio Okada

6. Description of your current research

The unique electrical and magnetic properties of nanoparticles stem from the large fraction of atoms that reside on surfaces. In periodic arrays of nanoparticles, physical properties depend on both the particle size and spacing. The relationship between material properties and particle dimensions allows for the fabrication of tailor-made materials. However, in order to impose length scales in self-organizing systems, an understanding of the thermodynamic and kinetic factors that influence organization is a necessity.

The aim of my current research is therefore to investigate a self-assembling system and clarify the relationship between self-assembling factors and predominant length scales. To this end, the spontaneous formation of monodisperse nanoparticles within AuSi/Si multilayer films is studied. The Au-Si binary system is characterized by a positive heat of mixing in the solid state. Therefore, amorphous AuSi alloys are prone to phase separation into Au-rich and Si-rich particles. When amorphous AuSi alloys are placed in contact with amorphous silicon and annealed, the ensuing phase separation and Si crystallization results in the formation of Au-rich nanoparticles, with uniform size and spacing, and associated crystalline Si nanostructures. By identifying the factors that drive nanoparticle formation and providing a few simple thermodynamic models, my research work elucidates some of the self-guiding features and characteristic length scales seen in Au-Si multilayer films.

7. Research implementation and results under the program

(As much as possible, describe the contents and results of your research in a manner that is easily understandable to a non-specialist in your field.):

Title of your research plan:

Silicon nanocrystal formation in SiOx/SiO2 superlattices

Description of the research activities:

Bulk crystalline silicon is the standard material for semiconductor processing and electronic devices but light emission from this material is highly inefficient due to its indirect energy band gap. Silicon nanocrystals, however, show a strong luminescence in the visible spectrum where emitted wavelengths are determined by nanoparticle size as well as the local bonding environment. Therefore, control over nanocrystal shape, position, and its surrounding matrix represents an important step in realizing future silicon optoelectronic devices.

One technique for preparing silicon nanocrystals is through the phase separation of bulk SiOx suboxides where $x<2$. SiOx is thermodynamically unstable and readily decomposes into stable crystalline silicon and amorphous silicon dioxide as shown below.

$$SiOx \rightarrow (x / 2)\ SiO_2 + (1 - x / 2)\ Si$$

In bulk SiOx phase separation, nanocrystal size is dictated by the silicon concentration in the SiOx matrix, but crystal size and position cannot be controlled independently. By utilizing SiOx/SiO2 multilayer structures, it has been shown that nanocrystal position can be controlled in the out of plane direction, however, the effect of layer thickness on nanoscrystal shape and crystallization is not yet well understood.

For the summer program, it was our aim to study the crystallization behavior of SiO/xSiO2 superlattice structures. During the first two weeks, I fabricated SiOx/SiO2 superlattice thin films using rf sputtering deposition. The buffer SiO2 layer was kept constant at 3nm, while the SiOx thickness ranged from 1.5nm-12nm. The number of bilayers was selected to keep the total volume of SiOx constant. In this respect, I was able to study the effect of layer thickness on SiOx phase separation and subsequent silicon crystallization. Films were investigated using both in-plane and out-of-plane X-ray diffraction. This technique is quite versatile and allowed for the determination of crystallization temperature, extent of silicon crystallization, and nanoparticle shape as a function of temperature. Films were

annealed between 900-1150C in 50C increments.

Initially films were heated in vacuum with pressures ranging from 8*10^-5 to 2*10^-4 Pa. At temperatures around 100C, however, the x-ray scan intensity dropped significantly and the film surface roughened. After investigation using Scanning Electron Microscopy (SEM) and X-ray Photoelectron Spectroscopy (XPS), I found that the silicon substrate had undergone surface reconstruction, large silicon particles (8nm) were formed on the surface, and the multilayer structure was destroyed. These results were caused by SiOx desorption from the surface. To prevent SiOx desorption, I conducted high temperature anneals in a high purity nitrogen atmosphere.

From the x-ray measurements, I found that as the SiOx layer thickness decreases, the crystallization temperature increases and the extent of silicon crystallization decreases. Additionally, I determined that the average out of plane particle diameter reduces slightly from 3.8nm to 2.8nm when the SiOx layer thickness decreases from 12nm to 1.5nm. It is interesting to note that the nanocrystal diameter remains larger than the original SiOx layer thickness for the case of 1.5nm and 3nm. These results imply that as SiOx layer thickness decreases, the particle diameter remains almost constant, but the nanocrystal density reduces. TEM measurements will be performed to confirm this hypothesis and to confirm the x-ray diffraction results.

8. Please add your comments (if any):

This is was a wonderful opportunity! I had enjoyable daily interactions with the students and professors in my laboratory, both professionally and personally. Through the summer program, I have gained both fruitful collaborations and personal friendships that will continue in the future.

RESEARCH REPORT

1. Name: Joel Chestnutt （ID No.: SP05008 ）

2. Current affiliation: Carnegie Mellon University

3. Research fields and specialties:

Humanities Social Sciences Mathematical and Physical Sciences
Chemistry **X Engineering Sciences** Biological Sciences
Agricultural Sciences Medical, Dental and Pharmaceutical Sciences
X Interdisciplinary and Frontier Sciences

4. Host institution: Digital Human Research Center, National Institute of Advanced Industrial Science and Technology (AIST)

5. Host researcher: Dr. Satoshi Kagami

6. Description of your current research

My research attempts to bring some measure of autonomy to biped robots. While walking robots have advanced greatly in the last 10 years, they still have difficulty moving through real environments that include obstacles or uneven surfaces. My work has been in the area of planning paths for biped robots, so that they can find their way through complex real-world environments to reach a goal. At Carnegie Mellon, we have worked with Honda's ASIMO robot to have it autonomously navigate through changing environments. Previously, with my advisor I was able to collaborate with Dr. Satoshi Kagami and Dr. Koichi Nishiwaki at the University of Tokyo for planning for the robot H7. In simulation, we have been able to show that the planning work we have done can handle much more complicated environments that have so far not been implemented on real robots. Current research involves both increasing the planning capabilities of the system, and overcoming the sensing and control limitations which have thus far prevented implementation on real robots.

7. Research implementation and results under the program

(As much as possible, describe the contents and results of your research in a manner that is easily understandable to a non-specialist in your field.):

Title of your research plan:

Footstep Planning for HRP-2

Description of the research activities:

At the Digital Human Research Center in Tokyo, I have been working with Dr.

Nishiwaki and Dr. Kagami to integrate a planning system which can help their humanoid robots find safe paths through cluttered environments. This summer I have been focusing on putting the algorithms we have worked on previously into effect on the real robots, allowing them to do things which have only been accomplished in simulation so far. By the end of the summer, I plan to have two systems working with the DHRC robots. First, a system which allows the user to control the path of the robot with a joystick, in which the robot will intelligently place it feet to avoid obstacles which following the joystick commands. Second, have the robots be able to autonomously walk through an environment to reach a goal, while intelligently deciding when to step onto or over large obstacles.

During this summer, We used a motion capture system installed in the lab for much of our sensing and debugging. By putting motion capture markers on the robot and relevant obstacles, we could detect where everything in the scene was to allow us to avoid obstacles, localize the robot, and manipulate the environment. In addition, by putting motion capture markers on a camera, we could overlay information about what the robot was planning onto the video stream. Because we knew the 3D location of the camera, we could draw onto the camera image in such a way as to make objects or information appear to be a part of the scene. This proved to be immensely helpful in working out errors in the sensing, planning, and control.

Over the course of the summer, we created several tools using the motion capture to allow us to robustly track and display various objects. In addition, we made several improvements to the planning system, based on the insights from Dr. Kagami and Dr. Nishiwaki. They also had many ideas for the system that we have run out of time this summer to implement, and I hope to be able to continue this collaboration to further increase the capabilities of the planning systems and the autonomy of the system.

RESEARCH REPORT

1. Name: Vikram S. Chib （ID No.: SP05009 ）

2. Current affiliation:

Department of Biomedical Engineering; Northwestern University

3. Research fields and specialties:

Humanities Social Sciences Mathematical and Physical Sciences
Chemistry X-Engineering Sciences X-Biological Sciences
Agricultural Sciences Medical, Dental and Pharmaceutical Sciences
Interdisciplinary and Frontier Sciences

4. Host institution: Advanced Telecommunications Research (ATR) Institute International

5. Host researcher: Mitsuo Kawato

6. Description of your current research

The ability to obtain information about the shape and mechanical properties of objects in our workspace is integral to effective interaction with our environment. During reaching movements information about surfaces and obstacles is implicitly incorporated into our actions. Much research has been performed to understand how humans acquire haptic information through touch. There has also been a great deal of work performed to understand how we generate reaching movements. While each of these topics in and of itself is important to understand how we interact with our environment, it is evident that true understanding of environmental interaction involves the simultaneous incorporation of the neural processes involved in haptic interaction as well as reaching movement. However, very little work has been performed to understand how movement is effected by haptic sense. My work examines the neural processes involved during reaching movements in contact with fixtures. My goal is to bring haptic research and motor control research into a unified conceptual framework. I perform psychophysical experiments and develop computational models in order to understand how the nervous system incorporates haptic information into motor actions.

7. Research implementation and results under the program

(As much as possible, describe the contents and results of your research in a manner that is easily understandable to a non-specialist in your field.):

Title of your research plan:

Decoding of Direction and Velocity During Passive Movement

Description of the research activities:

I have been participating in research concerning the elucidation of information representations in motor cortical areas. To this end, I have been utilizing a functional magnetic resonance imaging (fMRI) compatible robotic manipulandum to

identify brain structures underlying control and learning of motor tasks. This fMRI compatible robotic manipulandum is one of handful of such systems in the world. The fMRI data from these experiments are expected to yield important information with respect to existing hypotheses of human control of dynamics. This information could be very important for rehabilitation paradigms in addition to providing crucial information for human motor control hypotheses.

During my summer study at ATR I performed experiments to determine how direction and velocity of passive movement is encoded in the brain. These experiments involved subjects being passively moved between two positions via the fMRI robotic manipulandum. Movement was enforced at two different velocities. Results from these experiments showed that passive movement direction and velocity are encoded in the primary motor cortex of the brain. Spatial location in the brain appears to encode direction of movement, while velocity of movement is encoded by the intensity of neural firing. These results are particularly interesting because they suggest the brain is able to encode the state (position and velocity) of motor actions in a unified area in the brain. This implies that the nervous system has a compact representation of the positions and velocities necessary to plan a desired movement trajectory.

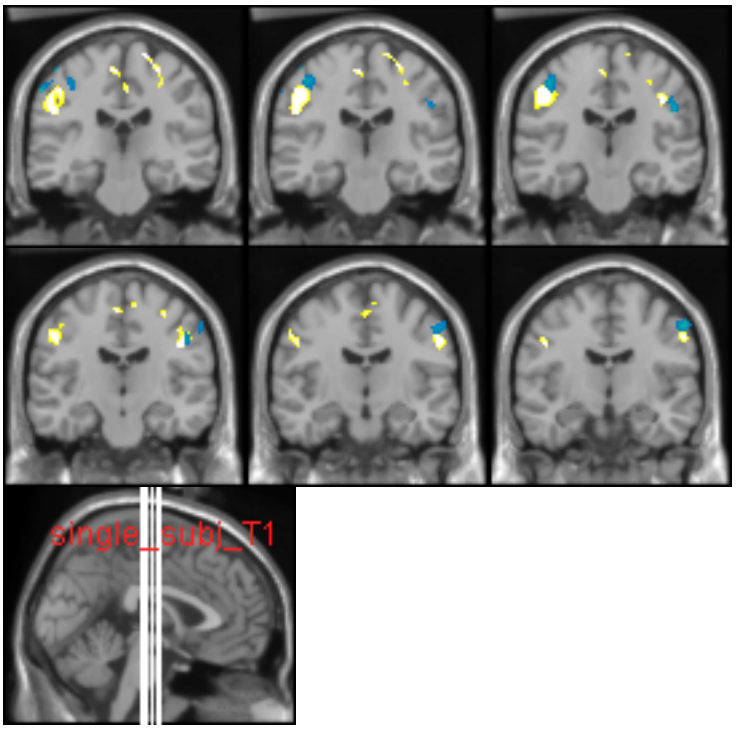


Figure. Hot colors represent voxels more active for the flexion condition (position 1), during fast movements. Cold colors represent voxels more active for extension condition (position 2), during fast movement. ($p<0.001$; cluster size > 50 voxels). Results show a distinct encoding of different postural conditions.

RESEARCH REPORT

1. Name: Carl Co （ID No.: SP05010 ）

2. Current affiliation: University of California, San Francisco

3. Research fields and specialties:

Humanities Social Sciences x Mathematical and Physical Sciences
Chemistry Engineering Sciences x Biological Sciences
Agricultural Sciences Medical, Dental and Pharmaceutical Sciences
Interdisciplinary and Frontier Sciences

4. Host institution: University of Tokyo, Undergraduate Program for Bioinformatics and Systems Biology

5. Host researcher: Shinya Kuroda, M.D., Ph.D.

6. Description of your current research: The actin cytoskeleton is a dynamic protein machine that transforms chemical energy into mechanical force. Immune cells and epidermal cells are examples of cells that use actin polymerization for movement when attacking pathogens or healing wounds. The signaling pathways that control the actin cytoskeleton are complex and reminiscent of the intricacies of a spider web. To understand the mechanisms that govern actin polymerization, I have reconstituted one signaling pathway using 15 pure proteins. This model demonstrates how the cytosolic actin machinery is recruited and activated at the plasma membrane. The actin machinery produces a highly polarized structure that is capable of generating force for cell movement. Using this pure protein system, I was able to dissect how this dynamic actin machinery is connected to the plasma membrane. In the future, this system will be used to predict specific biological phenomena such as cancer metastasis within a test tube and furthermore to validate these hypotheses within the living cell.

7. Research implementation and results under the program

(As much as possible, describe the contents and results of your research in a manner that is easily understandable to a non-specialist in your field.):

Title of your research plan:

Reconstitution of neutrophil cell polarity in silico

Description of the research activities: The cell uses on the order of hundreds to thousands of molecules to transmit signals from the outside into mechanical or chemical work intracellularly. These molecules are connected by intricate pathways that diverge and converge amongst themselves. One biological phenomenon that exemplifies this complexity is the property of immune cells to

migrate towards extracellular cues and to adapt dynamically to changing environments. Cell polarity is the ability of a cell to sense an external signal gradient and to convert it into an intracellular signaling response. Experiments in cell biology, biochemistry and genetics have uncovered hundreds of molecules that are involved in cell polarity. With the increasing complexity of biological systems, there is an urgency to create model systems that encompass systems of pathways rather than systems of proteins.

I used the modeling simulator Genesis Kinetikit to construct a biological map based on previous models that reconstitutes specific phenomena of neutrophil cell polarity in silico. The model consists of over 160 total molecules and over 300 pathways. We aimed to model three fundamental processes that are essential for neutrophil cell polarity: (1) How does the cell recognize and adapt to extracellular signals? (2) How does the cell amplify signals? (3) How are specific molecular activities spatially restricted in a 3-dimensional cell where all molecules are allowed to freely diffuse?

The model successfully recapitulates two of the three specific aims. The complete model can be broken down into three major parts. First, the model's core describes the regulation of the lipid signaling molecule phosphotidylinositol-3,4,5-triphosphate, PIP3. PIP3 is a key signaling molecule that localizes the cell polarity machinery to the "front" of the cell. PIP3 is converted from PIP2 by PI3-Kinase and is dephosphorylated by the phosphatase PTEN. Both molecules are activated by the same extracellular cue. However, the difference in their activation kinetics results in a burst of PIP3 production followed by an increase in PTEN activity and a PIP3 decrease. This effect yields a transient PIP3 profile, which is consistent with the ability of a cell to respond and more importantly, adapt to extracellular cues. The second major part of the model is the signal amplification module. In the current model, a positive feedback loop was created to recapitulate signal amplification. The most end product of the cell polarity model is the conversion of monomeric actin to filamentous actin, F-actin. This conversion generates the mechanical force used for neutrophil movement. In this model, the production of PIP3 by PI3-Kinase leads to the production of F-actin. In turn, F-actin activates more PI3-Kinase and closes the positive feedback loop. Unfortunately, the signal amplification from this current module is negligible and must be modified. The final part consists of a cross-talk system involving the Rho family of GTPases. We have demonstrated that the inclusion of this system into this model is sufficient to explain the restricted spatial localization of PTEN to the posterior part of the cell. PTEN activity is controlled by the RhoA protein. Upon a gradient stimulation where the front of the cell perceives a higher concentration of signal than the back, fast activation of the Rho family protein Cdc42 inhibits RhoA and in turn inhibits PTEN activity. This effect restricts PTEN activity to the back

of the cell and creates an increasing intracellular gradient of PIP3 concentration from front to back.

The current complete model of neutrophil cell polarity recapitulates two important biological events that lead to cell movement. In the future, this in silico model will be the basis to predict other signaling events in cell motility. More importantly, the hypotheses formed from the analysis of this in silico model will generate experiments that can be validated in the living neutrophil cell.

9. Advisor's remarks (if any): Carl tried to develop in silico model of cell polarity based on the recent experimental findings. What he have done in this program are 1) developing molecular networks (block diagram) of cell polarity, and 2) develop the in silico model based on the block diagram. His achievement is, frankly, more than I expected. Thinking his biological background, it might not be difficult to develop the molecular networks based on the literature because he has sufficient knowledge and experience in the field of Rho small GTPases and their effectors, which play major roles in the regulation of cell polarity. What made me surprised is to develop the in silico mathematical model of cell polarity because, in general, it is difficult to develop the mathematical model for biologists who do not have specific background of mathematics and modeling. His study brought us an important progress of our cell polarity project. I am very satisfied with his achievement in our lab, and hope that his systems biology experience in our lab will help him to find a new direction in his career.

RESEARCH REPORT

1. Name: Jessica L. Crast （ID No.: SP05011)

2. Current affiliation: University of Georgia

3. Research fields and specialties:

Humanities Social Sciences Mathematical and Physical Sciences
Chemistry Engineering Sciences X Biological Sciences
Agricultural Sciences Medical, Dental and Pharmaceutical Sciences
Interdisciplinary and Frontier Sciences

4. Host institution: Kyoto University Primate Research Institute

5. Host researcher: Dr. Tetsuro Matsuzawa

6. Description of your current research

For the past two years at the University of Georgia, I have been investigating object manipulation and manual dexterity in capuchin monkeys (*Cebus apella*) and chimpanzees (*Pan troglodytes*). Capuchin monkeys are a species of new world monkey very distantly related to apes and humans. However, of all new world primate species, capuchins possess a relatively high degree of manual dexterity and manipulate objects frequently. For example, they forage on hard-to-process foods and use tools both in the wild and in captivity. In fact, their manipulative behavior is more reminiscent of chimpanzees than any other monkey. Given this similarity between chimpanzees and capuchin monkeys, we sought to examine their manual behaviors to reveal the extent of convergent evolution of a motor capacity in two distantly related primate species. Additionally, we aimed to explore the specific characteristics of their hand movements *per se* and compare them to human manual actions. It is hoped that these comparisons across distantly related primate species will help us understand the evolution and function of the hand, an anatomical characteristic that is particularly advantageous and unique to the primate order.

In September 2001, my advisor Professor Dorothy Fragaszy visited her colleague in Japan, Professor Matsuzawa, at the Primate Research Institute to pilot a study concerning chimpanzee manual action while performing an object manipulation task. Three adult female chimpanzees were filmed participating in the task, in which a small three-dimensional shape was to be aligned and inserted through a corresponding cutout of the shape in a panel. In the fall of 2003, when I arrived at the University of Georgia, we presented six adult male capuchin monkeys with the same task (scaled down to the size of the capuchin hand) to observe their hand movements. In particular, we investigated the use of intrinsic movements of the hand, or “in-hand movements”, which involve moving an object within the hand by manipulation of the fingers alone. We used the frequency and range of in-hand movements as a measure of the degree of sophistication of manual

dexterity, as in-hand movements require individuation of the digits.

Despite their frequent manipulation of objects, our preliminary analyses indicate that when compared to chimpanzees, capuchin monkeys are far less capable of in-hand movements; the chimpanzees exhibited a greater range of in-hand movements and performed them more frequently. While humans remain the most skilled at fine finger movements and dexterous object manipulation, the adult female chimpanzees performed many of the same in-hand movements that are common in humans, in a clumsier, less fine-tuned fashion. I am currently working on finalizing these analyses and writing my masters thesis on this comparison between capuchin monkeys, chimpanzees and humans. However, as no study has systematically demonstrated that chimpanzees are capable of in-hand movements, my Master's project is only the first step of this line of research. The chimpanzees' dexterity and similarity to humans in this task generated many questions concerning sex differences, cognitive strategies, motor development and other aspects of chimpanzee manual function. These questions were best answered by traveling to the Primate Research Institute to test new adult and infant chimpanzees on our object manipulation task.

With the results from my previous and current research done at the Primate Research Institute, I intend to speculate on the anatomical constraints on manual action in chimpanzees and capuchin monkeys. Specifically, I will focus on the neuromuscular correlates of digit movement and the cognitive differences between chimpanzees and capuchin monkeys when performing the object manipulation task. By looking more closely at adult and infant chimpanzees, I plan to further clarify sex differences and motor development of manual dexterity in chimpanzees. These studies address aspects of evolution, cognition, and motor development in two non-human primate species, concerning an anatomical feature that is linked with the evolution of bipedalism, brain enlargement, and language.

7. Research implementation and results under the program

(As much as possible, describe the contents and results of your research in a manner that is easily understandable to a non-specialist in your field.):

Title of your research plan:
Manual Dexterity in Adult and Infant Chimpanzees

Description of the research activities:

As stated above, our previous research demonstrated that adult female chimpanzees are capable of performing in-hand movements, which suggests a relatively sophisticated manual repertoire. To determine the developmental time-course and possible sex differences in this motor ability, we presented three adult females, one adult male, and three infants (one male, two females) with the same materials used in our previous investigations. We requested the chimpanzees to

insert small three-dimensional shapes (circle, square, triangle, star, and asymmetrical cross) through corresponding cutouts in a panel. In order to pass the shape through the panel, the chimpanzees were required to modify the shape's orientation with respect to the cutout. We were interested in the strategies that the chimpanzees used to accomplish the task, particularly their use of in-hand movements to realign the shape to the cutout. In addition to the materials used previously, we presented three new panels, each with three shape cutouts (circle, square, and triangle), counterbalanced for location. We presented one shape at a time with each new panel, so that there were three options available to attempt alignment and insertion of the shape through a cutout. The second set of panels were designed to add another level of difficulty to the task and enabled us to look at cognitive and perceptual issues in the future, such as visual discrimination, cutout choice and planning.

During my stay at the PRI, we completed five testing sessions with each subject, and I coded and analyzed each subject's first session. These preliminary results indicate both sex and age differences, suggesting a difference in development of manual skill between males and females. Interestingly, it looks as though the infant chimpanzees resemble capuchin monkeys in the frequency and range of in-hand movements, performing forms of in-hand movements that require less digital independence. The adult male subject employed a strategy for alignment that differs from all other subjects, by placing the shape in his mouth to re-grasp with a different position in the hand. The infant male chimpanzee performed the fewest number of in-hand movements and was less successful at insertion. The adult female subjects remain the most skilled at alignment and perform in-hand movements most frequently. These results suggest that digital independence and manual skill improve with development and differ between sexes. Such a difference may reflect a division of labor among primates, such as the tendency for females to attend to the fine details of a task more so than males.

8. Please add your comments (if any):

In addition to the on-going research, I began writing an introduction and methods section for the paper we intend to write and submit to a scientific journal. I was also able to present these results in a public forum in the form of a poster presentation and an informal talk during my stay at the Primate Research Institute. The EAPSI program helped me to progress already begun research and gain further experience presenting my research. Perhaps more importantly, I was able to establish professional relationships with several prominent researchers in my field. While furthering my research and forming many friendships and academic ties, I learned a great deal about another culture, became more independent and had a great time.

RESEARCH REPORT

1. Name: Patricia Decker （ID No.: SP05012）

2. Current affiliation: University of California, Berkeley

3. Research fields and specialties:

Humanities Social Sciences Mathematical and Physical Sciences
Chemistry X Engineering Sciences Biological Sciences
Agricultural Sciences Medical, Dental and Pharmaceutical Sciences
Interdisciplinary and Frontier Sciences

4. Host institution: University of Tokyo, Department of Civil Engineering

5. Host researcher: Professor Yozo Fujino, Bridge & Structure Laboratory

6. Description of your current research

The Vincent Thomas Bridge, located in the Los Angeles metropolitan area, is an essential route for commercial traffic flow in and out of the Los Angeles Harbor. This structure is particularly vulnerable to seismic forces, as it crosses the Palos Verdes fault zone. In this study, both linear and non-linear system identification techniques are employed to obtain a complete reduced-order, multi-input-multi-output (MIMO) dynamic model of the Vincent Thomas Bridge. This model is based on the dynamic response of the structure to the 1987 Whittier and 1994 Northridge earthquakes.

Using the available acceleration measurements (26 channels consisting of 15 accelerometers on the structure itself, an additional 10 accelerometers along the base and one channel of unusable data), an efficient least-squares-based time-domain identification procedure is applied to the data set to develop a reduced-order, equivalent linear, multi-degree-of-freedom (MDOF) model. The final results of this study yielded measurements of the equivalent linear modal properties (frequencies, mode shapes and non-proportional damping) in addition to information about the nature and extent of nonlinear behavior.

Long-span bridges such as the Vincent Thomas Bridge in San Pedro, CA have complex dynamic properties. Rather than attempt to theoretically derive these properties such as the natural frequency and critical damping, the dynamic properties can be obtained using either ambient or seismic data. System identification allows for the construction of mathematical models of a dynamic system based on measured data. This is accomplished by adjusting parameters within a given model until its output coincides as well as possible with the measured output. Predominant methods for describing the system include state-space models and several variants of difference equation descriptions.

In this case, acceleration records for the 1994 Northridge and 1987 Whittier earthquakes were processed in order to obtain an estimate of the dynamic properties. The goal of this research was to confirm values previously published based on ambient data.

Once the model has been constructed using system identification techniques, its adequacy should be evaluated. To verify the adequacy of the model one good test is to take a close look at the model's output compared to the measured one on a data set that wasn't used for the fit (validation data). Additionally, it is also valuable to look at what the model couldn't reproduce in the data (the residuals) to assess the model quality. This should not be correlated with other available information, such as the system's input.

Most common models are difference equations descriptions, such as ARX and ARMAX models, as well as all types of linear state-space models. For parametric models, there is a need to specify the structure; this could be as easy as selecting a single integer, the model order, or may involve several choices. With the assumption that the system is linear, the impulse or step responses can be directly estimated correlation analysis or its frequency response using spectral analysis. This allows useful comparisons with other estimated models. Many common model nonlinearities are such that the measured data should be nonlinearly transformed using physical insight about the system. It is important to remember that any estimated model it only a reflection of reality. Surprisingly often, however, this is sufficient for rational decision making.

7. Research implementation and results under the program

(As much as possible, describe the contents and results of your research in a manner that is easily understandable to a non-specialist in your field.):

Title of your research plan:

Analysis of Earthquake Data for the Vincent Thomas Bridge using System Identification

Description of the research activities:

Development of Matlab scripts to process data for initial observation. The data that was available was raw data downloaded from the California Geological Survey website. Records from both the Northridge (1994) and Whittier (1987) earthquakes were processed using an original Matlab script to produce plots of the ground and structural accelerations as well as plots of the Fast Fourier Transforms of these accelerations.

Use of system identification toolbox provided with Matlab to conduct a more in-depth study of the data. Dynamic properties of the structure could be identified by processing input data (ground accelerations) with output data (structural response).

I consulted regularly with a doctoral graduate student in the laboratory who

conducted similar research.

8. Please add your comments (if any):

I am thankful to have had the opportunity to study here at the University of Tokyo. I have gained much insight into the differences between engineering research in the United States and that in Japan. It was informative to conduct my research in the environment of my lab group because it allowed me to see how other students approached their projects. Our laboratory trips were extremely beneficial, and my daily life in Tokyo was a research experience in itself.

RESEARCH REPORT

1. Name: Neal Krishna Devaraj （ID No.: SP05013 ）

2. Current Affiliation: Stanford University

3. Research fields and specialties:

Chemistry

4. Host institution: Hokkaido University

5. Host researcher: Kohei Uosaki

6. Description of your current research

We are hoping to understand how the rate of electron transfer affects multielectron redox catalysis. We have immobilized multielectron redox catalysts on self-assembled monolayers and changed the composition of the monolayer to tune the electron transfer rate.

7. Research implementation and results under the program

Title of your research plan: Imaging Self-Assembled Monolayers Using Scanning Tunneling Microscopy

Description of the research activities:

The goals of this summer research program were to first learn how to use a scanning tunneling microscope (STM) to image self-assembled monolayers (SAMs) on gold surfaces and second to apply this technique to image various interesting mixed monolayers in order to gain detailed information about the surface structure. Scanning tunneling microscopy is an imaging technique that takes advantage of the distance dependence of electron tunneling rates between two electrodes in order to acquire images with atomic resolution. The first month of my summer was spent learning various techniques that are required for STM. These included formation of single crystalline gold surfaces (on which the monolayers are formed), cutting and checking platinum/iridium tips (which raster the gold surface) and basic operation techniques for the microscope itself. Initially I focused efforts to image simple monolayers of alkyl thiols on gold. Figure 1 depicts an example of such a monolayer (octyl thiol on gold). The spheres are the terminal methyl groups. After successfully being able to achieve molecular resolution on simple monolayers, the focus of the second month of research was to use these skills to image more complicated monolayers. Because STM reflects the tunneling probability from tip to surface, we were interested in acquiring images of monolayers that were doped with extremely small quantities of highly conducting molecules. Our lab at

Stanford University has recently synthesized two such molecules (see Figure 2) that could in principle have interesting applications in molecular electronics. These molecules were doped into SAMs of non-conducting alkyl thiols (such as octylthiol and decanethiol). Images of SAMs doped with conducting molecules differed from the undoped images in that numerous bright spots could be seen intermixed with the rest of the SAM (Figure 3). In STM images, the brightness within an image corresponds to relative heights (see adjacent bar for specific heights). The conducting molecules are most likely the bright spots. Although the molecules are not much taller that the adjacent non-conducting molecules, they appear taller because the imaging technique uses electron tunneling rates to judge the distance of the tip from the surface. Faster tunneling rates mean closer distance to the surface. Generally an STM is run in constant current mode; the tip tries to keep the same distance from the surface at all times and the movement of the tip to achieve this is used to judge the surface structure. When the tip moves over a region of a highly conducting molecule, electrons flow rapidly to the tip compared to non-conducting regions. The tip responds my moving away from the molecule in order make the current the same as compared to non-conducting regions. In the image, this effect has the consequence of making the conducting molecules appear "taller." These images are evidence that the conjugated molecules that we have recently synthesized are indeed effective conduits for electron tunneling. Further work to be done at Stanford will quantify just how effective they are.

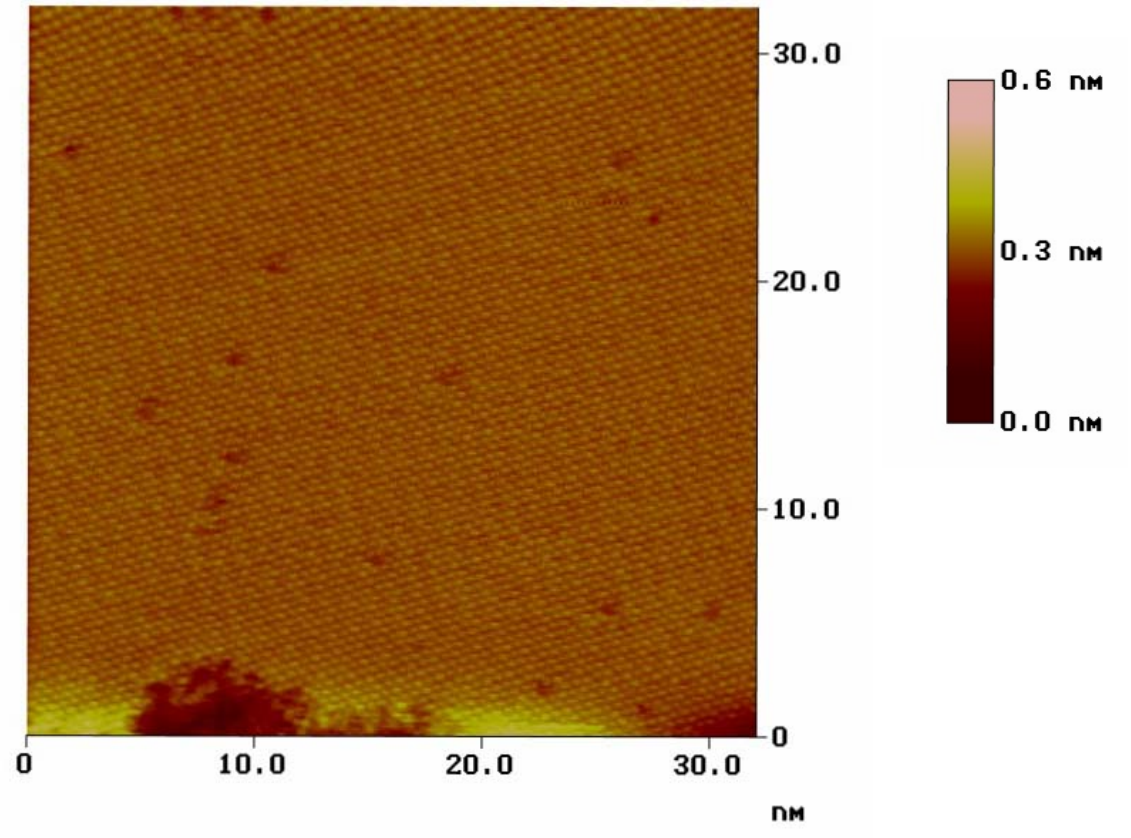


Figure 1: Octyl thiol monolayer on gold electrode. The scale bar on the right displays the height from the electrode surface.

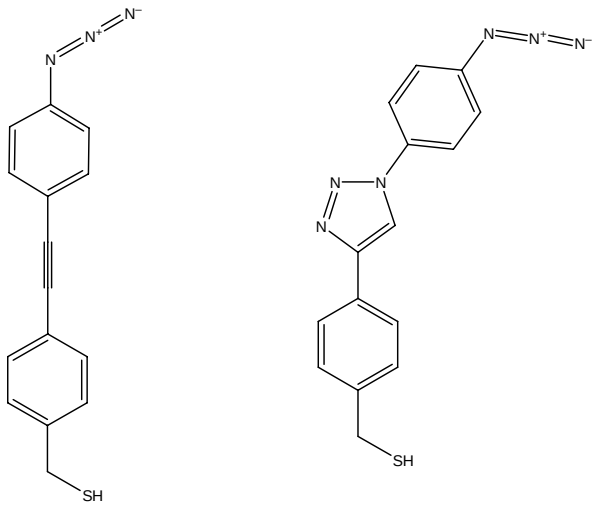


Figure 2: two molecules that can bind to the gold surface and allow rapid electron tunneling from the gold surface to the Pt STM tip

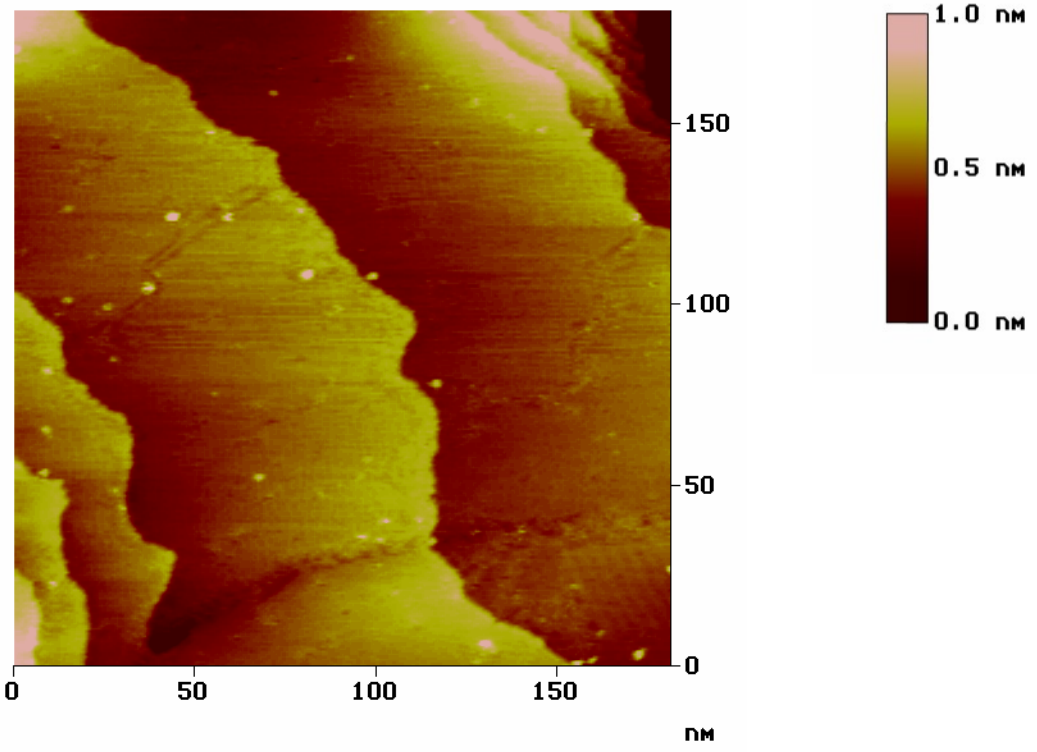


Figure 3: An image of a mixed monolayer of octanethiol and conjugated thiol (the right molecule from figure 2). The bright spots in the image are believed to be the conjugated molecules.

RESEARCH REPORT

1. Name: Michael Doosey （ID No.: SP05014 ）

2. Current affiliation: Tulane University, New Orleans, LA

3. Research fields and specialties:

Humanities Social Sciences Mathematical and Physical Sciences
Chemistry Engineering Sciences Biological Sciences X
Agricultural Sciences Medical, Dental and Pharmaceutical Sciences
Interdisciplinary and Frontier Sciences

4. Host institution: Tohoku National Fisheries Research Institute

5. Host researcher: Dr. Kenji Saitoh

6. Description of your current research

Order Cypriniformes is a diverse group of freshwater fishes comprising about 3300 species in five families (Balitoridae, Catostomidae, Cobitidae, Cyprinidae, and Gyrinocheilidae). Catostomidae (suckers) contains about 70 species distributed across North America and one species in China. The primary research objective for the JSPS summer program was phylogenetic systematics of the order Cypriniformes with emphasis on the family Catostomidae based on sequence data from ND4 and ND5 mitochondrial genes. The goal was to determine the interrelationships of catostomid genera and relationships of the cypriniform families. Utility of ND4/ND5 for phylogenetic inference has been demonstrated. Multiple hypotheses of catostomid relationships have been proposed and the novel hypothesis will ultimately form the foundation for my dissertation work in comparative morphology and evolution of pharyngeal structures of Catostomidae. The secondary research objective for the JSPS summer program was to learn methods for determining complete mitochondrial genomes of fishes. The goal was to determine the mitogenome for one species of Catostomidae. Determination of complete mitochondrial genomes is important to studies of genomics and phylogenetics. Approximately 800 fish mitogenomes have been determined to date and the utility of mitogenomes for phylogenetic study of deep divergences (i.e. among orders) has been exemplified.

I outlined four goals for the research project and my professional and personal development: 1) Master laboratory techniques and computer skills requisite for molecular phylogenetic analysis and mitogenomics. 2) Generate phylogeny of Catostomidae based on sequence data from ND4/ND5 genes. 3) Determine at least one complete mitogenome. 4) Broaden cultural awareness and increase work productivity.

7. Research implementation and results under the program

(As much as possible, describe the contents and results of your research in a manner that is easily understandable to a non-specialist in your field.):

Title of your research plan:

Systematics of Catostomidae (Cypriniformes) Using Mitochondrial Genes ND4/ND5 and Methodology of Fish Mitogenomics

Description of the research activities:

Systematics of Catostomidae based on sequence data from ND4/ND5

This research was conducted in Dr. Saitoh's laboratory at the Tohoku National Fisheries Research Institute. We worked together in the laboratory and with sit down discussion of the research project daily. The laboratory research activities for the ND4/ND5 phylogenetic study are summarized in Table 1. Genomic DNA was extracted from 35 tissues of 28 different fish species. Mid-range polymerase chain reaction (PCR) was conducted three times and the products were used for short PCR numerous times. Sequences were read with an automated DNA analyzer eight times.

Table 1. Laboratory Activities

DNA extraction from fish tissue and quality check
Mid-range PCR to amplify 4200-base region of mtDNA
Short, full-nested PCR of mid-range PCR products
Purification of short PCR products
Sequencing reactions of template DNA
Purification of sequencing products
Sequences read with automated DNA analyzer

Sequence data were assembled into contigs and edited using computer software Phred, Phrap, and Consed. The unambiguous consensus sequence for each contig was aligned with BioEdit and by eye. Homology search for ND4 and ND5 genes was conducted by using known reference sequences which were obtained from GenBank and Dr. Saitoh. Phylogenetic analyses were conducted with MrBayes, MOLPHY, and PAML.

A total of 21 species (17 Catostomidae, three Cyprinidae, and one Cobitidae) was sequenced for the ND4/ND5 genes. ND4 was 1383 nucleotides in length and ND5 was 1836-1839 nucleotides. The concatenated gene sequences were aligned with other species of Cypriniformes from Dr. Saitoh's dataset. Thirty-four species (24 Catostomidae, five Cyprinidae, two Balitoridae, two Cobitidae, one Gyrinocheilidae, and one Ictaluridae (outgroup)) were included in a Bayesian

analysis using MrBayes. An exhaustive maximum likelihood analysis using MOLPHY of 12 species (nine Catostomidae, one Cyprinidae, one Cobitidae, and one Ictaluridae) was conducted to determine the basal branching pattern of catostomid genera. Partitioned maximum likelihood was conducted with PAML for each codon position. Total maximum likelihood was then conducted for all data using MOLPHY to determine the most highly supported phylogenetic tree.

Methods of fish mitogenomics

The laboratory activities for the fish mitogenomic sequences were identical to the methods for ND4/ND5, except long PCR was used to amplify products up to 15 kilobases. After the sequences were read, contigs were assembled in the same way as for ND4/ND5. Gaps in the consensus sequence were closed with multiple rounds of short PCR. A homology search of the unambiguous consensus sequence with a known sequence was conducted to locate tRNA phenylalanine and tRNA proline to confirm that the sequence was complete. Complete mitogenome sequences were annotated in GenBank format. The complete mitochondrial genome sequence for three fish species (one each of Catostomidae, Cobitidae, and Cyprinidae) was determined during JSPS summer program. Each genome was approximately 16.6 kilobases in length.

Summary

ND4/ND5 sequence data for 21 species of Cypriniformes was determined and a preliminary hypothesis of relationships was made. Upon completion of sequencing of two additional catostomid species, one paper is planned on the relationships of catostomid genera. Three complete mitochondrial genomes were also determined. I acquired sophisticated laboratory, computer, and data management skills. I mastered many laboratory techniques, operation of equipment, and economical use of reagents and supplies. I exceeded my goals for research and increasing knowledge. I broadened my cultural awareness and had an enjoyable time living and working in Japan. I envision future collaborations with Dr. Saitoh and other Japanese scientists.

8. Please add your comments (if any):

The JSPS summer program was an excellent way to increase my knowledge of molecular systematics, collaborate with Dr. Saitoh, and experience Japan's culture and people. I will encourage other students from Tulane University and elsewhere to apply for this program. Tohoku National Fisheries Research Institute and Dr. Saitoh were excellent hosts. I thank Dr. Saitoh for sharing his knowledge, careful instruction, and great patience.

9. Advisor's remarks (if any):

Molecular phylogeny needs diverse skills; anatomy, lab work, computing, statistics, mathematics, etc. Mr. Michael Doosey worked here very well not only for lab works but also for computing and phylogenetic statistical analysis. Mr. Doosey has got mitochondrial ND4/5 sequences of about 3.5kb from 21 species, and three complete mitochondrial genomic sequences of about 16.5kb as well. Not only doing well of these lab works, but also Mr. Doosey successfully analyzed phylogenetic relationships among cypriniform fishes including many catostomids using computer software unfamiliar to him. I am pleased to see Mr. Doosey has learned how to do with large sequence data; to get them quickly, to set up a computer system for analyzing large datasets, to analyze interrelationships among sequences with appropriate evolutionary models, etc.

RESEARCH REPORT

1. Name: Jacob Egge （ID No.: SP05015 ）

2. Current affiliation: University of Minnesota

3. Research fields and specialties:

Humanities Social Sciences Mathematical and Physical Sciences
Chemistry Engineering Sciences X Biological Sciences
Agricultural Sciences Medical, Dental and Pharmaceutical Sciences
Interdisciplinary and Frontier Sciences

4. Host institution: Ocean Research Institute (University of Tokyo)

5. Host researcher: Dr. Mutsumi Nishida

6. Description of your current research:

My research focuses on the evolutionary biology of North American catfishes in the family Ictaluridae. This involves determining relationships and surveying diversity. With approximately 50 extant species, ictalurids range in size from large, commercially important species like the channel catfish, *Ictalurus punctatus*, to small reclusive species like the least madtom, *Noturus hildebrandi*. Most ictalurid species have robust spines with associated venom glands on the pectoral and dorsal fins. The spines on the pectoral fins vary in size and shape between species. I am particularly interested in examining the evolution of these spines and their associated venom glands. My explicit objectives are as follows: 1) Survey morphology among ictalurid catfishes by examining external characters (color, shape), osteology, myology, and histology. 2) Recover a phylogeny for all ictalurid catfishes based on morphological and molecular characters. 3) Map morphological character data onto this phylogeny and determine if spine shape and venom gland morphology are related.

7. Research implementation and results under the program

(As much as possible, describe the contents and results of your research in a manner that is easily understandable to a non-specialist in your field.):

Title of your research plan: Mitogenome sequencing of ictalurid catfishes

Description of the research activities:

My summer research activities involved sequencing DNA from the entire mitochondrial genome (mitogenome) of four North American catfish species: the

flathead catfish, *Pylodictis olivaris*, the white catfish, *Ameiurus catus*, the margined madtom, *Noturus insignis*, and the brindled madtom, *Noturus miurus*. In all, I sequenced approximately 16,500 bp of mitochondrial DNA for each species. This includes the control region, 12S and 16S ribosomal subunits, NADH dehydrogenase subunits 1-6 (including ND4L), cytochrome c oxidase (CO) subunits I-III, ATPase8 and 6, cytochrome *b*, and 22 tRNA's.

To amplify and sequence the necessary regions, I used techniques and methods developed by Dr. Mutsumi Nishida and Dr. Masaki Miya. This involved first amplifying large sections of the mitogenome (9,700 – 15,000 bp) with the polymerase chain reaction (PCR) using specially designed, fish versatile long primers. The product of the long PCR reactions was then used as a template for a series of shorter, nested PCR's that amplified the entire genome in smaller, 1,000 – 1,500 bp pieces. A series of over 200 fish versatile primers previously developed in Dr. Nishida's lab were used for these amplifications. Sequencing of these products was done using the same primers and direct cycle sequencing and an ABI automated gene sequencer. Two catfish species, *N. insignis*, and *A. catus*, required me to develop species specific primers to amplify and sequence a portion of ND4.

In addition to completing these mitogenomes, I was also able to work out protocols for amplifying and sequencing the ND4-ND5 region for all other ictalurid species. I successfully amplified and sequenced this region for four additional ictalurid species: *Noturus gyrinus*, *N. flavus*, *N. gladiator*, and *Prietella phraetophila*. According to Dr. Miya, this region has great phylogenetic utility and is more practical when a large number of taxa need to be sequenced. Using primers and techniques developed with the help of Dr. Miya I will be able to sequence this region for other ictalurid taxa.

I will use the mitogenome data to construct a phylogeny of generic level relationships within Ictaluridae. I will also continue sequencing the ND4-ND5 region on remaining ictalurid taxa and construct a species level phylogeny of ictalurid catfishes. This project will be completed upon my return to Minnesota.

8. Please add your comments (if any): The data I was able to gather and the methods I was able to learn during this experience will be valuable tools for me to carry forward in the future as I complete my dissertation work and will carry forward into future research projects.

9. Advisor's remarks (if any): Jacob has made research work enthusiastically in my laboratory and has produced considerable achievements. I have enjoyed his companionship very much. I hope that our continuous cooperation will bear abundant scientific and cultural fruit in the future.

RESEARCH REPORT

1. Name: Dwight Anthony Evans （ID No.: SP05016 ）

2. Current affiliation: University of California, Berkeley

3. Research fields and specialties:

Humanities Social Sciences Mathematical and Physical Sciences
Chemistry **X** Engineering Sciences Biological Sciences
Agricultural Sciences Medical, Dental and Pharmaceutical Sciences
Interdisciplinary and Frontier Sciences

4. Host institution: Tokyo Institute of Technology

5. Host researcher: Dr. Kazuhiko Kawashima

6. Description of your current research

In recent years, there have been several developments made in the fields of earthquake engineering and design to limit the total displacement of structures during earthquakes (dampers), reduce inter-story drifts of superstructures (base isolators) and to ensure either stiffness or ductility of lateral resisting frames of buildings (i.e., using buckling restrained braces in braced frames and redeveloped moment connections prescribed in FEMA documents for moment frames). All of these developments are aimed at making buildings safer in the event of earthquakes and minimizing post operation cost and economic impact to building owners in the occurrence of large events.

Most of these developments are preventative measures that are used to keep buildings from deforming. For example, dampers are used as energy dissipation devices that limit the response of a building during ground excitation and isolators are intended to shift the period of given building outward in order to reduce inertial forces and relative displacements (drift) in the superstructure. With the exception of a few cases, these devices are highly successful in meeting their intent. Though these modifications may reduce the total displacement of a building or bridge, given a large seismic event there may be a great deal of residual displacement left in the structure after the ground motion has ceased. Such an occurrence will lead to high post-operation costs and a compromise in safety. Hence the question still remains, “What can be done if such an event were to happen?”

My research deals with the residual displacement response of structures, namely, how to model structures to capture this behavior accurately and how to design structures to control this behavior. At the moment, I am focusing on the latter aspect. In order to have structures exhibit little residual displacement, I am in the process of developing a structure that exhibits origin-oriented, or “pinched,” hysteretic behavior. I believe that hysteresis loops can be tailored to perform in a desired manner, and that structures can be manipulated to achieve an idealized behavior. With this in mind, I have developed an algorithm for creating a hysteresis loop of various stiffness and re-centering capabilities. In the algorithm, I am describing the hysteresis loop characteristics with three parameters and subjecting a series of single degree of freedom systems of various periods to a suite of ground motions. For each single DOF system, the parameters describing the behavior of the hysteresis loop are to be altered and the effects noted. In addition to monitoring the residual displacement quantities, the results of the analysis will be compiled and compared against the responses of systems whose hysteresis loops exhibit elasto-plastic and bilinear hardening behaviors. After the completion of the pinched and conventional hysteretic shape comparisons, analytical tools must be checked and calibrated to assure the accuracy of modeling structures that employ pinched-hysteretic devices.

7. Research implementation and results under the program

(As much as possible, describe the contents and results of your research in a manner that is easily understandable to a non-specialist in your field.):

Title of your research plan:

Modeling Residual Displacements For Concrete Bridge Columns

Description of the research activities:

This summer I extended a previous study on residual displacements of concrete bridge columns conducted by a former student of my host researcher. Understanding that there is a direct relationship between bridge functionality and residual displacement, my host researcher introduced me to an experimental study dealing with methods of limiting residual displacements among bridge columns. The experimental study compared the dynamic response of a conventionally designed reinforced concrete column to a newly developed column that incorporated various types of pre-stressing with the intent of initiating origin-oriented hysteretic behavior.

Having obtained the experimental results, I spent the summer developing various analytical tools to discretize the concrete columns for the purposes of analyses and experimental correlation. Various models were developed including force-formulation series models and displacement models that incorporate fiber elements at specified integration points along the column length. Currently, displacement formulation fiber elements have been used in the analyses.

8. Please add your comments (if any):

Experimental results demonstrate that the various pre-stressing configurations employed in the residual displacement study are highly effective. The designs proposed for controlling the residual displacement of bridge columns allow the bridge columns to experience a maximum displacement similar to that of a conventionally reinforced concrete column, but with far less residual displacement (an average of 10% of the residual displacement of the conventional column). However, there was an unsatisfactory correlation between the experimental and analytical results given the element used in this summer's analyses. In summary, analyses show agreement between maximum displacements for conventional columns and newly proposed bridge columns with pre-stressing, but show less agreement for the residual quantities. Given that the objective is to monitor, represent and control residual displacement, the elements used in the analyses conducted must be refined.

RESEARCH REPORT

1. Name: Stephanie C. Feldman （ID No.: SP05017 ）

2. Current affiliation: University of Pennsylvania

3. Research fields and specialties:

Humanities Social Sciences Mathematical and Physical Sciences
Chemistry X Engineering Sciences Biological Sciences
Agricultural Sciences Medical, Dental and Pharmaceutical Sciences
Interdisciplinary and Frontier Sciences

4. Host institution: Waseda University

5. Host researcher: Pr. Furuya Nobuaki

6. Description of your current research

I am currently attempting to gather information on the use of mass dampers in the form of roof top gardens.

With increasingly dense high-rise developments popping up all over large cities in Japan, the city of Tokyo created an ordinance a few years ago, requiring that all new developments account for at least 10% of their built surface as “green” or landscaped. In response to this ordinance, Mori Building, on of the largest developers in Japan, developed the first green mass damper (or GMD) on one of the buildings in its new project, Roppongi Hills. This garden has a rice field, a number of cherry trees, and a variety of grasses, shrubs and other vegetation.

My research entails finding information, and understanding the processes and systems Mori Building developed to create a successful seismic system in the form of a garden.

7. Research implementation and results under the program

(As much as possible, describe the contents and results of your research in a manner that is easily understandable to a non-specialist in your field.):

Title of your research plan:

Seismic Systems as Roof Top Gardens

Description of the research activities:

I started my research by focusing on two main leads, one for general background knowledge, and the other for specific information. At first, I met with my host

professor, to talk about my research and my goals, and to get as much information and help I could from him and his lab. Then, I contacted Mori Building Company in order to get an appointment with their engineering team. At Waseda, with the help of my host, I was able to learn about the generalities of seismic design, and the various systems currently available and used. I even managed to get general information on Green Mass Dampers. When I finally met with Mori Building Engineering team, I had a pretty good understanding of the various systems, and was able to get specific and detailed descriptions of how they implemented their design for a Green Mass Damper.

In addition to these two sources, I contacted a variety of other architects, and visited both construction sites and finished projects, learning more about their structure and seismic designs. These visits not only enabled me to meet new architects, but also to get a better understanding of structural design and general seismic systems in Japan.

8. Please add your comments (if any):

I believe that, in a very limited amount of time, I learned a tremendous amount about the subject of my interest, and many other things, including cultural and professional differences and similarities between the US and Japan. Being in Japan, and affiliated to JSPS as a grantee, enabled me to meet a wide variety of professionals who were amazingly helpful and generous with their time, knowledge and contacts. I am sure that I will remain in contact with many of these people and develop with them strong and fruitful relationships in the future. It has been –thanks to NSF and JSPS- a wonderfully enriching and exciting experience.

RESEARCH REPORT

1. Name: Robert Fiorentino （ID No.: SP05018 ）

2. Current affiliation: University of Maryland, College Park

3. Research fields and specialties:

Humanities Social Sciences Mathematical and Physical Sciences
Chemistry Engineering Sciences Biological Sciences
Agricultural Sciences Medical, Dental and Pharmaceutical Sciences
X Interdisciplinary and Frontier Sciences

4. Host institution: Hiroshima University

5. Host researcher: Dr. Hiromu Sakai

6. Description of your current research

My current research program explores how the brain represents and processes language in real-time. To approach this question, I conduct research integrating linguistic theory, psychological research methods (psycholinguistics), and cognitive neuroscience (using state-of-the-art brain imaging methods such as magnetoencephalography, measuring brain processing with millisecond temporal accuracy, and fMRI, measuring the location of brain activity with millimeter spatial accuracy). My research program investigates domains of language in which fundamentally different approaches (both linguistic theories and theories of mental representation in general) make specific, divergent predictions about real-time processing. One example is the domain of word-formation. Competing theories of linguistic representation (atomist vs. decompositional theories; differing theories of the time course of decomposition), make divergent predictions regarding whether the seeming complexity of words like ‘teacup’ or ‘government’ is psychologically real and how it impacts processing. That is, does the brain represent and process these linguistic objects as atoms, or in terms of their internal parts, in real time? To investigate this, I utilize an experimental method which combines measurement of participants’ responses (e.g. reaction times and accuracy measures) with simultaneous recordings of brain-activity using magnetoencephalography, which reflects differences at the earliest stages of processing before the overt response. This research suggests that even the processing of known compound words involves access to their constituent parts, reflected both in the response data and in the brain-activity components sensitive by the earliest stages of lexical processing during the recognition of a visual word. The results in this project suggest rapid, automatic access to the parts of complex words.

However, to investigate the composition and interpretation of the parts of linguistic

structures, it becomes interesting to look at multi-word noun phrases (e.g. 'student film discussion', which is ambiguous among two internal structures). Further, it becomes interesting to explore cross-linguistic differences. For example, in Japanese there are also multi-word compounds like English, made up of words with no overt cues to the internal structure. However, in Japanese, in some linguistic environments, if two of the parts of the compound are more closely related in the structure as 'sisters', then the beginning consonant of the second word undergoes a change, in a process called 'rendaku' or sequential voicing. For example, if 'black chopsticks box' is to mean 'a box for black chopsticks' its structure is like [[black chopsticks] box], where 'black' and 'chopsticks' are bound together as sisters. In this case, the first consonant sound in 'hashi' (chopsticks) changes as a result, becoming 'bashi'. However, if the compound means 'a chopstick box that is black,' the structure is like [black [chopsticks box]. Since 'black' and 'chopstick' are not directly bound together as sisters, 'hashi' remains as 'hashi' without a sound change. These differences allow for interesting tests of the decomposition and composition of complex words. In decomposing 'kuro bashi…' the speaker must rapidly access the underlying form 'hashi', regardless of the surface sound difference. In composing the meaning of the whole compound, the 'rendaku' cue might also provide a discrete cue to correctly assign and interpret the structure in real time. These issues directly motivate the research implemented during the Summer Program, and also represent an example of the general approach sketched above— testing specific hypotheses about mental representations for language and language processing, from a linguistic and cognitive neuroscience perspective.

7. Research implementation and results under the program

(As much as possible, describe the contents and results of your research in a manner that is easily understandable to a non-specialist in your field.):

Title of your research plan: Processing Japanese NPs: Incrementality and Functional Organization

Description of the research activities:

This summer, we developed and implemented a series of experiments to test how the brain represents and processes language in real time. To better understand the brain's functional organization for representing and processing language, we conducted a study using functional Magnetic Resonance Imaging (fMRI), investigating the building and interpretation of compound noun phrases. We focused on the processing of noun phrases such as long compound words since it is a domain in which we could carefully parametrically vary the information available for building and interpreting the language structures. In this experiment, we compared the brain responses from participants who listened to three types of noun phrase stimuli: word lists without any cues to build a structure, compound words with internal structure,

cued by differences in the sounds of the words showing their relations in the structure (the ‘rendaku’ or ‘sequential voicing’ sound change reflecting closely bound ‘sisters’ in the structure), and noun phrases using the same words including additional morphological marking overtly indicating the internal structure. Our results identified separate areas contributing to the processing of the sound representations of words on the one hand, and their integration into the compound structure in the compound condition, on the other. Further research will focus more precisely on which computations are subserved by the activated areas.

To pursue whether the brain decomposes complex words like compounds into their parts in real-time, we designed and conducted two psycholinguistic studies. The first used a priming task to show that speakers immediately identify the constituent parts of compounds even when their sound changes due to ‘rendaku’ For example, ‘kani’ (crab) becomes ‘gani’ in compounds like ‘shirogani’ (‘white crab’). Using a priming paradigm in which participants hear a fragment of speech, and them immediately make a response about a word printed on the screen, we show that speakers activate ‘kani’ when hearing ‘shirogani’, regardless of the differences in the surface sounds of the parts. Further, we obtained results suggesting that even the fragment ‘shiroga_’ will activate ‘kani’, suggesting that the brain makes predictions about the underlying representations of following words, taking into consideration the rules which can change their surface sounds. Follow-up studies seek to specify the nature of these effects.

Additionally, we tested whether suffixes (functional parts) of complex words have independent underlying representations which the brain activates in real-time. To investigate this, we explored whether words with different bases, but with the same suffix, prime each other, such as ‘ooki-sa’ (‘largeness’) and ‘yutaka-sa’ (‘richness’), under specific circumstances. We used an experimental paradigm in which we present one’ prime’ word for a very short duration (~50ms) which cannot be consciously recognized. Immediately following, the ‘target’ word is presented overtly, lasting until the participant’s response judging whether it is a real word. Crucially, in this paradigm, similarity in sound or meaning typically does not facilitate responses to the consciously presented target. Priming in this paradigm suggests morphological-level identity of representations. We show priming of the consciously presented word by the unconscious prime, again suggesting abstract and incremental real-time processing of internal structure.

8. Please add your comments (if any):

My summer program at Hiroshima University in Dr. Hiromu Sakai’s laboratory was exciting both for the opportunity to conduct research, but also to find an active research community in the laboratory where I was welcomed to participate in many activities in

addition to my research: reading groups, colloquia/guest lectures, as well as meetings to discuss the in-progress research of the students in my host laboratory. I am grateful that I shared more learning experiences and built much stronger contacts and friendships with my peers than I could have ever expected.

9. Advisor’s remarks (if any)

Mr. Fiorentino actively participated in all of the research activities in our laboratory, including a journal club, colloquium, and summer seminar. He enjoyed discussions with Japanese students not only about his own research but also about their research. During his stay, he set up designs of two experiments using Japanese complex morphology and conducted the experiments. Taking all of these activities into consideration, I am quite confident to say that his research was extremely successful.

RESEARCH REPORT

1. Name: Mr. Dana A. FREIBURGER （ID No.: SP05019 ）

2. Current affiliation: University of Wisconsin

3. Research fields and specialties:

Humanities X Social Sciences Mathematical and Physical Sciences
Chemistry Engineering Sciences Biological Sciences
Agricultural Sciences Medical, Dental and Pharmaceutical Sciences
Interdisciplinary and Frontier Sciences

4. Host institution: University of Tokyo

5. Host researcher: Dr. Takuji OKAMOTO

6. Description of your current research

My research focuses on the history of Japanese spectroscopy and the use of a specific optical instrument: the hi-resolution spectroscopes made by Adam Hilger of London. Many of these precision instruments came to Japan from 1902 through 1933 and my research in the JSPS summer program has allowed me to visit a number of museums, archives, and libraries to gather data and view surviving scientific apparatus as I work to understand the historical relationship between science, scientists, institutions, and instruments in Japan.

Specific research goals involve an examination of individual Japanese scientists, their institutions, and their spectrographic instruments. In particular, I want to look at the research done by Nagaoka Hantarō and Takamine Toshio during the period they were located at RIKEN, the Institute of Physical and Chemical Research in Tokyo, coupled with their use of Hilger spectroscopes. Out of this union of scientist, institution, and instrument, I hope my research data will allow me to construct a convincing argument for why Japanese scientists held such a strong fidelity to Hilger instruments and how a long-term research tradition into atomic structure spectroscopy developed in Japan.

7. Research implementation and results under the program

(As much as possible, describe the contents and results of your research in a manner that is easily understandable to a non-specialist in your field.):

Title of your research plan:

History of Spectroscopy in Japan during the late-Meiji and Taishō Periods.

Description of the research activities:

My main activity has been finding historical documents and surviving Hilger instruments that will explain the growth of this scientific field of research in Japan and why a striking quantity of Hilger instruments came to Japan. In doing my research, I plan to visit archives, libraries, and museums in Tokyo, Sapporo, Sendai, Kanazawa, Osaka, and Kyoto to study these questions.

Two further goals of my project have been to assist my host professor with his activities linked to the study of scientific instruments and to make this subject better known to historians, students, and practicing scientists. Three formal talks have been planned along with having informal discussions with Japanese professors and their students.

RESEARCH REPORT

1. Name: Shana L. Fruehan （ID No.: SP05020）

2. Current affiliation: University of Chicago

3. Research fields and specialties:

Humanities X Social Sciences Mathematical and Physical Sciences
Chemistry Engineering Sciences Biological Sciences
Agricultural Sciences Medical, Dental and Pharmaceutical Sciences
Interdisciplinary and Frontier Sciences

4. Host institution: University of Tokyo

5. Host researcher: Dr. Ueno Chizuko

6. Description of your current research

My dissertation research examines social representations and personal experiences of romance, sexual relationships, and reproduction during the period of early adulthood (ages 20-30) for women living in contemporary Tokyo. The research is divided into five parts: (1) an overview of the historical context on romance, sexual relationships, and female reproduction in Japan over the past 150 years and the new category of "singles;" (2) an analysis of contemporary media debates about women's roles, sexuality, and female bodies and an examination of the way that young and unmarried women have been implicated in the breakdown of traditional social institutions; (3) ethnographic interviews with young adult women living in Tokyo about their experiences of young adulthood and various aspects of their romantic and sexual relationships; (4) discourses and practices concerning contraception among young adult women living in Tokyo; and (5) an examination of activist groups that are working to change perceptions and practices regarding romance, sexual relationships, and reproduction in contemporary Tokyo.

The majority of the research for the dissertation was conducted in Tokyo from 2002-2004, funded by a research fellowship from the Japanese Ministry of Education and a Fulbright-Hays Doctoral Dissertation award from the U.S. Department of Education.

7. Research implementation and results under the program

(As much as possible, describe the contents and results of your research in a manner that is easily understandable to a non-specialist in your field.):

Title of your research plan:

Supplementary Data Collection for Dissertation on Young Women and Relationships in Japan

Description of the research activities:

This summer I was able to complete the data collection for my dissertation project described above. I brought the total number of subjects interviewed to 45, and increased the depth and quality of the interviews by working closely with a Japanese research assistant. With the help of my host researcher, I was able to find many useful books and articles related to my research topic and also attended a weekly seminar on gender studies led by my host researcher. During the summer I also collaborated with other social scientists residing in Japan to prepare a conference panel proposal for the 2006 Association of Asian Studies Meetings in San Francisco.

8. Please add your comments (if any):

I appreciate the many friends and research contacts I made this summer.

Thank you to JSPS for making this possible!

RESEARCH REPORT

1. Name: Janel D. Funk （ID No.: SP05021）

2. Current affiliation: Colorado State University

3. Research fields and specialties:

Humanities Social Sciences Mathematical and Physical Sciences
Chemistry Engineering Sciences **X** Biological Sciences
Agricultural Sciences Medical, Dental and Pharmaceutical Sciences
Interdisciplinary and Frontier Sciences

4. Host institution: Institute for Behavioral Sciences
Gunma University School of Medicine

5. Host researcher: Dr. Hiroshi Kuromi

6. Description of your current research

My current research project seeks to unravel some of the molecular level mysteries of neurotransmitter release from nerve terminals. While one action potential results in the simultaneous fusion of multiple synaptic vesicles with the presynaptic membrane, it remains unclear exactly how vesicles are "readied" for fusion, how a neuron meets the demands of a high frequency stimulation train, and how vesicles are recycled during and after stimulation. Of the many proteins that are involved in maintaining neurotransmission, it is the behavior of one protein, actin, that captures my attention. Actin is an essential cellular protein that can exist as a monomer, or as long polymers that can dynamically rearrange or serve as structural components. Drugs that disrupt actin dynamics have been shown to disrupt neurotransmitter release, therefore the aims of my project are twofold: 1) to determine what step(s) of synaptic vesicle cycling require actin dynamics, and 2) to test the hypothesis that actin depolymerizing factor (ADF) is the physiological regulator of presynaptic actin dynamics. Using the *Drosophila* larval neuromuscular junction as a model system, I have determined that the *Drosophila* central nervous system contains both active and inactive forms of ADF, and that a *Drosophila* line expressing decreased levels of ADF exhibits a defect under high frequency stimulation (10 Hz) but not low frequency stimulation (0.1 Hz). Current work is focused on testing the hypothesis that ADF-regulated actin dynamics are required for mobilization of a "reserve pool" of synaptic vesicles that are utilized only during high frequency stimulation of the neuron.

7. Research implementation and results under the program

(As much as possible, describe the contents and results of your research in a manner that is easily understandable to a non-specialist in your field.):

Title of your research plan:

I. Visualization of endocytosed synaptic vesicles in live *Drosophila* nerve terminals using FM-dye labeling techniques

II. Analysis of synaptic vesicle pools upon disruption of actin dynamics

Description of the research activities:

I. Visualization of endocytosed synaptic vesicle in live *Drosophila* nerve terminals using FM-dye labeling techniques.

The first part of my research plan involved learning how to fluorescently label synaptic vesicles within live third instar *Drosophila* larvae. While synaptic vesicles can be visualized in fixed preparations (Figure 1A), labeling of synaptic vesicles in live preparations allows the efficiency of the synaptic vesicle cycle to be analyzed under various conditions (i.e. drug treatment or genetic mutation). For my project I used the fluorescent styryl dye FM1-43, which binds to the outer leaflet of neuronal plasma membranes but cannot pass through the plasma membrane. The dye in the solution is taken up into synaptic vesicles by endocytosis. Figure 1B shows synaptic vesicles that have been endocytosed over a 5 minute period of nerve stimulation (induced by standard *Drosophila* saline containing 90 mM KCl).

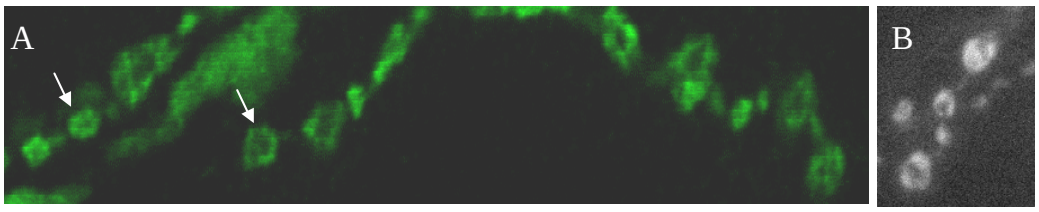


Figure 1. A) Fixed third instar neuromuscular junction. Synaptic vesicles within synaptic boutons are labeled with a fluorescent antibody to the synaptic vesicle protein synaptotagmin. Arrows indicate two of many synaptic boutons, which are embedded in the muscle fiber (not visible). **B) Live third instar neuromuscular junction.** Synaptic vesicles within boutons are labeled with the fluorescent dye FM1-43.

II. Analysis of synaptic vesicle pools upon disruption of actin dynamics

There are at least two populations of synaptic vesicles in the presynaptic terminal of *Drosophila*: the exocytosis/endocytosis cycling pool (ECP) and the reserve pool (RP). These pools can be distinguished by their location (the ECP is located close to active synaptic vesicle release sites in the periphery of the bouton whereas the RP is more centrally located) and also by their kinetics of use during various stimulation protocols. High KCl stimulation predominantly causes FM-dye to be loaded into the

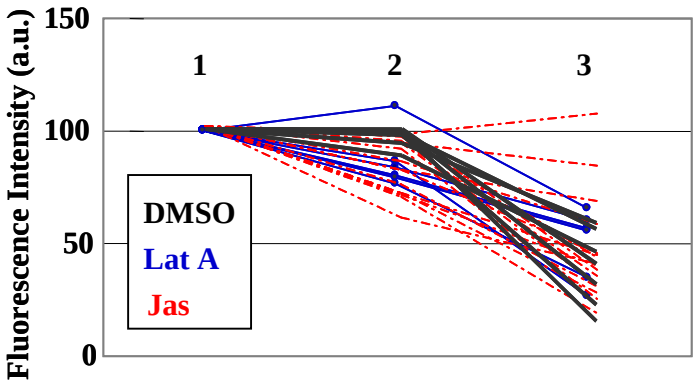


Figure 2. Actin disrupting agents have no discernable effect on the unloading of FM-dye from the ECP. Fluorescence intensity of each bouton loaded with FM-dye by high KCl stimulation was given a value of 100% (points at position 1). Points at position 2 indicate the fluorescence intensity following 10 min incubation in DMSO, Jas or Lat. Points at position 3 indicate the fluorescence intensity remaining upon unloading dye from nerve terminals with high KCl for 6 min.

periphery of synaptic boutons and is therefore a good tool for measurement of ECP mobility. To determine the effects of the actin disrupting agents Jasplakinolide (Jas) and Latrunculin A (Lat A) on ECP mobility, images similar to that shown in Figure 1B were taken of larval preparations loaded with FM-dye before and after treatment with control solution (DMSO), Jas or Lat A. The preparations were then stimulated with 60 mM KCl in the presence of the drug and images collected following stimulation. No discernable differences were found between drug treated and control preparations (Figure 2). These data suggest that actin dynamics are not critically involved in the cycling of the ECP.

To corroborate these results, larval preparations were electrically stimulated at low (1 Hz) or high (10 Hz) frequency in the presence of Lat A and evoked junctional potentials (EJPs) of the muscle fiber recorded. Interestingly, the EJP amplitudes at both frequencies of stimulation were increased upon incubation in Lat A (data not shown). As Lat A facilitates depolymerization of actin filaments, this suggests that actin filaments act as a barrier to synaptic vesicle release. Low frequency stimulation is thought to utilize only the ECP, therefore the involvement of actin dynamics in ECP cycling suggested by the electrophysiological data do not agree with the data obtained in the FM1-43 studies. Future experiments testing the time course of FM1-43 unloading from the ECP may reveal a visible difference between drug treated and control preparations, however it may also be that the resolution of FM-dye imaging is not sensitive enough to detect the changes observed electrophysiologically.

Experiments performed during the final weeks of the EAPSI program focused on learning the more complex task of labeling the reserve synaptic vesicle pool with FM1-43, and analyzing both the ECP and RP dynamics of transgenic *Drosophila* lines expressing mutant regulators of ADF activity. While I encountered some difficulties in being able to consistently identify the RP, I was able to see a clear difference between the ECP and the RP (Figure 3) and begin the analysis of the transgenic lines. Figure 3 shows the fluorescence distribution after ECP and RP

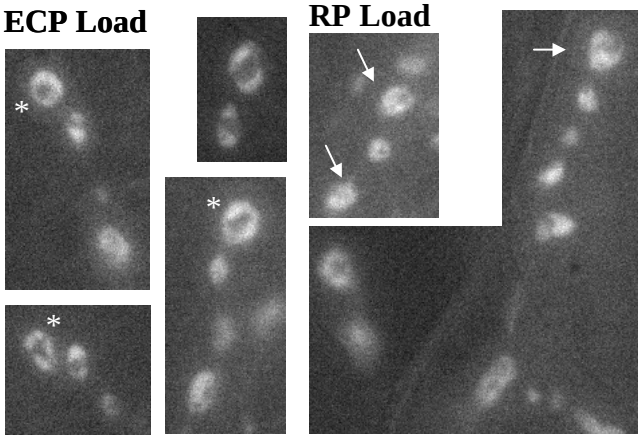


Figure 3. FM1-43 labeling of the ECP and the RP in a *Drosophila* line expressing mutant Slingshot phosphatase in the nervous system. Asterisks denote the typical peripheral fluorescence of boutons after FM1-43 loading with high KCl ("ECP load"). Arrows denote the centrally located flourescence often observed after FM1-43 loading in the presence of veratridine, a potent Na+ channel opener ("RP load").

loading in a transgenic *Drosophila* line expressing a mutant form of Slingshot phosphatase in the nervous system, which causes a decrease in the dephosphorylation-activation of ADF. Current experiments are underway to determine if these loading patterns differ significantly from controls.

Overall, mastery of this technique will provide a useful and necessary tool for detailed analysis of the role of actin dynamics in synaptic vesicle cycling. This program gave me a wonderful opportunity to not only learn from the master of FM1-43 labeling in *Drosophila*, but also spend an incredible eight weeks in Japan! I am very happy to have had this unique opportunity to learn new skills in a new environment and hope to be able to return to Japan in the future.

8. Please add your comments (if any):

Thank you for giving me this opportunity to do research in Japan, and special thanks to Dr. Kuromi and members of his laboratory for all of their patience in teaching me and helping me to work through problems! I really appreciate the kindness shown by every person in the laboratory and will miss everyone very much!

9. Advisor's remarks (if any):

Ms. Janel D. Funk has worked hard during staying at my laboratory (she has worked even on Saturday and Sunday). She has learned how to label synaptic vesicles endocytosed in Drosophila motor nerve terminals with fluorescence FM dye and how to record synaptic potentials at neuromuscular junction of Drosophila. Through the experiments with these techniques, she has learned electrophysiological and optical analysis of synaptic transmission. To clarify roles of actin in synaptic vesicle trafficking and synaptic transmission, she has examined effects of drugs and gene mutations affecting actin dynamics on trafficking of synaptic vesicles labeled with FM1-43 and on synaptic potentials evoked at low and high frequency. She has got the data to suggest that actin

filaments play as a barrier to synaptic transmitter release. She has been examining roles of actin in recruitments of synaptic vesicles from reserve pool.

She has achieved a lot in friendships between USA and Japan. She has rapidly fitted herself into my lab. She has showed high entertaining by having the party and talking with members in my lab. She has studied Japanese and also Japanese characters by talking with members in my lab. I sincerely hope that she continues to do experiments with techniques and ideas which she got in Japan and also that she returns to Japan.

Hiroshi Kuromi, PhD.

Institute for Behavioral Sciences, Gunma University School of Medicine

RESEARCH REPORT

1. Name: Christopher Paul Garris （ID No.: SP05022）

2. Current affiliation: University of Kentucky

3. Research fields and specialties:

Humanities X Social Sciences Mathematical and Physical Sciences
Chemistry Engineering Sciences Biological Sciences
Agricultural Sciences Medical, Dental and Pharmaceutical Sciences
Interdisciplinary and Frontier Sciences

4. Host institution: Tohoku University

5. Host researcher: Dr. Ken-ichi Ohbuchi

6. Description of your current research

Interpersonal rejection has been recognized as a primary human motivator (the need to belong; Baumeister & Leary, 1995). The acceptance of those around us is important to our mental health, social adaptation, and, in some cases survival. Research has also been shown that reject challenges three additional human needs: need for control, the need for a meaningful existence, and the need for self-esteem (Williams & Govan, 2003).

Rejection also has been shown to have detrimental effects on such important aspects as emotion, health, well-being, cognition, and interpersonal behavior (Sommer & Baumeister, 2002).

Among the array of empirically demonstrated effects of rejection, the most relevant to the current research are research findings regarding rejected individuals' behavior toward others. Numerous other researchers have shown that regression increases aggression, both physical (Gaertner & Iuzzini, in press) and nonphysical (Twenge et al., 2001). Rejection has also been implicated in recent publicized instances of school violence. Drawing from news reports, empirical data, and anecdotal evidence, Leary et al. (2003) examined 15 school violence incidents and determined that 13 of the perpetrators had experienced interpersonal rejection of some sort at school.

The purpose of the current study is to expand upon the small number of cross

cultural rejection studies, especially regarding aggression. This study should illuminate a possible moderating role of collectivism and individualism on the effects of rejection.

7. Research implementation and results under the program

Method

Participants will be approximately 100 American and 50 Japanese undergraduates. Participants are recruited for two separate studies, investigating impression formation and performance under stress. They also are led to believe that they are participating alongside two other participants, who are stationed in separate rooms.

At this point, the participant completes two questionnaires and completes a form describing themselves. This form is then collected, and ostensibly taken to the "other participants." The participant is then provided with two prefabricated descriptions believed to be completed by the "other participants." Based on this information, the participant is told that the "other participants" either wanted to get to know him/her or not (rejection manipulation). After the manipulation has been administered, the participant is told the first study is over and the second study is about to begin, which involves administering noise to the "other participants" while they complete math tasks. Further instructions will explain that the participant will be given the opportunity to adjust the volume level at one minute intervals for 5 minutes. At each minute interval, the experimenter will enter the laboratory, record the volume level, and give the participant the opportunity to change the level of volume. This acts as our measure of aggression.

Next, the participant is administered three more questionnaires. Once these are completed, they are offered the opportunity to wait either alone or with the "other participants." This acts as a measure of prosocial behavior. Lastly, the participant is extensively debriefed and dismissed.Results

Data collection began in August 2005. Results will be ready for analysis at the end of data collection, projected to be completed by December 2005. Result inquiries can be addressed to Christopher Garris, at garris@uky.edu.

Title of your research plan:

The Cross Cultural Effects of Rejection on Aggression

RESEARCH REPORT

1. Name: Thomas Grimes （ID No.: SP05024）

2. Current affiliation: University of North Texas

3. Research fields and specialties:

Humanities Social Sciences Mathematical and Physical Sciences
X Chemistry Engineering Sciences Biological Sciences
Agricultural Sciences Medical, Dental and Pharmaceutical Sciences
Interdisciplinary and Frontier Sciences

4. Host institution: Osaka Prefecture University

5. Host researcher: Dr. Shiro KOSEKI

6. Description of your current research

The primary purpose of this research was to learn how to perform spin-orbit coupling calculations using currently available computational software. Spin-orbit coupling arises from the application of special relativity to quantum mechanics and has significant impact on the photophysical properties of compounds containing heavy atoms. Specifically, a collaborating group in the US has been investigating the luminescent properties of gold (I) phosphines. These compounds are promising as a class of potentially tunable novel phosphors. For example, they may have the potential for use as novel phosphors in light emitting devices, such as laptop computer screens. The presence of a heavy atom, gold, in this case, enhances the efficiency of the phosphorescence process. Spin-orbit coupling also changes the calculated absorption/emission wavelengths, in comparison with the non-relativistic computation. From a purely theoretical aspect, these compounds are interesting because they display a huge Stokes' shift due to a large geometric distortion caused by the Jahn-Teller effect.

Gold (I) phosphines provide an ideal class of test cases for the practical application of spin-orbit coupling calculations both because of the availability of relatively simple model systems and because the information gathered can be of immediate use to experimentalists working with this class of compounds. The calculations themselves are non-trivial, though relatively small model systems can be found in this class of compounds. There are a number of techniques necessary to learn in order to successfully perform the calculations using the available computational resources. The primary goal of this research may be restated as learning about these techniques and gaining experience applying them to an immediately useful system.

The textbook model for explaining absorption and emission processes of a

compound starts with a molecule in the ground state. Upon absorption of a photon of the correct energy, the molecule enters an excited state of the same spin multiplicity. Since the electronic wavefunction responds instantly in comparison with the nuclear wavefunction, the state energies and dipole transition moment between the ground state and excited states at the ground state geometry provide an estimate of the absorption wavelengths and relative intensities. From there, the molecule may vibrationally relax toward the excited state equilibrium geometry. The molecule may then undergo a transition back to the ground state with the emission of a fluorescence photon, the energy of which is determined by the difference in energy between the excited state and the ground state at that geometry. If instead the molecule crosses into a state of higher spin multiplicity, it may relax from this state back to the ground state with the emission of a phosphorescence photon. Transition between two states of different spin multiplicity is formally forbidden in nonrelativistic quantum mechanics, but spin-orbit coupling provides a mechanism for these "spin-forbidden" transitions to occur. The magnitude of coupling increases dramatically with increasing atomic number, hence the importance of performing spin-orbit coupling calculations on gold (I) phosphines.

7. Research implementation and results under the program

Title of your research plan:

The Effects of Spin-Orbit Coupling on the Emission/Absorption Spectra of $\{Au(PH_3)_3\}^+$.

Description of the research activities:

In light of the model emission process, it was necessary to obtain the structures of the ground state singlet, first singlet excited state, and first triplet state for the model compound. Experimental spectra are available for $\{Au(TPA)_3\}^+$ (TPA = 1,3,5-triaza-7-phosphaadamantane), but this compound proved intractably large for the limited time available. Accordingly, $\{Au(PH_3)_3\}^+$ was chosen as a model system that should be close enough to the TPA compound to evaluate the effects of spin-orbit coupling. The process of carrying out a spin-orbit coupling calculation requires (i) determining the equilibrium geometry of a state, (ii) generating an appropriate wavefunction, and (iii) performing the spin-orbit coupling calculation itself.

The ground state singlet geometry was determined to be trigonal planar, *i.e.*, Y-shaped, where the ligands are equally spaced. Generation of an appropriate wavefunction requires consideration of the density of states, versus the accuracy of the calculation, versus the computational resources available. Determining the density of states requires a separate calculation for each spin multiplicity and symmetry species. Once this information has been gathered, the wavefunction for the spin-orbit coupling calculation can be generated. All these calculations are

computationally expensive, and it is not unusual for a single calculation to run for many hours. For example, the spin-orbit coupling calculation alone for the ground state took over 88 hours to perform, using 10 processors and 80 GB of RAM. Similarly, the geometries of the triplet and excited singlet states were determined and the same type of calculations performed. Both the excited singlet and the triplet showed a large geometric distortion to a T-shape, as predicted in previous research.

The results of the current research indicate spin-orbit coupling is necessary for accurate determination of the absorption and emission spectra of $\{Au(PH_3)_3\}^+$. One possibility suggested by these findings is that application of spin-orbit coupling to the wavefunction of a structure that has been optimized using the nonrelativistic potential energy surface may not be sufficient to explain the absorption and emission wavelengths accurately enough to rationally tune the emission of these compounds. Now that the kinks of the basic procedure have been worked out, future research can concentrate on applying this procedure to the larger TPA model, for which experimental data exists. In addition, the current system should be used to further refine the current computational methodology.

8. Please add your comments (if any):

A fully detailed report of my findings will be made available to JSPS by request after 1-October 2005.

RESEARCH REPORT

1. Name: Roger Ho （ID No.: SP05025）

2. Current affiliation: Johns Hopkins School of Medicine

3. Research fields and specialties:

Humanities Social Sciences Mathematical and Physical Sciences
Chemistry Engineering Sciences X Biological Sciences
Agricultural Sciences Medical, Dental and Pharmaceutical Sciences
Interdisciplinary and Frontier Sciences

4. Host institution: University of Tokyo

5. Host researcher: Dr. Takeshi Iwatsubo

6. Description of your current research

I am currently a medical student (MS2) at the Johns Hopkins University School of Medicine. Previously, I obtained my Master of Science degree from Yale University via working with Professor Thomas Steitz on X-ray crystallographic structural studies of γδ-resolvase.

7. Research implementation and results under the program

Title of your research plan: The Role of LRRK2 in the Pathogenesis of Parkinson's Disease

Description of the research activities: Parkinson's Disease is a severe, progressive neurodegenerative disease clinically characterized by bradykinesia (slowness of movement), tremors, rigidity, and postural instability. The disease is caused by the death of dopaminergic neurons in the *substantia nigra* of the basal ganglia. The pathophysiology leading to such neuronal cell death is, for the most part, unknown. Post-mortem brain analyses of Parkinson's Disease patients reveal the presence of fibrillar aggregates known as Lewy bodies and Lewy neurites, whose main component is the protein α-synuclein. In normal patients, these α-synuclein proteins, whose function is yet to be discovered, are localized close to synaptic vesicles in pre-synaptic terminals. Analyses of patients with Parkinson's Disease reveal that their α-synuclein proteins either have a missense mutation (A53T, A30P, or E46K) or are pathologically phosphorylated at Ser129. Both the A53T mutation and the phosphorylation at Ser129 have been shown to increase the formation and aggregation of α-synuclein filaments in vitro. It has been hypothesized that such aggregations lead to the death of the dopaminergic neurons of the *substantia nigra*.

Parkinson's Disease is usually identified clinically as a sporadic disease. Nonetheless, rare familial forms of Parkinson's Disease that have been linked to specific genetic loci do exist. One such familial form, PARK8, is an autosomal dominant disease that exhibits clinical and pathological

phenotypes similar to sporadic Parkinson's Disease with a late-onset. PARK8 parkinsonism has been mapped to chromosome 12p11.2-q13.1, a 13.6 cM region containing approximately 116 genes. Recent genetic linkage and segregation analyses have refined the genetic locus to a 144 kb region, whose 9 kb transcript gives rise to a 2527 amino acid protein known as LRRK2 (Leucine Rich Repeat Kinase 2). Protein sequence analyses reveal multiple conserved functional domains including a kinase(MAPKKK) catalytic domain and a small GTPase-like (ROCO) domain. Since phosphorylation of Ser129 of -synuclein has previously been shown to potentially result in the formation of Lewy bodies and Lewy neurites, the discovery of LRRK2, a protein that possesses a putative kinase domain, has provided a link to the understanding of the molecular mechanisms underlying dopaminergic neurodegeneration. As a result, in order to gain further insights into the pathogenesis of Parkinson's Disease, we aim to examine the physiological and pathological functions of LRRK2. One of the main goals is to analyze the kinase activity of LRRK2 by detecting the oligomerization domain required for kinase activity via differential tagging and co-mmunoprecipitation.

We successfully constructed a 6x-myc tagged LRRK2 protein and expressed it using HEK293T cells. We then cotransfected the HEK293T cells with the 6x-myc tagged LRRK2 plasmid and a previously made 3x-flag tagged LRRK2 plasmid. Such differential tagging, along with immunoprecipitation, allowed us to examine the oligomerization of, hence kinase activity of, LRRK2. IP samples were then subjected to Western blot analysis. Blot membrane was first probed with M2 anti-flag tag antibody. Membrane was then incubated at 67° C in strip buffer for 90 min and subsequently reprobed with 9B11 anti-myc tag antibody. When probed with M2, a faint band of size similar to full-length LRRK2 was seen in the myc IP double transfection sample. Similarly, when probed with 9B11, a band of similar size was seen in the flag IP double transfection sample. This shows that LRRK2 possesses a dimerization domain and does indeed dimerize in vivo, though the extent of wild-type dimerization is quite low as demonstrated by the faintness of detected bands. A subsequent repetition of the experiment showed similar results.

8. Please add your comments (if any): Activation of kinases typically requires dimerization. LRRK2 shows sequence homology to MAPKKK, a kinase which also requires dimerization for its activation. Here we showed that LRRK2 does contain a dimerization domain and is capable of dimerizing in vivo. The extent of wild-type dimerization, however, as shown in this experiment, is quite low, indicating that the interaction between LRRK2 is quite weak. Several interpretations can be drawn from this result. It is possible that LRRK2 is normally inactive or only mildly active physiologically. Mutations in the kinase domain, like the G2019S mutation, might enhance the dimerizability of LRRK2. The mutated glycine into serine could have contributed to the enhancement in dimerization alone structurally without any modifications. However, given the prevalence of the G2019S mutation in PARK8 and the proximity of the residue to the kinase catalytic site, it is also

plausible that the weak interaction between LRRK2 is enhanced by autophosphorylation of the G2019S residue in a mechanism reminiscent of the receptor tyrosine kinase. In other words, the weak interaction may activate the kinase, leading to the autophosphorylation of G2019S, which subsequently locks the LRRK2 complex in the activated dimerized state. If this were the case, LRRK2 could be a serine kinase. This can then lead to the simple view that the increased level of dimerization results in a greater kinase activity that gives rise to the phosphorylation of α-synuclein at Ser129 seen in Lewy Bodies in Parkinson's disease. Alternatively, the phosphorylation of another physiological substrate might be at work, or that the G2019S mutation, phosphorylation of G2019S, or the dimerization itself might have brought upon a conformation change carried through to the other homologous domains, resulting in the activation or deactivation of the ROC-COR domain, or enhanced or decreased interaction with other proteins via the LRR and the WD40 domain.

Nonetheless, one might also wonder why the kinase domain exists if the dimerization interaction is normally weak. It is possible that a basal level of kinase activity is needed to maintain cellular integrity. LRRK2 may also be part of a scaffold protein which dimerizes upon interacting with other proteins via the WD40 or LRR domain. The physiological substrate of the LRRK2 scaffolding complex might be different from the one acted on by the LRRK2 dimer alone. As a result, mutations that enhance the self-dimerization of LRRK2 might result in abnormal activity by LRRK2, resulting in neuronal cell death, giving rise to symptoms typical of Parkinson's disease.

The aforementioned hypotheses are difficult to be justified at this point. Mutagenesis experiments, showing the effect of mutations on the degree of dimerization would be informative. Similarly, a yeast-two hybrid experiment searching for the physiological substrate of LRRK2 would also be interesting. Structural studies demonstrating the conformational changes due to mutation and dimerization could provide much crucial information in terms of the role of LRRK2 in the pathogenesis of Parkinson's disease.

RESEARCH REPORT

1. Name: Lisa Hsuan （ID No.: SP05026 ）

2. Current affiliation:

University of California, Davis School of Veterinary Medicine

3. Research fields and specialties:

Humanities Social Sciences Mathematical and Physical Sciences
Chemistry Engineering Sciences X Biological Sciences
X Agricultural Sciences Medical, Dental and Pharmaceutical Sciences
Interdisciplinary and Frontier Sciences

4. Host institution: University of Tokyo, Graduate School of Agriculture and Life Sciences, Department of Veterinary Medicine

5. Host researcher: Dr. Kunio Doi and Dr. Hiroyuki Nakayama

6. Description of your current research

I am working to clarify the mechanism of 5-azacytidine toxicity in the fetal brain using NIH Image computer software for image analysis. 5-azacytidine is a potent inducer of apoptosis in mouse fetal brains and these lesions are usually examined by *in situ* staining or immunohistochemistry. The stained cells are then counted manually using a light microscope. However, this method is subjective and problematic because of overlapping or fused cells, and accuracy of data generated is dependent on the skill and experience of the researcher. I am trying to achieve an objective and volumetric measurement of the degree of apoptosis by measuring the surface area of apoptotic lesions using digitally manipulated images of stained fetal brain sections.

7. Research implementation and results under the program

I have found NIH Image to be a poor substitute for conventional methods of counting apoptotic cells. First of all, immunohistochemical cell staining involves the use of different colors in order to improve contrast and maximize visualization of cell structures. NIH Image cannot interpret the various hues and shadows generated by cell staining and this has led to false positives and false negatives. Secondly, the borders of neural tissue are often ambiguous and misinterpreted by the program, which can only accurately assess binary images. This would adversely affect the measured ratio of apoptotic versus normal tissue.

My protocol now includes initial manipulation of the images in Adobe Photoshop before applying NIH Image, a process that is time consuming and subjective. The problem of dependency on the researcher’s experience in assessing apoptosis has not

been circumvented. This, in addition to the shortcomings of the program itself, does not make NIH Image analysis a strong substitution for classical methods. However, the program can be used to support manually acquired data. Though the exact measurements differ, the two methods do show the same trends when plotted on a graph. Furthermore, the digital manipulation of stained cell images facilitates traditional cell counting and cell architecture and structures can be better visualized.

Title of your research plan:

NIH Image software as a means to measure the distribution of apoptotic brain lesions induced by 5-azacytidine in the fetal mouse

Description of the research activities:

Pregnant mice received an intra-peritoneal (IP) injection of 5-azacytidine, a toxic compound known to cause apoptosis. Fetuses were collected at varying time points between 3 to 24 hr after treatment. Fetuses were fixed in formalin and embedded in paraffin blocks. Blocks are sectioned by microtome into 4-micron slices and mounted on glass slides. Slides near the midbrain region of the left telencephalic wall were collected for immunohistochemistry staining and analysis. Apoptotic lesions were evaluated using Adobe Photoshop and NIH Image computer software. These data were compared to those obtained via traditional analysis methods and found to be comparable though not exact.

8. Please add your comments (if any): This has been an exceedingly educational and rewarding experience. I have learned valuable pathological techniques such as preparing tissue samples for microtome sectioning, slide preparation and harvesting of fetal tissue. I have also had the opportunity to attend pathology slide presentations, necropsies, journal article presentations, data review sessions and a 3-day toxicology conference headed by my professor. I witnessed how animal research is conducted and regulated in Japan. I visited animal housing and veterinary facilities at both the University of Tokyo and Hokkaido University veterinary schools. The two schools are quite different in terms of facility and administration. Furthermore, everyday in the laboratory I would engage in meaningful conversations with my lab mates. I was lucky to be part of a very sociable laboratory. My professors were attentive and went out of their way to ensure that my experience in Japan was well rounded. All laboratory members were proficient in English. From talking to them, I learned much about science, working in Japan and Japanese culture. I consider these to be my most valuable lessons of the summer. Becoming familiar with the culture and attitude of the Japanese people is something one can only attain from an extended stay and the opportunity to participate in a working environment or university setting. I will not doubt continue to use my acquired pathology skills and exposure to Japanese culture in my future as a veterinary pathologist with international interests.

RESEARCH REPORT

1. Name: Amy Hubbard （ID No.: SP05027 ）

2. Current affiliation:

UCLA, Applied Linguistics

3. Research fields and specialties: Neurobiology of Language and Language Acquisition

Humanities Social Sciences Mathematical and Physical Sciences
Chemistry Engineering Sciences Biological Sciences
Agricultural Sciences Medical, Dental and Pharmaceutical Sciences
Interdisciplinary and Frontier Sciences

4. Host institution: ATR International

5. Host researcher: Dan Callan

6. Description of your current research

Using functional MRI to gain a better understanding of neural processes underlying language processing in the brain. Specific areas of interest include 1) the integration of multisensory stimuli related to human communication and 2) neural processing of a second language during various stages of language learning.

7. Research implementation and results under the program

(As much as possible, describe the contents and results of your research in a manner that is easily understandable to a non-specialist in your field.):

Title of your research plan:

Investigate neural responses correlated with North American English and prosodically-coordinated movement in native speakers of English and in native speakers of Japanese.

Description of the research activities:

Constructed video stimuli for projection in the fMRI scanner; gathered data from 26 subjects in the fMRI scanner while subjects watched stimuli; analyzed fMRI data using SPM 2 and examined activation coordinates for pre-established regions of interest.

RESEARCH REPORT

1. Name: Jason A. Kenney （ID No.: SP05028）

2. Current affiliation: University of Texas at Austin

3. Research fields and specialties:

Humanities Social Sciences Mathematical and Physical Sciences
Chemistry X Engineering Sciences Biological Sciences
Agricultural Sciences Medical, Dental and Pharmaceutical Sciences
Interdisciplinary and Frontier Sciences

4. Host institution: Tokyo University of Agriculture and Technology

5. Host researcher: Dr. Masanori Kunieda

6. Description of your current research

My research investigates the processes which occur during electrochemical reactions when the system is not at steady-state. My primary focus is on the transient behavior of a micromachining system which uses ultrashort (tens of nanoseconds) voltage pulses to modify electrically-active substrates. To date, I have focused on the applied aspects of this area of study, such as the relationship among the duration of the pulse, the size of the tool electrode, and the size of the resulting modification on the substrate. In addition, I have looked at the nature of the electric fields that form when using tool electrodes of different shapes and complexity. The interaction of these fields with each other impacts the communication of the shape to the substrate.

In the future, I will look at more fundamental aspects of transient electrochemical behavior. In particular, I wish to examine the nature of the electrochemical double layer during charging and discharging processes. While much is known about double layer behavior at equilibrium, there is still a great deal of uncertainty in the relative importance of migration, diffusion, and solvation of ions when the system has been perturbed.

7. Research implementation and results under the program

(As much as possible, describe the contents and results of your research in a manner that is easily understandable to a non-specialist in your field.):

Title of your research plan:

Reduced Feature Size in Electrolyte Jet Machining

Description of the research activities:

In electrolyte jet machining, a stream of electrolyte from a small nozzle (< 250 microns in diameter) is directed at a substrate and a potential is applied between the nozzle and substrate. Between the pulsed nature of the potential and the narrow nature of the flow, the electrochemical reaction on the substrate is physically-confined to a small region near the nozzle. Movement of the nozzle along the substrate and selective application of the potential allows the creation of complex patterns, either through etching or deposition.

My research this summer involved evaluating a new, smaller nozzle in the hopes of reducing the size of the smallest feature that could be etched or deposited. The new nozzle was made of a ceramic, giving it a higher durability than the previous metallic nozzles, but the smaller diameter introduced problems with obtaining flow. Due to the frequent and rapid clogging of the nozzle, we designed a new electrolyte delivery system using a syringe and filter. This allowed flow to occur without clogging of the nozzle but has introduced new problems due to the loss of pressure through the filter, leading to an electrolyte jet which is not as powerful as the previous system. This in turn has changed the nature of the flow of electrolyte along the substrate, making it difficult to obtain the proper conditions for etching. At present, we have demonstrated that this new nozzle system can provide smaller etched features, but we are having difficulty in reliably reproducing the results.

8. Please add your comments (if any):

I cannot emphasis enough how wonderful this experience has been. As I come from a simulation background, it was great to have the opportunity to do experiments in a lab for two months. That is secondary, however, to being able to meet so many nice, generous, thoughtful people both in my laboratory and around Japan. My only complaint is that the program is too short.

RESEARCH REPORT

1. Name: Amir A. Kharazi （ID No.: SP05029 ）

2. Current affiliation: Michigan State University (USA)

3. Research fields and specialties:

Humanities Social Sciences Mathematical and Physical Sciences
Chemistry Engineering Sciences X Biological Sciences
Agricultural Sciences Medical, Dental and Pharmaceutical Sciences
Interdisciplinary and Frontier Sciences

4. Host institution: University of Tokyo

5. Host researcher: Professor Nagashima

6. Description of your current research

Within the family of wave devices, wave rotors have demonstrated an attractive potential for reaching the ultra-high performance targets of power systems and for lowering their cost. In this respect, using 3-port condensing wave rotors in R-718 water refrigeration cycles appears a promising technology. Water is a natural and clean refrigerant with no Ozone Depletion Potential (ODP=0), no contribution to the global warming (GWP=0), and without any safety risk. It is chemically stable, non-toxic, non-flammable, commonly available, and easily disposable after use. In R718 systems, water serves as both refrigerant and heat transfer fluid. However, with today's state of the art, R-718 refrigeration units require two bulky compressor stages mostly with inter-cooling. Their efficiency is also substantially limited by the efficiency of the pressure recovery of the steady-state diffuser, which decelerates the high speed vapor flow out of the compressor wheel. Additionally achieving a high efficiency of pressure recovery is more complicated due to the fact that the Reynolds numbers of water vapor under vacuum are very low (like 300 times lower than those using R134a or R12). Integration of a condensing wave rotor can improve COP of R-718 units while reducing their cost and size. Its successful implementation may substitute three subsystems: the intercooler, one compressor stage, and the condenser.

The compression problem states a perfect application for a wave device, increasing the efficiency of the pressure recovery in the decelerated flow substantially by utilizing time-depended flow features. This allows then for a lower compressor pressure ratio, which is associated with a higher isentropic efficiency of the compressor, increasing the overall efficiency additionally. Furthermore the combination of this will then also allow the use of more compact axial compressors in the most compact form as counter-rotating stages eliminating the need of bulky guide vane apparatuses. Integration of the proposed condensing wave rotor is ultimately

well suited for a mass-production that will substitute the current manufacturing process and will promote the new environmental friendly and energy efficient R-718 technology for refrigeration, air-conditioning and heat pump applications also for capacities <300 kW, which is not available today in form of an economical and efficient solution. In the period of two years that I have been involved with this project, I have developed a prediction model for the flow regimes inside the channels of the condensing wave rotor. More over I have predicted performance enhancement of R718 cycles when a condensing wave rotor is integrated. My work is already published in four technical papers and two journal articles.

7. Research implementation and results under the program

(As much as possible, describe the contents and results of your research in a manner that is easily understandable to a non-specialist in your field.):

Title of your research plan:

Visualization of shock propagation in miniaturized channels of a wave rotor

Description of the research activities:

During the Summer program at University of Tokyo, the fluid flow inside a single channel of a miniaturized wave rotor was studied. During the program, an experimental test rig for microtube visualization was built. Schlieren visualization technique was used for observation of primary and secondary shock waves. Pressure distribution at the end wall was measured to help understanding the shock phenomena. The test rig built for this study is almost the same idea used at the University of Tokyo several years ago, fixing the channel, and rotating the ports. However, in the real wave rotor the channels are rotating and inlet and outlet ports are fixed. The flow dynamics for both cases should be the same; therefore, the present studying and its continuation help understanding the fluid dynamics of flow inside channels of a micro-wave rotor. Figure 1 shows a photograph of the real equipment made at the University of Tokyo.

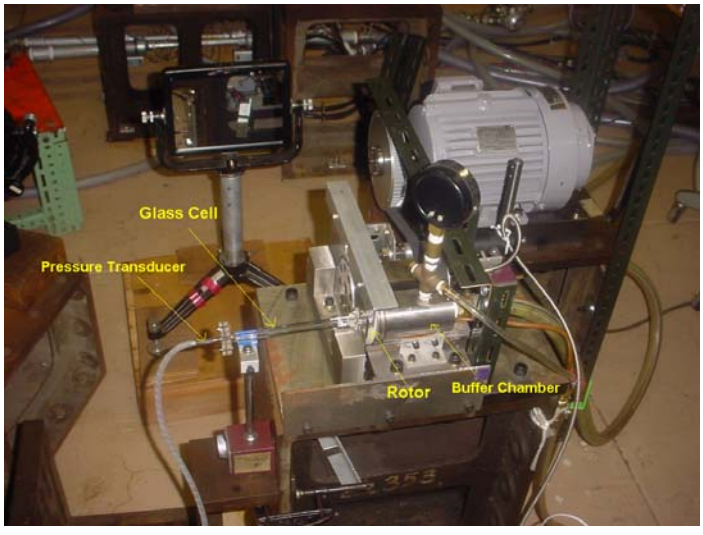


Fig.1: Experimental Test Rig for Micro Channel Shock Visualization

In this special design, buffer chamber is fixed. Therefore, high pressure air coming from a screw compressor is supplied constantly. On the other hand, a rotor with inlet and outlet ports is rotating. Therefore, high pressure air is introduced to the glass chamber periodically. A pressure transducer is used to monitor the pressure change at the end of the tube.

To study the flow inside the miniaturized wave rotors, two glass-made cells with the lengths of 38 and 165 mm and rectangular cross sectional area of 3*3 were considered. Figure 2 shows a photograph of the 38 mm glass-cell used for this study. The first study was attempted using the plastic test section but because of visualization problems the current study was done using glass material.

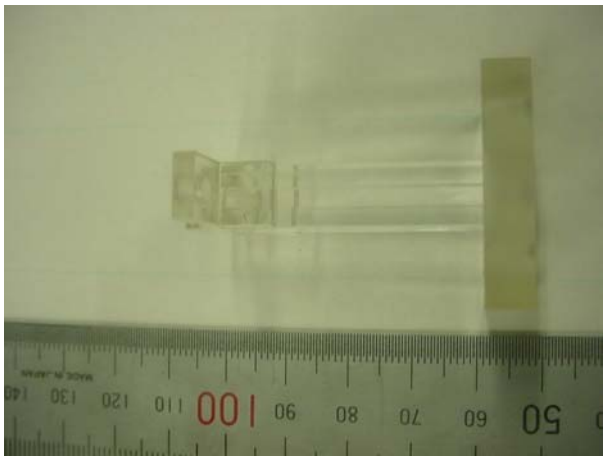


Fig.2: A 38 mm Glass-made channel for Shock Visualization

In order to measure the pressure and velocity distribution at the cell end, a Laser Doppler Anemometry (LDA) is used. In this LDA measurement, the light source is a CW Nd: YAG laser (532 nm), and ethanol droplets are seeded as scattering particles.

In the wave rotors τ is defined as the ratio of passage opening time and the wave travel time. To compare the pressure distribution at the end wall of test sections, cases with the same τ value are considered. Rotor rotational speed of 40 Hz for the short cross section is corresponding to the 10 Hz rotor rotational speed for the long test section. As shown in Fig. 3, the gradient of pressure jump for both test sections up to pressure ratio of .25 MPa is the same. This pressure ratio is corresponding to the primary shock wave. After this point the short cross section has sharper gradient. This difference in the gradient could be due to the size scale effect which results in different shock interactions such as different arrival time of expansion waves. The fluctuations in the short cross section are mainly due to the oscillatory nature of pressure injection by the compressor.

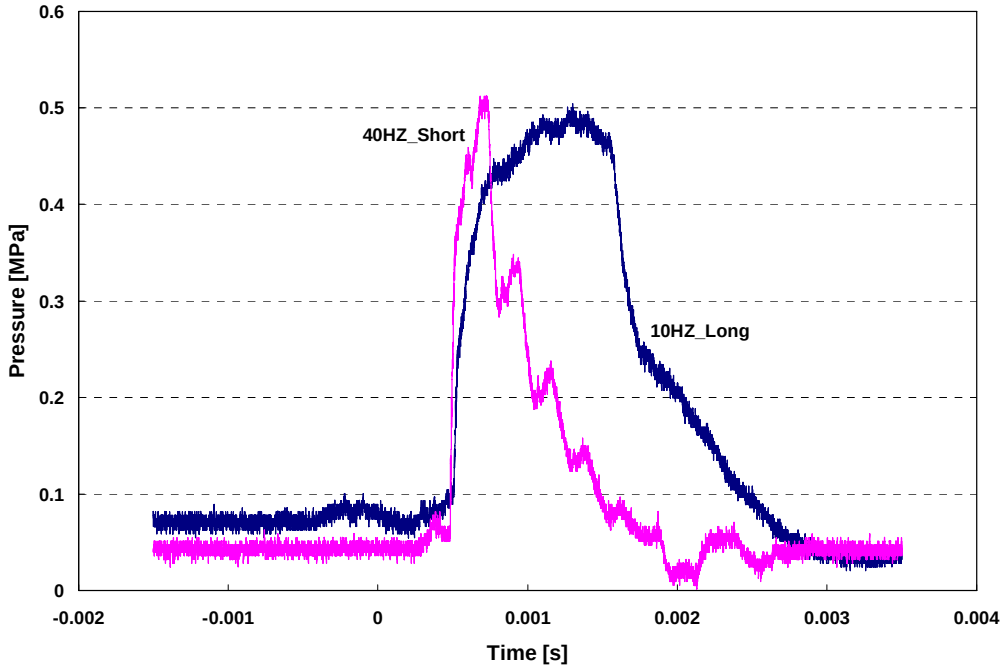


Fig.3: Pressure distribution at the end wall of short and long test sections.

Figure 4 shows the picture obtained using the Schlieren method. In this picture, the primary and secondary shock waves are clearly observed. The speed of the primary shock is 470 m/s and the secondary shock 315 m/s which are slightly higher than the calculated values. This could be due to the error of measurement devices such as the pressure gage. In figure 3, the start of pressure jump is at 470 microseconds. This fact can be observed in Figure 4, as the primary shock wave reaches to the end wall and is reflected at 470 microsecond.

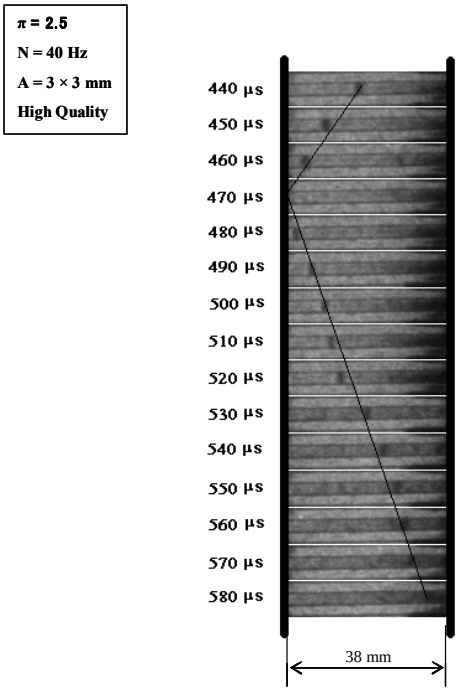


Fig.4: Shock Wave Visualization using Schilieren Method for 38 mm Test Section

Figure 5 is the same observation for the longer test section. During the experiment, it was observed that the higher the rotational speed, the easer to visualize the shock wave. Also, for the longer test section, visualization of the primary shock using Shlieren method was not possible, and as it can be seen in the picture only the secondary shock is observable.

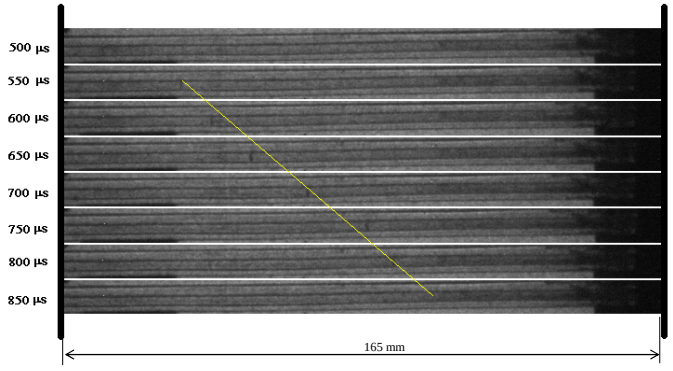


Fig.5: Shock Wave Visualization using Schilieren Method for 165 mm Test Section

Recommendation for future work is to increase the quality of the Schlieren method, also using smaller cross sectional area to understand the fluid mechanics of the flow for microscale tubes.

8. Please add your comments (if any):

The summer program was very helpful for my project as it gave me the opportunity to get familiar with the experimental aspects of my work. Before, I had just dealt with analytical procedure or numerical methods.

RESEARCH REPORT

1. Name: Julie A. Kientz （ID No.: SP05030）

2. Current affiliation: Georgia Institute of Technology

3. Research fields and specialties:

Humanities Social Sciences Mathematical and Physical Sciences
Chemistry X Engineering Sciences Biological Sciences
Agricultural Sciences Medical, Dental and Pharmaceutical Sciences
Interdisciplinary and Frontier Sciences

4. Host institution: National Institute for Advanced Industrial Science and Technology

5. Host researcher: Dr. Takanori Shibata

6. Description of your current research

The major focus of my research at Georgia Tech has been on developing technologies to support the caregivers of children with autism, namely, a project called Abaris. Abaris is a prototype capture and access system designed for use of therapists for children with autism who use a particular type of therapy known as Discrete Trial Training (DTT). It allows therapists to use a digitally augmented ink pen to mark grades for trials that can then be used to index into specific times into a video of their session. The access interface for Abaris allows therapists to review graphs of their sessions and see overall trends for particular target programs. Therapists can also review videos of their sessions and easily find and verify specific trials, compare sessions of different therapists, and use the system to verify how certain trials should be graded with other members of the therapy team during team meetings.

Overall, the aim of the system is to allow groups of therapists to use video-based evidence in order to facilitate a more accurate discussion over the child's progress. My work on this far has been an in depth field study on autism and DTT therapy, which has included becoming a trained therapist myself and regularly performing therapy for one particular child. I have also iterated through several designs of the prototype and have helped with the development of our most recent prototype. I am currently deploying the prototype with one particular group of therapists and am looking to evaluate its long-term use in practice as well evaluate its ability to affect the dynamics of the research team. This work will continue as I explore other domains for this type of work to generalize the results.

7. Research implementation and results under the program

(As much as possible, describe the contents and results of your research in a manner that is easily understandable to a non-specialist in your field.):

Title of your research plan:

Studying the Effectiveness of the Paro Mental Commit Robot on Children with Autism

Description of the research activities:

In the evaluation of the Paro robot, elderly patients are surveyed on their feelings before and after use of Paro. While results of the survey have indicated an overall improvement in feelings, it is hard to rely solely on survey results to indicate the ability of Paro to relieve stress. This is especially true in cases where patients are unable to answer surveys due to physical disabilities or may not be able to understand the meaning of a survey or an interview. This can include people with physical disabilities (such as Amyotrophic Lateral Sclerosis (ALS)) or cognitive disabilities (such as autism).

The focus of my research this summer was to design a study on determining the effectiveness of the Paro robot on children with autism. Research has shown that interaction with live animals can help calm and reduce stress in children with autism. We want to determine if Paro can mimic at least some of those effects. The study we will conduct will compare the use of Paro in full operation mode to a similar stuffed animal. The study will involve approximately 5 individuals with autism and take place in two separate 30-minute sessions: one with Paro and one with the stuffed animal. To test the child's stress level, we will use Galvanic Skin Response as an objective measure of the stress level of children with autism. Additionally, we will video record the sessions and then count the percentage of time the child is interacting with the robot, the number of vocalizations, eye contact, etc. The study will likely take place in an individual's home, school, or any environment in which the individual with autism would feel comfortable.

Due to limited access to children with autism in Japan, language barriers between myself and potential subjects, and pending ethics board approval, we were not able to conduct the study in Japan. The work completed this summer involved the design, building, and testing of the GSR sensors, shown in Figure 1 below. It also involved designing the study, gathering materials, and writing the proposal for ethics board approval. Once I return to Georgia Tech, I will conduct the study and perform the analysis of the results to determine if children with autism experience reduced stress levels after interacting with the Paro robot.

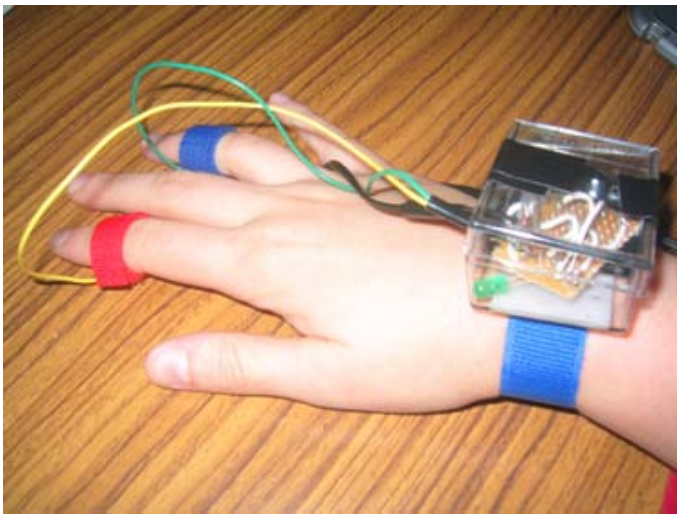


Figure 1: Prototype wearable Galvanic Skin Response sensor

RESEARCH REPORT

1. Name: Sora Kim （ID No.: SP05031）

2. Current affiliation: University of California, Santa Cruz

Department of Earth Sciences

1156 High St., Santa Cruz, CA 95064

3. Research fields and specialties:

Humanities Social Sciences Mathematical and Physical Sciences
Chemistry Engineering Sciences X Biological Sciences
Agricultural Sciences Medical, Dental and Pharmaceutical Sciences
Interdisciplinary and Frontier Sciences

4. Host institution: Tokai University, School of Marine Science and Technology

5. Host researcher: Dr. Sho Tanaka

6. Description of your current research

The diet and migration of sharks is largely unknown due to the difficulty in sampling. In many instances, there are limited or no stomach contents and tagging is very expensive. Therefore, I am using biogeochemistry with stable isotope analysis to determine diet and migration of sharks.

Stable isotope ratios of carbon ($^{13}C/^{12}C$), nitrogen ($^{15}N/^{14}N$), and oxygen ($^{18}O/^{16}O$) can be used as tracers for biological, chemical, and physical processes. These are not radioactive isotopes, but simply slightly different weights of the normal elements. There are consistent shifts of these isotope ratios between substances due to preferential sorting based on differences in bond strengths. Carbon isotope variations indicate differences in primary producers at the base of the food web. There are spatial and temporal $\delta^{13}C$ gradients spanning longitude and onshore-offshore ecosystems. Understanding the input of C from food sources, will allow us to “track” wild sharks, once tissue samples are taken. In addition, animal tissues become enriched by ~3 parts per thousand (‰) in ^{15}N with each trophic step because animals preferentially excrete the lighter isotope (^{14}N). Finally, oxygen isotope ratios in animal tooth and bone mineral reflect the isotopic composition of ambient fluids, which may vary with salinity; they are also affected by the temperature at which tissues form. By analyzing tissues that vary in turnover rates or that grow by accretion, we can assess temporal changes through an individual’s life.

Although stable isotope analysis has been applied to many species (fish, insects, birds, and mammals), this approach has not been "ground-truthed" for sharks. At UC Santa Cruz, I am performing a controlled feeding experiment with leopard sharks in order to monitor isotopic fractionations between environmental C, N, and O and shark tissues.
In addition, I am collecting "wild" samples in order to determine the effectiveness of stable isotope analysis for interpreting the life history and ecology of sharks.

The focus of my thesis will be utilizing stable isotope analysis to study "ancient" sharks from fossils. From the data of modern sharks, I will extrapolate patterns associated with various niche partitioning, such as trophic level and migration.

7. Research implementation and results under the program

(As much as possible, describe the contents and results of your research in a manner that is easily understandable to a non-specialist in your field.):

Title of your research plan:

The isotopic ecology of modern sharks: groundtruthing for paleontological studies

Description of the research activities:

In the United States, I am in a stable isotope lab at the Earth Sciences department located at the University of California, Santa Cruz. Although my advisor and members of my lab study the application of stable isotope analysis with paleo- and modern ecology, there is no one working on sharks. Therefore, my time in Japan was critical in learning shark physiology and ecology.

Dr. Tanaka and his students at Tokai University gathered samples for me starting in April, since this was the prime "sharking" period. However, during my stay in Japan I had many opportunities (almost every week) to go on fishing boats in order to collect samples. On the boats, I got first hand experience of capturing sharks. In the laboratory, full dissections are performed with gut content analysis. In the Tanaka laboratory, I learned to dissect sharks, while identifying organs, gut content, and special features of evolution. These are fundamental tools of being an ichthyologist, which I did not have experience before Japan.

Initially, I had only planned to acquire deep-sea shark samples. These were going to be my focus because they are primitive and therefore closer related to ancient,

fossilized sharks. However, during my stay, I realized there were many of the same species as I studied in Baja, Mexico. Therefore I decided to sample this population of hammerhead and smoothhound sharks for comparison. Table 1 is a summary of sample specimens collected in Japan.

Currently, there are no conclusive published results for the application of stable isotope analysis to shark ecology. This is due to the lack of biogeochemists' understanding shark ecology, or vice versa. The summer experience in an ichthyology lab was invaluable in understanding shark ecology so I can better interpret the stable isotope data. There is not a mass spectrometer at Tokai University, therefore the actual stable isotope analysis will be performed back at UCSC.

8. Please add your comments (if any):

Thank you JSPS and NSF for giving me this amazing opportunity. I would also like to thank Dr. Tanaka who was always willing to assist me in everything from purchasing chemicals and finding a fume hood to making sure I was comfortable and happy. I am excited to have worked with such a well-respected ichthyologist and look forward to our future collaborations. In addition, Dr. Horie, an assistant professor, and the undergraduate students of the lab were very helpful in sampling sharks and enjoying Shimizu.

Table 1: List of species caught with details of total number, number of females and males, total length, weight, habitat and diet. Species for deep-sea study are indicated with (a) and (*) denotes that weights are missing due to dissections taking place on the boat.

Species	total number	female	male	total length (cm)	weight (g)	habitat and diet
Heptranchais perlo[a]	10	9	1	78.3-117.5	1740-6480	deepwater, benthic and epibenthic; fish, small sharks, crustaceans, squid, and cuttlefish
Squalus mitsukarii[a]	3	3	0	42.5-51.3	355-675	continental and insular shelves, near bottom; bony fish & invertebrates
Squalus japonicus	3	0	3	64.7-65.1	1075-1104	on or near bottom; diet unknown
Etmopterus molleri[a]	1	0	1	31.7	80.7	outer continental and insular shelves, near bottom; diet unknown
Mustelus manazo	7	5	2	52.2-82.6	2100-4683	temperate to troptical continental shelf, intertidal to close inshore; invertebrates, mostly crustceans
Hemitrikis japanica	7	6	1	64.8-109.8	900-5620	temperate to tropical continental shelf; diet unknown
Sphyrna zygaena	12	10	2	55.4-106.1	744-5150	continental to insular shelves, inshore and offshore; bony fish, small sharks, skates, and stingrays

(Table 1 continued)

Species	total number	female	male	total length (cm)	weight (g)	habitat and diet
Carcharinus obscurus	5	3	2	92.3-119.2	4600-9350	continental to insular shelves, shoreline to adjacent ocean waters; bony fish, elasmobranches, and crustaceans
Carcharinus brevipinna	2	2	0	84.5-85.5	3630-3800	coastal-pelagic on continental and insular shelves, common close to inshore; primarily fish, but also stingrays and cephalopods
Centroscymnus owstomi[a]	5	3	2	79.2-112	*	on or near bottom, continental slope and submarine ridges; bony fish and cephalopods
Zameus ichiharai[a]	2	0	2	88.4-91.0	2350-2790	slope on or near bottom, Suruga Bay; diet unknown
Deania hystricosa[a]	20	16	4	82.5-122	*	probably benthic and epibenthic, deepwater; diet unknown
Deania calcea[a]	1	1	0	72	*	continental and insular shelves, deepwater; diet unknown
Centrophorus acus[a]	9	9	0	139-150.5	*	outer continental shelves and outer slopes, deepwater; diet unknown

RESEARCH REPORT

1. Name: Su-Jong Kim （ID No.: SP05032 ）

2. Current affiliation: Uniformed Services University of the Health Sciences, USA

3. Research fields and specialties:

Humanities **X Social Sciences** Mathematical and Physical Sciences
Chemistry Engineering Sciences Biological Sciences
Agricultural Sciences Medical, Dental and Pharmaceutical Sciences
Interdisciplinary and Frontier Sciences

4. Host institution: National Institute of Health and Nutrition, Japan

5. Host researcher: Shigeho Tanaka, Ph.D.

6. Description of your current research

[SEE ATTACHED]

Eating Pattern and Dietary Underreporting in a Japanese Adult Sample

Dietary self-monitoring is an important aspect of dietary intake reports. Both empirical research and clinical settings regarding body weight and food consumption rely heavily upon dietary self-monitoring. In particular, the relationship between eating behavior and health, specifically understanding the development of a particular disease related to nutrition, would be made clearer if the accuracy of dietary reporting was more reliable (Macdiarmid & Blundell, 1998). Unfortunately, dietary underreporting has been a fundamental problem with self-monitoring of dietary food intake (Livingstone, 1995; McGloin et al., 2002). Although there is a growing interest among researchers to better understand dietary underreporting, it continues to be a problem (Black, 2000).

The literature shows that gender, body weight, and age are associated with accuracy of dietary intake reports. One of my previous works involved examining the relationship of eating style (i.e., gorging), accuracy of dietary intake report, and metabolic rates in normal weight (BMI$\leq$ 25 kg/m^2) and obese (BMI$\geq$ 30 kg/m^2) women. The study examined metabolic suppression as a possible cause of underreporting among individuals who gorge (i.e., skip breakfast $\geq$3 times/week, eat $\leq$2 meals/day, first meal occurs $\geq$7 hours upon waking) compared to non-gorgers. However, the results indicated that the people with different eating patterns did not show differences in their metabolic rates, eating pathology, and body compositions. The only notable difference between gorgers and non-gorgers was the magnitude of the dietary reporting accuracy such that gorgers reported eating a significantly less amount of food.

Building up on the findings from our previous work of obese and non-obese American women, the current study examined the relationship between dietary reporting accuracy and specific components of gorging: time of first eating episode, and number of eating episodes throughout the day. In addition, the current study utilized a doubly labeled water method to accurately measure energy expenditure in order to provide a more accurate representation of the magnitude of dietary reporting accuracy. The purpose of the current study was to examine the dietary intake habits and dietary reporting accuracy in a healthy Japanese adult sample using a doubly labeled water method.

Methods

Data from 76 healthy adult populations were analyzed. The data were collected between October of 2001 to February of 2004 as a part of a larger study which examined energy expenditure and physical activity.

Dietary Intake record and activity record: Participants have completed a 3 consecutive day dietary intake and physical activity record. For dietary intake record, participants recorded time, menu, list of foods, and also weighed each dish before and after consumption. Additionally, participants were asked to take photographs of each dish using a digital camera before and after the meal. When this dietary record was completed, a trained registered dietitian verified the accuracy of the dietary record based on the pictures. Energy intake was calculated using Standard Tables of Food Composition in Japan, 5th edition. Similarly, participants completed a 3 day activity record by providing time and type of activity over the course of the three days.

Total Energy Expenditure (TEE): Doubly Labeled Water (DLW) and Basal Metabolic Rate (BMR): TEE was estimated using DLW over a 12 day period in free living conditions. After a baseline urine sample was collected, participants drank .06 g/kg body weight of ^2H_2O

and .14 g/kg body weight of $H_2{}^{18}O$. A urine sample was collected every day for the next 12 days. BMR was measured using indirect calorimetry using a mask and Douglas bag. The BMR measurements were taken in the morning after overnight fasting. O_2 and CO_2 concentrations were measured and Weir method was used to calculate BMR.

Anthropometric Measures: Body weight was measured twice: at the beginning of the DLW administration (Day 1) and the end of the study (Day 12). Baseline height was also measured. Weight and height were used to generate body mass index (BMI).

Statistical methods: The term "eating episode" was used to denote a period of food consumption of more than 100 kilocalories. Eating episode was used to reduce confusion regarding reporting of "meal" patterns. The frequency of eating episodes was generated by counting separate eating episodes over the three day period. Separate recordings of an eating episode were considered to be one eating episode if they occurred less than 30 minutes apart. Variability of eating frequency was generated by subtracting the smallest number of eating episodes a day from the largest number of eating episodes a day. Eating episode time was generated by subtracting the time of waking from the first eating episode of the day. These 3 day values were added to yield total hours between waking and eating over 3 days. Variability of eating episode time was generated by subtracting the least time from the most time it took between waking and the first eating episode. For each of these 4 values (frequency, variability of frequency, time, variability of time), two groups were formed based on the rank of participants. The top 33% and the bottom 33% individuals were grouped for each of the 4 independent variables. All the analyses were completed with ANCOVA and covariates were Age and BMI. For all analyses, significance level was set at .05.

Results

Table. Number of Eating Episodes and Dietary Reporting Accuracy (Mean (SD)).

Total number of eating episodes combined over 3 days: The number of eating episodes over 3 days are added together				
	WOMEN=24		**MEN=24**	
	Small # Eater=12	**Large # Eater=12**	**Small # Eater=12**	**Large # Eater=12**
# of Eating Episode	9.00 (1.04)	12.08 (1.44)	8.25 (1.82)	12.50 (1.45)
3-D Average Kcal	1736.34 (390.78)	1854.65 (445.57)	2071.8 (495.22) *	2533.5 (626.15) *
BMI	21.06 (1.37)	22.34 (5.02)	24.31(2.66)	23.50 (4.95)
BMR	1159.79 (118.74)	1176.05 (212.03)	1547.83 (263.98)	1524.26 (397.27)
TEE	2062.29 (308.93)	2120.01 (399.60)	2771.35 (464.90)	2821.75(626.97)
EIEE (Accuracy)	85.53 (21.62)	89.33 (23.01)	76.19 (20.41) *	90.67 (15.35) *
Variability of total number of eating episodes during 3 days: Most – Least number of eating episodes of 3 days				
	Small Variability=12	**Large Variability=12**	**Small Variability=12**	**Large Variability=12**
Variability	.92 (.29)	2.58 (.67)	.58 (.52)	3.17 (.94)
3-D Average Kcal	1977.10(509.29) **	1619.95(254.15) **	2257.25 (453.75)	2614.60 (661.91)
BMI	20.54 (1.13)	23.32 (5.61)	23.75 (2.08)	23.12 (4.91)
BMR	1140.49 (119.96)	1202.35 (206.52)	1525.65 (251.50)	1609.21 (307.33)
TEE	1995.89 (270.45)	2179.17 (393.66)	2818.40 (415.92)	2887.17 (558.61)
EIEE (Accuracy)	99.34 (23.00) **	75.63 (14.03) **	80.79 (16.38) *	90.66 (15.10) *

BMI: Body Mass Index = weight in kg/height in m^2; BMR: Basal metabolic rate; TEE: total energy expenditure from DLW; EIEE (Accuracy): Energy Intake over 3 days (3-day average kcal)/Total Energy Expenditure
* $p<.05$; ** $p<.01$

Participants ranged from 20 to 70 years of age and 37 were men and 39 were women. Eating time and eating time variability were not associated with differences in dietary underreporting in both men and women (data not shown). Eating frequency was associated with dietary underreporting in both men and women, however, the relationships were different for men and women (See Table).

Discussion

The group of men who ate more frequently had a more accurate dietary intake report in the study. Variability of eating frequency was significantly associated with underreporting for both men and women, however the direction was different for each gender group. Similar to our previous research study results, data from the current study do not support the metabolic suppression hypothesis. The meal time variability was significantly correlated with dietary reporting accuracy in the predicted direction when included all the participants in the study (more variability was associated with more underreporting) (data not shown). However, when ANCOVA was used to analyze the data of the top and bottom 33% of the participants, the significant relationship disappeared. This is believed to be associated with the loss of power due to reduced number of participants in the data analyses.

Studies have repeatedly found that women are more likely to underreport their dietary intake than men (Macdiarmid & Blundell, 1998). Our data support such previous findings. It has been suggested that given the social demands placed on women to be thin, it is not surprising that women are likely to report an intake they perceive as socially acceptable (Schoeller et al., 1990). A logical next step will be to include several psychological questionnaires in future studies to examine such psychological factors associated with dietary underreporting in Japanese women. Further, a notable difference in underreporting was found between frequent eating and non-frequent eating male participants. However, the direction is completely opposite of what we had expected and that of the women's. Clearly, there is a gender difference in the accuracy of dietary reporting associated with frequency of eating, yet the mechanism underlying such difference is not clear. Therefore, it will be important to investigate different mechanisms that underlie accuracy of dietary reporting in Japanese men and women in the future studies.

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McGloin, A.F., Livingstone, M.B.E., Greene, L.C., Webb, S.E., Gibson, J.M.A., Jebb, S.A, Cole, T.J., Coward, W.A., Wright, A., & Prentice, A.M. (2002). Energy and fat intake in obese and lean children at varying risk of obesity. International Journal of Obesity, 26, 200-207.

Livingstone, M. B. E. (1995). Assessment of food intake: Are we measuring what people eat? British Journal of Biomedical Science, 52, 58-67.

Black, A. E. (2000). Critical evaluation of energy intake using the Goldberg cut-off for energy intake: Basal metabolic rate. A practical guide to its calculation, use and limitations. International Journal of Obesity, 24(9), 1119-1130.

Schoeller DA, Bandini, L.G., & Dietz, W.H. (1990). Inaccuracies in self-reported intake identified by comparison with the doubly-labeled water method. Canadian Journal of Physiological Pharmacology, 68, 941-949.

RESEARCH REPORT

1. Name: Angela Kingsley （ID No.: SP05033）

2. Current affiliation: University of Washington

3. Research fields and specialties:

Humanities Social Sciences Mathematical and Physical Sciences
Chemistry X Engineering Sciences Biological Sciences
Agricultural Sciences Medical, Dental and Pharmaceutical Sciences
Interdisciplinary and Frontier Sciences

4. Host institution: Disaster Prevention Research Institute, Kyoto University

5. Host researcher: Dr. Masayoshi Nakashima

6. Description of your current research

An ongoing research program at the University of Washington is designed to investigate the use of concrete-filled vanadium-alloy steel tubes (CFVST) as structural members in civil and military applications. As part of this program, my research focuses on developing CFVST column-to-footing connections adequate to resist gravity, wind, seismic and blast loading. Linear and nonlinear finite element analyses of various embedded CFVST column-to-footing connections were performed to identify connection design parameters appropriate for experimental investigation, such as embedment length, end-plate geometry and footing reinforcement. An experimental research program was designed to test four full-scale CFVST column-to-footing connections. The behavior of the experimental specimens is evaluated based on maximum load and deformation capacity, as well as footing damage level.

7. Research implementation and results under the program

Title of your research plan: Survey and Analysis of Japanese and U.S. Embedded Column Base Connections.

Description of the research activities:

A series of experimental tests investigating shallowly embedded steel box column base connections are currently being conducted by Dr. Masayoshi Nakashima with the Earthquake Resistant Structures research group at the Disaster Prevention Research Institute. Similar research is underway at the University of Washington,

focusing on developing adequate embedded column base connections for concrete-filled steel tubes (CFT). Experimental variables in this study include embedment depth, footing reinforcement, and construction procedure. The research conducted as part of the Summer Institute considers the methods used by Dr. Nakashima's research group to analyze and evaluate column base performance. These methods were then applied to the results of the experimental tests conducted at the University of Washington (UW).

The experimental investigation at UW included four CFT-footing connection specimens: C1 had shallow column embedment and no shear reinforcement in the footing; C2 had shallow embedment, but included shear reinforcement; C3 had the same shear reinforcement as C2, but with deep embedment; C4 had shallow embedment, but the construction sequence was altered such that the embedded portion of the column was surrounded by grout rather than concrete. For each UW test specimen, a hysteretic model for the moment-rotation relationship of the CFT column base connection was defined. These models include the stiffness degradation and post-peak behavior unique to each experimental connection. The hysteretic models were used to define column base hinges as part of a discrete analytical frame model. One frame model was developed for each column base model, to determine the effect of the column base hysteresis on frame behavior. The frame model is based on a typical 3-story, steel frame structure, designed for construction near Seattle, WA. The steel columns are replaced by equivalent strength CFT columns. The columns were assumed to remain elastic, with the exception of the hysteretic hinges at the column base; plasticity is considered at the beam ends. Incremental dynamic analyses were carried out on each frame using a suite of eighteen artificial ground motion records, at increasing intensity levels. Each ground motion scaled such that the ground motion spectrum matched the design spectrum for the frame; corresponding to intensity level one. The intensity level was increased incrementally to ten.

At each intensity level, the probability of reaching column base yielding, column base deterioration, and exceeding the maximum allowable story drift was evaluated for each connection model. Figures 1-3 present the results of this evaluation. The results show that at all intensity levels, connections C1 and C2 have similar probability of reaching yielding or failure. At most intensity levels, connection C3 is least likely to reach column base yielding. Connection C4 has the lowest probability of reaching column base deterioration at all intensity levels. The results also indicate that at moderate intensity levels, connections C3 and C4 have slightly lower probability of exceeding the allowable story drift limit.

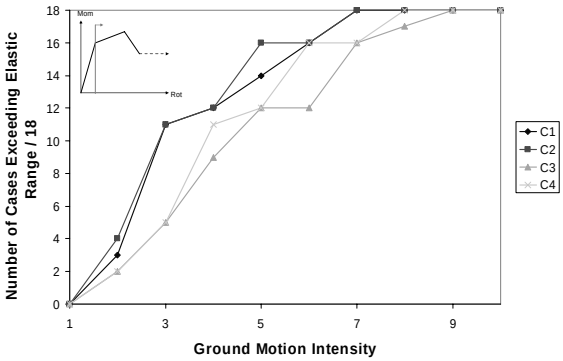

Figure 1 Number of Yielding Cases

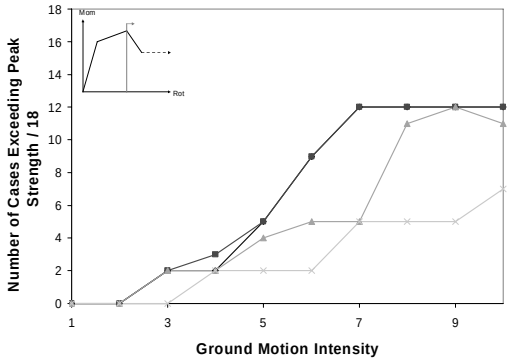

Figure 2 Number of Deteriorating Cases

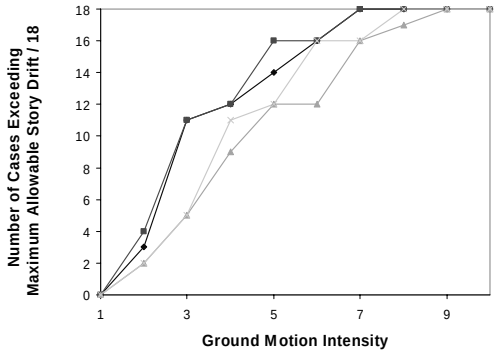

Figure 3 Number of Cases Exceeding Story Drift Limit

RESEARCH REPORT

1. Name: RICHARD J. KLINE （ID No.: SP05034）

2. Current affiliation: University Texas at Austin, Marine Science Institute

3. Research fields and specialties:

Humanities Social Sciences Mathematical and Physical Sciences
Chemistry Engineering Sciences **X** Biological Sciences
Agricultural Sciences Medical, Dental and Pharmaceutical Sciences
Interdisciplinary and Frontier Sciences

4. Host institution: Nagasaki University, Institute for East China Sea Research

5. Host researcher: Dr. Kiyoshi Soyano

6. Description of your current research

I am investigating the reproductive physiology of groupers (Serranidae). Groupers are protogynous hermaphrodites, meaning they transition from female to male sex as they grow older. Specifically, I am examining the role of the brain in this transition. I want to determine if there is a specific component of the brain responsible for this transition and if so, what peptides are produced in the brain during sex change.

7. Research implementation and results under the program

(As much as possible, describe the contents and results of your research in a manner that is easily understandable to a non-specialist in your field.):

Title of your research plan: The effects of follicle stimulating hormone (FSH) and androgen treatment on gonadal development and sexual inversion in the sevenband grouper (*Epinephelus septemfasciatus*).

Description of the research activities: As a first step to understanding the sexual inversion process, I conducted an experiment to cause sex change with the administration of hormones. I injected follicle stimulating hormone at levels of 0 (control) and 100 μl per kg body weight into 72 immature, sevenband grouper. Later, testosterone mixture implants of 0 (control), 0.1 and 5 mg/kg body weight were also injected. Thirty six fish were sampled at 3 weeks and another 36 fish at 5 weeks. Samples of whole brain, gonad, liver and blood were taken as well as body mass and morphometric measurements.

Cross sections of gonad tissue were scored for gender and stage of development. Blood samples will be analyzed for sex steroid hormone levels and brain samples will be analyzed for several neurotransmitter levels and their metabolites. Due to time constraints, these samples were shipped back to my home institution for analysis.

The experimental results, thus far, are that FSH and androgen treatment have a significant effect on sexual development and inversion in the sevenband grouper. Histological examination revealed treatment groups could easily be distinguished from the control groups by the amount and type of cell present.

8. Please add your comments (if any): I have enjoyed my stay in Nagasaki and Okinawa. I feel I have advanced my knowledge of reproductive physiology and ecology of the groupers.

RESEARCH REPORT

1. Name: Albert Kottke （ID No.: SP05035）

2. Current affiliation:

The University of Texas at Austin

3. Research fields and specialties:

Humanities Social Sciences Mathematical and Physical Sciences
Chemistry **X** Engineering Sciences Biological Sciences
Agricultural Sciences Medical, Dental and Pharmaceutical Sciences
Interdisciplinary and Frontier Sciences

4. Host institution: Chuo University

5. Host researcher: Professor Takaji Kokusho

6. Description of your current research

The goal of the research is to explore the frequency dependent nature of damping within a soil column. In the laboratory, damping measurements can be easily measured, but fail to capture the frequency dependence due to disturbance of the soil structure. In the field, there is no direct measurement of damping. Instead, by combining wave propagation theory and recordings the damping may back-calculated.

In this study, the back-calculation was done by using the Bayesian Method. This back-calculation method is quite robust as it combines both prior knowledge and recorded information. The back-calculation adjusts the stiffness and damping in each soil layer to achieve a maximum likelihood between the predicted and measured spectral ratios. This back-calculation is then carried out for three different damping models. The accuracy of each model is then assessed by using the Akaike Information Criterion statistics which balances the number of parameters and the fit of the model.

7. Research implementation and results under the program

(As much as possible, describe the contents and results of your research in a manner that is easily understandable to a non-specialist in your field.):

Title of your research plan:

The Frequency Dependence of Damping Back-Calculated from Earthquake Records

Description of the research activities:

Geotechnical engineering is a specialization within the department of Civil engineering. A geotechnical engineer faces problems that consider the behavior of

soil in relation to the design of a structure. The engineer is challenged by the large volume of soil in question, expensive cost of sampling a small volume, and the natural variability within the soil. As a result the engineer must base the design decisions on the relatively small amount given information and their previous experience.

In earthquake related geotechnical engineering, site response analysis is used to predict how the soil column will behave for a given earthquake intensity. The prediction is important because the soil influences the level of shaking and frequency content of the signal, both of which are critical in safe design of the structure. The response of the site is governed by the height, density, stiffness, and damping of each of the soil layers. While height and density remain constant, the stiffness and damping change with varying strain. The dependence on strain is well defined for stiffness and damping, as it can be directly measured in the laboratory. Damping, however, is dependent not only on the strain, but the frequency of the excitation.

The dependence of frequency on damping can not be observed in the laboratory, but it is evident when the theory is compared to measured records. At higher frequencies the predicted response is much lower than the recorded response. The under prediction of the high frequency response can lead to unsafe designs. By developing a better understanding of the frequency dependence of damping, more accurate site response predictions can be made.

Bore-hole arrays offer are powerful tools that can be used to develop a better understanding the frequency dependence of damping. A bore-hole array consists of accelerometers that are distributed vertically through a soil column. During an earthquake, the acceleration-time histories are recorded by the accelerometers. The influence of the soil between two accelerometers is calculated by taking the ratio of the Fourier amplitude spectra of each acceleration-time histories. A similar spectral ratio can be predicted using site response analysis with input data collected during the placement of the accelerometers. Any difference between the measured and predicted ratio is a result of incorrect input.

In this research, the difference between the measured and predicted ratio is minimized through an iterative process that applies Bayes Theorem, in this manner the soil properties are back-calculated. The method is very robust as it combines the uncertainty in the prior information with the uncertainty in the recorded information. After back-calculating the soil properties Akaike Information Criterion was used to determine how well the damping model fits the recorded data. Akaike Information Criterion provides an unbiased measurement of the fit of the model by taking into consideration the likelihood that the model matches data and the number of parameters used in the model.

The preliminary results confirm that the frequency dependence of damping

can be represented by a simple model and has a dramatic impact on the accuracy of the predicted site response. In the following months, the back-calculation method will be applied to earthquakes at several bore-hole arrays in hopes of better defining the frequency dependence of damping. Through this work, more accurate predictions of the response of a site to earthquake shaking can be made.

RESEARCH REPORT

1. Name: Chi－yun Charles Kung （ID No.: SP05036 ）

2. Current affiliation: University of California, San Francisco

3. Research fields and specialties:

Humanities Social Sciences Mathematical and Physical Sciences

X Chemistry Engineering Sciences X Biological Sciences

Agricultural Sciences Medical, Dental and Pharmaceutical Sciences

Interdisciplinary and Frontier Sciences

4. Host institution: Sankyo Corporation, Ltd.

5. Host researcher: Masahiro Tanaka, Ph.D.

6. Description of your current research

Our lab has developed a number of chemical tools to study protein kinase signal transduction. My research has focused on the application of these these tools to address the problem of understanding the target specificity of small molecule kinase inhibitors within cells. We have used a chemical genomics approach to assess the global cellular effects of kinase inhibitors and to deconvolute these effects into specific drug-target interactions.

7. Research implementation and results under the program

(As much as possible, describe the contents and results of your research in a manner that is easily understandable to a non-specialist in your field.):

Title of your research plan: Affinity Purification of Cellular Targets of the Natural Product Virantmycin

Description of the research activities:

The goal of my research has been to identify the cellular targets of the natural product virantmycin in order to help elucidate the molecular mechanisms behind its biological effects. Virantmycin was identified in a screen at Sankyo Corporation as a potent activator of the hypoxic response. Structure-activity studies revealed that virantmycin might act by forming a covalent linkage with its target protein. To identify the target of virantmycin, I synthesized a series of biotinylated virantmycin analogues to use as chemical agents for the affinity purification of the cellular targets. I tested these analogues in cellular assays and showed that the biotinylated agents retained the cellular activity of the untagged molecule. Furthermore, I demonstrated that these analogues specifically labeled a putative target protein and showed through cellular fractionation studies that this protein was located in the cell nucleus. Unfortunately, the final target identification was not possible due to low cellular abundance of the protein in the cell lysates examined. Future studies will require the use of further cellular fractionation experiments to enrich the relative abundance of this protein.

8. Please add your comments (if any):

I had a fantastic time at Sankyo. I am very grateful to Dr. Tanaka and all of his colleagues for their hospitality. I hope some day to return to Japan for future collaborations.

9. Advisor's remarks (if any):

Charles tried to figure out the mechanism of action of an interesting compound using his wide knowledge in chemistry, biochemistry, and cell biology. He made very good progress and we were happy to have him in the lab. He also stimulated the group both scientifically and culturally.

RESEARCH REPORT

1. Name: Nicholas J. Lang （ID No.: SP05037）

2. Current affiliation: Saint Louis University

3. Research fields and specialties:

Humanities Social Sciences Mathematical and Physical Sciences
Chemistry Engineering Sciences X Biological Sciences
Agricultural Sciences Medical, Dental and Pharmaceutical Sciences
Interdisciplinary and Frontier Sciences

4. Host institution: Ocean Research Institute, University of Tokyo

5. Host researcher: Dr. Mutsumi Nishida

6. Description of your current research

My research is focused on hypothesizing the relationships among lampreys (Order Petromyzontiformes), a type of aquatic, jawless vertebrate, using DNA sequence data. This data is important because lamprey have been historically grouped based on a small number of available characteristics found mostly on the head and mouth. Unfortunately, half of the known species of lamprey retain larval characters as adults and do not develop the characters needed to fully classify them. The fully formed species are parasitic on fishes after transforming in to the adult form, while the others (non-parasitic) spawn and die before forming a feeding adult morphology. Incorporating all hypothesized species is vital to any study of lamprey relationships because there is a long-standing and interesting hypothesis that the parasitic species have given rise to, in some cases multiple, species of non-parasitic lamprey.

Although I have been able to sequence the mitochondrial gene cytochrome *b* from all species of lamprey I have attempted, the three divergent lineages within lamprey are so different that a larger dataset is needed in order to have a well-resolved understanding of relationships among these distant groups. This is due to the fact that, although all DNA sequence datasets contain some random “noise”, this effect can be reduced through larger datasets. As more data is obtained, the true signal is supported, while the random noise cancels itself out. Therefore, it is vital that we gather an appropriately sized dataset in order to examine deep relationship in the tree of life.

7. Research implementation and results under the program

(As much as possible, describe the contents and results of your research in a manner that is easily understandable to a non-specialist in your field.):

Title of your research plan:

Mitogenomics of Lampreys (Order Petromyzontiformes).

Description of the research activities:

Mitogenomic sequencing has existed for several years. Initially, this process required that the mitochondria of an organism be extracted from a complete cellular preparation, followed by isolation of the mitochondrial DNA. When a pure mitochondrial DNA sample was achieved, the DNA was cut into pieces using restriction enzymes and amplified by inserting the pieces into the DNA of special bacterial cells. When enough sequences had been generated by this process, scientists were able to develop primers for use in Polymerase Chain Reaction (PCR) amplification of specific mitogenomic regions from total DNA extracts. Several studies used this method for single species or groups of closely related species, but it was not until Drs. Mutsumi Nishida, Masaki Miya and their colleagues developed a set of primers for use across all teleost fishes that mitogenomic data was used in large-scale phylogenetic analyses.

Upon my arrival in Dr. Nishida's lab, I attempted the first step of their protocol, amplification of large pieces of DNA for use as later template, using DNA extractions from two species of Northern Hemisphere lampreys, *Ichthyomyzon unicuspis* (North America) and *Caspiomyzon wagneri* (Eurasia). These species represent the only two genera of the family Petromyzontidae from which a mitogenome has not been sequenced. Generating data from these species will allow for the resolution of deep relationships within this family, which are currently ambiguous. Unfortunately, their primer set, which works well with many vertebrate groups, was unable to consistently amplify comparable regions of the lamprey mitogenome. This failure was likely due to the fact that these two groups diverged in the very distant past, and that the evolution of their mitochondrial DNA proceeded in a manner such that certain elements conserved among other groups changed greatly in lamprey. Fortunately, the mitogenomes of two lampreys have already been sequenced and several lamprey-specific PCR primers exist.

Using a combination of Dr. Nishida's primers and lamprey-specific primers, I was able to amplify and sequence several small portions of the mitochondrial genome from both species. After this data was edited and aligned, a new set of primers was designed based on existing lamprey sequences. These primers were as species-specific as possible depending on both the availability and necessity of data.

These new primers allowed me to amplify both large and small pieces of mitochondrial DNA. Some small segments were amplified from a dilution of the larger segments, while others were amplified directly from total DNA extracts. Following sequencing, the process of primer design was repeated in order to amplify remaining segments of DNA. This process was repeated twice, with a total of 34 new primers being designed for sites across the mitogenome of both species. I was able to generate 10,645 base pairs (bp) of data for *C. wagneri* and 11,181 bp for *I. unicuspis* out of an approximate total of 16,200 bp. It is impossible to know the exact number of base pairs that remain to be sequenced due to interspecific variation in the length of several mitogenomic elements. Unsequenced regions include from COI to COIII and L2 to E, and reflect the availability of primers based on previously gathered data.

I will be able to finish this project with, at most, two additional rounds of primer design and DNA sequencing. When the dataset is complete, I will check the identity and order of the mitochondrial gene regions for comparison to both closely related and distant species. Once sequences have been identified, I will prepare a dataset in order to hypothesize the relationships among the genera of lamprey in the family Petromyzontidae in collaboration with Drs. Nishida, Miya, and Yusuke Yamanoue. This analysis will be submitted to an appropriate journal in a timely manner for peer review and eventual publication.

8. Please add your comments (if any):

Although the primer sets that Dr. Nishida's lab made available to me did not work as well as I had hoped for my project, the progress I made would not have been possible without the experience of many researchers who have gone through the same process of trial and error in the past. The laboratory environment at the Ocean Research Institute allowed me to make much greater progress than I would have at my graduate institution. In addition to directly helping my research, my experience in a new lab setting has taught me new protocols that I will implement not only when I run my own lab, but also upon my return to my current advisor's lab.

Additionally, Dr. Nishida was able to set up meetings for me with several prominent ichthyologists, including Drs. Masaki Miya and Yuji Yamazaki. Dr. Miya was, and will continue to be, an invaluable resource for my studies of mitogenomics and molecular systematics of fishes and lampreys. He also allowed me to sample native Japanese fishes, which exposed me to diversity that I have not had access to in North American waters. Dr. Yamazaki is an expert on the lampreys of eastern Asia and Japan, and I look forward to productive future collaborations with him on many difficult questions regarding this group of animals.

9. Advisor’s remarks (if any):

Mr. Lang has made research work enthusiastically in my laboratory and has produced considerable achievements. I have enjoyed his companionship very much. I hope that our continuous cooperation will bear abundant scientific and cultural fruit in the future.

RESEARCH REPORT

1. Name: Kenneth Jan-Hwang Loh （ID No.: SP05038）

2. Current affiliation: University of Michigan-Ann Arbor

3. Research fields and specialties:

Humanities Social Sciences Mathematical and Physical Sciences
Chemistry X Engineering Sciences Biological Sciences
Agricultural Sciences Medical, Dental and Pharmaceutical Sciences
Interdisciplinary and Frontier Sciences

4. Host institution: Kajima Corporation, Kobori Research Complex

5. Host researcher: Dr. Narito Kurata

6. Description of your current research

My research interest focuses on designing and implementing wireless sensors and sensor networks for the purpose of civil infrastructure structural health monitoring (SHM). The increased size of infrastructures, the need for assessing the health of aging buildings, and the high cost of traditional health monitoring techniques requires research in miniaturization and extension of the power efficiency of wireless structural sensors. Currently, my research at the University of Michigan-Ann Arbor, under Professor Jerome Lynch, focuses on developing low-cost and low-power wireless sensing unit prototypes with advanced embedded computing capabilities. In addition to developing our own academic wireless sensor prototypes, we have begun to explore the use of a new generic wireless sensor platform developed by Intel, called iMotes (Kling 2004). Using the programming language C/NesC, we are developing new sensor communication methodologies specific to the Intel iMotes to reap more efficient node-to-node communication and distributed computing.

It is our goal to modify the communication methodologies employed by the iMotes to attain higher efficiency in node-to-node communication and distributed computing. We foresee that the development of such a low-power, low-cost wireless sensor platform is the first step of many to be taken in the near future to commercialize the widespread use of affordable wireless sensing units for structural monitoring. Provided that the sensor network application is developed using *TinyOS*, we have been modifying the code with hopes to achieve higher performance nodes when a dense array of such sensors are utilized for structural health monitoring. By referencing Spencer, *et al.* (2003, 2004) and Kurata, *et al.* (2004), we have come to understand the benefits and limitations of the *TinyOS* operation system. Their work in utilizing the MICA and MICA2 motes for structural health monitoring has demonstrated that wireless sensor can replace traditional cabled sensors in the near future.

7. Research implementation and results under the program
(As much as possible, describe the contents and results of your research in a manner that is easily understandable to a non-specialist in your field.):

Title of your research plan: Embedded Damage Detection and Wireless Communications Performance Comparison between Crossbow MICA2 Motes and the WiMMS System

Description of the research activities:

In the past two decades, researchers have come to realize the need for a monitoring scheme that can monitor and assess the behavior of the aging civil infrastructures around the world. In the United States alone, among the 500,000 highway bridges nationwide, 200,000 of them have been deemed structurally deficient. Although scheduled inspections by trained technicians can visually identify apparent deterioration damage, damage can occur anywhere within a structure without being identified for long periods of time. Consequently, the need for a permanent and reliable structural monitoring system is pertinent. While cable-based systems utilizing hub-spoke network architectures have been a tradition, its high installation and maintenance costs prevents widespread adoption of such sensing systems. Other sensing techniques including ultrasound, fiber-optics, and X-ray, to mention a few, seek to out-perform traditional cable-based monitoring systems. Unfortunately, high costs and the difficulty to operate such systems limit their popularity among the structural monitoring community.

Recent interests to develop reliable, cost-effective structural monitoring systems have motivated a boom in the wide variety of commercial and academic prototype wireless sensing units available today [1]. Combined with processing capabilities onboard each sensing unit and peer-to-peer communications between sensor nodes, researchers seek to achieve ubiquitous sensing and computing in civil structures. The independence of each sensor node allows for data collection and onboard processing; yet, the network of distributed sensors can collaborate with each other, detect the failure of other sensing units, and hop data autonomously. Consequently, the network of sensing units becomes a "smart" system that not only collects data but can also be used as a computational unit with damage detection capabilities. Global-based damage detection can be achieved through embedded algorithms (firmware) such as the Fast Fourier Transform (FFT) or the AR-ARX time series model. Through the elimination of cables, previous high maintenance and installation costs can be reduced to approximately $100 to $200 per sensor node, allowing for dense instrumentation of sensor nodes. Furthermore, dense distribution of wireless sensing units creates the potential for local-based monitoring techniques. As demonstrated after the 1994 Northridge earthquakes, beam-column connections and poor welding have been responsible for a majority of the structural failures. Local-based monitoring schemes can detect and warn residents and building owners to conduct adequate repair and retrofit.

The efforts to provide a robust and "smart" structural health monitoring system motivate researchers to develop the different types of wireless sensing units available today. In particular, one of the most widely-used commercial-based wireless units is the MICA2 Mote, designed and manufactured by Crossbow [2].

This open-hardware, open-software sensing unit provides for easy implementation and modification of its hardware and software. With data-hopping and a modified sensing interface board, the MICA2 Motes have been demonstrated to be capable of long-term structural monitoring. On the other hand, an academic prototype developed by [3] utilizes a different design methodology. This sensing system, termed WiMMS, is tailored specifically for structural health monitoring applications such that each hardware component is selected to maximize the efficiency and performance for such applications. However, needless to say, while both of these systems (and most other sensing platforms) can achieve wireless structural monitoring, each system is characterized by its merits and shortcomings. Thus, it is interesting to the sensing community to compare the performance of different sensing platforms to evaluate the performance of each of the various systems. In particular, this paper will present the side-by-side comparison between the MICA2 Motes and the WiMMS system. The purpose of the study is not to promote nor diminish the performance capabilities of each system, bur rather, much can be learned by observing the different levels of performance in a laboratory-controlled environment. This study can serve as a basis to identify hardware and software weaknesses for future improvements.

Laboratory-based validation studies are performed at KaTRI (Kajima Technical Research Institute, Tobidakyu, Japan) using a two-story shear structure mounted on a small-scale shaking table. Three sensing platforms, namely the MICA2, the WiMMS system, and a cable-based system are instrumented on the base and top story of the shear structure. To compare the performance of each of these monitoring systems, the shaking table is inputted with a swept-sine-wave input (2 to 20 Hz) as well as the Kobe earthquake time history record. The study shows that simultaneous data acquisition at sampling rates between 70 and 500 Hz can be accomplished in a laboratory-controlled environment. A selection of the collected time history records using the MICA2 and WiMMS systems is presented in the following figures.

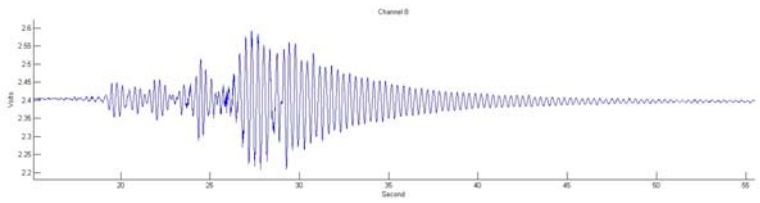

Figure 1: Collected time history of second story of shear structure from swept-sine wave input.

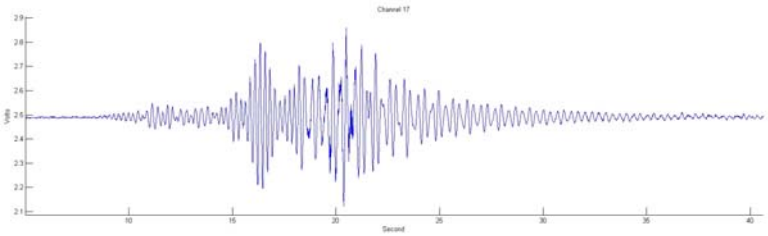

Figure 2: Collected time history of second story of shear structure from Kobe earthquake input.

From the acquired time history records, it can be seen that while both systems can adequately capture the dynamic response of the shear structure, the MICA2 exhibits a higher noise floor. Upon close inspection, the high noise floor is not associated with the interfaced Silicon Design 1221 high-sensitivity accelerometer. In fact, the noise floor is limited by the 10-bit analog-to-digital converter (ADC) on the MICA2 sensing board. With a 10-bit ADC, the full scale range of the accelerometer can only be represented by 1,024 data points. In fact, the interfaced accelerometer out-performs the MICA2 platform since the 10-bit ADC limits the resolution of the sample data. On the other hand, the WiMMS system's 16-bit ADC can convert the accelerometer output into 65,536 significant data points. This study reveals that a high resolution analog-to-digital converter is necessary to accurately capture the response of structures for structural monitoring purposes.

This work will be extended to determine the computational capabilities of the MICA2 sensing platform. In particular, work has begun to embed onboard discrete Fast Fourier Transform (FFT) to pre-process the data prior to wireless transmission of the raw data points. FFT has already been successfully embedded with the operating system (TinyOS) of the MICA2 sensing platform. Laboratory-based validation studies will continue for the next few weeks to compare the onboard computing performance capabilities between the MICA2 Motes and the WiMMS system. Such monitoring techniques can allow researchers to achieve near-real-time infrastructure damage detection under extreme loads such as earthquakes.

RESEARCH REPORT

1. Name: Daniel Maynes-Aminzade （ID No.: SP05039）

2. Current affiliation: Stanford University

3. Research fields and specialties:

Engineering Sciences (Computer Science)

4. Host institution: University of Tokyo

5. Host researcher: Dr. Takeo Igarashi

6. Description of your current research

I am interested in building toolkits that simplify the process of rapid prototyping for designers of new types of interactive systems. Software toolkits for designing traditional graphical user interfaces have become highly evolved, achieving widespread usage, but toolkits for building more advanced types of interactive systems (such as ubiquitous computing applications, tangible interfaces, and multimodal interfaces incorporating speech and gesture) are less thoroughly developed.

The advent of toolkits for software user interface design has had a tremendous impact on the current practice of software development. Nearly all of today's commercial software applications are built using some sort of window manager or interface builder. Tools for building software user interfaces have become incredibly sophisticated, but they have also lead to homogeneity in interface design. During the early days of computing, there was a tremendous amount of experimentation with different input devices and user interface styles, but much of this diversity has vanished today, with applications across all platforms looking and acting in a very similar fashion, primarily using a small set of constructs invented decades ago.

Although consistency in user interface design can have its advantages, there is a danger of succumbing to stagnation and losing opportunities for improved interfaces. In addition, conventional GUI techniques are ill-suited to newly emerging interactive platforms, with ubiquitous computing devices using a wide variety of display sizes and incorporating recognition-based user interfaces that integrate speech and gesture. In the future we are likely to observe a dramatic increase in both the diversity of computing devices and the task contexts in which they operate. As these changes occur, we will encounter a pressing need for toolkits to build these new interfaces.

In particular, I am interested in designing a toolkit that allows interaction designers to more easily use computer vision techniques in their applications. Computer vision is a problem that is currently understood by only a select group of technologists and

researchers. Many of the techniques used in computer vision, such as optical flow, image moments, pattern matching, and face detection, can be easily understood at the surface level, but to actually use these techniques in the design of a computer interface requires a level of mathematical and technical expertise that the majority of interaction designers do not possess.

Digital video cameras are becoming increasingly inexpensive and widespread; today the cost of a USB web-cam is only about $30, on par with the cost of traditional input devices like keyboards and mice. Although web-cams are currently used primarily for video conferencing, they open up exciting possibilities for multimodal gestural input, recognized through computer vision. These possibilities have not been thoroughly explored, in part because of the tremendous overhead associated with implementing vision-based interaction techniques.

7. Research implementation and results under the program

(As much as possible, describe the contents and results of your research in a manner that is easily understandable to a non-specialist in your field.):

Title of your research plan:

Vidgets: A Toolkit for Rapid Prototyping of Computer Vision Interfaces

Description of the research activities:

In 2001, Saul Greenberg and his colleagues at the University of Calgary developed a set of devices called “phidgets”: physical versions of the graphical user interface “widgets” common in software toolkits for user interface design. Similar to widgets, phidgets were designed to abstract and package input and output devices such as servo motors, electrical relays, and physical knobs and sliders, hiding implementation details and exposing functionality through a well-defined API. Phidgets simplified the construction of tangible user interfaces, making it comparable in complexity to building a graphical user interface. Interface designers could use phidgets to rapidly prototype their designs without soldering together electronics components or designing custom protocols for interfacing with a desktop PC.

Dr. Igarashi and I are taking a similar approach to the design of vision-based interfaces, developing a set of “vidgets,” reusable morsels of computer vision and image processing code that can be combined in a modular fashion to rapidly prototype camera-based systems without a detailed knowledge of the mathematical complexity behind computer vision techniques. By creating vidgets for object tracking, pattern matching, optical flow, face detection and recognition, edge detection, camera calibration, and other standard techniques, and packaging them in a smart programming toolkit, we hope to make the programming of vision-based

interfaces just as accessible as programming graphical user interfaces.

Graphical interface toolkits such as Visual Basic allow users to program simple macros to satisfy their individual needs. We would like our toolkit to allow similar types of prototyping; for example, an end user could program macros to detect when his houseplants were withering; tell him what was in his refrigerator; advise him when a visitor was at his doorway; open doors and drawers for him as he approached; count the number of cars passing by his apartment; or warn him when he was about to run a red light in his car.

Over the course of the summer, we developed six vidgets, implemented as ActiveX Controls that can be programming using simple scripting in Visual Basic, C#, or Javascript. In many cases, programmers can use these vidgets to create a complete computer vision-based application by writing fewer than 20 lines of code. Each vidget is accompanied by documentation and a series of examples illustrating its usage.

During the fall semester, our vidgets toolkit will be used for class projects by the undergraduate students in Dr. Igarashi's Human-Computer Interaction course. We expect this experience to offer us additional insight into the design of our toolkit and give us opportunities to improve and augment it based on suggestions and feedback from the students.

RESEARCH REPORT

1. Name: Hope McCaslin （ID No.: SP05040）

2. Current affiliation: University of California, Davis

3. Research fields and specialties:

Humanities Social Sciences Mathematical and Physical Sciences
Chemistry X Engineering Sciences X Biological Sciences
Agricultural Sciences Medical, Dental and Pharmaceutical Sciences
Interdisciplinary and Frontier Sciences

4. Host institution: Hokkaido University

5. Host researcher: Dr. Satoshi Okabe

6. Description of your current research:

Bioremediation is an effective means of treating contaminated water or soils. I am interested in enhancing the bioremediation of hazardous chemicals in wastewater, by adding a bacterial strain to a treatment system that can pass the genes for contaminant degradation to other bacteria. In this manner, the genes for removing the contaminant can be spread among bacteria in the treatment system.

My research focuses on treatment of 3-chloroaniline (3CA), a contaminant from manufacturing processes and from herbicide degradation. I grow bacteria in small-scale flow chambers, and monitor biofilm (bacterial growth on a surface) development using confocal microscopy. I introduce a bacterial strain that serves as a donor of a plasmid containing genes for 3-chloroaniline removal, and using microscopy can monitor transfer of the genes to other bacteria. By following red fluorescence, which is expressed when bacteria contain the plasmid, I can monitor and quantify bacteria which receive the genes.

Specifically, we are interested in studying the effect of the varying selective pressure of contaminants on the populations of bacteria capable of carrying out degradation. We are testing whether selective pressure increases the fitness of the bacteria harboring genes for contaminant degradation, and how degradative capability can be maintained over long-term fluctuations in selective pressure.

7. Research implementation and results under the program

(As much as possible, describe the contents and results of your research in a manner that is easily understandable to a non-specialist in your field.):

Title of your research plan:

Application of FISH-MAR to identify 3-chloroaniline-degrading bacteria.

Description of the research activities:

The main goal of my research under the program was to use the technique of microradiography (MAR)-fluorescence in situ hybridization (FISH) to identify bacteria that degrade 3-chloroaniline. The MAR-FISH procedure involves incubation of a bacterial culture with radioisotope-labeled substrate, followed by microradiography. Following MAR, the cells that took up [^{14}C]-substrate during incubation can be directly visualized. Viewed by microscopy, [^{14}C] from the radiolabeled carbon appears as silver grains, and cells that use the [^{14}C]-substrate for

growth appear surrounded by dense silver grains. Major subgroups and species of bacteria can be identified based on hybridization with rRNA fluorescent probes, through FISH.

Before applying MAR-FISH, we tested to see if we could achieve transfer of the genes for 3CA degradation to bacteria in a biofilm. Biofilms were grown in small chambers, and the donor bacteria was added. The biofilms were hybridized with fluorescent probes to identify major subgroups of bacteria using FISH, and examined via microscopy to correlate the red fluorescence from the plasmid with the fluorescence from FISH. We identified bacteria that obtained the plasmid, and determined that transfer of the plasmid occurred.

Subsequently, we applied the MAR-FISH procedure, using [^{14}C]-3CA, to identify bacteria that use 3CA as a carbon source. First, we tested the procedure with bacteria with known 3CA degradation abilities. The procedure was successful, since bacteria which cannot use 3CA did not show any uptake of [^{14}C]-substrate, while bacteria that can use 3CA showed significant [^{14}C]-substrate uptake and appeared surrounded by silver grains after MAR.

Once the procedure was shown to work for my experimental system, we attempted to apply MAR to investigate if bacteria from a biofilm sample will take up 3CA after bioaugmentation with the donor strain containing genes for 3CA removal. This experiment was performed by growing biofilms from bacteria taken from a reactor at a wastewater treatment plant. The donor bacteria were added to the biofilm, and after two days the biofilm was homogenized and incubated with [^{14}C]-3CA. The bioaugmented samples showed a slight increase in [^{14}C] uptake, but did not yield positive MAR results. We performed a parallel mating between the donor strain and the wastewater treatment reactor sample, in which we did obtain a MAR positive result. We are still testing incubation conditions to optimize the uptake of [^{14}C]-3CA by biofilm samples.

In summary, we were able to apply MAR-FISH to identify bacteria that degrade 3-chloroaniline. We need to optimize the technique further in order to apply it to experimental biofilm conditions, where the expected number of MAR positive bacteria is very low.

RESEARCH REPORT

1. Name: Kelly McGowan （ID No.: SP05041）

2. Current affiliation: University of Florida

3. Research fields and specialties:

Humanities Social Sciences XMathematical and Physical Sciences
XChemistry Engineering Sciences Biological Sciences
Agricultural Sciences Medical, Dental and Pharmaceutical Sciences
XInterdisciplinary and Frontier Sciences

4. Host institution: Research Institute for Humanity and Nature

5. Host researcher: Dr. Makoto Taniguchi

6. Description of your current research

My research interests encompass the very broad study of submarine groundwater discharge (SGD). More specifically, I am interested in the geochemical, as well as physical, behavior of SGD, and its effects surface water quality. Submarine groundwater discharge, which includes both terrestrial SGD derived from coastal aquifers, and marine SGD derived from recirculated seawater (Burnett et. al., 2003), has been suggested to be a major source of water and solutes to coastal oceans. For example, Moore (1996) suggested that along the South Atlantic Bight, volumes of terrestrial SGD may be as much as 40% of the volume of water that discharges from rivers. Later models (e.g. Younger, 1996) suggest that terrestrial SGD accounts for only 0.01 to 10% of river water flux. Regardless of water fluxes, however, if the concentrations of the chemical components of SGD are sufficiently different from seawater, then small amounts of SGD could be a major geochemical supply to the world's oceans, and have a significant effect on coastal ecosystems.

7. Research implementation and results under the program

(As much as possible, describe the contents and results of your research in a manner that is easily understandable to a non-specialist in your field.):

Title of your research plan: A comparison of varying techniques used for measuring submarine groundwater discharge

Description of the research activities:

The purpose of this project is to use the automated seepage meter in combination with other methods of measuring SGD, such as chemical tracers. The use of multiple methods of measuring SGD at a single site would allow the accuracy of the different techniques to be evaluated. Because past studies have created discrepancies in the measurement of groundwater flux (Moore, 1996; Younger 1996), a comparison of the methods most commonly used would benefit future measurements of SGD.

RESEARCH REPORT

1. Name: Christyanne Melendez （ID No.: SP05042）

2. Current affiliation: Northern Arizona University

3. Research fields and specialties:

Humanities Social Sciences X Mathematical and Physical Sciences

Chemistry Engineering Sciences Biological Sciences

Agricultural Sciences Medical, Dental and Pharmaceutical Sciences

Interdisciplinary and Frontier Sciences

4. Host institution: National Institute of Advanced Industrial Science and Technology

5. Host researcher: Dr. Shinji Takarada

6. Description of your current research

I am currently pursuing a Masters of Science degree in geology, specifically volcanology, at Northern Arizona University located in Flagstaff, Arizona, USA. Mass-movement type events, including block-and-ash flows and debris avalanches, generated by gravitational lava dome-collapse and the hazards associated with these events is the current focus of my research interests.

A lava dome is a volcanic edifice formed from the accumulation of silica-rich lava onto the Earth's surface over a vent. The hazards associated with lava domes are predominantly attributed to explosive or gravitational dome-collapse events due to structural instability. The most hazardous product of dome collapse is a pyroclastic density current (pyroclastic flow). A pyroclastic density current is a high-velocity mixture of ash, gas, and magma. Block-and-ash flows are small-volume pyroclastic density currents. Recently, lava-dome emplacement has presented one of the most deadly types of volcanic eruptions, such that over 100 fatalities can be attributed to dome-collapse events at active lava domes at Unzen Volcano, Japan in 1991 and Merapi Volcano, Indonesia in 1994. Approximately 30,000 deaths were attributed to a dome-collapse event on Mt Pelee, Martinique, in 1902.

Another hazardous result of dome-collapse is a volcanic debris avalanche. A volcanic debris avalanche is a large-scale, rapid, mass movement, instigated by a catastrophic landslide formed as a result of structural instability on a segment of a volcano. In 1792, a large debris avalanche was initiated by the earthquake-triggered collapse of Mayuyama, a lava dome associated with Unzen volcano.

My MS research at Northern Arizona University encompasses a comparative study of block-and-ash flow and debris avalanche events associated with lava dome collapse at two lava domes including an ancient lava dome, Cerro Pizarro, located in central Mexico and an active lava dome, Heisei Shinzan, associated with Unzen volcano located in southern Japan.

A comparative study of both ancient and modern deposits provides an opportunity to determine if the depositional characteristics of both block-and-ash flow and debris avalanche deposits are independent of lava dome type. In addition, it allows for a more complete analysis, such that one area may provide information that the other is lacking.

7. Research implementation and results under the program

(As much as possible, describe the contents and results of your research in a manner that is easily understandable to a non-specialist in your field.):

Title of your research plan:

Comparative Study of Dome-Collapse Products: Unzen volcano, Japan

Description of the research activities:

The May 18, 1980 eruption of Mount St. Helens introduced much of the world to the destructive force of debris avalanche and pyroclastic flow events triggered by dome collapse. Debris avalanche and pyroclastic flow events initiated by dome collapse have since been recognized as a potential hazard affecting dome-forming volcanoes. However, predicting the response to dome collapse is not yet precisely constrained. Past deposits can be difficult to identify due to poor exposure, reworking, and compositional similarity between primary and secondary (reworked) deposits. If a set criteria can be established to distinguish these deposits, a more accurate and repeatable method of identification could be employed. Accurate identification of prehistoric dome collapse products can be applied to understanding the size, extent, and frequency of past events, which may be used as a proxy for future behavior and aid in hazard map design. In addition, these deposits can be used to understand transport processes and better constrain the potential hazards of specific types of events.

Unzen volcano is an ideal study location being the site of dome-collapse related block-and-ash flow and debris avalanche events. After nearly 198 years of dormancy, Unzen volcano began to effusively erupt dacite lava in May 1991. Repeated eruption of dacite lava during 1991-1995 led to the formation of a lava dome at the Fugen-dake summit area. Gravitational instability caused by the growing lava dome resulted in frequent dome-collapse episodes generating numerous block-and-ash flows (~ 9,400), destroying small communities located on the Shimabara Bay. A large and unexpected pyroclastic flow on June 3, 1991 spawned a deadly pyroclastic surge killing 43 people including volcanologist Dr. Harry Glicken and Maurice and Katia Kraft.

As a result of the continuous sediment supply from frequent block-and-ash flow events and the rainy climate, the surrounding river basins were continually inundated with repeated lahars. Although not a direct product of dome-collapse, lahars were responsible for further damage and destruction during the 1991-1995 eruptive period. In the Mizunashi River basin, houses, many roads, and a railway were buried and damaged. Approximately 1700 buildings were damaged by lahars in the Mizunashi and Nakao River basins.

Mayuyama, a dacitic lava dome complex that is genetically related to Unzen volcano, formed about 4000 years ago. It is located just east of Unzen volcano and west of Shimabara City. In 1792, a strong earthquake triggered the collapse of the eastern flank of the Mayuyama edifice generating a destructive debris avalanche. The 1792 debris avalanche material violently entered the Ariake Sea, producing a large tsunami that hit the Higo district, causing 15,000 fatalities in Shimabara City and Higo. This collapse event is considered the worst volcanic disaster in Japan.

The initial goal of the Unzen specific study was to analyze deposits and remnant structures resulting from 1991-1995 block-and-ash flows and 1792 Mayuyama debris avalanche at Unzen volcano, Japan, to compare their characteristics and 1) determine what differences exist between the two deposits, 2) what implications these differences have on current theories and models for transport mechanism, and 3) if these differences can be used as a set criteria for distinguishing the deposits. The developed criteria would then be applied to similar deposits at Cerro Pizarro. The comparative study was expanded to include relevant deposits such as lahar, stream flow, and talus deposits.

The research agenda included a 20 day preparatory period, 20 day field season, and 20 days of lab/office work. The initial preparatory period included any preparatory work necessary for field work and a literature review. Field work included assessment of the area and identification of representative outcrops. A

detailed examination of the different deposit types was conducted at each outcrop, creating detailed facies descriptions and measured sections, noting such depositional characteristics as composition, texture, fracture patterns and degree of angularity/roundness among clasts, and grain size distribution. In addition, samples were collected at significant outcrops. Whole sample and matrix only portions of the deposit types were collected for grain-size analysis to compare grain-size populations among the deposits and Scanning Electron Microscope (SEM) analysis to examine microtextures. Clasts samples were collected to examine degree of angularity/roundness and fracture patterns. The 20 day laboratory/office time was used for sample organization and sample preparation.

This is a two tier study including field and laboratory analysis. Due to time constraints, field analysis was the primary focus of this research experience. Samples were collected for continued laboratory work at my home institution. Field analysis yielded identifiable differences most notably between block-and-ash flow, debris avalanche, and lahar deposits. In general, block-and-ash flows showed the following characteristics: angular to subrounded clasts, weak to moderate reverse grading, monolithologic, sporadically contained carbon, and were occasionally bounded by surge deposits. Lahar deposits typically displayed the following characteristics: subrounded to rounded clasts, moderate to strong reverse grading, polylithologic, well mixed deposit, fines-depleted, sometimes displayed a gradational boundary between overlying/underlying stream flow and hyperconcentrated flow deposits, large clasts often displayed vertical cracks, and a vesiculated matrix. Debris avalanche deposits displayed the most unique characteristics including angular and often jigsaw-fractured clasts, block facies consisted of pulverized yet intact blocks of the same material, while matrix facies contained sheared clasts and mixtures of available rock types, and no grading. The current findings are only prelimary.

Future work is concentrated in finding a way to quantify theses differences for measurable comparison. This will be accomplished by employing a variety of techniques including continued grain size analysis, SEM analysis, and analysis of fracture patterns among clasts. The ultimate goal of this analysis is to utilize the results from the comparative study to develop transportation models for the 1991-1995 block-and-ash flows and the 1792 debris avalanche at Unzen volcano. Understanding the transport mechanisms of each event type will aid in the efficacy of hazards mitigation of future events at Unzen volcano and other dome-forming volcanoes.

8. Please add your comments (if any):

The EAPSI/JSPS summer fellowship has been an invaluable experience. This experience afforded me the opportunity to work with and meet some of the most influential researchers in my field, while allowing me to benefit from their knowledge and experience. My research experience not only helped me to refine my thesis direction, but also my long term career goals. However, perhaps the most invaluable experience was the cultural exchange. The wealth of knowledge gained by experiencing life through the filter of a different country has left me with a greater sense of myself and the world around me. Thank you JSPS and NSF.

9. Advisor's remarks (if any): Christyanne Melendez is a very active young researcher. She worked very well even in a quite hot and humid condition in Unzen Volcano during fieldwork this summer. She is very much interested in lava dome-related volcanic gravity flows: debris avalanches and block-and-ash flows. It is wonderful that she will keep working on Unzen for her Maser thesis. I believe that she will complete excellent research works on Unzen volcanic gravity flows in her Mater thesis. I think that this JSPS summer program was very important for her research works.

RESEARCH REPORT

1. Name: Todd W. Miller （ID No.: SP05043）

2. Current affiliation: Hatfield Marine Science Center, Oregon State University

3. Research fields and specialties:

Humanities Social Sciences Mathematical and Physical Sciences
Chemistry Engineering Sciences **X** Biological Sciences
Agricultural Sciences Medical, Dental and Pharmaceutical Sciences
Interdisciplinary and Frontier Sciences

4. Host institution: Center for Marine Environmental Research, Ehime University

5. Host researcher: Dr. Koji Omori

6. Description of your current research

My dissertation research examines processes that link near-shore coastal ocean productivity to less-productive systems offshore. Between Northern California (US) and British Columbia (Canada), the near-shore shelf waters (within 10km) are highly productive and associated with rich assemblages of invertebrates, fish and other sea life. Beyond 10-20km offshore, production is considerably lower with nearly a different community assemblage. Coastal wind-driven upwelling, however, may be significant in transporting near-shore production to offshore waters. To examine this I am using the natural difference in carbon stable isotope ratios of near-shore and offshore organisms to trace the movement of near-shore production to offshore communities. My results show very distinct signatures between onshore and offshore organisms from low upwelling regions, with onshore species having higher isotope values relative to offshore species. However this distinction becomes less clear from areas where upwelling is more persistent, thus indicating that offshore species from high-upwelling zones assimilate more near-shore production relative to organisms from lower-upwelling regions. The significance of this result is the connection between large-scale atmospheric forcing (wind-driven upwelling) and smaller-scale community trophic dynamics.

7. Research implementation and results under the program

(As much as possible, describe the contents and results of your research in a manner that is easily understandable to a non-specialist in your field.):

Title of your research plan: The importance of river and Pacific Ocean nutrients to ecosystem functioning within the Seto Inland Sea

Description of the research activities:

In collaboration with my host researcher Dr. Koji Omori (Center for Marine Environmental Studies - CMES, Ehime University) our research focused on ecosystem connectivity of the Seto Inland Sea to external inputs from rivers and the Pacific Ocean. The Seto Inland Sea is highly productive and supports a number of important commercial fisheries. Yet it is also surrounded by industrial, urban and agricultural development, and is a major conduit for removal of terrestrial-based organic and inorganic pollutants (agricultural and industrial) of central Japan. The purpose of this study was to examine the influence of freshwater (river) and marine (Pacific Ocean) organic inputs into the Iyo subsystem of the Seto Inland Sea, which can then be applied to material-balance models to help define ecological health and establish water quality criteria. This in-turn can be used for optimal management of the entire ecosystem.

To examine the importance of Pacific Ocean and freshwater material inputs into the Iyo subsystem, we measured carbon and nitrogen stable isotopes of various organisms (algae, zooplankton and fish) within the Iyo subsystem, and within the Pacific Ocean and Shigenobu River ecosystems. By measuring the stable isotopes of organisms within these ecosystems, we can obtain their chemical ‘signature’ to determine the relative importance they have on ecosystem functioning within the Iyo subsystem.

A total of 21 stations were sampled for phytoplankton, zooplankton and fish within the Shigonobu River and estuary system, within the Iyo subsystem of the Seto Inland Sea, and between the Pacific Ocean and Iyo subsystem. River and estuary sampling was performed by small boat or along the shore by car; marine sampling was performed from an 11-ton research vessel, the *R/V Tobi-uwo*. Several extended sampling trips across the Iyo subsystem and to the Pacific (Bungo Straight) were performed to collect samples. At each sampling station phytoplankton was sampled using a surface pump and filtration through fiber filters. Fish and zooplankton were collected using a 0.5 m zooplankton net. Environmental data such as water depth profiles of temperature and salinity were measured using a conductivity, temperature, depth (CTD) profiler. Samples were taken to the lab to measure the stable isotope ratios of carbon and nitrogen using a mass spectrometer.

Results from carbon and nitrogen stable isotope analysis of organisms from river and Pacific Ocean system showed strong differences between the two, with organisms from river systems being lighter in carbon and nitrogen relative to Pacific Ocean organisms. Stable isotope analysis of primary production (algae) and other organisms (zooplankton and fish) from the Iyo subsystem within the Seto Inland Sea showed carbon isotope values similar to those obtained from the Pacific Ocean, indicating that Pacific Ocean waters contributed more to ecosystem functioning than freshwater input. However, our results differed from a previous study by Takai et al. (2002)* of the Hiroshima Bay subsystem of the Seto Inland Sea where they observed higher carbon and nitrogen stable isotope values. Higher isotope values may be indicative of higher nutrient recycling within Hiroshima Bay, which is more enclosed and less-influenced by Pacific Ocean water relative to the Iyo subsystem. As nutrients are recycled the heavier isotopes are retained resulting in overall higher isotope values for carbon and nitrogen.

In summary, our results indicate the importance of understanding and managing the Seto Inland Sea as subsystems and not as a homologous well-mixed ecosystem. Future investigation will involve examining subsystems within the Seto Inland Sea separately, then applying river and ocean circulation models to quantify balance transfer of material within and between subsystems.

*Takai, N., Y. Mishima, A. Yorozu and A. Hoshika. 2002. Carbon sources for demersal fish in the western Seto Inland Sea, Japan, examined by $\delta^{13}C$ and $\delta^{15}N$ analyses. Limnology and Oceanography 47(3):730-741

8. Please add your comments (if any):

Research through JSPS/EAPSI program has fostered a strong working and personal relationship with my host advisor and institution. I have applied for a 2-yr postdoctoral position through JSPS to continue research initiated through the JSPS/EAPSI program.

RESEARCH REPORT

1. Name: Laura Nelson (ID No.: SP05044)

2. Current affiliation: North Dakota State University

3. Research fields and specialties:

Humanities Social Sciences Mathematical and Physical Sciences
Chemistry Engineering Sciences **Biological Sciences**
Agricultural Sciences Medical, Dental and Pharmaceutical Sciences
Interdisciplinary and Frontier Sciences

4. Host institution: National Institute of Basic Biology

5. Host researcher: Dr. Yoshitaka Nagahama

6. Description of your current research:

Invertebrates and teleost fish are useful model organisms for studying the evolution and function of endocrine peptides. Both are evolutionarily ancient groups that may provide insight into the loss or gain of function of many peptides in humans. Salmonids, including rainbow trout (*Oncorhynchus mykiss*), are unique for examining metabolic mechanisms of action and intracellular pathways because of the distinct separation of the endocrine pancreatic tissue, known as the Brockmann body, from the exocrine portion. Many peptides are produced by the different cell types in the Brockmann body; in particular, the somatostatin family of peptides has proved to be critically important in metabolism, growth, and reproduction.

Somatostatin (SS) belongs to a diverse family of peptide hormones that have been isolated from almost every extant vertebrate studied to date. Somatostatins are widely distributed throughout the body, with most studies examining their expression in the brain, liver, and Brockmann body. Previous studies have reported many interactions between SS and multiple hormones (*e.g.*, insulin, 17β-estradiol) that affect SS production and secretion. Moreover, the actions of SS are elicited by the binding of the peptide to membrane-specific SS receptors (SSTR), and in many cases, the expression of SSTRs appear to be regulated by other hormones as well.

For my current research, I am examining the direct effects of insulin and growth hormone treatment on SSTR expression in rainbow trout liver and pancreatic tissues, the goal of which is to help provide for a better understanding of the evolution and function of SS signaling mechanisms. Further research will need to examine the details of these signaling pathways in other regulatory systems, and invertebrates, such as starfish, prove to be excellent model organisms for eliciting these functions.

7. Research implementation and results under the program

(As much as possible, describe the contents and results of your research in a manner that is easily understandable to a non-specialist in your field.):

Title of your research plan:

Localization of Starfish Gonadotropin, Gonad-Stimulating Substance (GSS) in *Asterina pectinifera*

Description of the research activities:

Starfish gonad-stimulating substance (GSS) was first described over 40 years ago as a substance that induced gamete release from female starfish. It was not until recently, however, that my colleagues in the Laboratory for Reproductive Biology in Okazaki were able to isolate and characterize this interesting peptide from starfish radial nerves. From genomic DNA, they were then able to elucidate the amino acid orientation and possible 3D conformation of GSS. This has allowed them to create a functional synthetic peptide that, when injected into starfish, produces similar results as the naturally produced product. This peptide is of significant interest, not only for its reproductive effects in starfish, but because of its structural similarities to insulin peptides found in mammals.

This summer, my research goal was to characterize the localization and distribution of GSS in the starfish, *Asterina pectinifera*. I first used RT-PCR to determine whether the production and distribution of GSS is wide-spread throughout multiple tissue types such as ovaries, testis, tube feet, hepatopancreas, and radial nerves. Quantitative real-time PCR was used to determine the abundance of the peptides in these tissues as well. Both of these methods proved to be very difficult, however, because during these processes, it was discovered that starfish mRNA contains an inhibiting substance that does not allow for proper reverse transcription and amplification of PCR products. I was eventually able to obtain an amplified product from each of the tissues, and sequencing analysis revealed that each tissue yielded the same GSS sequence. Although this information is useful, it did not help identify the site of GSS production.

In order to identify the production sites of GSS, it was then necessary to locate the cell bodies of the GSS-producing neurons. This would allow us to identify the area where mRNA and, therefore, possible GSS production occurs. In an attempt to do this, we microinjected a hydrophobic dye into starfish radial nerves in hopes that the axon would be traced along the length of the arm to the cell body. This procedure may prove to be effective in the future, but we did not have enough time to work out the experiment details before the end of this program. After finding the cell bodies, I would have then performed *in situ*

hybridization techniques to determine which specific cells are responsible for GSS production.

8. Please add your comments (if any):

I had an incredible and unforgettable research and living experience while participating in this program. Dr. Nagahama, along with his colleagues and students, are extremely talented scientists that were very welcoming and always willing to help me, both in the lab and after work. This program has allowed me to meet and establish contacts with many scientists throughout Japan, which I know will be very useful to me in the future. In addition, I was also fortunate to have many opportunities to travel throughout Japan and learn about Japanese culture and the history behind it.

RESEARCH REPORT

1. Name: Nam Nguyen （ID No.: SP05045）

2. Current affiliation: University of Washington

3. Research fields and specialties:

Humanities Social Sciences Mathematical and Physical Sciences
Chemistry X Engineering Sciences Biological Sciences
Agricultural Sciences Medical, Dental and Pharmaceutical Sciences
Interdisciplinary and Frontier Sciences

4. Host institution: National Institute of Materials Science

5. Host researcher: Dr. Toyochiro Chikyow

6. Description of your current research

Thermoelectrics are an exciting new class of materials that generate electricity when subjected to temperature gradient. For decades, it has been used to provide the electric power to spacecrafts. With millions of hour of failure-free operation to date, this technology holds great promise for direct conversion of wasted heat to useful electricity. It is well known that as much of 40 to 50 percent of the energy involved in large-scale industrial processes, gasoline and diesel engines is lost through smokestacks and/or wasted heat; even if a small fraction to this heat is recovered, it will have a major impact on reducing energy consumption and air pollution. Converting wasted heat to electricity is therefore one of the most important technological issues in the future.

Over the years, metallic and semiconductor alloys have received much attention in the search for thermoelectric materials; however, they are restricted in applications due to the materials' susceptibility to oxidation, decomposition, and melting at high temperature. Renewed interest in utilizing "thermoelectricity" for additional energy sources has led to a search for more efficient materials, resulting in sensational discovery of new transition-metal-oxide based materials, such as Na_xCoO_2, in Japan. As a result of the discovery, a number of potentially useful thermoelectric oxide materials have been developed. However, the science and technology of this area is still in its infancy and there are significant challenges that still remain to be addressed in order to exploit the full potential of these materials. In particular, research is needed to develop for new synthesis processes, optimize the doping to characterize key features for enhancing thermoelectric properties of the materials.

The goal of my research is to fundamentally tailor the chemical-, electronic-, and micro-structures to develop economical feasible processes for optimal oxide thermoelectric materials with high conversion efficiency. Experimental, I have been working on investigate modified V_2O_5 and TiO_2 compositions by insertion of the transition metal elements using Pulsed Laser Deposition Technique and solution processes. Several specific tasks for achieving my goal include: (1) Understand of the role of dopants and the thermoelectric transport conduction mechanism in these oxides, (2) Identify the optimal dopant levels and process parameters for improving the thermoelectric properties of the oxides, and (3) Evaluate the practical use of these materials for wasted heat management.

7. Research implementation and results under the program

(As much as possible, describe the contents and results of your research in a manner that is easily understandable to a non-specialist in your field.):

Title of your research plan:

Thermoelectric Properties of Compositionally Graded Co-doped TiO_2 Rutile Thin Films Grown by Pulsed Laser Deposition

Description of the research activities:

In the JSPS summer program, I have used a combinatorial material search (CMS) at NIMS to deposit compositionally graded Co doped TiO_2 thin films at oxygen partial pressure of 10^{-6}, 10^{-7}, and 10^{-8} torr. The CMS refers to parallel experimentation to map out the specific properties by examining graded composition fabricated by pulsed laser deposition technique.

The compositionally graded Co doped TiO_2 samples were fabricated by combinatorial pulsed laser deposition (Combi-PLD) using a moving shutter and a rotating substrate holder. The sample consists of two intermixed strips of elemental oxides. Each strip was deposited in multiple steps to insure atomic mixing of the cations. To achieve a uniform film, most of the plume was screened by the mask, with only the center area of the plume used for deposition of the film. The width of the opening of the mask and therefore, the width of the single strip, was 7 mm.

First, a single wedged strip of TiO_2 was deposited with the shutter moved to the right and pulsed ablation with deposition rate of approximately ~0.05 Å per pulse. Then the substrate was rotated and the 5% Co:TiO_2 strip was deposited with the shutter moved to the left. After all individual wedged strips were formed the process was repeated to eventually obtain 350 nm-thick composition spreads. All films were deposited onto the $LaAlO_3$ and $SrTiO_3$(100) substrates. The temperature of the substrate was maintained at 750°C during the course of the deposition.

The deposition rate for each elemental oxide was determined prior to fabrication of the compositionally graded films, and the number of pulses for forming each strip was adjusted to obtain the binary film of a uniform thickness. The crystal structure of the deposited elemental oxide films was verified by X-Ray diffraction (XRD). The thermoelectric properties of the deposited films were determined using a custom designed scanning probe.

8. Please add your comments (if any):

Participation in JSPS summer program was a great experiment for me. I was able to participate in one of the cutting edge of the thermoelectric technology (NIMS) and was able to learn the aspects of public policy and the implementation of the thermoelectric program in Japan. This research program had also provided me a unique educational experience including interactions with scientists working in a premier Nanoscience Laboratory in Japan, while gained sophisticated challenges of teamwork across national, disciplinary, and cultural boundaries. Finally, through this project, I have gained valuables experiences in materials synthesis, processing, characterization techniques in materials and devices for energy conversion.

RESEARCH REPORT

1. Name: John Novembre （ID No.: SP05046 ）

2. Current affiliation: University of California-Berkeley

3. Research fields and specialties:

Humanities Social Sciences Mathematical and Physical Sciences
Chemistry Engineering Sciences x Biological Sciences
Agricultural Sciences Medical, Dental and Pharmaceutical Sciences
Interdisciplinary and Frontier Sciences

4. Host institution: Graduate University for Advanced Studies, Hayama

5. Host researcher: Professor Yoko Satta

6. Description of your current research

As a student of population genetics and evolutionary biology, I am interested in how basic population-level processes (such as dispersal, natural selection, and demographic history) and molecular-level processes (such as recombination and mutation) impact the genetic variation within a species. I am also interested how these biological processes can be studied indirectly using observed patterns of genetic variation. As a reflection of this broad interest I have worked on three research topics as a graduate student. My first research was on how mutational biases and nucleotide composition influence patterns of synonymous codon usage within a species. The second was on how recombination hotspots can be inferred from haplotype data. Currently, I am finishing my dissertation by working on how dispersal influences the spread of advantageous alleles and the distribution of low-frequency neutral alleles.

7. Research implementation and results under the program

(As much as possible, describe the contents and results of your research in a manner that is easily understandable to a non-specialist in your field.):

Title of your research plan:

The plausibility of selective constraint and CpG dinucleotide mutation bias as a mechanism for elevating synonymous substitution rates

Description of the research activities:

After some fruitless but still instructive work that showed our initial project would be too difficult to solve over the summer, I began work on a new project suggested

by Dr. Takahata. That project has consisted of analyzing mathematical models of DNA sequence evolution to evaluate a recently suggested hypothesis that selective constraint and CpG dinucleotide mutation bias interact to elevate the synonymous substitution rate in primate genomes. Understanding these fundamental properties of sequence evolution is crucial for developing an understanding of the mechanisms that give rise to the diversity of genome sequences among species as well as patterns of genetic variation within species. During my summer visit, I have been able to formulate the problem in terms of a family of continuous time Markov chain models and to analyze the dynamics of these models. My results indicate that neither of two plausible forms of selective constraint can adequately elevate the synonymous substitution rate to explain observed values of the rate. The results suggest an alternative mechanism may need to be proposed to account for sequence divergence data.

8. Please add your comments (if any):

During my stay I was able to make academic visits to meet Dr. Tachida of Kyushu University, Dr. Iizuka of Kyushu Dental College, Drs. Ohta and Takano at Idenken in Mishima, and Dr. Kaifu at the Museum of Natural History in Shinjuku. I also had the opportunity to meet Drs. Tajima and Ota of Tokyo University, Dr. Tamura of Tokyo Metropolitan University, and Dr. Saitou of Idenken when they each visited Sokendai in Hayama. I met a large number of the major Japanese figures in population genetics and that was one of the many highlights of my summer.

Drs. Takahata, Satta, have been excellent hosts during my stay at Sokendai and I am especially grateful for their kindness. I am also thankful to Drs. Ota, Omoto, Ikemura, Tanabe, and Watanabe as well as the students, postdocs, and staff of Sokendai who have all been very generous to me during my stay.

Overall the program has been wonderful and engaging. I overwhelmed myself with new experiences and hours well spent, whether it was in research or cultural exploration. Thanks for funding and organizing the program!

RESEARCH REPORT

1. Name: Shwetak N. Patel （ID No.: SP05047 ）

2. Current affiliation: Georgia Institute of Technology

3. Research fields and specialties:

Humanities Social Sciences Mathematical and Physical Sciences
Chemistry X Engineering Sciences Biological Sciences
Agricultural Sciences Medical, Dental and Pharmaceutical Sciences
Interdisciplinary and Frontier Sciences

4. Host institution: Sony Computer Science Laboratory

5. Host researcher: Dr. Jun Rekimoto

6. Description of your current research

The widespread availability and popularity of mobile phones presents us with new opportunities for constantly available services. Compared with their predecessors of even a few years ago, today's mobile phones come with significant computational capabilities, a nearly always-on network connection, video cameras, and high quality audio and display systems. The mobile phone handset is emerging as a truly viable wearable computing alternative. As mobile phone handsets attain increasing capabilities, we see many more opportunities for novel applications development. However, mobile phones feature relatively impoverished input systems and small displays. In addition, development on these platforms is more difficult than their desktop counterparts. Despite these limitations researchers have seized the opportunity to address this challenge. Much of my Ph.D. research has focused around novel exploration of the mobile phone application space that extends beyond traditional telephony. My work on mobile handsets has included continuous a near-term audio capture system (The Personal Audio Loop), long-term video capture and automatic annotation (The ContextCam), physical/digital interaction techniques (2-way Laser-assisted Selection), authentication using mobile phones (Gesture-based authentication), input systems and interaction techniques (Pressure sensitive mobile phone keypad), privacy concerns with mobile camera capture (Capture Resistant Environments) and mobile gaming and entertainment (LoCoL: Location-based Collector Game).

7. Research implementation and results under the program

(As much as possible, describe the contents and results of your research in a manner that is easily understandable to a non-specialist in your field.):

Title of your research plan:

Developing a Precise Indoor Location-aware Handheld Device

Description of the research activities:

The purpose of this project was to design and develop a handheld device that could accurately locate its position indoors and determine its absolute orientation. In addition, we wanted to create a set of applications that took advantage of this capability. The resulting prototype (shown in figure 1) is a Sony Vaio Type-U handheld instrumented with a variety of sensors. The device can location itself in 3D space within 7 cm of accuracy, determine its orientation (azimuth, tilt, and roll) within 1 degree, and determine the 3D location of other objects within 10 cm. This is accomplished by using a specifically designed ultra-wideband location system, a 3 axis magnetic compass, a 2 axis accelerometer, and a laser pointer tracked by a camera mounted on the handheld.

Location: The device locates itself using an ultra-wideband tracking system installed in the environment. The handheld is instrumented with an active tag that constantly emits it identity at very high frequency bands. Sensors placed in the environment detect these signals and triangulates it location based on the signal's time of arrival and the angle of arrival.

Orientation: Absolution orientation is accomplished with a 3 axis magnetic compass and a 2 axis accelerometer. The compass is used to determine the handheld's azimuth or bearing angle and the accelerometer determines the tilt and roll angles. Since magnetic compasses are only accurate when parallel to the ground, the accelerometers also provide a means to help compensate for the tilt and roll angles when calculating the azimuth angle. This allows the user to freely move the handheld and still provide accurate orientation. Another problem indoors is the magnetic interference produced by consumer electronic devices. This device mitigates this problem by constantly monitoring the magnetic values in all 3 directions and dynamically calibrates out any abnormal readings.

Ranging: By coupling the handheld's position and orientation with its distance from an object it is then possible to determine the position of that object. This is accomplished by using the camera to track a red dot produced by a laser pointer. The laser pointer serves two purposes: both as a ranging tool and a way to provide visual feedback on what object to target. The laser diode is mounted at a fix position parallel to the camera (see figure 1). The distance is calculated by using the angle between the camera's central focal point and position of the dot in the cameras view.

Applications: We designed various applications that take advantage of the capabilities available on this handheld. The most compelling suite are augmented reality applications, which take live video imagery and overlay or "augment" additional computer generated information. This is interesting because often times it is faster and easier to add information to the virtual realm than the physical world. Consider the simple example of a light switch. In the physical world it is a fairly simple bi-state device. However, overlaying virtual controls for brightness, timing, and mood is often easier than modifying the physical object itself. The way this would work is a user would determine an object of interest and use the handheld device to scan the space through the viewfinder. Anywhere there are virtual objects it will be overlaid on top the live feed on the screen. If the object it interactive, the user can directly interact with it through the handheld.

Another application we have designed is digital post-it notes. The user can find an object or region of interest and attach a post-it note to that object. By using the laser pointer the user can precisely define where to place the note. The post-it can be a simple text message, an audio note, or imagery. Other people would be able to view its contents by using their handheld device.

Copy and paste is another application. A user can select an area in the physical space and paste it to another part of that space. For example, a user could trace the outline of a poster and paste a virtual copy of it to another room.

These are just some application we developed to demonstrate the capabilities of our handheld device and there are a breadth of others that will emerge as a system like this becomes more refined and mainstream.

Figure 1: The left and middle show the instrumented handheld and the right shows the back view

RESEARCH REPORT

1. Name: Stephen Sebestyen （ID No.: SP05048）

2. Current affiliation: Ph.D. candidate, Forest and Natural Resources Management, State University of New York College of Environmental Science & Forestry, Syracuse, NY, USA. Currently a visiting student at Environmental Science, Policy, & Management, University of California, Berkeley

3. Research fields and specialties:

Humanities Social Sciences Mathematical and Physical Sciences
Chemistry Engineering Sciences Biological Sciences
Agricultural Sciences Medical, Dental and Pharmaceutical Sciences
X Interdisciplinary and Frontier Sciences: Biogeochemistry and Hydrology

4. Host institution: Lab of Forest Hydrology, Graduate School of Agriculture, Kyoto University, Kyoto, Japan

5. Host researcher: Dr. Nobuhito Ohte

6. Description of your current research

Nitrogen (N) emitted by industry, agriculture, and vehicles affects forest ecosystems worldwide when the N is deposited across broad geographic areas from air masses and with precipitation. Deposition of reduced and oxidized N species affects forest growth and contributes to air, soil, and water quality problems. Forms and amounts of N deposited on forested watersheds vary over space and time reflecting contributions from different sources and chemical reactions that occur in or between the atmosphere and the land. Over the summer of 2005, I am characterizing the spatial variability of N deposition in forests by sampling the forms and concentrations of N in water that passes through the forest canopy (termed “throughfall”) to quantify N inputs from both rain inputs and “wash-off” of N that is deposited on canopy surfaces between rainfall events. In addition, I am measuring N gases (in the forms of nitric acid, ammonia, and nitrite) to characterize how the forms, concentrations, and isotopic composition of atmospheric N vary within forests in a field study using dense sampling networks in watersheds located near Lake Biwa, Japan. Results will show how atmospheric N inputs vary across the forest – contributing to an understanding of N sources to this region and the effects on ecosystems. Such information is needed by scientists, land managers, and legislators to protect the valuable commercial and natural resources provided by forests in Japan and around the world.

7. Research implementation and results under the program

(As much as possible, describe the contents and results of your research in a manner that is easily understandable to a non-specialist in your field.):

Title of your research plan:

Tracing atmospheric nitrogen deposition in a forested watershed in Japan.

Description of the research activities:

With colleagues in the Lab of Forest Hydrology at Kyoto University, I am studying patterns of nitrogen (N) deposition to forests from atmospheric sources. The recent introduction of passive, atmospheric depositon monitoring devices permits widespread measurement of the forms, concentrations, and isotopes of inorganic N species in gases. Previous studies have measured water and chemical inputs in rainfall that passes through the forest canopy to reach the forest floor (throughfall) but have not simultaneously measured rain, throughfall, and gases to characterize the inputs of N to forests. In Japan, we used combined passive sampling with rain and throughfall monitoring approaches to characterize the areal chemical and isotopic composition of atmospheric N deposition to forests.

At the 4.3 km^2 Fudoji Watershed near Lake Biwa, we collected samples from a spatial network of 22 sampling stations that span the range of land forms (elevations, slopes, aspects, streams drainages) and atmospheric exposures within the watershed. We believe that this is the first study of its kind to use such a dense and areally expansive network of samplers. After several weeks of planning and preparation, the samplers were deployed on 13 July 2005. Throughfall samples were collected twice midway and at the time when the passive gas samplers (Pall air monitoring cartridges and Ogawa passive samplers) were retrieved on 8 August 2005 (after equilibrating with the atmosphere for 26 days). During sampler deployment, temperature and relative humidity were recorded at seven sites with dataloggers; leaf cover, GPS location, and throughfall volume were measured at each site; and rainfall intensity was measured with a tipping bucket rain gage at two locations in the watershed to characterize the variables that influence deposition.

The throughfall samples will be analyzed for major ion, dissolved organic N, ammonium, and nitrate concentrations and to determine the isotope ratios of water ($\delta^{18}O$ and δD) and nitrate ($\delta^{18}O$ & $\delta^{15}N$ with a microbial denitrifier method). The passive deposition samples have been or will be eluted from the collection membranes (Ogawa & Co pre-coated filters for nitrite and ammonia and Nylasorb for nitric acid) and analyzed by automated flow injection analysis (auto analyzer) to determine the deposition of ammonia, nitrite, and nitric acid as well as the isotopic composition for the nitrite and nitric acid samples (with the microbial denitrifier method). In addition to the watershed-scale study, we continue to collect

throughfall at five collection sites that are all located within a 10 meter diameter plot to assess the small-scale spatial variability of throughfall.

As an ongoing component of this study to complete my laboratory analyses and expand the scope of this research, I will extend my stay in Japan until mid-September, 2005. We expanded the work to include measurement of the variability of the forms, concentrations, and isotopes of atmospheric deposition with height in the forest canopy. On 18 August 2005, five gas and throughfall samplers were deployed at four different heights within, and one height above the forest canopy at the Kiryu Experimental Forest (within 20 km of the Fudoji watershed) where there is a 30 meter tower extending from the ground through the forest canopy. In addition, another small-scale array of samplers will be areally deployed at a site in the Kiryu Forest where passive deposition was previously measured in 2002 and will provide another characterization of the small-scale variability of throughfall at the study catchments. These samplers will be retrieved in early September and analyzed as previously described.

These studies will contribute to understanding how N sources effect forested ecosystems where nitrogen deposition can be problematic. In addition, my time in Japan has been enriched through: 1) site visits that have introduced me to new and different ecosystems from the sites in the USA where I study similar hydrological and biogeochemical processes 2) interaction with Japanese scientist both within and external to my host's lab group 3) attending an important international conference on catchment science in mid-July, and 4) through the cultural learning experience that can only come to be through an extended work/study experience in a new environment.

8. Please add your comments (if any): A wonderful cultural and professional experience that will be memorable for a lifetime as a tremendous opportunity for me to live, study and learn in Japan.

RESEARCH REPORT

1. Name: David R. Shelly （ID No.: SP05049 ）

2. Current affiliation: Stanford University

3. Research fields and specialties:

Humanities Social Sciences XMathematical and Physical Sciences
Chemistry Engineering Sciences Biological Sciences
Agricultural Sciences Medical, Dental and Pharmaceutical Sciences
Interdisciplinary and Frontier Sciences

4. Host institution: Tokyo University

5. Host researcher: Dr. Satoshi Ide

6. Description of your current research

I am studying subduction zone earthquakes in Japan by estimating and examining precise hypocenter locations and seismic velocity structure in the subsurface where these earthquakes occur. We are using a method know as double-difference tomography, which includes differences between travel times of two events to a common station. The inclusion of the data, in addition to standard absolute travel times, allows determination of higher precision hypocenter locations and higher resolution velocity structure, compared with conventional methods. Japan is an ideal study area because of the high rate and variety of subduction seismicity as well as the presence of a dense, high-quality seismic recording network. I am working to understand both shallow (generally < 50 km depth) thrust earthquakes that occur on the plate interface and intermediate-depthearthquakes (50-300 km depth) that occur within the subducting plate itself. The shallow plate interface produces the largest earthquakes on earth. Intermediate-depth earthquakes have a smaller maximum size, but are less well understood and are more likely to occur directly beneath populated areas.

7. Research implementation and results under the program

(As much as possible, describe the contents and results of your research in a manner that is easily understandable to a non-specialist in your field.):

Title of your research plan: Subduction Zone Seismicity and Mechanics in Japan

Description of the research activities:

During the summer program I have worked on two main aspects of my research. First, I have refined previous work determining earthquake hypocenters and seismic velocity structure beneath Ibaraki Prefecture. I presented this work both at Tokyo University and Tohoku University. With the inclusion of feedback generated from these presentations, I have a prepared a draft of a paper describing this work to be submitted to a scientific journal. The second aspect of my work this summer was to begin a new study of the western Shikoku region of the Nankai trough subduction zone. While we are applying a similar method to the one used in the Ibaraki region, here we are focusing on examining low-frequency earthquakes that occur as part of recently discovered non-volcanic tremor in this region. Studying this phenomenon may give us new insight into the role of fluids in subducting (and possibly faulting in general) as well as information about the coupling between the subducting and overriding plates. Preliminary results for this region look very interesting, and I plan to present this work at the upcoming American Geophysical Union (AGU) Fall Meeting in December in San Francisco. I also plan to prepare a paper for publication based on this work.

8. Please add your comments (if any):

This has been a fantastic program for me, and I think I will benefit from my experience here for many years to come.

RESEARCH REPORT

1. Name: Krista M. Shipley （ID No.: SP05050）

2. Current affiliation: University of California – San Francisco

3. Research fields and specialties:

Humanities Social Sciences Mathematical and Physical Sciences
Chemistry Engineering Sciences X Biological Sciences
Agricultural Sciences Medical, Dental and Pharmaceutical Sciences
Interdisciplinary and Frontier Sciences

4. Host institution: University of Osaka

5. Host researcher: Dr. Toshio Yanagida

6. Description of your current research

Kinesins are a family of motor proteins that walk on microtubules, the "bones" of the cytoskeleton, in order to move various cargos within the cell. I am studying an unusual subgroup, called internal kinesins or "KinI", which bind to the ends of microtubules and initiate their depolymerization (disassembly), rather than walking on them. Microtubule shortening is important for cell division, and this protein helps to regulate the process. We would like to know what differences between KinI kinesins and regular walking kinesins lead to the change in function, because the motor core is sufficient to initiate depolymerization although it is very highly conserved among all kinesins.

Previously we solved the crystal structure of the malarial homologue of KinI. We also identified amino acid residues that are uniquely conserved in the KinI subgroup and mutated them to alanine to determine their effect on function. In this way we discovered a set of three residues in the loop-2 insert that appear to affect depolymerization function specifically, and not ATP-hydrolysis or microtubule binding. Other studies suggest that the KinI neck region (not included in our structure) may be important for targeting the protein to the ends of the microtubules, where it can perform its function.

Currently I am trying to confirm that the neck and loop-2 region are sufficient to change kinesin function, by introducing these regions into regular "walking" kinesins. First I am inserting the neck from the human KinI homologue hMCAK into 3 different kinesins (NCD, huKHC, and ceUnc104). After expressing and purifying fluorescently-labeled protein I will add them to microtubules and use a fluorescent microscope to see if they are targeting more to the microtubule ends, compared to neckless controls. Next, I will add the loop-2 insert to the kinesins with hMCAK neck and assay

for their ability to depolymerize microtubules. Even a small amount of depolymerization is significant for this study as a gain of function.

7. Research implementation and results under the program

(As much as possible, describe the contents and results of your research in a manner that is easily understandable to a non-specialist in your field.):

Title of your research plan: Single-molecule studies of myosin-6 processivity

Description of the research activities:

When I first arrived at the Yanagida lab, the student I was going to be working with was preparing to go to a Gordon Conference in America in early July. So I spent most of my first two weeks talking to various people in the motor-protein subgroup and learning about what they do. I also learned how to prepare slides for the microscopes and some microscope operation. First, I used the Total Internal Reflection Fluorescence Microscope (TIRFM), which uses specially directed lasers and prisms to illuminate only the molecules near the surface of the glass slide, which are what we're most interested in anyway. This reduces background fluorescence from molecules in solution, so we can see single molecules at better resolution. I was able to use this to see single myosin motor proteins attaching to and walking on actin protein filaments.

Another useful microscope they use here is the laser trap (or optical trap) microscope, in which you attach a protein of interest to small beads, and use an infrared laser to exert force on the beads to a) move the protein where you want it to be and b) measure the movement of the protein and the force it produces at high precision. They even have a special double-trap microscope, in which you attach two beads to a single protein filament, then hold the beads with two separate lasers. You then move the filament over the glass surface coated with a motor protein of interest, and measure the force exerted by the protein that way. I was able to get some data of a single motor protein pushing on the filament, but did not perform any experiments. I also learned about another technique here, where they attach motor proteins to a glass needle, which is stiffer than the laser trap and allows even more precise measurements. I managed to make a needle myself, but the technique beyond that is very difficult so they only had me try that much then observe an experiment.

As for my actual research this summer, I mainly studied myosin-6. Myosins are motor proteins that are mainly known for producing movement in muscle cells, but they also move cargos along actin filaments inside of cells. Usually motion needs to be processive (i.e., several steps in a row on the same track) in order to be effective, and usually motor proteins connect to each other in pairs or more in order

to move in this way. However, myosin-6 does not have the specialized protein segment for connecting to another myosin-6, and studies on it show that it does not form dimers (pairs) under the usual conditions. In spite of this, myosin-6 is able to carry cargos long distances in the cell, so it must be moving processively somehow.

Mitsuhiro Iwaki, the graduate student in Dr. Toshio Yanagida's lab who I mainly worked with this summer, experimented with one idea for how this could work, and is currently writing a paper about it. However, some informal results he learned about at a Gordon Conference in July suggested that myosin-6 might be able to form dimers when the solution pH is 7.2, close to physiological pH. Since he did his experiments using pH 7.8 buffer, he wanted to test the motor's activity at the lower pH. So much of my work involved making a lower pH buffer and preparing single-molecule slides of myosin-6 and actin filaments, then using the TIRF microscope to see if the myosin-6 is able to walk processively on actin, or more so than at the higher pH. We saw no processive movement at all. We also did a photobleaching experiment with just myosin-6 in solution, which can tell us whether the molecules are associated in pairs or are only single molecules, and found no evidence for dimerization. So, we think that the change in pH probably doesn't affect myosin-6 in the way the informal data suggested, although the experiments I had time to do should probably be repeated to be certain.

8. Please add your comments (if any):

Although I wasn't able to do as much as I would have liked (as is usual, I'm sure), the experience I gained learning how to use the microscopes and prepare the samples will be very useful for the microscope studies I will be starting after I return to San Francisco. The newer technologies I learned, such as TIRF and laser-trap microscopy, will be very useful for studying motor protein function if I continue to work in the field, and the basic idea of studying molecular function at the single-molecule level is finding application to other proteins with a wide range of functions, so I think this was a good research experience in the long-term view.

I also had a wonderful time working with and getting to know the other people in lab, and seeing what the life of a researcher in Japan is like, as well as other aspects of Japanese life. Although I am undecided on my post-doctoral plans, I might return to Japan if the opportunity presents itself.

RESEARCH REPORT

1. Name: Alana K. Simorellis （ID No.: SP05051 ）

2. Current affiliation: University of Utah

3. Research fields and specialties:

Humanities Social Sciences Mathematical and Physical Sciences
Chemistry Engineering Sciences X Biological Sciences
Agricultural Sciences Medical, Dental and Pharmaceutical Sciences
Interdisciplinary and Frontier Sciences

4. Host institution: Kinki University and RIKEN Harima Institute

5. Host researcher: Dr. Kazuyuki Akasaka

6. Description of your current research:

There are alternate conformations that are biologically relevant to the function of many proteins. These conformations are usually high in energy and are difficult to observe. Using high pressure solution NMR, we are able to apply mechanical stress to the protein system and watch as the protein adopts these important higher energy structures. We have been studying outer surface protein A (OspA), a protein associated with the bacterium *Borrelia burgdorferi*, the bacterium responsible for Lyme disease. OspA is involved in the transmission of Lyme disease, as it mediates bacterial attachment to the tick gut. A vaccine for Lyme disease (Lymerix) was based on an antigen created from the C-terminal binding region. It was pulled from the market in the late 1990's due to unwanted side effects. In order to create a highly effective vaccine for Lyme disease, it is necessary to understand both the highly populated structure of OspA and the high energy structures that the protein naturally adopts in order to bind to its tick host. We have studied OspA at pressures from 30 to 3000 bar. We have seen a two state unfolding of the protein. We have seen evidence for a high energy conformation of the protein, that with further research might prove to be the high energy structure, and hence the binding conformation, of OspA. High pressure NMR allows us to detect multiple structures of OspA without destroying the protein. Further research will allow structural assignment of this high energy conformation. OspA, at 28 kDa, will also be the largest protein studied by high pressure NMR to this date, furthering the progress in this relatively young field.

7. Research implementation and results under the program

(As much as possible, describe the contents and results of your research in a manner that is easily understandable to a non-specialist in your field.):

Title of your research plan: High Pressure Solution NMR Studies of Outer Surface Protein A

Description of the research activities:

Modern biophysical studies of proteins include investigations of both its structure and its local and global dynamics. The dynamics of the polypeptide backbone and side-chain amino acids will reflect the physical properties of the protein, such as stability, its interactions with other molecules, and conformational flexibility. Dynamic studies, therefore, allow one to understand how a protein is functioning on a detailed level. High pressure solution NMR allows investigation of high energy conformations of proteins. These conformations are typically involved in substrate binding or protein-protein interactions. It is important to study the dynamics of these high energy conformations to fully understand the biophysical properties and thus function of a protein.

My work over the summer has focused on learning to use the high pressure NMR cell. A high pressure NMR cell capable of reaching pressures up to 3000 bar exist only in this lab Japan and one other lab in Germany, so training with the apparatus is highly valued. I hope to use what I have learned to educate scientists in America about high pressure solution NMR. Second, I investigated outer surface protein A (OspA) of the bacterium *Borrelia burgdorferi* at varying temperatures and pressures. I used one dimensional ^{1}H NMR, multidimensional deuterium-proton NMR (TROSY), and NOE experiments to investigate the structure and energy landscape of OspA. Evidence for partial protein unfolding was detected which agrees with a hypothesis based on current literature that OspA exists in more than one conformational form. It is this secondary conformational form that is responsible for the binding of the protein to help spread Lyme disease. Based on my results, I was able to extrapolate the change in free energy and volume between the native and partially unfolded state. Using solution NMR to study this high energy conformation might someday lead to the entire structure of the high energy OspA to be solved. Knowledge of the high energy structure will be crucial to create a more effective vaccine can be created for Lyme disease.

RESEARCH REPORT

1. Name: James Sims （ID No.: SP05052）

2. Current affiliation: University of Utah

3. Research fields and specialties:

Humanities Social Sciences Mathematical and Physical Sciences
Chemistry Engineering Sciences X Biological Sciences
Agricultural Sciences Medical, Dental and Pharmaceutical Sciences
Interdisciplinary and Frontier Sciences

4. Host institution: University of Tokyo

5. Host researcher: Dr. Yutaka Ebizuka

6. Description of your current research

Many of the drugs used in the treatment of human disease are, or are based, on naturally occurring compounds from nature. Bacteria, fungi, marine organisms and plants are some of the primary producers of these compounds. Our research is designed to gain a better understanding of the biosynthesis of these compounds.

We work on understanding the mechanism of tetramic acid biosynthesis. Molecules containing the tetramic acid motif, or proposed derivatives thereof, are produced by a wide range of organisms, including marine organisms and fungi, and have shown therapeutic potential, displaying antitumor, antibiotic and antifungal activities. The filamentous fungus *Fusarium heterosporum*, which produces the tetramic acid equisetin, is used as a model system for these studies. Even though equisetin is not a good drug candidate it is an excellent model system for biosynthetic studies. Recently the genes believed to be responsible for equisetin were reported. With knowledge of the genes responsible for compound production, a better understanding of the biochemical processes that form the compound can be achieved. We hope to achieve this understanding by producing compound forming protein in a heterologous host, *Aspergillus oryzae* in this case.

7. Research implementation and results under the program

(As much as possible, describe the contents and results of your research in a manner that is easily understandable to a non-specialist in your field.):

Title of your research plan: Expression, purification and biochemical analysis of the biosynthetic protein EqiS

Description of the research activities:

Research activities at the University of Tokyo have been two-fold. Firstly, to use a known standard for learning the techniques involved in producing proteins in the fungus *Aspergillus oryzae*. Using control genetic material I was able to introduce the genes responsible for melanin production into the *A. oryzae* strain. This was shown effective by changing the color of the growth. When the gene is produced the fungus turns black as melanin is produced. The second aspect, producing EqiS in *A. oryzae*, has not been as effective. The genetic engineering of the DNA for introduction has proven problematic. Several different methodologies for preparing the EqiS gene were introduced to me during the research program.

8. Please add your comments (if any):

Even though my main goal for this research was not achieved, I believe this was still a good learning opportunity. I was able to learn some new techniques and gained small insights into ways to optimize other techniques. During this period I was also able to establish friendships and contacts in our field, which is a valuable result. I was also able to learn the basics of the my main goal, and hopefully will be able to complete this project when I return to the University of Utah.

RESEARCH REPORT

1. Name: Surya Singh （ID No.: SP05053 ）

2. Current affiliation: Stanford University (Ph.D. student)

3. Research fields and specialties:

Humanities Social Sciences Mathematical and Physical Sciences
Chemistry [Engineering Sciences] Biological Sciences
Agricultural Sciences Medical, Dental and Pharmaceutical Sciences
Interdisciplinary and Frontier Sciences

4. Host institution: Tokyo Institute of Technology

5. Host researcher: Prof. Shigeo Hirose

6. Description of your current research

The research is investigating methods for rapid motion control of a flexible robot arm during high-impact operations. By incorporating dynamic information in the task planning and trajectory generation processes, the method provides faster and more accurate coverage than traditional methods which tend to excite significant vibration in the arm. Unlike dynamic compensation algorithms, this method does not require a complete dynamic model in advance, but rather, uses an approximate model that is tuned using feedback.

This method extends work originally done at Stanford on KOLT (a galloping robot with ground impacts of over 6*g*) to Gyrphon, a demining robot developed at Tokyo Institute of Technology (see picture below). This robot is studying the partial automation of scanning process in humanitarian demining, a tedious pursuit where less than 1% of suspected targets are indeed mines. Initial experiments show that this method improves scan quality (i.e., keeps the metal detector closer to the ground) and reduces scanning times.

Figure 1: Gyrphon's Field Arm scanning in front of the Tokyo Institute of Technology Main Tower

7. Research implementation and results under the program

(As much as possible, describe the contents and results of your research in a manner that is easily understandable to a non-specialist in your field.):

Title of your research plan:

Dynamic Motion Compensation Methods as Applied to a Landmine Searching Field Robot

Description of the research activities:

Research activities undertaken include:

- Design and testing of 3D (stereo range) map filter methods that preserve key features, while reducing noise. For example, traditional methods would smooth terrain features and underestimate obstacle (e.g., rock) dimensions. This hybrid filter varies filter parameters based on the overall planarity (i.e., how level or hilly) the terrain
- Online calibration and feedback through the development of a passive contact sensor that contains no moving metal parts (so as to prevent interference with the metal detector used for demining)
- Method for online estimation and correction of scanning trajectory so as to compensate for arm dynamics
- Construction of an artificial terrain so as to enable controlled testing of various algorithms.

8. Please add your comments (if any):

Although the time was short and the research results were somewhat expected, I had a wonderful time during my visit. I might like to add that the exchange was nice. There is no better learning experience than to “speak the language” and “get your hands dirty”. I feel I have learnt something new everyday.

9. Advisor’s remarks (if any):

(none)

RESEARCH REPORT

1. Name: Dan Steingart （ID No.: SP05054 ）

2. Current affiliation: UC Berkeley

3. Research fields and specialties:

Humanities Social Sciences Mathematical and Physical Sciences

Chemistry **Engineering Sciences** Biological Sciences

Agricultural Sciences Medical, Dental and Pharmaceutical Sciences

Interdisciplinary and Frontier Sciences

4. Host institution: AIST Central, Tsukuba

5. Host researcher: Dr. Kazuhiro Murata

6. Description of your current research

Low temperature screen-printing of novel electrode materials is explored to create microfabrication compatible thick-film microbatteries. A screen-printing/stenciling process has been developed to create cells between 0.25 cm^2 and 1 cm^2 in area and 200μm to 300μm in thickness. The actual printing is done completely within a high purity argon glovebox at atmospheric pressure. Solution processing enables many different combinations of gels and pastes to be applied at ambient pressures and temperatures. Pastes of colloidal silver, carbon/PVDF, carbon/PEO, $LiCoO_2$/PVDF, $LiCoO_2$/PEO and composite gels of V_2O_5/PEO and V_2O_5/PVDF are under consideration. We find that screen-printing yields good feature control, while stencil printing can be utilized to quickly lay down thick films with surface aliasing determined primarily by the nature of the paste applied. These devices are printed directly upon SiO_2 and Si_3N_4 insulated wafers. A lithium-polymer-ion battery is simulated in DUALFOIL to optimize cell geometries for a few different smart dust applications that can be made with screen-printing technologies. As expected, current density and duty cycle have a large effect on the capacity achieved for a given discharge. The simulations indicate that our printing method, in conjunction with power management, should be able to meet the application parameters

7. Research implementation and results under the program

Title of your research plan: Dispenser/Inkjet Combination for low temperature – ambient pressure fabrication of Microbatteries

Description of the research activities:

A four-axis stage was built and placed inside of an inert atmosphere glovebox to study how effectively electrodes of carbon and silver could be deposited and dried/sintered in a successive process within the same atmosphere. Colloidal silver inks as well as silver nano-pastes were printed, as well highly ordered graphitic carbon mixed with polymeric binder and a proper solvent. Initial findings indicate that nano-pastes as well as sol-gel derived ink can be modified to work well with inkjet processes, but dispenser technology is better suited to conventional battery pastes. Subsequent studies will focus on cathodic materials as well as the effect of printing parameters on the electrochemical behavior of the electrode.

The work highlighted the need for iterative process over a number of parameters, including: 1) initial ink viscosity, 2) particle percentage/size in ink, 3) dispenser pressure, 4) dispensing time (if raster scan) or stage speed (if vector scan), 5) dispenser height from substrate, 6) ink/substrate surface compatibility, and 7) sintering/drying requirements.

There is a rich literature to provide guidance on the first two items, but solvent addition or removal is a quick way to tweak ink properties. To facilitate fast determination of factors 3-5, I programmed a USB joystick to control the stage/dispenser combination and used a CCD video camera with a macro lens to monitor the printing. The final items require a combination of optical microscopy and surface profiling done *in situ* while the sample is dried or sintered.

All of these factors are ultimately tied to the performance of the layer in question. By placing this printer in a glove box, I can use the same chamber to refine my process and then test the resulting product very quickly. I plan to build a similar system in Berkeley.

RESEARCH REPORT

1. Name: Michael Stilman （ID No.: SP05055 ）

2. Current affiliation: The Robotics Institute: Carnegie Mellon University

3. Research fields and specialties:

Humanities Social Sciences Mathematical and Physical Sciences
Chemistry X Engineering Sciences Biological Sciences
Agricultural Sciences Medical, Dental and Pharmaceutical Sciences
Interdisciplinary and Frontier Sciences

4. Host institution: Digital Human Research Center: National Institute of Advanced Industrial Science and Technology (AIST)

5. Host researcher: Dr. Satoshi Kagami

6. Description of your current research:

Humanoid Robotics: Robots that look, think and act in a way that we perceive as human or intelligent. Dexterous, mobile robots that resemble human beings are a reality. In my research, I strive to develop algorithms for planning and control that would enable these robots to autonomously perform human tasks.

Human tasks, from everyday housekeeping to complex search and rescue, almost always require significant interaction with the environment. Pushing objects out of the way, using tools and supports are all examples of the immense possibilities for environment contact. Humans not only exercise such contact routinely, but do so intuitively - often subconsciously. I believe that choosing meaningful contacts and performing useful manipulation that is unspecified in a robot's task would not only expand the skill set of current robots, but also demonstrate progress towards Artificial Intelligence in the physical world.

Prior to my work at the Digital Human Research Center (DHRC), my research focused on the planning problem of Navigation Among Movable Obstacles (NAMO). As in traditional motion planning problems, the robot is placed in a given initial configuration and instructed to navigate to the goal configuration. The robot must autonomously construct the intermediate sequence of actions that will lead to the goal. Typically in motion planning, the sequence of actions involves only the motion of the robot. In NAMO, we allow the robot to also move objects when this motion facilitates the navigation.

In contrast to Manipulation Planning, the particular details of the robot's interaction with objects are left unspecified. As a result, the robot is required to reason about the environment and decide which objects should be manipulated and how they should be moved in order to allow the robot to reach the goal. The difficulty lies in the fact that a search space of motions for multiple objects is exponential in the number of objects and hence infeasible for current computers.

Our previous work introduced an efficient planning algorithm that would reason about the disconnected nature of the space occupied by the robot. Exploiting this understanding of the space, we were able to reduce the complexity of the problem from the quantity of objects present in a scene to the actual difficulty of clearing a path for the robot navigation. The resulting algorithm would efficiently find solutions to a defined subclass of NAMO problems in environments containing close to a hundred obstacles.

7. Research implementation and results under the program:

Title of your research plan:

Autonomous Environment Manipulation:
NAMO Planning and Execution by a Humanoid Robot

Description of the research activities:

My previous work on NAMO was validated on a simulated robot in a planar world. This summer, my goal was to implement the planning algorithm in the real three dimensional world, on the humanoid robot HRP-2.

We successfully applied the algorithm for high-level object selection and motion planning to the new environment. Furthermore, this summer we overcame a number of fascinating challenges presented by the real world implementation. Perception, grasping and walking manipulation were some of the most exciting.

PERCEPTION:

In contrast to simulation, the robot did not have direct access to global knowledge of the world. Constructing laser scans of movable objects and using a motion capture system for tracking and localization, we were able to provide the robot with precise visual information of the structure of its environment. Using these observations, the robot could then effectively make use of the planner.

GRASPING:

In the real world, we must not only decide which object to grasp, but where and how to grasp it. We were able to find initial solutions for automatically selecting contact points on objects and performing power grasps at these locations.

WALKING MANIPULATION:

The researchers at the DHRC had previously developed algorithms to enable dynamic balance for robot walking. These algorithms move the robot torso to compensate for gravity and prevent the robot from falling. We extended these algorithms to allow the robot to precisely control the motion of its arms during the walk regardless of torso motion. This enabled the robot to smoothly move objects without interfering with walking dynamics.

COMPLIANCE:

Since our manipulated objects, such as chairs, were constantly in contact with the environment, some of the forces exerted on the object would be directly reflected to the robot. We implemented active compliance control techniques that moved the robot's torso and arms during grasping and walking. Consequently, the rigid HRP-2 would behave as a soft, compliant robot and not be affected by the reflected forces.

The final result of this work was the successful implementation of autonomous NAMO. We have experimentally demonstrated a scenario where the robot is trapped behind a table and chair and instructed to get out. The robot autonomously selects the chair for motion, navigates to it, walks while pushing it out of the way and then navigates again along the newly opened free path.

8. Please add your comments (if any): This summer I not only had the unique opportunity to implement my algorithms on a humanoid platform, but also an incredible chance to learn about the functions and capabilities of real humanoid robots. Dr. Kagami and Dr. Nishiwaki of the DHRC were incredibly supportive of my work and we are currently making plans to continue this exciting joint research.

RESEARCH REPORT

1. Name: Toral Shailesh Surti （ID No.: SP05056）

2. Current affiliation: University of California San Francisco

3. Research fields and specialties:

Humanities Social Sciences Mathematical and Physical Sciences
Chemistry Engineering Sciences X Biological Sciences
Agricultural Sciences Medical, Dental and Pharmaceutical Sciences
Interdisciplinary and Frontier Sciences

4. Host institution: RIKEN Brain Science Institute

5. Host researcher: Dr. Takao K. Hensch

6. Description of your current research

I am studying the regulation of KCNQ voltage-gated potassium channels by phosphorylation. KCNQ2 and KCNQ3 channels prevent the repetitive firing of neurons. Their importance in controlling neuronal activity is highlighted by mutations in KCNQ2 and KCNQ3 genes that cause human diseases of neuronal hyper-excitability, including myokymia (the involuntary twitching of muscle) and benign familial neonatal convulsions, an epilepsy syndrome. KCNQ2 and KCNQ3 channels provide a way for neuronal activity patterns to be regulated by neurotransmitters, as the activity of these channels can be modulated by a variety of neurotransmitters. Little is known about the mechanisms underlying such modulations, although their effects on neuronal activity can be quite dramatic. Phosphorylation is a possible mechanism for such modulation. By mimicking the effects of phosphorylation by site-directed mutagenesis, I hope to learn how phosphorylation can affect KCNQ channel properties to better understand how neuronal activity can be regulated via KCNQ channels.

7. Research implementation and results under the program

(As much as possible, describe the contents and results of your research in a manner that is easily understandable to a non-specialist in your field.):

Title of your research plan:

Effect of Sensory Experience on Adult Visual Acuity

Description of the research activities:

Although the visual system is the best characterized sensory system and the

mouse an important animal model, there are few methods for quickly and reliably assessing visual ability in rodents. This summer, I have helped establish a rapid assay for determining visual function in mice. When a mouse is presented with visual stimulus consisting of vertical stripes moving horizontally, the mouse will track the movement of the lines with its head and neck, provided it can detect that there are lines present. The tracking movements are known as the optomotor response. The spacing between the stripes (the spatial frequency) is varied, and a mouse's response to each stimulus is observed. The more closely spaced the stripes (the higher the spatial frequency) the mouse is able to respond to, the better the animal's visual acuity.

Once the assay was optimized, visual acuity of five C57BL6 (genetically normal) adult male mice was measured and found to be around 0.45 cycles per degree (cpd), which is well within the range of mouse visual acuity found in the literature. The incidence of optomotor response was also tabulated as a function of spatial frequency. Though the variability of these measurements was high, the peak average optomotor response incidence was elicited at 0.1 cpd when spatial frequencies of 0.05-0.55 cpd were tested in increments of 0.05 cpd.

Next, we wanted to see how altering sensory experience in the adult mouse affects visual acuity. There have been reports that monocular deprivation (MD), or closing one eye so that no visual information can be obtained from that eye, for several days in the adult can enhance the physiological and behavioral response to visual information presented to the non-deprived eye. These reports are surprising, as it has been well-established that there is a critical period early in development during which the brain is most sensitive to sensory experience. MD during the critical period causes dramatic re-organization of neuronal circuitry: the deprived eye itself remains functional but the connections to the brain that process visual information are markedly decreased. We found that eight-day MD did improve visual function in the non-deprived eye. After about six days of MD, visual acuity enhancement reached a plateau and was 0.675 ± 0.1 cpd.

We then wanted to study the mechanism of this enhancement, namely whether the enhancement of visual function in the adult is governed by the same molecules that are responsible for the neural reorganization that occurs during the critical period. Mice lacking the enzyme GAD65 (GAD 65 KO mice) have decreased inhibitory neurotransmission and they do not have a critical period during which the neural circuits in higher parts of their visual systems are exquisitely sensitive to MD. We tested whether MD could improve the visual abilities of adult GAD65 KO mice. We found no difference between the baseline measurements of visual acuity of GAD65 KO animals and genetically normal animals. This information provided a useful control: GAD65 KO mice have been shown to have slightly abnormal retinal

and cortical physiology, but we now know that their vision is similar to that of normal mice. We also found that the performance of GAD65 KO mice in the optometry assay improved with MD to the same extent (visual acuity after 6 days MD 0.696 ± 0.066 cpd) and with the similar kinetics as for the normal mice. These results strongly imply that the mechanisms underlying that enhancement induced by adult monocular deprivation are distinct from those responsible for the rewiring of the brain during the critical period of development. This theory is further supported by physiology experiments I observed that proved that adult animals with enhanced visual function following monocular deprivation do not have the same changes in neuronal physiology that result from monocular deprivation during the critical period.

8. Please add your comments (if any): This work was done in collaboration with Dr. H. Miyamoto.

9. Advisor's remarks (if any):

These results reflect remarkable progress in such a short internship period. Not also has Ms. Surti established a reliable behavioral assay for measuring visual acuity, she has made the important scientific observation that adult plasticity in this sensory system differs mechanistically from that in development. An excellent achievement. (Takao Hensch, Group Director, RIKEN BSI)

RESEARCH REPORT

1. Name: John D. Sweeney （ID No.: SP05057 ）

2. Current affiliation: University of Massachusetts Amherst

3. Research fields and specialties:

Humanities Social Sciences Mathematical and Physical Sciences
Chemistry X Engineering Sciences Biological Sciences
Agricultural Sciences Medical, Dental and Pharmaceutical Sciences
Interdisciplinary and Frontier Sciences

4. Host institution: Osaka University

5. Host researcher: Dr. Minoru Asada

6. Description of your current research

In my current research, I have been working on learning by demonstration on a humanoid robot using teleoperation. A human operates the robot to complete a pick and place task, while the robot observes these actions. The robot is able to represent and reproduce the task in a novel arrangement by building an understanding of the underlying actions used by the teleoperator. The robot has a set of controllers that it uses to affect various affordances identified to it in the environment using visual information. For example, the robot uses its cameras to identify the objects in the scene, such as a coffee mug, and using built-in heuristics, the robot knows about two different affordances for the mug: to be grasped from above, or be grasped from the side. Each of these affordances has an associated controller, allowing the robot to perform that action. To understand the behavior of the teleoperator, the robot compares the actions of the teleoperator to those that each of its controllers would execute if they were active. The controller that most closely matches the movements of the teleoperator is said to explain the demonstrated actions. The robot performs this matching process to extract the sequence of actions performed by the teleoperator. For instance, to pick up the coffee mug and place it on a certain target. The robot can then replay this sequence of demonstrated actions even if they are arranged in a new configuration, by finding correspondences between the objects in the demonstration and the new instance.

7. Research implementation and results under the program

(As much as possible, describe the contents and results of your research in a manner that is easily understandable to a non-specialist in your field.):

Title of your research plan:
The Development of Teleological Reasoning Through Demonstration

Description of the research activities:

This summer in the Asada lab, I continued working on my research involving learning by demonstration in humanoid robots. At the urging of Prof. Asada, I tried to develop a more general approach to some of my previous work, and I also developed a new model of behavior explanation based on a teleological framework. In my prior work, we had given the robot the knowledge of affordances of objects a

priori, in the form of heuristics it used to process visual features. A new approach I developed this summer uses teleoperator demonstrations to inform the robot of the affordances of objects. The robot should be able to observe a demonstrator interact with an object and from this, the robot should be able to infer the affordances of that object. Furthermore, the robot should be able to associate visual features of the object with the discovered affordances, and use this mapping to predict the affordances of novel objects. For example, if the robot sees the teleoperator grasp a tall object from the side, then it should infer that other tall objects can also be grasped this way. The affordances I examined were those involved with picking and placing tasks, so this includes grasping objects as well as placing them at target locations. Teleological explanations of behavior are based on knowledge of the goals, actions, and constraints on the behavior. If the robot has knowledge of any two of those three properties, it can deduce, by using a rationality principle, what the third should be. This allows the robot to explain the behavior of the demonstrator in a more general way than has been developed. This framework also allows the robot to generate behavior to solve tasks based on its notion of rationality. Furthermore, it is hypothesized that a teleological representation can provide the foundation for a more complex mentalistic system of behavior explanation based on the notions of beliefs, desires, and intentions. In my research, I propose to use a Bayesian belief network to represent the various components of behavior (action, goals, and constraints), where demonstration provides a way of encoding what rational behavior entails. Furthermore, the robot can perform inference in the network to infer the unknown component of a behavior, given other known parts. This network can be used for explaining behavior, that is, when then robot knows the actions and whats to know the goals of the demonstration, or for generating behavior, when the robot knows the goal, but needs to infer the correct action to achieve it. The network can also be structured in a hierarchical way, so that common, repeatable actions can be composed into more complex tasks. Putting everything together, the robot will be able to observe a demonstrator (initially a teleoperator) perform a set of pick and place tasks, and from this be able to learn the affordances of the objects in the task (and generalize to novel objects). It will also use the observations to "seed" its teleological reasoning network, so that it will be able to offer explanations of what a demonstrator is trying to do, and be able to generate actions on its own to solve novel tasks.

Due to the short time period, I was not able to implement any of this system on the robots in the Asada lab, but I have become more familiar with their platforms, so that perhaps in the future I will be able to carry out experiments in the lab. I also had discussions with lab members about my research that were very helpful in broadening my perspective and giving me new ideas. Furthermore, I was able to attend the International Conference on Development and Learning in Osaka, and met new researchers in my field. I also attended Robocup, the robotic soccer tournament, that was held in Osaka, and featured a lot of very interesting robots. These are all experiences I never would have had if I had remained in the US this summer.

9. Advisor's remarks (if any):

During his two-month stay at my lab., John attended the research meetings with the staff and Ph.D candidates, where he often seriously discussed the research issues on imitation. So, I asked him to review some papers close to his own research issue, and his reviews were always adequate and suggestive to the authors. Also, his stay was helpful for my Japanese students to level up their communication skill.

RESEARCH REPORT

1. Name: Michael Tsay （ID No.: SP05058 ）

2. Current affiliation: Massachusetts Institute of Technology

3. Research fields and specialties:

Humanities Social Sciences Mathematical and Physical Sciences

Chemistry X Engineering Sciences Biological Sciences

Agricultural Sciences Medical, Dental and Pharmaceutical Sciences

Interdisciplinary and Frontier Sciences

4. Host institution: Japanese Aerospace Exploration Agency (JAXA) / Institute of Space and Astronautical Science (ISAS)

5. Host researcher: Professor Kozo Fujii

6. Description of your current research

My research in MIT involves simulation of a miniature radio-frequency (RF) ion thruster. The nature of inductively coupled plasma (ICP) discharge of a RF ion thruster is researched and studied. Ion density and electron temperature are simulated in a 3-cm-radius cylindrical discharge chamber, and then thrust performance is calculated from the plasma properties and the potential applied to the acceleration grid. Results of my simulation will help design and optimize an actual flight model of the RF ion thruster.

7. Research implementation and results under the program

(As much as possible, describe the contents and results of your research in a manner that is easily understandable to a non-specialist in your field.):

Title of your research plan: **CFD Study of a 2-D Linear Aerospike Nozzle**

Description of the research activities:

Implementation

Flow field around a linear aerospike nozzle is simulated with the approach of computational fluid dynamics (CFD). The linear aerospike nozzle is truncated at 39.3% of its ideal length and sideward expansions are roughly neglected. A conventional bell-type nozzle, as seen in space shuttle engines, is also simulated for the purpose of comparison. The computation is performed with grids shown in figure 1, where there are a total of 215,610 grid points for the linear aerospike nozzle (339×3×201 external; 91×3×41 internal) and 145,140 grid points for the bell-type nozzle (181×3×201 external; 169×3×71 internal). Due to the limited period of this research, only 2-D simulations are carried out. In the simulations, flow field and thrust performance of both type of rocket nozzle are investigated under different ground testing conditions (various pressure ratios without free-stream flow) and flight conditions (various pressure ratios corresponding to increasing Mach numbers).

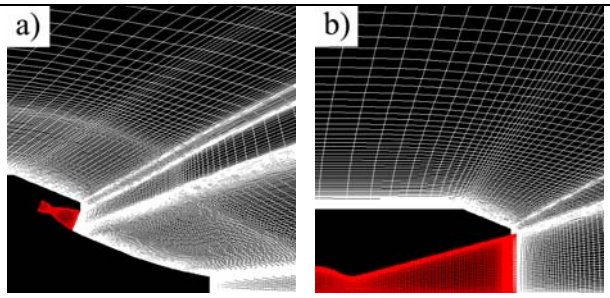

Figure 1. Computational grids for a) aerospike nozzle b) bell nozzle

Results

Sample computational results for the ground-testing cases (no free-stream) for both linear aerospike nozzle and bell nozzle can be found in figure 2 and 3, respectively. Other physical properties of the flow, such as pressure and density distributions are also plotted (but not shown here) in order to investigate the flow field.

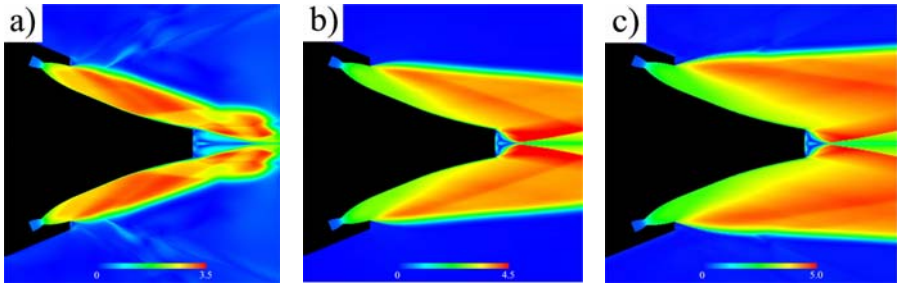

Figure 2. Mach number contour for the linear aerospike nozzle at ground-testing condition for a) PR=45.4, over-expansion b) PR = 116.5, near optimum-expansion c) PR = 250, under-expansion

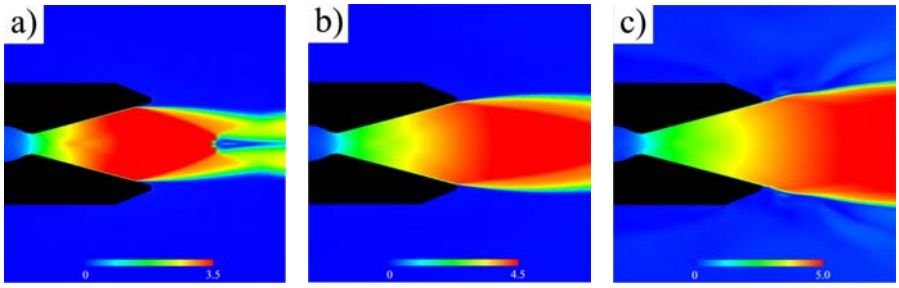

Figure 3. Mach number contour for the bell nozzle at ground-testing condition for a) PR=45.4, over-expansion b) PR = 116.5, near optimum-expansion c) PR = 250, under-expansion

The pressure distribution at the ramp wall of the aerospike nozzle is also plotted in 1-D to study the effect of pressure ratio and shockwave impingement. A sample of this investigation can be found in figure 4. The performance of both linear aerospike and bell nozzle is also calculated and compared. The aerospike nozzle demonstrates its altitude-compensation ability and delivers higher performance than the bell nozzle in whole range of operation. A sample of this performance comparison is shown in figure 5.

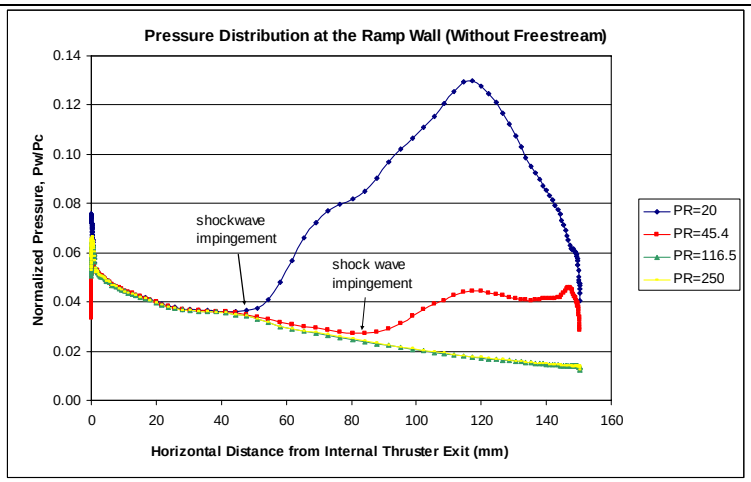

Figure 4. Pressure distribution at the ramp of the linear aerospike nozzle

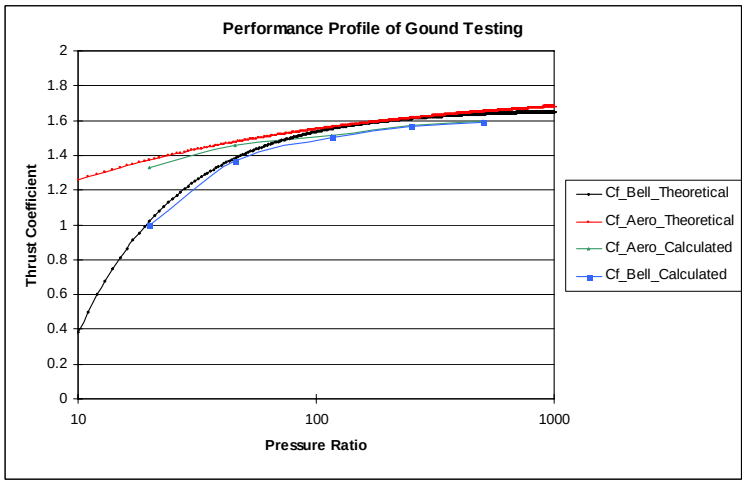

Figure 5. Performance comparison between linear aerospike nozzle and bell nozzle

8. Please add your comments (if any):

I am very grateful for such a wonderful opportunity that JSPS and NSF have offered to me. It has been a truly extraordinary journey. I'd like to thank Prof. Fujii from ISAS for hosting me; even though I have no experience with CFD before, he was very kind and tolerant for my lack of discipline. I also sincerely appreciate Dr. Takashi Ito from JAXA for preparing most of the computation codes for me so I can learn what CFD is about in this short period of time and explore new areas for my future research. Last but not least, I'd like to thank everyone in the Fujii Laboratory for taking care of me during my stay in Japan. I will never forget the friendships we've built and the many laughs (and drinks and yummy food) we had together. This memory will surely last for the rest of my life.

RESEARCH REPORT

1. Name: Mr. Schaun L. Valdovinos （ID No.: SP05059 ）

2. Current affiliation: University of Illinois at Urbana-Champaign

3. Research fields and specialties:

Humanities Social Sciences Mathematical and Physical Sciences
Chemistry **X Engineering Sciences** Biological Sciences
Agricultural Sciences Medical, Dental and Pharmaceutical Sciences
Interdisciplinary and Frontier Sciences

4. Host institution: University of Tokyo

5. Host researcher: Dr. Yozo Fujino

6. Description of your current research:

The Minato Bridge is the world's third longest steel truss cantilever bridge. Following the 1995 Kobe earthquake, studies revealed it is quite susceptible to strong motion. This mandated a scheme for seismically retrofitting this important bridge located in the Kansai region near Osaka. By base isolating the traffic decks of the bridge, a massive Tuned Mass Damper (TMD) was created to counteract vibration induced by ground motion.

My studies have looked at the optimal system parameters of this TMD system. The desire to create a robust damper led to studies into a Multiple Tuned Mass Damper (MTMD) system by giving each of the 14 deck segments a different fundamental frequency and damping coefficient. This widens the operating frequency range of the system and lowers its susceptibility to detuning from changes in the structural characteristics under strong motion. One source of uncertainty in response is hinge movement between the central span and pier spans. It has been observed that the pins slip under moderate earthquakes causing the fundamental longitudinal period of the bridge to elongate.

By using an arbitrary distribution of parameters in the MTMD system, low damping bearings can be used as part of the optimal solution. This implies lower retrofit costs at increased performance. It was also found that the very high mass ratio of 70% between the deck and structure makes the system less sensitive to detuning and the choice of damping ratio. It is felt that the performance of the retrofit scheme should help lower stresses in the main truss member and should allow the bridge to stay operational after a major event.

7. Research implementation and results under the program

(As much as possible, describe the contents and results of your research in a manner that is easily understandable to a non-specialist in your field.):

Title of your research plan: Evaluate the Minato Bridge Tuned Mass Damper Seismic Retrofit Scheme

Description of the research activities:

My research began with a literature review to understand the current state of research on Tuned Mass Dampers (TMD) for seismic application. These systems have proven very successful for wind vibration mitigation but have not been as widely applied to suppression of seismic motion due to certain limitations. TMDs with low mass ratios (in the range of 1%) are especially susceptible.

Theories for optimizing the TMD and Multiple TMD parameters have been proposed. My efforts at Todai looked into the optimization of an MTMD using an arbitrary distribution of frequency and damping amongst the individual system components to create a more robust arrangement. It was found through computer simulation [by a colleague in my lab] that this led to a preferred solution over the other proposals. Numerical models were the primary means of exploring this topic. TMD and MTMD parameters were varied to observe the effect this had on the system when subjected to different excitation signals (included earthquake records)

8. Please add your comments (if any):

Investigating this retrofit proposal has provided me with special insight into how innovative engineering thought can lead to unique solutions. The Minato Bridge is one of the first long-span bridges in Japan to be retrofit for seismic performance. I have been very impressed with the country's enthusiasm to embrace new technology and ideas in dealing with hazard mitigation. Instead of simply fearing *The Big One*, the Japanese government has taken a proactive stance in protecting its people and economy from the aftermath of such an inevitable event. It is quite impressive.

Japan is definitely one of the world's most seismically active regions. During my three months stay, I felt eight earthquakes including a M7.2 whose epicenter was located some 220-miles north of Tokyo. Earthquake engineering is essential in this country.

RESEARCH REPORT

1. Name: Matthew Wickens （ID No.: SP05061）

2. Current affiliation: PhD Graduate Student, American University, Washington D.C.

3. Research fields and specialties:

Humanities X Social Sciences Mathematical and Physical Sciences
Chemistry Engineering Sciences Biological Sciences
Agricultural Sciences Medical, Dental and Pharmaceutical Sciences
Interdisciplinary and Frontier Sciences

4. Host institution: Japan Women's University, Kawasaki Japan

5. Host researcher: Dr. Iwata Masami

6. Description of your current research

As a cultural anthropologist, I have had a long interest in the causes and consequences of poverty and how they develop cross-culturally. My current research explores the intersection of poverty and culture, specifically looking at the causes of homelessness. I explored this question at a large homeless shelter for women and children in Atlanta, Georgia. After completing this research, I taught urban anthropology in Japan and participated in food patrols with two different nonprofit agencies. After this experience I wanted to undertake a more rigorous investigation of poverty in Japan. To this extent, I began by focusing on the current literature in preparation for conducting my doctoral research in Japan. Grounding my research in historic context is important to show the development of homelessness in Japan across time.

I am focusing my research on the role of kin networks for the homeless in Japan. Much of the literature shows that the dominant expectation in both society and in government planning of the Japanese welfare system is that one has to ask family members for help before receiving benefits. For healthy homeless men not yet eligible for retirement funds, their family is their only resource. My research seeks to understand why the homeless fail to ask their family members for help and why their families do not provide assistance. While much research shows familial relationships are strained, this is not always the case. What happens when family members are in contact with a homeless relative is one of my current research questions.

Title of your research plan:

Homelessness in Tokyo: Survival Strategies, Work, and Family Relationships

Description of the research activities:

I conducted participant observation in Tokyo among homeless men. I focused mostly on the area around Ueno Park and Sanya. I interviewed homeless men about their work histories, survival strategies, their families and how they survive in Ueno and the surrounding area.

I also participated in weekly food patrols with Sanyukai on Thursdays. Through this activity, I met two other researchers interested in homelessness and exchanged ideas with them. Participating with the weekly food patrols I could deliver the remaining food such as boxed lunches to my informants in Ueno. This was especially important because on Thursday, there were no groups giving out food in Ueno Park.

I learned about survival strategies employed by the homeless. These include decisions about participating in soup lines and exchanging information regarding them and social networks for support and exchange. These networks are important for receiving clothing and food, knowing about work opportunities and safe locations to sleep. A new project sponsored by the Tokyo government ad administered by the Taito Ward office to provide work and an apartment for the homeless was targeting the homeless in Ueno Park. I attended several meetings and interviewed homeless men regarding this project. They were concerned about finding work when the initial six months of government provided work ends. Some men refused to participate in the program because they thought they would be back in Ueno after six months. My research also included volunteering with a nonprofit agency that served food to the homeless and exploring perspectives from both the homeless and the various churches that serve lunch to them.

I had intended to focus on family relationships and kin networks among the homeless and to trace these relationships. However, after several weeks it became apparent that this is a sensitive subject and some people would not talk about it. Others would talk about their relationship with their kin, but only to say that the relationship is severed or that they have not been home in more than ten years. Many people both homeless and those who have worked with the homeless often said that family relationships are severed. Nevertheless, some people are in touch with their families, but not in regular contact and visits are sporadic. It is noteworthy that among the homeless they do not share information about their family.

8. Please add your comments (if any):

I had a productive summer in Tokyo and significantly advanced my research. I enjoyed the training at Sokendai and my time with my host family was especially rewarding. I only wish I had more time to conduct my research. Therefore, I plan to return to Japan to further my research and explore unanswered questions about social welfare in Japan. Thank you for this wonderful opportunity.

RESEARCH REPORT

1. Name: Latanya Williams （ID No.: SP05062 ）

2. Current affiliation: Howard University, Washington DC

3. Research fields and specialties:

Humanities Social Sciences Mathematical and Physical Sciences
Chemistry Engineering Sciences X Biological Sciences
Agricultural Sciences Medical, Dental and Pharmaceutical Sciences
Interdisciplinary and Frontier Sciences

4. Host institution: RIKEN Tsukuba Institute Bioresources Center

5. Host researcher: Dr. Masatomo Kobayashi, Ph.D.

6. Description of your current research: At Howard University, I am currently investigation the role of sumoylation of RACK1 mediated environmental stress response signaling pathways in *Arabidopsis* with focus on the drought response. If the RACK 1 sumoylation site is mutated and the plants are found to be drought resistant, that would support evidence that RACK 1 is involved in a stress response pathway. RACK1 belongs to a broader family of RACK proteins that have been found in various organisms. RACK1 is a scaffolding protein that allows specific multi-protein complexes to form during different signaling events. Within the sequence of RACK1 is a binding site for SUMO proteins. These SUMO proteins have been found to bind to RACK1, specifically when the plant is subjected to stressful conditions. It is hypothesized by this research that RACK1 plays a role in the drought stress response; a mutation in RACK1 prevents its sumoylation, causing *Arabidopsis* plants to conserve water and survive under drought like-conditions. Uncovering the role of RACK1 in drought response in *Arabidopsis* can have broad effects in society. Drought is an environmental issue plaguing many third world countries. Creating drought-resistant crops would provide an alternative source for food production, potentially elimination import costs for some crops in arid regions. Genetically engineered seeds could also be used in areas where fertile soil has been depleted of nutrients due to improper farming techniques.

7. Research implementation and results under the program

(As much as possible, describe the contents and results of your research in a manner that is easily understandable to a non-specialist in your field.):

Title of your research plan: Application of transcriptome technique for studying signal transduction.

Description of the research activities: Arabidopsis wild type and mutant plants previously exposed to heat stress were analyzed using Affimetrix Genechip technology. Wild type and *rackla* mutant plants were grown at 24 C for four weeks with 16 hours light and 8 hours darkness. The plants were then transplanted to liquid 1X MS medium and heat treated at 37 C for 1 hour. RNA isolation was performed using the TRIzol method and further purification of RNA was achieved using Qiagen RNeasy Mini Elute kit. cDNA was synthesized form total RNA and labeled with biotin. cRNA was synthesized from cDNA. cRNA was fragmented, hybridized to GeneChip, and scanned using the Affimetrix system. Data was analyzed using Gene Spring computer software. Data form wild type and mutated plants grown at 24 C and 37 C were compared against root and shoot data from *Arabidopsis* plants subjected to the stressors of drought, heat, high salinity, osmotic pressure, and oxidative and genotoxic conditions from 0 h up to 24h. Up regulated genes were analyzed at 2 and seven fold increases, while down regulated genes were analyzed from 0.3 and 0.4 fold decreases. The mutant plant displayed heat inducible genes down regulated in root and shoot tissue at 24 C that are expressed in the cell wall. One interesting gene that deserves mention is xyloglucan transferase. This gene encodes an enzyme that is involved in cell wall structure. Further analysis of the effects of this gene in Arabidopsis should be studied, and the size of the mutant plant versus the wild type plant should be observed. If the mutant plant is shown to be smaller in size as compared to the wild type, this could be due in part to the down regulation of xyloglucan transferase. In addition, the mutant also demonstrated genes expressed in the cell wall normally induced by salt stress also down regulated. Based on all of the comparisons made, the greatest deviations from the wild type was shown in the salt stress root and shoot responses of the mutant. Salt inducible genes were down regulated at a higher frequency as compared to heat inducible genes. This hints to a correlation between salt and heat stress. The significant variations in the data discussed here should be further investigated to establish definitive relationships between preliminarily observed phenomenons.

8. Please add your comments (if any): Time limitations and regulations prevented cultivation of additional plants, but this can be done at the home institution using the data collected as a reference.

RESEARCH REPORT

1. Name: May P. Xiong （ID No.: SP05063 ）

2. Current affiliation: University of Wisconsin-Madison

3. Research fields and specialties:

Humanities Social Sciences Mathematical and Physical Sciences
Chemistry X Engineering Sciences Biological Sciences
Agricultural Sciences Medical, Dental and Pharmaceutical Sciences
Interdisciplinary and Frontier Sciences

4. Host institution: Tokyo University

5. Host researcher: Prof. Kazunori Kataoka

6. Description of your current research

Poly(ethylene glycol) (PEG) reduces immunogenicity, protects against enzymatic degradation and improves tumor accumulation of conjugates when attached to various liposomes, enzymes and polycations.[1-5] *In vivo* studies in mice have demonstrated that PEGylated-PEI25 complexes are taken into RES organs less than PEI25.[6] However, PEG minimizes interactions with cells and can reduce transfection efficiency.[7] We hypothesize that through the use of a degradable poly(amino acid) block-co-polymer, one for condensing pDNA and the other for pH-sensitive linkage to PEG, it may be possible to study structure-property relationships, varying PEG size as well as block-copolymer sizes. The DNA condensing polymer block should interact with pDNA at physiologic pH. The second block containing hydrazine groups will remain exposed at this pH; hence allowing us the opportunity to prepare polymers containing PEG brushes for pre- and post-PEGylation of polyplexes. We believe that this approach may form more stable polyplexes for *in vivo* gene delivery since pre-PEGylation may hinder the formation of well-packed polyplexes. Furthermore, the pH-triggered release of PEG from complexes in endosomal compartments may help unpackage the pDNA from the polymer and facilitate pDNA escape into the cytoplasm.

7. Research implementation and results under the program

(As much as possible, describe the contents and results of your research in a manner that is easily understandable to a non-specialist in your field.):

Title of your research plan:

pH-sensitive PEGylation of a degradable block-copolymer for gene delivery

Description of the research activities:

We have successfully synthesized two kinds of block-copolymers: p(Asp-Hyd)-poly(L-lysine(TFA)) and p(Asp-Hyd)-poly(L-lysine(Z)). We have shown using p(Asp-Hyd)-poly(L-lysine(TFA)) that hydrazide groups introduced on the block-copolymer can interact with PEG-aldehyde to form an acid-sensitive Schiff base (pre-PEGylation strategy for forming polyplexes). Formation of p(Asp-Hyd-**PEG**)-poly(L-lysine(TFA)) at three different molar ratios did not increase much beyond 2 days of incubation due to steric hindrance from earlier PEG attachment and/or lost of aldehyde-PEG reactivity. We have also checked the acid sensitivity of **p(Asp-Hyd-PEG)-poly(L-lysine(TFA))** by verifying release of PEG from the block-copolymer with GPC through the addition of a few drops of TFA and incubating overnight (data not shown). There are many issues at hand that we still need to consider for the future. So far, we have only worked on forming pre-PEGylated block-copolymers and we will also have to compare these results with post-PEGylated block-copolymer polyplexes.

RESEARCH REPORT

1. Name: Jasmine J. Yang （ID No.: SP05064）

2. Current affiliation: Boston University

3. Research fields and specialties:

Humanities Social Sciences Mathematical and Physical Sciences

Chemistry Engineering Sciences X Biological Sciences

Agricultural Sciences Medical, Dental and Pharmaceutical Sciences

Interdisciplinary and Frontier Sciences

4. Host institution: Kochi Medical School

5. Host researcher: Dr. Hideto Kaba

6. Description of your current research

This project is part of my thesis dissertation which examines the role of progestin receptors in the induction of neuroendocine memory. In my home lab, the neuroendocrine model used is pseudopregnancy in mice. Here at Kochi Medical School, the olfactory block to pregnancy, known as the Bruce effect in mice, is used as a model of olfactory neuroendocrine memory. The Bruce effect occurs when a newly mated female is exposed to a strange or foreign male, and his pheromone blocks the female's pregnancy. The mating male, however, does not block his mate's pregnancy. This is because the mated female forms a memory to the pheromones of the male partner at mating, thereby preventing his pheromones from inducing pregnancy block. This memory is triggered by mating stimulation and requires subsequent exposure to male pheromones.

Both neuroendocrine models are triggered by vaginal cervical stimulation and the transduction of the mating stimulation involves the amygdala in the brain. The role of the hormone, progesterone, and the activation of its progestin receptors in the establishment of neuroendocrine memory are currently unknown. The progestin receptor antagonist, RU486, is used to block possible activation by mating stimulation and thus the triggering of neuroendocrine memory.

7. Research implementation and results under the program

(As much as possible, describe the contents and results of your research in a manner that is easily understandable to a non-specialist in your field.):

Title of your research plan:

Examining the role of progestin receptors using progestin receptor antagonist (RU486) in the establishment of olfactory neuroendocrine memory associated with the Bruce effect in mice.

Description of the research activities:

After implanting a stainless steel guide cannula into the lateral ventricle of female mice using stereotaxic methods, the estrous cycle of the females are monitored by

daily vaginal lavage. Females are mated on sexually receptive days with a vasectomized stud male. Immediately after successful mating, RU486 (the progestin receptor antagonist) or vehicle is infused into the lateral ventricle. The female is then transferred to mating male pheromone soiled bedding to establish olfactory memory of the stud male which requires 4-6 hours of exposure post mating. The following day, the experimental females are re-exposed to mating male bedding. If memory of mating male's pheromone is established by the female, the subsequent pheromone challenge will not disrupt her pseudopregnancy. However, if RU486 successfully blocks the establishment of memory then the subsequent pheromone challenge should disrupt pseudopregnancy. This then suggests that progestin receptors are involved in the establishment of the olfactory neuroendocrine memory involved in the Bruce effect. Whether the amygdala is the site of memory disruption that is still unknown. Further tests will need to be conducted to test this question.

8. Please add your comments (if any):

I have had quite an experience here at Kochi Medical School. I have learned much in terms of technique from Dr. Kaba and his graduate student, Long-Yun Fang. It is always good, and I think very important, to see how different techniques and methods of science are done in other labs.

Dr. Kaba and his lab members, particularly Mrs. Hamaguchi and Mr. Fang, have been incredibly helpful and kind within the lab as well as outside the lab.

I'm grateful to Dr. Kaba and his lab and to NSF and JSPS for their research support and for giving me the opportunity to work in Japan.

RESEARCH REPORT

1. Name: Sai Wing Yeung （ID No.: SP05065）

2. Current affiliation: University of California, Berkeley

3. Research fields and specialties:

Humanities X **Social Sciences** Mathematical and Physical Sciences
Chemistry Engineering Sciences Biological Sciences
Agricultural Sciences Medical, Dental and Pharmaceutical Sciences
Interdisciplinary and Frontier Sciences

4. Host institution: The University of Tokyo

5. Host researcher: Susumu Yamaguchi

6. Description of your current research

My research tries to discover the relationship between culture and a number of human cognition process, especially how one's own culture and language influence reasoning and decision making.

7. Research implementation and results under the program

(As much as possible, describe the contents and results of your research in a manner that is easily understandable to a non-specialist in your field.):

Title of your research plan:

Culture and similarity judgment

Description of the research activities:

Similarity is a vital part of cognitive processing in our everyday life. It affects problem solving (Bassok & Holyoak, 1989), categorization (Norenzayan, Smith, Kim, & Nisbett, 2002), and decision making (Markman & Moreau, 2001).

Culture has been shown to affect a number of cognitive processes. Nisbett, Peng, Choi, and Norenzayan (2001) summarized results of a series of studies showing that East Asians, compared to European Americans, think more holistically, focus more on and perceive more relationships (Ji, Peng, & Nisbett, 2000), use more contextual and relational information in attribution (Morris & Peng, 1994), pay more attention to relationship in remembering things, and use more relational resemblance in categorization (Norenzayan, Smith, Kim, & Nisbett, 2002); whereas Americans

focus more on objects and their features.

I planned to study whether there is a difference in the cognition of similarity between participants from American and Japanese culture. I first presented a draft of my plan to Prof. Yamaguchi and members of his lab. I received some very valuable feedback and have worked to address and incorporate them in the study. I have also collaborated with some of Prof. Yamaguchi's students in their studies. A graduate student of Prof. Yamaguchi's, Sumi Mori, will come to Berkeley as a post-doc and we will continue our collaboration there. One of Prof. Yamaguchi's colleague, Dr. Morio, will also come to Berkeley this fall to conduct a study and I will assist him as a local graduate student.