A Comparative Analysis of the St. Paul (MN) Hmong in Charter and non-Charter Schools  Leah Corey

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The logo for the Office of Undergraduate Research, on the front cover of this publication, consists of an “impossible triangle” within a starburst. To some, the triangle evokes the challenge of puzzles to be solved or the eternal research question “How does that work?” To others, the triangle represents the Greek letter Δ, the mathematical symbol for change.
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UNDERGRADUATE RESEARCH PEER REVIEW BOARD
Foreword

The Washington University Office of Undergraduate Research proudly presents the fall 2007 edition of the WUURD, maintaining our commitment to excellence in the undergraduate research experience. To continue the evolution and improvement of the publication, we present four feature articles each of which have been peer-edited by select members of the WUURD Peer Review Board. These peer-editors worked directly with the authors of featured articles to produce works of the highest quality. We are indebted to their significant contribution to increasing student participation in the publication of this digest.

Two of the feature articles in this edition come from the honors theses of students in Arts and Sciences, a result of strengthened ties between academic departments and the Office of Undergraduate Research. Leah Corey’s thesis investigates the effects of educational programs on a population of first-generation immigrant children. Models of national identity that developed during the French Revolution are explored in the thesis of Christina Skelley. Each serves to advance the body of knowledge associated with both current and historical issues within a society.

Equally significant to the advancement of knowledge are the studies reported in the second two of the four featured articles. Research in the sciences, both natural and social, are reported on in the works of Michelle Mo and Nathaniel Meadow. Mo’s work, performed at the Cornell Medical College, investigates amyloid-beta, a peptide responsible for plaques that form in the brains of Alzheimer’s patients. Meadow’s research investigates memory for written passages by volunteer subjects measured under various experimental conditions and finds that gesturing with hands appears to aide the brain in encoding information, leading to better memory.

We would also like to direct attention to the “Summaries of Student Work” section of this edition; the work of over sixty students is highlighted. Research in the Performing Arts, in form of dance choreography, Engineering, and Business, as well as numerous disciplines within Arts and Sciences are represented. Many are the result of the senior capstone experience. The research reported in this section was conducted in places as diverse as rural China, Mexico City, Croatia, Kazakhstan, Madagascar, and a Missouri cave. The breadth of the research illustrates the greatest diversity in exploration published thus far by the WUURD.
We hope that you enjoy exploring the many works reported in the fall 2007 edition of the WUURD. The commitment of the undergraduate researchers and their faculty mentors to the search for knowledge and understanding in their various fields of study here at Washington University continues to grow. In the publication of this Digest, the Undergraduate Research Office takes pride in supporting this commitment.

Respectfully,

KIRSTIN SOBOTKA
Editor

JOY ZALIS KIEFER
Assistant Dean, Co-editor
A Comparative Analysis of the St. Paul (MN) Hmong in Charter and non-Charter Schools

Author:
Leah Corey
Leah Corey graduated from Washington University in May 2007, with a degree in American Cultural Studies and now works in the public school system in Minneapolis. This article is an adaptation of her Senior Honors Thesis which she describes as “unlike any other work I have ever done because rather than only reflecting upon the work other scholars have done, I was able to produce my own study with my own data and my own voice.”

ABSTRACT
This study examines whether charter schools are effective educational institutions for Hmong students, specifically English-language learners. While many studies on the efficacy of Charter Schools exist, few, if any, focus specifically on Hmong students. This study examines the relationship between school climate and academic achievement (various standardized test scores and cumulative GPA) by assessing the data from one charter school and from one non-charter public high school in Minnesota, each of which serve students with similar demographics. The achievement data indicate that ELL Hmong students attending a charter school perform better than their counterparts at the non-charter public school. This result was not observed for non-ELL students. The data also reveal smaller achievement gaps between the ELL and non-ELL Hmong students at the charter school than at the non-charter public school. Thus, for students from traditional homes and limited English proficiency, attending smaller schools with programming devoted to the needs of the Hmong may be beneficial to their academic success. This research can be used to inform how public schools address the needs of their student populations. As schools continue to diversify, it will be increasingly crucial for schools to address the unique learning characteristics of all students.

FACULTY MENTOR: DR. MARGARET L. BROWN
Margaret Brown holds a Ph.D. in anthropology and is the Academic Coordinator for American Culture Studies. Her research interests are in the areas of informal and formal social and cultural institutions, including family and kinship, property rights, economic production and distribution, and education.

ACKNOWLEDGEMENTS
I would like to thank Community of Peace Academy, particularly Dr. Nancy Healy and the St. Paul Public School district, particularly Dr. Steven Schellenberg. Without the cooperation of these institutions I would not have been able to conduct this research. I would also like to thank Dr. Jere Confrey who inspired this entire project. Her guidance and mentorship throughout the past few years have shaped my undergraduate experience. Finally, I would also like to thank Dr. Sunita Parikh and Dr. Margaret Brown.

KEY TERMS
- Achievement Gap
- Basic Skills Test
- Charter School
- English-language learner
- Hmong
- Minnesota Comprehensive Assessment-II

Peer Editor:
Shweta Murthi, Senior, Majoring in Biology
INTRODUCTION

The Hmong are a refugee population from Northern Laos that has been coming to the United States in large numbers since the 1970s. Minnesota has the second largest Hmong population in the United States with 41,800 individuals. This count may be miscalculated due to the language barrier preventing Hmong adults with limited English skills from completing census forms. Community leaders estimate the real population may exceed 70,000. Hmong families are attracted to Minnesota's stable job market and welfare system. Additionally, because the Hmong are traditionally clan-based, the large existing community influences families around the nation to resettle there. From 1990 to 2000, Minnesota’s Hmong population increased by 135%, mostly through secondary migration from within the country.

Hmong refugees must be distinguished from other Asian immigrant groups because of the motives driving their immigration. While many immigrant groups come to the United States seeking out promising economic conditions or employment opportunities, the Hmong came to the United States to escape the war trauma, political upheaval, and familial separation that defined their experience as an ethnic group in Southeast Asia. Their need for survival, safety, and stability has influenced their transition into American society. As a response to the assimilation pressures within this context, the Hmong have adopted what anthropologist John Ogbu calls the “tourist attitude.” They practice enough American customs to function in society without compromising their cultural traditions.

The portion of society that recent immigrants move into influences how they adapt, because people tend to adopt whatever trends, ideas, and sentiments are considered “mainstream” around them. Many Hmong families with little financial capital or profitable job skills enter into low-income urban communities, where they confront poverty, drug use, violence, and crime. These inner-city problems have a strong impact on youth, who are susceptible to developing these risky behaviors.

The scholarship on Hmong youth suggests many have difficulty adapting to American society because they feel caught between traditional parents and mainstream peers. Unable to connect with either group, these young people adapt by forming social networks with Hmong peers facing similar conditions. These peer group relationships often lead to gang involvement and truancy. The scope of this study is not on behavior issues, but rather on education, because the literature on immigrant youth living in America suggests academic achievement is a strong indicator of successful adaptation.

Because their unique outside school experiences are dissimilar from mainstream youth, many Hmong students struggle in traditional classrooms. Because Hmong culture is based on oral and group traditions, Hmong students excel at small group activities and verbal, rather than written communication. American teachers tend to be unfamiliar with these characteristics affecting Hmong students’ learning style and do not assess their abilities accurately. Many teachers also stereotype Hmong students as traditional “Asian nerds.” This false stereotype causes teachers to overlook Hmong students’ potential academic difficulties.
As an additional educational obstacle, many Hmong students come from families whose primary language is Hmong. Traditional parents, who may be fluent only in Hmong, may hold the idea that schools provide everything their children need for future survival in American society. Some schools' inability to communicate and connect with traditional Hmong parents exacerbates the barriers that exist between students and teachers. Schools should address these barriers since all students, Hmong included, benefit from parent participation.

Schools must develop environments that ensure all students have the opportunity to excel by affirming students' culture, involving parents in the educative process, and developing meaningful relationships between students and staff. Researcher James Griffith's study on academic achievement suggests that in-school relationships between teachers and students impact the academic success of minority students from poverty stricken backgrounds and may be even more influential in benefiting their overall welfare than academic supports alone. Griffith did not note this trend for middle class white students. Thus, cultivating these relationships is particularly critical for Hmong students, many of whom fall into the lower-income bracket.

John Ogbu's cultural ecological theory of minority academic performance describes many of the forces mediating Hmong students' academic success. Within Ogbu's framework, the school system refers to how minorities are treated by the policy and pedagogy within schools and school districts. The community forces refer to how minorities, influenced by their greater community, perceive and respond to their education and the institutions controlling education. Ogbu believes addressing both aspects is necessary to understand the trends within a minority group's school performance.

Educators have attempted to connect with Hmong students through charter schools, free alternatives to public schools that represent the growing trend toward privatizing education. These schools are locally governed, are exempt from some of the rules governing public schools, and have the potential to employ flexible and creative curricular and extra-curricular programming. However, many scholars are not convinced that charter schools produce gains in student academic achievement as defined by test scores or grades. As there is little data regarding Hmong students' performance in charter schools, it is necessary to assess whether charter schools with programming catering to Hmong students’ unique needs increases their academic achievement. Given Hmong students’ past negative experiences in public schools, charter schools may be a viable alternative for them.

This study examines the qualitative characteristics of one charter school and one non-charter public school as well as the academic achievement of the Hmong students attending both schools, to determine which climate is most conducive to academic performance (as measured by MCA-II scores, BST passing rate, and cumulative GPA). Both schools are located in St. Paul, Minnesota and cater to students with similar demographics. This study maintains that CPA, a K-12 charter school with a multicultural mission that encourages parent participation, will increase Hmong students' academic achievement as compared to Hmong students attending the non-charter public high school, HHS.

The study assesses English language learners (ELL) in public and charter schools. An ELL student is defined by the Minnesota Department of Education as a learner who: “(a) first learned a language other than English, comes from a home where a
language other than English is usually spoken, or does not use English as a primary language; AND (b) lacks the necessary English skills to fully participate in classes taught in English.” I am interested in whether ELL students perform better at CPA than at HHS, and whether there are differences in the achievement gaps (based on standardized testing) between the ELL and non-ELL students at both schools.

**METHODS**

A qualitative analysis of school climate using information from each school’s websites, CPA’s annual accountability reports, and HHS’ administrative manual was conducted. Additionally, a secondary analysis of data obtained from CPA’s curricular developer and HHS’ assessment office was performed. Student demographics including gender, primary home language, Free or Reduced Price Lunch (FRP), special education status, and English Language Learning (ELL) status are reported in Table A. (An ELL student is defined by the Minnesota Department of Education as a learner who: (a) first learned a language other than English, comes from a home where a language other than English is usually spoken, or does not use English as a primary language; AND (b) lacks the necessary English skills to fully participate in classes taught in English.) Because the students at both schools have similar demographics, student characteristics may be eliminated as a confounding factor. However, HHS is much bigger than CPA. Because all Asian American students attending both schools are included, sample sizes are different.

<table>
<thead>
<tr>
<th>Table A. Demographic Data from CPA &amp; HHS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
</tr>
<tr>
<td>HHS (n=56)</td>
</tr>
<tr>
<td>CPA (n=434)</td>
</tr>
</tbody>
</table>

_GPA was chosen as one measure of academic achievement because it yields a fair assessment of classroom engagement for ELL students._18, 19 Objective measures including the scores from the Minnesota Comprehensive Assessment-II (MCA-II), an exam that all public and charter school students must take and measures Minnesota students’ achievement in reading and math with respect to Minnesota’s academic standards were assessed. Students are exempt from taking the MCA-II depending on their level of English or special education supports. The Basic Skills Test (BST), another objective measure included in this study, is the graduation test all public and charter school students entered in 8th grade in or before 2004-2005 must take, and covers math, reading, and writing. This test has more explicit exemption rules for English language learners than the MCA-II exams. These data for each Asian
American student enrolled in 11th and 12th grade at both schools during the 2006-2007 academic year were collected.

The statistical package SPSS was used to analyze the academic achievement data. The first test conducted was an independent samples t-test, which determined whether observed differences between the two school-wide samples were statistically significant. This test was performed for MCA-II reading and math scores, as well as for cumulative GPA. Because BST passing rate is a nominal variable, a chi-square test to determine whether there were statistically significant differences in the passing rates between samples was also performed.

School-wide samples were disaggregated by ELL status to compare the performance of ELL students at CPA to ELL students at HHS utilizing the independent samples t-tests and chi-square tests. The procedure was repeated for the non-ELL students at both schools. Lastly, the performance of ELL students was compared to that of non-ELL students within each school, allowing assessment of the achievement gaps between the student subgroups at each school.

QUALITATIVE RESULTS

Based on the findings from the school website, CPA’s school system adequately reflects the needs of its students’ community. Although the school’s mission does not articulate it, the school targets Hmong students; nearly 70% of its nearly 600 students are Hmong. One of the priorities of CPA’s mission is to foster a non-violent and healthy community. The school maintains this community via PeaceBuilder’s program, a violence prevention program that encourages self-respect, self-discipline and positive social interactions so that students can create peaceful environments. This program also contributes to the school’s curriculum, which in addition to the traditional core subjects, requires all students in grades 9 through 12 to enroll in an ethics class. CPA also ensures students maintain a peaceful lifestyle outside the school building through its mentoring program. CPA requires all enrolled students to have an academic/spiritual mentor, typically a parent or legal guardian, who participates in all aspects of the student’s life inside and outside of school.

In addition to its peaceful mission, CPA ensures one-on-one contact between students and faculty. CPA’s teachers are trained in the Responsive Classroom method, a pedagogical approach in which teachers modify each classroom to match students’ specific needs. This method, coupled with CPA’s small class sizes, strives to provide individual attention for all students. Within this framework, CPA has developed a strong individualized ELL program for students needing English supports. Over the years, CPA has struggled with providing effective ELL services, but the school has made strengthening this service a priority. Currently, the school’s ELL supports meet each student’s specific English needs according to annual accountability reports conducted by outside agencies.

CPA provides a number of supports specific to Hmong families including a Hmong speaking home-school liaison. CPA also has developed supports addressing Hmong students’ tendency toward risky behaviors. The school partners with the Hmong Gang Strike Force, a community organization committed to identifying, investigating, and prosecuting Hmong gang members in Minnesota. A relationship with
the Truancy Intervention Program, a program run by the Ramsey County District Attorney’s office that administers legal consequences for students with poor attendance, also has been developed.22

HHS, a high school with an enrollment of nearly 2,200 students, does not overtly promote the non-violent agenda in its mission statement. HHS’ mission is to promote self-pride and life-long learning, respect all cultures, and provide a four-year school-to-work curriculum.23 Ultimately, HHS does not offer the same non-violent community-based programming as CPA. However, to compensate for the large overall community, HHS students divide into learning academies based on potential career interests. These include Fine Arts, Human Services, Medical and Environmental Studies, and Science Engineering and Industrial Technology. These academies allow students to develop relationships with their peers who share their interests, while encouraging students to think about their futures.24

In spite of HHS’ lack of required parent participation and non-violent programming, the school attempts to curb truancy and school violence in some of the same ways as CPA. For instance, HHS has a relationship with Ramsey County’s Truancy Intervention Program to prevent truancy. The school also provides extra-curricular activities that provide support for students based on shared ethnicity. These after-school groups, which include a Black Achievers Program, Hmong club and a multicultural excellence program, are attempts to provide another forum for students to connect with others and to establish a small community.25

QUANTITATIVE RESULTS

There were several differences in performance data between CPA and HHS, including statistically significant differences in cumulative GPA, MCA-II reading score, and BST math passing rate. There were no significant differences between the two samples in any other measure (Table B).

Table B. Comparison of Academic Achievement Indicators for Entire School Population

<table>
<thead>
<tr>
<th></th>
<th>Cumulative GPA</th>
<th>MCA-II Reading</th>
<th>MCA-II Math</th>
<th>BST Reading</th>
<th>BST Writing</th>
<th>BST Math</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPA</td>
<td>3.10 ± .51</td>
<td>1052.10 ± 11.47</td>
<td>1132.87 ± 5.50</td>
<td>95%*</td>
<td>87%*</td>
<td>96%*</td>
</tr>
<tr>
<td></td>
<td>(n=56)</td>
<td>(n=20)</td>
<td>(n=23)</td>
<td>(n=56)</td>
<td>(n=56)</td>
<td>(n=56)</td>
</tr>
<tr>
<td>HHS</td>
<td>2.73 ± .76</td>
<td>1044.12 ± 15.75</td>
<td>1129.62 ± 13.6</td>
<td>87%*</td>
<td>80%*</td>
<td>79%*</td>
</tr>
<tr>
<td></td>
<td>(n=433)</td>
<td>(n=189)</td>
<td>(n=201)</td>
<td>(n=434)</td>
<td>(n=434)</td>
<td>(n=434)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Statistically Significant?</th>
<th>Yes</th>
<th>Yes</th>
<th>No</th>
<th>No</th>
<th>Yes</th>
<th>p=.01</th>
</tr>
</thead>
</table>

*Percent of students who passed
To understand the overall performance differences between the samples at CPA and HHS, it is necessary to examine the performance of student subgroups. After disaggregating the samples by ELL status, the performance of non-ELL students at CPA was compared to that of the non-ELL students at HHS. There were no statistically significant differences between the non-ELL students at CPA and their counterparts at HHS in any measure but cumulative GPA (Table C).

Table C. Non-ELL Students at CPA vs. Non-ELL Students at HHS

<table>
<thead>
<tr>
<th></th>
<th>CPA</th>
<th>HHS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cumulative GPA</td>
<td>3.21 ± .54 (n=35)</td>
<td>2.99 ± .63 (n=181)</td>
</tr>
<tr>
<td>MCA-II Reading</td>
<td>1052.10 ± 5.50 (n=20)</td>
<td>1056.55 ± 9.78 (n=54)</td>
</tr>
<tr>
<td>MCA-II Math</td>
<td>1137.20 ± 8.54 (n=15)</td>
<td>1136.72 ± 13.25 (n=122)</td>
</tr>
<tr>
<td>BST Reading</td>
<td>100%* (n=35)</td>
<td>98%* (n=181)</td>
</tr>
<tr>
<td>BST Writing</td>
<td>97%* (n=35)</td>
<td>97%* (n=181)</td>
</tr>
<tr>
<td>BST Math</td>
<td>100%* (n=35)</td>
<td>100%* (n=181)</td>
</tr>
<tr>
<td>Statistically Significant?</td>
<td>Yes p=.05</td>
<td>No</td>
</tr>
</tbody>
</table>

*Percent of students who passed

When comparing the ELL students at CPA to those at HHS, there were no differences in MCA-II reading score, BST reading passing rate, or BST writing passing rate. It is important to note that all ELL students at CPA who would have been required to take the MCA-II reading exam were exempt due to their level of English supports. There were statistically significant differences in cumulative GPA, MCA-II math score, and BST math passing rate (Table D).

Table D. ELL Students at CPA vs. ELL Students at HHS

<table>
<thead>
<tr>
<th></th>
<th>CPA</th>
<th>HHS</th>
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<tbody>
<tr>
<td>Cumulative GPA</td>
<td>2.92 ± .40 (n=21)</td>
<td>2.55 ± .79 (n=252)</td>
</tr>
<tr>
<td>MCA-II Reading</td>
<td>N/A</td>
<td>1039.12 ± 11.60 (n=135)</td>
</tr>
<tr>
<td>MCA-II Math</td>
<td>1128.13 ± 9.93 (n=8)</td>
<td>1118.66 ± 12.82 (n=79)</td>
</tr>
<tr>
<td>BST Reading</td>
<td>85.7%* (n=21)</td>
<td>75.5%* (n=253)</td>
</tr>
<tr>
<td>BST Writing</td>
<td>76.2%* (n=21)</td>
<td>59.7%* (n=253)</td>
</tr>
<tr>
<td>BST Math</td>
<td>90.5%* (n=21)</td>
<td>60.1%* (n=253)</td>
</tr>
<tr>
<td>Statistically Significant?</td>
<td>Yes p=.01</td>
<td>N/A</td>
</tr>
</tbody>
</table>

*Percent of students who passed
The achievement gaps between the ELL and non-ELL students within each school were examined by comparing the performance of the ELL students at CPA to the non-ELL students at CPA. This process was repeated with the data from HHS. Performance gaps on all measures except MCA-II reading score between ELL and non-ELL students at HHS were larger than gaps between the two groups at CPA. See Table E for achievement gap data at CPA and Table F for achievement gap data at HHS.

**Table E. Achievement Gap Data for CPA**

<table>
<thead>
<tr>
<th></th>
<th>Cumulative GPA</th>
<th>MCA-II Reading</th>
<th>MCA-II Math</th>
<th>BST Reading</th>
<th>BST Writing</th>
<th>BST Math</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ELL</strong></td>
<td>2.92 ± .40</td>
<td>N/A</td>
<td>1128.73 ± 9.93 (n=8)</td>
<td>86%* (n=21)</td>
<td>76%* (n=21)</td>
<td>91%* (n=21)</td>
</tr>
<tr>
<td><strong>Non-ELL</strong></td>
<td>3.22 ± .54</td>
<td>1052.10 ± 11.47 (n=20)</td>
<td>1137.20 ± 8.54 (n=15)</td>
<td>100%* (n=35)</td>
<td>97%* (n=35)</td>
<td>100%* (n=35)</td>
</tr>
<tr>
<td><strong>Statistically Significant?</strong></td>
<td>Yes, p=.05</td>
<td>Yes p=.05</td>
<td>Yes p=.05</td>
<td>Yes p=.05</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td><strong>Gaps in Performance</strong></td>
<td>0.3 grade points</td>
<td>N/A</td>
<td>8.6 points</td>
<td>14 percentage points</td>
<td>21 percentage points</td>
<td>9 percentage points</td>
</tr>
</tbody>
</table>

*Percent of students who passed

**Table F. Achievement Gap Data for HHS**

<table>
<thead>
<tr>
<th></th>
<th>Cumulative GPA</th>
<th>MCA-II Reading</th>
<th>MCA-II Math</th>
<th>BST Reading</th>
<th>BST Writing</th>
<th>BST Math</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ELL</strong></td>
<td>2.55 ± .79</td>
<td>1039.41 ± 11.61 (n=135)</td>
<td>1118.66 ± 12.82 (n=79)</td>
<td>76%* (n=253)</td>
<td>60%* (n=253)</td>
<td>60%* (n=253)</td>
</tr>
<tr>
<td><strong>Non-ELL</strong></td>
<td>3.00 ± .63</td>
<td>1056.56 ± 9.78 (n=54)</td>
<td>1136 ± 13.25 (n=122)</td>
<td>97%* (n=181)</td>
<td>98%* (n=181)</td>
<td>98%* (n=181)</td>
</tr>
<tr>
<td><strong>Statistically Significant?</strong></td>
<td>Yes p=.01</td>
<td>Yes p=.01</td>
<td>Yes p=.01</td>
<td>Yes p=.01</td>
<td>Yes p=.01</td>
<td>Yes p=.01</td>
</tr>
<tr>
<td><strong>Gaps in Performance</strong></td>
<td>0.45 grade points</td>
<td>17.15 points</td>
<td>17.34 points</td>
<td>21 percentage points</td>
<td>38 percentage points</td>
<td>38 percentage points</td>
</tr>
</tbody>
</table>

*Percent of students who passed
CONCLUSIONS

This study helps to explain how learning environments impact the academic performance of Hmong students in Minnesota. Results indicate that while non-ELL Hmong students perform comparably at either type of school, ELL Hmong students may benefit from attending a charter school. This conclusion is based on the findings that ELL students at CPA performed better on many achievement measures compared to their counterparts at HHS, and that achievement gaps are smaller between ELL and non-ELL students at CPA than at HHS.

The explanations for these observed results stem from each school’s overall climate. CPA requires parent involvement, which is instrumental in enhancing students’ achievement. However, the fact that parents choose to send their children to CPA may indicate a confounding factor. In spite of this potential bias, other factors may have influenced the differences in performance between the two sets of ELL Hmong students. CPA has programming that targets at-risk Hmong students to ensure they do not succumb to the pressures of violence and truancy. Furthermore, CPA is smaller than HHS and has the resources to devote more attention to each student. On the other hand, students at HHS, ELL students specifically, may feel anonymous and without support. All teachers at both schools are expected to cultivate positive and peaceful classrooms. However, when coupled with small class sizes, the classrooms within CPA provide an individualized context for learning in which ELL students are not neglected. Although the classrooms at HHS undoubtedly provide a context for learning, the classrooms within CPA may address the needs of ELL Hmong students more adequately than those at HHS.

This study complements Ogbu’s cultural-ecological theory, which states that schools’ practices and the attitudes toward education existing in minority communities affect student achievement. The school system at CPA favors the educational and emotional growth of its minority students. Parents’ agreement to partner with the school to promote a healthy lifestyle is an illustration of their belief that obtaining an education will be beneficial. These school- and community-wide supports do not play as pivotal a role in the mission of HHS. The differences in underlying attitude may explain the differences found to exist between ELL Hmong students at CPA and HHS.

To be certain of such differences, future research could include a qualitative assessment of school climate to determine whether both schools provide what they claim to provide in their mission statements. Additionally, it would be useful to research other measures of school engagement such as attendance or participation in after-school activities.

NOTES


6 Zhou, 63-95.


12 Ogbu & Simmons, 158.


15 See Methods section for a full description of these exams.

16 Minnesota Department of Education, “Minnesota English Language Proficiency Standards for English language learners k-12,” (July 10, 2003), 1.

17 As a charter school, CPA is required to publish annual reports highlighting their strengths and weaknesses. These reports can be downloaded from the CPA website. These reports are not required of public schools.


22 Lange, 1-10.


25 Harding High School, 8-10.
ABSTRACT

What is it that our hands are doing while we speak? Gesture naturally accompanies spoken explanations for many people, but does it affect cognition or is it simply there for show? A previous experiment (Roediger & Karpicke, 2006b) demonstrated that when studying for a future test, writing out studied material is more beneficial than simply re-reading it. We hypothesized that gesturing would serve the same beneficial function as writing.

In our experiment we added two conditions to the previous Roediger paradigm. We investigated how explaining information on Day 1 would compare to re-reading and written recall. We divided explanation into two conditions: explanation with and explanation without gesture. During the gesture condition, subjects were allowed to move their hands freely. During explanation without gesture, subjects were asked to keep their hands on the table while they explained the passage. Subjects returned 48 hours later and took a written recall test for each of the four studied passages.

We found that written recall and explaining the passage with gesture on Day 1 produced equivalent memory when tested on Day 2. Furthermore, both of these conditions were significantly better than the re-reading condition. Explanation without gesture produced slightly better memory than re-reading, but was significantly worse when compared to explanation with gesture and almost significantly worse when compared to written recall. It appears that gesture aids the brain when encoding the information, leading to better memory at retrieval.

FACULTY MENTOR: DR. HENRY L. ROEDIGIER III

Professor Henry L. Roediger III is a James S. McDonnell Distinguished University Professor in Psychology and the Dean of Academic Planning in Arts & Sciences. Dr. Roediger’s research interests include such topics as how people can suffer memory illusions and false memories), implicit memory and, most recently, applying cognitive psychology to improving learning in educational situations.

ACKNOWLEDGEMENTS

A very special thank you to Professor Henry L. Roediger III who gave me the opportunity to create an original study as an undergraduate. Thank you very much as well to Keith Lyle who mentored me throughout the year, helping me turn ideas into studies and guiding me once we discovered our finding. Thanks also to all my friends who volunteered their time; without you there would be nothing to report. This research was supported by a Collaborative Activity Grant from the James S. McDonnell Foundation to Henry L. Roediger III.
INTRODUCTION

Memory in some respects works like a muscle. For a muscle to be as large and strong as possible, we must practice using it. A wealth of research shows that memory for an event is enhanced when we practice retrieving the memory. A recent study by Roediger and Karpicke1 neatly demonstrates this effect. Subjects studied two short expository passages and then were tested on their memory of the passages either at the end of the same experimental session, two days later, or one week later. The key manipulation was what subjects did immediately after studying each passage. After studying one of the passages, subjects simply restudied it. After studying the other passage, subjects wrote out as much of the passage as they could remember. The final test consisted of writing out everything subjects could remember from both passages. The results were clear: On a final test taken two days or one week after initial study, subjects recalled more information from the passage they wrote out than from the one they restudied. In other words, memory for a passage was better when people had practiced retrieving their memory.

To the extent that retrieval practice following initial study constitutes an instance of encoding the material prior to a final written test, written retrieval practice could be thought of as involving more transfer appropriate processing,2,3 than rereading. According to TAP, memory is better if the processing that occurred at encoding overlaps with the processing that occurs at retrieval.4 Therefore a possible prediction is that given a written final test, written retrieval practice would benefit memory more than rereading the passage would. With written practice, the identical type of mental and motoric processing (i.e., retrieving information and writing it down) would occur at both practice and final test, while with rereading, the studying process bears little resemblance to the final test.

Another common way to implement retrieval practice under real-world conditions is to describe, or explain, out loud, the content of a text after reading it. This sort of spoken retrieval practice may occur in study groups or other collaborative settings in which people read material and then convey it to others via the spoken word. Spoken retrieval may be more feasible than written, but does it “strengthen” the memory muscle in the same way? Given a written final test—which has an obvious analogue in educational settings—does spoken retrieval practice enhance memory compared to restudying, and how does spoken retrieval compare to written? In other words, does the benefit of retrieval practice depend on whether it is spoken or written?

Along with spoken recall comes another phenomenon—gesture. Gesture is a ubiquitous aspect of verbal communication,5 but does it have any impact on memory for what is said? Research by Goldin-Meadow, Nusbaum, Kelly & Wagner6 has shown that gesture has consequences for working memory. For example, when people are asked to explain how they solved a math problem while simultaneously trying to remember a list of unrelated items, they remember more of the items if they gesture during their explanation than if they do not gesture (see also Wagner, Nusbaum & Goldin-Meadow7). This is true whether it is their own choice not to gesture or whether they are instructed not to gesture. Thus, it seems that gesture may free up cognitive resources that would otherwise be used to explain the solution and allow those resources to be allocated to processing the to-be-remembered words.
How might gesturing, versus not gesturing, during spoken retrieval practice affect memory for a passage? If, as Goldin-Meadow et al. argue, gesture frees up cognitive resources, then retrieval practice accompanied by gesture would allow the subject more available resources during practice to process what they are saying in a deeper or more varied way, as opposed to spending resources primarily on “getting the words out.”

In addition to comparing the benefits of written versus spoken retrieval practice on a final written test, in the present investigation we asked whether the value of spoken practice depends on whether it is accompanied by gesture. Therefore, in Experiments 1A and 1B, we replicated the two-day retention interval condition in the Roediger & Karpicke research, but we had subjects study four passages, instead of two, and had them engage in two novel activities immediately after studying the additional passages. Thus, one passage was followed by restudy, one by written retrieval, and the other two by spoken retrieval. Specifically, in the latter case, subjects were asked to explain everything they could remember from the passage to the experimenter, who remained in the room and listened attentively. During explanation of one of the passages, subjects were encouraged to move their hands. During explanation of the other passage, subjects were told to keep their hands palms down on the table in front of them, thereby depriving them of hand gestures.

We predicted that on the final test, subjects would remember more of the passage that they explained with gesture than the one they explained without gesture. We furthermore predicted that more would be remembered from the passage that was explained with gesture than the passage that was restudied. It was less clear if subjects would remember more from the passage they explained without gesture than the one they restudied. However, this comparison provides an excellent way to strain out the pure effects of gesture because the explanation without gesture acts as a control for the effects of gesture. Finally, we wondered how explanation with gesture would compare to written retrieval in terms of impact on final written recall, but we ventured no prediction about whether one condition would be better than the other.

**METHODS**

Experiments 1A and 1B were very similar and data from them were combined for the purpose of analysis. Therefore, we describe the Method for each of the two experiments separately before presenting the Results from the two experiments together.

**EXPERIMENT 1A**

**SUBJECTS**

Twenty-four Washington University undergraduates, ages 18 to 23, participated in partial fulfillment of course requirements or for money.
MATERIALS

Four prose passages were selected from the reading comprehension section of a test-preparation book for the Test of English as a Foreign Language (TOEFL; Rogers, 2001). Each passage covered a single topic (“Traffic and Communities,” “The Sun,” “Sea Otters,” and “History of Jazz”), and each was divided into 30 idea units for scoring purposes. For the written recall condition and all final tests, lined paper with the topic name at the top was used.

PROCEDURE

Each subject came into the lab for two experimental sessions, held 48 hours apart. In Session 1, subjects were given six minutes to study each passage. After studying each passage, they engaged in one of the following tasks:

Restudy—subjects restudied the same passage.

Written recall—subjects wrote out everything they could remember from the passage they had just studied.

Explain with gesture—subjects explained everything they could remember from the passage they had just read to the experimenter, who sat in the testing room and listened silently but attentively. To encourage movement, subjects were told not to hold their hands in their lap. If the subjects did not move their hands, the experimenter would gently remind them by visibly moving his own hands, or by repeating the instruction encouraging gesture.

Explain without gesture—same as explain with gesture, except that subjects kept their hands palms down on the table in front of them while they gave their explanation. If the subjects began to move their hands, the experimenter would gently remind them not to by putting his own hands palms down on the table, or by repeating the instruction.

Subjects were given up to six minutes for each post-study activity. In the restudy and written recall tasks, if subjects finished in less than six minutes, they were asked to continue with the task until the six minutes elapsed. In the explanation tasks (with and without gesture) all subjects finished explaining the passage well before the six minutes were up. After subjects stated that their explanation was complete, they were asked to take an additional thirty seconds to think back through the passage in case there was anything they wanted to add. The extra time mirrored the opportunity given to the reread and written recall conditions to look over either the passage or what they had written during the six minutes. Each subject performed all four post-study activities, one per passage.

In Session 2, subjects were tested on their memory for all four passages. Using the same instructions and materials as in the written recall post-study activity in Session
1, subjects wrote down as much as they could remember about each of the four passages. Passages were tested in the same order they were studied on Day 1. Subjects were allowed six minutes to recall as much information as they could from each passage.

The four passages were cycled from position one to position four to partially counterbalance them, and the follow-up tasks were fully counterbalanced.

### EXPERIMENT 1B

#### SUBJECTS

Twenty-four Washington University undergraduates, ages 17-22, participated in partial fulfillment of course requirements or for money.

#### MATERIALS

Same as in Experiment 1A.

#### PROCEDURE

The procedure was very similar to Experiment 1A, but with the following changes: Subjects were given ten minutes instead of six for the written recall post-study activity in Session 1 and they were given ten minutes instead of six to recall each passage on the final test in Session 2. Also, subjects’ explanations of the passages (both with and without gesture) in Session 1 were recorded on audiotapes.

#### RESULTS

##### Final Test

We first report performance on the final test. For each subject, we calculated the proportion (out of 30) of idea units recalled from each passage. We then entered the proportions into a 2 (experiment 1A or 1B) X 4 (post-study activity: restudy, written recall, explain with gesture, explain without gesture) ANOVA in which the first factor was between-subjects and the second was within. There was no main effect of experiment and no interaction with post-study activity, indicating that the minor procedural changes we made between experiments did not influence our results. Therefore, we removed experiment as a factor and report the results of a one-way, within-subjects ANOVA on post-study activity. Figure 1 shows the pattern of results obtained. There was an effect of post-study activity \[ F(3, 141) = 4.03, MSe = .01, p < .01 \], with recall lowest for the passage that was restudied, slightly higher for the passage that was explained without gesture, and higher still for the passages that were explained with gesture or recalled in the written modality. Mean recall in the latter two conditions was exactly equivalent. We then performed a number of follow-up \( t \)-tests to determine which differences between conditions were reliable.
Written recall and explain with gesture, which did not differ from one another, both produced significantly greater recall than restudy [smallest \( t(47) = 2.64, p = .01 \)]. In contrast, explain without gesture did not lead to a reliable increase in recall over restudy \([t(47) = .84]\). Furthermore, explain without gesture was significantly lower than explain with gesture \([t(47) = 2.06, p < .05]\) and marginally significantly lower than written recall \([t(47) = 1.93, p = .06]\).

Session 1 Recall
In both experiments, subjects recalled three of the passages immediately after studying them during Session 1 (the fourth passage was restudied). Thus, it is interesting to compare how many idea units subjects recalled under the three different recall conditions (written, spoken with gesture, spoken without gesture) during this initial recall period. In Experiment 1B, we recorded subjects’ spoken explanations and hence were able to make this comparison. For each subject, we calculated the proportion of idea units (out of 30) they produced (either on the written recall sheet or on the audiotape) immediately after studying the passages. We submitted the proportions to a one-way ANOVA with three levels corresponding to the three post-study activities. There was no main effect of activity \([F(2, 46) = 1.75, MSe = .01]\). The mean proportions of idea units recalled are plotted in Figure 2.

DISCUSSION
Together, Experiments 1A and 1B show that spoken retrieval practice benefits memory on a written final test as much as does written practice, but only if speech is accompanied by gesture. When spoken retrieval practice was performed in the absence of hand gestures, retrieval did not increase memory for a passage compared to restudying a passage. We first discuss issues arising from the observed equivalence of spoken and written retrieval practice and then consider why spoken practice without gesture was not as beneficial.

The fact that spoken retrieval practice with gesture benefited memory every bit as much as written retrieval is striking because the processing done at initial retrieval in the former case can be viewed as less transfer appropriate than in the latter case, given a written final test. One interpretation of this finding is that the effect of retrieval practice on subsequent memory does not depend on reinstating motoric processing that occurred during initial retrieval. However, this interpretation is premature because we did not fully cross practice modality with final test modality. Therefore, we do not know whether, given written practice, subsequent memory would have been worse on an oral final test versus a written test, or whether, given spoken practice, subsequent memory would have been better on an oral final test versus a written one. The equivalence of spoken and written practice, given a written test, does not necessarily mean that reinstating motoric processing has no effect on the magnitude of the testing effect. Rather, such equivalence could arise if spoken retrieval practice is, in fact, more powerful than written, but this greater power was offset by the failure of the final test in our procedure to reinstate processing involved in speaking and gesturing. By this interpretation, spoken retrieval may be viewed as having been, in our experiments, as beneficial as written, not because transfer appropriate processing does not
matter, but in spite of the fact that transfer appropriate processing does matter.

Whatever the true case may be, from a practical perspective, the equivalence of spoken and written retrieval practice is welcome because exams in classroom settings are likely to be written but, as discussed in the Introduction, written retrieval practice may be undesirable to students. Indeed, in these experiments, we observed one reason why written practice may be less attractive to students than spoken; namely, the former takes longer than the latter. Although we did not record how long subjects spent on task in the written recall condition, we consistently observed that they spent much more time writing than they did explaining the passage to the experimenter. This is not surprising—speech is faster than handwriting—but it is important insofar as it makes speech a more efficient modality for retrieval practice. In a single study session, a student can practice retrieving more information via speech than via writing.

If retrieving information in the spoken modality benefits memory on a written final test, as shown by performance in the explanation with gesture condition, then why did such retrieval not have that effect in the explanation without gesture condition? One possibility concerns the attentional demands placed on subjects in the without-gesture versus the with-gesture condition. It is possible to see the without-gesture task, which required subjects to monitor the position of their hands so that they did not lift them from the table, as demanding attention. After all, we may assume that people would not naturally keep their hands flat on the table while giving an explanation, but rather would move them freely. In contrast, in the with-gesture condition, subjects were encouraged to move their hands, a more natural task for the subject to perform. Thus, one could hypothesize that although subjects practiced retrieval in both the with- and without-gesture conditions, the subjects’ attention was divided from retrieval in the latter condition by the presence of the without-gesture task, and this reduced the benefit of retrieval practice on subsequent memory.

By the above hypothesis, one might expect that if the without-gesture task distracted subjects from retrieval, they would retrieve less about a passage immediately after reading it given the without-gesture instructions than the with-gesture instructions. However, as seen in Figure 2, this was not the case. In fact, subjects recalled numerically more in the without-gesture condition than the with-gesture condition in Session 1. This finding weakens the plausibility of the hypothesis that attention was divided in the without-gesture condition, thereby eliminating the benefit of retrieval practice. Although it is not clear why spoken retrieval practice without gesture did not produce a significant testing effect, the null effect is reminiscent of one obtained by Noice and Noice. They found that subjects who practiced speaking dialogue to another person subsequently failed to recall significantly more of the dialogue on a written test than did subjects who studied the dialogue silently. In Noice and Noice’s experiments, the only condition that produced significantly better subsequent memory than silent study was one in which subjects both spoke the dialogue and walked around the laboratory. Noice and Noice’s finding, along with our own, suggest that the natural movement that accompanies speech, the use of hand gesture in our study, gives the subject a cognitive advantage that generates better recall for studied items.
Notes


Alzheimer’s Disease: Generation of Amyloid-beta

Author:
Michelle Mo
Michelle is a junior majoring in Biology. She first started research through the Summer Scholars in Biology and Biomedical Research Program at Washington University and has continued ever since. She was fortunate enough to have a wonderful mentor, Dr. Nathan Wolins, who fueled her love for research and helped her grow as a scientist. Her research over the summer at Cornell Medical University with Dr. Gunnar Gouras furthered her passion. Michelle would eventually like to pursue a Ph.D. in biology focusing on cancer related research.

KEY TERMS
- Alzheimer’s Disease
- Amyloid-beta (Aβ)
- Amyloid Precursor Protein (APP)
- DAPT
- Tetracysteine

ABSTRACT
Amyloid-beta (Aβ) is a peptide largely responsible for the amyloid plaques that form in the brains of Alzheimer’s disease patients. An increase in the concentration of a specific type of Aβ, Aβ42, has been linked to familial and sporadic Alzheimer’s disease. An understanding of where Aβ42 is generated will give much needed insight into the process involved in amyloid plaque formation.

Because Aβ42 is a small peptide located in the middle of the APP gene, distinguishing Aβ42 from its larger counterpart, APP, has proven especially difficult. Common tags such as green fluorescent protein (GFP) cannot be used due to the inability of Aβ to accommodate them. To address this, a construct was generated using a tetracysteine tag inserted into a region designed potentially redundant for Aβ function given the normal generation of Aβ 1-40/42 and Aβ 11-40/42. Using both live cell imaging and fluorescent microscopy, the movement of Aβ throughout a cell can be tracked and knowledge as to where Aβ is generated and transported in a neuron relative to APP can be known.

In order to better understand the process of Aβ generation, an alternative method was developed. Using a Y-secretase inhibitor and subcellular markers, buildup of C-terminal fragments of APP can be observed and the location of Aβ formation can be deduced.

FACULTY MENTOR: DR. GUNNAR GOURAS
Dr. Gunnar Gouras M.D. is an Associate Professor of Neurology and Neuroscience at the Cornell Medical College. He is a neurologist and neuroscientist with expertise in neurodegenerative diseases of aging, especially those associated with cognitive and memory decline. Dr. Gouras’s and his colleagues are working to elucidate the molecular and cellular biology of Alzheimer’s disease with the goal of developing novel treatment strategies for this ever more prevalent disease of aging.

ACKNOWLEDGEMENTS
I would like to thank Dr. Gunnar Gouras, Dr. Estibaliz Capetillo, and the other members of the Gouras lab for their help this summer. I would also like to thank the Maxfield laboratory for their assistance with the generation of the tetracysteine constructs. Finally, I would like to thank the Gateways to the Laboratory Program, Jason Willis, and the Office of Undergraduate Research.
INTRODUCTION

“We are the sum of our memories. Everything we know, everything we perceive, every movement we make is shaped by them.”

Pathology of Alzheimer’s disease

It was in March of 1907 that the world first became aware of the presence of a terrible neurodegenerative disease. Four and a half years earlier, Auguste D. had been admitted to a psychiatric hospital in Germany with puzzling symptoms – memory loss, disorientation, and unexplainable bursts of anger towards her husband. Alois Alzheimer had been the first physician to treat Auguste, and was perplexed at how a once seemingly healthy 51-year old woman could suddenly demonstrate progressively worsening symptoms of senility that eventually would lead to death.

During Auguste’s autopsy, Alzheimer found something thoroughly shocking. At the microscopic level, he was able to see that Auguste’s cortex was spotted with brown plaques too numerous to count. They varied in size and shape, located between neurons normally occupied by glial cells. The cortex also harbored tangles that were composed of overgrown fibrils. Neurons that grew near these fibrils were either destroyed, missing a nucleus, or missing entire cell contents. Auguste D.’s disease was not the result of some psychic disturbance, but was instead a progressive neurodegenerative disease that invaded the brain causing neuronal death.

Much more is now known about what causes Alzheimer’s disease and the symptoms that are associated with it. Currently, more than five million Americans have Alzheimer’s disease. That number is expected to increase dramatically in the coming years as life expectancy rises. While a cure for Alzheimer’s may seem as farfetched as a cure for cancer, the continuation of research allows for such a cure to someday become a reality.

Amyloid precursor protein and Amyloid-beta

Amyloid-beta (Aβ) is a small unimposing peptide of 40 to 42/43 amino acids that has the ability to wreak havoc on neurons. It is derived through a series of sequential cleavage steps from a larger parent protein that has been implicated in Alzheimer’s disease, the amyloid precursor protein (APP). There are two pathways that APP follows – a non-amyloidogenic pathway and an amyloidogenic pathway (Figure 1). In the non-amyloidogenic pathway, APP is cleaved by the \( \alpha \)-secretase and \( \gamma \)-secretase into a soluble and harmless P3 peptide. In the amyloidogenic pathway, APP is cleaved by \( \beta \)-secretase and \( \gamma \)-secretase into Aβ40 or Aβ42.

It is known that APP follows the amyloidogenic pathway less frequently than it does the non-amyloidogenic pathway. It has been found that when mutations occur in either the APP molecule or the cleavage enzymes, APP follows the amyloidogenic pathway more often. Mutations in APP results in buildup of Aβ and are therefore linked to familial Alzheimer’s disease (FAD). The symptoms associated with Alzheimer’s disease, however, are not only due to the amount of Aβ produced, but to the ratio of Aβ40 to Aβ42 as well. This is due to the fact that Aβ42 is more hydrophobic and less soluble of a peptide than Aβ40. If one has a greater amount of Aβ40 in
neurons than Aβ242, fewer plaques will form. However, if one has a greater amount of Aβ42 in neurons than Aβ40, more plaques will form.2

Tetracysteine and Aβ42

Knowing where Aβ42 is generated within a neuron or a model cell can lead to therapeutic agents targeting formation of that peptide. Inhibiting production of Aβ42 may slow down or even stop the symptoms of Alzheimer’s disease from progressing. However, proper inhibition of Aβ42 would be difficult until the exact location of Aβ42 generation is discovered.

In order to target the location of Aβ42 generation, one needs to be able to visualize the peptide within a cell or neuron. Visualizing and labeling Aβ42 has proven difficult, as Aβ42 is a small peptide when cleaved and is also part of a larger protein complex. Common fluorescent tags such as green fluorescent protein (GFP) cannot be used because the size of the tag exceeds the length of Aβ42. Also, because GFP is a large tag consisting of 238 amino acids, its folding and processing within a cell may interfere with another protein’s function. To combat this predicament, tetracysteine, a small tag consisting of six amino acids, can be used to label the Aβ42 peptide. The tetracysteine motif consists of the sequence – Cys-Cys-Xaa-Xaa-Cys-Cys – where Xaa is any amino acid except cysteine.3 What makes this motif unique is that it is rarely found in naturally occurring proteins and is therefore a specific tag to the agents that bind onto it.4 Once the tetracysteine motif has been incorporated into the protein of interest, biarsenical reagents, called FlAsH or ReAsH can be used to induce fluorescent emission of that protein. The manner in which this works is that FlAsH and ReAsH contain two arsenics that enables them to bind specifically to the tetracysteine motif. The binding of FlAsH or ReAsH causes a change in conformation of that region and results in the FlAsH/ReAsH reagent converting to a highly fluorescent state that can be detected at various emission peaks.4

DAPT and Aβ42

N-[N-(3,5-difluorophenacetyl)-L-alanyl]-S-phenylglycine t-butyl ester, more commonly known as DAPT, is a γ-secretase inhibitor. DAPT inhibition is an alternative method to the tetracysteine tag method, allowing identification of Aβ generation and a better understanding of γ-secretase’s activity.

Elucidation of these two factors is crucial because although therapeutic inhibition of γ-secretase is possible, it is extremely difficult since γ-secretase is responsible for many roles within different cells. Knowing specifically where and how γ-secretase acts on APP allows for more specific targeting of the enzyme. In addition, knowing which organelles γ-secretase is associated with and where in a cell or neuron γ-secretase operates can bring us one step closer to knowing where Aβ42 is generated. Therefore, it is hypothesized that DAPT can be used to inhibit γ-secretase activity within neurons, subcellular markers can be added to identify organelles associated with γ-secretase activity, and selective steps can be blocked along the endocytic pathway in order to better understand where exactly γ-secretase operates.
METHOD

Western Blot
Proteins were extracted from N2A cells or COS-1 cells that were transfected with desired construct. Each protein sample was separated using either a 10-12% Tris-Glycine SDS-PAGE (Invitrogen) or NuPage 4-12% Bis-Tris SDS-PAGE (Invitrogen). They were then transferred onto a nitrocellulose membrane, and developed in a Konica Minolta film processor (SRX-101A, Konica Minolta Medical Imaging, Wayne, NJ).

Fluorescence Microscopy
N2A cells, COS-1 cells, and neurons cultured on coverslips were fixed and then labeled with primary antibodies in 2% NGS overnight. Secondary antibodies diluted in 2% NGS were added to the coverslips for an hour.

Mouse Primary Neurons
Primary neurons were obtained from the embryos of transgenic Tg2576 mice (over-expresses APP and has K670N, M671L double mutation) and wild type mice. The cortices from the embryos were dissected, trypsinized, and broken up by pipeting with a glass pipette. The recently harvested neurons were then placed on poly-D-lysine coated plates in neurobasal medium and the cultures were then maintained at 37 ºC in 5% CO₂.

Tetracysteine
N2A cells and COS-1 cells were split at a low density onto coverslips. They were transfected the following day using Lipofectamine (Invitrogen) and various tetracysteine constructs (Table 1). Following the overnight incubation, 200 nM FlAsH was added to each coverslip and allowed to incubate overnight at 37 ºC in 5% CO₂. Coverslips were washed, fixed, and then mounted.

<table>
<thead>
<tr>
<th>Construct</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>TC-Swe-II</td>
<td>Contains the Swedish mutation with a second generation tetracysteine tag at the first 16 aa of Aβ</td>
</tr>
<tr>
<td>TC-Swe-III</td>
<td>Contains the Swedish mutation with the third generation tetracysteine tag at the first 12 aa of Aβ</td>
</tr>
<tr>
<td>TC-Swe-III Cherry</td>
<td>Contains the Swedish mutation with the third generation tetracysteine tag and a cherry tag at the C-terminus</td>
</tr>
<tr>
<td>APP-YFP</td>
<td>Contains a YFP tag at the C-terminus of APP</td>
</tr>
</tbody>
</table>
DAPT Treatment
Primary neurons were harvested as described above and were plated onto coverslips. DAPT was added to half the coverslips while the other half remained untreated. Following overnight incubation, coverslips were fixed, labeled with primary and secondary antibodies, and then mounted.

RESULTS

Imaging of TC constructs
When FlAsH was added, N2A cells had more background and nonspecific staining than did COS cells. In the images displayed, the FlAsH region emits a green fluorescence and the mCherry a red fluorescence. When the two images are overlayed, colocalization is indicated in yellow. The colocalized regions designate areas where APP has not yet been cleaved, while the isolated green and red punctate designate the formation of Aβ and the CTFs, respectively.

Figure 2 shows a magnified view of a COS cell transfected with the TC-Swe-III Cherry construct and treated with FlAsH. In this cell, colocalization is seen in the middle, indicating that in that particular region, Aβ has not yet been cleaved from the CTF. The arrows in the figure indicate a likely location of Aβ generation. Further studies using subcellular markers can be performed to isolate the specific organelle of Aβ generation.

Imaging γ-secretase Inhibition in Swedish N2A
Swedish N2A cells were stained with 369, an antibody that recognizes the C-terminal fragment of APP, and P21, an antibody that recognizes the N-terminal fragment of APP. An increased fluorescence of the 369 antibody was observed in DAPT treated cells, indicating higher levels of CTFs compared to untreated cells, and supporting γ-secretase inhibition.

Imaging γ-secretase Inhibition in Transgenic Neurons
Once DAPT treatment revealed positive results in Swedish N2A cells, treatment was performed in mouse neurons in order to better understand γ-secretase inhibition at the neuronal level. The neurons were obtained from the embryos of Tg2576 mice; mice that contain the Swedish mutation that allows for overexpression of Aβ. Figure 3 shows transgenic neurons that were either treated or untreated with DAPT. Both conditions were taken at 40x magnification with a 500 ms exposure time.

When the two treatment conditions are compared, there is evidence of increased levels of CTFs in DAPT treated neurons, due to increased fluorescence levels of the 369 antibody. There are also many more individualized punctate visible in the processes of DAPT treated neurons compared to the untreated neurons, indicating vesicle buildup of either CTFs or uncleaved APP.

Figure 4 depicts an enlarged view of a neuronal process in the overlayed panel of the DAPT treated neuron in Figure 3. The production site of CTFs after introduction of DAPT is of particular interest to this study. According to the fluorescence used,
individual red puncta within the neuronal processes indicate buildup of CTFs and are likely the region where CTFs are cleaved by the γ-secretase. The arrows in Figure 4 point to specific regions within the neuronal process that indicate buildup of the CTFs in vesicles. Such vesicle buildup of CTFs leads to the possibility of certain organelle association with the CTFs as well as potential sites of γ-secretase activity.

DISCUSSION
In this study, we are looking for the site of Aβ generation using two distinct methods: a tetracysteine tag attached to an Aβ construct and a γ-secretase inhibition method. While the tetracysteine method more directly indicates the location of Aβ generation, experiments have proven difficult due to excessive background with the fluorescence. An alternative method, using γ-secretase inhibition, was therefore used in order to better understand Aβ generation.

Tetracysteine
Although there was difficulty with the FlAsH staining and washes, promising results were obtained from the tetracysteine experiments. After numerous transfections and incubations with FlAsH, COS cells were found to be better than N2A cells at reducing the amount of background and nonspecific staining. Ideally, it would be best if the TCIII cherry construct could be visualized through live imaging and pulse chase experiments. By using live imaging, when and where the Aβ peptide is cleaved within a cell could be observed. Cells can then be fixed and stained with subcellular markers so that the organelle in which Aβ is generated can be located.

The pulse chase experiment, while conceptually similar to the live imaging experiment, is a time course experiment that takes advantage of two biarsenical reagents – FlAsH and ReAsH. Using these two reagents and a construct containing a CFP tag at the C-terminus, one would be able to observe where the previously generated Aβ peptide has migrated to, and where the novel Aβ peptide is being generated. Both these methods allow APP and the Aβ peptide to be tracked within cells and ultimately, in neurons.

γ-secretase Inhibition
Understanding the location of γ-secretase activity within a cell is crucial as γ-secretase is the enzyme that releases the Aβ peptide and the APP intracellular domain (AICD). Although blocking γ-secretase cleavage may not be as ideal as blocking production of Aβ directly, it is a step closer to limiting the devastating symptoms of Alzheimer’s disease. Similar to Aβ, many locations of γ-secretase cleavage activity have been proposed. In the experiments that we have performed thus far, the results obtained have been extremely promising. The western blot performed with Swedish N2A cells treated with or without DAPT shows an increase of α- and β- CTFs when γ-secretase activity is blocked. At the cellular level, Swedish N2A cells treated with DAPT for 24 hours show a large amplification in CTF production, indicated by a noticeable increase in red fluorescence. In transgenic neurons similar results were obtained. However, unlike Swedish N2As, neurons contain long processes, allowing for a more accurate depiction of γ-secretase activity in the brain. Most of the CTFs are
Figure 1.
APP Processing into Amyloid-beta

This figure depicts the two pathways that the amyloid precursor protein follows. The first is the non-amyloidogenic pathway and the second is the amyloidogenic pathway. Both pathways are cleaved in sequential steps. The non-amyloidogenic is cleaved by an α-secretase, while the amyloidogenic is cleaved by a β-secretase. While the non-amyloidogenic pathway does not seem to produce any harmful peptidyl products, the amyloidogenic pathway is responsible for producing the amyloid-beta peptide (Aβ).

CONCLUSION

Understanding the location of Aβ generation is crucial because therapeutic agents can be used to target formation of a peptide that wreaks havoc within human brains. Although it has been difficult to verify the location of Aβ generation within a cell using the tetracysteine tag, results have been promising and location of Aβ generation will likely be determined in the near future.

While pharmacological inhibition of γ-secretase activity is not as ideal as inhibition of Aβ peptide formation alone, an understanding of γ-secretase’s activity in relation to APP cleavage is crucial. γ-secretase plays many roles within different cells. Knowing specifically where and how it acts on APP allows for more precise inhibition of the enzyme. Inhibition of γ-secretase activity within neurons, addition of subcellular markers to identify organelles associated with γ-secretase activity, and blockage of selective steps along the secretory pathway can better allow the inhibition of Aβ production.

Knowledge of Aβ generation will likely play a large role in the development of pharmacological agents that can be used to target formation of the Aβ peptide, hopefully preventing progression of the devastating symptoms of Alzheimer’s disease.
Figure 2.
Magnified View of COS Cell
This figure depicts a magnified view of a single COS cell. The arrows are pointing to areas where the puncta are not colocalized. The red fluorescence indicates a CTF of the APP molecule while the green fluorescence indicates the Aβ peptide. The non-colocalized region of the cell indicates potential areas of Aβ generation.

Figure 3.
Fluorescent Microscopy of DAPT/nonDAPT Treated Neurons
These images show DAPT treated transgenic neurons and untreated neurons. A 40x magnification at an exposure of 500 ms was used. An antibody that recognizes the C-terminus of APP, 369 was used along with an antibody that recognizes the middle region of APP, P21. The box in the overlayed panel of the DAPT treated neurons indicates the magnified view seen in Figure 4.

Figure 4.
Enlarged Process of DAPT treated transgenic Neuron
The figure shows an enlarged portion of the transgenic neuron treated with DAPT for 24 hours. Arrows are pointing to region where CTFs have accumulated. The accumulation of CTFs indicates the region where γ-secretase normally cleaves.
NOTES


Author:
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Christina graduated Summa cum Laude from Washington University in May 2007 with a B.A. in the Interdisciplinary Project in the Humanities (IPH) and minors in French and Music. Majoring in IPH allowed her to indulge her love for the humanities and pursue several independent research experiences. She completed her first research project on Germaine de Staël as a sophomore. Her continuing research and interest in the culture and literature of the French Revolution period led to the senior thesis on which the following article is based. Christina is currently an intern at the Washington University Catholic Student Center and plans to pursue a career in arts administration or teaching English.

ABSTRACT
The French Revolution gave rise to the modern nation and sparked vigorous debates about who should belong to it. This study analyzes the models of national identity in two eyewitness accounts of the Revolution: Germaine de Staël's Considerations on the French Revolution and Helen Maria Williams's Letters from France. As women and religious minorities, Staël and Williams had historically been second-class citizens; furthermore, their nationalities were not easily classified because their lives crossed geographical boundaries. Yet their views about national identity have not been thoroughly explored, as most previous studies of their works have concentrated on gender. Through analysis of the Considerations and the Letters, this study concludes that Staël and Williams based membership in the nation on two factors: support for liberty, characterized by moderate representative government, and emotional attachment to the nation. Their inclusive, cosmopolitan model was independent of gender or religion and allowed people to belong to multiple nations. Though this ideal seemed attainable in the early Revolution, France reverted to exclusive nationalism during both the Reign of Terror and Napoleon's empire. While their ideas were not widely accepted, Williams and Staël presented an important alternative to the ethnic nationalism that came to dominate Europe in the nineteenth century. Furthermore, they offer two insights into modern discussions of citizenship: first, that one's experience of belonging to a nation is not determined by one's legal status; and second, that cosmopolitanism can coexist with patriotism.

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Professor Steven C. Hause Ph.D. is a Professor in the Department of History and a Senior Scholar in the Humanities in International and Area Studies. His research explores the Protestant minority in France, especially during the period 1860-1910 and the role of Protestants in the founding of the Third Republic. Of particular interest is the creation of a republic dedicated to human rights (especially the rights of women and minorities). Dr. Hause's publications include the award winning "Women's Suffrage and Social Politics in the French Third Republic."

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KEY TERMS
- Calvinism
- Citizen
- Cosmopolitanism
- Dissenter
- French Revolution
- National Identity
- Sensibility

Peer Editor:
Olga Lozovskaya, a sophomore majoring in Economics and Mathematics
ARTICLE 15

1. Everyone has the right to a nationality.
2. No one shall be arbitrarily deprived of his nationality nor denied the right to change his nationality.

-UN Universal Declaration of Human Rights, 1948

The Declaration of Human Rights presumes that the possession of a nationality is, or should be, part of the universal human experience. However, it does not address the question of how to define “nationality.” By what criteria should it be determined? If everyone has the right to a single nationality, what about those who wish to add another without abandoning their first?

This question is no less salient to democratic societies today than it was in 1948. However, it does not begin with the UN Declaration. In fact, it has its European roots in the French Revolution, which is commonly associated with the rise of modern nationalism. Before 1789, membership in France and other European countries was based on a subject’s relationship to a monarch. However, in June 1789 a group of deputies broke away from France’s traditional parliamentary body, the Estates General, to form the National Assembly. In doing so, they abolished all privileges of special groups such as nobles, clergy, and guilds. They envisioned the nation as a community of free and equal citizens in their Declaration of the Rights of Man and the Citizen, the intellectual ancestor of the UN Declaration quoted above. Yet immediately they confronted a new question, which historian Lynn Hunt frames as: “Who was included in the definition of a ‘man and citizen’?” France had traditionally excluded members of various groups, including women and Protestants, from full membership in the country, and the revolutionaries had to decide whether to include such groups in the new nation. Furthermore, as scholar Michael Rapport points out, the revolutionaries’ belief that all people had universal rights sometimes conflicted with their concept of a finite nation to which some belonged and others did not. The idea of universal rights implied that people from many countries could participate in French public life, but the idea of a nation meant that only French citizens, defined by birth or naturalization, had certain privileges in France. During the period 1789-1815, French leaders repeatedly confronted the question of whom to exclude from the nation and whom to include. Answering it was no small matter, but rather a central part of the revolutionary project.

Two commentators on the French Revolution, Germaine de Staël and Helen Maria Williams, offer valuable perspectives on this important question, not only because of their involvement in revolutionary politics but also because of their own complex experiences of national identity. Born and raised in Catholic France by Swiss Calvinist parents, Germaine de Staël (1766-1817) had ties to multiple countries all her life. She strongly supported the early Revolution but fled to Switzerland and England during the more radical Reign of Terror. She was quite outspoken about her political views, and as a result, first the Directory and then Napoleon exiled her during most of the period between 1795 and 1814. During that time, she traveled widely in Europe and wrote influential works about countries such as Germany and Italy. However, she still considered France her home, even though she was never granted citizenship there. She
became a prominent intellectual who held Enlightenment salons and wrote in many genres, ranging from novels to political commentary. Her *Considerations on the French Revolution* (1818) was only published posthumously, but it had a major influence on nineteenth-century liberal historiography of the Revolution. Afterwards, however, it was largely overlooked until the later twentieth century. Although Staël considered herself French, she struggled throughout her life to claim membership in her chosen nation.

Helen Maria Williams (1761-1827) was born and raised on the other side of the English Channel, in Britain. Like Staël, she belonged to a Protestant group which was a religious minority: Dissenters outside the established Anglican Church. While her nationality at birth was easier to classify than Staël’s, her Francophilia complicated her national identity. She visited France in 1790 and 1791 and enthusiastically supported the early Revolution. She wrote her first two volumes of *Letters from France* to explain the Revolution to British readers, and these were very popular, comparable to major works by male writers. However, as the Revolution grew more radical and British public opinion turned increasingly conservative, Williams faced widespread disapproval. She left Britain for the third time in 1792 and never returned, living in France nearly all the rest of her life. Her political opinions were similar to Staël’s: she wrote six more volumes of *Letters from France* in which she condemned the Jacobins, and she also opposed Napoleon. Williams was imprisoned briefly under both these governments and fled to Switzerland for six months in 1794, although she never faced the level of persecution that Staël did. She published further political commentaries in 1801, 1815, and 1819 and became a French citizen in 1817 under the Restoration. At her death she was nearly forgotten, but recently she has received increased attention as one of the foremost British observers of the Revolution. As Staël’s French loyalties were repeatedly questioned, so were Williams’s British ones. Williams did not, however, see loyalty to both France and Britain as contradictory but portrayed herself as an unofficial dual citizen of both countries in her works.

Staël’s *Considerations on the French Revolution* and Williams’s *Letters from France* were influential in their time and remain worthy of historical study. However, both received little scholarly attention until the advent of feminism in the late twentieth century. Not surprisingly, most recent research has viewed their gender as the most important, or even the only, influence on their work. While Staël’s and Williams’s experiences as women cannot be ignored, their experiences of national identity, which have not often been studied, are also essential for understanding their lives and their work. They are natural subjects for a comparative study because, among women authors of the period, they wrote the most comprehensive accounts of the French Revolution. Furthermore, Staël and Williams offer insight into the larger context of revolutionary debates about the nation. They proposed a far more inclusive model of the nation than most revolutionaries, probably because they were often excluded from nations to which they wanted to belong. This study thus fills a gap in research on Staël and Williams as well as on the idea of the nation during the French Revolution. By analyzing the *Considerations on the French Revolution* and the *Letters from France*, this research asks: What were Staël’s and Williams’s models of national identity? In particular, what criteria did they propose for belonging to a nation, and how did they characterize their own complex national identities?
In the eighteenth century, just like today, birth and ancestry were obvious criteria for determining membership in a country. However, like many others caught up in the promise of 1789, Staël and Williams envisioned a nation in which place of origin mattered little. Instead, Staël argued that commitment to political ideal of “liberty” produced national loyalty, declaring, “dans un grand état, la liberté et le bonheur que donne cette liberté, peuvent seuls inspirer un véritable patriotisme” (“in a great state, liberty, and the happiness arising from that liberty, can alone inspire true patriotism.”) Williams also praised “liberty” repeatedly. Although neither explicitly defined the word, they used it to characterize a moderate political position comprising several elements. Some of these elements were liberal for the time, such as legal equality for all, widespread political participation, and a consistent justice system. Others, such as educated leadership and minimal violence, were more conservative and led them to oppose the Jacobins during the Reign of Terror. Overall, Williams and Staël envisioned a nation based not on narrow political orthodoxy, but on broad principles which allowed for a variety of opinions.

Although their concept of liberty may seem mundane in modern-day democracies, it led Staël and Williams to argue that membership in the nation should be greatly expanded, to a degree that was radical in the late eighteenth century. When Williams wrote of her arrival in France at the 1790 Festival of the Federation, one year after the fall of the Bastille, she cried ecstatically, “Oh no! this was not a time in which the distinctions of country were remembered. It was the triumph of human kind; it was man asserting the noblest privileges of his nature; and it required but the common feelings of humanity to become in that moment a citizen of the world.” Deborah Kennedy, Williams’s biographer, concludes that this experience was “not one of foreignness, but one of belonging, so that her political agreement with revolutionary ideals acts as a bond between her and the people around her.” As a revolutionary, Williams cared little that she was legally British. Claiming allegiance to an ideal of liberty that united her with the French, and indeed with all “human kind” across national boundaries, she declared that political principles mattered more than birth in determining who could belong to the nation.

Staël and Williams considered political liberalism a rational position and a necessary prerequisite for membership in a nation, but they believed that strong emotional ties to a country were equally indispensable. Both expressed their feelings of belonging to nations in passionate language. Williams, for instance, recounted that upon joining the crowd at the former site of the Bastille, “I too, though but a sojourner in their land, rejoiced in their happiness, joined the universal voice, and repeated with all my heart and soul, ‘Vive la Nation!’” While she acknowledged her foreignness as a British “sojourner,” she could still share in the French citizens’ joy. Her emotional reaction led her to join “the universal voice” of the revolutionary cause, and she symbolically became part of the French nation as she shouted its motto. Such a style was characteristic of the late eighteenth-century ethic of sensibility, which emphasized personal emotion in proper balance with reason. In this passage, Williams used the passionate language of sensibility to present herself as both British and French, demonstrating a sense of unofficial dual citizenship that persisted throughout her years of writing.

Staël used the language of sensibility less often than Williams, but it still reinforced her connection to France at key points in the Considerations. Both women infused
autobiographical, often emotional passages into their writing, a mixture of genres that was not uncommon among eighteenth-century historians. Staël’s description of her return with her father to Paris in 1789, shortly after the fall of the Bastille, is a case in point. She remembered that as the French surrounded her father in adoration, her happiness was so great that “je perdis connaissance à force de joie” [“I was bereft of my senses by joy”]. Echoing Williams at the Festival of the Federation, she used her own sentiment, combined with the crowd’s collective sentiments, to validate the political events of the Revolution.

Continuing her account, Staël made it clear that her ecstatic fainting expressed not only love of her father but love of France. Asserting that the Revolution had gone downhill after the celebration of the fall of the Bastille, she cried, “Adieu, France qui vouliez la liberté, et qui pouviez alors si facilement l’obtenir! …Toutefois, vous avez tant mérité d’être aimée, qu’on se flatte encore de vous retrouver enfin telle que vous étiez dans les premiers jours de la réunion nationale. Un ami, qui reviendroit après une longue absence, n’en seroit que plus vivement accueilli!” [“Farewell, France, which desired liberty, and which might then so easily have obtained it! …Yet you have ever so deserved to be loved, that one still hopes to find you again at last, as you were in the first days of the national reunion. A friend who reappeared after a long absence would not be more warmly welcomed”]. Like Williams’s reaction at the Bastille, this remark was based more on eyewitness emotion than reason. Staël’s cries of “Adieu!” personified France as a long-lost friend; according to Marilyn Yalom, “this emotional rhetoric, inherited directly from Rousseau, situates moral authority in one’s feelings.” In the new nation envisioned by Staël and Williams, moral authority came from both emotional belonging and liberal principles. France’s very existence was in question when its leaders turned away from liberty, but Staël remained loyal to it because of her affective ties: it was “a friend” who “deserved to be loved” even in its darkest days.

Many recent commentators have seen in Williams’s and Staël’s use of sensibility a particularly “feminine” method of defending the Revolution, given that in this era women were generally considered more emotional than rational. However, it is problematic to link this technique too closely to gender or politics. For example, Edmund Burke, the foremost British opponent of the French Revolution, frequently used the language of sensibility; it was not the exclusively the tool of women or of liberals. Yet gender certainly plays a role in the Considerations and the Letters, even if not as large a one as many scholars have argued. While these works did not advocate political equality for the sexes, they created a space in which women could act in the public sphere. Women and men were equally capable of filling the criteria for belonging to the nation: support for liberty and emotional attachment. While most male revolutionaries classified women as only “passive” citizens, Williams and Staël developed an idea of the nation which allowed the active participation of both sexes, a position consistent with their own political involvement in their writings and salons.

Just as gender was not a barrier to membership in Williams’s and Staël’s ideal nations, neither was religion. Both women were religious minorities before the Revolution, Williams as a Presbyterian Dissenter in Anglican Britain and Staël as a Calvinist in Catholic France. In both countries, those who did not conform to the established church were usually tolerated in the eighteenth century. In Britain, they were allowed to attend their own churches. In France, the law prohibited non-Catholic
services, but Calvinists still worshipped openly in some areas. However, in both Britain and France, members of religious minorities continually faced doubts about their loyalty and threats of persecution. In contrast, one did not have to belong to a certain church to fulfill Williams’s and Staël’s criteria of liberty and emotional attachment, so they believed people of any religion could belong to the nation. Both women celebrated the early Revolution’s institution of religious freedom. Williams provided a shining example of ecumenical harmony in the 1790 Festival of the Bastille at Negre-Pelifffe, where “half of the inhabitants being Protestants, and the other half Catholics, the Curé and the Protestant Minister ascended together one altar...and administered the [national] oath to their respective parishioners at the same moment; after which, Catholic and Protestants joined in singing Te Deum.”

She enthused that “religious worship was never performed more truly in the spirit of the Divine author of Christianity, whose great precept is that of universal love!” In this passage, Williams showed that the “universal love” of Christian faith could foster an emotional attachment to the Revolution, enabling members of all churches to be loyal members of the nation as well. While Williams said little about religions other than Christianity, her proclamation of universal love could be applicable to followers of any faith. She believed that the early French Revolution established an inclusive liberal nation, in which all were French regardless of their religion and religion and revolution supported each other.

Both women staunchly opposed a state-supported church, but they incorporated Protestant principles into their political ideas on the grounds that these could strengthen the liberal nation. They considered Protestantism a faith that fostered support for liberty and sincere emotion; thus, it could encourage national loyalty without excluding members of other religions. Staël explicitly connected her religion to her politics when she asserted that “l’ordre social, qui admet tous nos semblables à l’égalité devant la loi, comme devant Dieu, est aussi-bien d’accord avec la religion chrétienne qu’avec la véritable liberté” (“social order, which admits all our fellow creatures to equality before the law, as before God, is as much in harmony with the Christian religion as with true liberty”). In contrast to Old Regime Catholicism, which supported the social hierarchy, she argued that true Christianity justified legal equality. Just as Protestants believed that everyone was equal before God, everyone should be equal before the law. For Staël and Williams, religion provided further support for an inclusive nation which would break down old barriers to membership.

Staël and Williams wanted nations to accept people outside usual categories of political party, gender, and religion, as long as they supported liberty and loved the country. But to which nations did they themselves belong? Two additional factors complicated their national identities: cosmopolitanism and displacement. The first, “cosmopolitanism,” describes an appreciation for and connection to multiple countries rather than a coherent philosophy. Staël’s and Williams’s views were, like those Adriana Craciun discusses, part of a “radicalizing cosmopolitanism, developing doctrines of universal human rights, and resisting national ‘prejudices’” during the Revolution, even in an “era of intensifying nationalisms.” In fact, despite the usual opposition between cosmopolitanism and nationalism (i.e. loyalty to a single country), Staël and Williams believed the two were not incompatible. Furthermore, their cosmopolitanism was influenced by experiences of displacement: Staël spent her exile
from France in many European countries, and Williams was a British expatriate in France.

Although Staël wrote extensively on many nations she visited, including Germany and Italy, her cosmopolitanism in the Considerations consisted mainly of praise for England. She strongly admired its institutions and encouraged France to emulate them, while at the same time asserting her French identity. Simone Balayé, a leading Staël scholar, argues that Staël tried “d’ouvrir les Français…à ce qui est autre, sans répudier le moi” [“to open the French…to what is other, without repudiating the self”]. However, many French were skeptical of this project: Napoleon’s police chief, the Duke of Rovigo, renewed her exile in 1810 with the comment, “It has seemed to me that the air of this country did not agree with you, and we are not yet reduced to seeking models among the nations you admire. Your latest work is not French.”

While Staël argued that cosmopolitanism and patriotism could be compatible, increasingly exclusive French nationalism insisted otherwise.

Despite her admiration for other countries, Staël deeply mourned her exile from France. She presented exile as a punishment worse than death that weakened people’s emotional attachments to the nation: “Les affections de choix, souvent même celles de famille, les habitudes de société, les intérêts de fortune, tout est compromis ; et, ce qui est plus cruel encore, tous les liens se relâchent, et l’on finit par être étranger à sa patrie.” [“What one most loves, often even family, social life, material interests, is imperiled; and what is even more cruel, all ties are loosened and one ends up a stranger to one’s own land”]. In this passage Staël revealed that, for her, the most painful part of exile was separation from people. It “loosened all ties” and left the victim almost totally alienated, even “a stranger to one's own land.” However, she did not abandon her French identity in exile, as concern for loved ones still gave her an affective connection to France. She viewed her nation not as an abstract entity, but as the location of beloved people and possessions that gave life meaning.

Staël faced perhaps her greatest crisis of national identity in 1798 when Napoleon invaded Switzerland on behalf of the Directory. She met with him personally and attempted to dissuade him, to no avail. The fact that Switzerland was her parents’ country seems to have contributed to her strong opposition. In fact, the invasion upset her so much that she admitted, “je fis des voeux alors contre les François pour la première fois de ma vie; pour la première fois de ma vie, j’éprouvai la douloureuse angoisse de blâmer mon propre pays assez pour souhaiter le triomphe de ceux qui le combattoient” [“then I entertained wishes against the French for the first time in my life; for the first time in my life I experienced the painful anguish of blaming my own country enough to desire the triumph of those who fought against it”]. At this crucial moment, Staël seemed surprised at her paradoxical reactions: she “desired” for the Swiss to win and the French to lose. Suddenly, a strong emotional bond to her parents’ nation overpowered her usual loyalties. Yet her attachment to France was not gone, for she called it “my own country” and felt “painful anguish” at her wish for its defeat. Two of her national identities warred against each other, on an emotional rather than an intellectual level. Although this atypical incident should not be taken as a renunciation of Staël’s French identity, it demonstrated that cosmopolitan citizenship was unsustainable in a world of conquest. Staël wanted to be French without renouncing her family ties to Switzerland, but war between the two countries forced her to take sides,
even if only for a short time.

Williams's experiences differed from Staël's in that she voluntarily left her birth country rather than being forcibly exiled. Furthermore, she viewed herself fairly consistently as a member of both Britain and France, while Staël identified primarily with France. However, Williams resembled Staël in that she envisioned a model of national identity which would not be at odds with her experiences of cosmopolitanism and displacement. She at first saw the Revolution as a triumph of cosmopolitanism, as shown in the famous passage cited earlier declaring herself “a citizen of the world.”

She identified even more strongly with the French nation when she stated, “it seems the recompense of my French patriotism that I have on several occasions had the good fortune to witness those scenes [of the Revolution].” Williams's claim to “French patriotism” could be seen as a repudiation of her Englishness. However, Rapport finds that “foreign patriot” was not a contradiction during the early Revolution, for “French” identity was based on support for liberal principles which were theoretically universal. Because emotional attachment played a central role in her concept of national identity, Williams could be considered French when she joined the crowd at the Federation “with all her heart and soul.”

However, Williams also asserted her Englishness in the early Letters, suggesting that she did not intend to repudiate her birth country when she claimed to be a “citizen of the world” and a “French patriot.” During her second journey, she wrote to her friend Dr. Moore that “in long exile far from you I roam” and nostalgically recalled “the landscapes of my native isle,” i.e. England. She also lamented her friends’ “social circle, and my vacant place!” Like Staël, Williams experienced separation from her country most keenly as separation from the people she loved. When she missed them, even a voluntary trip abroad could be an “exile” comparable to Staël’s, and her emotional ties connected her to England. These statements came just a few pages after Williams spoke of her “French patriotism,” and the juxtaposition is evidence that she did not see a contradiction between her two national identities.

However, many Britons found Williams's love for Britain incompatible with her love for France because of the centuries-old rivalry between the two countries. Research on British nationalism helps to explain why Williams's position was so dangerous: Linda Colley argues that during the eighteenth and early nineteenth centuries, the British developed a sense of themselves as a nation in response to conflict with the French Other. Williams's Francophilia thus threatened the British-French opposition at the heart of British national identity: the belief that the British were different from and superior to the French in every way. Her former friend Anna Seward wrote to her in a letter published in February 1793, urging, “Love and respect your country half as well as I love and respect you; and I trust we shall soon cease to view you in a state of cold alienation.” She suggested that Williams betrayed her birth country by loving France. Although she asserted both her British and French sympathies, many members of both nations considered her an outsider. The problem became worse when Britain and France went to war in 1793 and remained at war for most of the next two decades. While Staël wrote openly about her conflicted loyalties when France invaded Switzerland, for the most part Williams avoided mentioning the wars between her two nations. She tried to walk a fine line of neutrality but apparently could find no satisfactory solution to the problem of what side she was on.
The Terror tempered Williams’s Francophilia somewhat, both because she disagreed with French politics and because the government was often hostile to foreigners. As surveillance of everyone in France increased, a law passed on October 9, 1793 ordered the arrest of all British subjects in the country. When imprisoned in Les Anglaises, a convent of English nuns, Williams found that “the tie of a common country” bound the women there together “so strong[ly], that it seemed…that we were born each other’s friends.”33 Now that Williams had been rejected by radical republican France, she became more willing to embrace her own English nationality based on birth. However, she continued to show the futility of determining national identity primarily by birthplace. She described “a few persons, who born of French parents, having passed their whole lives in France, and not speaking one word of our native language, seemed astonished to find by their imprisonment that they were English women. They had no trace or recollection of that country which in evil hour chanced to give them birth.”34 These women, though born in England, had no ties to the nation by ancestry, memory, language, or emotion. In mocking the Jacobins for classifying them as English, Williams suggested that determinations of national identity had to consider more than birth.

Williams never set aside her years in her adopted nation, explaining in 1815, “France is to me also the country of my friends—of persons endeared to me by the tie of common suffering…How should I have lived so many years among the French without loving that amiable people…!”35 Like Staël, Williams demonstrated that much of her connection to France was based on relationships with people. Her statement that she had “lived…among the French” implied that she did not quite consider herself one of them, but after living in France for two decades of much “suffering” and “tempest,” she maintained her emotional ties there in addition to her English identity.

Williams’s and Staël’s experiences of national identity extended beyond the borders of a single nation, and they suggested that liberty and love should be the only criteria for belonging to inclusive nations. In their writings, they strove to validate their own senses of belonging, which did not match official classifications of their nationalities. They hoped the French Revolution’s cosmopolitanism would allow them to be members of multiple countries—Staël could be French despite having a Swiss family, and Williams could be British and French simultaneously. However, their concepts of national identity proved impossible to implement fully as more exclusionary ideas of nationality developed under the Terror and Napoleon’s empire.

Staël’s and Williams’s writings revealed the limits of revolutionary concepts of citizenship, with which liberal societies still struggle today. Nations need to define who their members are, but neat legal boundaries do not always agree with individuals’ intangible feelings of belonging to national communities. As a result, a legal document like the UN Declaration of Rights does little to untangle the complexities of national identity. Perhaps the problems of defining nationality arise most clearly today in discussions about immigration. While people may not be legal citizens of a nation, they may feel more emotional attachment to that nation than to their family’s country of origin, just as Staël felt herself to be French rather than Swiss. Even though many countries now allow dual citizenship, many people argue that immigrants should leave their old loyalties behind altogether when they come to a new nation, an idea Williams resisted. It is essential to remember that experiences of national identity are highly
personal and individual, and that Williams and Staël are only two cases. However, these women show that loyalty to one nation can coexist with appreciation for and even membership in others—a lesson modern nations would do well to remember.

Notes


4 Rapport, 332.

5 During some of this time Staël was exiled only from Paris, but at other times she was exiled from all of France. See the sources below for details.


7 Biographical information for Williams is based on Deborah Kennedy, *Helen Maria Williams and the Age of Revolution* (Lewisburg: Bucknell University Press, 2002).


13 Staël, *Considérations*, 1.168 [trans. adapted from Baldwin, Cradock, and Joy, 1.253].

14 Staël, *Considérations*, 1.169 [trans. adapted from Baldwin, Cradock, and Joy, 1.253].


17 Williams, *Letters*, 1.1.63.

18 Williams, *Letters*, 1.1.64.
Staël, *Considérations*, 1.64 [trans. Baldwin, Cradock, and Joy, 1.4].

Adriana Craciun, *British Women Writers and the French Revolution: Citizens of the World* (New York: Palgrave Macmillan, 2005), 3. The word “nationalism” was not yet in use during the revolutionary period, but the concept was developing.


Trans. and qtd. in Berger, 273.

Staël, *Considérations*, 4.385 [trans. adapted from Berger, 103-104].

Staël, *Considérations*, 3.345 [trans. adapted from Baldwin, Cradock, and Joy, 3.214].


Williams, *Letters*, 1.2.2.

Rapport, 4.


Williams, *Letters*, 1.2.10.


Qtd. in Kennedy, *Helen Maria Williams*, 96.


Helen Maria Williams, *A Narrative of the Events Which Have Taken Place in France from the Landing of Napoleon Bonaparte on the First of March, 1815, till the Restoration of Louis XVIII* (Cleveland: Burrows, 1894), 304.
Toward a Better Understanding of...  

Growth Cone Navigation  
Mostafa Ahmed  

Mentor: Dr. Paul Bridgman

The precise navigation of growing axons to their targets is critical to the mammalian nervous system. Filopodia, projections of growth cones, are believed to have receptors that integrate environmental cues that signal where growth should take place. Two important types of cues are those on the extracellular matrix (substratum) and those soluble in the media. Integrins are a major class of receptors that mediate matrix environment signaling and respond to laminin, fibronectin and collagen. Diffusible cues have cell-type specific receptors that allow for growth towards the cue (attractant cue) or away from the cue (repulsive cue). One important cue is the neurotrophin Nerve Growth Factor (NGF) that binds to its high-affinity receptor trkA. Understanding how the extracellular matrix and diffusible cues induce precise navigation is the focus of this investigation.

An assay to study the process of growth cone turning at laminin and NGF borders has been developed using microfluidic devices. An interesting feature is that the diffusible cue NGF is substrate bound. High temporal and spatial resolution live imaging of growth cone interactions at laminin-NGF borders is accomplished using a Zeiss LSM 510 two-photon microscope. At these interfaces there are two phenomena of interest: 1) growth cones that start on laminin cross onto NGF and 2) growth cones that start on NGF turn at the laminin-NGF interface. Since growth cones are expected to show preference for laminin, the latter phenomenon is especially interesting. Turning at laminin-NGF borders from NGF suggests that growth cones are integrating signals from laminin and NGF in a manner that prevents complete preference for laminin or NGF. It is believed that these signals converge to act upon neuronal myosin II which is abundant in growth cones. Myosin II has been implicated as a necessary protein for growth cone guidance on laminin, but this work shows that guidance by diffusible cues such as NGF are also myosin II dependent.
Due to launch and cost restrictions, the ability to develop and operate a modern satellite is limited to a few nations with outstanding space programs and advanced private industry. The development of nanosatellites – satellites on the order of 50 kg instead of 5,000 kg, and $100,000 instead of $10 billion – may rapidly increase the number of missions launched.

The Akoya and Bandit satellites developed by Washington University’s Aerospace Systems Laboratory were designed to demonstrate a nanosatellite’s ability to perform proximity operations and rapid integration missions with a budget of $300,000 over the past three years. Proximity operations consist of one satellite maneuvering relative to another nearby satellite. The Akoya host spacecraft (35 kg) contains two Bandit free-flyers (3 kg) that can be released from Akoya and perform autonomous flight operations, such as inspection and redocking. This is the first space mission to test flight and repeatable docking of extremely small spacecraft at millimeter-level separation. Rapid integration verifies the ability to integrate space hardware quickly – within minutes – by standardizing interfaces and communication between subsystems. The space industry is dominated by “safe” legacy hardware; rapid integration allows risk-averse, efficient, and a low-cost build of new novel payloads and components. This experiment was successfully ground tested with the Washington University and Santa Clara University satellites at the Small Satellite Conference in August, 2006. The satellites were connected and interoperated within 45 minutes of seeing each other’s hardware for the first time.

The development of Bandit and Akoya are a part of the Air Force Research Laboratory’s University Nanosat-4 and –5 competitions. Bandit/Akoya placed second of eleven schools at Nanosat-4 in March, 2007, and is currently preparing to launch as the final flight hardware is completed.
Finding a Neurochemical Marker for Pacemaking Cells in the Suprachiasmatic Nucleus
Nikhil Angelo

Mentor: Dr. Erik D. Herzog

Circadian rhythms in behavior and physiology are driven by biological clocks with intrinsic periods close to 24 hours. Neurons within the mammalian suprachiasmatic nucleus (SCN) are circadian pacemakers. Some SCN neurons express either arginine-vasopressin (AVP), vasoactive intestinal peptide (VIP) or other neuropeptides and, in the absence of cell-to-cell communication, display either sustained, damped, or no rhythms in gene expression. To test the hypothesis that a neuropeptide marks a class of identifiable SCN pacemaker neurons, each cell’s circadian rhythmicity was correlated with its neurochemical content.

SCN neurons taken from PERIOD2:LUCIFERASE (PER2:LUC) transgenic mice were cultured and bioluminescence was recorded as a reporter of gene expression. Methods to maintain the health of neurons cultured at low density by supplementing with glial-conditioned medium were developed so gene expression could be recorded for up to 5 days in the absence of cell-to-cell communication. Neurons were scored as sustained, damped or non-oscillators based on their changes in bioluminescence over time. The cultures were then fixed, immunolabeled for AVP and VIP, and imaged using epifluorescence microscopy. Preliminary findings show that a subset of low-density SCN neurons label for either AVP or VIP. Additionally, the percentage of AVP and VIP-expressing neurons in these cultures is consistent with that in high-density and previous anatomical studies. Methods are being developed to identify immunolabeled cells after bioluminescence recording and the neuropeptide content of rhythmic, damped and cells.
Delay discounting refers to the decrease in the subjective value of a reward as the time before it is received increases. A hyperboloid function has been shown to describe the discounting observed in both humans using hypothetical monetary rewards and rats and pigeons using consumable food rewards. Prior research has suggested that differences in income levels affect the rate of discounting in human subjects. Lower-income individuals discounted delayed hypothetical monetary rewards significantly more steeply than upper-income individuals.

The current research examines an animal model of income level using pigeons and rats using food-deprivation level as a proxy for income level. A modified adjusting-amount procedure was used to estimate the amount of immediate reward judged equal in value to a delayed reward, using cellulose pellets sweetened with saccharin as the edible reward. A 32-pellet delayed reward was studied at 6 delays varying from 1 second to 24 seconds. The animals experienced both high- and low-deprivation conditions, in which they were kept at 75-80% and 90-95% of their free feeding (pigeon) or growth-adjusted weight (rat), respectively. The data were analyzed using both a simple hyperbolic function and area under the curve to determine if the animals displayed greater discounting under greater levels of deprivation (i.e., lower income level).
This study evaluates how companies’ investment decisions change based on substantial changes in firm ownership by the Chief Executive Officer (CEO). While extensive research has been performed on how and to what extent CEOs change their business decisions based on the number of options received in their compensation package, little is known about what happens after those options are exercised. Data on stock ownership by CEOs as well as levels of corporate investment in research and development, capital expenditures, and leverage ratios were analyzed to infer how these CEOs choose to invest corporate funds after their investment in the firm has changed significantly.
The dance concert Close. Closer. Closed is a choreographic investigation of relationships. The show is composed of five pieces, *She’s Come Undone, Exchange, Unbounded, What’s/Who’s Left Behind*, and *Ghosts*. All were conceived utilizing different choreographic processes. The piece, *She’s Come Undone*, has undergone the most extensive research. It was performed in several dance workshops and critiqued by students and members of the dance faculty. *She’s Come Undone* was performed at the American College Dance Festival, where it was adjudicated and given more feedback by a panel of esteemed choreographers. The inspiration for *She’s Come Undone* came from various gender stratification theories, bad stereotypes of women, and ideas developed from Introduction to Women’s Studies class discussions. The dance became an artistic and physical extension of the choreographer’s own personal experiences as a woman in today’s society. During rehearsals and improvisation, the dance built upon four female dancers, each of whom began to embody their own personal female stereotype. *She’s Come Undone* became a piece that portrayed the reluctance of women to stand alone because they feel pressured to depend on one another. The four very feminine dancers perform violent, angry movements to show their disgust for one another, but also continue to reach for one another out of habit or the insecurity of being alone. This work has been a creative journey, portraying the significant personal relationships that have characterized the choreographer’s life and culminates in a symbolic compilation of choreography.
How do we give the triers of fact leeway to assess a legitimate case of provocation or self-defense without allowing their illegitimate biases about sexual orientation to permeate the process? Presently, our legal system has rejected a strict categorical approach in such cases, in favor of an approach that allows the fact-finder to assess what a reasonable person would have done under a given set of circumstances. This doctrine of reasonableness provides the fact-finder with flexibility to interpret a dispute on a case-by-case basis. Thus, reasonableness is often key in reaching a fair conclusion, but it also allows prejudices and stereotypes to leak into and contaminate the legal process. “What would a reasonable person do in a given circumstance?” already begs the question of normalcy and may lead to a conclusion that is not necessarily fair nor equal, but rather normal. In a world that views homosexuality as abnormal and aberrant, gays and lesbians may be subjected to a different kind of justice. This investigation examines how the flexibility embedded within the doctrine of reasonableness leads to unequal justice when it is applied to gays and lesbians because the current state of reasonableness allows for prejudices to infect fair adjudication. Therefore, the law should be allowed to reject a claim of reasonableness when it is based solely on prejudices or unwarranted stereotypes.
Negative interactions between invasive species can potentially moderate their impacts on native ecosystems. The invasive predatory European green crab *Carcinus maenas* has experienced declines in the rocky intertidal coincident with the recent invasion of the Asian shore crab, *Hemigrapsus sanguineus*, into New England. This study examines the relative abundance and resource use of both species in the region where they currently overlap (central Massachusetts to central Maine). Crab densities were expected to reflect the expanding range of *H. sanguineus* into the Gulf of Maine and subsequent displacement of *C. maenas*. Furthermore, dietary overlap of the species was expected to cause a shift in resource use for one or both species. Results from fourteen sites show a negative correlation in the abundance of *C. maenas* and *H. sanguineus* across latitude. While densities of the two species were negatively correlated across sites, the density of heterospecific crabs did not explain a significant amount of the variation in density for either species, after accounting for the effects of latitude. The percent contribution of the blue mussel, *Mytilus edulis*, to the diet of both species increased with higher mussel density. The percent contribution of mussels to *C. maenas’* diet decreased with higher *H. sanguineus* densities, but the percent contribution of mussels to *H. sanguineus’* diet was not affected by *C. maenas* densities. Decreased consumption of mussels by *C. maenas* at high densities of *H. sanguineus* may explain the recent declines of *C. maenas* observed in the Gulf of Maine. Rather than an invasion-al meltdown scenario, this study demonstrates that a newly introduced species can moderate the impacts of an earlier invader on the community.
This research explores the controversy over oil drilling in the Arctic National Wildlife Refuge. The Arctic Refuge is a 19.3-million-acre tract of Alaskan land containing the only portion of the state’s coast which is not currently open for oil development. Oil drilling interest groups and urban Alaskans have been pressing the federal government to allow oil exploration in this area. Environmental organizations and representatives of the indigenous Gwich’in people (natives of the Refuge) oppose incursions on the Refuge.

The central issues in this debate concern economic and political arguments about U.S. oil dependency, as well as scientific arguments about the environmental consequences of oil drilling. This research examines each debate and reveals conflicting values and the politicization of the scientific research involved. Although it seems evident from these examinations that the anti-drilling side possesses the strongest arguments, it becomes clear that there is no straightforward “answer” in this matter. This research finds that a cost-benefit analysis pitting various human uses of the Refuge against one another should not be the central issue of the debate. The more important issue to consider is that this area has already been designated a Refuge, and this federal designation constitutes a binding commitment to governmental protection of the land. Even if developing the Refuge presented clear benefits, development would still be irresponsible given the government’s prior commitment to preserve the Refuge for future generations. Since the potential benefits of drilling seem to be questionable at best, and the country is not currently in a state of emergency, the research concludes that the government should honor its promise to protect the Arctic National Wildlife Refuge.
This project demonstrates the viability of high efficiency power transfer between two satellites using a system of laser diodes and solar panels. This configuration allows small “nano” satellites to recharge themselves from a host satellite while reducing the mass of both. A current trend in satellite development is the use of several small, low cost “nano” satellites that perform tasks similar to single complex satellites. However, current power generation systems are too large for these nano-satellites. Current techniques recharge remote satellites through magnetic induction. While this system is very effective at close range, the efficiency decays as the square of the distance. A laser diode power transmission system would have less mass and lack any distance restriction. This project consists of several simple test prototypes that demonstrate 30% transfer efficiency between source and receiver in multiple configurations. High efficiencies were achieved by combining 780 nm laser diodes operating at 5mW with triple layer space rated GaAs solar arrays. The GaAs solar cells have a quantum efficiency of 90% in the 780 nm range. Due to safety and legal concerns, the research was limited to diodes that operate below 5mW. Current work examines the effect of using higher power beams on the solar cells.

The resultant prototype presents a viable prospect for the transmission of power between satellites. It achieves high efficiency while minimizing mass, cost and profile space. Each cylindrical diode weighs only 10 grams and has a diameter of just 10.6 mm and a length of 17 mm. The cost of the final system is reasonable. The current diodes cost $50 per diode, however future designs are not cost-prohibitive because the diodes will produce 1,000 times the power at six times the cost.
Until recently, the traditional coffee market was one in which coffee was grown in far-away lands with no sense of connection between the farmers and the buyer. Following the coffee crisis of the late 1990s, the growth of alternative markets with philosophies of social justice and “fair” prices for farmers challenged this system. Fair trade ethical commodities networks have made great improvements in the economic division between North and South. However, the networks will never be sustainable or representative if there is not more involvement on the side of the producers in the South.

The emphasis on advocacy over scholarship regarding fair trade networks has made critical study of the impacts of fair trade difficult, especially regarding the standards of Fairtrade Labelling Organizations International (FLO) that qualify cooperatives to participate in the alternative market. Fair trade advocacy organizations like TransFair USA, the Fair Trade Federation and Oxfam International present FLO as a neutral body that serves in the interests of the farmers, when in fact it is a political body that acts according to dominant Western values regarding development, economics, gender, political organization and environmentalism. Interviews with fair trade cooperative farmers revealed widespread confusion regarding what fair trade is and how it works. Because local farmers do not have a way to voice their opinions on what is important to them at the grassroots level, an ideological disconnect forms between standard formation in the North and implementation in the South. As a result of this detachment there is concern that the producers have no interest in the values that fair trade represents and that they comply with FLO standards because of market demand, not out of solidarity. Exploration of the growing market value of fair trade goods and the farmers’ lack of understanding of the values inherent in fair trade has revealed that the alternative market inadvertently uses its own market values to exert control over local communities.
Jean Laffite was a pirate outlaw who successfully developed a legend as a hero in the minds of Americans, and yet his legend deviates significantly from historical fact. By exploring the cultural background in which his legend was developed, we discover the discrepancies between legend and fact, the reasons for such variations, as well as the secret of a successful good-pirate legend. Yet the legacy of Jean Laffite does not stop there. Laffite’s legend and subsequent glorification can be attributed to many different factors, and when we consider these factors in light of current events, an eerie similarity between piracy and terrorism casts a shadow upon our cultural values. The legend of Jean Laffite offers a new interpretation of the cultural significance of the faceless form of terrorism.
Toward a Better Understanding of...

Modeling Modern Soil Erosion at Danilo Polje Using the Revised Universal Soil Loss Equation

Jessica L. Friedman

Mentor: Dr. Jennifer Smith

Danilo Polje, in coastal Croatia, has been intensively farmed since the Neolithic. To recreate the environment in which its early cultivators lived, it is necessary to understand what the topography looked like and how it may have responded to changes in climate, vegetation, or human use of the land. This project recreated paleo-processes by using the Revised Universal Soil Loss Equation (RUSLE) to approximate average annual rates of soil erosion in the present day at Danilo Polje. The equation, developed by the U.S. Department of Agriculture, is the product of six parameters: rainfall/runoff erosivity, soil erodibility, length and steepness of slope, cropping or vegetation, and support practice. Using information from remote sensing and data collected in the field, the research provides estimates of each of these factors, calculates average annual soil loss in Danilo Polje, and models how changes in a parameter affect this loss. The uncertainties associated with estimating each RUSLE parameter, and the sensitivity of erosion rates to changes in any of these six components, indicate that groundtruthing must be a part of future models of modern erosion and geoarchaeological data must be included in any models of past erosion.
Previous research on older adults in residential care facilities has revealed a positive correlation between participation in activity programs and residents’ cognitive functioning, location preferences, and sense of involvement during the activity. Furthermore, residents’ level of choice in activity selection is associated with the likelihood of their continued participation in those activities. The Assisted Living Activities Participation Project was designed to determine the current activity patterns of residents of a local assisted living facility, to identify additional activities residents would prefer, and to elicit their input in the development of an intergenerational program. This project lays the groundwork for the development of a student volunteer activities program that will be based on the interests of both residents and students. The interaction will give residents the opportunity to act as mentors, and will allow students to benefit from having the intergenerational relationship.

Research methods included enlisting the assisted living facility’s activities director to inform staff and residents about the project, making field observations of public spaces and specific activities, and conducting in-depth key informant interviews with eight willing residents and staff members. Future plans will take into account the preferences of residents as described by both the residents and the staff. The development of an intergenerational program will include a variety of interactions between residents and students. Current community service programs may be expanded to allow students and residents to work side-by-side on community service projects. Other student groups involved in singing, dancing, or acting will be invited to stage a monthly performance at the Assisted Living Facility. Eventual goals also include student volunteers pairing with residents and conversing with them on a weekly or bi-weekly basis, and offering computer lessons as requested.
Basic education is a key factor in long-term, sustainable economic growth. However, providing widespread and high-quality education is a major challenge for many developing nations. In China, there are significant educational disparities between more developed urban regions and less developed rural regions. The question most central to this research is: What are the causes of the urban-rural inequalities in education, and what are the best solutions? This question is critical because it is one faced by many developing nations, and a study of China could prove to be useful to other nations. Additionally, learning more about the differences between more and less developed areas within a country could be applicable to healthcare, environmental protection, and other policy areas.

This project examines previous research on education problems in rural China and compares the development of rural China with that of urban China to track the role of basic education in each. In terms of finding solutions to the educational inequalities, this research considers possibilities that have been implemented in other developed and developing countries as well as comparisons with urban China.

This research is premised on the expectation that basic education played a fundamental role in the development of urban China, and that the lack of basic education has impeded development there. Additionally, the research may reveal that a lack of development has had a negative impact on basic education in rural China. Finally, the project predicts that adapting basic education to local needs, coupled with strong government financial support, will have a positive impact on abating regional educational disparities.
**Toward a Better Understanding of...**

**Diabetes, Depression, and Cognitive-Behavioral Therapy in Pregnancy**

*Tassy Hayden*

*Mentor: Dr. Tamara Hershey*

Diabetes and depression during pregnancy have separately been linked to negative infant outcome as measured by the Bayley Scales of Infant Development (BSID), but the impact of depression in the context of diabetic pregnancy is unknown. Since depression has been linked with poor adherence to diabetes-care regimens and poor glycemic control, this research examines whether depression interacts with diabetes during pregnancy to produce worse infant outcome, and whether these effects can be diminished with depression treatment.

Diabetic, pregnant women were diagnosed at study entry as having or not having major depressive disorder. Women with depression randomly received either ten weeks of cognitive-behavioral therapy (CBT) or supportive counseling (SC). Beck Depression Index (BDI) scores were collected at baseline testing and after ten weeks of therapy. HbA1c levels (indicative of long-term blood glucose control) were collected every four weeks and averaged over the prepartum interval. Infants of these pregnancies were examined at six months of age using the BSID.

Infants of depressed mothers had lower mean scores on the BSID Behavior Rating Scale (BRS) compared to infants of non-depressed mothers. HbA1c levels in the group with vs. without depression were not statistically different, suggesting that depression during diabetic pregnancy can have a negative impact on infant development independent of hyperglycemia.

CBT was more effective than SC in decreasing the severity of maternal depression, and infants of mothers who underwent CBT had better BSID BRS outcomes than those who underwent SC. Further, the BRS scores of CBT infants were not statistically different from those for infants of non-depressed mothers. CBT proved to be an effective depression reduction tool in pregnant diabetics, and depression reduction led to better infant outcome at six months of age. This method should be further investigated in this population and in all pregnant women.
Plaster holds the modern world together. The development of plaster in the Near East dates back to 7000 B.C. and corresponds with the rise of complex architecture. Plasters from numerous archaeological sites in Egypt have been characterized, but plasters from the western oases have never before been examined or characterized. The western oases have been occupied for 150,000 years and contain numerous Egyptian and Roman archaeological sites. More recently, the oases have attracted increased attention because they are the purported origin of the cobalt-rich sulfate deposits used in Egyptian blue glass and faience.

This double blind study examines twelve gypsum and lime plasters from various archaeological sites in the western oases. The plasters were characterized using X-ray powder diffraction, thin section analysis, and digital image analysis. Additionally, major and trace element composition was determined by X-ray fluorescence analysis.

The twelve plasters were divided into groups on the basis of observed physical characteristics and these groups were compared to their archaeological context. The elemental compositions were compared to published elemental data for Egyptian blue glass and faience. This study presents the first-ever analysis of plasters from an important region of Egypt and examines their connection to Egyptian blue dye trade.
This study uses strontium isotope analysis to determine the geographical origins and ranges of Bronze Age (c. 2500-1000 BCE) and Iron Age (1000 BCE-200 CE) humans in eastern Kazakhstan. This region fits into the wider Eurasian steppe zone where populations practiced nomadic pastoralism. These pastoralists are associated with certain technological, cultural, and linguistic innovations. During the Bronze Age, these innovations included the proliferation of horse-riding and chariot technology, bronze metallurgy, and Indo-European languages. The Iron Age ushered further changes: introduction of agriculture, iron metallurgy, and shifts in burial and ceramic praxis. Previous studies characterized these societies as regional-archaeological horizons that spanned Eurasia and shared a common material culture. They explained the genesis of this distribution through models of mass migrations or cultural diffusion. Recent scholarship challenges these theories with others concerned with localized societies that constitute long-distant networks of interaction. To test these contrasting theories, one rodent and human teeth and bone samples from six human burials were collected from two settlement loci in the Koksu River valley (eastern Kazakhstan). For each sample, the ratio between two specific isotopes, $^{87}\text{Sr}/^{86}\text{Sr}$, were determined using high-resolution mass-spectrometry. Results indicate that all of the samples originated from the same geographic locality and shared similar ranges of mobility. Since the samples included a short-range animal, the data seem to indicate that the humans under study exhibited limited geographic mobility. This conclusion supports the existence of regionally constrained societies that could have contributed to the punctuated but vast dissemination of culture throughout the Eurasian steppe.
Arsenic is commonly characterized as a toxic compound, and the hazards it poses to many organisms are well known. Certain microorganisms, however, obtain energy from arsenic redox chemistry. Microbes using arsenate (As V) as a terminal electron acceptor are relatively well studied, but the microbial oxidation of arsenite (As III) remains a poorly understood metabolism. Shallow marine hydrothermal vents near Ambitie Island, Papua New Guinea may provide an ideal environment for finding As(III)-oxidizing organisms. This site vents hydrothermal fluid containing up to 1,000 parts per billion (ppb) As III, and As V is co-precipitated with iron oxyhydroxide minerals on rocks adjacent to the vent openings. Also coating these rocks are red and green biofilms, suggesting a possible microbial mechanism for the oxidation of arsenite to arsenate in this ecosystem.

Fluid samples from various vent sites were used to inoculate tubes of liquid media designed to target specific metabolisms. These tubes were incubated at high temperatures (50°C and 80°C) and examined for microbial activity. Inspection of these tubes using epifluorescent and phase contrast microscopy revealed large numbers of actively growing organisms. The growth of these organisms indicates that they appear to possess various metabolisms targeted by the media, including possible arsenic oxidation. Current work includes the isolation and characterization of specific organisms of interest to gain a better understanding of their metabolic processes and compare them to known organisms through genetic analysis. A novel bacterium was isolated on an autotrophic medium targeting arsenite oxidation coupled to sulfate reduction; however, the bacterium’s specific metabolism is still being investigated. Another bacterium, *Brevibacillus agri*, was isolated on an aerobic, heterotrophic medium. All of these media contain arsenic concentrations of approximately 4 parts per million, which is significantly higher than the U.S. Environmental Protection Agency standard for drinking water at 10 ppb. Further study of the biogeochemical cycling of arsenic may lead to better methods for arsenic remediation in contaminated environments.
One of the cornerstones of contemporary biomedicine and HIV-related health care is the patient-provider relationship. Anthropological theory is uniquely able to describe its individual, interpersonal, and structural determinants. Observations of and narratives from HIV-positive patients at the Washington University Infectious Diseases Clinic demonstrate that a patient’s contextualized experiences impact the ways in which he or she interacts with providers. The medical relationship is also impacted by macro-level factors, such as ideologies of race and the structure of managed care, that limit a patient’s quality of care and constrain provider agency. A multifaceted conceptual framework of the patient-provider relationship successfully identifies entry points of intervention that seek to harness its full capacity to facilitate optimal patient health outcomes.
For 30 years the Missouri Botanical Gardens has been working to conserve the natural resources in Madagascar. Five percent of the world’s plant and animal species can be found in Madagascar and more than 80 percent of them are endemic to the island. Attempting to conserve this ecosystem has proven impossible while the indigenous population lives in extreme poverty. Resource conservation must be an economically rational decision for the villagers. This research team is working in collaboration with the Missouri Botanical Gardens in an attempt to provide the citizens of Madagascar with the tools to create sustainable economic development and to solve problems such as malaria and malnutrition. The village of focus, Mohabo, is in south-eastern Madagascar, but processes will be scalable. This will allow similar implementations in three other pre-chosen villages in Madagascar and potentially internationally.

The ultimate goal is a long term, self-sustaining quality of life improvement for the indigenous population. A sustainability plan will be presented to the Missouri Botanical Gardens that includes a prioritization of the problems and a plan for implementing solutions. These solutions will not come solely through original projects, but will draw upon existing development programs. The plan will focus on short-term actions with long-term sustainability and results.
Autism is a devastating disorder that affects millions of families around the world. A recent study, which was released in February of 2007, indicated that the Autism Spectrum Disorder prevalence was approximately 6.7 per 1,000 or approximately 1 in every 150 children. With such unsettling statistics coming out of multiple industrialized nations, many researchers are currently investigating various aspects of this perplexing disorder in hopes of gaining further insight that could provide better therapies for children with autism and possibly lead to a cure.

The present study aims to examine two popular assessments currently in use, the Sensory Profile and the Social Responsiveness Scale (SRS). Data for the present study was collected from an existing database that was originally compiled by Dr. Patricia LaVesser at the School of Occupation Therapy at Washington University. Children from the database were included in the present study if they met all inclusion criteria, which meant they were 24-90 months, had been previously given a pervasive developmental diagnosis and had both Sensory Profile scores and SRS assessments in their folder. The relationship between Sensory Profile scores and SRS was examined using both Pearson correlations and one-way ANOVAs.

A significant inverse correlation was found; Sensory Profile scores went down (indicating more severe sensory processing difficulties), SRS scores increased (indicating more severe social deficits). A significant relationship was found between the number of quadrants in which a participant showed definite difference from peers as measured by the Sensory Profile and the participant’s SRS scores. This is an indication that the more sensory processing issues the child is dealing with, the worse his social responsiveness skills are. The present study indicates that sensory processing issues are an integral part of the autism framework and indicates that further research investigating the relationship between sensory processing issues and social deficits could prove useful for the diagnosis and treatment of autism.
Toward a Better Understanding of...

Homosexuality in Cameroon’s Public Sphere: Rejecting Homosexuality as Protest against the Other

*Micah King*

*Mentor: Dr. Robert Canfield*

In January 2006, four fringe Cameroonian newspapers published a high profile list of over fifty allegedly gay and lesbian Cameroonians, among them governmental ministers, athletes, musicians, community leaders and members of the clergy. This research aims to understand the List, the layers of meaning embedded within the term homosexuality within Cameroonian society and how homosexuality emerged into the public sphere within that nation.

To understand these problems, the research examined the events leading up to the List and its subsequent emergence. Interviews were conducted with religious leaders, those involved in the media, social scientists, lesbian, gay, and bisexual Cameroonians, and those working for lesbian, gay, bisexual and transgender rights. Two hundred and seventy questionnaires were distributed and collected at Cameroon’s Université de Yaoundé.

This study builds upon previous research on homosexuality in Cameroon creating a basis for understanding homosexuality in post-List Cameroon, and presenting a new way of looking at homosexuality in Cameroonian society. The study finds that the List was the main catalyst for the emergence of homosexuality into the public sphere, but that there were predating events that helped prime homosexuality for emergence, specifically the liberalization of media laws, information from the Global North, the arrest of eleven people on charges of homosexuality, widely publicized persecution, and the Yaoundé Archbishop’s Christmas 2005 homily against homosexuality. Rejection of homosexuality carries with it layers of meaning and is a means of attacking elite Cameroonians within acceptable discourse. The emergence of homosexuality into the public sphere has opened public discourse in which Cameroonians critique homosexuality as a means of denouncing the meanings it has acquired there, which primarily include corruption, Western influence, and political and social elites.
Toward a Better Understanding of...

Gender, Eating Attitudes, and the Perception of Food Consumption

Sara Klayton

Mentor: Dr. Denise Wilfley

Though research has indicated that gender and/or disordered eating may influence either portion size or calorie estimation, no study has examined both gender and a range of disordered eating behaviors and attitudes on these caloric estimates. The goal of this study was to examine the effect of both the gender of the participant (rater gender) and the gender of the person described as consuming the foods (target gender) and to examine the effect of disordered eating behaviors (restraint, weight concern, and shape concern) on both portion size and calorie estimates. 138 participants (male n = 61, female n = 77) provided self-report data on 1) portion size estimates using the Food Amount Rating Scale (FARS), 2) calorie estimation, using a measure of calorie estimation designed for the study, and 3) disordered eating attitudes and behaviors, as assessed by the Eating Disorders Examination Questionnaire (EDE-Q). Analysis of variance (ANOVA) results revealed a main effect for target gender for the FARS, such that portions were rated as smaller for males, and a main effect for rater gender for the calorie measure, in which females estimated calories to be greater than males for foods with 100-149, 150-199, 200-249, and 250 or more calories. ANOVA results also revealed an interactive effect between rater and target gender for the 150-199, 200-249, and 250 or more calorie subscales, such that female participants rated calories as greater for male targets, while male participants rated calories to be greater for female targets. Finally, analyses indicated a moderating effect for restraint on calorie estimates: females estimated more calories on the 150-199, 200-249, and 250 or more calorie subscales, but only in comparison to males with low restraint. These findings provide insight into specific individual characteristics that may influence portion size and calorie estimation.
The expression of submissive and nonassertive behaviors with friends was investigated in participants with different levels of social anxiety. 65 college students completed the Social Interaction Anxiety Scale and were randomly assigned to play in a social dilemma game (a version of the ‘prisoner’s dilemma’ involving giving tokens to a computerized partner) with a friendly strategy (Raise-the-Stakes; RTS) or a flaky friend strategy (FF). All participants reported on real-life submissive and assertive behaviors when a friend had made them unhappy. On the first ten trials of the game, where the strategies are identical, a curvilinear relationship was found in which participants with low and high social anxiety gave more tokens than those with moderate social anxiety. Beyond the first ten trials, participants with higher social anxiety gave moderately with both strategies, indicating social constraint as a possible mediating factor between social anxiety and less interpersonal closeness. Lower social anxiety was related to greater investment with RTS and greater punishment of FF. Social anxiety was related to self-reported submissive and nonassertive behaviors. Implications for interpersonal styles and investment in relationships are discussed in this study.
In the last two decades, Mexico's political and economic systems underwent monumental transformations, from political reforms leading to democratization, to the assumption of neo-liberal economic policies and the enactment of the North American Free Trade Agreement (NAFTA). The 2000 presidential election ended over seventy consecutive years of PRI (Institutional Revolutionary Party) rule, bringing hope to Mexicans seeking democratic reform under the newly elected President, Vicente Fox. However, conservative economic policies during his term and claims of electoral corruption in the subsequent 2006 presidential election resulted in renewed suspicions concerning governmental functioning. This research uses economic and political history to explore how reforms in Mexico have resulted in a political and social movement towards the Left.

This research examines secondary sources such as political science research on Mexican democratization, the technocratic revolution, and specific mayoral and presidential elections. Works discussing the assumption of neo-liberal policy and the enactment of NAFTA were used to research economic history. The research provides an alternative perspective to these reforms through critiques of Neo-liberalism and discussion of its effects on the sufferings of Mexican farmers, rather than the economic benefits of large corporations. Mexican radio stations, daily newspapers, articles, and a visit to the Federal District provides for a current discussion of the everyday political events occurring in Mexico.

This research seeks to determine which factors have led to the Federal District serving as the heart of Mexico’s Left. Ultimately, it questions Leftist methods to gain power, why Mexico needs a Leftist president, and what this might entail for Mexico’s political and economic future. This research attempts to uncover the relevance of reoccurring Leftist movements in Latin and South America, and whether this realization requires revolution or whether it can occur through democratic and institutionalized means.
The focus of this documentary is public health care in St. Louis. Historically, it has been recognized that more affluent and medically well-insured populations have been well served in health care. St. Louis boasts an impressive array of medical services, and the aforementioned individuals are able to take advantage of them. However, a largely neglected uninsured and underinsured population has limited access to these resources. This disturbing disparity has led to the following research questions: “What barriers exist that limit access to health care for the disadvantaged?” and “What are organizations in St. Louis doing to mitigate these circumstances?”

Specific barriers were identified through research published by the St. Louis Regional Health Commission, and include transportation barriers, lack of knowledge regarding preventative services, language and cultural barriers, and lack of health literacy. These barriers were researched through exploratory interviews with various community leaders. 17 video interviews with educators, authors, journalists, County and City officials, and volunteers were conducted. The resulting documentary examines the roles that these individuals and their organizations play to mitigate health care disparities. Organizations include NARAL Pro-Choice Missouri, Williams & Associates, La Clínica, and Lead Safe St. Louis. Particular health concerns that disproportionately affect St. Louis’ disadvantaged population and are the focus of these organizations were also identified. They include teen pregnancy, STDs, HIV/AIDS, diabetes, obesity, and lead poisoning.

This documentary unites barriers to health care, organizations and health concerns in St. Louis in an attempt to understand the issues throughout the United States and the world. It explores how St. Louis’ unique history informs its present day health care scene and probes its current conditions. The documentary concerns efforts to lower identified barriers in an endeavor to increase access to health care.
Previous research indicates that single-sex high schools encourage math pursuit in female students. Single-sex schools achieve this either by eliminating stereotype threat – the fear that one’s performance will confirm negative stereotypes about the individual’s group – or by eliminating bias in coeducational teaching. This study distinguishes between these two mechanisms by assessing the influence of type of high school (either single-sex private or coeducational private) attended on math self-esteem, math course selection and career pursuit in female college students. Fifty participants (twenty-six from coeducational high schools) completed questionnaires to determine levels of math self-esteem, and math pursuit. Independent t-tests revealed no difference between students who attended single-sex high schools and coeducational high schools on these variables, providing evidence for the stereotype threat mechanism.
Toward a Better Understanding of...

Katrina and the Waves: Congress’ Role in the Failure to Prevent the Flooding of New Orleans

Jonathan Lane

Mentor: Dr. William Lowry

Congress’ role in the failure to prevent the flooding of New Orleans is addressed through the previously developed framework of reelection-driven incumbents. The unique relationship between Congress and the Army Corps of Engineers is a primary focus. Destruction and protection of Louisiana wetlands are extensively addressed, as is the slow progress of the Lake Pontchartrain and Vicinity Hurricane Protection Project and other flood protection efforts from 1965 to 2005. It is concluded there is strong evidence that Congress did play a significant role in the failure to prevent the flooding of New Orleans, and that much of this may be attributed to Congressional desire for re-election and the behavior this desire promotes.
Kallari is an Ecuadorian cooperative of hundreds of cocoa farmers living in 30 communities in and around the Amazon region. They are one of the few groups who grow and process cocoa and make their own chocolate bars within Ecuador, providing sustainable income as an alternative to the petroleum extraction and deforestation taking place in the area. Kallari currently rents a factory to produce their chocolate, but the process would better benefit the cocoa producers if a chocolate factory was built to serve the organization in Ecuador. To aid Kallari in their efforts and help them save money on design costs, a multidisciplinary group of eight students has been formed to help develop preliminary architecture and business plans for the proposed factory. The business plan will follow a traditional outline, including background, marketing, production and manufacturing, finance, and human resources. The architecture plan will follow an environmentally sustainable design. This cooperation and idea sharing will have the following outcomes:

- Reduce Kallari’s expenses through complete internalization of the chocolate production process.
- Create “clean” job opportunities that pay socially responsible wages and offer a high quality work environment for the people of the Napo Province.
- Raise the number of Kallari member communities by increasing production capacity.
- Stimulate the local economies of the Napo Province through tourism and job creation.
- Create a unique tourist attraction where visitors can follow chocolate production from bean to bar, generating educational tourism revenue for Kallari and the region.
- Strengthen Kallari’s reputation for and commitment to environmental sustainability in all aspects of their organization by pursuing certification as the first Leadership in Energy and Environmental Design (LEED) building in Ecuador.
The European Union Services Directive that was recently passed decreases administrative barriers so that small and medium-sized enterprises can easily access the services markets of other Member States. The directive faced opposition from conservatives and unionists who feared that workers were not sufficiently protected. However, these fears were unfounded and unjustly aimed towards this directive. The media overemphasized the problem when it should have drawn public attention to other problems of the directive, such as its numerous vague clauses that require clarification by the courts. The directive brings the European Union a step closer to creating a single internal market in services but because of its vague wording its effects will not be felt for some time.
More than social and economic changes, creative changes invoked by war can be extraordinary. The strong resurgence of the belief in national polity of the early Showa Period in Japan (1926-1989) led society to turn inward and become more traditional. The internment and deportment of Japanese-Americans in the United States during World War II restricted the creation of modern dance, particularly by Michio Ito. Radical post-War thought significantly affected modern dance, leading to the creation of Butoh. Born out of the ashes of World War II, Butoh is a rebellion against traditional theatre in Japan, and against Japanese conservativeness. Butoh dancers often paint their bodies white, as in Kabuki, and dance completely nude. Since its introduction in 1959 with founder Tatsumi Hijikata’s performance of Kinjiki (Forbidden Colors), Butoh has expanded phenomenally, and is performed by dance companies in major U.S. cities and throughout the world.

This project focuses on modern dance pioneer Michio Ito and Butoh founder, Tatsumi Hijikata, highlights the vibrancy and uniqueness of Japanese culture and history, and shows that the relationship between Japanese identity and modern dance requires much more study. The research compares and contrasts the ways that Butoh and Japanese modern dance have been shaped by Japanese cultural identity and traditional dance and also explores the social repercussions that have arisen as a result of these radical movements. The research methods utilize video and text to perform close readings of the dances and draw conclusions about the dance in its own historical context.
Eukaryotic DNA is packaged in two different forms: euchromatin and heterochromatin. Euchromatin is loosely packaged and transcriptionally active. Heterochromatin is very densely packaged and plays a critical role in maintaining chromosome integrity and regulating gene expression in eukaryotic genomes. Disruption of heterochromatin formation has been linked to a variety of human diseases from cancer to developmental disorders. The Elgin Lab is interested in understanding the mechanisms by which certain regions of the D. melanogaster genome are designated as heterochromatic. Position effect variegation (PEV) occurs in Drosophila when normally euchromatic genes are relocated to a heterochromatic domain by either rearrangement or transposition. This variegating phenotype, which results from silencing gene expression in some of the cells where it is normally active, is indicative of heterochromatin formation. In a previous screen, it was found that 1360, a remnant of a DNA transposon, was in close proximity to variegating inserts. To directly test if 1360 is capable of initiating heterochromatin formation, transgenes containing either one or four copies of 1360 upstream of an hsp70-white reporter were constructed and transformants were recovered (Haynes et al. 2006). Additional inserts were generated by mobilization of the P element transgenes containing 1360. After screening 2,500 crosses for each construct, we obtained 77 lines from the construct carrying four copies of 1360 (12%) and 56 lines carrying one copy of 1360 (4%) that displayed a variegating phenotype. Previous mobilizations of an hsp70-white P element reporter lacking the 1360 element resulted in a 1% recovery rate of flies exhibiting PEV. These results suggest that an increasing number of copies of 1360 increase the likelihood of initiating heterochromatin formation. We are currently in the process of mapping the location of the transgene in each of these lines.
Toward a Better Understanding of…

Sequence Requirements for the Elimination of the R-IES and the Effect of Flanking Sequences on IES Rearrangement

Cristina Montero Diez

Mentor: Dr. Doug Chalker

A homology-dependent mechanism is involved in the recognition and excision of thousands of DNA sequences from the developing somatic macronucleus in *Tetrahymena thermophila*. Recent work on the M-IES has identified the flanking regulatory sequences that delineate deletion boundaries and found that no specific micronucleus-limited sequences are required in cis for elimination. Rather, M-IES rearrangement efficiency correlated with the amount of micronucleus-limited sequence present, with a lower threshold of ~300 bp. This suggests that the amount of IES sequence to which homologous small RNAs (sRNAs) can base pair is the determining factor for M-IES rearrangement. To ascertain whether this can be generalized to other IESs, we studied the cis requirements for the elimination of the R-IES and tested the ability of flanking sequences to promote rearrangement of the M-IES. All tested R-IES subclones were able to promote their rearrangement, indicating that the R-IES also lacks any critical cis-acting sequences, though no definitive size dependence was observed. This, along with the low levels of R-IES-specific sRNAs detected, suggests that the abundance of the sRNAs present in the cell prior to DNA rearrangement is the limiting factor for the excision of the R-IES. Small RNAs are sufficiently scarce that the amount of micronucleus-limited sequence of the R-IES present has no significant effect on its ability to be recognized and excised. Further, flanking regulatory sequences were shown to play a role in promoting rearrangement, as DNA rearrangement occurred whether the M-IES was flanked by M- or R- flanking regions but rearranged more efficiently when flanked by M-regulatory sequences. Flanking sequences may thus play a role in directing sRNAs more efficiently to their homologous IES sequence. This study further supports the existence of a common mechanism underlying the recognition and elimination of IESs, where recognition by homologous sRNAs plays a key role.
The properties of Ca isotopes, from neutron deficient $^{46}$Ca to neutron rich $^{70}$Ca, were studied using a special model for the atomic nucleus. In this model, a complex (real and imaginary) potential is constructed by applying constraints from a large body of data. These data included both n and p scattering data and the properties of the bound (single-particle) levels. Using the extracted complex potential, effective masses, single-particle level properties (energies, widths and occupancies) are deduced for Ca isotopes from $^{36}$Ca to $^{70}$Ca.

The principal finding is that with increasing rarity, the minority species (e.g. p’s in $^{46}$Ca) become less like independent particles while the majority species (n’s in $^{48}$Ca or, in the extreme in $^{70}$Ca) become more like independent particles. The properties of nuclei near the n-drip line (the most extreme n rich region allowed by nature), a region important for element synthesis, are predicted.
This study investigated the impact of multiple talkers on low-frequency English vocabulary learning. Previous research has suggested that increased acoustic variability (i.e. multiple talkers or multiple voice-types) can facilitate speech perception and vocabulary acquisition. Variable input includes additional information that creates a more distributed cognitive representation, which aids in comprehension and recollection. The current study presented subjects with 24 low-frequency English nouns spoken by 1, 3, or 6 different talkers while a picture of the word was shown. Accuracy and reaction time measures were taken during a picture-to-spoken word recall test, and compared across levels of variability. Strong trends supported the hypotheses that increased variability leads to improved memory accuracy and reduced reaction times. These findings support the use of acoustic variability for vocabulary learning. Vocabulary instruction systems could be developed that employ these variability strategies for all levels of students, from beginning learners to those with more advanced preexisting vocabularies. Simply increasing the number of speakers presenting the novel words should provide significant improvement for struggling students.
Previous studies have found that chronic schizophrenia subjects have reduced thalamic volumes and abnormal shape, which were observed in the anterior and posterior aspects of the thalamus. In this study three thalamic surface zones were compared in 52 schizophrenia subjects and 65 controls to determine the locations of the shape differences. These zones were defined on the thalamic surface according to the following functional subdivisions of thalamic nuclei groups: specific relay, association, and non-specific. Nuclei in the specific relay thalamic zone receive sensory and motor input and projects to their respective cortical regions. Nuclei in the association thalamic zone receive sensory input and projects to the temporo-parietal-occipital, prefrontal, and limbic association cortex. Nuclei in the non-specific zone include the central median nucleus as well as regions on the surface of the thalamus that were not otherwise included. Abnormalities in any of these thalamic nuclei may be responsible for memory deficits seen in schizophrenia subjects. 3D surfaces and quantified deformations of the three zones were generated using high-resolution magnetic resonance imaging and large-deformation high-dimensional brain mapping. A significant decrease in thalamic volume (p < 0.016) was found in schizophrenic subjects compared to controls. After adjusting for multiple comparisons, the surface deformation differences between schizophrenic subjects and controls were significant in the specific relay (p = 0.0114) and association zones (p = 0.0111), but not in the non-specific zone (p = 0.0465). These findings suggest that the specific relay and association zones form a substantial portion of the total observed shape deformity of the thalamus.
Previous research has shown that visual search is facilitated when a person repeatedly searches a familiar scene for a target. This “contextual cuing” effect could occur because the target appears in the same location each time the scene is repeated, or it could be because the participant is familiar with the scene. The present experiment tested whether familiarity with a scene facilitates visual search of a target in real-world scenes. Participants were first made familiar with realistic scenes. The familiar scenes were presented in tandem with novel scenes and participants were asked to search for target shapes in both sets of scenes. Each occurrence of a familiar scene contained the target in a new location. Nevertheless, participants found the targets more quickly in repeated scenes as compared to novel ones. Thus, familiarity with a scene does facilitate visual search. This research presents a comparison of familiarity with a scene and contextual cuing.
Massively Multiplayer Online Role Playing Games (MMORPGs) are computer-based role-playing games in which thousands of users interact online through a game interface. MMORPGs do not just involve individuals who play games and communicate at the same time; in fact, participants interact—albeit through text—within what can best be described as an “immersive” world.

Because MMORPGs promote, if not require, social interaction within a virtual world, in order to gain insight into how a culturally pluralistic virtual world functions holistically, a characteristically multicultural MMORPG, Final Fantasy XI, was investigated. The research consists of six months of participant-observation, player interviews, and data collected from web forums. Academic and non-academic publications on this subject were also considered.

The project is based on the argument that players of MMORPGs bring with them a worldview which is consequently challenged—for better or for worse—as they engage in this virtual space. As they build communities and social networks, they create an environment that allows for situated learning to occur in an emergent, digitally-mediated social space. This emergence occurs on an international scale; individuals from varied cultural and linguistic backgrounds come together, in what is argued to be a third-place. The potential to shape the understandings of not only social dynamics, but also of cultural similarities and differences emerges through the intercultural communication and interaction of the players within this space. Therefore, this potential becomes significant and bears some—possibly implicit—weight on the possibly altered schemas of players when they face similar experiences in real life.

This study aims to further understand the implications of internet-mediated social interactions as they pertain to psychological, sociological, and anthropological concerns. It also explores new ways of analyzing intercultural interactions and communication in an era of increasing digital connectedness worldwide.
Since colonial times, indigenous peoples have been treated as sub-citizens in their native countries. Initially enforced to maximize profits for imperial powers, racial hierarchies persisted into the Republican era. Rejecting the past negations of indigenous existence and agency, current movements such as the EZLN in Mexico, the CONAIE in Ecuador, and the MAS Bolivia are using their indigenous heritages to support their claims to citizenship and participation. Their discussions of their own indigeneity shift as their political power changes. Initially relying on their subaltern statuses within society, indigenous movements begin to use their culture to legitimize their own leadership as their political leverage grows. Once in the position of state power, such as the MAS in Bolivia, indigenous movements concentrate on popular demands that represent the entire country, instead of using their indigenous heritage to solidify their support bases.
To determine the ecological causes and correlates of plant rarity and invasiveness, it is necessary to study plants that occur in similar habitats and are closely related to minimize differences in environmental variability and evolutionary history. This study includes six species within the genus *Cirsium* that co-occur in northern California. These species range from endangered to noxious invaders. This study found significant differences in the total reproductive success of these species; the endangered species had among the lowest seed output and the invasive species displayed the highest. The research is based on the hypothesis that differences in reproductive success were due to differences in the pollination biology, breeding system, and competitive abilities of the various species. This study quantified pollinator visitation rates and the composition of visiting species, and determined that the invasive plant species *Cirsium vulgare* (Bull Thistle, Spear Thistle) attracted more pollinators than its non-invasive congener. Further, *Cirsium vulgare* has an autogamous breeding system, whereas the other species required pollinator visitation in order to reproduce. A pollen supplementation experiment was conducted to quantify the magnitude of pollen limitation across these species. Despite variance in pollinator visitation rates and degrees of autogamy among species, none of the species showed significant levels of pollen limitation. This suggests that other factors besides pollination biology, such as intra and interspecific competition, determine the difference in reproductive success of these species.
The Somali wild ass is critically endangered in the wild and rare in zoos, and has never been the subject of a behavioral study. This study aims to accumulate a body of information on the social and reproductive behavior of the Somali wild ass (*Equus africanus somaliensis*) using Grevy’s zebra (*Equus grevyi*) as a control and is a collaboration between Dr. Fiona Marshall of the anthropology department at Washington University in St. Louis and the St. Louis Zoo. Data collected from the study will be used to determine why the wild ass, the wild progenitor of the donkey, was domesticated while the zebra was not. The St. Louis Zoo has just acquired a herd of wild ass suitable for breeding and hopes that the study will yield information necessary to increase the efficiency of the captive breeding of the species.

Zoo interns and Washington University students collect data by observing each species on alternating days when the weather allows for the animals to be outdoors. A focal animal observation pattern is used with observations beginning at 9 AM and the focal animal changing every ten minutes. Specific behaviors listed on an ethogram are recorded along with the time at which they occur.

This is an on-going study that has not yet produced any definitive results. The researchers hope that data accumulated over the next several years will lead to a fuller understanding of the behavior of the Somali Wild Ass and the behavioral factors that made the wild ass more suitable for domestication than Grevy’s zebra and to increased efficiency in breeding the species in captivity.
Cytochromes are a class of proteins that function in electron transport. $c$-type cytochromes are distinguishable by the covalent attachment of the heme moiety to specific cysteine residues of the apocytochrome. Three distinct systems (I, II, III) have evolved for cytochrome $c$ biogenesis. Systems I and II are found in bacteria and are relevant to this research. System I differs from System II in its use of a heme chaperone protein (CcmE) capable of heme storage and an ATP-mediated heme release complex (CcmABCD) for high affinity heme transport. The fact that two distinct pathways (Systems I and II) exist in bacteria for the assembly of a highly conserved protein (cytochrome $c$) is of much interest from an evolutionary perspective. Therefore, this research aims to identify the selective environmental pressure that led to the evolution of these two pathways. Using recombinant cytochrome $c$ biogenesis systems, the Kranz Lab has previously demonstrated that the high affinity transport of heme by System I allows it to synthesize $c$-type cytochromes at significantly lower heme levels than those required for System II cytochrome $c$ biogenesis. Heme consists of an iron atom surrounded by a protoporphyrin ring, therefore iron concentrations limit heme biosynthesis. Thus, it is possible that iron availability represents the selective pressure that led to the evolution of distinct Systems I and II. This research shows that the amount of environmentally available iron can be a limiting factor in the synthesis of $c$-type cytochromes. Therefore the high-affinity heme-transport aspect of System I may have evolved to allow for the more efficient production of $c$-type cytochromes in low-iron environments.
Hepatitis B has been responsible for tremendous morbidity and mortality worldwide, affecting over one-third of the global population. The health consequences of the infection vary greatly. Some individuals may only experience flu-like symptoms while others develop serious liver damage such as liver cirrhosis and liver cancer, which can lead to death. To complicate matters further, symptoms of the more life-threatening condition, often go unnoticed and worsen over time. Despite the serious threat it poses to public health, the hepatitis B epidemic has been silenced in the United States.

The study intends to answer the question, “What factors may have led to the silencing of the hepatitis B epidemic in the United States?”, to raise awareness of this public health problem, and to investigate health care professionals’ current knowledge of and attitudes toward hepatitis B and other infectious diseases such as HIV. Moreover, as a result of this work, the researcher hopes that the medical community will pay more attention to the epidemic, and that the general public will acquire a better understanding of the disease.

A large portion of the project was done by historical analysis of medical literature. Additionally, a web-based survey was distributed to fourth year medical students at Washington University’s School of Medicine. Through the investigative analysis of the literature, it is evident that the medical community played a significant role in the silencing of the hepatitis B epidemic in the 1970s. Findings from the web-based survey indicated that current medical students are less confident, and less knowledgeable of hepatitis B than they are of other infectious diseases, particularly, HIV. The conclusions of the research call for greater collaboration between disciplines to raise people’s awareness of hepatitis B.
In recent years, the Internet and other new media arenas have contributed to the spread of cultural forms and practices around the world. This research explores the ongoing proliferation of ‘modern’ graffiti world-wide through a broad survey of the Buenos Aires graffiti ‘scene.’ It also examines the local aspects of graffiti production, and asserts that graffiti is ‘locally’ constructed. The research presents styles and techniques unique to the Argentinean capital and explains the significance of the messages communicated by the ‘writings on the walls’ within a framework of the political, historical, cultural and economic context of the city. Interviews with graffiti writers conducted during January 2007, and secondary-source material research contribute to an understanding of the motivations and objectives that underpin this cultural practice, as well as the history of this relatively young and fairly undocumented ‘scene.’

Much has changed since American youth began ‘tagging’ their nicknames on city walls during the late 1960s. Today, so-called street artists produce stencils, stickers, wheatpastes, and posters, while ‘hip hop’ graffiti writers continue to scrawl ‘tags’ and larger-sized ‘throwups’ and ‘pieces’. Many of them still use ‘old-school’ styles and others newer, ‘post-graffiti’ ones. In Buenos Aires, the profound economic crisis of 2001, which resulted in the drastic devaluation of the peso as well as increased socioeconomic inequality, also gave rise to a veritable explosion of stencil graffiti in city streets. In this project, photographs and text pay homage to the various forms of Buenos Aires’ graffiti – including ‘popular graffiti’ – but the research principally focuses on stencil graffiti and ‘hip hop’ graffiti. The interviews contribute to an appreciation of some of the similarities and differences in styles, viewpoints, and objectives that simultaneously divide and unite these subcultural members in a culture of rebellion.
The development of the British New Left is an important and controversial part of the history of socialism of the post-war period. The New Left was a unique intellectual and political undercurrent that transformed British politics and society. Having sought a middle road between the failures of the British Communist Party and the shortcomings of the Labour Party, yet never establishing itself as a popular political movement, the New Left is frequently overlooked in the analyses of Britain’s political history of the twentieth century. Many historians argue that the advent of the Campaign for Nuclear Disarmament in Britain signified the end of its “First” stage if not the end of the New Left all together. While the New Left was undoubtedly a fractured movement from its inception, the Campaign for Nuclear Disarmament functioned as an evolutionary bridge for the New Left rather than a sign of the end of its beginning. From its inception, the New Left’s mission was to exact political and social change. Regardless of its members’ disagreements over the specific approach, the fact that the members worked together at one time is indicative of the commonalities between them. To acknowledge similarities between the “First” New Left and the “Second”, yet still create a division between them, fails to account for this fact. Although individuals changed, the overall goals of the movement remained the same. To many historians, the Second New Left is unique, because of its new tactics for generating awareness of its agenda that, in turn, effectively garnered more public support; not because of a decisive departure from the ideology of the earlier New Left. Thus, implicit in this analysis is the assumption that a movement that evolves or adapts its tactics becomes something separate from its origins. While there is no doubt that the later period of the New Left was marked by new developments and strategies for achieving its goals, it nevertheless retained the same broad agenda aimed at achieving socialist reform.
Spain, like many European countries, is known for its patriarchal societal arrangement. It is, however, one of the only Western European countries to have had a major Civil War fought on its soil in the recent past, resulting in an extreme restructuring of its social construction. During the Civil War, in great contrast to their previous way of life, women in Spain enjoyed more freedom in terms of employment, education, and social visibility and were generally able to step outside their traditional roles as the subservient female to fight for their elected cause alongside men or to fill in the absent men’s provisional roles. Photography is a useful tool in documenting this historical shift of power and provides some of the only evidence presently available to accurately communicate the important positions women took during the war. Images of women at home, in factories and even fighting on the front lines, as well as the accounts of the few courageous female photographers who were among the first of their kind, are an important part of history that cannot be forgotten or denied. This research intends to shed light on the women of Spain who are doubly forgotten—by their patriarchal society and by the attempts of all Spaniards to leave behind the tumultuous times that have stained the history of a proud country—by examining historical accounts of Spanish women during the Civil War, female members of the International Brigades sent to aid the Spanish Republic, and female photographers who covered Spain during the Civil War along with images that depict them.
The past-tense formation of English verbs is considered a quasi-regular task. Most verbs are regular, i.e., inflected by adding –ed (e.g., walk – walked), but about 100 exception verbs (e.g., sing – sang) violate this principle. The dual-route model of past-tense formation (Pinker, 1999) claims that regular and exception verbs are processed by discrete mechanisms, one for regular and one for exception verbs. The connectionist alternative (Rumelhart & McClelland, 1986) claims that both regular and exception verbs undergo a common mechanism that encodes statistical regularities. This study distinguishes between the two approaches by examining the effects of neighborhood consistency on the past tense formation of real and made-up verbs, with response times (RTs) and accuracy as dependent variables. Neighborhood consistency is operationally defined as the extent to which similarly spelled verbs are inflected the same way (e.g., sleep-slept, keep-kept, weep-wept).

Participants were visually presented with real (e.g., sing) or made-up (e.g., ling) verbs and were asked to produce the past tense, either via a vocal response or a button-press. Continuous measures of neighborhood consistency (ratio of similarly spelled and inflected neighbors to all neighbors) were then used to predict performance.

For real verbs, consistency influenced the past-tense formation of regular but not exception verbs, in both RTs and accuracy. This is more consistent with the dual-route than the connectionist approach, because the latter predicts neighborhood effects for regular and exception verbs. For made-up verbs, the fastest, most common response was the regular (–ed) inflection but consistency effects were also observed; these effects were more pronounced for accuracy than for RT. Overall, the results appear most consistent with a dual-route model that processes exception and regular verbs using distinct mechanisms. For unrepresented nonwords, the default is the regular inflection, but effects of phonological neighbors persist.
Simone de Beauvoir’s *The Second Sex* has been discussed and studied extensively since its publication in 1949 within the feminist discussion and existential tradition. Beauvoir’s vast autobiographical oeuvre is not as well known, but it reflects her interest in memoir. This research project shows that Beauvoir’s unique perspective as the woman philosopher in the existential movement during its development in early 20th Century France allowed her to offer a more circumstantial view of this highly theoretical school of thought. Using the existential concept of situation as a jumping-off point, she showed that in order to understand an individual’s self or essence (the “for-itself”), it is necessary to take into account the person’s situation (the parts of the “in-itself” or context relevant to the individual’s life goals). Beauvoir diverged from her male existentialist counterparts in her claim that the self is actually formed in large part around a person’s individual situation.

This research shows that this seemingly small difference is one of the foundations of *The Second Sex*, in which Beauvoir shows that woman is fundamentally different from man precisely because of the experience of being a woman. This conclusion has profound consequences from a philosophical standpoint: if the self is formed by a person’s situation, is essence gendered? Are women capable of the transcendence that existential philosophers deem necessary? The final chapter of this research looks at Beauvoir’s autobiography, her attempt to define her own situation to get to the foundations of herself. Because essence is gendered and situation matters, this research implies consequences for the ways children are raised and educated and how social and economic diversity is dealt with on a political level.
Alternative energy sources and energy storage systems are being investigated by scientists around the world, as well as by the United States Department of Energy (DOE). A strong emphasis has been placed on hydrogen gas, which could be used in fuel cells for vehicular applications. However, the hydrogen gas would need to be stored at a high density, which is difficult to accomplish. At high densities, hydrogen cannot be stored in conventional tanks without conditions of dangerously high pressures or extremely low temperatures. Therefore, other means of storage that employ hydrogen-adsorbing materials are under construction.

Materials suitable for hydrogen storage were investigated using quantum mechanical calculations. Molecules and molecular fragments were investigated for their ability to weakly bind, or “physisorb”, hydrogen molecules. The binding energy of hydrogen to each fragment was calculated as the energy difference between the lowest-energy hydrogen-HSM (Hydrogen Storage Material) structure and the sum of the energies of the free hydrogen molecule and the HSM. Results suggest that hydrogen molecules bind strongly to charged species but that poisoning by common atmospheric gases may limit these species' potential as hydrogen gas storage materials.
This research examines the vast disparities between different neighborhoods in America’s metropolitan areas. Specifically, the study compares two suburbs in Cook County, Illinois, which consists of the city of Chicago and its near suburbs. This region has suffered the effects of uncurbed sprawl, extensive economic transitions that resulted from increasing globalization, and hostilities between ethnic groups due to massive migrations during past centuries. Changing demographic processes have led to significant inequities in resources and opportunities that neighborhoods can offer. The research is important because it draws attention to the contemporary impacts of concentrated poverty, inequitable distribution of resources, and unequal access to opportunity.

This research employs an embedded multiple case study, where the factors under investigation are viewed for more than one site. The cases under study are Winnetka and Robbins, Illinois. An embedded design incorporates other subunits of analysis, such as the larger areas in which these two suburbs are located. This work is a descriptive analysis of the characteristics of different neighborhoods and how they have evolved into their current condition. The principal factors of investigation include economic resources, job opportunities, diversity and ethnic makeup, political dynamics, crime, and public schools.

The study finds that Winnetka residents enjoy a greater array of public services and resources than Robbins residents, mainly due to generational poverty and the accompanying demographics associated with entrenched poverty over time. The current pattern of development within urban areas leads to high concentrations of poverty, an unequal allocation of resources throughout the region, an on-going lack of government policies and programs to ameliorate conditions that lead to entrenched poverty. Without significant changes to curb sprawl and the distribution of assets at the regional level, disadvantaged areas will not be able to end the cycles that lead to even higher concentrations of poverty.
Environmentally friendly behavior in America is low, even though many people claim to support the environment. The purpose of this study was to determine the best predictors of pro-environmental behavior and gender differences associated with them. This experiment utilizes the Theory of Planned Behavior which stresses that intentions directly influence behavior in order to understand factors that contribute to environmental behavior. Explicit attitudes, intentions and knowledge, all established as correlates of environmental behavior, were assessed in conjunction with a new test of Implicit Attitudes to provide a more complete picture of environmental behavior. Intentions and knowledge significantly predicted behavior, and explicit attitudes predicted intentions. Women expressed higher levels of explicit environmental support, while men were significantly more knowledgeable about the environment. There were no significant gender differences in behavior. The many significant interactions related to gender indicate that different processes operate to determine behavior for men and women. Findings show that intentions and implicit attitudes are a more significant determinant of environmental behavior for women.
Yoruba Vowel Elision

Cordula Simon

Mentor: Dr. Brett Hyde

In the Niger-Congo language Yoruba, vowel elision (deletion) frequently occurs when two vowels are adjacent and straddle a syllable boundary. Specifically, if the $V_1+V_2$ sequence straddles the boundary between two words and the word containing $V_1$ is subminimal (has only one syllable), then $V_1$ is deleted. If the word containing $V_1$ is minimal (has at least two syllables), or supraminimal (has more than two syllables), then hiatus is resolved through assimilation rather than deletion, and the $V_1+V_2$ sequence becomes $V_2+V_2$. The same is true if the $V_1 + V_2$ sequence is contained in a single word.

The research demonstrates that the deletion is triggered by Onset, a constraint according to which it is preferable for a syllable to have an initial consonant. In other words, CV (consonant + vowel) syllables are more optimal than V syllables. Although previous accounts have claimed that Onset-triggered deletion can not be restricted to the appropriate context in Yoruba, using relativized Contiguity constraints places the necessary restrictions on Onset. There are two types of Contiguity: domain contiguity and juncture contiguity. Juncture contiguity prohibits deletion at word boundaries. Domain contiguity prohibits deletion word-internally. These Contiguity constraints discourage deletion within single grammatical words and at the juncture of two prosodic words. When ranked above Onset, these constraints restrict its effects to the appropriate context.
Limestone cave formation is controlled by interactions between groundwater, carbon dioxide (CO₂), and calcite. Shallow groundwater acquires a high partial pressure of CO₂ from soil air and upon arrival in a vadose cave, degasses and promotes the development of cave formations. The exchange of CO₂(g) between air and water is further subject to isotopic fractionation at known values; however, chemical interactions in caves have not been analyzed from an isotopic perspective. Using 1L glass vessels, air samples were collected at two caves, Cliff Cave and 23° Cave, purified on a vacuum line using a series of liquid nitrogen and dry ice-isopropanol traps, and analyzed using the Stable Isotope Lab mass spectrometer. Samples collected at Cliff Cave in April 2006 and 23° Cave showed a progressive increase in the partial pressure of CO₂(g) with increasing distance from the cave entrance, consistent with the degassing of the CO₂-rich groundwater in combination with increased mixing with normal air proximal to the cave entrance. The CO₂(g) in the cave air is depleted in ¹³C and ¹⁸O relative to CO₂(g) in the outside air. This suggests that bicarbonate in groundwater, which differs in isotopic composition from that in ocean water, which controls average atmospheric ¹³C and ¹⁸O values, acts as an effectively infinite isotopic reservoir relative to the small, nearly isolated volume of cave air. The changes in partial pressure of CO₂, ¹³C, and ¹⁸O with distance from the cave entrance indicate a mixing process between cave air and outside air. A second set of samples collected at Cliff Cave in March 2007 revealed a seasonal variation due to increased mixing of cave air with decreased outside temperature. These data are not only an excellent confirmation of laboratory-derived isotopic principles, but may be of use to paleoclimatologists using speleothem analysis to reconstruct past environments.
Does acting experience affect the way students acquire and recall texts? How does labeling a text as a monologue or an encyclopedia article affect its subsequent recall? The purpose of this study is to examine the effects of acting experience and context on memory for text. It is the first study to examine the effects of acting experience on theatrical monologue acquisition; all previous studies on acting experience investigated dialogue or non-theatrical passages. It is also the first study to combine context and acting research. Thirty-two students with acting experience and thirty-two students without acting experience participated in the study. Each memorized two passages: an excerpt from a monologue and an excerpt from an encyclopedia article. Half of the time, the texts were labeled incorrectly (i.e., a monologue would be labeled as an encyclopedia article). Results indicated that students with acting experience were better at memorizing the text passages than the students without acting experience. Results suggest that students with acting experience may be better at memorizing difficult texts labeled as monologues, while students without acting experience may be better at memorizing difficult texts labeled as encyclopedias. This trend does not appear for easier texts, suggesting that context becomes more important as the text increases in difficulty.
Studies show that mycorrhiza, a type of soil fungus, is integral to many ecosystems. This particular type of fungus colonizes plant roots and helps increase the host plant’s uptake of key resources. Many native plants depend on these fungi. However, the interaction between mycorrhiza and native plants can be interrupted by the introduction of invasive allelopathic plants.

Plants release secondary chemicals into the surrounding environment. Although plants normally produce these allelopathic chemicals to keep threats and competition at bay, the compounds can interfere and change biological interactions within communities outside their native system. The secondary chemicals released from these invasives can damage mycorrhiza that native plants need. Despite this important interaction, there little is understood about how such allelopathic activity affects the mycorrhizal community over time.

This study examines the long-term effect of the allelopathic invasive plant, garlic mustard (*Alliaria petiolata*), on mycorrhizal communities. The research compared mycorrhizal densities on corn roots grown in soil collected from sites with a twenty-year-old garlic mustard population, a ten-year-old population, a six-year-old population and one site free of garlic mustard. The results show that garlic mustard reduces mycorrhizal associations in the corn growing in the soil from the uninvaded site, but did not impact the level of mycorrhizal density in soil from the historically invaded sites. However, it was also found that mycorrhizal densities were much lower for previously invaded sites than the uninvaded site. The study suggests that the mycorrhizal community may be evolving in response to garlic mustard, or garlic mustard is destroying certain species of mycorrhiza. The long-term impact of garlic mustard on mycorrhiza could influence succession and ecological restoration efforts on previously invaded sites.
Delay and Probability Discounting in Smokers, Ex-Smokers, and Non-Smokers

Sharad Wadhwani

Mentor: Dr. Leonard Green

Discounting refers to the decreased subjective value of a commodity (e.g. money, soda) as another variable changes. Of particular interest to psychologists is how the subjective value of a commodity decreases due to increased delay until receipt or decreased probability of receipt. For example, the minimum amount of money an individual would be willing to take immediately will be greater if they are being offered $100 in three months as opposed to three years. Research has found that individuals discount the value of delayed primary reinforcers (e.g. food) at steeper rates than delayed secondary reinforcers (e.g. money). Research has also shown that drug abusers discount the delayed drug of abuse at steeper rates than delayed money. This raises the question of whether the drug of abuse is discounted at steeper rates because it is an addictive drug or because it can be consumed immediately (as opposed to money). Prior research has not focused on how drug abusing individuals discount due to decreased probability of receipt. Cigarette smokers, non-smokers, and ex-smokers were used in the present study.

Participants for this study were recruited from the St. Louis area through newspaper advertisements. Participants were screened for age requirements, drug abuse, psychiatric disorders, alcohol abuse, and group requirements. Qualified candidates were invited to participate.

Ex-smokers were not analyzed due to the limited data set. Data seem to suggest that smokers discount delayed cigarettes at steeper rates than delayed primary reinforcers (i.e. beer, soda). Thus, something apart from their existence as primary reinforcers is intrinsic in the abused substances that accounts for the different rates of delay discounting. Additionally, previous findings that smokers discount delayed money more steeply than non-smokers were replicated in the present study.
This project aims to implement a support network to help Egyptian youth deal with the hepatitis C epidemic that has ravaged the country. The plan includes recruiting and training a core of educated young adults to spread the message of hepatitis C awareness to their communities and social circles. The mobilization of these youths will be used to leverage the establishment of several youth-focused hepatitis C support groups that will provide a forum for dialogue and discussion for those who have the disease or have relatives/friends with the disease. Partnerships with the Missouri/Kansas chapter of the American Liver foundation, and Freedom, a well established non-governmental organization (NGO) based in Cairo that is targeted at reducing substance abuse in youth, have been established to support the project. Ultimately, it is hoped that the program will energize and inspire youth to take action now to forestall the possibility of a more serious disease epidemic in the country in the future. As natives of the country, these trained young people can spread this message to more communities and groups in Egypt than a non-native. Through these “multiplier effects”, the message of the program will continue to thrive for long after the current project ends. Additionally, Freedom has expressed interest in continuing the program in future years as part of its ongoing efforts to reach out and promote resiliency in youth.
This research examines the issues surrounding China’s growing economic influence in Latin America. Import and export trade data between six strategic countries in Latin America (Argentina, Brazil, Chile, Mexico, Peru, and Venezuela) and the U.S. and China during the years 1980-2004 were analyzed to determine the implications of China’s recent increased economic and political foray into Latin America for U.S. interests and policy in the region. Regression analyses showed that U.S. dwarfs China in trade importance in the region and that neither country contributed to Latin America’s macroeconomic stability. While China does not constitute a direct threat to U.S. interests in the region, U.S. policymakers should monitor China’s growing involvement and work to solidify trade and political relationships in Latin America.
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A Comparative Analysis of the St. Paul (MN) Hmong in Charter and non-Charter Schools

Leah Corey

Memory in Motion: How Gesture Affects Our Ability to Remember

Nathaniel G. Meadow

Alzheimer’s Disease: Generation of Amyloid-beta

Michelle Mo

Expanding the Membership of the Revolutionary Nation: Germaine de Staël’s Considerations on the French Revolution and Helen Maria Williams’s Letters from France

Christina S. Skelley