APPLICANT BIOGRAPHICAL SKETCH

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NAME OF APPLICANT: Carmen Lin

eRA COMMONS USER NAME (credential, e.g., agency login): carmenlin

POSITION TITLE: Ph.D. Candidate

EDUCATION/TRAINING

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	START DATE MM/YYYY	END DATE *(or expected end date)* MM/YYYY	FIELD OF STUDY
Colgate University	B.A.	08/2008	05/2012	Cellular Neuroscience; Japanese
Northwestern University	Ph.D.	08/2012	06/2018	Neuroscience

A. Personal Statement

My “big picture” research interest is in learning and memory, the neurobiological mechanisms thereof, and how these mechanisms become aberrant in disease states such as Alzheimer’s disease. As an undergraduate at Colgate University, I studied the neural correlates underlying learning and memory on the cognitive level. I trained under Dr. Spencer Kelly, a cognitive neuroscientist, utilizing electroencephalography to investigate learning in human subjects. I served first as a research assistant, before performing research for my senior thesis in neuroscience in his laboratory. For my thesis, I incorporated my Japanese major into my neuroscience thesis and utilized electroencephalography in order to investigate the neural correlates behind second language acquisition in human subjects. Not only did I receive a high honors award for my thesis, I presented the results of my research at the International Society for Gesture Studies conference in Sweden in that year. For my graduate training at Northwestern, I was passionate about developing my interest beyond the cognitive level and investigate on other levels. I also became intrigued about how these mechanisms that underlie learning and memory may go awry during disease states such as Alzheimer’s disease, Huntington’s disease, or even with normal senescence. I took the Mechanisms of Aging and Dementia course at Northwestern in my first year in order to gain a better background on these interests. To pursue a combination of my research interests, I also joined the laboratory of Dr. John F. Disterhoft, a world-renowned expert on the neurobiology of learning, memory, and age-related learning deficits. His laboratory utilizes a wide range of techniques, from animal behavioral training to *in vitro* and *in vivo* electroencephalography, and molecular techniques such as PCR and western blotting. For my initial project, I developed a head-fixed paradigm for whisker-evoked trace eyeblink conditioning in mice, a widely used tool for investigating hippocampally dependent learning and memory. I have published this paradigm in a first-author paper in the *Journal of Visualized Experiments*. For my thesis project, I am employing *in vitro* electrophysiology and trace eyeblink conditioning to investigate learning and age-related learning impairments in a crucial area for memory formation: the lateral entorhinal cortex. In addition to my own thesis project, I am also involved in a project examining the consequences of traumatic brain injury and Alzheimer’s disease and their convergence on learning. I will present the results of the TBI study at this year’s Society for Neuroscience conference. These results are also currently being written up for publication. Outside the laboratory, I have promoted scientific interest in the brain and neuroscience amongst Chicago public schools through the I Northwestern University

Brain Awareness Outreach program. I also serve as a member of the Northwestern University Interdepartmental Neuroscience (NUIN) Ph.D. Program Student Advisory Committee.

B. Positions and Honors

ACTIVITY/ OCCUPATION	START DATE (mm/yy)	END DATE (mm/yy)	FIELD	INSTITUTION/ COMPANY	SUPERVISOR/ EMPLOYER
Research Assistant	09/2010	05/2011	Neuroscience	Colgate University	Spencer D. Kelly, Ph.D.
Research Assistant	09/2010	05/2012	Japanese	Colgate University	Yukari Hirata, Ph.D.
Representative	09/2012	Present	Neuroscience	Northwestern University	NUIN Student Advisory Committee
Teaching Assistant	09/2013	12/2013	Neuroscience	Northwestern University	James Baker, Ph.D.
Teaching Assistant	01/2014	03/2014	Neuroscience	Northwestern University	Mark Segraves, Ph.D.
Ph.D. Candidate	09/2014	Present	Neuroscience	Northwestern University	John Disterhoft, Ph.D.
Study Group Facilitator	09/2014	12/2014	Neuroscience	Northwestern University/Collaborative Learning and Integrative Mentoring in the Biosciences	Toni Gutierrez, Ph.D.

Academic and Professional Honors

Ruth L. Kirschstein National Research Service Award- Individual Predoctoral Fellowship (F31-AG055331), 2016-2019

Trainee, NIH T32 the Mechanisms of Aging and Dementia Training Program, Northwestern University, 2015

Magna cum laude, Bachelor of Arts, Colgate University, 2012

High Honors Thesis in Neuroscience, Colgate University, 2012

High Honors Thesis in Japanese, Colgate University, 2012

The Phi Beta Kappa (ΦBK) National Academic Honor Society, 2012

The William E. & Nellie K. Edmonston Neuroscience Award, Colgate University, 2012

Associate, The Institute for the Recruitment of Teachers, Phillips Academy, 2011

Levern Cheney Endowed Scholarship, Colgate University, 2009-2011

Dean's Award for Academic Excellence, Colgate University, 2008-2011

Memberships in Professional Societies

Student Member, The Society for Neuroscience

Member, Northwestern University Brain Awareness Outreach Program

C. Contributions to Science

I. Undergraduate Research (Colgate University)

a. Second Language Phonetic Acquisition: For my neuroscience senior thesis, my goal was to integrate my knowledge from my Japanese linguistics studies into my experiment. Under the supervision of Dr. Spencer Kelly, a cognitive neuroscientist, I therefore designed an experiment to teach native English speakers to hear and differentiate Japanese long and short vowel phonemes with gestures. I measured their neural correlates of learning using electroencephalography. This study revealed that more complex gestural training may in fact be

more detrimental to second language acquisition when the phonological demands are high. The simplest gestural paradigm revealed a negative going electrical potential at 200 ms following stimulus (N2), indicating implicit learning. I was able to present the results of this study at the International Society for Gesture Studies conference in Sweden. This study has been carried further and was written into a paper for publication.

Publications:
Kelly, S., Hirata, Y., **Lin, C.**, Zhao, Z., Huang, J., Bailey, A., Manansala, M., Weiner, K. Neural versus Behavioral Sensitivity to Foreign Language Training with Co-Speech Hand Gestures. *Language Learning.* In Review.

Abstracts:
Lin, C., Zhao, L., Kelly, S., Hirata, Y. (2012). *Beat it!: The Use of Beat Gestures in Learning Japanese Vowel Length Distinctions*. International Society for Gesture Studies. Lund, Sweden.

b. Japanese Phonetic Long and Short Vowel Distinction: My Japanese linguistics research informed quite a bit of my neuroscience research (See Ia. Second Language Phonetic Acquisition). I worked with Dr. Yukari Hirata, a linguist in the field of Japanese linguistics, to investigate how native Japanese speakers distinguish the Japanese phonemes of long and short (i.e. single and geminate vowel) vowel in the Japanese language. We found that the vowel onset within the target word to the following word within a sentence to be a reliable temporal marker. The results of this study was presented at the Acoustics conference in Hong Kong and also published into a paper which was published in 2012.

Publications:
Hirata, Y. and **Lin, C**. Vowel Onset as a Rhythmic Marker in Japanese Single and Geminate Stop Distinctions. *The Journal of the Acoustical Society of America.* April 2012. 131 (4): 3345.

Abstracts:
Hirata, Y. and **Lin, C.** *Vowel Onset as a Rhythmic Marker in Japanese Single and Geminate Stop Distinctions*. (2012). The Acoustics Conference. Hong Kong, China

II. Graduate Research (Northwestern University)

a. Neurobiology of Learning and Memory and Age-Related Learning Deficits: My current research project focuses on investigating aging and learning-related excitability changes within the cells of the lateral entorhinal cortex. Despite the importance of the entorhinal cortex in memory formation and the fact that the entorhinal cortex is the first brain region where hallmarks of Alzheimer's disease manifests, little is known about the cellular mechanisms underlying learning and age-related learning deficits. I will perform whole-cell current clamp recordings on the cells within this region in young and aged rats to investigate the effect of aging on neuronal excitability. I will also train young and aged rats on the hippocampus-dependent task of trace eyeblink conditioning to investigate the effect of learning on excitability. I have mastered the technique of trace eyeblink conditioning and have not only given a lecture about trace eyeblink conditioning, but also written a first-author method paper about the technique in *The Journal of Visualized Experiments*.

Ongoing research in the Disterhoft laboratory is also focusing on investigating mechanisms supporting learning within the cerebellum. This project is in collaboration with the laboratory of Dr. Christian Hansel at the University of Chicago. The goal of this research project is to investigate learning-related changes in excitability in the cerebellum following the acquisition of delay eyeblink conditioning. I am training mice on delay conditioning using the head-fixed paradigm that I have developed and published and our collaborators are measuring differences in excitability in purkinje cells between trained and pseudo-trained animals. Future plans for this project will be to investigate the behavioral effect of an SK2 channel knockout on these mice.

Publications:

Lin, C., Disterhoft, J.F., Weiss, C. Whisker-Evoked Eyeblink Classical Conditioning in Mice. *The Journal of Visualized Experiments*. March 2016. 109. doi: 10.3791/53310.

Abstracts:
Lin, C., Oh, M.M., Disterhoft, J.F. (2016). *Aging decreases intrinsic excitability within layer II/III principal cells of the lateral entorhinal cortex*. Society for Neuroscience Conference.

Titley, H.K., Watkins, G.V., **Lin, C.**, Grasselli, G., Weiss, C., Disterhoft, J.F., Hansel, C. (2016). *Enhanced Intrinsic Excitability in Cerebellar Purkinje Cells Following Delay Eyeblink Conditioning in Mice*. Society for Neuroscience Conference.

Lin, C., Oh, M.M., Disterhoft, J.F. (2016). *Functional Changes of the Principal Neurons of the Lateral Entorhinal Cortex in Aging*. 22nd Annual Alzheimer's Day.

Lectures & Seminars:
"Functional Changes of the Principal Neurons of the Lateral Entorhinal Cortex in Learning and Aging." Mechanisms of Aging and Dementia Training Grant Day, Chicago, IL, USA. 2016

"Expanding on the Neural Substrates behind Pavlovian Classical Conditioning." 2015. Walter Payton Seminar Series, Lecture, Chicago, IL, USA

"Classical Conditioning and the Neural Substrates behind Animal Behavioral Testing." 2014. Walter Payton Seminar Series, Lecture, Chicago, IL, USA

b. Traumatic Brain Injury and Alzheimer's disease: This project is a collaboration between Dr. John Disterhoft's laboratory and Dr. Savio Chan's laboratory. This project seeks to characterize the convergence of traumatic brain injury and Alzheimer's disease because increased production of the β-amyloid protein, a hallmark of AD, is also present following TBI. We are currently examining the effects of TBI in non-transgenic and AD mice, observing changes in excitability within neurons and astrocytes of the hippocampus, and also the effect of these changes on the hippocampus-dependent behavioral paradigm of trace fear conditioning. Our results so far indicate that while mild traumatic brain injury can increase acquisition of trace fear conditioning, it impairs retention of the fear memory. The results of this study are currently being written for publication and will be presented at the Society for Neuroscience conference in 2015.

Abstracts:
Lin, C., Weiss, C., Pitt, J., Chan, S., and Disterhoft, J.F. (2015) *Mild Traumatic Brain Injury Enhances Acquisition and Impairs Retention of Fear Learning*. Society for Neuroscience Conference.

Del Mar Ortiz-Vétez, Y., **Lin, C.**, Fiske, M., Weiss, C., Chan, C.S., Disterhoft, J.F. (2014*). How traumatic brain injury affects wild-type mice in comparison with transgenic Alzheimer's disease models.* Annual Biomedical Research Conference for Minority Students.

Presentations:
"TBI and its implications for PTSD: A mouse model for the convergence of mTBI on PTSD." 2015. Press Conference. Society for Neuroscience Conference.