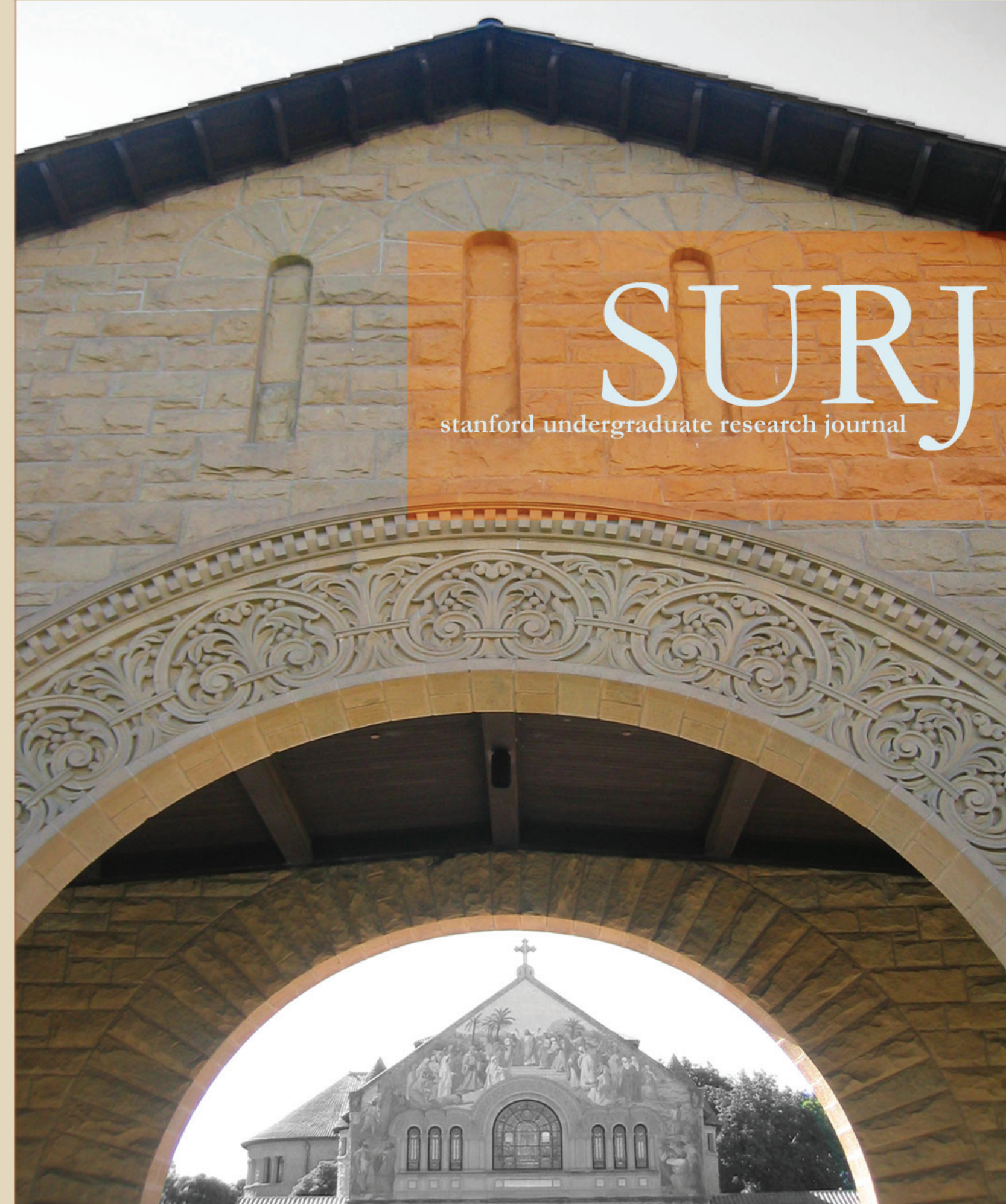




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SURJ

stanford undergraduate research journal



SURJ

the stanford
undergraduate
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journal

Volume V
Spring 2006

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Editors' Note

The Spring 2006 volume of the Stanford Undergraduate Research Journal (SURJ) marks the journal's fifth published issue. We are proud of the strides SURJ has made in its five years as a voluntary student organization, led and staffed exclusively by undergraduates for the benefit of undergraduates at our university.

As a publication, SURJ prides itself on its rootedness in the Stanford community. While other undergraduate research journals around the country have opened their submission process to undergraduates from any university, anywhere in the world, SURJ has made a commitment to remaining a forum just for Stanford University students. We firmly believe that the research done here - supported by the Undergraduate Research Program (URP), as well as by individual departments and faculty members - is some of the best research done anywhere by undergraduates. This does not mean, however, that we have our sights limited to the Farm. On the contrary, we have sought and maintained relationships with journals at our peer institutions, acting as both mentor and collaborator to these other publications.

SURJ has also further strengthened its on-campus ties. The Office of Undergraduate Admissions continues to send copies of the journal to newly admitted students who indicate they are interested in research. SURJ has also been a strong presence at URP events, introducing Stanford parents, prospective freshmen, and other community members to the journal. Collectively and individually, SURJ staff members have reached out to faculty and staff, garnering both recognition of the publication and support in producing the highest quality journal possible. We hope that our close relationships with the many facets of the Stanford community will continue to grow stronger.

In recognition of our place in the Stanford community, we have made one major change to the content of the journal in Volume V. Since its founding, SURJ has aspired to be a tool of inspiration to students to pursue research here in it all its forms; for this issue, in addition, SURJ aspires to provide information about the research process at Stanford. We took our Special Features section - which in past volumes languished in the back of the journal - and transformed it into a front-and-center series of articles on the formulating, conducting, and presenting research. We hope you enjoy this addition to the journal as much as our staff has. Any feedback on this revitalized section of the journal would be most welcome.

On behalf of the 2005-2006 SURJ staff and authors, we would like to thank you for taking the time to read this publication. SURJ seeks to exhibit some of the best undergraduate research done at Stanford, while never neglecting the diversity of topics and methodologies that characterize the wide array of research pursued by Stanford undergraduates. The strong support given to SURJ by the Stanford community has been the driving force behind the journal's success and growth during the past five years. As we celebrate this benchmark, we hope that your continued support will help us not only to thrive, but to grow and adapt far into the future.

Sincerely,

Emily L.W. Gustafson and Victor R.S. McFarland
Editors-in-Chief, 2005-2006



SURJ



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SURJ



Special Features

Piecing Together the Research Process

The Stanford Undergraduate Research Journal presents student research across varied disciplines at the University. While each project is narrowly focused on a topic within a field, the processes by which students engage in their research are fundamentally the same.

Every research question challenges investigators to develop feasible methodology, undertake rigorous data collection and analysis, suggest creative applications for their work, and present their findings to a broader audience. The student researchers whose work is published within this journal have all immersed themselves in this dynamic process of research. This year's Special Features section seeks to highlight the individual stages of academic research within the context of diverse projects at Stanford. By sharing their work with SURJ, these students have each initiated a dialogue with the Stanford community. They demonstrate that while their projects are distinct, their research journeys share remarkable similarity.



Motivation



Methodolgy



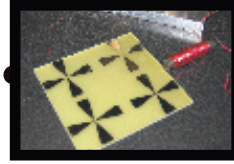
**Data
Collection**



Application



Presentation



Motivation

Exploring International Security: Reality Motivates

By Kelly Cheng

Motivation to engage in research develops under many settings. Academic curiosities become research interests as they flourish in classes, dorms and student organizations. As a research idea grows, academic programs can often match a student's motivations with the tools required for in-depth research.

Sophomore Jon Phua and Senior Paul Yoo share a fascination with international security. Stanford's CISAC (Center for International Security and Cooperation) has supported their intellectual pursuits. CISAC, where faculty and students conduct groundbreaking political science research, focuses on policymaking in the security arena. The range of expertise at CISAC provides a multitude of research opportunities for undergraduates, and its honors program, open to all majors, assists those who are completing theses.

In the following, Jon and Paul share how their common interest led both of them to CISAC.

Q: How are you engaging in undergraduate research?

Paul: I am currently writing my thesis on North Korea's negotiating behaviors. By analyzing, coding, and weighing event data from 1990-2005, I hope to find whether North Korea has been acting as a "madman" state, implementing coercive bargaining, or engaging in a tit-for-tat strategy vis-à-vis the United States. These three theories have been utilized to describe North Korea's behavior in various scholarly journals, columns, and books, but each theory has very different implications. Thus by thoroughly analyzing North Korea's interactions with the United States in a fifteen-year time span (from the first nuclear crisis to the September Agreement of 2005), I hope to generate an accurate picture of North Korea's negotiation behaviors that may illuminate the U.S.'s best response.

Jon: As Professor Jeremy Weinstein's Research Assistant at CISAC, I've been helping him construct a new dataset on violent incidents during Sierra Leone's nine-year civil war. It's been interesting to see how Professor Weinstein formulates and tests broad hypotheses (for example, rebel-perpetrated violence tends to occur more when rebel groups recruit members from resource-rich areas, because they tend to be in the movement for their own short-term gain).

8



CISAC (Center for International Security and Cooperation) provides students incredible resources through its honors programs, social science and applied science seminars on international security issues, and visiting experts.

Q: Where did you find the motivation to pursue your research?

Paul: I had been living in Santa Cruz, Bolivia when the September 11th attacks occurred. I skipped class all day to watch CNN clips of the attacks. But I did not understand the incredible impact the attacks would have within the United States, perhaps because a surge of anti-Americanism had begun to spread across Bolivia. Although the whole system of real politik had shifted in a single day, and America was suddenly faced with new enemies, the idea of terrorism felt distant from me. Shortly after September 11th, however, a newly built police station near my home was hit by a car bomb. I was shocked. I passed that station every day on my way to school, and any of my friends and family members could have been a victim. That day I understood the shift that had taken place on September 11th, and realized I wanted to understand why the world had changed.

I pursued political science at Stanford taking classes that dealt

with international security issues (Technology in National Security; Strategy, War, and Politics; International Security in a Changing World). After my sophomore year, I decided to work at the Peace and Disarmament division at a South Korean think tank/civil society group called People's Solidarity for Participatory Democracy (PSPD). That summer I worked extensively on the North Korean nuclear issue with other researchers, but was often perplexed by North Korea's inconsistent negotiation tactics. When I came back to Stanford, I realized that CISAC would offer the perfect opportunity to explore this interest further. If we can understand how exactly North Korea is engaging the United States and what its motivations are, we may discover how we can influence its future behavior in order to provide for a safer, more stable, and peaceful region in East Asia

Jon: Some Political Science and IR [International Relations] classes which I've taken are held in the CISAC building as opposed to the Political Science building. These classes take advantage of visiting professors working at CISAC, who give seminars on their research. I thought it was an interesting place, so I wanted to find work opportunities, which led me to Professor Weinstein. I'm also trying to figure out if I enjoy research. That's a pretty big factor in your decision to go to grad school—and it's important to see whether you enjoy doing research at this level.

I didn't specifically have a previous interest in Sierra Leone, but definitely had one in political science. I've taken an Introductory Seminar with Professor David Laitin, in the Political Science department, whose primary area of research is Africa, so that class definitely contributed to my interest Professor Weinstein's work. Seminars are a great avenue to get to know professors and do research.

Q: *What is involved in your methodology?*

Paul: I collected data primarily by compiling events involving North Korea, the US, and relevant third parties two aggregate sources: the World News Digest and the Nuclear Threat Initiative Chronology. These events were reported in international newspapers, and help eliminate nationalistic bias. I then coded the events according to a scale developed by the Conflict and Peace Data Bank (COPDAB – originally designed by Edward E. Azar from the Center for International Development and Conflict Management). The events were structured to show when North Korea and the United States cooperated or reneged on agreements, and were then assigned weights



Senior Paul Yoo and Sophomore Jon Phua took Political Science classes (department building shown here) that inspired them to investigate North Korea's negotiations with the U.S. and trends of violence from Sierra Leone's civil war.

“Shortly after September 11th, however, a newly built police station near my home was hit by a car bomb. That day I understood the shift that had taken place... and realized I wanted to understand why the world had changed.”

- Paul Yoo

to account for the intensity and frequency of one nation's actions toward the other.

Jon: My role as a research assistant has involved combing through a huge online document archive and extracting the information found in verbose news reports. Professor Weinstein also considers surveys of ex-combatants in Sierra Leone. For my analysis, I use Excel to create graphs that illustrate trends in large datasets. I then figure out how to transform the enormous amounts of data to extract specific information. The challenges in my research involve creating a clear dataset that doesn't duplicate variables and maintaining consistency in really low-level details. For example, if a news report says “several people were killed,” I have to decide what number to code in my data.

Q: *Where are you finding support for your research?*

Paul: My primary thesis advisor is Kenneth Schultz from the Political Science Department, but I have also benefited from the immense resources at CISAC. I feel very privileged to have such a dedicated group of advisors that are always willing to provide time for honors students. The CISAC honors program also very prudently assigns internal deadlines for honors students, which has kept me from procrastinating (for the most part). In terms of funding, I hope to apply for a Spring Quarterly Grant from the URP in order to conduct critical interviews with key policymakers.

Q: *How else could an undergraduate researcher use CISAC as a resource?*

Jon: The Center has public science and technology and social science seminars every week, focusing on some aspect of international security that can be studied using these disciplines. It's really interesting just to pop by to see different professors at the top of their field discussing their latest work. You can talk to them afterwards and they can provide useful input regarding your research. A large proportion of the research fellows and professors at CISAC attend these seminars too, so it's an easy way to meet these faculty members. This type of interaction can help students fine-tune their research questions.

Q: *What fascinates or challenges you most in your research?*

Paul: I've learned that even a "fuzzy" topic can be scrutinized with a very structured methodology (it almost feels like I'm conducting an experiment). On the flip side however, I've found that a qualitative method has helped me explain subtleties otherwise

difficult to capture. For instance, my research has shown that the United States has often been the first to renege on agreements with North Korea and that North Korea has often created crises in response to the perceived defection. This phenomena has best been explained in my thesis with qualitative evidence which I believe has strengthened my argument overall.

Jon: It's been very hard work, but it's pretty fascinating to see the actual methodologies political scientists will use to test their hypotheses. CISAC has lots of resources and it's a cool place to work—lots of interesting social science and applied science seminars on security issues, with great scholars presenting really cutting-edge material.

The author would like to thank Paul Yoo and Jon Phua for their large contributions to this article.



Methodology

CSRE Research: The Challenges and Rewards of Developing a Methodology

By Jennifer Lee

Does race matter? How does ethnicity influence the way people behave? To what extent do cultural differences account for the way society is organized? Timely questions like these inspire Stanford undergraduates to major in Comparative Studies in Race and Ethnicity. The program spans several fields, allowing students to combine relevant courses from the Departments of Political Science, Religious Studies, and Sociology, among many others. Considering the diverse kaleidoscope of cultures that coexist in present-day America, it comes as no surprise that CSRE is one of the fastest growing majors on campus. Having received unanimous approval from the Faculty Senate in 1996, the department had already attracted more than 100 majors and minors by its second year of operation.

Doing research in such a new interdisciplinary department is difficult, but Stanford seniors Kiyomi Burchill, Chris Vaughan, and Helen Kim have stepped up to the challenge. While Kiyomi, Helen, and Chris are all CSRE majors, their diverse research projects attest to the flexibility and independence that CSRE affords to each individual researcher. According to Helen, “CSRE majors have to be creative in how [they] come up with [their] methodologies and chart a method of studying that might be new to many people.” As a result, each CSRE research project has a unique methodology that draws from a distinctive combination of academic fields.

Kiyomi Burchill:

“Post-Census: The Changing Politics of the Multiracial Movement”

For the past three years, Kiyomi has researched mixed race politics, garnering support from faculty in both the Political Science and English departments in addition to the program in CSRE and the Undergraduate Research Programs Office. Inspired by classes on racial identity and literature on mixed race people, Kiyomi decided to address the absence of published scholarly re-

search on mixed-race politics since 1998. In 1997, the U.S. Census changed from providing one stand-alone multiracial category to providing ‘mark one or more’ racial categories, in response to the activism of national mixed race advocacy organizations. Kiyomi sought to answer the question of what current mixed race advocacy organizations were doing, given the completion of the Census campaign.

In-depth analysis of a subject with no recent scholarly research required a hands-on methodology, which Kiyomi constructed with guidance from English professor Michele Elam and Political Science professor Luis Fraga. Having received a Chappell-Lougee scholarship, Kiyomi spent the summer after her sophomore year traveling all over the United States to interview leaders and members of various national mixed-race organizations. Kiyomi found two of the organizations particularly provocative. Both formed after the 1997 Census change, the MAVIN Foundation and Swirl, Inc. have had “a leading presence within the multiracial movement

and have yet to be identified in scholarly literature” (Burchill xi). While the MAVIN Foundation works to eliminate disparities in health care for mixed-race patients, Swirl, Inc. focuses more on grassroots community-building. To present the activism of these organizations, Kiyomi integrated three types of primary sources: in-depth interviews with the organizations’ participants and leaders, organizational documents produced by the group, and news media accounts of the group’s activities.

After having thoroughly integrated information on post-Census change in multiracial organizations, Kiyomi wanted to examine the change itself at a federal level. As a junior, Kiyomi successfully applied for an Undergraduate Research Programs Major Grant and traveled to Washington, D.C. to interview federal policymakers on the 1997 Census change. Kiyomi’s interviews revealed that these policymakers were “more interested in the mixed race organizations in anticipation for what they might do than [for] past policy decisions” that they had affected. Al-

“CSRE majors have to be creative in how [they] come up with [their] methodologies and chart a method of studying that might be new to many people.”

- Helen Kim



Last summer, Kiyomi Burchill worked as an intern in the U.S. House of Representatives and interviewed federal policymakers on the 1997 Census change.

though Kiyomi did not find the exact information she had sought in Washington, her efforts paid off: she was awarded the Dean's Award for Academic Accomplishment for her research, which she shared with professors at Harvard this May.

Even with all these honors, Kiyomi believes that the greatest reward for her in CSRE has been the process of doing multidisciplinary research. Because "every discipline has its own approach to research," multidisciplinary researchers must "present knowledge in an accessible and yet academically rigorous manner." Pursuing research in CSRE has taught Kiyomi how to intelligibly and intelligently communicate her knowledge, making the experience meaningful not only for her, but also for multi-race investigators around the nation.

Chris Vaughan:

"The History of Labor at Stanford, 1969-2003"

Like Kiyomi's research, Chris's project originated from his desire to fill a gap in scholarly literature. In the winter of 2005, Chris took a student-initiated course entitled "Jobs with Justice," and Chris noticed a lack of discussion on the history of labor at Stanford. After class, Chris approached the course's faculty sponsor, Dr. Michael Kahan, and found out that no one had ever written a notable history of labor at Stanford. Thus, a project was born: Chris viewed this scholarly gap as a calling to research Stanford's labor history.

Chris describes his research as a "project of a million avenues," with a fluid methodology that led him in many different but relevant directions. In late February and March of 2005, he completed a directed reading on American labor history with Mark Mancall, an emeritus professor in the history department. When Chris described his research interest, Mancall helped him

obtain a URP grant and directed him toward several experts, including Maggie Kimball, a Stanford archivist. With initial assistance from Kimball, Chris spent the summer of 2005 doing research at Green Library – a task that involved laborious searches for articles in the card catalog and on microfilm about various labor movements at Stanford.

Wanting more direct evidence of historical labor movements, Chris also interviewed workers, union activists, San Mateo County health inspectors and university administrators. To find out more about farm-worker issues specifically, Chris examined archived files of the San Mateo County Environmental Health Division. Chris zeroed in on San Mateo County farm-workers because of the controversy surrounding Webb Ranch, a University-owned parcel of land in Menlo Park with underpaid Mexican farm-workers. The chapter on Webb Ranch in Chris's thesis is the longest and most relevant to CSRE research. Attesting to the significance of a CSRE perspective for Stanford's labor history, Chris believes "you can't study labor in California without also studying race and ethnicity in California."

Aware of his project's relevance to the history of Chicanos and Latinos at Stanford, Chris has been discussing his research with students and instructors of a related course in the School of Education and the Institute for Diversity in the Arts. Chris also plans to give back to the Stanford Labor Action Coalition, his initial source of inspiration, by presenting his research and distributing historical booklets to fellow SLAC members.

Helen Kim:

"The Asian-American Movement and an Asian-American Liberation Theology"

While Kiyomi and Chris embarked on their research mainly for academic interests, Helen Kim's CSRE research idea stemmed from a more personal experience. During her freshman year, Helen went on the Asian-American Identity Alternative Spring Break trip, during which the group picketed against unjust workers' wages in front of a Los Angeles Korean supermarket. To her dismay, Helen noticed that many Korean-Americans were driving by the supermarket demonstration with disinterested attitudes. Notably, this supermarket also held worship services on Sundays for its workers. Even though this Korean-American community apparently valued Christian worship, they had little regard for social justice – a disconnect that "chillingly disheartened" Helen and intrigued her to further examine the cross-section between radical protest and religion in a research project of her own.

Helen has approached her research with a flexible methodology, using a variety of primary and secondary sources. Helen planted the seeds of her research thesis in a short paper for a class entitled "Asian-American Politics," taught by Carolyn Wong. Passionate about the relationship between religion and social activism, Helen conducted an in-depth interview with a Chinese-American pastor who was also the leader of a faith-based non-profit organization. Having worked with students at Berkeley and San Francisco State University, the pastor readily

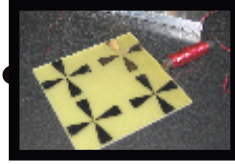
connected with Helen, telling her about his involvement with affordable housing projects in Chinatown. Professor Wong enthusiastically assisted Helen throughout the writing of her paper and ultimately became her adviser – an outcome that Helen describes as “serendipitous.” “Sometimes,” Helen said, “it seemed as though she was even more interested in my research topic than I was.”

Helen discovered another fruitful resource at the Berkeley Graduate Theological Union’s Pacific Asian American Center for Theologies and Strategies archive. When she visited the archive for herself, she felt as though she had landed on a gold mine – she had to return at least five times to extract all that she could from the archive. She focused on four important figures – all theologians and pastors who had written in the 1960s and 1970s. Because they had written so recently, Helen could interview them in-person to find out what they did to eliminate racism within the church, and hear their views on contextualizing theology to suit the Asian-American community. Helen had always held a

personal interest in theology that extended beyond her research purposes; from her interviews with theologians, she came away with meaningful principles of ethnic and religious consciousness.

Like Kiyomi and Chris, Helen found value in doing multidisciplinary research because of the methodological liberty it afforded her. Since she is also majoring in English literature, Helen was accustomed to research with an emphasis on literary analysis and initially hesitated to pursue the dynamic, changing methodologies of CSRE research. But now, she thoroughly appreciates the multidisciplinary nature of CSRE research. “We have to be creative with our research methodologies,” she says, “but it is also really rewarding and freeing because we can express our individuality in our projects.”

The author would like to thank Kiyomi Burchill, Chris Vaughan, and Helen Kim for their large contributions to this article.



Data Collection

The Lotus Living Laboratory Project: Data Collection En Route to Stanford's Green Dorm

By Carol Cao

Ideas for an “evolving, influential, flexible, and desirable” green space on Stanford campus, devoted to shared living and learning functions, originated from a November 2003 brainstorming session organized by the Department of Civil and Environmental Engineering (CEE), and gave rise to the current Lotus Living Laboratory Project. Previous models of university-based green residential spaces such as Duke University’s 4,500 square foot live-in laboratory, the DELTA Smart House, as well as non-residential university projects such as University of California-Santa Barbara’s Donald Bren Hall and Stanford’s own Leslie Shao-ming Sun Field Station at Jasper Ridge Biological Preserve have provided added inspiration. Engineering students, faculty, outside professionals, and university entities including Stanford Housing and Woods Institute for the Environment are currently collaborating to advance the proposal for designing and constructing an on-campus green dormitory. In April 2006, results of the Green Dorm Feasibility Study, conducted by a design team led by San Francisco-based firm, EHDD Architecture, were released; the report concluded that “desirable student housing and world-class building research can be realized in a shared facility that operates at the highest standards of environmental performance.”

So, perhaps as early as fall of 2008 or 2009, among the row houses lining Mayfield Avenue may be a new addition—the Green Dorm’s proposed program site is directly behind Casa Italiana. With the site’s proximity to Tresidder Student Union and its unobstructed solar access enabling careful manipulation of building orientations, the 21,150 square foot, three-story building will house approximately 47 students. The building systems laboratory, serving the



View of potential Green Dorm from the southwest.

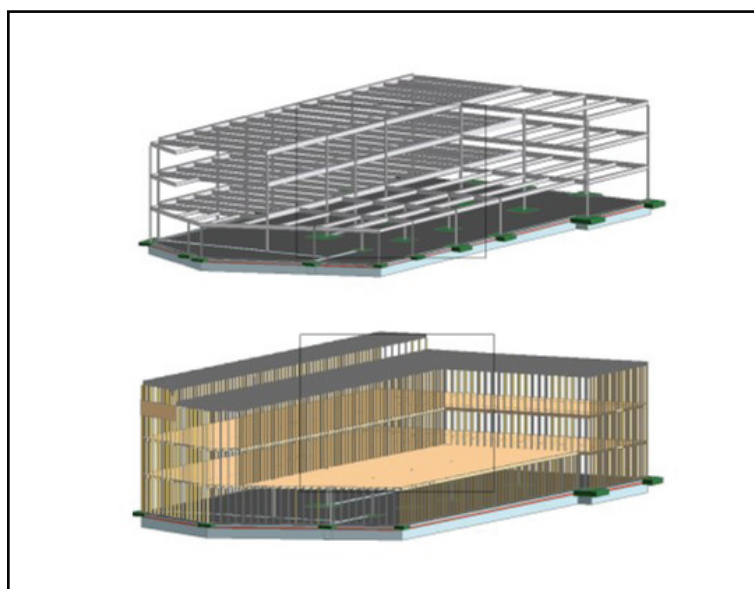
“Students... collect background information and raw experimental data by reviewing current literature, actively building models, practicing hands-on testing, and utilizing computer software.”

- Carol Cao

School of Engineering, and common residential spaces will occupy an enlarged ground floor. The second and third floor singles and two-room doubles will serve as living spaces, and a second floor roof deck will allow for green roof testing, installation of solar panels, and outdoor socializing. An “information center” will provide access to real-time Green Dorm performance metering to visitors, residents, and other building users. Flexible design is emphasized so that evolving building systems may be incorporated, creating a space for truly experiential education.

However, in addition to collecting and synthesizing data from research aimed toward optimizing the Green Dorm’s design, construction, and operation, the Lotus Living Laboratory has broader goals of applying the findings here to existing models of building technology, design processes, and

collaboration. Ultimately, when the Green Dorm is built, it will become a functioning data collection center itself, accumulating performance test results of various innovative green technologies. Thus, the project's main goals are fourfold. First is to create the most desirable student housing on campus, one that places at the top of the housing draw. Second is to implement a live research laboratory within a residential dorm. Third is to achieve measurable environmental performance—for instance, to address global warming concerns, the Green Dorm is being designed as a zero net carbon building (i.e. its annual electric output offsets all of its carbon emissions from energy consumption). And fourth is the attainment of economic sustainability—financial and environmental costs, and life cycle impacts for all resources used will be assessed.



ArchiCAD models of steel (above) and wood (below) structural systems.

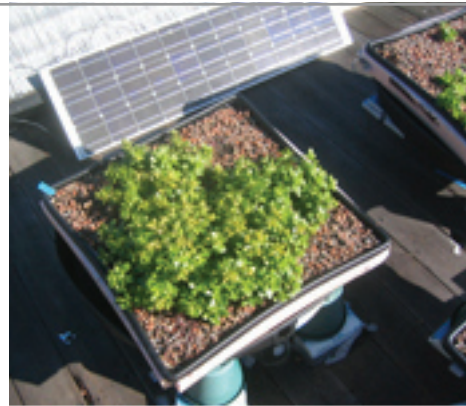
Working with student groups such as Students for a Sustainable Stanford, the Roosevelt Institution's Center on the Environment and Energy, outside professionals, and CEE faculty including Professor Richard Luthy, Professor Craig Criddle, and Professor Emeritus Gil Masters, the five graduate students and approximately ten undergraduates of the Green Dorm's Project Team have conducted research in topics concerning water, energy, materials and structure, design innovation and aesthetics, and monitoring and feedback. Through the course CEE124/224 (Sustainable Development Studio), students, under the mentorship of faculty advisors, execute independent projects in which they collect background information and raw experimental data by reviewing current literature, actively building models, practicing hands-on testing, and utilizing computer software programs to generate analyses, given rough inputs and assumptions. Students' findings contribute directly to hired architects' decisions regarding the development of the Green Dorm, currently in its first design phase.

For example, since the Green Dorm's primary demand for hot water comes from showering, sophomore Jonas Ketterle, majoring in Mechanical Engineering, and an official student representative for the Green Dorm Project, investigated student showering patterns and the times at which daily shower loads peaked. In addition to gathering data showing that average shower length in a standard row house was nine minutes, ranging from three to thirty minutes, with an average temperature of 107.5°F, Jonas also found that if the Green Dorm installs the currently mandated Stanford dormitory standard of 2.5 gallons per minute (gpm) low-flow showerheads, then showering alone would demand approximately 5,800 gallons of water per week, averaging to around 18 gallons per student per day. These results will be applied to models of Green Dorm hot water demand, design plans for a solar water-heating array, and initiatives aimed toward reducing shower water consumption. Jonas also conducted a related project in which he surveyed student preferences for a selection of ultra-low-flow showerheads, with flow rates from 1.5 to 2.4 gpm, lower than the 2.5 gpm standard. With the advantages of conserving water as well as the energy typically required to heat water for showers, the 2.1-gpm ultra-low-flow showerhead that gained the most widespread student approval will be implemented in the Green Dorm. With great potential benefit for the entire Stanford campus, a trial program is in the works to examine the effect of replacing all current dormitory showerheads with Jonas's new models; a quick quantitative analysis shows a rough total annual water savings estimate of 3.6 million gallons, amounting to approximately \$30,000 saved per year.

In a similar effort to maximize energy efficiency during showering, senior Paul Kreiner, also a Mechanical Engineering major, researched the feasibility of a shower drain heat exchanger that would use warm water draining away from showers to pre-heat cold water going into showers. His objectives were to determine typical dorm drain temperatures, to develop a quantitative model establishing the potential for energy savings, and finally to design, construct, and test a prototype heat exchanger. To collect needed data, Paul employed sensors to measure the temperatures of water coming out of the showerhead and at the drain; he found the former to average around 107.5°F, consistent with Jonas's findings, and the latter to be 95°F. Inputting these numbers and other known values (e.g. hot shower water flow rate equals the dorm standard of 2.4/2.5 gpm) into mathematical calculations, Paul applied the Log Mean Temperature Difference (LMTD) Method to determine the heat transfer rate and the required surface area for a heat exchanger apparatus with a reasonable U-value. Although other potential Green Dorm technologies and practices (e.g. ultra-low-flow showerheads and lowering the shower furnace temperature) may reduce the heat exchanger's performance, future systems integration research will resolve such issues. Taking all these factors into account, Paul's analysis showed that a well-designed heat exchanger may recover more than twenty percent of the energy used by showers, corresponding to over 15 million Btu's saved per year for the Green Dorm—a savings of over \$250



Shower Drain Heat Exchanger – Paul Kreiner



Symbiosis of Green Roofs and PVs – David Sheu



Ultra Low Flow Shower Head Testing – Jonas Ketterle

per year.

Freshman Chi Nguyen, majoring in Environmental Engineering, researched energy usage also, but focused on studying how the Green Dorm kitchen may reduce its overall carbon emissions. Familiarizing herself with the work of the Food Service Technology Center (FSTC) based in the local East Bay, Chi compiled information on the environmental friendliness of various existing models and types of kitchen appliances, determined Stanford's current kitchen energy efficiency level, relative to FSTC standards, and suggested incorporation of appropriate technologies for the Green Dorm kitchen. She found that worthwhile investments include variable-speed-control ventilation hood fans, steamers in place of open stoves, and low-temperature dishwashers. Although not yet well tested, one of the most advanced FSTC-endorsed technologies is magnetic induction cooking, in which an electromagnetic field, created on a ceramic surface, heats food by moving particles in pots made of magnetic metals. Additionally, a solar cooker, consisting of a reflector protruding from the south-facing wall and reflecting heat into a black box-like contraption, could prepare, say fresh bread throughout the day and have it ready by dinnertime. "However," Chi says, "with kitchen appliances, there really isn't anything that can magically reduce carbon emissions to zero." So, daily practice—usage and maintenance—matter greatly; for instance, broilers and dishwashers, two of the kitchen's highest energy consumers, should be turned off when not in use and run only when fully loaded. In future, Chi plans to look beyond the FSTC for even more novel kitchen technologies such as thermo-acoustic refrigeration in which high-amplitude sound waves in a pressurized gas are used to pump heat from one place to another.

Sophomore Jennifer Tobias, majoring in CEE with a concentration in architecture, collected her research data for the "materials and structure" sub-area of the Lotus Living Laboratory Project. "Engineering for sustainability requires objective comparison of the environmental impacts of different building materials," she states. Having built three-dimensional computer models of both steel and wood structural systems for the Green Dorm with ArchiCAD software, Jennifer used LCADesign soft-

ware to conduct Life Cycle Analysis (LCA) of the building materials, creating quantitative reports, or ecoProfiles, detailing their environmental impacts. These reports have shown that although no absolute standard exists by which to evaluate green building materials, construction decisions can still be made in favor of materials with lower impacts. A major obstacle for Jennifer is the lack of sufficient United States data—LCADesign currently has an Australian database. However, international collaboration among LCA organizations may make the integration of U.S. data into LCADesign possible. After this issue becomes resolved, Jennifer will present her findings to the Green Dorm design team, providing them with concrete data to facilitate the choice of a sustainable structural system. Beyond this project, Jennifer hopes that her work "will help to join scientific research and industry outreach to increase awareness of environmental impacts associated with building materials."

In addition to a project on formulating an architectural scheme for day-lit hallways in the Green Dorm, junior Engin Ayaz, majoring in Civil Engineering, has recently focused on design process modeling and evaluation. Realizing that current unit matrices for decision-making cannot thoroughly encompass all decision criteria and sources of input information, Engin chose to specifically study the room type decision for the Green Dorm. By experimentally synthesizing organizational and visualization methodologies such as Multi-Attribute Collaborative Decision Analysis and Narratives, he has created comprehensive, intuitive charts that explicitly detail particular decision-making processes. Such mapping will enable more effective communication and management of all design decisions impacting the Green Dorm and allow any stakeholder, whether an architect, engineering student, or university housing representative, to more easily revisit specific decisions as necessary.

Several other student projects address data collection for a multitude of interdisciplinary Green Dorm-derived research initiatives. For example, junior David Sheu has been reviewing literature on green roofs, collecting relevant articles and case studies. Hypothesizing that if a green roof is placed directly beneath photovoltaic cells (PVs), then evapotranspiration, cooling the

air above the green roof, may reduce the PVs' operating temperatures and so increase their total energy output, David will apply what he learns on plant biology and cultivation to an experiment testing for a symbiotic relationship between green roofs and PVs. Further directions of exploration are many and diverse. Research on a facility-integrated vehicle is broadening the scope of the Green Dorm Project by integrating building issues and possibly even campus dining with sustainable transportation. Also, studies on how to incorporate monitoring and feedback apparatus and displays within the Green Dorm suggest possibilities for future cross-disciplinary research collaborations—for instance, collecting data on how hall lighting and other factors may impact residents' sleep patterns may be valuable to the research efforts of Stanford's Center for Human Sleep Research.

Currently, a main source of funding for student research contributing to the Green Dorm Project is the Environmental Protection Agency's second annual People, Prosperity, and the Planet (P3) grant—Stanford students, comprising one of 42 student teams selected as Phase I award winners, received \$10,000 for use on student projects, computer and sensing equipment, and travel expenses. In early May, students traveled to Washington D.C. to compete with 40 other teams for an additional \$75,000 of Phase II P3 funding, awarded on the basis of research done in the past year. Not only have they successfully brought this sum home, but also the Stanford team won the Green Building Initiative's Green Globes award (including an \$1000 cash prize) after impressing the judges with the Green Dorm Project's goals of furthering research and education on sustainable pathways for other current and future projects.

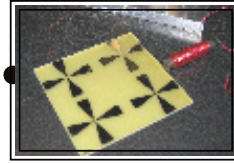
Quantitative costs of the Green Dorm will exceed that for a regular building of its size, mainly due to its incorporation of a lab space and research expenses. However, in the long run, net costs for the Green Dorm will be much lower. The successful installation of more innovative, energy saving building systems and technologies will result in reduced operating costs. The demonstration, education, and research benefits provided for those interested in sustainability and environmental engineering will

more than offset the hard costs of its design and construction. Faculty-led classes, in particular Brad Jacobson's winter-quarter CEE136 (Green Architecture), are already using the Green Dorm Project as a teaching model. Moreover, upon approval by local jurisdictions, the completed Green Dorm building, adhering to safe laboratory procedures and regulations, will serve as an optimal testing facility for more experimental ideas (e.g. developing wastewater treatment methods, thereby working toward the goal of closing the water cycle).

Additionally, students will not have to be diehard, tree-hugging environmentalists in order to live in the dorm. Rather, efficient design and effective use of available technologies should allow the Green Dorm to stand alone in accomplishing its four major objectives, as previously outlined. However, while lifestyle changes are not required, increased environmental consciousness, "awareness of their own impact, and resulting decisions to make lifestyle adjustments will certainly be encouraged in residents in order to supplement the building's own intrinsic performance," says Jonas Ketterle. So, whatever residents choose, they can still enjoy "guiltless hot showers and cold beer."

With the earth's growing population and the accompanying increase in demand for energy consumption, the world faces a pressing need to conserve and share the limited quantities of existing natural resources. As students, it is sometimes all too easy to complacently go on existing within the sheltering confines of the Stanford bubble. However, as the Lotus Living Laboratory Project demonstrates, Stanford students can break out of this bubble—by channeling their energy and enthusiasm towards an endeavor to promote active reevaluation of common architectural and lifestyle practices, those involved in Green Dorm Project renew their respect for each other's livelihoods and welfare and for the environment's, reminding us to do the same.

The author would like to thank Jonas Ketterle and each of the other students featured in this article (Paul Kreiner, Chi Nguyen, Jennifer Tobias, Engin Ayaz, David Sheu) for their large contributions to this article.



Application

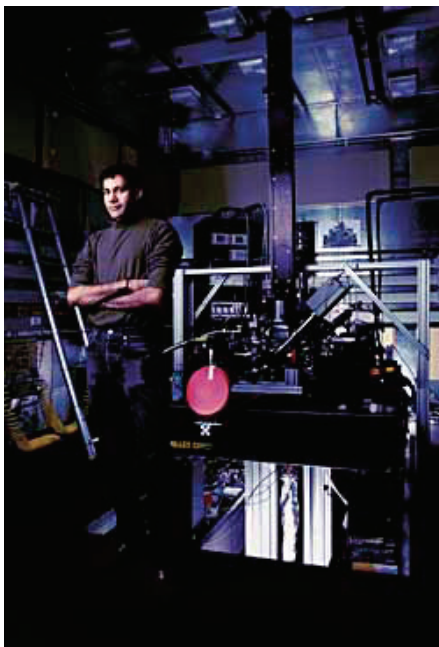
Performing Applied Research: Undergraduates in the Manoharan Lab

By Vineeta Agarwala

In the basement of the Varian physics building, junior Naveen Sinha is figuring out how to use fifty cent quartz crystals - found within digital watches people wear every day - to study quantum phenomena that underlie cutting edge imaging techniques. Junior A.J. Kumar is working to construct and control a set of magnetic “tweezers” that could probe the world of cell biology. And senior Aaron Ligon is writing a physics honors thesis about his own development of magnetic tweezers that will enable manipulation of magnetic particles at microscopic scales.

Like most undergraduate researchers, these students, all working in Professor Hari Manoharan’s lab in the Stanford Physics Department, are motivated to generate knowledge within their field of study. But something more keeps them coming into lab to perform experiments during the busy academic year, and that is the potential application of their work. Aaron, A.J., and Naveen are excited by the possibility that the devices they build will one day be used not only to examine, but also to interact with natural systems at the smallest scales ever achieved by science.

Much of this motivation is common to the entire Manoharan Lab, renowned for the low-temperature scanning tunneling microscope (STM) that its members are currently building from scratch. Capable of both “studying and controlling matter at atomic length scales,” the STM inspires a number of other projects within the Manoharan Lab, each of which is related to



Professor Hari Manoharan standing by the lab’s famous Scanning Tunneling Microscope (STM).

“I try to realistically evaluate what I have designed and built... so that... I can go back to the drawing board and try to make modifications before I dive into the next steps”

- Aaron Ligon

the exploration of the nano-scale in what A.J. describes as “new and creative ways.” Affiliated with the Geballe Laboratory for Advanced Materials (GLAM) as well as the Center for Probing the Nanoscale (CPN) at Stanford, the Manoharan Lab conducts research on topics including nano-assembly and single quanta physics.

Naveen characterizes research within this exciting field of physics as “playing with the Lego blocks of matter,” and recalls being eager to apply the material he was learning in class to a lab setting. For the past year and a half, Naveen, one of this year’s recipients of the Goldwater Scholarship, has been working in the Manoharan lab, exploring the possibility of using cheap, commercially available quartz crystals to observe quantum phenomena. Initially, Naveen set out to develop erasable electrostatic lithography, a technique in which static charges are deposited on an insulated surface to direct the positions of gaseous electrons below. Putting the quartz crystals to use in this “atomic size etch-a-sketch,” however, proved to be more difficult than had originally anticipated. Such a project would have taken years of preparation, not to mention construction, and so in order to “get [his] hands dirty with experimental work,” Naveen opted to modify his research goals.

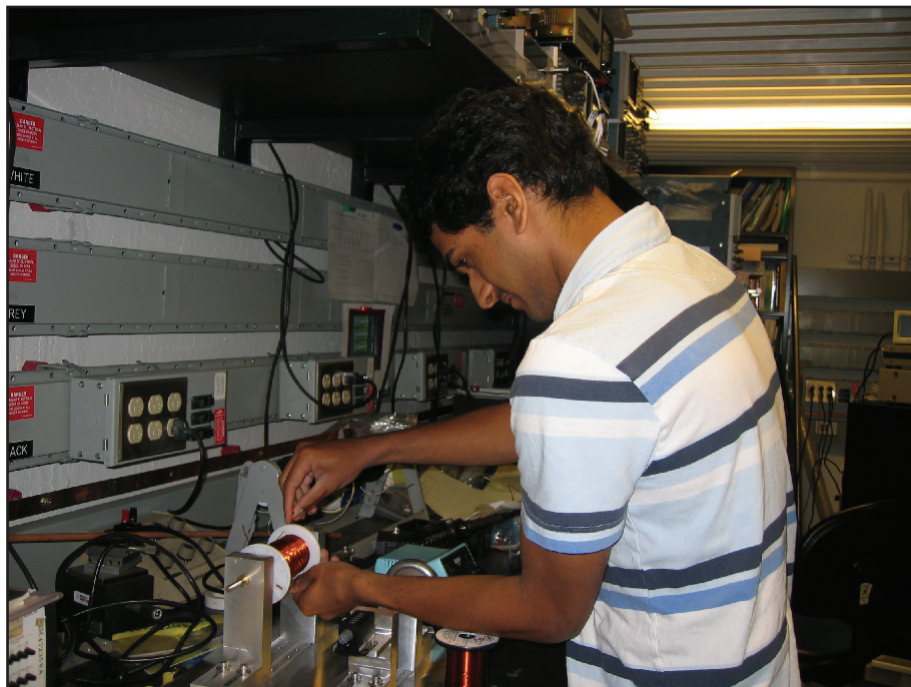
His new project, which is more achievable in the short-term, has given Naveen the chance to experiment more with those quartz crystals. The goal of his research is now to use the quartz tuning forks as sensors to detect electron spin resonance. The applications of this work include three dimensional imaging that would allow scientists to “deduce atomic locations within a sample” based on where electrons resonate in the presence of a mag-

netic field. The distinct benefit of this approach, as compared to current STM and AFM (Atomic Force Microscopy) technology, is that it can be used to examine matter below a scanned surface. The possibility of such an imaging device, Naveen says, is “definitely something which excites me.” Because such technology could be readily applied to other disciplines, such as structural biology, Naveen also notes that his research has “really helped [him] see the connections between different fields of science.”

Although a similar electron resonance detection experiment has been done before in another lab using specially-designed micro-cantilevers and expensive optical interferometry, performing the measurement with the tuning forks that Naveen wants to use has been a challenge. “It’s like trying to piece together a puzzle to gather the knowledge I need to use these tuning forks,” Naveen says. The parts of the puzzle come from a variety of sources. Much of Naveen’s research so far has been an in-depth study of the properties of the quartz crystals. He has conducted experiments in lab to measure the sensitivity of the crystals and explore the ways in which he can simplify detection of the small magnetic forces exerted by the electrons. Naveen gathers additional knowledge from his research advisor, Professor Manoharan, and graduate and post-doctoral students in the lab. “One of the things I like most,” Naveen says, “is the great sense of camaraderie in my lab – we all help each other out, and you learn so much more that way.”

Working at a bench near Naveen’s, undergraduate researchers A.J. and Aaron, also feel the collaborative spirit within the Manoharan lab. The graduate students are “always willing to help out with problems, or just talk about grad school, physics, and research,” Aaron says. A.J. and Aaron, both developing different types of magnetic tweezer devices, have two graduate student mentors in the lab. Because they are interested in similar research questions, A.J. and Aaron also often cooperate with one another. Both are working to build different microelectromagnet configurations to manipulate magnetic beads in two dimensions. In the final product, the magnets will be used to move a superparamagnetic bead without physically contacting it; this is a key advantage of these ‘invisible’ magnetic tweezers, since they run no risk of damaging a sample in the way that optical tweezers or other devices do.

Furthermore, because such a device doesn’t require low temperature and high vacuum conditions, as the STM does, its applications are more diverse. By “functionalizing” the surface of the bead – attaching it to a protein of interest, for example – the device could be used to control particle movement and make measurements within complex in vivo systems, like cells. Specifically, magnetic tweezers could be powerful sorting devices; by using different chemical coatings on the magnetic beads, dif-



A.J. works on his magnetic tweezer device at a bench in the Manoharan Lab.

ferent types of cells could be separated from one another. They could also be useful, Aaron observes, in measuring the elasticity properties of chain-molecules, like DNA. “As long as the ends [of the molecule] were attached to two beads...a known force could be applied to cause the molecule to stretch,” and the distance could be “measured by a tracking camera.” It is applications like these that make both Aaron and A.J. so enthusiastic to perform nano-science research; as A.J. puts it, his research has “opened [his] eyes to how much physics can contribute to other fields.”

A.J.’s version of the magnetic tweezer contains four magnetic poles that concentrate a strong magnetic field gradient at the center of his 3cm by 3cm grid. The controlled region at the center is of width on the order of one hundred microns. Eventually, he hopes to reduce this width even more – to about twenty microns – but for now, this is the smallest size at which he can obtain sufficient field concentration, and yet use affordable parts. A.J. began work on his device last summer, when he decided to loosely follow the design strategy developed by a researcher in the Netherlands. Building his own version of the tweezer with limited resources has been A.J.’s challenge. His first step was to conduct experiments to find out how many magnetic poles – three or four – would optimize the device design. By using existing software in the lab, A.J. was able to simulate the magnetic gradients that would result from each set-up, and settled on four magnetic poles. A.J. had the opportunity to present his work this past autumn at the Symposium for Undergraduate Research in-Progress (SURP) held annually at Stanford.

Aaron has been working since last June on a different version of the tweezer, basing his device on a design pioneered by the Westervelt Group at Harvard, which involves a grid of microwires instead of A.J.’s magnetic poles. Aaron began his work

last summer with the support of the Physics Department's summer research college for undergraduates. Like A.J., Aaron has since been testing what kind of magnetic gradient he will need to move the beads and is now designing the device itself. Working simultaneously to "read literature, create computer models, build custom electronics, write computer control code, and design the microelectromagnet grid," Aaron's research has "challenged [him] to organize the process of design." Collaborating with IBM on the actual fabrication of microwires, which have a width of just ten microns, Aaron recently reduced the size of his second prototype for the magnetic tweezers. Throughout this year, he has continued conducting research in the Manoharan lab for academic credit, and is working towards his senior honors thesis.

Reflecting on his undergraduate research experience, Aaron notes that he has "learned a lot about...the process of design, testing, evaluation and iteration" by working in an applied physics lab. Because he is always working towards building a testable and practically useful device, Aaron is "forced...to be a very objective and careful observer of [his] own work." Describing

his research approach, Aaron says, "I try to realistically evaluate what I have designed and built on a regular basis so that if something is clearly not going to work well, I can go back to the drawing board and try to make modifications before I dive into the next steps." A.J. echoes a similar sentiment when asked what he finds difficult about applied research. "Since I am building my own parts," he says, "each step I take has a huge impact on what I can do later, which requires a lot of planning."

With exciting applications in sight, however, Naveen, A.J., and Aaron all agree that the hard work up front is worth it. Whether their projects will allow them to image the nano-scale in novel ways or direct the movement of biological cells, the process of research itself has allowed these undergraduates to tackle problems that are "new and individual." Classes and problem sets are much the same for each student, Naveen notes, "but research is unique."

The author would like to thank Naveen Sinha, A.J. Kumar, and Aaron Ligon for their large contributions to this article.



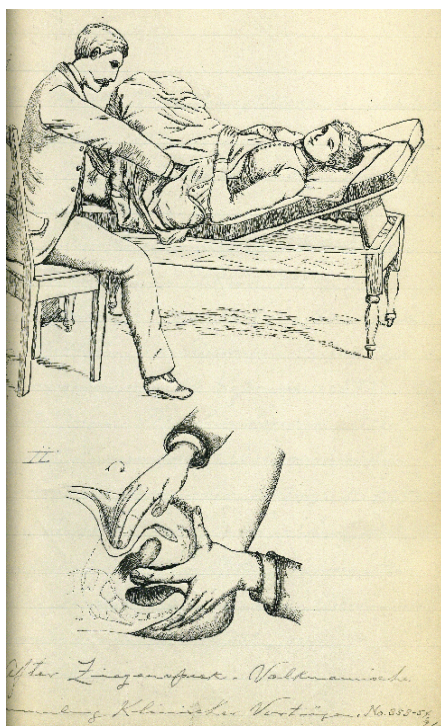
Presentation

Presenting Research on Rhetoric and Medical Writing: A Senior Honors Thesis

By Kelly Cheng

One of the greatest challenges presented by research in any subject is the creation of a final product and dissemination of discoveries into larger worlds. What begins in an enclosed lab or dusty library ultimately finds an audience in scientific symposia, research journals, and in honors theses. Thus, choosing one's major not only influences which library one delves into for hundreds of hours, but also offers a culmination of that degree with the honors thesis: a common and yet personal way to present undergraduate research.

Senior Jenna Tonn completed her honors thesis in Feminist Studies. Her work as a student researcher in that department piqued an interest in American medicine between 1890 and 1900. At that time, she says, "The medical community was at a crossroads of language--how do you talk about uterine disorders when the only language relating to the uterus available is embedded in neurasthenic/hysterical literature?" According to Jenna, neurasthenia was coined for "nervous exhaustion caused by mental overexertion," and along with hysteria, became associated with uterine disorders. In her thesis, Jenna explores that decade's rhetorical changes regarding neurasthenia, hysteria, and uterine disorders



A picture from one of the source theses that Jenna discusses in one of her chapters (Clarance Kellogg, Class of 1891). It is a hand-drawn sketch of Dr. Kellogg giving a gynecological exam to a female patient. The image is drawn by Dr. Kellogg himself.

within the medical community and media. She analyzes the advances of obstetric technologies, access to medical education for women, and the tightening regulations of the American Medical Association, among other effects on the changing reliance on neurasthenic language in medical writing.

Like other undergraduate researchers, Jenna has become an audience to other theses in creating her own. Inside Stanford Medical Center's Lane Library Special Collections and Archives, she plunged into countless theses written by graduates from Cooper Medical College of San Francisco. That medical school, one of few coeducational medical institutions in the U.S. of its time—a unique focus of the thesis—later became Stanford University Medical College.

Jenna presented her thesis at the Feminist Studies colloquium, a year-end event common in honors programs. She values "the opportunity to truly 'produce' an intellectual or academic work," and sees the thesis as "a form of presentation for the researcher, a structure that benefits the researcher's development as a member of the academic community." However, she sees limits in sharing the research through a thesis "because it is so embedded in the formalities of the academic world." Jenna points to the Haas Center as an answer to this problem.

The Public Service Scholars Program provides researchers an even larger audience in a specific organization or community and in the general public. However, the focus of this program accepts theses that can specifically contribute to public service. This one-year program also provides additional support for seniors to perfect their work. The program concludes with the mini-conference of formal presentations, "Research with a Public Purpose," and links thesis abstracts on the Haas website.

"The thesis...is 'a structure that benefits the researcher's development as a member of the academic community.'"

- Kelly Cheng

Jenna's research employed resources available to undergraduates. She successfully applied to fund her summer research through an URP grant. At the URP office, Jenna also found her "main support," Hilton Obenzinger, her mentor for the feminist studies internship, who helped her find an advisor for her honors thesis. According to Jenna, her advisor Andrea Lunsford "is always open to reading chapter drafts and has been very enthusiastic." Patty French, the curator of Special Collections at Lane Medical Library, has also been very helpful. The feminist studies department supports seniors pursuing undergraduate research with an honors college program and an honors thesis seminar.

Perhaps one day, Jenna's thesis will become another researcher's memorable material. Within Lane Medical Library, she "opened one thesis and the most amazing, disturbing, perfect image was engraved on the front page!" On that auspicious day, another student's research became "the cornerstone of her thesis, a brilliant find!" In the meantime, she continues to engage in the timeless tradition of research: a rigorous, in-depth presentation of her passions that could lead future researchers into new worlds.

The author would like to thank Jenna Tonn for her large contribution to this article.

Innovative HOPES Project: A Cartoon Book on Genetics and Huntington's Disease for Young Children

By Christina Ann Chen

All I remember from the interview was: "We can work that out for you." I had just become a new student researcher for HOPES, and already I had the freedom to choose whatever research project I was interested in. HOPES (Huntington's Outreach Project for Education at Stanford) is a student and faculty-run website project that provides the general public with up-to-date scientific information on Huntington's Disease (HD) in everyday language. Video clips, interactive timelines, and articles summarizing findings in medical journals are just a few examples of the group's online postings (<http://hopes.stanford.edu>). And my first proposed project was perfectly in line with the group's goal of educating the public through creative presentation: I wanted to create a cartoon children's book explaining the genetics of HD.

Writing for HOPES is not just about writing—it's about collaborating with different people and applying resources in order to make medical information about HD clear and entertaining. I chose to center my project on children, as children's education would vastly increase the reach of the HOPES website. Specifically, I wanted to write about the heredity of HD for young children between the ages of eight to ten. With my target audience in mind, I began sketching cartoons of googly-eyed flies and curled arms of pea plants to animate the genetics of heredity.

Based on these sketches, Stanislav Jourin—the graphic artist for this project—was able to bring my ideas to life in a way that I never could have.

To make sure that our book would not overlap with currently available educational materials, Stanislav and I researched

local bookstores. After hours of searching, we were astonished to discover that there were virtually no children's books on specific diseases in teaching specialty stores or mainstream bookstores. Instead, we found books that either glossed over genetics or were too advanced for young children.

Furthermore, the quality and creativity of illustrations in these books were obsolete. The rare find of a humorous cartoon book – which only covered general health topics – pointed to an obvious gap in children's educational literature that needed to be filled.

Our research prompted us to conclusively decide that we must create this cartoon gene book. Additionally, the research helped me to make decisions regarding my narrative format by exposing me to the most effective writing styles. Some educational stories tell of a child who discovers a lesson through his own mishaps. Others have children explaining lessons to one another. Still other traditional stories contain an omniscient narrator. Finally, more modern books introduce a comical character that narrates the story of a child learning a lesson. Conversations with teaching specialty personnel led me to conclude that children found the last style most appealing: the character had enough distance from the protagonist child to make the story hu-



GENSEN THE RUNAWAY GENE



morous, but was close enough to the subject material to provide educational understanding.

I merged several of the styles together to make the narration of genetics as entertaining as possible. The main narrator and star of the book, Gensen, is a naïve gene who doesn't know his own purpose as the gene responsible for HD in a human cell (creatively called Cell). Fortunately, Gensen comes across a magical Ball, who takes him on an educational adventure to teach him about the importance of genetics to the Cell.

Together, Ball and Gensen travel back in time to visit Mendel's garden, where they learn about Mendel's famous pea plant experiments and heredity by talking to Patsy Pea Plant. They also take the time to shrink themselves sufficiently so as to investigate the structure of DNA. Through a conversation with Rosalind Franklin, they learn how DNA sequences code for specific proteins. Gensen returns back to Cell where he meets Kromie, the Chromosome 4 of which Gensen is a part. In the end, Gensen puts together all the genetics lessons he has learned to understand how HD causes its symptoms. While I cannot spoil the ending of the story, I can tell you its take-home message: scientists are working around-the-clock for a cure that will allow the HD community to continue to hope. Our group is thus appropri-

ately titled HOPES.

A few sample illustrations, which appear throughout the book, are shown below. We plan to make the story available in several multimedia forms, as well as in an easy-to-print form. There are also plans to publish the book in adapted forms, such as video à la Veggie Tales.

(insert one image here)

With exciting plans for the future, HOPES continues to be a model student-research group by presenting current research and education to the HD community in clear and creative ways. Our outreach efforts remind people with HD that there are scientists constantly working on their behalf in the research arena, and people like members of HOPES that are promoting this research through accessible education. With a more recent focus on educating youth, HOPES is committed to ensuring that future generations will continue making innovative contributions to the presentation and dissemination of scientific research.



Quantitative Assessment of the Impact of the Service-Learning Course “Mental Health and the Veteran Population: Case Study and Practicum” on Undergraduate Students

Manisha Bahl and Jason Hom

*Class of 2005
Human Biology*

*Class of 2005
Biological Sciences*

Few studies have evaluated the effectiveness of service-learning courses, given that the field of service-learning is relatively new. Our study assesses the impact of the service-learning course “Mental Health and the Veteran Population: Case Study and Practicum” at Stanford University, which involved volunteer service in the geropsychiatric ward of the Menlo Park Veterans’ Administration Hospital and an academic component. Fourteen students participated in the course and completed questionnaires detailing their pre- and post-course attitudes. The results suggest that service-learning significantly changed the attitudes of the students who participated, making them more comfortable with interacting with the elderly and mentally ill and more aware of societal misconceptions.

Direct service through volunteerism has been an integral part of our society for years. In fact, the US Department of Labor reported that approximately 65.4 million people volunteered through or for an organization at least once between September 2004 and September 2005. The study, conducted by the US Bureau of Labor Statistics, also demonstrated that community service involves individuals from a diverse segment of society – the amount of time spent on volunteering is comparable among men and women and among people of different ethnicities, ages, and religious backgrounds – and that the religious, educational, philanthropic, and social welfare groups involved in organizing community service are just as diverse as the actual volunteers (US Department of Labor, 2005).

Traditional volunteer service is distinct from service-learning. According to Timothy Stanton, Dwight Giles, Jr.,

and Nadinne Cruz in *Service-Learning: A Movement’s Pioneers Reflect on Its Origins, Practice, and Future*, “service-learning programs should not just recruit students to volunteer in soup kitchens. They should also ask them to reflect on why people are hungry. Literacy volunteers should be asked to consider why there are so many illiterate people in an ‘advanced society.’” Unlike traditional volunteer service, service learning calls for structured opportunities for reflection, which may entail pre-service preparation courses, field seminars, reflection workshops, and journaling. Whereas traditional volunteer service is based on a one-way model in which a charitable giver paternalistically gives to a receiver who lacks resources, service-learning evokes the concept of reciprocity between server and served (Stanton et al., 1999).

While volunteerism and direct-service are well-established, the related field of service-learning is comparatively new.

The actual development of service-learning began in the 1960s when, across the nation, students were reacting strongly to the Vietnam War, racial tensions, inequities in education and income, and a host of community issues (Stanton et al., 1999). As activism evolved, community activists and educators “found themselves drawn to the idea that action in communities and structured learning could be combined to provide stronger service and leadership in communities and deeper, more relevant education for students” (Stanton et al., 1999). From this early, relatively unorganized movement, service-learning eventually become a recognized field; however, it was only in the 1980s and 1990s that service-learning courses, which integrate academics and service, were introduced.

Because service-learning courses were only recently developed, few studies have evaluated the impact of service-learning courses on students. Our study is unique in that it quantitatively evaluates the im-

impact of a service-learning course on students. To conduct this study, we designed and led a service-learning course titled "Mental Health and the Veteran Population: Case Study and Practicum" at Stanford University under the sponsorship of Clifford Barnett, PhD. This service-learning course involved: 1) direct service in the geropsychiatric ward of the Menlo Park Veterans' Administration Hospital; and 2) an academic component, which provided opportunities for structured reflection, guest lectures, and discussions of the political, social, and ethical issues surrounding mental illness and the veteran population.

Given the recent emergence of service-learning, the number of course assessment studies – and, in particular, the number of quantitative course assessment studies – is not large, making this study particularly relevant. Other studies on the impact of service-learning on college students, while few, differ from our study. A study at Dartmouth College examined the effects of a small-scale, very short-term service-learning experience on college undergraduates. It found that students participating in this experience, when compared to non-participating matched counterparts, reported maintenance of their sense of social responsibility, an increased sense of the meaningfulness of college, and an increased likelihood of choosing a service-related occupation (Reed et al., 2005). Another study involved a one-semester course and a separate service-learning project for students at Susquehanna University and found that student comments about the course were quite positive (Elison and Radecke, 2005).

Providing a quantitative assessment of the impact of a service-learning course, which is a relatively new academic model, is important because it can suggest room for improvement, provide data on the benefits of service-learning, and help further legitimize the field. Our study differs from the Dartmouth study in that it involves a longer, more intensive service-learning experience. While the Susquehanna study asked students to evaluate the course with predominantly open-ended questions, our

study quantitatively assesses the impact of service-learning courses on students. While qualitative, anecdotal assessment has many merits, we felt that a quantitative assessment had the potential to more precisely and thoroughly provide an indicator of course impact upon all students. Such an assessment of their impact is very relevant for the funding of service-learning programs, the expansion of service-learning programs at Stanford and other schools, and the potential of making service-learning courses required components of the student curriculum. Before conducting the study but after leading the course, our hypothesis was that the course would substantially change student views toward the elderly and the mentally ill.

Materials and Methods

Subjects

Fourteen students participated in the quarter-long (10-week) service-learning program. The students were Stanford undergraduates ranging from ages 18 to 21. Attendance at the lecture component of the course and participation in the service component of the course were monitored, and all students satisfactorily fulfilled both aspects of the program. All students completed and returned the survey (see Appendix A), which was done anonymously during the last course session.

Service-Learning Course Service Component

Carpools were arranged at several times throughout the week so that students could volunteer once per week for two hours for the duration of the course, and all volunteering occurred in the geropsychiatric ward of the Menlo Park Veterans' Administration (VA) Hospital. At the beginning of the class, an on-site orientation at the Menlo Park VA Hospital was conducted by VA staff. Topics covered included patient confidentiality and an overview of the layout of the hospital, and TB tests were also conducted.

Following this on-site orientation, each volunteer completed a survey detailing their personality traits, interests,

and other relevant items. The survey was then provided to VA Hospital staff who matched each volunteer with two veterans whom they felt the volunteer would be especially compatible with, based on personal knowledge of the veteran's personality and interests and the student's answers to the survey. Students were asked to spend one hour per week with each of the veterans (during the same trip to the VA Hospital). Any problems encountered by the students were satisfactorily addressed by the VA staff.

Service-Learning Course Lecture Component

The lecture component of the service-learning course involved eight sessions, each one hour long. Guest speakers were invited to five of the eight sessions. The speakers included a professor of psychiatry, professor of philosophy, campus minister, professor of psychology, and professor of geriatrics. With the exception of the presentation by the professor of geriatrics, which took place at the Menlo Park VA Hospital, all other guest lectures took place at Stanford University. Students were given relevant reading material before each guest speaker and encouraged to ask questions during the presentations. The guest speakers all addressed the broad goals of the course by not only helping students understand the issues facing the elderly, veterans, and the mentally ill, but also by contextualizing the volunteer experience and environment for students. Topics covered by the guest speakers included theories about schizophrenia, issues of autonomy and medical consent among those with Alzheimer's and related ailments, background information about the number of mentally ill veterans, a survey of cross-cultural perspectives on mental illness, and extensive information about the aging process and its correlations with mental illness.

There were three sessions at which guest speakers were not present. The first of these sessions (the very first session of the course) included introductions, an explanation of the structure and format of the course, and a group discussion on a

current newspaper article about veterans. Also, students were asked, as a group, to list stereotypes they associated with the elderly, the mentally ill, and the elderly mentally ill in a Venn diagram. During the second session at which guest speakers were not present (the second-to-last course session), students had an opportunity for structured reflection about their experiences, which involved reading excerpts from journals they had kept throughout the quarter detailing their experiences at the VA Hospital. During this session, several students mentioned how the course had enhanced their academic experience, shed new light on their desire to be doctors, and made them interested in learning more about mental health and the veteran population.

During the third session at which guest speakers were not present (the very last session of the course), students were shown the Venn diagram they had created at the beginning of the quarter. As a group, students discussed whether they thought these stereotypes were justified now, given their new quarter-long experience with the patients at the VA Hospital.

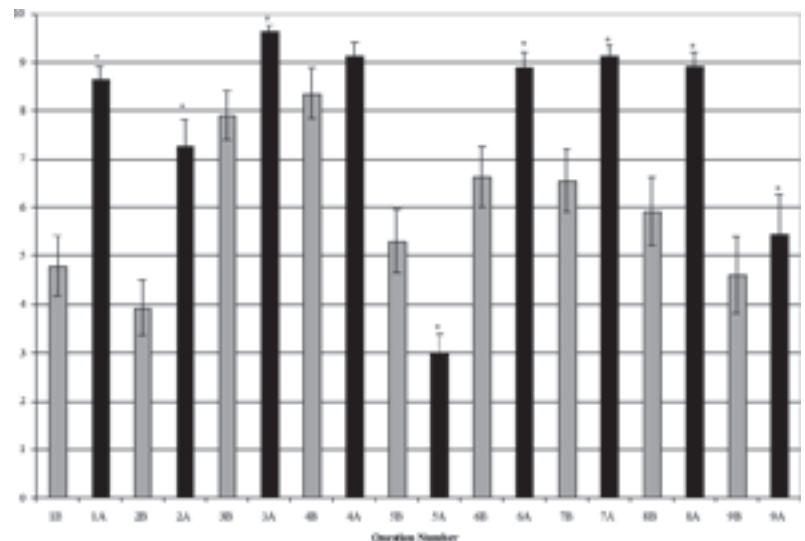
Statistical Analysis

All 14 students who completed the service-learning course completed a comprehensive questionnaire (see Appendix A) detailing their pre- and post-course attitudes during the final session of the course. The questionnaire asked students to rank their “before”-course and “after”-course attitudes using a 1-10 scale. Results for each question were averaged, and statistical analyses were performed using Student’s t test. P-values of less than 0.01 were considered statistically significant.

Figure 1. This graph depicts the results and standard deviations for each of the nine questions asked of the students. 1B refers to question 1 and “before”-course attitudes, 1A refers to question 1 and “after”-course attitudes, etc. Asterisks indicate that the before-after difference is statistically significant at a p-value less than 0.01.

	Question (Scale Used)	Before	After	p-value
1	How comfortable do you feel working with the mentally ill? (10 – very comfortable; 5 – somewhat comfortable; 1 – not comfortable at all)	4.79	8.64	p < 0.01
2	The mentally ill are people I would want to regularly spend time with. (10 – strongly agree; 5 – neutral; 1 – strongly disagree)	3.93	7.29	p < 0.01
3	I believe that, in addition to medication-based therapies, socialization and recreation therapies are useful to treat the mentally ill. (10 – strongly agree; 5 – neutral; 1 – strongly disagree)	7.91	9.64	p < 0.01
4	When compared to diseases or conditions such as diabetes and cancer, mental illness carries an additional stigma in society. (10 – strongly agree; 5 – neutral; 1 – strongly disagree)	8.36	9.14	p = 0.229
5	If yes to the previous question (rating of 6-10), this stigma is justified. (10 – strongly agree; 5 – neutral; 1 – strongly disagree)	5.31	3.00	p < 0.01
6	Destigmatizing mental illness through education, awareness, and exposure programs is necessary for better care and understanding of mental illness. (10 – strongly agree; 5 – neutral; 1 – strongly disagree)	6.64	8.91	p < 0.01
7	How comfortable do you feel working with the elderly? (10 – very comfortable; 5 – somewhat comfortable; 1 – not comfortable at all)	6.57	9.14	p < 0.01
8	How receptive was your patient the first time you visited him/her? (before) (10 – very receptive; 5 – somewhat receptive; 1 – not receptive at all) How receptive was your patient the most recent time you visited him/her? (after) (10 – very receptive; 5 – somewhat receptive; 1 – not receptive at all)	5.93	8.93	p < 0.01
9	I am interested in the career fields of psychiatry and mental health care. (10 – strongly agree; 5 – neutral; 1 – strongly disagree)	4.62	5.46	p < 0.01

Table I. This table shows the averaged results and p-values for each of the nine questions asked of the 14 students.



All 14 students answered each of the 11 questions with the exception of Question 3 (11 students), Question 5 (13 students), and Question 6 (11 students). Of the 14 students, 13 students agreed (rating of 6, 7, 8, 9, or 10) with the statement in Question 4, so only those 13 students answered the following question (Question 5).

Discussion

Students in the service-learning course were asked nine questions that involved an evaluation of before and after attitudes. Student responses significantly changed after the experience, as compared to before, for eight of the nine questions (p -value < 0.05), suggesting that the service-learning experience affected their attitudes toward service and the elderly. In general, after the service-learning experience, students were more comfortable working and interacting with the elderly and mentally ill. Most reported having positive interactions with the patients they visited, noting that their patients had become more receptive over time. In fact, as compared to their before assessment, students acknowledged after their experience wanting to regularly spend time with mentally ill patients. Our results are consistent with the findings from a study conducted at California State University, Northridge, which found that students who initially had negative attitudes toward older adults significantly improved their attitudes after a service-learning experience (Beling, 2003).

After the service-learning course, students became more accepting of the use of socialization and recreation therapies to treat the mentally ill, two commonly used techniques at the Menlo Park VA Hospital. All acknowledged that destigmatizing mental illness through education, awareness, and exposure programs are necessary for better care and understanding of mental illness; all found the lectures about mental illness to be helpful in better understanding their patients and their needs; all found the service-learning visits to the hospital beneficial. Interestingly, many more students expressed an interest in

the career fields of psychiatry and mental health care after the service-learning experience than before. Other studies (Ellison and Radecke, 2005; Reed, et al., 2005), in fact, also found that students who engage in service-learning experiences report an increased likelihood of choosing a service-related occupation.

The only question for which student responses did not change significantly after the experience involved an attitude toward the stigma that mental illness carries in society. As compared to before, post-course student responses did not change significantly in evaluating the statement, "When compared to diseases or conditions such as diabetes and cancer, mental illness carries an additional stigma in society." This lack of change is likely due to the fact that, while individual student perceptions of mental illness changed, students recognized that societal attitudes did not, thus continuing to strongly agree with the statement that mental illness does indeed carry an additional stigma. Students, however, became less accepting of the notion that this stigma is justified.

Future directions include conducting an assessment of attitude changes in students who volunteer at the hospital but who have not participated in any academic experience related to that service, which would allow us to compare the effects of traditional direct-service volunteering and service-learning. Additionally, we wish to assess the impact of service-learning on a more diverse group of students. Because we only looked at students who chose to enroll in the course, we looked at a fairly self-selected group in terms of their interest and receptiveness to volunteering with and learning about the elderly and mentally ill. It may be the case that such students are more likely to change their attitudes or report positive experiences than students in the general population. Naturally, it would be hard to design a course and concomitant study that avoids this problem, but it might be possible if a future course were mandatory.

A qualifying remark must be made about the methodology. We asked stu-

dents to detail both their pre-course and post-course attitudes retrospectively. We are well-aware that the standard methodology would be to give the survey prospectively at the beginning of the course and then retrospectively at the end of the course. We would have preferred to do this, but we were unable to do so because we did not decide to do a quantitative assessment of the effect of the course until after it was almost over. Although giving the surveys in this fashion may be preferable, we feel that our methodology does have some significant advantages. By giving the entire survey retrospectively and having students detail both their pre-course and post-course attitudes retrospectively, students had a chance to compare their pre-course attitudes to their post-course attitudes with an adequate basis for comparison.

As a final caveat, we must acknowledge that because our study only focused on one particular service-learning experience, there is a limit to how much we can reasonably extrapolate to service-learning experiences in general. Presumably, other service-learning experiences that involve different opportunities have different dynamics and attract a different demographic of students. It may be the case that our study would have been somewhat different in its results had we looked at students volunteering with the homeless, with severely ill children, or other populations. Future studies may take a similar approach to ours but look at several different service-learning courses. Overall, however, we feel that our study's conclusions about the benefits of our service-learning course on student attitudes have considerable general applicability.

Taken together, our results suggest that service-learning significantly changed the attitudes of the students participating in the experience, making them more comfortable with working and interacting with the elderly and mentally ill and more aware of societal misconceptions. These findings strongly support the value of service-learning experiences, emphasizing the need for the integration of service and

Appendix A
Questionnaire

How comfortable do you feel working with the mentally ill?
(10 – very comfortable; 5 – somewhat comfortable; 1 – not comfortable at all)

BEFORE YOU BEGAN VOLUNTEERING										
1	2	3	4	5	6	7	8	9	10	No opinion
NOW										
1	2	3	4	5	6	7	8	9	10	No opinion

The mentally ill are people I would want to regularly spend time with.
(10 – strongly agree; 5 – neutral; 1 – strongly disagree)

BEFORE YOU BEGAN VOLUNTEERING										
1	2	3	4	5	6	7	8	9	10	No opinion
NOW										
1	2	3	4	5	6	7	8	9	10	No opinion

I believe that, in addition to medication-based therapies, socialization and recreation therapies are useful to treat the mentally ill.
(10 – strongly agree; 5 – neutral; 1 – strongly disagree)

BEFORE YOU BEGAN VOLUNTEERING										
1	2	3	4	5	6	7	8	9	10	No opinion
NOW										
1	2	3	4	5	6	7	8	9	10	No opinion

When compared to diseases or conditions such as diabetes and cancer, mental illness carries an additional stigma in society.
(10 – strongly agree; 5 – neutral; 1 – strongly disagree)

BEFORE YOU BEGAN VOLUNTEERING										
1	2	3	4	5	6	7	8	9	10	No opinion
NOW										
1	2	3	4	5	6	7	8	9	10	No opinion

If yes to the previous question, this stigma is justified.
(10 – strongly agree; 5 – neutral; 1 – strongly disagree)

BEFORE YOU BEGAN VOLUNTEERING										
1	2	3	4	5	6	7	8	9	10	No opinion
NOW										
1	2	3	4	5	6	7	8	9	10	No opinion

Destigmatizing mental illness through education, awareness, and exposure programs is necessary for better care and understanding of mental illness.
(10 – strongly agree; 5 – neutral; 1 – strongly disagree)

BEFORE YOU BEGAN VOLUNTEERING										
1	2	3	4	5	6	7	8	9	10	No opinion

NOW

1 2 3 4 5 6 7 8 9 10 No opinion

How comfortable do you feel working with the elderly?
(10 – very comfortable; 5 – somewhat comfortable; 1 – not comfortable at all)

BEFORE YOU BEGAN VOLUNTEERING

1 2 3 4 5 6 7 8 9 10 No opinion

NOW

1 2 3 4 5 6 7 8 9 10 No opinion

How receptive was your patient the first time you visited him/her?
(10 – very receptive; 5 – somewhat receptive; 1 – not receptive at all)

1 2 3 4 5 6 7 8 9 10 No opinion

How receptive was your patient the most recent time your visited him/her?
(10 – very receptive; 5 – somewhat receptive; 1 – not receptive at all)

1 2 3 4 5 6 7 8 9 10 No opinion

My patient looked forward to my visits.
(10 – strongly agree; 5 – neutral; 1 – strongly disagree)

1 2 3 4 5 6 7 8 9 10 No opinion

The lectures about mental illness helped me better understand my patient(s) and his/her/their needs.
(10 – strongly agree; 5 – neutral; 1 – strongly disagree)

1 2 3 4 5 6 7 8 9 10 No opinion

The service-learning visits to the VA Hospital were beneficial.
(10 – strongly agree; 5 – neutral; 1 – strongly disagree)

1 2 3 4 5 6 7 8 9 10 No opinion

I am interested in the career fields of psychiatry and mental health care.
(10 – strongly agree; 5 – neutral; 1 – strongly disagree)

BEFORE YOU BEGAN VOLUNTEERING

1 2 3 4 5 6 7 8 9 10 No opinion

NOW

1 2 3 4 5 6 7 8 9 10 No opinion

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Manisha Bahl and Jason Hom
Class of 2005
Human Biology and Biological Sciences

Manisha Bahl and Jason Hom graduated from Stanford University in 2005 and are currently first-year medical students at the University of California, San Francisco. While at Stanford, they were actively involved in United Students for Veterans' Health (USVH), a national program whose mission is to enrich the quality of life of hospitalized veterans. Based on their involvement with USVH, Manisha and Jason designed and led the service-learning course studied in this paper in Spring 2003 under the guidance of Dr. Clifford Barnett (Anthropological Sciences). The course was based on a similar one offered by Helene Mik in Winter 2002.

Ethics

Marketing Morality: The Future of the Extremist Animal Rights Movement in America

Anya Bershad

Class of 2009

Human Biology, English

The animal rights movement, initially founded by a few ethicists writing about the animal interest in avoiding suffering, blossomed into what it is today in the past twenty years. Now, groups such as People for the Ethical Treatment of Animals (PETA) are facing a dilemma common to all rising grass-roots organizations: how is it possible to achieve widespread public recognition when the very extremism that attracts attention also seems to alienate a broader support base? This paper attempts to illuminate this paradox through a sociological, ethical, and rhetorical examination. Malcolm Gladwell's "The Tipping Point," and Peter Singer's "Animal Liberation" are two of the sources that help to provide answers to the pervasive question of the marketing of ideas.

Today, the refrigerated section of Albertson's is stocked with Morning Star vegetarian sausage links, Tofurkey deli slices, and garden burgers of every sort. In an organic-obsessed culture, vegetarianism is no longer eccentric. Despite the unprecedented prevalence of non-meat-eaters, animal welfare supporters maintain an overzealous, foolish or even violent reputation. Organizations that promote the humane treatment of farm animals have valid and compelling causes. However, their methods are often injudicious. Fifteen years ago, 100 million cows, pigs, and sheep were slaughtered in the U.S., along with 5 billion chickens, and these figures are growing rapidly (Singer, *Animal Liberation* 95). The animals used to produce our meat and dairy products often endure unnecessary suffering as a result of an increasingly mechanized farming industry. Over the past thirty years, the animal rights movement has grown from a few thoughtful ethicists responding to livestock conditions into a large-scale campaign with a reputation for extremism. This evolution

has encouraged animal welfare supporters, despite the critical press received by many of the more radical demonstrations. However, now that the animal rights campaign has broader recognition, it has reached a critical point in its rhetorical development: it is time to lay down the blood-stained chicken costumes and inflammatory signs and begin to approach the public with a rational, palatable appeal for reform.

In discussing the issues surrounding radical demonstrations for the sake of animals, it is necessary not only to examine specific cases, but also to consider the broader implications that apply to all budding social movements. The animal welfare movement can be investigated from three different perspectives: philosophically, the rhetorically, and sociologically. The first of these relates to the messages of related organizations, the second to their chosen methods of presentation, and the third to the effects of these methods. In the examination these three aspects, lies an important lesson for all radical grass-roots organizations seeking to garner public support. In the case of animal wel-

fare, the organization People for the Ethical Treatment of Animals (PETA) led the movement throughout its recent developments and is representative of the progress of animal welfare as a whole. Perhaps more can be learned from PETA's rhetorical failures than from its rhetorical successes, so it is appropriate to first investigate a recent PETA campaign that brought only shouts of scorn from the public.

In August of 2005, PETA demonstrators gathered in New Haven, Connecticut for their new campaign entitled "Are Animals the New Slaves?" This outdoor demonstration was part of a 10-week, 42-city tour that PETA had planned in order to improve animal welfare awareness (PETA's Aug. 2005 Demonstrations). Protesters crowded New Haven street corners waving graphic banners at passersby. The displays depicted human suffering juxtaposed with animal suffering – two black lynch victims hanging above a white crowd next to rows of butchered animals; a concentration camp inmate with a tattoo on his chest pictured alongside a monkey in an animal testing lab with a similar tattoo; children

laboring in filthy factories next to photos of cattle and sheep being tortured, sold, and killed (Christie 1). The demonstration was incredibly controversial. “You can’t compare me to a freaking cow,” shouted one man as he passed the protesters. Another observer remarked, “I think he’s right. To compare people to animals is an unfairness [sic] to people.” The president of the local chapter of the NAACP arrived on the scene and demanded that the banners be taken down (PETA’s Aug. 2005 Demonstrations). PETA and other animal welfare groups have used the comparison between humans and animals extensively in an attempt to convince the public that animal suffering is a worthwhile consideration. In 2004, PETA tried to air an ad during the Super bowl that was rejected for its violent content. The ad showed a lady in a fur coat being clubbed to death by a thief who then rips off her coat and runs away with it. The caption read: “What if you were killed for your coat?” (Animal Rights Television). This tactic of controversial comparison has repeatedly been met with scorn and contempt. People often see it as a trivialization of human suffering (Nibert 239). PETA justifies its protests with similar reasoning to that of author Barbara Noske, who comments, “Time and time again new versions of Darwinism have cropped up providing new genetic justifications for class oppression and sexual and racial discrimination, all of which have been labeled ‘natural.’ [. . .] In order to safeguard humans from another onslaught of biological determinism, social scientists tend to be quite defensive about the non-animalness [sic] of humans” (Nibert 241). Despite possible rationalizations for such offensive demonstrations, these protests are clearly designed to win support, yet only succeed in alienating a significant portion of the community. In the early years of a protest movement, these kinds of demonstrations can be beneficial to the growth of obscure organizations – extreme actions attract attention and media recognition. However, PETA is now the most well known organization of its kind, and these controversial displays are only detrimental to its reputation. These protests reveal PETA’s

failure to recognize an idea central to the development of any successful movement: activists must remember that their goal is to appeal to the very same group they criticize for inactivity. Creating a saleable campaign requires tact, and most importantly the ability to make ideas agreeable to the broader public through a sophisticated marketing strategy.

The animal welfare movement began to materialize in the mid-seventies and early eighties, almost immediately making use of radicalism to foster recognition of its cause. This movement, as distinguished from the collection of pet protection agencies such as the Humane Society, focuses on the humane treatment of the animals that we use for food, clothing, scientific testing, and entertainment (Garner 39). Prior to the development of the first animal welfare organizations, the meat industry had grown steadily throughout the twentieth century, and its relatively recent automation caused a new degree of livestock suffering. The authors and activists who came together to protest the distress of animals in the early stages of the movement had solid grounds for their argument: there was (and still is) a tremendous amount of unnecessary suffering inflicted upon the animals we use and consume (Garner 7).

As early as the beginning of the twentieth century, Upton Sinclair, in his revolutionary novel, *The Jungle*, exposed the downsides of the newly industrialized meat industry. He writes:

In the slaughter-houses of Europe, where there are laws, they fit over the head of the animal a leather cap having a nail in it; then, provided the knocker has only skill enough to hit the nail with a big mallet, he cannot fail to kill the animal. But they never stopped for things like that in the yards - the knocker would always lean over the pens and slap away at the creatures with a pointed hammer, and if they did not kill on the first blow, they had only to try again [. . .] Now and then you might see one banging away for a full minute, with the steer plunging and bellowing in agony and terror. (Sinclair 104)

Even now, a hundred years later, conditions have not improved much for

animals slaughtered in the United States. The pork industry permits perhaps the most appalling practices within the meat packing industry. To increase production speeds, three or more pigs are often put into a ‘knocking box’ meant for a single animal (Eisnitz 70). Because of this, one of the three is generally not killed immediately, and remains conscious while it is hoisted on to the hanging conveyor by one leg. The pigs’ throats are slit while on the conveyor, but the workers are often unable to cut in the right place, due to their efforts to avoid the animals’ thrashing legs (Eisnitz 70). Some of the pigs are even alive when they reach the ‘scalding tank,’ a large basin of boiling water designed to remove hair from the carcasses. A slaughterhouse worker at the packing business John Morrell and Company commented, “There’s a rotating arm that pushes them under, no chance for them to get out. I’m not sure if they burn to death before they drown, but it takes them a couple of minutes to stop thrashing. You think management cares about the pain of being drowned or boiled to death?” (Eisnitz 84).

Over the last hundred years, the large meat-packing businesses have increasingly sacrificed humane treatment for maximum production speeds and maximum profit – a natural result of the economic forces of supply and demand. Furthermore, meat consumption has never been higher in the U.S. The average American eats 195 pounds of red meat, poultry, or fish each year, as reported by the government, which is 57 pounds more than in the 1950s (Quaid). As the U.S. demands more meat, the companies will do all they can to supply it.

Many of those involved in the livestock farming business consider the rise of the poultry industry one of the greatest agricultural success stories in U.S. history (Animal Liberation 98). Today, due to an increasing demand for chicken, more chickens are slaughtered per day than were killed in the entire year of 1930 (Eisnitz appendix). In 1997, first-hand reporter Gail Eisnitz commented:

With huge corporate packing plants putting thousands of smaller operations out

of business, slaughter line speeds have soared. A hog “sticker” may cut the throats of as many as 1,100 hogs an hour -- or nearly one hog every three seconds. With line speeds this fast, workers often resort to brutality to keep the production line running to keep from losing their jobs. (Eisnitz appendix)

As the country moves toward large-scale standardized businesses, fast food franchises flourish as well. This has a tremendous effect upon the meat industry as a whole and serious consequences for the animals involved (Schlosser 5). The effect of consumer demand on this industry is vital, for it drives the changes in the slaughtering process. This power for the public to affect change will be essential in considering the tactics of animal welfare agencies and protest activists.

As a relatively new movement, animal welfare has made remarkable progress. ‘Vegetarian by Choice,’ is no longer an eccentricity. Animal rights articles are repeatedly published in national magazines, and PETA’s name has become infamous. Despite its increasing recognition, however, animal welfare agencies and supporters have not done much to adapt their programs to the evolving public response. Many of the current ideas proselytized by animal welfare supporters have stemmed from ethicist Peter Singer’s canonical text, *Animal Liberation*, published for the first time in 1975. The book discusses the country’s moral and ethical responsibilities toward animals. Singer argues that the United States’ circle of moral consideration has expanded to admit first blacks, then women, then homosexuals. In each case, a group considered to be undeserving of civil rights was allowed into the realm of acceptance after great struggle. Singer contends that there will come a time when United States citizens will look upon this age of animal cruelty in the same way slavery is looked upon today (Singer, *Animal Liberation* 4). This argument is remarkably similar to the ones made in the recent PETA demonstration “Are Animals the New Slaves?” Perhaps it would be worthwhile to consider the consequences of this idea in the two separate contexts. The publication of Singer’s book launched

a succession of personal accounts by employees of slaughterhouses, and seemed to provide the substrate for the formation of several animal rights groups across the country. Used thirty years later in New Haven, on the other hand, this argument only provokes indignation and anger. There is an essential difference between these times, however. PETA employed this argument at a much later stage in the development of the movement — after it had won the recognition the initial argument sought to attract. To wage such campaigns successfully, organizations must be aware of context: what once worked to win over the first wave of supporters may not work to attract the next few. The presentation — in effect the marketing — of such arguments significantly affects the level of public receptiveness. Ironically, when Alex Pacheco, the founder of PETA, described his idea of modern activism in a recent interview, radicalism did not come up. Pacheco summarized the approach as “marketing compassion” (Nibert 244). The trick, he explained, is to create demand for products that compete with the mechanized industry — fake fur, vegetarian meat substitutes, and non-leather shoes (Nibert 244). This notion of marketing compassion requires a different strategy than did the New Haven demonstration.

The *Tipping Point*, published in 2000 by Malcolm Gladwell, examines the concept of contagion in social trends. This book explores the factors that cause a particular movement to ‘tip’ or become suddenly popular. One of the key elements of any marketing strategy or trend itself is what Gladwell calls “the stickiness factor.” This is the degree to which a message will remain in an individual’s mind and convert him from hostility to acceptance (Gladwell 166). This concept can also be seen as an argument’s level of rhetorical success. In his chapter on the “stickiness factor,” Gladwell discusses the rise of the popular children’s show *Sesame Street*.

In the late 1960s, psychologist Ed Palmer, as head of the Children’s Television Workshop, conducted a series of experiments involving preschoolers and their absorption of knowledge through

television. Researchers observed children as they watched an episode of *Sesame Street*. Next to the television they projected images — a rainbow, a building, a leaf in a rippling pond — called “distracters” because they were designed to lure the child’s wandering attention. The children were then instructed to watch the TV show. Every time they lost interest in the episode, their eyes would wander to the slide show, giving researchers the opportunity to record exactly which parts of the episode did not hold their attention. In this sense, the Distracter machine measured the “stickiness” of the show (Gladwell 103). This experiment was not as successful as the researchers had hoped. In one episode of *Sesame Street*, Oscar the Grouch and a Muppet help children sound out words. The word “cat” pops up on the screen and the characters go back and forth saying “cuh” and “at” until they form the word “cat” (Gladwell 107). The children glued their eyes to the TV set, but the experiment provided no way of knowing whether they were focused on the lesson at hand or if their attention was instead drawn to the grating voice of the furry green grouch (Gladwell 108). The concept of stickiness became immediately more complicated; what if the sticky image that holds the children’s attention to the show is exactly that which distracts them from the lesson?

This question is directly applicable to PETA and many other grass roots organizations. Protest demonstrations are designed to be noticed and remembered. In a sense, they are supposed to be ‘sticky.’ However, the main goal of all these groups is to promote recognition not of their shocking exhibitions, but of the underlying, foundational messages. In the same way that the *Sesame Street* lesson was perhaps drowned out by Oscar’s charisma, PETA’s ideas are obscured by the radicalism of its spray paint and costumes.

All protest groups, then, are confronted with this seemingly insurmountable paradox: to discover how they can make their ideas attractive to the public without distracting from the ideas themselves. In the early stages of any such or-

ganization, simple recognition is so essential that shocking demonstrations may be appropriate. However, now that PETA has achieved the infamy it initially sought its social context must change and its “stickiness” must evolve as well. At this point, shocking protests are unnecessary or even detrimental to the movement’s goals. Now, rational arguments should be compelling enough to bring the movement to its “tipping point.”

In the August PETA protest, the public did not absorb the ideas because they were not presented comprehensibly — most people simply cannot see the connection between animal suffering and human suffering. If the animal welfare movement is ever to reach its tipping point, or the point at which awareness is common and factory-farms are reformed and regulated, it must tailor its techniques to both appeal to and educate as broad an audience as possible. As Gladwell writes, “The lesson of stickiness is the same. There is a simple way to package information that, under the right circumstances, can make it irresistible. All you have to do is find it” (132). The animal welfare activists of this country must reassess this packaging as the movement builds momentum and recognition.

Increasingly, animal welfare articles have been appearing in nationally recognized magazines. The authors of these publications have done a commendable job of presenting the subject in a more understandable and palatable light. In 2002, journalist Michael Pollan followed a calf from birth until death to get a sense of the life of an animal intended for slaughter. Pollan’s article about his experience appeared on the cover of the *New York Times Magazine* in the same year. His article brings to light critical issues regarding the industry and he asks the public to examine its perspective on meat animals in general:

Half the dogs in America will receive Christmas presents this year, yet few of us pause to consider the miserable life of the pig— an animal easily as intelligent as a dog—that becomes the Christmas ham [. . .] We tolerate this disconnect because the life of the pig has moved out of view. When was the last time you saw a pig?

(Pollan 60)

Pollan’s article accomplishes something important for the animal welfare movement: it presents an articulate argument for the improvement of slaughter conditions tactfully and through socially acceptable reasoning. In doing so, he inspired a new phase of civil awareness. The appearance of animal rights articles on the covers of such prevalent magazines suggests that the movement could be approaching its tipping point.

Pollan expands upon Singer’s arguments in his article, presenting them in a manner appropriate to this stage in the movement’s development. He explains that equality is not based on fact, but morality. Everyone is not, in fact created equal: some are prettier, smarter, and stronger than others. Therefore, equality is simply the belief that everyone’s interests should be valued equally, without regard for their differences. According to Pollan, “If possessing a higher level of intelligence does not entitle one human to use another for his or her own ends, how can it entitle humans to exploit nonhumans for the same purpose?” (Pollan 60). This quotation presents the same idea that was behind the “Are Animals the New Slaves” protest, but it is more rhetorically successful for several reasons. Pollan skillfully uses the idea of “marketing compassion” to manipulate his readers into remaining open to his ideas. His rhetorical strategy is exceptional. First, he employs ethos to entice his readers to think of him as a teammate and not simply ‘some crazy animal welfare protester.’ He begins his article with a description of his dinner conversation with Peter Singer. Pollan includes a reference to his own initial mockery of the ‘hard-core’ activists and deliberately refers to the plate of steak he has ordered (Pollan 59). Gradually, Pollan describes his mental path: he was skeptical of the movement’s principles and goals, then he directly questioned Singer, who articulated his points well. Finally Pollan came not only to understand, but to support the cause with vigor. He peppers the article with his own skeptical questions, “Why treat animals more ethically than they treat one another? [

. . .] Don’t humans and animals differ in morally significant ways? [. . .] Without us [domesticated animals] wouldn’t exist at all” (Pollan 61). Immediately after posing these questions, Pollan provides answers. He expresses a clear example of Gladwell’s “stickiness factor” at work. Peter Singer, considered the father of the animal rights movement, was able to present his points with a considerable degree of rhetorical “stickiness.” Instead of using the traditional shocking displays, Singer used rationality to expose Pollan to his ideas. Pollan, then exposed the public to these ideas through his masterful article, without the distraction of a gory display. Due to Singer’s writing, and later that of Pollan, the notion that animals and humans share a common instinct in the interest of avoiding pain has grown increasingly prevalent (Pollan 60). This article is not only effective in the fact it is perfectly comprehensible, but it also markets its concepts by allowing the reader to feel that if he acts in accordance with the article’s proposals, he will become morally superior to those around him — those who are unenlightened by the contagion of the movement.

Michael Pollan was not the only one to articulate important arguments for the animal rights movement. In the summer of 2004, David Foster Wallace published an article in *Gourmet* magazine called “Consider the Lobster.” The fourteen-page article explores the notion of lobsters suffering as they are boiled to death (Wallace 50). This publication signified enormous progress for the animal welfare movement. It was a novel idea for a renowned culinary magazine to take an interest in the humane treatment of animals. In light of these public writings, it seems as though the animal welfare movement is now heading in the right direction. However, Only a fraction of intellectuals are able to articulate their ideas so effectively. The remaining activists join PETA or other such organizations and participate in more radical displays that have recently been shunned by the larger part of society.

In his essay, “The Dynamics of Protest Waves,” Dutch social analyst Ruud Koopmans discusses the common trajec-

tory of social movements. He introduces the Karstedt-Henke theory, published in 1980, which proposes a model for protests. This theory explains that movements tend to begin with confrontational actions leading to media attention, recognition, and the development of a larger public support base (Koopmans 642). Once the movement or organization (which can be seen as a micro-movement) gains popularity, it begins to faction into parties with divergent goals. A fraction of the initial supporters either become increasingly extreme or fail to successfully adapt their radical actions to a constantly changing social environment. This part of the group is ultimately estranged from mainstream society and its demonstrations devolve into small riots, no longer even associated with the issues at hand (Koopmans 642). The remainder – the more moderate members – gain conciliatory (and mostly palliative) institutional support, and the movement eventually fades away. As the

movement is institutionalized, the moderates lose the bartering power that stemmed from radicalism, and they are forced to accept whatever superficial concessions the government is willing to make (642). So, if Koopmans is correct, the animal welfare movement is destined to split: the moderates like Michael Pollan will be placated, while the radical welfare groups such as PETA will continue to shout until they are entirely disregarded. Unless animal welfare activists recognize the necessary changes that must be made in their strategies, the movement will expire.

Public awareness of slaughterhouse cruelty has increased over the past twenty years due to the tactful publications of animal rights authors, and initially to the crude demonstrations of organizations. However, the industry is still largely unregulated and unnecessarily inhumane. The radicalism of early protests was essential to the birth of the animal welfare movement. Now it is time for the activists

to direct their efforts toward a more deliberate marketing strategy — they must try to ‘sell’ their ideas to the public if they intend for their movement to reach its “tipping point.” To do this, the protesters must not split, as predicted by Koopmans, but remain unified and ‘infect’ as many members of society as possible with what Gladwell would call the contagion of compassion. Only then will the movement gain the momentum it needs to initiate true reform. In his book, *Fast Food Nation*, Eric Schlosser explains the power of public demand, “They will sell free-range, organic, grass-fed hamburgers if you demand it. They will sell whatever sells at a profit. The usefulness of the market, its effectiveness as a tool, cuts both ways” (Schlosser 269). This upheaval of demand is what will ultimately ‘tip’ this industry, and if activists can market their product effectively, consumers will line up to follow a new trend for the ethical treatment of animals.

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Anya Bershad

Class of 2009

Human Biology, English

Anya Bershad grew up in Santa Fe, New Mexico and graduated from Santa Fe Prep School in 2005. She has had an interest in bioethics since she could see the connection between a steak and a cow. At Stanford, she intends to pursue degrees in human biology and English.

Colonial Echoes in Kenyan Education: A First Person Account

Molly Cunningham

Class of 2008

Cultural and Social Anthropology, English

In this paper, I critique the educational system in Kenya through personal narratives from a visit I took there in 2004. By examining the history, curriculum, and language difficulties of this system, I paint a complicated portrait of a system that is overburdened and underfinanced. Deliberately avoiding any normative conclusions, my purpose is to expose the postcolonial currents that run through the educational system, continually stunting its success and compromising the autonomy of its subjects. Education must become a site for transitions to independence, not only for the young minds in the classroom, but also for a nation still plagued by postcolonial ghosts.

I arrived at New Hope Children's Centre in the Uplands district outside of Nairobi, Kenya on March 13, 2004. The two-story orphanage is located off the Nairobi-Nakuru Highway, right on the Great Rift Valley. It houses 65 girls, most of who are between the ages of 12 and 16. I was there to live and volunteer in the home and teach at the local school. Most of the girls were orphaned by the AIDS epidemic; many of them had suffered some combination of sexual and physical abuse, malnourishment, and homelessness. There are 1.7 million such children in Kenya, approximately 40% of who lost their parents to AIDS (Unicef). New Hope offers sanctuary to a lucky few of these kids and, in many ways, rehabilitation. The home was founded in January 2000 by a woman named Anne Chege, who explains her dedication to the girls as "answering God's call." She brings up the kids in the Christian faith and gives them practical training for the real world.

She also sends them all to school. Some of them even make it to secondary school, and "Mama" Chege prays she may even have the resources to send a couple of the girls to university.

The notes started to come in the second week of my visit. Throughout my day, between chores, games, or prayers, a little hand would slip a little piece of paper into mine. They were each decorated with unique flair and signed with a unique name. But they all read the same:

molly,
first of all recieve a lot of greetings like a sand in the ocean. next is to thank you because of the love that you love us with. may God bless you. and in the last day, you shall be called. sons of God. and you will see the kingdom of God. bye bye.
from your lovely friend
Elizabeth Wangui

More than half of the girls referred to "the sand in the ocean." Many quoted the Bible or just jotted down "John 3:14." All sent greetings to my family and called on

me to praise God.

SMY students in my English composition class at the local school were no different. In their writing, every student was "as happy as a peasant marrying a king's daughter," or vowed to remember some event until "the worms ate [their] corpse." Besides these identical idioms, most of their writing was incoherent, filled with muddled spelling and grammatical errors. This did not deter me; in all of my earnest ignorance, I only wanted my students to discover some joy in writing. I asked them to dream of something wild and exciting and then put it to words, in a story. I told them not to fret over the rules they had been taught, but just to have fun. Eight of my 37 students turned something in. Only three of those were stories; the other five had just copied what I had written on the board. I was excited about the stories that I had, especially one involving a girl who escaped rape by telling her tormenters that she was HIV/AIDS positive.

When I boasted of this student's story in the teacher's lounge, the other teachers laughed and explained that the class had read that same story in a different class earlier in the week. They did not feel I should penalize the student; on the contrary, she was given good marks for her good penmanship and grammar.

I believed my students were missing something—some main point. But how could I understand what it was? Their world means slums, unemployment, developing—stagnantly, desperately. Their country's history reveals insidious colonial takeover, strife and struggle, and a hard-earned, twisted version of independence. Their lives outside of the classroom mean everything to how my students will learn to think and what their education will represent. We must come to understand their present and their past and begin to ask ourselves: what will be their future?

I have sought to question and understand what I experienced in Kenya, exploring its history and economy, and examining the educational system in terms of its curriculum and language practices. These explorations have revealed incestuous connections between the legacy of colonialism and the psyche of a people, being perpetuated—despite its better intent—by the educational system. It is a dense and sensitive topic, and while I have tried to tease out some questions and nuances, I cannot boast of any definitive conclusions.

This is by no means my story. My insight cannot offer any candid portraits of the culture and the institution I wish to examine. My words can only show the collision of multiple voices and stories. Hopefully this polyphony can shed some light on the relationship between Africa and the West, focusing on the base of socialization and the vehicle that will lead us into the future: the education of our children.

As a guest, I accept the hot tea that is offered me although I am nearly sweating. It's sunny and cool out in the bustling city streets, but in the apartment where I am taking tea, I can hardly breathe. The apartment is really a room, or maybe a closet built to store a person. The bed doubles as a closet, the only table doubles

as a kitchen, and besides the small, ratty couch that I am sitting on, there is no more furniture. Our legs awkwardly mingle, hanging off the couch onto the single patch of floor space.

"I am lucky to have this place. It is quite expensive to live in the city, especially with no job." My host is an unemployed, unmarried, middle-aged woman. She is personable, welcoming, and bright. But she constantly laments her status and prospects, concerned for her financial future. She showers me with questions about the United States, but eagerly cuts off my answers.

"I wish that is how it could be in Kenya! It must be so nice there. Many single men! And with jobs! Our country is such a mess, so many without jobs and poor. The government takes all of the money. It is so corrupt. Sometimes I wish the white people, you know, that Britain would come back and rule for us!"

The Context: History and the Economy

Some Kenyan history textbooks gloss the country's colonial history positively. They characterize the British as a savior of some sort, "out to eradicate the slave trade and spread a 'civilizing mission' designed to make [Africans] all full human beings, on earth and in heaven" (Independent Kenya 3). In this light, British colonization appears as a benevolent, Christianizing force, implemented with the Africans' best interest in mind.

However conciliatory this view is, it is flagrantly incorrect. Kenya was snatched up in the Scramble for Africa at the beginning of the twentieth century as a means of protecting Britain's naval 'sphere of influence' (Ochieng' 12). "Direct territorial take-over was a way of forestalling competition and controlling areas of strategic economic value" (Independent Kenya 3). British settlers came in by the masses, snatching the best agricultural land. They began laying the groundwork for dependence, installing a colonial government to replace the former, less formal systems of the peaceful, indigenous Kenyans. Christian missionaries provided a mechanism for replacing indigenous value

systems (Ntarangwi 221).

Here begins the legacy of the colonial education of Africa: the first school in Kenya was created by a church missionary society. Its purpose after evangelism was to develop labor and staff for the new colonial administration (Ntarangwi 213). The colonial government's mandate for development amounted to defining native customs, health, and food as bad while establishing itself as the authority of change in education and Kenya (Ntarangwi 220).

The colonial powers needed to start capitalizing on their investment. They began injecting their own ideas of capitalist ideas of production, exchange, industrialization, and agriculture into Kenyan culture. It was in this "waxen pot of colonial urbanization [that] ethnic particularism and African nationalism developed simultaneously" (Ochieng' 66). However, the new modes of economics introduced by the British clashed with the traditional, indigenous methods, and by the 1920s, production as dictated by the settlers began to fail (Ochieng' 104).

Tension began mounting as the effects of the Great Depression began to reverberate around the world in the 1930s. Conflict and consciousness were rising, as Africans suffered the friction and failure of colonial misrule (Ochieng' 140). The British settlers reacted by attempting to exacerbate differences between ethnic groups. Despite these efforts, the resistance, especially of the powerful union movements, was powerfully multi-ethnic and tended to organize around class lines (Independent Kenya 9). Tensions peaked in the early 1950s when anti-colonial militants broke out into violence against colonial powers and loyalists. A state of Emergency was declared, and the "Mau Mau Rebellion" was eventually quelled. In the ensuing retaliation undertaken by the British, 11,503 Africans were killed, though some experts estimate the numbers actually spanned far beyond these official statistics into a massacre comparable to genocide (Bergner). But the unrest could not be stifled; the stage was set for independence. The British settlers began identifying indigenous loyalists, whom they exempted from taxes

and fees, creating a sympathetic middle class with earning power (Independent Kenya 11).

As these deep social changes were taking place, the economy that would be inherited by the winners of independence was being shaped and concretized. After World War II, the United States began to emerge as an international superpower, spreading its influence throughout the world. Nairobi was dramatically transformed by the resulting radical jerk towards capitalism. It became, in the hands of foreign capital, a “regional financial, marketing and manufacturing center for East Africa” (Independent Kenya 7). The influx of international capital transformed the economy of Kenya, giving settlers and foreign investors “monopoly control of marketing, prices, and inputs” (Independent Kenya 7). By the 1950s, 4,000 white settlers held over seven million acres of the best land in the country. Meanwhile, the average, indigenous Kenyan was earning an annual income of three pounds, despite the fact that the price of the staple crop, maize, had increased by 800%. The people were performing all the labor, and were not only robbed of the proceeds, but also starved out of their own economy (Independent Kenya 4, 6).

With economic losses of the WWII and US pressure bearing down (whether the US applied this pressure for ethical or financial purposes is debatable), Britain finally began the process of decolonization in Kenya, ultimately granting the people independence in 1963 (Ochieng` 196). All parties seemed to call for a continuity of lifestyles—at least all parties involved by the settlers arranging the transition. In his speech at Independence, the new president, Jomo Kenyatta, promised there would be no loss of land or security for the British settlers. The Kenyan people had to buy their own land back at inflated prices, affordable only with loans from Britain and the World Bank (Independent Kenya 12). Kenya embarked on its first year as a free nation already in obligation to the West. In effect, Britain managed to relieve itself of its nominal authority and all obligations of law and order, without

disturbing its economic interests or the self-interested systems it had embedded into Kenyan culture long ago, accomplishing “exploitation without responsibility” (Ochieng` 197).

Consistent with this smooth political and economic transition, the educational structure following independence was hardly touched. There were minor shifts in structure, but none in content. The teachers, trainers, movers, and shakers were now Kenyan, but the system remained British. All ensuing tweaks and reforms would be working from the foundation of Kenya’s colonial heritage.

“Good morning, guys.”

“Good morning, Teacher Molly!”

“Thank you! Please, sit down! Today, guys, we’re going to study nutrition!” I’m doing my best here, grinning ear-to-ear, as I turn to the board and write down ‘nutrition’ in large block letters. That morning, I was handed the textbook for Class 4 Science and was told to prepare a lesson on nutrition. I protested—“I know nothing about the subject!” They laughed—“But it’s in the textbook! Just tell them what it says.” And here I find myself, smiling and copying the four food groups from the book onto the board.

“To have healthy bodies and to grow, you need 2-3 servings of protein a day!”

Some of my middle-class students have meat once a week. The girls from New Hope each get a few pieces on holidays.

“To keep your bones strong, you need plenty of calcium! That means lots of milk!”

To even have water to drink, my girls must haul 5-gallon jugs for a mile. The little milk produced by the home’s cow goes to the youngest and weakest.

“To grow strong muscles and keep your nervous system healthy, you need magnesium! Magnesium is found in green vegetables, legumes, fish, and whole bran!”

I’m reading to forty blank faces. Faces that need healthy bodies, strong bones and muscles. And all I can offer them are these words; these awful, empty words.

Curriculum

Since independence, Kenya has struggled to define a philosophy of education and apply it meaningfully in an articulate and feasible curriculum. Working within

the brittle skeleton of the former colonial structure, critics and reformers have big ideas but face considerable challenges. For example, while the curriculum must be a means of conveying culture and a strong national identity, it must also accommodate high levels of cultural and linguistic diversity (Woolman 27). The curriculum must also be financially feasible, coping with the reality of too many student and too few resources. It must also incorporate the role of education in the critical issue of development. The evolution of curriculum in Kenya reflects a nation grappling with these issues and facing challenges with the best intentions.

At independence, the goals and expectations of curriculum development were fundamental: to produce manpower for economic development and to Africanize the civil service (Woolman 33). From 1965-1975, the Primary Curriculum Revision sought to infuse materials with Kenyan history and geography, starting by using locally produced teaching materials. This “Revision” outlined student-oriented teaching methods designed to develop cooperation, creativity, and innovation (Woolman 36). There was a sustained call for continued change and evaluation of the educational system. Intellectuals called for a sort of African literacy, an education “rooted in Africa’s own cultural heritage and values [that has] relevance to African societies” (Busia as quoted by Woolman 31). This idea raised questions on how to integrate scientific and technological innovations of the West (Woolman 31).

There was a Beecher Committee, a Binns Report, an Ominde Commission, the Gachathi Committee, and a Mackay Report: intensive investigations and recommendations, considerations and changes (Omulando). But to what avail? How was the Kenyan curriculum really affected by these deliberations? The textbooks have changed: they have black faces and beautiful African names. There have even been significant structural changes. The 8-4-4 system was adopted in 1985, breaking Kenyan schooling into 8 years of primary school, 4 of secondary, and 4 of university. This system was adopted to address

the lack of correlation between graduation and employment, providing vocational training so that each stage or cycle is self-containing for students who do not continue to the next (Omulando 265).

A student's chance at moving from one stage to the next depends entirely on his performance on a national examination, the Kenya Certificate of Primary Examinations (KCPE) or the Kenya Certificate of Secondary Examinations (KCSE). The tradition of exam-oriented education is a clear relic of the colonial system and British educational philosophy. With the introduction of the 8-4-4 system, many pushed for a reduction of these inherited systems. However, these proposals failed, and students are persistently overloaded by exam material, setting them up for failure (Woolman 36). In fact, the importance of the exams has only increased, as they are the sole indicators of whether a student will proceed to the next cycle—51% are eliminated in the first exam, and about 20% in the second. Every pronouncement in the curriculum must be considered under the light that the exam takes precedent to everything; therefore, facts and drills come first, and more important material at the end of the curriculum is neglected for the “front-loaded” examinations.

The current curriculum resonates with high ideas of values and holistic development. It encompasses life skills, national development and identity, universal ideas with equal opportunity, cultural heritage, social justice, human dignity, and multiculturalism—a strong laundry list of solid, foundational principles (Woolman 33). It seeks to help students “internalize the values that underlie the country's constitution and laws” (Omulando 305). The subjects are integrative and comprehensive, with aims to teach critical thinking, excite curiosity and improve communication (Omulando 303).

This new curriculum looks great on paper. All problems seem to be addressed by these abstract conceptions of educational philosophy. We are given an answer to multiculturalism and an answer to development. But what about resources? How does the Kenyan gov-

ernment plan to actually implement this nobly stated curriculum? What do these subjects and principles really mean to the students whom they are supposed to benefit? What is the reality for the young minds in my class on nutrition that need to be nourished with answers and promises for a future? The curriculum will be meaningless and empty to them if there is no implementation.

I asked Lucy to sit with me after class in the grass outside to review some things for English class. My tenure as a guest teacher at St. Joe's overlapped for one day with a woman earning her PhD. in Education in Canada. She told me about Lucy. Lucy, she explained, was dyslexic, confusing the b's and d's, p's and q's. At sixteen years old, Lucy was illiterate. A challenge.

Lucy and I sat in the sunshine. I held a workbook prepared by the Canadian teacher just for Lucy, filled with dotted outlines of letters and fill-in-the-blank _ogs and pe_cils.

“Lucy,” I spoke slowly. “Can you tell me what this says?”

She did not look at the notebook. She continued to look at me, smiling timidly. I pointed.

“Th-th-the...” I began sounding out. She looked from the notebook to me, with confused urgency flashing in her eyes. The smile stayed, stuck yet quivering.

“The tah-tah-tah-rah-rah-rah-eeeeeee... the tree,” Lucy was silently listening to me, the smile wavering with each awkward noise I made.

“Lucy, do you understand?” A hesitation. And a nod.

“Can you sound it out for me?” Pause. Nod.

Silence.

My insistence grew stronger as her smile grew weaker. As we both desperately tried to communicate, I suddenly realized that was precisely the problem: communication. Lucy didn't speak English. I was trying to teach, in English, a dyslexic child, who did not speak English, how to read, well, English.

I sent Lucy to lunch. I sat alone in my classroom and cried for the rest of the period.

Language

English is the official language of Ke-

nya; Kiswahili, on the other hand is the national language. This subtle distinction means that government and education are in English, while everything else tends to be in Swahili. And, in actuality, most of government is in Swahili also (Kenya.com).

But for Kenyans who live outside of urban centers, neither of these two languages is their first language. They are raised with their “mother tongue,” or MT, the language associated with their ethnic group. For example, in the Uplands, where I was staying, the mother tongue was Kikuyu. There are over 42 such language groups in Kenya (Woolman 38). And when children skip nursery and preschool (as often happens in rural areas), they lose their most critical years of language development.

English became the language of instruction in 1965, one of the few significant changes to the colonial administration, which taught in MT (Muthwii 3). To the newly independent nation, English was seen as the language for “empowerment and advancement,” the route to autonomy, development, and success (Woolman 38). This approach has been slightly modified since the 1970s, during which MT or Kiswahili (the former used only in monolingual schools) was implemented as the language of instruction for the first three years of primary school (Muthwii 4). This change both acknowledged English as the ultimate objective for students and accounted for the students' need to relate their education to their home environment.

But this is just policy; the question of language turns out to be a prime example of curriculum choices with sound intent but no means of practical implementation. In relatively affluent areas and urban centers—where English is often spoken at home or on television—the policy translates well, and the transition from MT or Kiswahili to English is smooth. But in most schools, the reality amounts to a faulty system of “code-switching,” in which teachers first instruct in English and then translate (Muthwii 16). Often in this system, when students do not understand,

they become silent, imitating the rest of the class' response: nodding, smiling, appeasing the teacher. Code-switching is a problematic band-aid for the language difficulties: students cannot respond, to the teacher or on tests, in the same code in which they were presented the material. Students who mix languages in class are often ridiculed by their teachers and heckled by their classmates, creating classrooms full of timid students who dread expressing themselves (Muthwii 45).

Many teachers from rural areas feel their students would have a better chance for success if they were taught and tested in MT or in Kiswahili. Currently, most students think in MT or Kiswahili, and then must translate their thoughts into English (Muthwii 28). In essence, they are tested twice in every exam they take: once on the subject matter and again on English. But there does not seem to be another possibility. Educational resources and textbooks are written in English; technical math and science vocabulary is often not translatable into MT; MT and Kiswahili can also compete with each other, leaving students juggling two or three languages at a time (Muthwii 19).

Besides, the students are by no means asking for a switch in language policy. Even while admitting they understand MT and Kiswahili much better, most students prefer English. Already at the primary level, they understand English as the language of success, the language that will lead them to a "bright future" (Muthwii 21). English provides access to a larger body of knowledge, to employment, and higher education. It opens pathways of communication across the country, the continent, and the globe (Muthwii 33). To the West. Some acknowledge that understanding words and meaning is more difficult in this language. Some even worry about English alienating ethnic heritage. But this worry is mitigated by the belief that it is in the homes and communities that should propagate culture. Ignoring the American programming on television and rap music on the radio waves that students are exposed to in their homes and communities, this justification of English

in the classroom is still problematic. In the previous discussion on curriculum, education was identified as precisely the opposite: it was a bastion of cultural ideals, Africanized images, and strong national identity. Are these thoughts somehow complementary, existing on different planes somehow? Or is the discord deeper than it seems?

As the situation currently stands, the examinations are English-oriented, and the curriculum is examination-oriented, so there is no clear alternative for classes being hindered by language problems. Some teachers resort to "code-switching"; others ridicule or even punish students for the casual use of MT. For the students who cannot grasp the language of instruction, the "spontaneous interactive response during learning activities" is obstructed (Muthwii 55). Students memorize facts that they do not comprehend and cannot apply to their lives or world. It is a difficult reality to address, and one that is not likely to change soon: even the most profoundly effective new policy from the government would—like most past policies—not be adhered to or fully be understood by teachers (Muthwii 55). Such policy changes require expensive tools of implementation: teacher training, resources, and an active process of analysis and evaluation. In the meantime, teachers keep pushing, while the students continue to nod and smile, and everybody waits to go to lunch.

This memory burns. Trust its accuracy: I can still smell it, see it, hear it...

I'm in the teacher's lounge. My shoes are muddy on the wet concrete floor, the rain is loud through broken window panes, the room smells of gloriously aged and mildewed textbooks—textbooks, only too few. I am, as usual, the only white person in the room. Usually, all the other teachers buzz around me, gossiping in Kikuyu, ignoring the eager, sycophantic young American preparing lessons in her corner.

But today, one of the teachers has become fascinated with me. He wants my opinion. He's wearing a second or third hand suit, too big for him, but freshly cleaned and pressed. I remember him getting off the bus that morning, walking leisurely with

his umbrella as the kids hurried to shelter from the rain.

He's asking me about America. His questions are all loaded; he wants me to tell him that it's better there, that I would only come to Africa out of pity. I protest, taking his words out of my mouths, walking on egg shells, begging him to understand. But my words fall on deaf ears.

And then he says it. He says it without sarcasm, without contempt. He takes for granted that I believe it, and he even believes it himself.

"You think that here in Africa, we are just like monkeys, swinging from the trees."

Ugly Truths and Inherited Lies

When Kenyans maintained the old, British structure of education, they attempted to Africanize it. But there was something inherently un-African about this structure. Traditional African education was organic, informal, and based in the community. Transitions between age groups were natural and inclusive, not based on any system of elimination. Learning was based on active discovery, not textbooks, no matter how Africanized (Woolman 31). The colonial structure was a complete "subordination of Africans" that introduced Eurocentric morality models that were individualistic and contradictory to the traditional, communal values (Uchendu as quoted by Woolman 29). This imported culture of egocentric materialism caused "the decline of collective responsibility" and "contribut[ed] directly to unemployment" (Rwomire as quoted by Woolman 30).

The stated value of traditional, African culture within the curriculum is also questionable. Mwenda Ntarangwi recalls being taught about the Mississippi and Rhine rivers before the Athi and Tana rivers of his nation (216). He remembers singing "London Bridge" without having seen anything like it or understanding remotely why. He argues that alienating students from their heritage causes self-loathing (Ntarangwi 216). Alternatively, superficial "Africanization" of materials manifests as "indigenous knowledge... as a relic to be documented and saved," rather than "a process that reaffirms different

ways of living and interpreting the world, that ultimately leads to more appropriate models of change” (Moita as quoted by Ntarangwi 219). Indigenous culture is undermined, and education deteriorates into students memorizing meaningless facts to be parroted in a meaningless language.

This reality echoes the ideas of Paulo Freire in his treatise on education, *Pedagogy of the Oppressed*. In this system, he illustrates, education is boiled down to the “banking concept” in which the teacher is the depositor of knowledge, and the students are the depositories (Freire). There is no comprehension or digestion of the material, only memorization. This system leaves the students with a view that knowledge and the world is somehow static, that there is no interaction or critical discourse with the reality they learn. The authoritative teacher role, in which the teacher holds all knowledge, projects ignorance onto the pupils, stifles inquiry, and undermines academic self-esteem (which Freire notes is “characteristic of oppression”) (Freire). By making learning passive and unquestioning, the banking concept produces passive and unquestioning students who adapt this approach to their society. The reality of oppression is disguised to the students who learn numbness, subjugation, and apathy, preparing them for their places in the world (Freire).

During colonial rule, the citizens became aware of the outright injustice of their situation and were able to actively resist. But in modern Kenya, the cultural and economic dependency has been insidiously ingrained into the next generation, creating citizens who don’t judge or challenge their government and society (Independent Kenya 2). The rich and complex process of education, “through which values, aesthetics, spiritual beliefs, and all parts of a people’s unique cultural orientation are transmitted from generation to the next” has been reduced to schooling, a cheapened “process of perpetuating and mandating a society’s existing power relations and its institution” (Ntarangwi 222). It is a system that prepares and divides the future leaders and future beggars,

herding everyone to their proper place without explanation (Independent Kenya 70). In fact, ex-President Moi was first a schoolmaster and went on to treat “his country like his classroom,” where activity falls “along rigidly authoritarian lines, designed to kill initiative and independent thought” (Independent Kenya 70). This is a “classroom” of the oppressed from which Kenyan citizens cannot emerge or escape.

Ironically, this oppression of thought often translates to thought on development. The popular belief—in both Kenya and the West—is that development is the natural answer for “underdeveloped” nations such as Kenya. But this belief and these terms may really be at the root of the problem. It reflects a certain spectrum that ranges from “primitive,” “underdeveloped,” “third world” (i.e., Africa) to “modern,” “developed,” “first world” (i.e., the West) (Ntarangwi 220). Built into this spectrum are the assumptions that Africa is somehow inferior, and that Africa must evolve along the same path towards the same success as the West. These assumptions are at the base of the Kenyan educational system; this spectrum implicates education as a sign of modernity and key to development. Kenya can never incorporate traditional material and systems in a meaningful way as long as the dominating belief is that prosperity means Westernized development means Westernized education (Ntarangwi 215). What results is a “system of education that is in itself a form of governmentality[...] where individuals absorb dominant ideologies that construct imaginary pictures of prosperity that are shaped by foreign lifestyles” (Ntarangwi 216).

Everyday Kenyans are told education is the key to development and that education accounts for 30% of the government’s budgetary expenditures (Ntarangwi 219). The reality is that 40% of Kenyans are unemployed (World Factbook) and that every year, highly-trained college graduates cannot find a job in the very fields that are supposed to be so “key to development.” Despite all the policies, spending and programs, there is a gap. Aid, loans, and well-meaning NGOs have been pouring into

Africa for years, and still, there is a gap.

It is time we face the possibility that the “Western diagnosis” for development does not answer to Africa’s realities (Ntarangwi 222). We have imported our culture, our resources, our technology, and our institutions into the country with the best and worst intentions. But to what avail? The Western model of education and economy is not working. The “shadow of the West” is stunting Kenya’s growth; Kenyan citizens must be allowed to create their own cultural framework and their own terms of development (Ntarangwi 222). In education, this means gearing the curriculum to teach towards economic self-sufficiency of a country. It means teaching citizenship skills that liberate students, engaging them with skills of questioning and critical thinking. It means teaching history as a collective, inclusive pool of human knowledge rather than as a demeaning spectrum of societal evolution (Ntarangwi 223). It must be relevant to students themselves, and it must foster a sense of self-worth and national pride that defies any comparison to the West. Perhaps this alternative could not make it past the embryonic stages of hypothesis, but it is a possibility that calls for a new debate. But there must be a debate, there must be new possibilities. There must be change.

Mgure’s Story (Conclusion)

We are implicated. Kenya—Brazil, Tanzania, Laos, the “undeveloped world”—is thousands of miles away, out of sight, out of mind. But this globalized world is shrinking everyday, and despite the thousands of miles, our culture has flooded their line of sight, and our economy has skewed their frame of mind. The West has set an international standard of education, language, and development that is insidiously colonizing a group of people who were granted independence decades ago. As a result, students are blocked from their own education, disallowed the means of communicating, expressing, and advancing. And worst of all, they hate themselves for it. Kenya’s problems may be thousands of miles away, but

we are implicated.

But IMF economists, the US government, or an Oxford think-tank cannot undertake solving this problem, outlining recommendations and creating committees. Neither can a white American Stanford student. I have presented a first person account: my trip to Africa, my placement in the school, the treatment I received as a teacher and as a traveler all reflect the very problem I seek to present. This paper itself has traces of this mentality. I will not seek to recommend or conclude because it is not my place to do so. We must finally trust Kenya to decide its fate.

Yet history cannot be retracted, and generations of oppression cannot be reversed. We cannot extricate ourselves so easily, nor will the reality of the “global village” ever allow us to do so. While Kenya re-examines its own role, we must understand our own, working towards a mutual approach to mutual understanding, esteem, and benefits. So while I cannot offer answers, sweeping conclusions, or even a

candid portrait of Kenyan culture, I can offer my first person account of the clash of cultures, the multiplicity of voices, and perhaps, a little hope. We can always start with understanding.

For a week, I have been conducting interviews with the girls at New Hope, collecting their stories to recruit potential donors. We talk one-on-one, in my bedroom. The interviews often last an hour; while the girls only speak for fifteen minutes, they spend the majority of the time crying. At first I thought I was doing irreparable damage, but Mama Chege assured me it was quite the opposite. The girls, she explained, have never been asked their story. They have never grieved, they have never explained, they have never been held and rocked and whispered to, “Everything will be just fine.”

Mgure has been in my room for an hour, but she has been speaking the whole time. She needs a translator, from whom I hear in fifteen second delay how Mgure was beaten and starved as a child, how when she ran away she was gang-raped by street boys, how she lived in dire poverty and

only managed to survive selling her body for a few shillings. And how, at the age of thirteen, Mama Chege found her and brought her in.

She continues to speak, despite her tears, despite the translator, despite my sporadic whimpers and sobs. She speaks for an hour, hurriedly, including details of all sorts: the cost of the first meal she had in exile from her own home, the number of street boys who found her all alone, the shoes she wore when she was taken in as a house girl by an abusive employer. I scribble furiously on my pad, never quite exhausting my tears.

When she finishes her story, I tell her everything will be okay and that she is so beautiful and so strong and that I love her so much. I tell her that people in America care and will love her so much too. I ask her what she would say to them. If she could tell America one thing, one thing that I promise I will tell the whole country.

She turns to me and wipes her tears and says to me in clear English, “I just want them to know.”

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Molly Cunningham is a sophomore planning to double major in Cultural and Social Anthropology and English. After spending time in East Africa, she has become interested in exploring cultural definitions of the orphan within the community and family in light of postcolonialism as well as the AIDS pandemic. She is currently planning a summer research project in Botswana to do ethnographic research on this topic. She is also interested in the politics of humanitarian aid and the interplay between community and international donors. She is pretty sure that the gods must be crazy.

Marine Ecology

Identifying the Sources of Nitrogen to Hanalei Bay, Kauai Utilizing the Nitrogen Isotope Signature of Macroalgae

Elizabeth Derse

*Class of 2006
Human Biology*

In Hawaii, land-use practices on shore have resulted in nutrient loading. This has been cited as a main factor in altering Hawaiian reef ecosystems. However, the source and fate of land-based nutrient loading is not well understood in locations where the impact of pollution is a relatively recent phenomenon, such as Hanalei Bay, Kauai. Here, the source and distribution of nutrients in Hanalei, particularly nitrogen, have been studied using stable isotopes. The isotopic ratio of $^{15}\text{N}/^{14}\text{N}$ as well as the N/P ratios in 11 species of reef macroalgae at Hanalei Bay, Kauai were measured and compared to potential source signatures to determine nutrient sources to the Bay. Fertilizer, rather than sewage, was found to be a key external source of nitrogen to the coastal water around Hanalei.

Coral reef ecosystems are essential marine environments around the world. Host to thousands (and perhaps millions) of diverse organisms, they are also vital to the economic well-being of an estimated 0.5 billion people, or 8% of the world's population who live on tropical coasts (Hoegh-Guldberg 1999). Income from tourism and fishing industries, for instance, is essential to the economic prosperity of many countries, and the various plant and animal species present in reef ecosystems are sources for different natural products and medicines. The degradation of coral reefs can therefore have a devastating impact on coastal populations, and it is estimated that between 50% and 70% of all reefs around the world are currently threatened (Hoegh-Guldberg). Anthropogenic influences are cited as the major cause of this degradation, including sewage, sedimentation, direct trampling of reefs, over-fishing of herbivorous fish,

and even global warming (Umezawa et al. 2002; Jones et al. 2001; Smith et al. 2001).

While coral reef conservation is being brought to international attention, a variety of stressors continue to make these fragile ecosystems susceptible to deterioration and potential extinction. In recent years, nutrient loading in several aquatic systems, including reefs in Japan, Australia, Hawaii, and the Caribbean, has been identified as a main cause of declining reef health (Costanzo et al. 2002; Umezawa et al. 2002; Cole et al. 2004). Nutrient loading is a consequence of runoff from roads, polluted rivers and groundwater as well as improper sewage treatment and disposal. When nutrients such as nitrogen and phosphorus enter an aquatic system in excessive amounts, a phase shift can be observed: the abundance of corals decreases while the population of large, fleshy macroalgae increases (McCook 1999; Stimson et al. 2001). Consequently, the excess algae not only deprive the naturally occur-

ring organisms of needed nutrients but likewise blocks out light needed to stimulate the growth of the coral reef.

In recent years, the coral reef ecosystems in the Hawaiian islands have been subject to heavy anthropogenic impact due to increasing population density along the main island chain (Laws 2003). Land-use practices on shore, such as agricultural production and increasing urban development, have been cited as main factors in the environmental alteration and nutrient loading of coral reef ecosystems in Hawaii (Fong et al. 1998). In some locations, such as Kaneohe Bay on the island of Oahu, this change has been documented since the 1970s (Stimson et al. 2001; Smith et al. 2001). However, on other Hawaiian reefs, including Hanalei Bay on the island of Kauai, nutrient loading is assumed to be a more recent phenomenon. Because it has not been closely monitored, the source and fate of land-based nutrient loading is not well understood in locations

such as Hanalei Bay. There have been no quantitative estimates of the total nutrient loading or studies investigating whether these nutrients are removed from the bay (which is approximately 2km across) by currents or are utilized by organisms such as algae within the bay waters. Therefore, this work attempts to trace the source and flow of nutrients in Hanalei Bay with specific emphasis on nitrogen.

The stable isotopes of nitrogen, ^{15}N and ^{14}N , provide a means to directly investigate nutrient sources, utilization, and cycling because they provide both a tracer of source as well as an integration of processes influencing nitrogen within the coastal water (Umezawa et al. 2002; Costanzo et al. 2002; Cole et al. 2004; Cohen and Fong 2005). Terrestrial nutrient sources can be identified by examining the chemical content of marine organisms that utilize them, including macroalgae and coral; the chemical composition of the organisms' tissue reflects the source and availability of nutrients over time (Umezawa et al. 2002). Certain marine organisms, such as macroalgae, can only take up nutrients directly from the water column, and thus they provide reliable insight into the long-term uptake and cycling of nutrients in an aquatic system as they integrate the signature of the source over their lifetime. By measuring the isotopic ratio of $^{15}\text{N}/^{14}\text{N}$ as well as the N/P ratio in reef macroalgae and comparing these ratios to potential source signatures, the sources of nitrogen to the reef ecosystem can potentially be determined (Costanzo et al. 2004).

While certain organisms, such as bacteria and phytoplankton, preferentially utilize ^{14}N over ^{15}N , there is no evidence which suggests that macroalgae fractionate N in a similar manner. That is, ^{15}N and ^{14}N are typically utilized in direct proportion to the supply from the source (Cohen and Fong 2005). After uptake, these isotopes remain in the tissue of these organisms for weeks at a time (as amino acids and other organic N compounds), and can therefore be extracted and measured using mass spectrometry (Cohen and Fong). When compared to potential sources of nitrogen to a coastal ecosystem

(open seawater, rivers, and groundwater), the results can be used to map the effect of land-derived nutrients and their cycling within the system.

The isotopic ratio of ^{15}N to ^{14}N can be expressed relative to atmospheric nitrogen, or N_2 , in a $\delta^{15}\text{N}$ value (in permil notation):

$$\delta^{15}\text{N}(\text{‰}) = \left\{ \left(\frac{R_{\text{sample}}}{R_{\text{standard}}} - 1 \right) \times 1000 \right.$$

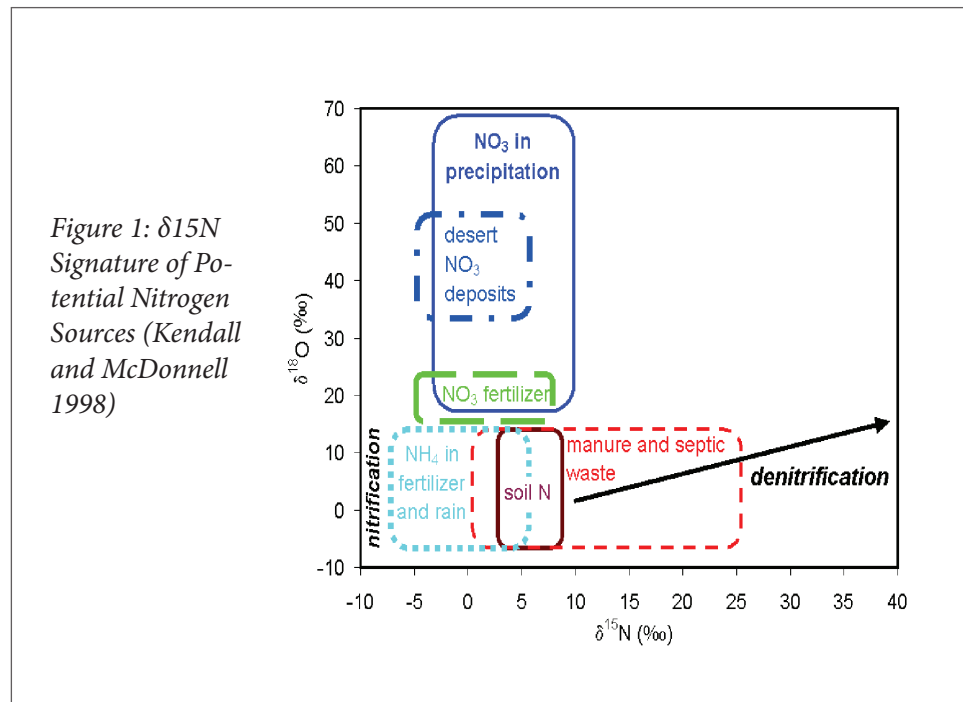
$$\left. \text{where } R = ^{15}\text{N}/^{14}\text{N} \right.$$

The $\delta^{15}\text{N}$ values, or signatures, for various potential nitrogen sources are summarized in Figure 1.

Bacteria metabolize dissolved inor-

a much lighter isotopic signature than sewage. Most fertilizers are made by the fixation of atmospheric N_2 which has a natural abundance of 0‰, and during the process of fixation the ^{14}N is preferentially incorporated into the fertilizer resulting in a lower than atmospheric (negative) isotopic signature. Thus, systems affected by a fertilizer input of nitrogen should exhibit isotopic ratios of somewhere between 6‰ and 4‰, with most fertilizers ranging below 0‰. In general, if the nitrogen is efficiently utilized by coastal organisms, specifically macroalgae, these signatures will be recorded in their tissue (Kendall and McDonnell 1998).

Nitrogen is the primary nutrient



ganic nitrogen during the sewage treatment process. However, due to the fact that ^{14}N is lighter and more easily metabolized by bacteria, the relative abundance of ^{15}N will be greater in the residual nutrients in sewage effluent. Accordingly, aquatic systems impacted by sewage will tend to exhibit higher $^{15}\text{N}/^{14}\text{N}$ ratios than pristine environments; sewage signatures generally range between 10 and 20‰ (permil) while soil nitrogen is typically between 2 and 4‰. In contrast, artificial fertilizers, while they contribute high concentrations of nitrate to an aquatic system, have

analyzed for isotopic signatures in this work (for some other purposes O or C are more useful) because it is a required nutrient for macroalgae growth, may be a limiting nutrient, and the isotopic signature of macroalgae N can be easily measured (Larned 1998). In Kanahoe Bay on Oahu, for instance, the total nitrogen (TN) to total phosphorus (TP) ratio is approximately 4:1 in the water column, while the TN:TP ratio in macroalgal tissue is 44:1 (Larned, 1998). This has been interpreted as suggesting that phosphorus is available in excess in the water column relative to

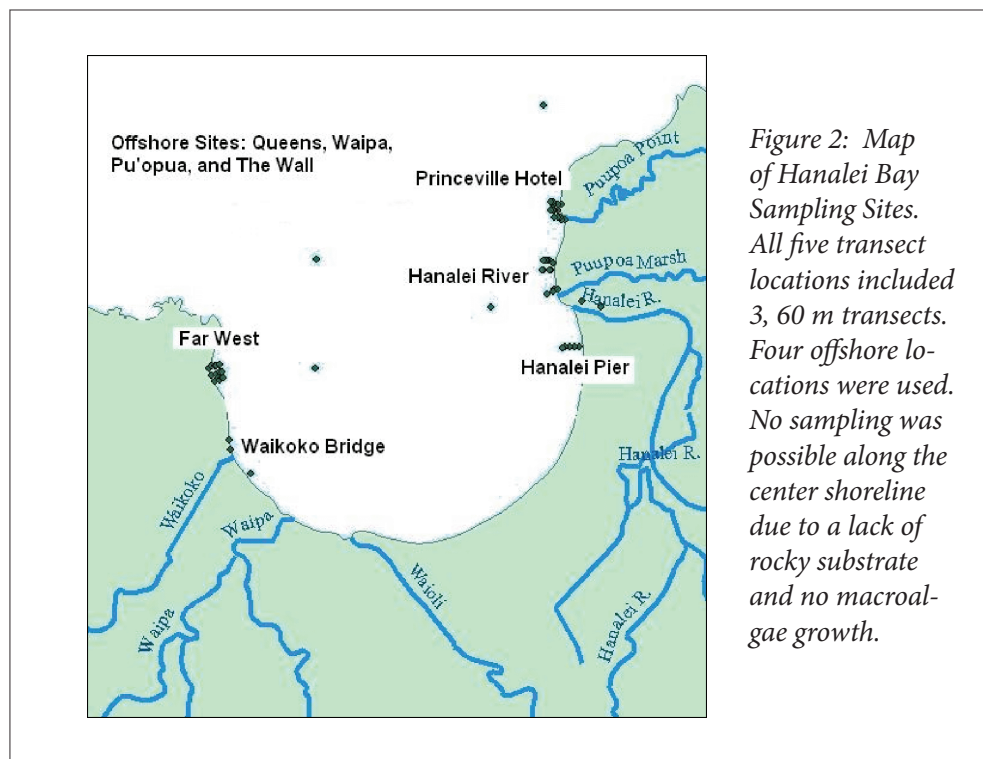


Figure 2: Map of Hanalei Bay Sampling Sites. All five transect locations included 3, 60 m transects. Four offshore locations were used. No sampling was possible along the center shoreline due to a lack of rocky substrate and no macroalgae growth.

the amount demanded by the macroalgae (e.g. the algae are N limited).

Materials and Methods

Five main locations throughout the bay were examined to provide a better analysis of potential point-source inputs of nutrients into the water and to account for spatial variability. Three, 60 m transects were conducted at each site and 11 separate species of algae were collected along these transects. The first location on the eastern fringes of the bay was chosen near the Princeville Hotel (see Figure 2) in an attempt to track potential nutrient flow associated with the impact of heavy tourism and urbanization. The second location, near the mouth of the Hanalei River was selected because of nutrient inputs from the watershed introduced by heavy river flow. The Hanalei Pier, located at the center of Hanalei town, was chosen due to its heavy boat and human traffic. Additionally, the pier is in close proximity to the septic pools of Hanalei town. Transects were also conducted at the Waikoko Bridge site to track the potentially large source of nutrients caused by the shoreline-road

and the small but possibly contaminated Waikoko stream. Finally, on the western fringes of the bay, a site was chosen for its relative lack of streams, roads, or human activity to serve as a possible control, although runoff and groundwater from the agriculture in that area may still enter the bay. The center portion of the Bay contained no algae to sample due to a lack of rocky substrate. In addition, algae were collected at four different offshore sites (see map, Figure 2).

Each of the fifteen separate transects were conducted perpendicular to the shoreline and measured 60 meters in length, starting where the water hit the shore. Macroalgae were collected at 15 meter intervals, or at five points along the 60 meter line. All samples were collected at low tide, and the maximum depth that any given transect reached was roughly 2.0 meters. A handheld global positioning device was utilized at each of the five points, and each location was recorded for later mapping. Species of macroalgae collected at each point were bagged, identified and labeled, and then frozen for transportation to the mainland. Taro field fertilizer and cesspool waste were sampled

as terrestrial end members. Additionally, 2 L water samples were taken along each transect line, at both the 0 m and the 60/45 m points. Approximately 100 mL of this water was filtered through a 0.2 μm filter to remove phytoplankton, bottled, and frozen for later nutrient analysis. Similarly, 20 mL was filtered and frozen for dissolved nitrate isotope analysis; 10mL was also filtered for later density analysis. Finally, 450mL was filtered through preashed 25 μm glass fiber filters for particulate organic matter (POC) analysis and these were placed in plastic Petri dishes and frozen.

The macroalgae samples were dried until their weight was constant in ovens not exceeding 50°C, and each sample was then ground and homogenized using a mortar and pestle. The ground samples were weighed into 2 mg portions using a microbalance and placed in small silver capsules for acidification before mass spectrometric analysis. The POC filters were also placed into folding tin capsules for mass spectrometric analysis. Phosphorus concentrations in the macroalgae were determined spectrophotometrically after digestion as described in Parkinson and Allen (1975). Nutrient (nitrate, nitrite, soluble reactive phosphate and ammonium) content of the water samples were determined using a nutrient flow through auto analyzer (at Oregon State University); nitrogen isotopes of dissolved nitrate were determined using a cadmium reduction method at Boston University and the density, and salinity of the water samples were obtained using a densitometer.

$\delta^{15}\text{N}$ data was graphed according to site, species, and distance from shore. T-tests were conducted to determine significance between these three different parameters. N:P ratios were calculated for both the macroalgae and the dissolved nutrients in the water column and were subsequently graphed.

Results

At any given location, there was no distinguishable or consistent difference in $\delta^{15}\text{N}$ values between species (see Figure 3). Across all species, $\delta^{15}\text{N}$ ratios generally

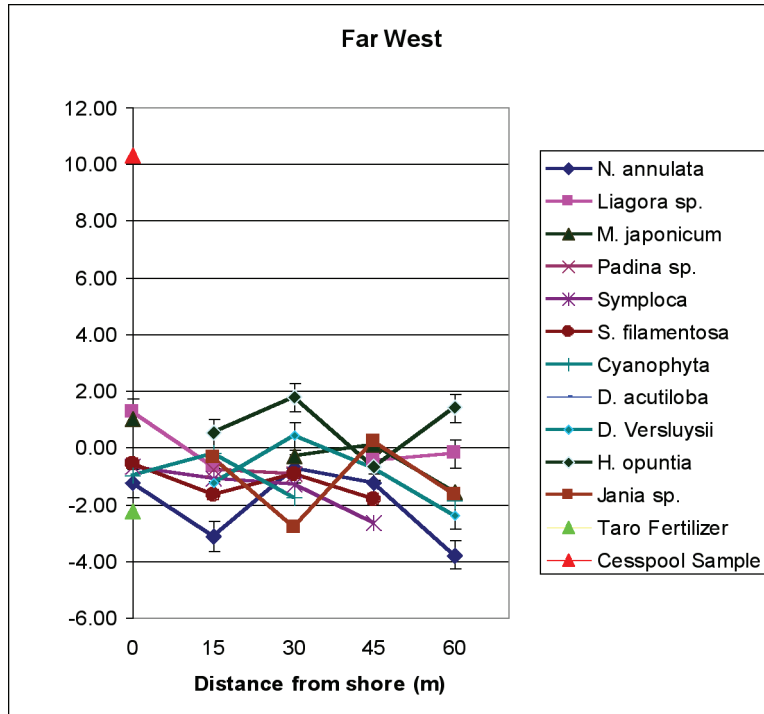


Figure 3: $\delta^{15}\text{N}$ of All Species at the Far West Site. There was no distinguishable difference in $\delta^{15}\text{N}$ ratios between any species sampled. The graph above depicts all species at the Far West site, where the x-axis represents distance from shore and the y-axis represents $\delta^{15}\text{N}$ (in ‰). Each point represents one sample, accurate to 0.5‰. The cesspool and taro fertilizer samples were also analyzed and graphed.

ranged between -4‰ and 4‰, $\pm 0.5\%$. However, these differences were not consistent or species specific and did not change in a coherent fashion with location or distance along the transect lines. This lack of distinguishable differences between species was seen at all transect locations.

Due to a lack of consistent variation between species at each of the sites, it was possible to analyze only one species of macroalgae to represent the field of data (see Figure 4), or to combine all species together into averaged values (see Figure 5). Thus, the differences in $\delta^{15}\text{N}$ between loca-

tions were evaluated using either a single representative species or the average values of all species sampled. No substantial differences were found in $\delta^{15}\text{N}$ values at all of the inshore transects, again taking into account an error of approximately 0.5‰ for each sample value (see Figure 4). To analyze this claim statistically, the average value for all species combined was computed and a p-value of greater than 10% was obtained for all of the inshore sites compared to this value (see Table 1 in Appendix). Thus, no significant differences were found amongst the inshore transect

locations. Similarly, distance from shore had no measurable effect on the $\delta^{15}\text{N}$ value, and thus no gradient effects were seen at any of the transects when analyzing single-species graphs (see Figure 4). There was, however, a significant difference between the inshore transect macroalgae and $\delta^{15}\text{N}$ values of algae collected offshore. Samples taken from offshore locations, on average, had more positive $\delta^{15}\text{N}$ ratios than inshore samples (see Figure 4, 5). While inshore $\delta^{15}\text{N}$ values had an overall species average of -0.15‰, offshore macroalgae $\delta^{15}\text{N}$ were typically much heavier than -0.15‰ with an all-inclusive species average of 1.4‰. This comparison between the average of all inshore values and the average of offshore values is statistically significant ($z=2.5$, $P<0.01$) (see Table 1 in Appendix). The cesspool and fertilizer end members were also analyzed and graphed. The cess-

Figure 4: $\delta^{15}\text{N}$ of *S. furcigera* With Distance From Shore at the Various Sites. Because no significant variation by species exists, one species (*S. furcigera*) is used to represent all of the species at different locations. No significant difference is observed between inshore sites, yet offshore values are significantly higher than those of inshore samples. Error bars depict the standard error.

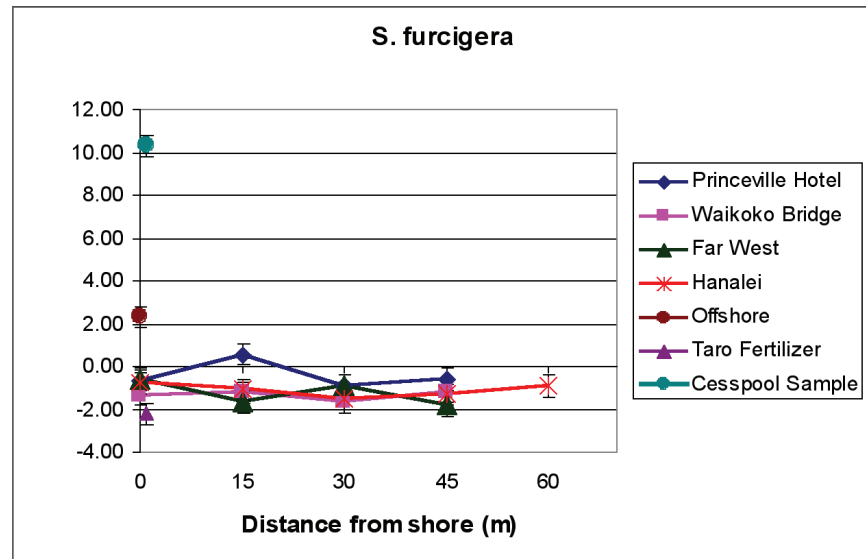
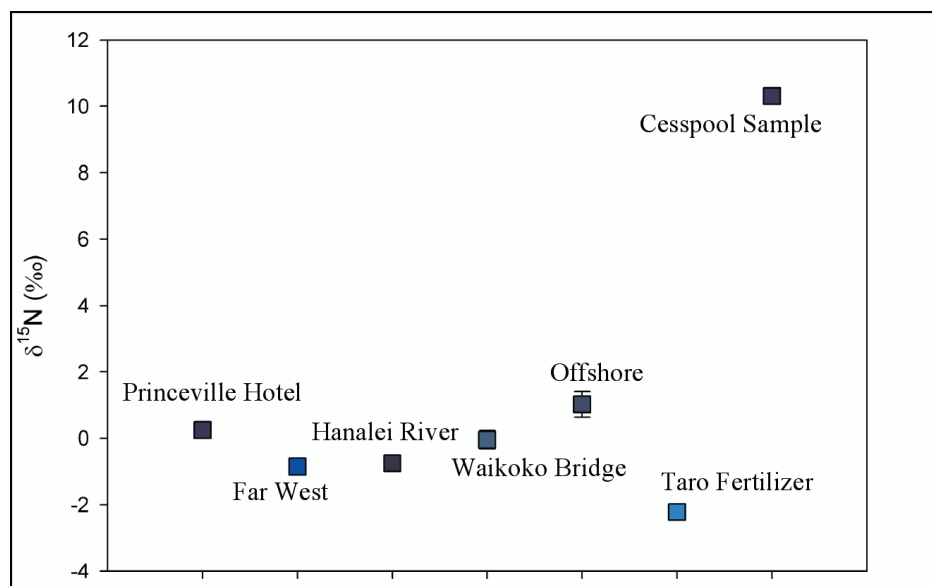


Figure 5: $\delta^{15}N$ of All Species (averaged) at Each Site. $\delta^{15}N$ values averaged amongst all of the species according to location. Note the inshore average is roughly -0.15‰ , while the offshore average is more positive at 1.4‰ . The inshore average (of all species and sites) was tested against the offshore average via a z-test, and this difference is significant ($p < 0.01$).



N:P Ratio by Species

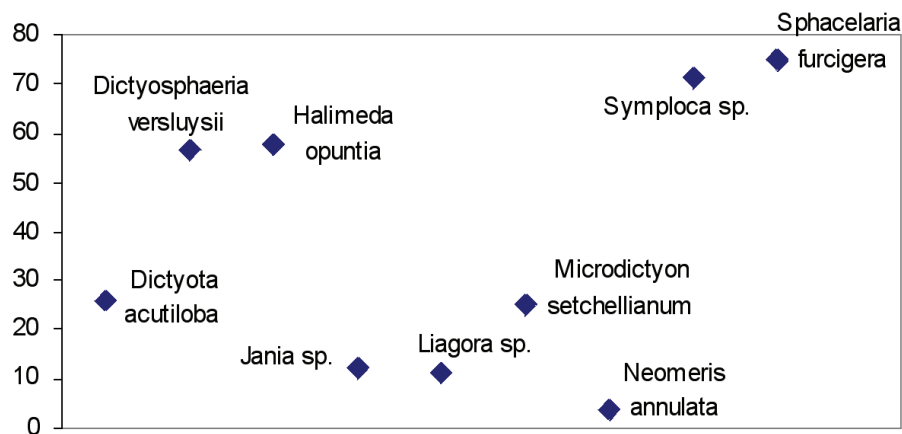
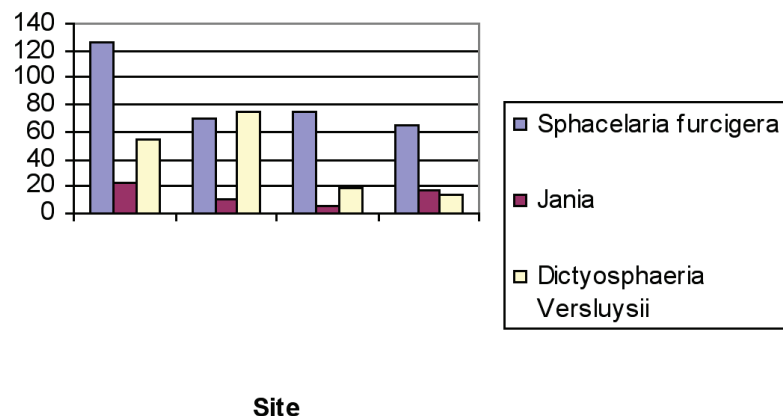


Figure 6: N:P Ratio by Species Averaged Over All Sites. N:P ratios according to species. Values are averaged for each species over all of the sites, and reflect the different N-processing pathways in each species. These species-specific ratios were then compared to the N:P ratios available in the water column (red line, 5.89). All but one species (*N. annulata*) had greater N:P ratios than was present in the water.

Figure 7: N:P Ratio by Site, Three Species. N:P ratio for three separate species according to site. No consistent trends are seen by site and a wide range of ratio values exist even amongst a single species. Location appears to have no consistently significant effect on N:P ratios.

N:P Ratio by Site



pool sample had a significantly high $\delta^{15}\text{N}$ value of 10.3‰ while the fertilizer had a significantly low value of -2.2‰.

Total nitrogen to total phosphorus ratios in the algae were calculated to determine whether the macroalgae are nitrogen limited in the bay. Large variations in N/P ratio were found between the different species, ranging between 4:1 and 78:1. These fluctuations were expected, and reflect the differential metabolic needs of each particular species. Previous research suggests that the average N:P ratio for macroalgae is approximately 40:1, and the values obtained in this study are consistent with the expected N:P ratios for each species (Larned 1998). Additionally, N:P ratios in the macroalgae tissue were compared to N:P ratios present in the water column. The average dissolved nutrients N:P ratio in Hanalei Bay at the time of our sampling was 5.89, a particularly low value for seawater. High N:P macroalgae tissue ratios combined with low nitrogen available in the water column indicates N limitation.

Discussion

No species or site variability in macroalgae $\delta^{15}\text{N}$ and no gradient (from-shore distance) effects imply that Hanalei is a very well-mixed bay and that no point-source identification of nutrient flow into the Bay is possible without further testing. Given the shape and size of the bay, in addition to the heavy current flow and large-wave potential during certain months of the year, this is not surprising (Gulko et al, 2000). In fact, the observation that the bay is well-mixed has profound implications for any anthropogenic nutrients or other pollutants that flow into Hanalei waters. Specifically, any point source pollution will be mixed and diluted into the whole bay, thus reducing potential localized impact. On the other hand, if the pollution is significant such that dilution is not enough to reduce the risk that the whole bay may be impacted, this is a cause for concern.

Overall, the macroalgae samples had relatively low values of $\delta^{15}\text{N}$ when com-

pared to other studies in similar reef environments. As noted, most ratios fell between -4‰ and +4‰, while the overall average (including all species) was approximately -0.5‰. While there may be a large range in $\delta^{15}\text{N}$ of macroalgae due to species specific nutrient uptake, this study does not show significant species-dependent variation in $\delta^{15}\text{N}$ ratios, and therefore the average of all species can be used as representative of the bay. In similar tropical environments with comparable rainfall, $\delta^{15}\text{N}$ values are typically much higher. For example, Costanzo et al. (2004) measured changes in sewage nitrogen plumes in Moreton Bay off the coast of eastern Australia by comparing $\delta^{15}\text{N}$ values in macroalgae between 1998 and 2003. In 1998, they discovered $\delta^{15}\text{N}$ ratios of up to 9‰ in macroalgae in Moreton Bay compared to 2‰ in macroalgae in low nutrient environments. In 2003, these ratios were reduced to 7‰ and it was concluded that the reduction in $\delta^{15}\text{N}$ ratio was due largely to the greater investments in sewage treatment infrastructure. Similarly, Umezawa et al. (2002) tracked land-derived nitrogen by observing $\delta^{15}\text{N}$ ratios in macroalgae off of the reefs of the Ryukyu Islands in Japan. They noticed values of up to 8‰ along the shoreline and approximately 2‰ along the reef crest. They concluded that land-derived nitrogen led to greater $\delta^{15}\text{N}$ values along the shoreline and that gradient effects were present as distance from the shore increased.

According to Kendall (1998), the $\delta^{15}\text{N}$ values obtained in this experiment can be explained by the source of nutrients into the bay. While it can be difficult to determine differences between sources with very similar $\delta^{15}\text{N}$ values, the previously identified sources of nutrients into Hanalei Bay (e.g. fertilizers and septic waste) have distinct isotopic signatures and thus can be easily differentiated and identified (see Figure 1). As noted, fertilizers have very low $\delta^{15}\text{N}$ values, averaging from approximately -5 to 0‰, while sewage and other similar wastes have very high $\delta^{15}\text{N}$ values that should increase the $\delta^{15}\text{N}$ values in macroalgae considerably. Rain, the

other source of nutrients to the bay with a very low $\delta^{15}\text{N}$ ratio, has very low nitrogen content and contributes very little nitrogen to the marine system even in tropical areas of heavy rainfall and can therefore be ignored as a potential source (reference????). My professor explained this phenomenon to me in passing. It's general knowledge for an ocean scientist and I don't have a reference for it. If you absolutely must have one, please let me know. In this work, the $\delta^{15}\text{N}$ value obtained for taro fertilizer was approximately -2.2‰ while the cesspool sample had a value of 10.3‰. Both of these values were expected and are consistent with Kendall. Therefore, the macroalgae $\delta^{15}\text{N}$ values, averaged at about -0.5‰, fall within the range that could be expected for locations heavily impacted by fertilizer, suggesting that fertilizer input through rivers and runoff is the major source of nitrogen to the bay waters. Indeed, in recent years, agricultural production and tourist attractions have led to an overall increase in the use of fertilizer in Hanalei and surrounding areas. In fact, much of the area surrounding Hanalei Bay is comprised of a large golf course (property of the Princeville Hotel) and farms producing Kauai's main export, taro (see Figure 8 in Appendix). Therefore, the assumption that increased fertilizer use has significantly impacted nutrient dynamics in the bay and possibly the surrounding reef environment has implications for the future of agriculture and tourism development in this region of Hawaii.

While no significant difference in $\delta^{15}\text{N}$ at any of the inshore sites was observed, perhaps the most noticeable distinction seen in this study is that offshore averages amongst the different species are significantly higher in $\delta^{15}\text{N}$. The nitrogen at the offshore sites may be elevated as a result of some additional contribution from open seawater nitrate which is characterized by $\delta^{15}\text{N}$ values of around 5‰, thus elevating the isotopic signature. However, the $\delta^{15}\text{N}$ in the macroalgae at the offshore sites is still unexpectedly low. While offshore values are more positive than inshore values (overall average of just over 1‰), it is

probable that the influence of the fertilizer nitrogen is still evident at these sites.

The impact of anthropogenic nutrient loading on macroalgae growth is more pronounced when the added nutrient is limiting growth. Accordingly, N:P ratios in algae and seawater were assessed to test whether nitrogen is truly the limiting nutrient in the bay. As expected, there was a substantial variation in N:P ratio amongst the species which reflects the different metabolic pathways in the plants. However, there is evidence which suggests that the values obtained in this study are consistent with normal (average) N:P ratios found for these particular species of macroalgae (Larned 1998; Atkinson and Smith 1983). The N:P ratio available in the

water column was then compared to the ratio in the algae and was used to assess whether the macroalgae are potentially nitrogen limited. As noted, the N:P ratio in the water, averaged over all of the sites, was approximately 6:1. This ratio is much lower than the N:P ratio of 16:1 expected for ocean water in pristine conditions. Because the ratio of N:P in the water column was significantly less than the N:P ratio in each macroalgae species (with the exception of *N. annulata*), this suggests that nitrogen is most likely the limiting nutrient for macroalgae productivity. Therefore, it is probable that all excess anthropogenic nitrogen inputs into the bay are utilized immediately for macroalgae growth. Indeed, preliminary analysis of the isotopic

composition of nitrate dissolved in the bay seawater is indicative of efficient utilization (e.g. relatively high oxygen and nitrogen isotope ratios). This implies that the macroalgae might be growing as fast as the nutrients can be supplied, and such macroalgae growth could have an alarming impact on the surrounding reef environment if input will increase in the future. This evidence, combined with the implications that fertilizer runoff is flowing into the bay in large-scale amounts, suggests that the reef off of Hanalei could be in crisis.

Appendix

Table 1: Summary of $\delta^{15}\text{N}$ by Site, N:P by Species. The above table summarizes $\delta^{15}\text{N}$ by site and includes calculated *p*-values. Note that only offshore macroalgae are significantly different in $\delta^{15}\text{N}$ value than the inshore sites. As depicted, not all species were found at each site. In addition, some species do not have N:P values due to a lack of sufficient sample mass to complete a phosphorus digest.

Species	Hanalei River $\delta^{15}\text{N}$	Far West $\delta^{15}\text{N}$	Waikoko Bridge $\delta^{15}\text{N}$	Princeville Hotel $\delta^{15}\text{N}$	Offshore $\delta^{15}\text{N}$	N:P (avg)
<i>N. annulata</i>	-0.69	-2.02	-1.11	-2.31		3.7204
<i>Liagora sp.</i>	4.19	-0.02			0.94	11.457
<i>M. Japonicum</i>	-0.46	-0.18	1.41	0.32		25.301
<i>Padina sp.</i>	-0.94	-0.83		2.13	1.57	
<i>Symploca</i>	-1.58	-1.41	-1.13	-0.31		71.262
<i>S. furcigera</i>	-1.11	-1.24	-1.36	-0.41	2.31	74.863
<i>Cyanophyta</i>	-2.18	-1.20		1.01	1.58	
<i>D. acutiloba</i>	0.26	0.62	1.16	1.83		25.946
<i>D. versluysii</i>	-1.41	-0.97	-1.19	0.49		56.594
<i>H. opuntia</i>		0.77	1.58	1.11	1.70	57.794
<i>Jania sp.</i>	1.10	-1.13	0.22	0.41	0.52	12.287
Site Avg.	-0.28	-0.69	-0.05	0.43	1.44	
SE	0.63	0.63	0.63	0.63	0.63	
z-value	0.20	0.85	0.31	0.92	2.5	
p-value	>10%	>10%	>10%	>10%	0.01	

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A novel Visual Tracking Algorithm based on Adaptive Three-step search, Hybrid Correlation, and Adaptive Template Renewal

Visual tracking is used in a wide range of applications such as robotics, industrial auto-control systems, traffic monitoring, and manufacturing. This paper describes a new algorithm for tracking objects. Existing object tracking algorithms maintain a static understanding of the object to be tracked. Our algorithm takes a dynamical approach by consistently reexamining the current state of the tracked object to better understand how the object is changing. As a result, objects tracked using this dynamical approach can generally change in appearance while still being tracked. We also develop a new recognition technique that is a composite of two existing methods. To overcome the resulting computational complexity, we develop a search technique that anticipates where the object is going to be and searching only in that area.

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*Fudan University, Student
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One category of visual tracking is based on the block matching algorithm [1]. This algorithm searches for a template of pixels called a target in an incoming video frame to find the location where the target and video frame most closely match.

The performance of block matching based visual tracking is dependent on how the best match between the target and incoming video frame is measured and how efficiently the block search is done.

To determine the similarity between the target and video frame, other algorithms use techniques based on the mean absolute difference (MAD) or sum of square difference (SDD) [2]. Although MAD is conceptually simple, it is vulnerable to noise and interference. We therefore propose a more robust similarity measure.

The typical block search algorithm is the three-step-search (TSS) algorithm [2]

which was originally used in video compression, where a fixed search range is acceptable. However, in the visual tracking field, the search range should change adaptively with the target's velocity in order to improve the precision of the target's location. Hence, we modified the TSS algorithm with an adaptive search range to better fit the needs of the system.

Another challenge facing the visual tracking field is how to deal with the gradual change of target appearance and abrupt obstructions by other objects. In order to keep track of a target with a changing appearance, the template has to change with it. However, when an obstruction appears, the algorithm should recognize something unusual has occurred and should not automatically update the template. This problem necessitates a strategy of adaptive template renewal.

Thus, overall, in this paper, we propose a new measure of similarity to determine where the correlation between the tem-

plate and the video frame is highest. This hybrid correlation takes into account both structural similarity and histogram similarity. We also propose an adaptive-three-step-search (ATSS) algorithm to make the original TSS algorithm better fit for visual tracking. Finally, we propose a strategy of adaptive template renewal that strikes a good balance between template flexibility and stability.

The paper is organized as follows. The next section will further illustrate the defect of MAD-based similarity measure and elaborate the new similarity measure based on hybrid correlation. In Section 3, the original TSS algorithm is reviewed and a detailed description of ATSS algorithm is provided. Section 4 will focus on the strategy of adaptive template update. Experimental results are given in Section 5 and we conclude this paper in Section 6.

Hybrid-correlation based similarity measure

In order to locate the best-fit position of the target in the video frame, various areas of the video frame have to be rated so it can be determined at which location the template best matches the video frame. We first have to find a numerical measure of similarity between the two image blocks. The ideal measure of similarity is exclusively large only when two image blocks are very similar and drops rapidly when similarity decreases. This property of similarity ensures the robustness that the target was positively identified. Also, the peak where the target is found should be as sharp as possible so there is a clear distinction of where the location of the template best fits on the frame. This distinction of best fit allows us to unambiguously determine a narrow area of where we believe the object to be.

Another benefit of this model is that we are able to rate the certainty with which we believe the match to be correct. As we will see later, we will make use of this certainty to determine if we should update the target template.

Mean Absolute Difference (MAD) has been widely used by block matching algorithms as a measure of similarity. MAD of two image blocks is defined as follows, where $S(i,j)$ and $T(i,j)$ indicates the grey-scale value of the pixel located at the i -th line and the j -th column of image block S and image block T .

$$d_{ST} = \frac{1}{MN} \sum_{i=1}^M \sum_{j=1}^N |S(i,j) - T(i,j)|$$

Although MAD method is conceptually simple, it is not a robust measure of similarity due to its intrinsic defect of losing phase information, as is demonstrated in Figure 1. As we can see, although the MAD of the two test signals with respect to the original signal are identical, it is evident that relative to the original signal, the similarity of test signal 1 is much higher than that of test signal 2. Therefore, MAD is not ideal for measuring similarity.

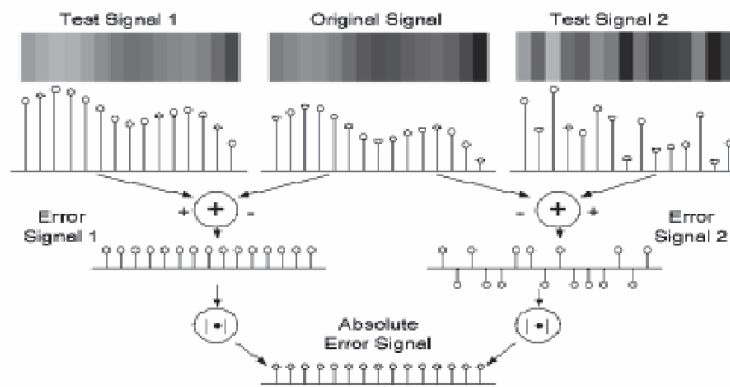


Figure 1
Two signals with equal MAD but very different similarity

A more mathematically sophisticated comparison involves the normalized linear correlation equation shown in the equation below. Normalized linear correlation preserves relative grayscale information and is thus free from the problem that MAD suffers. Normalized linear correlation between two image blocks is defined as follows, where $S(i,j)$ and $T(i,j)$ indicates the grey-scale value of the pixel located at the i -th line and the j -th column of image block S and image block T . m_S and m_T are the mean of all pixel values of image block S and image block T and N and M are the number of lines and the number of columns, respectively.

$$r_{ST}^l = \frac{\sum_{i=1}^N \sum_{j=1}^M (S(i,j) - m_S)(T(i,j) - m_T)}{\sqrt{\sum_{i=1}^N \sum_{j=1}^M (S(i,j) - m_S)^2} \sqrt{\sum_{i=1}^N \sum_{j=1}^M (T(i,j) - m_T)^2}}$$

Since correlation reflects the overall structural difference, rather than just the absolute value difference between two image blocks, linear correlation exhibits much higher robustness than MAD does. Linear correlation is an ideal measure of similarity in terms of using all the information in both the structure and grayscale of the images to find where the template is most similar to the frame. This is illustrated in Figure 2, where the x - y plane is a part of a video frame that contains an image block very similar to another template image block. The z -axis is the correlation between the template and the image blocks centered at various coordinates of the x - y plane. The sharp peak clearly demonstrates the robustness and preciseness of correlation as a measure of similarity.

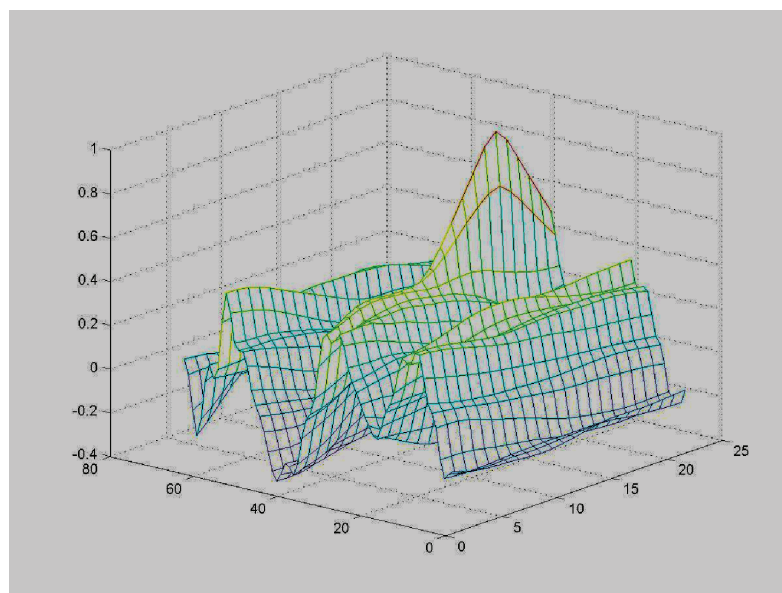


Figure 2
Plotting of Correlation

There are many visual tracking instances when objects of similar structure get very close to the target. For example, when tracking a vehicle on a highway and the target vehicle is overtaking another vehicle, the tracking algorithm will have a hard time determining which vehicle to track, since they are so similar in structure. The chance of locking onto another vehicle is may be high because the two correlation peaks are close. In order to enhance the robustness of target identification under such situations, more information related to the target should be extracted from the given image.

The histogram of an image is a very important feature that reflects the overall grey-scale distribution within the image. A histogram of an image is a 256-dimensional vector, each element of which is the percentage of the number of pixels whose grayscale values fall in the interval corresponding to the element. If we compare the similarities between two histograms of image blocks in addition to the structural similarity fulfilled by correlation in the space domain, the credibility of a positive target identification is even higher.

We denote the histogram of an image S as $H_s(g)$, which means the percentage of pixels with grey-levels between g and $g+1$. We again use normalized linear correlation as the measure of histogram similarity, which is defined as follows, where H_s and H_T are the histograms of image block S and image block T , respectively. $\overline{H_s}$ and $\overline{H_T}$ are the mean value of the corresponding histograms.

$$r_{ST}^H = \frac{\sum_{g=0}^{255} (H_s(g) - \overline{H_s})(H_T(g) - \overline{H_T})}{\sqrt{\sum_{g=0}^{255} (H_s(g) - \overline{H_s})^2} \sqrt{\sum_{g=0}^{255} (H_T(g) - \overline{H_T})^2}}$$

This equation reflects the similarity of grey-scale composition of two images blocks.

The final measure of image similarity is a composite of structural similarity and histogram similarity. If we let r_{ST}^I denote the structural similarity, r_{ST}^H denote the

histogram similarity, and sim denote the hybrid correlation, then these variables are related by:

$$sim = \beta r_{ST}^I + (1 - \beta) r_{ST}^H$$

In this equation, β is the combination coefficient whose optimal value we have found is 0.88. With this optimal value we have found that sim exhibits high robustness in target identification.

In the expression of hybrid correlation, more weight is put on structural similarity, because the information of target appearance is mostly conveyed by structural similarity, while histogram similarity only plays an auxiliary role that helps identify the target when interference is structurally similar to the target.

Adaptive three-step-search algorithm

In visual tracking, similarity is much greater than for other blocks, which enables the computer to determine the position of the target. The problem here is that if we search the region in an exhaustive manner, it will be too computationally heavy for any real-time system. Therefore, many fast search algorithms have been proposed. The three-step-search (TSS) algorithm is one of the most widely used algorithms.

As Figure 3 shows, TSS begins searching by examining the original point where the object last was and the adjacent 8 points spaced 4 pixels apart. In the second step, TSS moves the search center to the point having the maximal similarity value and continues to examine its 8 neighbors spaced 2 pixels apart. In the third step, TSS does the same as in the second step except that the 8 neighbors are tightly adjacent. The point with the maximal similarity value in the final step is assumed to be the target position. For a 15-by-15 search region, the exhaustive search measures 225 points, while the TSS algorithm measures only 25 points, which reduces computational burden by 88.9% with little loss in performance.

However, the TSS algorithm was ini-

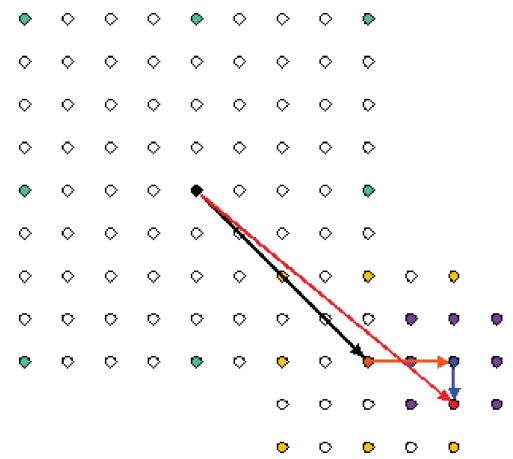


Figure 3 Three-step Search Algorithm

tially proposed for video compression applications where a fixed searching region (15 by 15) is sufficient. In visual tracking applications, the velocity of the target varies significantly. When target velocity is too large, the correlation peak may be more than 7 pixels away from the initial searching position, which means the target is out of the reach of the TSS algorithm. On the other hand, when target velocity is too small, the initial interval between two points (4 pixels) may be too large.

In order to solve this problem, we propose an adaptive three-step-search (ATSS) algorithm in which the size of the searching region adaptively changes with the target velocity. The algorithm determines the searching range of the TSS for the current frame according to the displacement of the target in the previous frame. A large displacement in the previous frame indicates that the target is moving at a relatively high velocity, and vice versa. Since target velocity cannot change abruptly during a short frame interval, it is reasonable to expect that the displacement in the current frame will be close to the previous one. Then the search range of the TSS algorithm can be set based on the expected value of displacement. If the displacement is large, a larger search range is set to cover the region where the target may possibly reach; if the displacement is small, a smaller search range is used.

The adjustment of the search range can be realized by changing the spaces

between adjacent search points in various steps. In the standard TSS algorithm, the spaces between adjacent search points are 4, 2, and 1 for each of the three steps. To enlarge the search range, the spaces may be set as 8, 4, 2, and 1 for sequential steps. Note that there are four steps here. A reduced-range search may involve only two steps with spaces of 2 and 1 for each step.

Search range of the ATSS algorithm is related to the number of search steps by the following equation, where d_1 is the space between adjacent search points in the first step, n is the number of search steps, and R is the search range.

$$R = d_1 + \frac{1}{2}d_1 + \frac{1}{4}d_1 + \dots + \frac{1}{2^{n-1}}d_1 = 2^{n-1} + 2^{n-2} + \dots + 2 + 1 = 2^n - 1$$

The relation between target displacement and search range is listed in Table 1.

The ATSS algorithm selects the search range for each frame according to Table 1 by a look up table operation, and thus requires almost no extra computational burden.

Adaptive template renewal

In most visual tracking cases, the appearance of the target gradually changes due to its rotation, deformation, or ambient light intensity. If the template remains unchanged, the difference between the actual target and the template will get increasingly large, which will finally lead to the loss of the target.

However, template update will bring about serious problems if an obstruction occurs in which part of the target is temporarily covered by other objects. If the template continues to be updated in this situation, it will be corrupted by the obstruction and unable to serve as a reference for searching the target. Most probably this will lead to an immediate loss of the target.

In order to strike a balance between updating the template under normal circumstances and keeping the template stable when there is an obstruction, we propose a strategy of adaptive template update. It is observed that when an obstruction occurs, the hybrid correlation value drops

Target Displacement	Search Range	The Number of Search Steps
0 ~ 2	3	2
3 ~ 6	7	3
7 ~ 14	15	4
15 ~ 30	31	5
31 ~ 62	63	6

Table 1. The relation between target displacement, search range and number of search steps

Figure 4 Plotting of hybrid correlation over frame indices

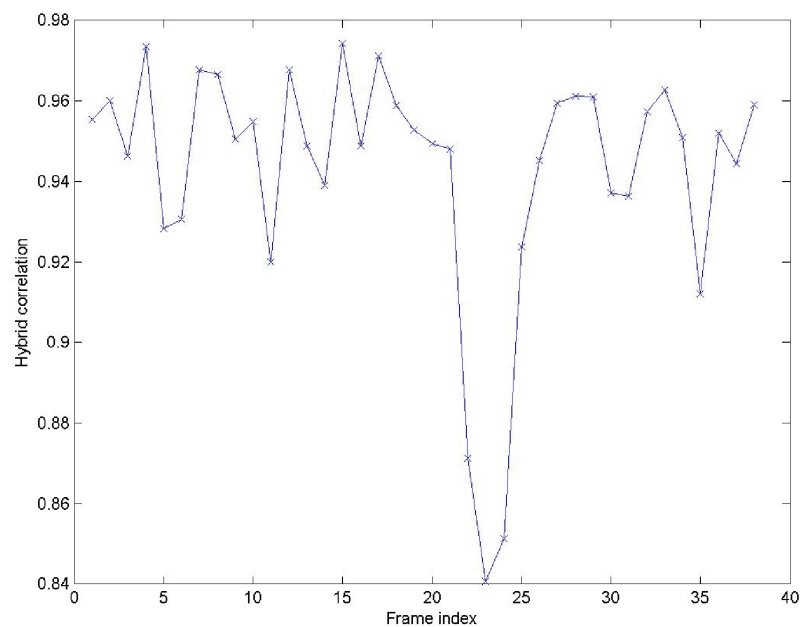


Figure 5 An obstruction occurs (Frm. 23) Figure 6 Normal situation (Frm. 31)

significantly, as opposed to slight fluctuation of the hybrid correlation value when only target appearance changes. This fact is best illustrated in Figure 4 through Figure 6. In Figure 4, we can see a dramatic drop of hybrid correlation around Frame 23. In the other parts of the figure, there is only minor fluctuation of hybrid correlation. Based on Figure 4, we expect that obstruction occurs around Frame 23. The actual video frames have confirmed our expectation, as are shown by Figure 5 and Figure 6. Figure 5 is taken from Frame 23, in which a TV antenna obscures the vehicle, and Figure 6 is taken from Frame 31, where there is no obstruction.

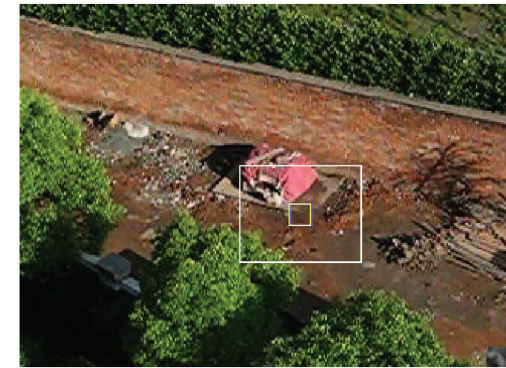
Therefore, a threshold can be set to distinguish between the two situations. Thus, if the hybrid correlation value is higher than the threshold, we keep updating the template to make it adapted to the target appearance change. If the hybrid correlation value is lower than the threshold, we stop updating the template to preserve its integrity until the hybrid correlation value is above the threshold again. In most cases, the threshold can be set to 0.88.

Experimental Results

In this section the experimental results of employing the new algorithms we have proposed will be given. The experiments are conducted on real-world video clips and the simulation platforms are Matlab 6.5 and Visual C++ 6.0.

Figure 7a through Figure 7d are taken from the tracking of a dog using MAD as measure of similarity. Figure 8a through Figure 8d are taken from the same clips employing hybrid correlation as similarity measure. As we can see, under complex circumstances, MAD-based tracking algorithm loses the target while hybrid-correlation-based one demonstrates high robustness.

Figure 9a through Figure 9d are taken from the tracking of a flying plane with standard TSS algorithm. Figure 10a through Figure 10d are dealt with using the ATSS algorithm. It is evident that when the velocity of the flying planes is



Top Row: Figure 7a, Figure 7b
 Second Row: Figure 7c, Figure 7d
 Third Row: Figure 8a, Figure 8b
 Fourth Row: Figure 8c, Figure 8d



Top Row: Figure 9a, Figure 9b
 Second Row: Figure 9c, Figure 9d
 Third Row: Figure 10a, Figure 10b
 Fourth Row: Figure 10c, Figure 10d

very high, the standard TSS algorithm fails to keep track of it, but the ATSS algorithm can handle it successfully.

Figure 11a through Figure 11d shows the case when the car being tracked is partly covered by an obstruction and the template is updated for every frame regardless of whether an obstruction appears. In Figures 12a through 12d, the same car is being tracked but the adaptive template update strategy is employed. The small figure immediately beside each frame is the current template.

We can see that updating the template during a period when the target is obstructed brings about disastrous consequences to the visual tracker. On the other hand, the adaptive template update strategy stops template updates on detection of an obstruction and has satisfactory performance under such situations.

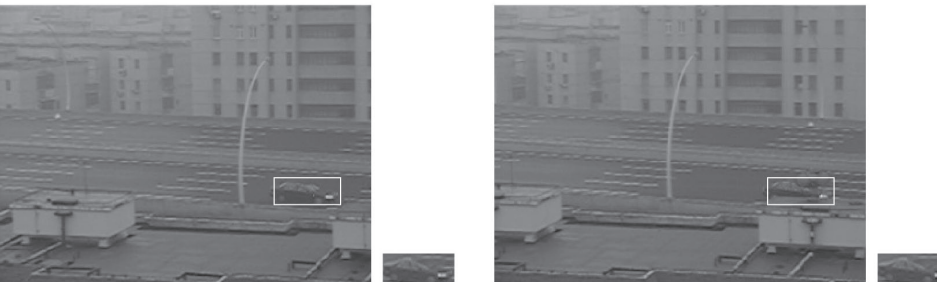
Conclusion

In this paper we propose a novel visual tracking algorithm based on the adaptive three-step search of hybrid correlation and adaptive template update. Hybrid correlation, defined as the linear combination of structural similarity and histogram similarity, has been shown to be an ideal similarity measure for visual tracking purposes. The adaptive three-step search algorithm adjusts the search range according to target velocity to achieve the capability of tracking high-speed targets. The adaptive template update solves the problem of interference by detecting when the target object is obscured using a hybrid correlation threshold and by pausing the updating template when interference is detected. Finally, experimental results have shown that the algorithm we have proposed greatly enhances visual tracking effects.





Top Row: Figure 11a, Figure 11b
 Second Row: Figure 11c, Figure 11d
 Third Row: Figure 12a, Figure 12b
 Fourth Row: Figure 12c, Figure 12d



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Ads with Ambition: An Examination of Voter Recruitment by Iraqis and Non-Iraqis in Iraq

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The author examines visual and rhetorical strategies used by Iraqi and non-Iraqi groups in recruiting voters for the January 2005 legislative and presidential elections. Case studies include the USAID, various Shiite clergy groups, and Future Iraq Assembly, which is a non-governmental organization of activists, businesspeople, and academicians. Religious appeals used by Iraqi clergy and interest groups are contrasted to nationalistic appeals used by the United States government. The author asserts that while religious rhetoric was most effective at prompting Iraqis to vote, it did not foster long-term understanding of the democratic process, and in fact heightened sectarian tensions, possibly having a destabilizing effect on the future of Iraq.

Imagine that you have been sent to Iraq to work on a voter recruitment campaign for the January 2005 legislative elections. According to a CNN news report, “With less than two weeks before the vote, U.S. officials admit that the insurgents have succeeded in discouraging Sunni participation by assassinating election workers, gunning down politicians and threatening with death anyone who shows up to vote.” Many Iraqis, especially Sunnis, do not trust you because you are an outsider. How are you going to convince them to go to the polls?

This challenge faced both Iraqi and international organizations working on the elections in Iraq. To examine these efforts, I will first briefly consider the political and ethnic context and why voter recruitment for this particular election was so challenging. Then, I will contrast the rhetoric used by Iraqi and non-Iraqi groups in voter recruitment ads, showing how groups from abroad appealed primarily to Iraqi

nationalism and unity, while Iraqi groups largely relied on religious and ethnic symbolism. Future Iraq Assembly provided a “middle ground” alternative to these two approaches, because it used nationalistic ads but integrated Iraqi traditions. After describing these strategies, I will evaluate their efficacy. I argue that religious rhetoric was the most effective at recruiting voters. The significance of the widespread use of religious rhetoric was that many Iraqi voters were uninformed about the candidates’ positions and political qualifications and had only a vague understanding of the practical value of the elections. The broader implication of the apparent success of religious rhetoric was the widening of ethnic and religious divisions, which could further destabilize Iraq in the future.

In order to assess the different voter recruitment approaches in Iraq, we must consider the ethnic and religious struggles that have been part of Iraqi society for decades. Saddam Hussein seized control of

Iraq in 1968, and his Baath Party consisted mainly of minority Sunni Arabs. Human rights abuses were perpetrated against Shiites, the ethnic group that makes up a majority of Iraq’s population, and Kurds, a minority group accused of harboring separatist intentions, throughout Hussein’s rule. In the 1990s the situation deteriorated even more for two principal reasons: first, United Nations economic sanctions made access to education and health care more difficult, and second, in order to consolidate his power, Hussein collaborated with Islamic tribal traditions. Reliance on tribal sheiks in rural areas was detrimental to human rights; it gave a substantial role in government to a conservative interpretation of Islamic law. This included a diminished role for women in society as well as fewer civil liberties for all Iraqis, which before the transition had been slightly more liberal than most Middle Eastern countries.

From Iraq’s history, it is evident that

not only is the country strongly Islamic, but it is also sectarian, because ethnic and religious divisions were institutionally reinforced by the Saddam Hussein regime. As an article from *The New York Times* explains, “The volatile sectarian mix is a holdover from the rule of Saddam Hussein, who gave favors to Sunni Arab landowners in the lush farmland around Baghdad to reinforce loyalties and to protect against Shiites in the south.” In terms of voter recruitment, this means that Iraqis are especially responsive to the rhetoric of their religious and ethnic groups. As Gareth Stansfield, a lecturer at the Institute of Arab and Islamic Studies at the University of Exeter, asserts, “The empowerment of groups associated with a communal identity is currently the norm within Iraq.” Thus, Iraqi ethnic and cultural ties are often stronger than nationalist sentiments.

Because of the presence of ethnic and religious partitions, the January 2005 elections in Iraq presented a significant challenge for organizations working to recruit voters. One consequence of sectarian tensions was a volatile security situation. The Woodrow Wilson International Center for Scholars held an election briefing with Iraqis on December 22, 2005 talking with Iraqis who “expressed concern about the current wave of violence against anyone working with the interim government, UN, coalition forces, or Iraqi military forces.” In addition, ethnic clashes meant that different Iraqis had different perspectives on the election; no single strategy could be applied to all ethnic and religious groups. One reporter from *The Washington Post* found that “[the] pre-election season has laid bare the sectarian fault lines that pit...religious Shiites—who are eager for power commensurate with their numbers—against Sunnis suspicious of both U.S. intentions and Shiite ambitions.” Shiites and Kurds, as the majority in Iraq, were largely supportive of the electoral process, while Sunnis opposed the elections because they feared that the new government would marginalize them. Many worried that Sunnis would boycott the elections, rendering the results illegitimate. This would essentially exclude

Sunnis from the electoral process, damaging the legitimacy and effectiveness of any new government. In the long-term view, political participation is a crucial step on the road to a democratic state. According to Glen Rangwala, a scholar at Cambridge University, “Open electoral contest will inevitably bring with it the possibility of a considerable realignment of political forces along national lines.” Voter turnout was also a pragmatic concern for both the United States military and Iraqis themselves; as one Sunni politician said, “It is a big message to the insurgents that people wanted to go forward with the political process.”

Given the disjointed nature of Iraqi society, it is no surprise that religious and ethnic rhetoric were effective techniques in voter recruitment. But because the United States government envisioned Iraq as a unified, secular democracy, it did not use appeals to Islam or ethnic groups to engage voters. One flyer distributed in rural Iraq by the US Army Civil Affairs division shows the Iraqi flag in the shape of Iraq, with hands reaching to put ballots in a ballot box in the background. (Figure 1) The way the hands are striving to reach the ballot box presents voting as a desirable and popular act. This image also says to Iraqis that because their compatriots are voting, they should too. Nationalism is the predominant appeal; the flyer has no faces, making it impossible to distinguish ethnic groups among the people pictured. The flyer does not address religion at all, which distinguishes it from appeals to religion and ethnicity used by Iraqi groups. The influence of media coverage on this process can also be seen; the fact that the photographer chose to use an older woman in his image emphasizes a new role for women in the political process, something rarely broached in strategies of religious rhetoric. Because the woman is in traditional dress and is from a rural area, it might also be expressing the universality of the elections.

Another American advertisement created by the United States Agency for International Development (USAID) shows a girl in a school uniform putting a ballot



Figure 1: US Army poster (Reuters)

into a ballot box. (Figure 2) The imagery of the child evokes a simplistic and wholesome view of elections, and perhaps aims to dispel the idea that democracy represents Western hegemony. This feeling of innocence is heightened by the fact that the ad is a cartoon, and the female child suggests the intention to give women a larger role in society. The girl's clothing is not necessarily Western, but she does not have a veil or chador and the bottoms of her legs are showing, taboos in a strict interpretation of Islam. This could imply a rejection of the repression of Iraqi women



Figure 2: USAID poster (www.usaid.gov)

under the Saddam Hussein after his ties to tribal sheiks strengthened. The United States aimed to build a secular democracy in Iraq, and this can be seen in its refusal to use religious or ethnic rhetoric to recruit voters. This aspect of US strategy differentiates it from that of Iraqi groups. Iraqi civil society groups, because they better understood how to reach potential voters, took advantage of existing divisions in their efforts to promote the elections. Through religious and ethnic appeals, Iraqi groups appear to have successfully reached their targeted portions of the Iraqi population. The Iraqi group most instrumental in the electoral process was Shiite clergy. Sami Shamousi, a Shiite prayer leader from Baghdad, said, "The clergy are advocating elections 100 percent...It has become a religious responsibility for us to encourage participation in the elections." The clergy's sense of duty undoubtedly came from religious edicts issued by Grand Ayatollah Ali al-Sistani, Iraq's most prominent and influential Shiite. Maher Hamra, a Shiite sheik whose office works under Sistani's name, helped to organize educational workshops and lectures about the elections for Iraqis. Hamra's office also sent clergymen to various high schools in order to encourage young people to participate in the elections. Quotations from Sistani, including, "One vote is like gold, but even more precious," could be seen on posters hung in many Shiite cities. Sistani was a pivotal figure in the monumental task of organizing elections; his support of the elections caused a ripple effect on all levels of Shiism, and many clerics subsequently encouraged their congregations to vote. Voter recruitment messages from clergy demonstrated the prevalence of religious rhetoric.

On the surface, the role of Shiite clergy in the electoral process seems entirely positive; they used their power to advocate for political engagement. However, the tactics of referring to Ayatollah Sistani and appealing to Islam became tools of extremism. A poster put out by an unknown Iraqi group read, "If you don't consider it your religious duty, then your national duty calls on you to vote." The tone of this ad



Figure 3: Poster with Sistani (<http://www.state.gov/r/pa/ei/pix/b/nea/iraq/39790.htm>)

is admonishing, and it seems to imply that voting should be considered a religious duty. Many Iraqis responded to religious pressure instead of considering personal reasons for voting. According to Nermeen al-Mufti from the Egyptian newspaper *Al-Ahram Weekly*, "Some do not even know whether this election is to select a national council or a president." The images of Sistani, on the other hand, were hard to miss: "The campaign has become so pitched that many Iraqis may have a better idea of Sistani's view of the election than what the election itself will decide." Many Shiite groups plastered their cities with posters of Sistani's face (Figure 3) next to a brief message from him urging Iraqis to vote. Information about the elections and their importance to Iraq's future was strangely absent from these posters, and for a population unaccustomed to open elections this explanation was sorely needed. For many Shiites it did not appear to matter. One merchant from Baghdad said, "I'm going [to the voting station] because Al-Sayid Al-Sistani said that whoever doesn't vote is going to hell." The connection that the man draws between voting and the after-life shows the strong influence of religious appeals. It appears that Iraqis internal-

ized Sistani's endorsement of the process as evidence that as Shiites they must vote, regardless of personal investment in the political process. The combination of Sistani's countenance and the word "duty" in all likelihood was enough persuasion for many Iraqis because of the tremendous esteem in which Iraqi Shiites hold Sistani.

Other Iraqis might have been confused by nationalistic and religious appeals. One bemused Iraqi teacher commented, "The electoral commission didn't explain why we are having elections now, it just spent hundreds of thousands of dollars on posters and television adverts that said things like 'Vote for Iraq.'" This man's bewilderment demonstrates how abstract the idea of a unified Iraq was in the midst of sectarian tensions and ongoing violence. The Iraqi groups' religious rhetoric may have prevented some Iraqis from questioning the validity of the elections, but others, such as this teacher, felt unengaged by a process without a clearly articulated purpose.

Even more alarming than the frequent employment of religious appeals was the trend of symbolism seen in many campaigns. Party symbols came about because fear of insurgent reprisal prevented some candidates from publicizing their names, and because of the fledgling nature of voter education programs. The same merchant also commented, "There are too many names on the list that it becomes difficult to recognise them. It is easier to refer to those electoral lists by the symbols they choose." Some of the symbols chosen included the candle (Unified Iraqi Coalition, the party backed by Sistani), a mosque minaret (Independent Democrats Coalition), a hand wearing a wedding ring (Iraqi Communist Party), a rose, a bridge, and various others. The candle is especially interesting because it evokes hope and faith; its image may have implied to Iraqis that the Unified Iraqi Coalition would bring a brighter future to Iraq. Because of the widespread use of symbols without accompanying explanations, many Iraqis voted based on the symbols, some without even knowing the names of the candidates. This can be viewed as the simpli-



Figure 4: Unified Iraqi Coalition Posters (Ali Al-Saadi, Agence France-Presse)

fication of a complex electoral process for a populace unfamiliar with elections, or the exploitation of internal divisions. For example, as seen in the ad for the Unified Iraqi Coalition (Figure 4), using Sistani's face and the candle in the same poster can be very powerful. Sistani and the candle become irrevocably joined in the minds of Shiite Iraqis, and when they go to the polls they will be likely to choose the candle. The lack of political discourse in the election was worrisome; according to Motohiro Ono, an economist specializing in the Middle East, "This was an election without policy debate or political ideology. This has also simply put off matters until later, and these problems will have to be addressed in the near future." Religious rhetoric contributed to the lack of genuine engagement in controversial political and social issues. And by emphasizing symbolism rather than ideology in campaigns, sectarian tensions were actually being reinforced, since Iraqis were encouraged to vote based on a party's symbol rather than its principles. A declaration by the Muslim Scholars' Board, a Sunni group, that the government formed by the election was "illegitimate," foreshadowed heightened tensions. The condemnation was made because the new government had almost no Sunnis in it, owing to the widespread Sunni election boycott.

Between the sectarian appeals of Iraqi religious groups and the nationalist rhet-

oric of the United States, were there any other strategies? In the grey area between "outsiders" and "insiders" lies Future Iraq Assembly, whose origins are unclear. The group describes itself as "[an] independent, non-governmental organization, comprised of a number of scholars, businesspersons, and activists, who share a common and firm belief in freedom and progress for all the Iraqi people." This group is an example of how democracy can be presented with an Iraqi character without the use of religious rhetoric, a feat that neither the Americans nor the Iraqis accomplished. Some of its goals include, "Reinforce the unity of Iraq, land and people; Ensure freedom to the people, political parties, assemblies, and associations; Consolidate Iraqis' full and operative sovereignty over our land." The group has been linked to Ayatollah Sistani and his allies, although there are also suggestions that it consists of Iraqi expatriates. Future Iraq Assembly produced an extensive billboard campaign spanning more than a dozen major Iraqi cities, using the of a hand placing an Iraqi flag into a ballot box. The slogan reads, "In order to give our children a better future." (Figure 5) The prominence of the Iraqi flag suggests the

kind of national unity that Western groups tried to emphasize, but the use of the word "our" seems to be an appeal from Iraqis to other Iraqis. The skin color could be considered either Arab or Caucasian, and this ambiguity might be deliberate. The hand is clearly a man's; perhaps because of varying levels of adherence to Islamic law in Iraq, a woman's hand would be too controversial. From the small amount of clothing that can be seen, the man is wearing a Western business suit, which hints at modernization and secularism. The poster subtly combines elements of Iraqi and American voter recruitment tactics.

Future Iraq Assembly also produced television ads for the 2005 election that used individual testimonials from Iraqis with a variety of backgrounds. One collection of quotations from Iraqis focused on their aspirations for the future. A woman in a Western-style business suit says, "I hope to be an ambassador one day." (Figure 6) The fact that a woman is expressing her ambition to be involved in government represents a departure from traditional gender roles. Her business attire shows a progressive, modern view of women in society. The ad cuts from a shepherd to a craftsman in his work-



Figure 5: Future Iraq Assembly billboard (www.futureiraq.org)



Figure 6: "I hope to be an ambassador one day" (www.futureiraq.org)

room, to a woman wearing a headscarf, and finally to a little boy playing with a toy airplane and saying, "I want to be a pilot." The child might function similarly to the poster of the schoolgirl discussed earlier; the use of children gives the democratic process an innocent simplicity, while simultaneously emphasizing the importance of elections for Iraq's future generations. The final slogan in the ad is, "Your dream is within your reach." This emphasis on "you" and the consistent use of "I" statements suggest an individualistic approach reminiscent of the West, but references in the ad to more "traditional" ways of life show a strong Iraqi influence. The fact that one of the women is wearing a headscarf shows more cultural sensitivity than many Western ads. One of the most interesting aspects of the televised ads is that each has both a Kurdish and an Arabic version, which are identical except for the language. This indicates that Future Iraq Assembly did not alter its pitch for differ-

ent ethnic or religious groups. However, it did weave in elements of Iraqi culture and so did not appear to be speaking from an outsider perspective. It is an interesting case study of a voter recruitment strategy lying between the extremes of secular nationalistic and religious appeals. Future Iraq Assembly's approach could be a model for future elections, because it promotes the ideals of human rights without alienating Iraqis.

It is evident that the sense of Iraqi nationalism that the United States government hoped to generate did not become a reality during or after the elections. Iraqis seemed to go to, or stay away from, the polls because their local or national religious leaders told them (directly or indirectly) that it was their religious duty. Many Iraqis did not seem to comprehend the significance of the elections, either for the immediate or distant future of their country, and much of this was a result of the techniques that other Iraqis used to persuade them to vote. This brings up another question; namely, was the Iraqi approach justified? Was it more important that Iraqis went to the polls, or was it more important that they were informed and voted because of personal convictions? While simply getting Iraqis to the polls in higher numbers was a significant achievement, was it a legitimate reason to appeal to religion? It could be argued that the outcome of the elections would have been the same even if religious rhetoric had been absent from the campaign, because Iraqis would still have voted for the party that coincided with their religion or ethnicity.

However, appeals to religion and ethnicity reinforced the divisions that already existed in Iraqi society by emphasizing, and in some cases exaggerating, the differences between sects. As is apparent from the case of Ayatollah Sistani, religious rhetoric could have impeded the state building process. By upholding Sistani as the ultimate authority in Shiites' lives, the legitimacy of the new Iraqi government was diminished even before its inception.

Religious and ethnic appeals augmented the fractured nature of Iraqi society, and they did not help the democratic process. According to Francis Fukuyama's model of democratic development, "Democracy cannot be considered fully consolidated until it is rooted in the political culture of the society." By persuading civilians to participate in the electoral process using religious pressure, the culture of Iraq was not being altered to foster democratic growth; on the contrary, long-standing non-democratic institutions were reinforced. Without a sound understanding of the political process, the cultural aspect of Iraqi society could not truly be engaged in democracy.

So if you were sent to Iraq to recruit voters, which approach would you choose? Would you opt for a more effective strategy of using Iraqis' sense of identity within a community, or would you take a risk on "Western" nationalistic appeals? The answer to this question may prove to be essential for the survival of a democratic Iraq.

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Kara Johnson is a sophomore at Stanford University majoring in Political Science. She is a Minnesota native. She is particularly interested in the democratic process in Iraq because she was involved with community action groups there around the time of the invasion of Iraq in 2003. This led her to various vigils, rallies, and marches, and exposed her to diverse perspectives about the war. A related research interest at Stanford is the role of the American media in shaping public opinion of the Iraq war. Other research interests have included the media and civil society in Sierra Leone and the role of women in Egyptian society.

Classics

The Torch Bearer and the Tutor: Prevalent attitudes towards the Roman Empire in Imperial Britain

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How do people in power use history to shape current policy? How does current policy influence conceptions of history? Examining these questions, this paper addresses how British imperialists during the late 19th and early 20th centuries redefined their ideas about the classical Roman Empire to fit their (imperialist) ideologies, and how British imperial policy helped set the agenda for research on classical history. Specifically, a shift in attitude towards the Roman Empire occurred in the late Victorian era. Until the mid 19th century, British historians viewed Roman imperialism as despotic. However, as Britain's imperialist ambitions grew, historians began to glorify Imperial Rome and sought to forge a stronger historical link between the two civilizations. Politicians, meanwhile, began to actively partake in classical studies, influencing research and stressing the relevance of studying Rome. By the early 20th century, a coherent ideology had appeared: Britain was the heir to Rome and, learning from its predecessor's mistakes, it would carry forward the "torch of civilization."

On the cover of Niall Ferguson's recent bestseller *Colossus: The Rise and Fall of the American Empire* is a photograph of two American tanks in front of the Colosseum in Rome. The book's title indicates the continuing relevance of imperialism to the modern world, but the choice of the cover photograph is intriguing. What does the Colosseum, the gladiatorial arena of the ancient Romans, have to do with the notion of an American Empire?

Though over fifteen centuries have passed since the fall of Rome and its western provinces to barbarian hordes, people continue to associate imperialism with the ancient Roman Empire. Before the last two centuries a number of Middle Eastern, Central Asian, and even European empires have risen and fallen, but the

memory of Rome persists. And America is not the only country whose activities have evoked parallels with Rome; Europe's connection is even stronger, and the governments of France, Germany, Russia, and Italy have all actively drawn upon the "Roman image" at different times¹.

In the British Empire, too, the "Roman image" was important. Just as Ferguson now compares the United States to Rome in *Colossus*, British historians during the Victorian and Edwardian periods drew parallels between their Empire and the Caesars'. But Rome had a greater impact on nineteenth and early twentieth century British elites than it does on Americans today. One reason for this, according to Richard Hingley, author of *Roman Offi-*

cers and English Gentlemen, is that "Greek and Roman authors talked in the first person to the English Gentleman."² In other words, educated Englishmen often had, from their schooling, an intimate knowledge of classical literature and ancient history. Winston Churchill is a good example. A recent paper examines the influence of the historian Edward Gibbon on Churchill and relates how he, as a youth, "rode triumphantly" through Gibbon's voluminous *History of the Decline and Fall of the Roman Empire* "from end to end."³ The tome affected the views of the future Prime Minister throughout his life.

Since the history of ancient Rome seems to have influenced the British elites

1. Hingley 157

2. Ibid 157

3. Quinault 317

who decided imperial policy, their interpretations of classical sources and their views on classical Rome may have had far-reaching consequences. What, therefore, was the prevalent British attitude towards the Roman Empire during the Imperial Era? And how was this attitude significant in terms of its effect on policy and history?

The issue is more complex than it first appears. First of all, views on ancient Rome in Britain were neither uniform or static. Over the course of the nineteenth century they evolved from a dismissal of the Roman Empire as a despotic regime to an “imperial discourse”, as Hingley calls it, that largely saw Rome in a positive light through the lens of Victorian virtues such as “civilization” and “progress.”⁴ Secondly, the prevalent attitude among British elites during the late Victorian and Edwardian eras, when this discourse reached the height of its relevance and authority, did not envision Rome as a simple analogue to the British Empire. Rather, Rome represented to them a less advanced predecessor empire that had passed on the torch of imperialism to Britain. The Roman Empire was an historical example, and England could benefit from studying its virtues as well as avoiding the vices that led to its downfall. In this context, the notion of Rome’s “decline and fall” held immense importance for the future of the British Empire.

Additionally, the influence of Roman history on British imperialism was a circular process. Just as British statesmen and academics sought to apply the lessons of classical Rome to current policy, prevalent attitudes about imperialism helped shape the development of Roman history and Roman archaeology. As Hingley shows in his book, a strong association existed between certain imperial administrators and scholars of classical History, such as Francis Haverfield, W.T. Arnold, Lord Cromer, and Stanley Baldwin, and these relationships helped facilitate the influence of one discipline on the other. This paper seeks to consider the impact of classical Rome

4. Seeley 188

on British imperialism by exploring the development and nature of the “imperial discourse” in the early twentieth century and briefly examining its significance to Britain’s imperial policy as well as Roman history and archaeology.

The Evolution of the “Roman Example”

“Historians seldom praise the Roman Empire,” reads the opening sentence of the influential archaeologist Francis Haverfield’s *Romanization of Roman Britain*, originally a speech given in 1905⁵. Indeed, though many late eighteenth century and nineteenth century British historians respected the Roman Republic, holding it “in honour for its freedom,”⁶ they regarded the Empire that followed and the concept of imperialism with distaste, often associating it with the perceived despotism of rulers such as Louis XIV and Napoleon Bonaparte of France⁷. However, over the course of the nineteenth century, as British international policy began to resemble that of an empire, this aversion to Imperial Rome changed into an acceptance of imperialism but criticism of particular aspects of the Roman variety. By the late Victorian period, what remained of this restrained criticism had turned into an outright appreciation for the classical Roman Empire and its “accomplishments.”

Edward Gibbon, author of the seminal *Decline and Fall of the Roman Empire*, published between 1776 and 1788, held a hostility towards imperialism that represented the stance of many nineteenth-century Roman historians that followed in his wake. After visiting ancient ruins at Rome in 1764, Gibbon wrote to his father that he was convinced “there never never existed such a nation and [he hoped] for the happiness of mankind that there never will again.”⁸ In *Decline and Fall* he

5. Haverfield 9

6. Seeley 188

7. Hingley 20

8. Gibbon in J.E. Norton’s *The Letters of Edward Gibbon*, cited from preface to 2000 edition of Penguin Classics’ *The History of the Decline and Fall of the Roman Empire*:

declares: “There is nothing perhaps more averse to nature and reason than to hold in obedience remote countries and foreign nations.”⁹ He therefore seemingly rejected fundamental aspects of imperialism.

Gibbon’s aversion to empire resonated down the decades, but as Britain developed as a world power and began to control “remote countries and foreign nations,” the concept of empire grew more relevant, and some historians warily started to see parallels between Roman and British policy. John Sheppard drew a memorable analogy in his 1861 history *The Fall of Rome and the Rise of the New Nationalities*. In one chapter, he gives the “reins to imagination” to illustrate how Britain would be if its condition directly resembled that of Imperial Rome:

Parliaments, meetings, and all the ordinary expressions of the national will, are no longer in existence. A free press has shared their fate [...] a number of the richest old gentlemen in London meet daily at Westminster to receive orders from Buckingham Palace. [...] The last heir of the house of Brunswick is lying dead [...] [Lord Clyde] in a few months will be marching upon London at the head of the Indian army. [...] Hyde Park has been converted into a gigantic arena, where criminals from Newgate “set to” with the animals from the Zoological Gardens.¹⁰

This account portrays the Roman Empire as despotic, chaotic, and immoral. And by contrasting Rome’s situation with Britain’s, it effectively “reflects the perfection of Victorian England and the British Empire.”¹¹ But is Sheppard simply making a smug reflection on current affairs? The fact that he draws this parallel alone indicates some level of concern about where Britain is headed. Indeed, at the end of the analogy, he offers a warning against despotism and refers to his fanciful story as “the language of prophecy.”¹² British policy overseas had begun to resemble Roman Imperialism, and Sheppard’s account shows us that some historians took an un-

Abridged Edition.

9. Gibbon 142

10. Sheppard 104-5

11. Hingley 20

12. Sheppard 106

easy notice of it. An author in Gibbon's day would not likely have envisioned a British lord at the head of an Indian army.

As England's imperial role grew more pronounced and as the reigns of "despots" such as France's Napoleon III waned, hostility towards imperialism started to decline. By the 1870s, Britain began to adopt the overt trappings of empire. In 1876, Queen Victoria took the title "Empress of India" after a heated debate about the Royal Titles Bill, which bestowed the honor¹³. Hingley argues that through discussions such as this an imperial discourse developed that "drew upon the image of the Roman Empire in a positive fashion."¹⁴

Indeed, between the 1850s and 1880s, views on the Roman Empire made an about-face. It became acceptable and even popular in Britain to be an imperialist—a label that now described someone who wanted to "tighten the bonds" which held the empire together¹⁵. Under the influence of classical historians such as the German scholar Theodor Mommsen, the very concepts with which historians associated the Roman Empire changed. Accounts of Roman history now focused on its positive effects, such as progress and the spreading of "civilization."

Historians were fully aware of the reversal in opinion. J.R. Seeley, in his important book *The Expansion of England* (published in 1883, only seven years after the Royal Titles Bill), charted and even explained the change in attitude:

There was a time no doubt when even the Roman Empire, because it was despotic and in some periods unhappy and half-barbarous, was thought uninteresting. A generation ago it was the reigning opinion that there is nothing good in politics but liberty [...]. The Roman Republic was held in honour for its freedom [...]. We have [now] learnt that there are many good things in politics beside liberty; for instance there is nationality, there is civilization¹⁶.

According to Seeley, previous Roman historians had dwelt on the weaknesses

and vices of the Roman Empire, and did not notice other good things, such as nationality. In seeing Rome's empire as a positive achievement that "stands out in the very centre of human history,"¹⁷ Seeley's view represented the new, reigning attitude towards Rome that effectively replaced Gibbon's by the end of the Victorian period.

Historians also revised Britain's connection to Rome. Mid-Victorians had most often associated their race and civilization with the Anglo-Saxons, who invaded England after the Romans had left the island. However, by Edwardian times, this theory had given way to theories of Romanization, advocated by influential archaeologists such as Francis Haverfield¹⁸. The Romanization hypothesis argued that Rome had passed its civilization to England and that some descendants of civilized Roman Britons survived after the Empire fell¹⁹. The English, therefore, were a people of "mixed race," and this characteristic was now seen as a "source not of weakness but of strength."²⁰ Romanization distanced the English from other Teutonic peoples such as the Germans, who in the early twentieth century had become a threat to national security, and forged a direct link to the classical Romans as ancestors of the English.

As the histories from Gibbon to Seeley show, by the late Victorian period, Britain had become overtly imperial, and in the process, its attitude towards the Roman Empire had changed. It began to see itself as the heir to Caesar's Empire and to draw upon Rome's imperial image with few scruples. Haverfield, in his Romanization of Roman Britain, explains that the old theory of the Roman Empire "has been overthrown, and the believer in human nature can now feel confident that, whatever their limitations, the men of the Empire wrought for the betterment and the happiness of the world."²¹ So too, by

extension, would the men of the British Empire.

Edwardian Attitudes Towards Rome: The Torch Bearer and the Tutor

The imperial discourse that evolved during Queen Victoria's reign arguably reached the height of its development and influence during the early twentieth century. Hingley identifies that a "range of relevant publications" appeared during the period from 1905 to 1914²². As the years led up to the Great War, a number of academics and administrators such as Lord Cromer, Charles Lucas, and Stanley Baldwin drew heavily from perceived parallels between the Roman and British Empires and sought to apply them to British policy overseas. Hingley implies in *Roman Officers and English Gentlemen* that these Edwardian scholars and politicians "stretched and distorted the archaeological and historical evidence" to create an analogy between the Roman and British empires, which were, in actuality, "very different in organization and development."²³ But the texts that he points to, such as Lord Cromer's 1910 *Ancient and Modern Imperialism*, chart important differences in addition to similarities between British and Roman imperialism. Though some evidence may undoubtedly appear distorted with respect to modern scholarship, for the most part, these texts do not envision Rome as a simple analogy to Britain. Rather, they consider Britain as Rome's heir to the concept of imperialism. The Roman Empire, in their view, was an experiment not to repeat but to learn from. Two pieces of evidence indicate their attitude: the use of images such as the "torch of civilization" passed from Rome to Britain, and explicit statements stressing the importance of learning from Rome by both emulating its fortes and avoiding its follies and foibles.

Of course, late Victorian and Edwardian authors enthusiastically noted any similarities that they could find between

13. Hingley 22

14. Ibid 22

15. Ibid 22

16. Seeley 188-9

17. Seeley, cited from Hingley 24

18. Hingley 4

19. Ibid 95

20. Ibid 94

21. Haverfield 10

22. Hingley 25

23. Ibid 156

the Roman and British empires. Lord Cromer, for example, thought that the notion of imperialism, “as we understand, and as the Romans, with many notable differences, understood the term” was in essence the same²⁴.

In *Ancient and Modern Imperialism* he proceeds to argue that Britain’s situation regarding its imperial role resembled Rome’s. Each step towards establishing empire was “taken with a reluctance which was by no means feigned.”²⁵ Further, he notes that Rome “was impelled onwards by the imperious and irresistible necessity of acquiring defensible frontiers; that the public opinion of the world scoffed 2,000 years ago, as it does now, at the alleged necessity; and that each onward move was attributed to an insatiable lust for extended dominion.”²⁶ The perceived similarities in world public opinion and basic reasons for acquiring empire are remarkable. Cromer also draws parallels between British and Roman methods of implementing empire, arguing that both of their imperialists displayed “undaunted audacity” in their “proceedings”²⁷ and that both empires used “auxiliaries drawn from the countries which they conquered.”²⁸ And, from his experience as the first Viceroy of Egypt, he noted that the system employed by the British in Egypt and India bears “a striking similarity to that adopted by the Romans.”²⁹ As is evident, at least some British administrators saw significant parallels between Roman and British rule.

However, Cromer, along with other authors, also notes major differences between Augustus’s empire and Victoria’s. Christianity, for example, “had intervened between the two periods,” and had bestowed moral principles on Britain that were essentially “unknown to the ancient world.”³⁰ Charles Lucas, meanwhile, in his 1912 book *Greater Rome and Greater*

Britain, raises more differences than similarities. According to him, concepts “of space, youth, and science” play an important role in British imperialism, but there exists “no analogy to be found in the Roman Empire.”³¹ The effects of religion, race, and medicine also differ³². Lucas even suggests that some fundamental motives behind British and Roman imperialism differ, such as commercialism: “British trade and colonization have known no limits. The policy has not been that of the Roman Wall.”³³ Furthermore, the few similarities he does record depict Britain’s Empire as morally and materially superior to Rome’s—perhaps a more fitting title for his book is *Greater Rome and Even Greater Britain*.

Despite pointing out vast differences between Roman and British imperialism, Lucas and related historians and politicians do not reject the importance of the Roman example. In fact, Lucas directly considers its relevance in *Greater Rome*: “How did the Romans hold their Empire for so long a time? How has the British Empire been held together up to date? And by what means, judging from past experience, and from the signs of the times, are we likely to continue holding it?” Even with all of its differences, the history of Rome still provided important questions for British imperialists. Hingley contends that “the parallel between British India and Roman Britain was not always felt to be exact but this did not detract from its value.”³⁴ This concept applied to the “Roman example” in general. As J.C. Stobart observes in his 1912 *The Grandeur that was Rome*, the contemporary Englishman “cannot help drawing analogies from Roman history and seeking in it ‘morals’ for his own guidance.”³⁵

Prominent classical scholars and imperial administrators explicitly echo Stobart’s notion. John Collingwood Bruce, in his book *The Roman Wall*, impelled

Englishmen to “[e]mulate the virtues that adorned [Rome’s] prosperity, and [. . .] shun the vices that were punished by her downfall”³⁶. Former British Prime Minister Stanley Baldwin endorsed this view in a 1926 address, saying that the British Empire shall fare more “worthily so long as we base our lives on the stern virtues of the Roman character and take to ourselves the warnings that Rome left for our guidance.”³⁷ Rome, as they saw it, was a historical lesson—Cromer called history “philosophy teaching by example”³⁸—and Britain should learn from its strengths and flaws. This was the essence of the Edwardian attitude towards the Roman Empire.

In this context, Britain was not analogous to Rome, but rather its student and successor. To evoke this notion, politicians such as Cromer and Baldwin repeatedly and explicitly used the picture of Britain as the latest bearer of a “torch of imperialism.” In his 1926 address to the Classical Association, Baldwin says “Rome ran her mighty race bearing her torch on high [. . .] after many centuries it was passed to us.”³⁹ Bruce, meanwhile, uses the image of a scepter to similar effect: “The scepter which Rome relinquished, we have taken up. Great is our Honour—great our Responsibility.”⁴⁰ In their eyes, Britain had clearly taken up the mantle of ancient Rome.

As these statements from Cromer, Baldwin, Bruce, and others suggest, British historians and politicians in the late Victorian and Edwardian periods had a highly specific notion of the Roman Empire and its relevance to their condition. These ideas were developed in a vibrant and influential “imperial discourse”. Under Darwinian evolutionary theory and Victorian notions of progress, Hingley notes, “Britain could be argued to represent the heir to Rome” but, importantly, an heir that has “improved upon [its] inheri-

24. Cromer 9

25. Ibid 19

26. Cromer 20

27. Ibid 34

28. Ibid 35

29. Ibid 35

30. Ibid 45

31. Lucas 21

32. Ibid 73

33. Ibid 62

34. Hingley 68

35. Stobart 3, cited from Hingley 34

36. Bruce 449-450, cited from Hingley 21

37. Page 9 of Baldwin’s address *The Classics and the Plain Man*, cited from Hingley 102

38. Cromer 14

39. Hingley 102

40. Bruce 449-450, cited from Hingley 21

tance.”⁴¹ Britain was Rome’s successor, and it could stand to benefit from the vices and virtues exhibited by the Roman example. Roman history and British attitudes on it had, with this in mind, likely influenced British imperial policy.

Significance: How the Imperial Discourse Affected History and Policy

The Edwardian fascination with the Roman Empire affected not only British imperial policy but also English scholarship on Roman history and archaeology. Just as imperial administrators culled lessons from Roman history—particularly about frontier policy, assimilation, and the decline and fall of empire—academics, perhaps inadvertently, projected Victorian and Edwardian concepts and attitudes onto ancient Rome. An association between several important classical Roman scholars and imperial administrators, such as Haverfield, Arnold, Cromer, and Baldwin, may have assisted in this osmosis of ideas.

Lord Cromer’s *Ancient and Modern Imperialism* illustrates how considerations of Roman history influenced frontier policy and the assimilation of cultures under the rule of the Empire. Hingley argues that studies such as Cromer’s comparison of Roman and British military frontiers directly informed policy concerning boundaries such as the northern “Customs Hedge” or “Salt Hedge” frontier of British India⁴². Cromer also uses Rome to reflect on faltering British attempts to assimilate foreign cultures. He contends that, in the light of history, the ability of Rome to effectively incorporate subjugated peoples is easily explained.⁴³ In a perhaps simplistic explanation of the situation, he argues that the Romans had only encountered “tribes” that easily accepted Roman culture in their Western European conquests. The British, meanwhile, faced peoples with “crystallized” customs, such as “Hindoos” and “Mohammedans”, and their traditions

41. Hingley 86
42. Hingley 41
43. Cromer 91

offered a “formidable barrier” to assimilation⁴⁴. He provides a historical example in support of his theory: the Romans had failed to incorporate Jews into their empire⁴⁵.

Perhaps the most important lesson that Rome held for British policymakers was how to avoid imperial decline. Germany’s mounting clout on the continent by the turn of the century had come to challenge the unrivalled dominance that Britain had enjoyed during the early Victorian era, and many officials during the Edwardian period and even into the 1920s turned to Roman history in an attempt to avoid the decay and collapse of their own empire. Former British Prime Minister Arthur Balfour devoted a third of his 1908 address on ‘Decadence’ to the decline of Rome⁴⁶. Gibbon’s vivid account also proved influential in this context. In 1905, for example, Elliot Mills anonymously released a pamphlet called *The Decline and Fall of the British Empire*, a fictional future account of Britain’s collapse around 1995. “Had the English people [. . .] turned to Gibbon’s *Decline and Fall of the Roman Empire*,” he warns, “they might have found in it a not inaccurate description of themselves.”⁴⁷ The implication is clear: Roman history could actually help save the British Empire from disintegration. Mills’s pamphlet sold successfully and enjoyed wide influence⁴⁸.

Just as accounts of Roman history influenced British public and official outlook on Empire, generally positive attitudes towards imperialism during the ‘late Victorian and Edwardian years influenced the study of Rome and especially of Roman Britain, infusing it with contemporary notions of progress⁴⁹. One of the main purposes of Hingley’s book is to illustrate how such “progressive views continued to inspire images of Roman Britain [until]

44. Ibid 90
45. Ibid 95
46. Hingley 33
47. Mills iii-iv, cited from Hingley 31
48. Hingley 32
49. Ibid 152

the 1990s,”⁵⁰ and his evaluation of twentieth century British literature on Rome demonstrates the continuing influence of scholars such as Haverfield. Archaeology stands equally affected. Hingley shows that until the 1960s, almost all excavation of Roman remains in Britain occurred in major towns and villas—sites originally of interest because they offered more evidence of Romanization—as opposed to villages⁵¹. According to him, Victorian concepts of progress and social evolution, along with the Romanization hypothesis and other scholarship they have inspired, are no longer valid⁵². Freeman, in his paper on the origin of Romanization, echoes this sentiment when he asks, “given its historical context in 19th-C. scholarship, is the concept of Romanization an appropriate one to use today?”⁵³ The entire field, according to these authors, may require revision.

Conclusion: Education, Politics, and the “British Example”

It may already be evident that one reason behind the circular influence of British imperial policy and British scholarship on Roman history is the connection between academics and administrators in late Victorian and Edwardian England. Officials such as Cromer admitted that even an “imperfect acquaintance with classical literature” conferred “immense benefits”⁵⁴. Meanwhile, as Hingley argues, intellectuals such as Haverfield “drew on the value of Roman imperial studies with a direct mention of the importance of foreign service.”⁵⁵

Haverfield and several other eminent classical scholars worked at key academic institutions such as Oxford University, which produced “a majority” of the Empire’s civil servants and administrators⁵⁶. From such intellectual bastions their views

50. Ibid 164
51. Ibid 150
52. Ibid 153
53. Freeman 47
54. Cromer 2
55. Hingley 54
56. Ibid 26

influenced current and future Imperial officials. But professors learned from politicians, too. Books and speeches concerning ancient Rome by Imperial administrators such as Lord Cromer and Lord Curzon⁵⁷ abound. A more dramatic indication of policymakers' influence on academia is the appointment of Lord Cromer in 1910 and Stanley Baldwin in 1926 to the Presidency of the Classical Association. From

57. For example, his speech *Frontiers*, given at Oxford University in 1907.

such positions, figures with power in the British Empire were able to affect views on the classical Roman Empire.

This relationship between academics and public policy is not unique to classical Roman history or, for that matter, the Edwardian period. Even today, professional and popular books by scholars such as Niall Ferguson (who is ironically from Oxford) spread academic views of concepts such as Empire to the public and to policymakers. We have seen how, facilitated by the connection between scholars

and administrators, British attitudes towards the Roman Empire during the Imperial Era—the notions of Britain as the heir to Rome's Empire and of Rome as a provider of lessons to Britain—affected imperial policy as well as Roman history and archaeology. Similarly, the history of Empire, both Roman and British, may influence the actions of the United States—perhaps the current bearer of the “imperial torch”—in the years to come.

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Manu Lakkur is a senior/co-term majoring in Electrical Engineering. Curious about the classical world, he used his grant from the Stanford University President Scholar program to visit Roman ruins in Italy last year. This paper was written while studying abroad at Oxford—many of the sources were rare books maintained by the Bodelian Library at Rhodes House. When he is not thinking about Ancient Rome, Manu enjoys skiing, tennis, and good conversations. He served as co-Editor-in-Chief of *Stanford Scientific* from 2005 to 2006.

Mechanical Engineering

Mechanical Properties of the Human Stratum Corneum: Hydration Effects on Graded Delamination of Human Stratum Corneum

The stratum corneum (SC) is the outermost layer of the skin. Its process of renewal is regulated by various mechanisms, including chemical and structural gradients through the SC thickness. In this study, an in vitro mechanics approach for studying the delamination behavior of SC in the direction perpendicular to the skin surface is applied to study the through-thickness mechanical properties of human SC. The effects of elevated tissue hydration are examined through tests performed on specimens either equilibrated and tested at high hydration or placed in a high relative humidity environment. Initial delamination values for both are lower than for an untreated control, while the delamination energies of subsequent SC layers are in fact higher than for the untreated control.

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Human stratum corneum (SC), the outermost layer of the skin, performs a critical barrier function and protects the human body against a variety of physical and environmental insults.^{1,2} The stratum corneum is composed of layers of keratinized disc-shaped cells, or corneocytes, surrounded by lipid lamellae and further bound together by degraded desmosomal protein junctions called corneosomes. In the direction perpendicular to the skin surface, the SC possesses graded mechanical properties that facilitate the normal shedding of outer SC cells, a process known as desquamation.^{3,4,5} In addition, hydration, pH, and corneosome density gradients are present through the SC layers. For example, the number of corneosome linkages per stratum corneum cell decreases as one moves towards the outer SC surface.^{4,12,13} These gradients help regulate proper desquamation. Studying the out-of-plane mechanical properties of the SC

has important consequences for various skin technologies, including the moisturization and cleansing industries. Medical applications include understanding disease states such as xerosis, or 'dry skin,' in which normal desquamation is disrupted, and facilitating the development of transdermal drug delivery systems that adhere to the SC.^{1,2,3}

A novel in vitro fracture mechanics approach to quantify the effects of temperature, humidity, and chemical treatment on the intercellular delamination energy of isolated SC has been developed previously by Wu et al.⁶ The delamination energy, G , also known as the strain energy release rate, is defined as the energy per unit area required to propagate a crack through a material with units J/m^2 .⁶ In this work, the approach is applied to progressively delaminate the SC to study the effects of increased hydration on graded mechanical SC properties. The stratum corneum readily absorbs water, which affects its

microstructure and causes cellular swelling.⁵ The effects of hydration conditioning on delamination energy are explored. One sample of SC is placed in a high humidity environment for 10 days, then re-equilibrated to nominal ambient conditions before testing. The other sample is equilibrated and tested at high humidity. For comparison, the delamination values for these specimens are compared to those for an untreated control equilibrated and tested at ambient conditions.

Materials and Methods

Tissue preparation

Human cadaver SC tissue is isolated from full thickness cadaver skin from the thigh (Caucasian, female, age 101). The stratum corneum is separated from underlying epidermis with a trypsin enzymatic digest, placed on filter paper to dry, and stored at ambient conditions ($\sim 25^\circ\text{C}$, 45% RH).

Two sets of high humidity condi-

tioned SC are prepared for progressive delamination. One tissue sample $\sim 40 \times 50 \text{ mm}^2$ is placed on filter paper for 10 days in a closed container maintained at 100% RH, and then equilibrated over a potassium carbonate saturated salt solution for one month ($\sim 53\%$ RH). The test specimen made from this set is tested in ambient conditions, nominally 25°C , 45% RH. A second tissue sample $\sim 40 \times 50 \text{ mm}^2$ is placed on filter paper for 60 h in a closed container at 100% RH. A test specimen is made immediately after treatment. This specimen is tested at 25°C , 93.5% RH in an environmental chamber (Model ZH-16-2-H/WC, Cincinnati Sub-Zero, Cincinnati, Ohio). One set of untreated control SC is prepared for progressive delamination by equilibrating in ambient conditions ($\sim 25^\circ\text{C}$, 45% RH). The specimen made from this set is tested in ambient conditions, nominally 25°C , 45% RH. Tissue thickness is estimated to be between 18 - 20 layers.⁴ Untreated control SC thickness is between 17 - 21 mm, as measured using a micrometer in ambient conditions.

Double cantilever beam (DCB) sample construction and testing

Double cantilever beam (DCB) specimens are fabricated by sandwiching SC between two polycarbonate substrates with dimensions $\sim 2.88 \times 10 \times 40 \text{ mm}^3$ (Fig. 1). A thin layer of cyanoacrylate adhesive (Instant Crazy Glue Gel, Elmer's Products Inc., Columbus, Ohio) is used to firmly attach the SC along the entire side of one substrate, and within 3 mm of the end of the other substrate. Moisture in the SC tissue initiates polymerization of the cyanoacrylate adhesive; this limits the presence of adhesive to the exterior surface of the SC.⁶ Excessive adhesive is removed with a scalpel, and loading tabs are adhered to the specimen for attachment to the test apparatus. Specimens are allowed to dry for at least 3 hours prior to testing in a computer-controlled, custom-built tensile/compressive testing machine. Displacements are actuated by a DC servo-electric actuator, and loads are measured by a 222 N load cell. Tests are run at a displacement rate of 5 microns/sec. For com-

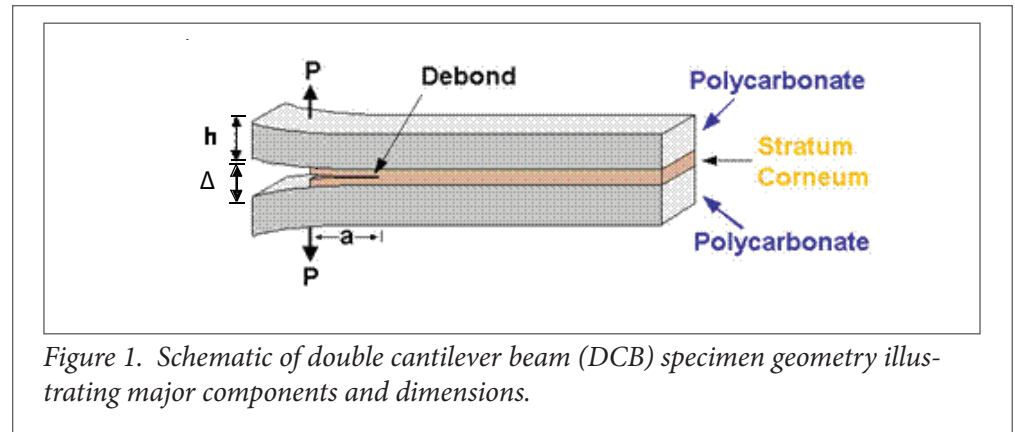


Figure 1. Schematic of double cantilever beam (DCB) specimen geometry illustrating major components and dimensions.

pliance curve measurements, the displacement rate is increased to 10 microns/sec. Specimen dimensions, load-displacement and compliance data are used to calculate crack length (a) and delamination energy (G) according to the following equations.⁷

$$C = \frac{\Delta}{P} = \frac{2a^3}{3EI} \left(1 + 1.92 \frac{h}{a}\right) \quad (1)$$

$$a = \left(\frac{C8Ebh^3}{3}\right)^{\frac{1}{3}} - 0.64h \quad (2)$$

$$G = \frac{12P^2 a^2}{B^2 E h^3} \left(1 + 0.64 \frac{h}{a}\right)^2 \quad (3)$$

where the moment of inertia $I = bh^3/12$, $\Delta/2$ is half of the imposed beam-opening displacement between the two substrates, P is the load, C is the specimen compliance (defined as the quotient of the imposed beam-opening displacement divided by the load), b is the width of the polycarbonate substrate, h is the thickness, a is the crack length, and E is the Young's modulus of the substrate. Nominally, $E = 2.379 \text{ GPa}$ for polycarbonate at 25°C .⁶ G is the delamination energy measured with units J/m^2 . Knowing the crack length (via specimen compliance, Eq. 1) and load at which the crack begins to propagate, the critical delamination energy value (G_c) which quantifies specimen resistance to debond propagation can be determined (Eq. 3).

Progressive delamination tests are an extension of the critical delamination

method described by Wu et al.⁶ Critical delamination energy tests yield G_c values for full-thickness SC. In progressive delamination, a series of critical tests are run on a single SC specimen (Fig. 2). A DCB sample is constructed and delaminated in the first round of testing. Each half of this sample becomes a substrate with SC already bonded to its surface. Additional beams are adhered to these substrates to form two new DCB samples that are subsequently delaminated in a second round of testing. The same two sample halves from the initial delamination are then used to make the next round of samples. Each subsequent round of delamination removes approximately 1-2 layers from the SC attached to the initial substrates. After the second or third delamination on the substrate adhered to the outer SC surface, there are no longer any more SC layers to remove; delamination then occurs by breaking apart individual SC cells. Scanning electron microscopy (SEM) has confirmed that the initial fracture pathway occurs along intercellular interfaces (Wu KS, Dauskardt RH, unpublished results, Stanford University, 2004). For untreated control SC this interface, at which resistance to debond propagation is lowest, lies in the outer layers of the SC.

Results

Progressive Delamination of Untreated Control SC

A progressive delamination test of untreated control SC is performed in ambient conditions. Outer layer delamination energies reach values above $\sim 50 \text{ J/m}^2$ by

the second round of delamination. Inner layer delamination energies demonstrate a gradual increase as successive layers are removed, and are comparable to outer layer values by the sixth delamination (Fig. 3). Measured delamination energies are presented as mean \pm standard deviation. This data demonstrates that SC mechanical properties are graded in the direction perpendicular to the skin surface.

Effect of High Humidity on SC Progressive Delamination

Progressive delamination tests of both the 10-day soak 100% RH (Fig. 4) and 60 h 100% RH conditioned SC are run (Fig. 5). Progressive delamination results of untreated control SC are plotted for comparison. Initial delamination energies are lower for SC exposed to high humidity conditions versus untreated control (Table 1). Measured delamination energies are presented as mean \pm standard deviation.

However, both sets of tests reveal higher delamination energies at each delamination compared to untreated control SC (Figs. 4,5). These increased values at each delamination suggest that hydration either affects the cohesion of SC or mechanism of delamination. These additional contributions to the delamination energies would lead to the elevated values observed compared to untreated specimens at comparable delamination numbers.

Discussion

Effects of Graded Mechanical Properties on Delamination Energies

Studies have identified corneosomes as central to the cohesive properties of the SC. The density of these protein linkages decreases from the inner to outer SC. The degradation of these protein linkages that produces this structural gradient is a key step in healthy desquamation.^{3,4,11,12,13,14} Our progressive delamination test of untreated control SC further corroborates the role of corneosome density gradient in healthy SC renewal. Delamination values for the inner layer of untreated control SC increase as successive layers are removed in each delamination round (Fig. 3). We observe that higher delamination energies

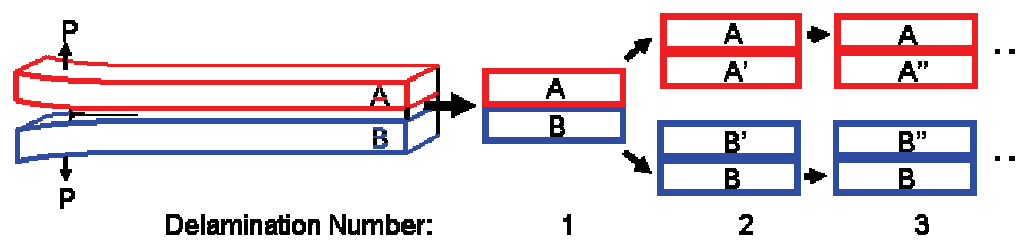
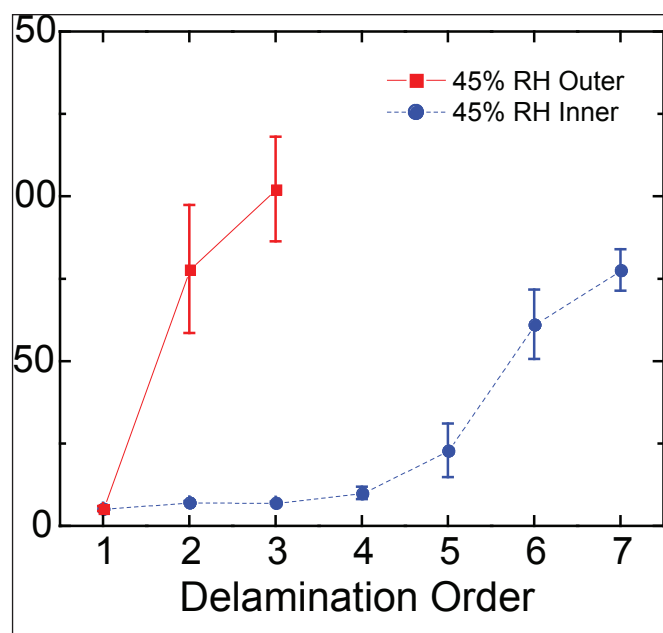


Figure 2 (above). Schematic of progressive delamination test method in which the initial substrates (A,B) are adhered to new substrates (A',B' etc.) to facilitate delamination energy measurements through the tissue thickness.

Figure 3 (left). Progressive delamination of untreated control SC. Stratum corneum equilibrated to ambient conditions (25°C 45% RH) prior to delamination testing. Tested at 25°C 45% RH. Delamination energy (J/m²) plotted versus the round of testing; mean \pm standard deviation.



are required to propagate debonds through SC layers with higher corneosome density; this trend in delamination energy correlates with the distribution of corneosomes in healthy SC. Our data supports a role for corneosomes in SC cohesion and indicates that progressive delamination is useful for studying the graded properties of the SC.⁴ Furthermore, the delamination energies for the outer layer of untreated control SC quickly reach non-physiological values by the second round of delamination i.e., higher delamination values than would be expected for the removal of individual layers (Fig. 3). This appears to indicate that the weakest fracture pathway occurs in the upper 1-2 layers of the SC. Scanning electron microscopy (SEM) images confirm that in subsequent delaminations the fracture pathway no longer occurs between layers of cells, but by tearing apart SC cells (Wu KS, Dauskardt RH, unpublished results, Stanford University, 2004). This de-

lamination energy gradient is indicative of the shedding of the upper layers of SC cells by mechanical perturbation during normal desquamation.^{11,12}

Additional components of SC microstructure also contribute to these delamination energies. Intercellular SC lipid lamellae as well as the SC cell walls, or corneocyte envelopes, have been shown to play roles in the cohesion of SC.^{4,10,13} The SC lipid lamellae is a highly ordered layer of lipids that fills the extracellular space and separates SC cells.^{3,4} In the “bricks and mortar” model of SC cohesion, the lipid lamellae is assigned the role of cohesively binding together SC cells.^{6,13} Chapman et al have demonstrated that the lipid lamellae may have a minor cohesive role, but more often works as a “spacer” between cells that prevents SC cell envelopes from interacting strongly.^{4,13} Stratum corneum cell envelopes define the cell boundary and are highly cross-linked protein

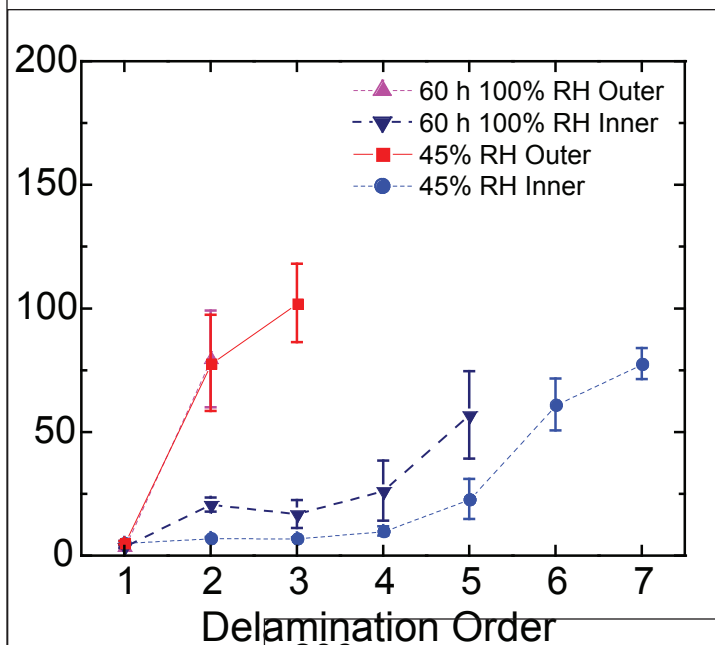


Figure 4. Progressive delamination of 10-day soak 100% RH SC equilibrated to ~53% RH prior to testing. Tested at 25°C 45% RH. Untreated control equilibrated and tested at 25°C 45% RH. Delamination energy (J/m²) plotted versus the round of testing; mean \pm standard deviation.

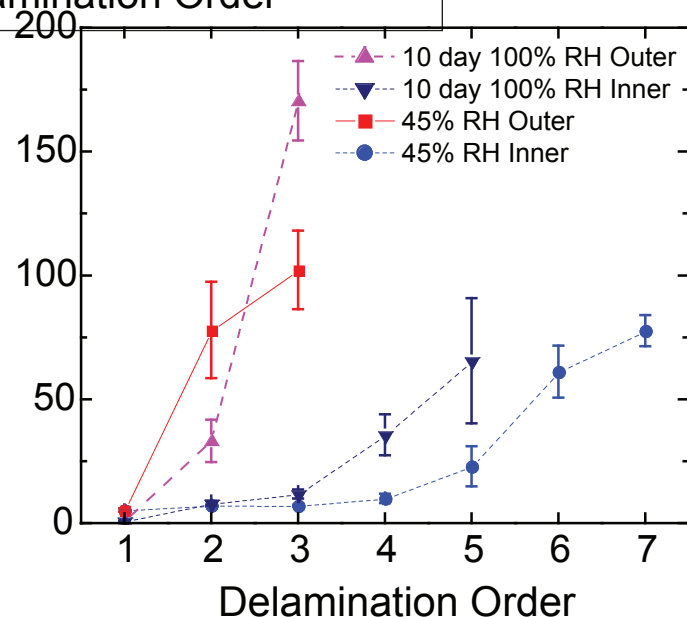
some density following a 7-day incubation of porcine SC at 80% RH.¹² Furthermore, a desquamatory hydrolase, stratum corneum chymotryptic enzyme (SCCE), has been shown to be modulated by the water content in SC. Water was found to be the rate limiting factor in corneosome degradation by SCCE in the upper layers of the SC.¹⁴ However, progressive delamination of SC equilibrated for 10 days at 100% RH then re-equilibrated to ~53% RH suggests that hydration affects SC microstructure beyond just corneosomes degradation (Fig. 4). A significant decrease in initial delamination energy for this hydrated sample is observed compared to the untreated control; this may be attributed to corneosome degradation (Table 1). But as discussed previously, the manner in which cohesive contributions of SC cell envelopes and lipid lamellae might be perturbed by changes in hydration is unclear. These results, similar to those observed by Wu et al, may instead support the pooling of intercellular water that could contribute to separation of SC cell envelopes and decreased cohesion.^{5,6} There are also conflicting reports on whether high water content results in lipid lamellae disordering and a subsequent decrease in cellular cohesion.^{5,8}

We observe a similar decrease in the initial delamination energy for 60 h 100% RH SC as compared to the untreated controls (Table 1). This initial delamination energy appears to be higher compared to the value for 10-day soak SC. However, it is unclear whether this is a result of a shortened 60 h exposure to high humidity. Further work needs to be done better understand the differences between these two treatments. As discussed in the next section, progressive delamination testing in high humidity may also include contributions from changes in energy dissipation mechanisms.

Humidity Effects on Progressive Delamination

Considering the major cohesive role of the corneosome gradient in untreated

Figure 5. Progressive delamination of 60 h 100% RH SC. Tested at 25°C 93.5% RH. Untreated control equilibrated and tested at 25°C 45% RH. Delamination energy (J/m²) plotted versus the round of testing; mean \pm standard deviation.



structures with a strongly bound outer lipid monolayer.^{3,4,10} Corneosomes rigidly link SC cells together via attachment to these envelopes.¹⁴ The lipid monolayers of these SC cell envelopes fuse together if the lipid lamellae is disrupted or extracted by chemical treatment. This greatly increases SC cohesion. However, in healthy SC these envelopes do not interact closely and appear to play only a small cohesive role.^{4,10} There is much evidence in support of the corneosome protein junction as a major, if not dominant, component of SC microstructure responsible for healthy, un-

treated SC cohesion.^{3,4,11,13,14} Nevertheless structural and biochemical gradients do exist for both SC cell envelopes and lipid lamellae.³ The cohesive roles these gradients might play and the effects of temperature, humidity, and chemical treatment are explored below.

Humidity Effects on Initial Delamination Values

Hydration of SC has been shown to play an important role in corneosome degradation.^{8,12} Rawlings et al demonstrated significant decreases in corneo-

control SC, the accelerating effects of hydration on corneosome degradation would suggest a general decrease in delamination energies as compared to untreated control SC for similar delamination numbers. However, we observe an apparent increase in delamination energies compared to untreated SC for similar delamination numbers (Fig. 4). This trend is even more pronounced for data from the progressive delamination of 60 h 100% RH SC tested at 93.5% RH (Fig. 5). Corneosome degradation cannot explain this increase in inner layer delamination energies for hydrated SC versus untreated (Figs. 4,5). These data suggest changes in delamination mechanism or additional complexity in the SC microstructure.

One mechanism that might lead to increased delamination energy measurements is related to the softening of the SC with increased hydration. This softening would be an additional mechanism for energy dissipation and contribute to the apparent increase in delamination energies as compared to untreated control SC for similar delamination numbers (Fig. 5). Previous investigators have shown that water reduces the failure stress and increases the

failure strain of SC in the direction parallel to SC layers.^{1,2} Furthermore, a decrease in SC water content results in brittleness, perceived as a loss of skin "softness".³ The progressive delamination tests of 60 h 100% RH SC tested at 93.5% RH seem to support this alternative energy dissipation mechanism. However, Wu et al have previously suggested that such deformation is unlikely to be the dominant means of energy dissipation because the amount of material available for deformation decreases with each delamination round, reducing the material available to deform and dissipate energy.⁶ On the other hand, the thickness of SC cells have been measured to swell from ~0.5 microns at ambient conditions to as much as ~3 microns at 100% RH.⁵ This increase in thickness coupled with SC softening might enable additional dissipation mechanisms in the SC structure due to the interaction of water with cellular components. This would lead to the higher delamination energies observed for 60 h 100% RH SC conditioned specimens compared to untreated SC beyond the initial delamination (Fig. 5).

Conclusions

An effective means to study the graded mechanical properties of SC has been introduced using a modified test method to examine the delamination energy of the SC. In this study, we observed the complex effects of hydration on SC cohesion and attempted to illuminate the affected components of SC microstructure. High humidity is observed to decrease initial delamination energy of SC compared to untreated SC, while subsequent delamination energies are increased compare to control SC, possibly attributed to changes in graded structural properties and contributions from increased cell softening. Further examination is necessary to understand the counterintuitive decrease then increase in delamination energies of hydrated specimens when compared to untreated controls.

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Humanities

Polyphonic Tides of Revolution: The Futurist Nocturne as a Modernized Portrait

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Interdisciplinary Studies in the Humanities

*At first glance, the night scenes in the Futurist paintings *Streetlight: A Study in Light*, by Giacomo Balla, and *Forces of the Street*, by Umberto Boccioni, seem to have little relation to James Whistler's *Nocturne: Grey and Gold*. Yet although the Futurists created their night scenes some 30 years later than Whistler, when we consider the Futurist night scenes as a response to the late 19th century nocturnes of Whistler, we can see the ways in which their creations departed from but also modernized the form of the nocturne in painting. In my paper, I will explore how the Futurist paintings of Balla and Boccioni embody the ideals advocated by the writings of the Futurist movement, which embraced violent progress through mechanization and destruction.*

At first glance, the night scenes in the Futurist paintings *Streetlight: A Study in Light*, by Giacomo Balla, and *Forces of the Street*, by Umberto Boccioni, seem to have little relation to James Whistler's *Nocturne: Grey and Gold*¹. Yet although the Futurists created their night scenes some 30 years after Whistler did, when we consider the Futurist night scenes as a response to the late 19th century nocturnes, we can see the ways in which their creations departed from but also modernized the form of the nocturne in painting. Whistler painted his compositions by blending of "tones" of color, writing, "the same colour ought to appear in the picture continually here and there, in the same way that a thread appears in embroidery... in this way, the whole will form a harmony."² Balla and

Boccioni, by contrast, seem to be struggling against just that sort of harmony in their attempts to capture fleeting movement and frenetic energy on the canvas. "The Technical Manifesto of Futurist Painting" states, "The gesture which we would reproduce on canvas shall no longer be a fixed moment in universal dynamism. It shall simply be the dynamic sensation itself."³ Using this philosophy, Balla and Boccioni depart from Whistler's night scenes through a modernized "Futurist Nocturne," one that embraces the new facets of the modern city like machines, buildings, and most importantly, electricity.

The new "Futurist Nocturnes" engage in dialogue with Whistler's Nocturnes, by modernizing both the subject and the vocabulary of such pieces as *Nocturne: Grey and Gold*. In the content of their paintings, Balla and Boccioni choose to focus

their attention and admiration on electric lights at night, making light itself the subject of the piece, instead of simply the lingering details in the background of *Nocturne: Grey and Gold*. They also redefine the vocabulary of description in painting: Balla with his fragmented precision borne out of his Divisionist past, and Boccioni with the influences of Cubism and Expressionism. However, both paintings are ultimately Futurist in their modern subject, in their violent glorification of the machine, and in their depiction of light as an active force that takes on anthropomorphic, even humanistic qualities. The Futurists embraced a comparison of painting to analogous sounds, evoked by both visual and musical energy in their paintings, as did Whistler with calm tones of the Nocturnes. Yet if his Nocturnes are comparable to the compositions of Chopin, then Balla and Boccioni's paintings evoke the violent, unpredictable and cacophonous noise of the modern city. Despite the dismissal of Romanticism implicit in the Futurist Manifestos, in Balla and Boccioni's

1. Color representations of *Streetlight*, *Forces of the Street*, and *Nocturne: Grey and Gold* are attached in Appendices A, B, & C, respectively.

2. Whistler's words, as quoted by Sutton, Denys. *Nocturne: the art of James McNeill Whistler*. Philadelphia: J.B. Lippincott Co.,

1964. p.64.

3. Boccioni, Carrà, Russolo, Balla, Severini. "Technical Manifesto of Futurist Painting." *Futurist Manifestos*. Ed. Umbro Apollonio. New York: Viking Press. 1970. p.27.

paintings, a new kind of glorious idealism emerges in their representations of electric lights: an idealism and reverence for the spirit of Futurism, and a celebration of the Futurists and their founder, Filippo Marinetti.

Kill the Moonlight⁴

“It differs from his early representations of a street light or illuminated lamp—where the lamp and its radiating light are but one component of the urban setting. In this composition, the artist brings his subject up to the surface, filling the canvas with it, obliterating all sense of locale, of spatial depth, and drowning the pale crescent of the moon in the vibrating pattern of light.”

-- Susan Barnes Robinson⁵

Balla's *Streetlight: Study of Light* depicts an explicit assertion of the modern superiority of electricity over the natural light of the moon. Balla fills his canvas with layered fragmented brushstrokes radiating from the electric streetlamp, leaving the moon only a small corner of the background in the upper right corner. The moon, as an icon of Romanticism in both art and literature, seems to represent the stagnant old traditions that Balla is trying to break away from. Susan Barnes Robinson explains that the streetlight itself was not a new subject, but that “bring[ing] his subject up to the surface,” and “obliterating all sense of locale” created a new perspective on the subject when isolated from the rest of the city street scene. In this painting, we can see Balla evoking the images that Marinetti coined in the “Founding Manifesto of Futurism,” particularly those of the first powerful sentence: “We had stayed up all night, my friends and I, under hanging mosque lamps with domes of filigreed brass, domes starred like our spirits, shining like them with the prisoned radiance of electric hearts.” This alludes to the other aspect of dynamism that Balla captures: the anthropomorphic comparison of light to the essence of the human spirit, emphasizing the radiation

of energy and the dynamic movement of light itself as an intangible form with great force and effect, despite a lack of physical substance. Marinetti used the shapes of the lamps, “starred like our spirits,” to imagine a shape for the emerging spirit of Futurism, projecting the violence of Futurist emotions into a lamp. The street lamps then, for Marinetti but perhaps also for Balla, become “electric hearts”⁶ with the power of the human spirit and none of the weakness of its sentimentalism.

The Streetlight first divides light into tiny piercing components, which then re-emerge as a forceful whole, radiating outwards from the deep yellow shining center, starred like Marinetti's description, and pulsing with movement. This movement is created by the use of many v-shaped strokes that are separated just enough to evoke fast, shooting, violent movement. The strokes fling outward from the center, as Balla attempts to codify a quality of the movement of light, in different saturations of yellow, orange and red applied in layers, with small spaces in between, our eye chasing one brushstroke to the next. The overlapping of different colors, moving between the warm reds and oranges into the darker greens and blues of the background, creates a separation of the particles, creating an effect not of harmony but of a staccato-like punctuated change. If Whistler's wide strokes and washes could be compared to a few long, sweet tones, then Balla's would be a fast snare drum roll, increasing in speed and intensity as the brushstrokes move outward. The synthesis in the mind of the viewer completes the tension between stasis and dynamism, since the brushstrokes radiate diagonally, but are patterned in circular formations, creating concentric rings of light constituted by the small pointed fragments of diagonal movement.

The shape of the lamppost itself, and the metal enclosure for the yellow glass bulb, is created not by the addition of paint, but by the absence of yellows and

oranges delineating light, and is instead represented by a negative space filled with the reds, blues and greens that create the background and separate the brushstrokes of light. Another notable absence is that of the radiating light of the moon, which while colored a pale yellow similar to the center of the streetlight, does not radiate fragmented beams of light at all. The pictorial domination of the streetlight over the moon is further signified by the overlap of the streetlight's diagonal rays over and into the yellow crescent of the moon, which literally obscure the moon with the more immediate, more exciting, and more modern movement of light.

In the upper left hand corner, there is a date: AN. 1909, which has been speculated not to have been the actual date of painting but the commemoration of the creation of Futurism⁷, honoring Marinetti's manifesto, and the effect of his energizing words. This sort of celebratory purpose for the painting implies that perhaps Balla did explicitly intend to make his *Streetlight* a portrait of the modern technology, or even a portrait of the Futurist spirit in a broader sense. When we examine some of his earlier preceding sketches for *Streetlight*, the larger oval shape of the lamp becomes very portrait-like, alluding to the shape of a face. In this way, Balla may be painting *Streetlight* to depict the new face of the spirit of Italian art. But he was a very precise painter who enjoyed Divisionism because of its stark purity and gesture towards scientific accuracy. I would rather suggest that instead of gesturing towards the entire spirit of the young Futurists, Balla painted in *Streetlight* a metaphorical portrait of Marinetti himself, borrowing inspiration from his words in the Founding Manifesto: “we will sing of the vibrant nightly fervor of arsenals and shipyard blazing with violent electric moons.”⁸ In this interpretation, the light itself takes on human properties, and the radiating of light can be understood as bringing both a sense of enlightenment and a violent challenge to the darkened, empty sky. In this way, Balla may be gesturing to the ways in

4. This quotation alludes to Filippo Marinetti's manifesto of the same title, 1909-1910.

5. Robinson, Susan Barnes. *Giacomo Balla, Divisionism and Futurism, 1871-1912*. Ann Arbor, Michigan: UMI Research Press, 1981. p.83.

6. Marinetti, Filippo. “The Founding and Manifesto of Futurism.” *Selected Writings*. New York: Farrar, Straus and Giroux, 1971. p.39.

7. Robinson, p.85.

8. Marinetti, p.42.

which Marinetti cast a bright light over an otherwise stagnated and desolate artistic milieu of Italy mired in the past, represented by the moon.

“Movement and light destroy the materiality of bodies”⁹

“Space no longer exists: the street pavement, soaked by rain beneath the glare of electric lamps, becomes immensely deep and gapes to the very center of the earth. Thousands of miles divide us from the sun; yet the house in front of us fits into the solar disk. / Who can still believe in the opacity of bodies, since our sharpened and multiplied sensitiveness has already penetrated the obscure manifestations of the medium?” -- Boccioni et al.¹⁰

Boccioni's *Forces of the Street* contrasts more directly with Whistler's *Nocturne: Grey and Gold*, since both depict a street scene, one or more people, buildings, and lights. But instead of using Whistler's “wash” effect, tying all aspects of the composition together, Boccioni rips them apart, using dark colors in stark contrast with one another, purples battling greens as voids of black and shadow crop up between them. Boccioni portrays the light shining from above as an active force of movement and destruction, and the people on the streets become flattened shadows and silhouettes, melting over the jagged edges and falling into the crevices and canyons created by the shadows, or perhaps, by the force of the lights themselves. We can imagine that the “Technical Manifesto of Futurist Painting” (in part written by Boccioni) may have been directly influential in the conceptualization of this painting, especially the line stating, “the street pavement, soaked by rain beneath the glare of electric lamps, becomes immensely deep, and gapes to the very center of the earth.” In this description, ideals of Futurism suggest a way to reconceptualize the way the reality is constructed, moving agency from men to the “forces” of the street scene. Unlike Whistler's street, which provides a stable

9. This quotation alludes to Boccioni et al. in the “Technical Manifesto of Futurist Painting,” p.30.

10. Boccioni et al., p.28.

and soothing background to the lone pedestrian, Boccioni's world of the streets is dangerous and unpredictable. The electric light cuts through the flimsy people, decimates the streets and leaves gaping holes, illuminating the world in a chaotic, even apocalyptic vision of modernity. Interesting, however, is that although the diagonal interlocking beams of light evokes destruction, it seems to simultaneously invoke the image of a divine light, alluding to Catholic imagery.

Examining the beams of light themselves, their source is not explicitly stated, but we imagine them to be electric streetlights shining down from either side of the street. Each beam of light starts as bright yellow-white, seemingly pure and unadulterated energy, but as it approaches the ground, it takes on the blue of the night and the texture of worldly reality, before it continues its trajectory into the ground, leaving behind the new climate of the modern city. In this way, light becomes simultaneously portrayed as a creation force— like the Catholic imagery of a divine light coming from above to usher in a new, rejuvenating potential for growth— and also a force of destruction, creating black gaping holes even as it provides inspiration. I would like to suggest that the tension in this work, then, reflects the tension between the creative and destructive impulses within the movement of Futurism itself, intent on progress and creation through destruction. Boccioni glorifies the intensity of the streetlights to suggest that the new godlike force in the modern world is electricity.

The black outlines in *Forces of the Street* depict an ephemeral sort of motion in the movement of the people in the picture, as shadowed pedestrians trudge toward the back of the painting and a suggestion of two bicycle wheels near the center seems to reveal the traces of motion already past. The buildings that should border the street as a frame of reference and stability have instead collapsed into overlapping planes and darkened voids, while the green and purple shapes to the left of the streetlights seem to be buildings in the process of collapse. The overlapping planes— colored

in liberal mixes of colors that tend purple, pink or green depending on their exposure to light— present a rocky landscape, uncertain and unstable, and it is unclear whether the jagged shapes are separated by distance, height, or merely time. Perhaps this painting depicts a small area of space expressed temporally over the course of a night.

Boccioni wrote in the catalogue for a Futurist show in Paris, which included this painting, that in Futurist works, that one could find:

... spots, lines, and areas of color that do not correspond to any reality, but, according to the law of our inner mathematics, musically prepare and increase the emotion of the spectator... We are destroying everyday, in ourselves and in our paintings, the realistic forms and obvious details that still serve to establish a bridge of intelligence between ourselves and the public.¹¹

In destroying “the realistic forms and obvious details,” Boccioni is dispensing with the usual traffic of the street travelers in favor of focusing on the effect of the electric lights on the passive atmosphere. The shadowy figures could be the people of the past, whether that past is a few minutes or a few decades. The electric light, however, is a force of the present, cutting through the specters of the past and the banalities of the everyday, in favor of a Futurist, mechanized spirit represented by the beams of a new sort of holy light.

The presence of the crossing of the beams also creates a sort of archway of light, which may again refer back to a religious image of a churchlike structure. Inside the lit archway could be a haven for those who embrace the spirit of the Futurists, and Boccioni, like Balla, may be offering his reverence for the new innovations of the modern city, to those who have inspired his appreciation, and even the ability to see the lights as they are in his painting, as opposed to the shadowy figures who seem to continue on their way, oblivious. In the “Technical Manifesto of Futurist Painting,” Boccioni et al. state, “The construction of pictures has hitherto been foolishly tradi-

11. Coen, Ester. *Boccioni*. New York: Metropolitan Museum of Art. Dist. By H.N. Abrams, 1988. p.134.

tional. Painters have shown us the objects and the people placed before us. We shall henceforward put the spectator in the center of the picture.”¹² In Boccioni’s world of *Forces of the Street*, the viewer is attracted first to the powerful streetlights, and thus escapes the fate of the “realistic forms” in favor of seeing the divine vision of the Futurists. Even the title, “Forces” of the street, suggests that what is depicted here is not reality and its “obvious details,” but instead a sort of hyper-reality, or the perceptual effect of living as a Futurist.

“We will sing of the multicolored, polyphonic tides of revolution in the modern capitals”¹³

“Nature contains the elements of color and form of all pictures—as the keyboard contains the notes of all music-- / but the artist is born to pick, and choose, and group with science, these elements, that the result may be beautiful—as the musician gathers his notes, and forms his chords, until he brings forth from chaos, glorious harmony—” -- James McNeill Whistler¹⁴

“Our renovated consciousness does not permit us to look upon man as the center of universal life. The suffering of a man is of the same interest to us as the suffering of an electric lamp, which, with spasmodic starts, shrieks out the most heartrending expressions of color” -- Umberto Boccioni et al.¹⁵

Whistler’s new artistic language of musical vocabulary was challenged, though perhaps not annihilated, by the Futurists. He described his use of color in terms of

12. Boccioni et al., p.28.

13. Marinetti, p.42.

14. Whistler, James McNeill. “Ten o’clock.” [A publication of his lecture] Boston: Houghton Mifflin. 1888. p.14.

15. Boccioni et al., p.29.

tones and harmonies, and created a base color that would permeate the whole piece, that he called the ‘sauce,’ since:

The liquid color was washed on to the composition and Whistler would lighten or darken the tone, as needs be, while working. In many Nocturnes, the entire expanse of the sky or the water, as may be seen even in reproduction, is rendered with great sweeps of the brush, and in exactly the right tone.¹⁶

Balla and Boccioni revolutionized this approach first in the desire to portray directly the nature of light as an active subject, instead of as an implicit atmospheric element, as Whistler had portrayed light subtly in his Nocturnes. And in the desire to show “the dynamic sensation itself,” they revolutionized the image of a city at night with fragmented brushstrokes, with the introduction of explicit movement to their pieces, and with an emphasis on the tension between excitement and danger in the modern atmosphere of their creations. As the cities themselves had changed much since Whistler’s time, the perspective through which Balla and Boccioni viewed their subjects differed greatly from Whistler’s.

Their final goal was also a different one, one that expanded beyond the representation of reality. At the time of the paintings’ creation, Balla was an older man feeling the stirrings of Futurism as a refreshing change. In *Streetlight*, he departs just far enough from his Divisionist background to portray an icon of Futurism, and in doing so, depicts a portrait of the Futurists themselves, and in particular of Marinetti, the torch-bearing leader of the artistic movement. Boccioni, on the other hand, had just returned from a visit to Paris when he painted *Forces of the Street*, and

16. Sutton, p.67.

his approach to the painting refers to the Cubism he has seen, but answers it in the dynamic, violent, expressionistic style he embodied. He not only represents accurate movement, like Balla did, but reflects personally on the experience of viewing a city street through the eyes of a Futurist, who emulates the dynamism of the shafts of light that cut through the infrastructure of the aesthetic and cultural world around him.

If we look at *Forces of the Street* in an autobiographical manner, we can see Boccioni’s complex emotional struggle to find a place for himself in the divinity of the new aesthetic experience, a world of active beams of light and passive figures. To illuminate the concept of his own role to play in the movement, I would like to point to the two lower beams of light at the center and bottom of the page, which I would like to consider as two headlights of a car. In an earlier sketch of *Forces of the Street*, the lower beams of light seem to be coming from a car, and there is a figure that seems to be driving. I would like to suggest that this figure is Boccioni, and that in the final painting, he removes the representation of the driver, because the entire painting can be considered his own self-portrait of himself in the driver’s seat. He steers the viewer into a world that holds cacophony and danger, but that can also move you, as it has moved him, in the glorious destruction of the old and the emergence of new hope in the shafts of light. Historically, however, this enrapture with the violent mechanization of modernity led to his early death as a soldier in World War I, and so when we view his painting now, we can also see him as one of the darkened silhouettes, ascending the overlapping planes, approaching the light head on.

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On the Nepali Question: Buddhism's Role in Framing the Bhutanese Constitution

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Religious Studies, Drama

The Kingdom of Bhutan has created an international buzz with its rejection of Gross Domestic Product (GDP) and subsequent adoption of Gross National Happiness (GNH) as the means by which to measure the country's "development." The policy challenges the powerful force of global capitalism and serves as a revolutionary way in which to consider the economy of microstates; rather than viewing "development" as an end in itself, GNH tries to orient the country's economy toward higher ends. The entire GNH project rests, importantly, on the distinctly Buddhist mental culture and values of Bhutan. Currently, Bhutan is drafting its first constitution, in which GNH precepts are to be codified. This paper will consider GNH from the perspective of ethnic pluralism, and argues for a greater emphasis on the Buddhist ethical foundation of the Bhutanese constitution, while arguing that explicitly Bhutanese-Buddhist cultural elements of the constitution should be more broadly construed to ensure the inclusion of the Nepalese and other minority groups in the political and cultural life of Bhutan.

Given that any constitution is inherently an ideological text, the unavoidable consequence of framing a constitution is that whatever ideology the constitution is based upon becomes the point of agreement between all the constituents of the state upon ratification. While the idea of building a constitution on a "religious" ideology may seem inconsistent with modern, secular notions about the nature of democracy or the proper role for religion in the state, in actuality, no state is free from an ideological position that runs the risk of excluding members of its state that hold close a conflicting ideology. Labeling an ideology "religious" because of the scriptural, cultural, or historical origins of its precepts does not change this basic tension. For example, article I, section xiii of the U.S. constitution, granting congress the right to lay and collect taxes, might conflict

with one who holds the ideological position of total laissez-faire capitalism. This individual might have voted against ratifying the U.S. constitution, but the reality is that an individual with this ideology may be forced – by birth or by being a minority voter in ratification – either to accept this tension or emigrant. A constitution cannot be a purely pluralistic document from an ideological standpoint.

The Kingdom of Bhutan's new constitution seeks, in part, to solidify the country's commitment to the GNH (Gross National Happiness) ideology – rather than any other strategy or value-set – in its movement toward becoming a modern state. By way of contrast, since the start of the Cold War, both the capitalist West and the Communists clung to very similar strategies in closing the gap between "developed" and "underdeveloped" countries. The underlying ideology was to organize

and concentrate a country's resources on economic *development*, rather than any competing objective.¹ Gross Domestic Product (GDP) or Gross National Product (GNP) emerged as means of measuring economic development. What distinguishes the GNH *Weltanschauung* from the development-for-development's-sake model is its commitment to a different fundamental objective – happiness – and consequently an attitude that development is not necessarily good for its own sake but only insofar as it promotes happiness.

While this idea of Gross National Happiness as a guiding principle in the foundation of a state could be derived from a variety of religious traditions, philosophical schools, or mental cultures, in Bhutan, the implementation of GNH takes a distinctively Buddhist character.

1. Mancall, Mark. *Gross National Happiness and Development: An Essay*, p27.

Thus the Buddhist foundation for the new Bhutanese constitution could, hypothetically, take a variety of forms. The framers could, in theory, draw solely upon the ethical precepts of Mahayana Buddhism, or they could extract only the cultural elements of Bhutanese Buddhism and incorporate these into the document. In reality, however, the distinction between the “cultural” and “ethical” aspects of Bhutanese Buddhism is less pronounced in the life of Bhutanese Buddhists, and this reality is reflected in the current draft of the constitution.

The Buddhist precepts informing GNH are primarily *ethical* ideas about the priorities a state should have with regard to its citizens and their well-being. Creating conditions for the flourishing of culture is certainly an integral part of promoting GNH, but striving to promote happiness in a population (rather than, say, “economic growth” or “development”) does not have to be tied to any particular cultural norms, any specific language, or any ritual practices of Bhutanese Buddhism. It does, however, need to be tied to the primary ethical directives of Mahayana Buddhism (for example, not harming others, or creating the conditions most suitable for reaching enlightenment, i.e. the elimination of the three poisons of greed, hatred, and delusion). In the current draft of the constitution, a cultural privilege is given to the Ngalong and central Bhutanese Buddhists of the country in an effort to promote a national culture, which is clearly a priority of GNH. But the Bhutanese constitution, in its assertion of a ‘nation culture,’ runs the risk of assuming a single, unified Bhutanese heritage.² This in some instances could marginalize other ethnic groups in the country, particularly the Nepalese in the south. Clearly, it is in the interest of Bhutan’s GNH to avoid discriminatory practices and ethnic and cultural tensions, as these conditions can quite directly impede one’s path to enlightenment by fostering hatred and delusion on both sides of ethnic divides.

2. Reinfield, Marti Ann. 2002. *Tourism and the Politics of Cultural Preservation: A Case Study of Bhutan*.

This paper argues for a greater emphasis on the Buddhist ethical foundation of the Bhutanese constitution, while arguing that explicitly Bhutanese-Buddhist cultural elements of the constitution should be more broadly construed to ensure the inclusion of the Nepalese and other minority groups in the political and cultural life of Bhutan.

The promotion of a national culture in Bhutan is certainly essential to the flourishing of its citizens. But this poses a difficult problem for the constitution’s framers, for on the one hand, the document must attempt to include all Bhutanese cultures in the political life of the state in order that GNH is truly concerned with the happiness of *all* of Bhutan’s citizens, while on the other hand, the overwhelming force of the modern, global world continually threatens the existence of Bhutanese culture, and a pluralism too generally delineated could jeopardize the very cultures the state should be trying to protect. I will examine three articles in particular (article 2 on the monarchy, article 3 on spiritual heritage, and article 6 on citizenship) and assess how well each promotes GNH in terms of this problem. I will also determine how consistent they are with other elements of the constitution that demonstrate a sound Buddhist ethical base.

Article 2:

The Institution of Monarchy

The king himself wishes to transition the monarch to more of a figurehead, cultural-fixture type of role with limited or generally unused political power. Why, then, is the monarch granted such unbridled power³ in the constitution? It may be somewhat ironic, but the answer seems to be that the current monarch, as the enlightened proponent of the GNH mentality and the transition to democracy, will much better serve the people of Bhutan

3. For example, in article 2, section 19, the king is given power to appoint – without parliamentary approval – the entire supreme court, among other important offices. Since the supreme court is the sole interpreter and defender of the constitution, the constitution itself could easily be rendered an inadequate protector of the citizens of Bhutan against a corrupt or irresponsible monarch.

than a potentially corrupt, but democratically elected, legislature and executive, who would very likely have their own interests in front of their constituents. The large majority that supports the king legitimates his current and continued authority, but the king recognizes that monarchy is generally a hit or miss endeavor, and that future generations cannot depend on an enlightened monarch to protect their interest, thus the king’s desire for further democratization.

Many Nepalese groups are anti-monarchical. In fact, the ethnic tension between western and central Bhutanese and the southern, ethnically Nepali Bhutanese is to some extent fueled by the government’s repression of these political factions in the south because of their demand for greater democratic representation and the abolition of the monarchy. Groups like the Bhutan People’s Party and the Bhutan National Democratic Party, which are comprised primarily of ethnic Nepalese exiles from Bhutan, have been regarded by the government as “terrorist and anti-national.”⁴

If the current constitution were to write in a procedure for decreasing the king’s political power through democratic means, this would enable the transition away from monarchy to continue beyond the lifetime of the current king and his son. Such a measure – in which parliament would be able to transfer *permanently* certain appointment powers to, for example, the elected executive – would increase the country’s commitment to GNH in two important ways.

First of all, it would demonstrate a greater commitment to democratic reform, which, while not necessarily translating into a higher GNH now, would certainly benefit the people of Bhutan greatly if a future monarch did not uphold the precepts of the constitution and appointed judges who served simply as an extension of his power. Second, the prospective elimination of the monarch as a highly influential political power into a more

4. U.S. Bureau of Democracy, Human Rights, and Labor. 2003. *Bhutan: Country Reports on Human Rights Practices*.

cultural role would also have a positive impact on the ethnic tensions currently present in the country. If Bhutan is truly committed to freedom of political expression, as stated not only in article 7 of the constitution⁵ but also by the very fact that the new constitution is based on a multi-party system,⁶ then it eventually must face the reality of the anti-monarchical political parties of the ethnic Nepalese. If these parties are truly practicing terrorist activities – a claim contested by human rights groups⁷ – then other aspects of the constitution provide the state with the power to defend itself. But if Bhutan takes seriously its commitment to the happiness of *all* its citizens, it must allow the members of the state who do not support the monarchy a legitimate chance to achieve their goal – a goal, by the way, which does not necessarily totally clash with the desires of the king himself. A provision allowing for the king's eventual withdrawal from the political process would help include a potentially marginalized minority in the political life of Bhutan.

As a side point, if it is in the interests of GNH to combat income disparity and concentration of wealth⁸, then the drafting committee should seriously consider section 13 of article 2, in which the royal family is granted continued state annuities, the provision of palaces, and an exemption from taxes. Because the king and his family serve as an important cultural symbol for the Bhutanese people, perhaps this article could be revised to allow for the king to set a positive example as regards concentration of wealth in Bhutan. Is supporting a monarch the best use of the state's coffers, particularly when that state claims to be committed to minimizing inequalities of income and equitable

5. Article 7, section 15: "All persons are equal before the law and are entitled to equal and effective protection of the law and shall not be discriminated against on the grounds of race, sex, language, religion, *politics*, or other status" [my italics].

6. Political parties, as of 2003, were illegal under the law.⁷

7. U.S. Bureau of Democracy, Human Rights, and Labor. 2002. *International Religious Freedom Report*.

8. Article 9, section 7.

distributing of public facilities? The king, as a Buddhist, should serve as an example of, and not as an exception to, this rule. Granted, there certainly exists an argument that supporting and preserving the royal family monetarily is in the interest of GNH because it promotes culture and a longstanding tradition in Bhutan. But the monarch does not need to be exempt from taxation or live in a palace to continue this tradition. The idea of a "palace" is inconsistent with GNH, and, as a symbolic gesture if nothing else, these palaces could be transformed into museums or other publicly used centerpieces of Bhutanese culture to doubly promote GNH (that is, by both promoting culture and eliminating concentrations of wealth). In general, it may be a good idea to incorporate into the constitution provisions that ensure that wealth of Bhutan is not concentrated in its political leaders, who should instead serve as examples of the GNH state's commitment to reduce income inequality. The king would be an important symbolic starting point.

Article 3: Spiritual Heritage

Section 1 of this article serves as an important articulation of Buddhism's commitment to GNH as regards religious matters.⁹ In the spirit of this commitment not only to tolerance but to compassion, the framers must rethink this article in an important respect.

While it is certainly essential to demonstrate Buddhism's role in the "spiritual heritage" of the country and to express Bhutan's commitment to Buddhist values, the primarily Nepalese Hindu minority in the country must also be considered a part of the spiritual heritage of the country. To this effect, the ensured state funding – laid out in section 7 – of certain Buddhist schools¹⁰ should be accompanied by

9. "Buddhism is the spiritual heritage of Bhutan, which promotes among others the principles and values of peace, non-violence, compassion, and tolerance."

10. "The Zhung Dratshang and Rabdeys shall continue to receive adequate funds and other facilities from the State."

a similar article ensuring the state funding of other religious institutions, including the Hindus in the south as well as the Sharchop Buddhists in the east. Furthermore, the article should guarantee that the government will not distribute funding unequally based on racial, religious, or cultural qualifications.

If this is not an economically feasible option, then the framers must reconsider the current privileged position given to the dominant religious tradition because of the discriminatory practice this promotes. Inequalities in a society are the quickest way to foster the three poisons that inhibit a person's path to enlightenment. Bhutan's commitment to these Buddhist precepts means it must avoid establishing a state religion, and this article, as it stands, comes very close to doing so.

Granting proportionately equal funding to all religious traditions would enhance the country's GNH by including all citizens in the cultural promotion efforts of this article. Furthermore, this more tolerant option would help resolve ethnic tensions that could diminish GNH by creating an atmosphere of minority resentment toward majority cultural privilege.¹¹

Article 6: Citizenship

Perhaps the most significant effort the framer's of the Bhutanese constitution can make in promoting GNH would involve reconsidering its citizenship regulations. The current citizenship requirements in the constitution reflect changes in the citizenship laws instituted in the late 1980s and early 1990s, where requirements became more strict in order to limit the amount of Nepalese immigrants residing in Bhutan.¹² During the census at this time, citizenship cards that had been issued to all Bhutanese in the years lead-

11. It might also be important, for the same reasons, to include a provision that reverses the fact that Buddhist texts are currently the only printed religious materials permitted to enter the country (according to U.S. Bureau of Democracy, Human Rights, and Labor. 2002. *International Religious Freedom Report*).

12. U.S. Bureau of Democracy, Human Rights, and Labor. 2003. *Bhutan: Country Reports on Human Rights Practices*.

ing up to 1998 were no longer accepted as proof of Bhutanese citizenship. Instead, a tax receipt from the first Nationality Law of 1958 was required for the ethnic Nepalese to prove that they had lived in Bhutan prior to that year.¹³ This stipulation lives in section 2 on this article.

Section 3(c) of the article requires all applicants for citizenship to speak and write Dzongkha, the national language of the country as laid out in article 1, section 8. In the early 1990s, it is estimated that Bhutan was populated by 160,000 speakers of Dzongkha, 138,000 speakers of Tshangla, the language of the Sharchops in the east, and 156,000 speakers of Nepali. This gives the three major non-English languages a 26.5%, 22.9%, and 25.9% speaking rate, respectively, out of a total population of 602,800 at that time.¹⁴ Given this diversity of language in the country, it seems inconsistent with other articles in the constitution not only that Dzongkha should be considered the “national language,” but more importantly that citizenship in Bhutan would depend upon an applicant knowing Dzongkha. If “all persons are equal before the law and are entitled to equal and effective protection of the law and shall not be discriminated against on the grounds of race, sex, *language*, religion, politics, or other status” as in article 7, section 15, and if “a Bhutanese citizen shall foster tolerance, mutual respect, and spirit of brotherhood amongst all the peoples of Bhutan transcending religious, *linguistic*, regional, or sectional diversities” as in article 8 section 3 [my italics], then the lan-

guage requirement for citizenship does not seem to belong in the constitution. Both of these articles represent core values of the GNH state because they promote equality among Bhutanese people, which, in turn, creates the society whose conditions are best for reaching enlightenment.

Both section 2 and section 3(c) in article 6 aim at restricting Bhutanese citizenship in the name of preserving national culture, and also in order to avoid the devastating economic burden a massive influx of immigrants could put on the Bhutanese economy. Presumably, these same concerns are what motivated the state’s policies in the late 80s and early 90s when tens of thousands of Nepalese immigrants left the country, supposedly, in many cases, by force.¹⁵ The status of these people – currently residing in refugee camps and desiring to return to their homes – remains a contentious issue.¹⁶

The threat the ethnic Nepalese can pose to Bhutan is not imagined. To a great extent, the Nepalese immigrant population’s marginalization of the once-dominant nationals in Sikkim is what caused the disintegration of the state of Sikkim into India, the precise destiny Bhutan is, naturally, trying to avoid.¹⁷ However, a greater threat is posed to Bhutan as a GNH state if it is to compromise its commitment to the welfare and well-being of its Nepalese people, and by excluding Nepalese people who either live in Bhutan or have lived in Bhutan from gaining citizenship, the state

is practicing the very discriminatory practices it claims to oppose in articles 7.15 and 8.3.

Instead, the citizenship article should be an important step in bridging this ethnic divide, and the constitution should make generous concessions to the Nepali-Bhutanese in particular as regards citizenship. The issue of repatriation of the roughly 100,000 Bhutanese refugees in conjunction with the changed citizenship requirements have resulted, in the past, in political protests and ethnic conflicts in the southern, primarily Nepalese districts in Bhutan.¹⁸ These sorts of conflicts are clearly against the interests of GNH, and harmonizing them remains a priority in the current constitution. Thus the broadening of the citizenship requirements in the constitution – perhaps even including a provision concerning people exiled from Bhutan in the past, and their right to Bhutanese citizenship – could help resolve a long standing ethnic conflict.

Deciding to measure one’s state on a basis Gross National Happiness rather than Gross Domestic Product is a lofty ethical ambition. While the king admits that Bhutan is not currently a “GNH state” but rather aspires to be one, the demands of working from a GNH mentality remain uncompromising. As Bhutan frames its first constitution, it has strived to place GNH at the center of the document, and to an overwhelming extent it appears to have done so. As this draft of the constitution is revisited, particular attention should be paid to the Nepali question – particularly to these three articles – if Bhutan’s aspiration to become a GNH state has any hopes of undisputed success.

13. Hutt, Michael. 2005. *The Bhutanese Refugees: Between Verification, Repatriation, and Royal Realpolitik*. Peace and Democracy in South Asia, Volume 1.

14. Van Driem, George. 1994. Language policy in Bhutan. In Michael Aris and Michael Hutt (ed) *Bhutan: Aspects of Culture and Development*. Gartmore: Kiscadale Publications.

15. U.S. Bureau of Democracy, Human Rights, and Labor. 2003. *Bhutan: Country Reports on Human Rights Practices*.

16. Hutt, Michael. 2005. *The Bhutanese Refugees: Between Verification, Repatriation, and Royal Realpolitik*. Peace and Democracy in South Asia, Volume 1.

17. Rahul, Ram. 1997. *Royal Bhutan: A Political History*. Bangalore: Vikas Publishing House Pvt Ltd.

18. U.S. Bureau of Democracy, Human Rights, and Labor. 2003. *Bhutan: Country Reports on Human Rights Practices*.



Jamie Poskin

Class of 2006

Religious Studies, Drama

Jamie Poskin has served as both a writer and an icon throughout the human history of the Americas. Originally unique to the Western Hemisphere, he was a literary favorite of the fierce Carib Indians who lived on islands in the sea that still bears their name. Over the course of time, Jamie naturally came to symbolize the high spirits of social events, his image coming to express the sense of welcome, good cheer, human warmth, and family affection inherent to gracious home gatherings. A Delicious Treat by Any Standard, Jamie Poskin has become a ubiquitous form for tabletop whimsy throughout the world.



Preparing for Growth: An Assessment of the Challenges to Expansion of Microfinance Services in India

Valerie Rozycki

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Microfinance has been a force of growing importance over the past few decades as a tool for grass-roots economic development. Each stage of development presents new challenges to expansion, and it is important for microfinance researchers, practitioners and policy-makers to fully understand these challenges when deciding where to allocate resources and efforts. Both changing legislation and an influx of money from commercial banks in India's microfinance sector present opportunities for expansion. However, practitioners should be aware of the most relevant challenges so that resources may yield optimal results. Based on open-ended interviews and closed-ended written surveys, both local-level microfinance administrators and national-level practitioners at support institutions agree that the need for regulatory reform and a lack of funds for infrastructure are there primary challenges, while differences between the responses of the two groups reveal some interesting implications about how solutions for these challenges should be addressed.

Microfinance and challenges in expansion

Global Microfinance

Microfinance (financial and social intermediation centered on providing loans to poor people for self-employment projects) has been growing exponentially in developing countries over the past three decades. The purpose of microfinance is to meet the financial needs of those populations excluded from formal financial services, especially the poorest of the poor. Microfinance has largely been an NGO-based initiative outside of the regulation of the government. Microfinance is not the definitive solution to end poverty, but it is a very important part. MFIs have the capability to lift the worlds poorest above the poverty line, and consequently, they provide a broad range of social ben-

efits for their clients, including improved education, better health, women's rights, and human rights in general.

The global microfinance sector faces many challenges such as finding bankable funding, ensuring accountability and credibility, addressing their clients' needs, sharing best practices with other MFIs, integrating with the local and national government, and training employees. Infant sectors may struggle with issues such as safety and security for loan officers or, even more fundamentally, properly assessing the demand for microfinance services within the society. However, developed microfinance sectors have flourished and the much more advanced sector faces advanced challenges. For example, in Bolivia, the trend has been toward commercializing MFIs that were once NGOs into regulated commercial banks. The concerns of these more developed institutions

shift toward questions of branding and upgrading technology systems in order to expand their businesses.

Within each country or region, it is important that researchers, practitioners and policymakers maintain awareness regarding the most relevant challenges to the expansion of microfinance services, if all three are to impact the sector positively and contribute to its development. Particularly in India where there is an anticipated influx of funds into the microfinance sector and subsequent rapid expansion of microfinance services in the coming years, maintaining this awareness is especially important. If researchers, practitioners, and policymakers understand the most relevant challenges to expansion, then they are more likely to administer programs for the sustainable growth of the sector.

In-depth Study of Challenges for India

India was selected for an in-depth look at current challenges to the expansion of microfinance because of two major developments in the Indian microfinance sector. Both of these developments will lead to a huge influx of funds into MFIs, namely (1) recently heightened interest of commercial banks in the microfinance sector as a market opportunity, and (2) very recent changes to legislation around funding MFIs.

The banking industry in India has historically been extremely consolidated, like many other industries in India. To illustrate, in 1999, the government-controlled State Bank of India alone held 94% of consumer deposits (McKinsey Quarterly 1999). Now that changes in legislation towards deregulation have opened India's banking industry, competition has increased and commercial banks have just recently started to turn towards microfinance clients as potential customers.

Commercial banks have started tapping into microfinance markets, using existing MFIs as distribution channels. Banks essentially give bulk loans to MFIs that in turn distribute these funds across tiny loans to clients, and then repay the loans to the banks (Anath 2005). This funding model is called the partnership-model and was pioneered by ICICI Bank (one of India's leading commercial banks). As this partnership-model gains more and more popularity among Indian commercial banks, the resulting influx of funds will greatly enhance MFIs' financial capacity to disperse loans.

The national government recognized this trend and has responded to facilitate increasing interest in funding MFIs. On January 25, 2006 India's central bank, the Reserve Bank of India (RBI), circulated an issue that now allows commercial banks to use "business correspondents" for the distribution of loans. The specific implementation of this issue means that banks will now use MFIs as intermediaries for disbursing loans to microfinance clients (Business Line 2006). This is a monumental event for microfinance in India, as

the national government is encouraging the flow of funds from commercial banks through MFIs to microfinance clients.

The heightened interest of commercial banks and the national government's support of banks' involvement with MFIs suggest that funds will begin to flow into the microfinance sector in India at an unprecedented rate. It is important for practitioners to be aware of the most current and relevant challenges to the sector to utilize these funds optimally. That is the motivation for this study.

Methodology and data collection

Data for this study was obtained through open-ended interviews as well as through closed-ended surveys. Of the 25 interviews conducted, 12 were local-level microfinance administrators and 13 were national-level practitioners at support institutions. Of the 18 surveys conducted, 8 were from the local-level group and 10 were from the national-level group. (See Appendix A for a complete list of study participants.) Study participants were asked to describe their experiences as well as express their opinions on questions related to challenges in the expansion of microfinance in India.

Data was analyzed using standard qualitative research methods. The Micro-analytic and the Holistic Approaches were used to analyze interview results, and Matrix-based Classification was employed to analyze survey results. The data revealed several interesting findings about the sector in general and also about each of the two participant groups, local-level and national-level.

Results of qualitative study

"What are the biggest challenges in the movement to expand the provision of microfinance in India?"

"A major challenge is always of a legal form...the industry needs its own, better legal environment."

Shiva Nageswara Rao

Planning Manager at SHARE Microfin

"Previously, resources were very scarce....

Now, there are a lot of funds, but partners [MFIs] have not matured."

Daksha Niranjana

Credit Program Head at Friends of Women's World Banking

Although the microfinancing schemes started in an efficient manner by the professionalized NGOs and MFIs, now there are innumerable NGOs totally new to the microfinancing sector, which leads to duplication of programs sometimes and which ultimately causes the beneficiaries to be indebted. This is the biggest challenge.

K. Loganathan

CEO at Association for Sustainable Community Development

One-to-one Interview Results

The most common response focused on the need for investments in sector infrastructure and management information systems (MIS) to reduce MFIs' operating costs and inefficiencies (14 of the total of 25 respondents, 8 of the 12 local-level respondents, and 6 of the 13 national-level respondents expressed this view). There is a severe lack of use of technology in Indian microfinance practices. Most MFIs still operate with hard copies of their records, and only a handful of the largest institutions employ MIS software. Resulting high operational costs are then passed on in higher interest rates to clients.

Interestingly, several respondents (11 of the total of 25 respondents, 4 of the 12 local-level respondents, and 7 of the 13 national-level respondents) explained that, over the next decade, there is expected to be substantial or adequate funding for the disbursement of loans, but funding for infrastructure is expected to be lacking. The influx of funding described above is earmarked for loan disbursement rather than for the general development of the sector's operations and infrastructure.

Respondents also emphasized the need to expand the set of products offered by MFIs (9/25 of total respondents, 4/12 of local-level respondents, and 5/13 national-level respondents expressed this view). While current loan models may be successful, many financial service needs such as savings and insurance are left unmet.

Another challenge commonly noted by study participants as a significant hindrance to the expansion of the Indian microfinance sector was the need for regulatory reform, especially regarding the difficulties NGOs face registering as financial institutions and legal restrictions on offering savings services (7/25 total respondents, 4/12 local, and 3/13 national respondents expressed this view).

Survey Results

The survey mirrored the interview by asking respondents to rank the importance of various challenges to the Indian microfinance sector on a scale from one to five, with one indicating “almost no importance” and five indicating “great importance”. The means, medians and modes of these scores were calculated (1) across all study participants, (2) local-level MFI administrators and (3) national-level practitioners at support institutions within the microfinance sector. These descriptive statistics were then used to rank responses according to importance-ratings assigned by study participants in each group. (See tables above for rankings.)

For the local-level group, mean importance-rating scores revealed the most important challenge as “Need for regulatory and policy reforms” (mean importance rating of 4.6). “Lack of funding for infrastructure” and the “Lack of technology infrastructure” both had the second highest importance rating (4.2), based on the mean importance rating of participants in the local-level group.

The rankings of the survey responses are generally consistent with the interview responses, except that the mean scores in the surveys assigned somewhat greater importance to regulatory reforms than was the case with the interview results.

The national-level group’s importance rankings showed “Lack of technology infrastructure” to be the most important challenge to the expansion of microfinance, according to the national-level group of study participants (mean importance rating of 4.4). “Need for regulatory and policy reforms” and “Lack of training and capabilities of staff” both had the sec-

Local-level Respondents:

Response (in order of importance ranking)	Mean Importance Rating	Median Importance Rating	Mode Importance Rating
Need for regulatory and policy reforms	4.6	4.5	5.0
Lack of funding for infrastructure	4.2	4.5	5.0
Lack of technology infrastructure	4.2	4.0	5.0
Lack of training and capabilities of staff	4.0	4.0	4.0
Lack of sharing of best practices	3.6	3.5	3.0
Lack of funding for loan disbursement	3.1	3.5	3.0

National-level Respondents:

Response (in order of importance ranking)	Mean Importance Rating	Median Importance Rating	Mode Importance Rating
Lack of technology infrastructure	4.4	4.5	5.0
Need for regulatory and policy reforms	4.2	4.0	5.0
Lack of training and capabilities of staff	4.2	4.0	4.0
Lack of sharing of best practices	3.8	4.0	4.0
Lack of funding for infrastructure	3.6	4.0	4.0

ond highest importance ranking (4.2).

The local-level and national-level groups both identified “Need for regulatory and policy reforms” and “Lack of technology infrastructure” as two of the three most important challenges to the expansion of microfinance in India.

There are also interesting differences between the two groups. The local-level group ranked “Lack of funding for infrastructure” second in importance (based on the mean score), whereas the national-level group ranked that challenge fifth in importance. Both groups ranked “Lack of technology infrastructure” as either highest or second highest in importance. However, the local group identified “Lack of funding for infrastructure” as close in importance to “Lack of technology infrastructure,” whereas the national group did not.

The patterning of similarities and differences in the two groups’ importance rankings suggests that the following processes may be operating: Both groups highlight the lack of technology infrastructure as impeding Indian MFIs. However, the national-level group highlights lack of staff training as a major problem, while the local-level group highlights lack

of funding for infrastructure as a major problem. While national-level practitioners have observed the increases in funding for MFIs over time, local-level practitioners have observed a more detailed earmarking in those increased funds. They realize that whereas increased funding has flowed into MFIs for the purpose of loan distribution, an adequate level of funding has not been made available for technology and infrastructure.

While neither group ranked “Lack of sharing of best practices” among the three biggest challenges, the national group assigned greater importance to this challenge especially according to median and modal importance ratings. This difference in perspective may reflect that whereas formal or informal sharing of best practices happens at the local level, national-level practitioners are not aware of this sharing. Alternatively, local-level microfinance administrators may be more narrowly focused on their local situation. If this were to be the case, local-level microfinance administrators would attribute less importance to the sharing of practices across institutions and hence perceive the lack of sharing as a subordinate challenge.

Conclusions and Implications of Results

The results of this study reveal underlying themes of problems with both poorly aligned incentives and poorly understood perspectives.

According to research subjects, the most important barriers to the expansion of microfinance are the need for regulatory reform as well as improvements in and funding of sector infrastructure. These challenges are collective, affecting the sector as a whole, as opposed to private challenges affecting the operations of individual MFIs such as the training of MFI staff and funding for loan disbursement. Microfinance practitioners can have a direct impact on private challenges, but each MFI has less incentive to tackle collective challenges because the resulting benefits are less immediate and spread across all MFIs. No single MFI has a strong incentive to bear the costs of creating solutions for these collective challenges.

Therefore, in order to find solutions more rapidly, these collective challenges must either be solved collectively or turned into private challenges. There is evidence that India's microfinance sector is in fact heading in this direction.

For example, a national network of Indian MFIs called Sa-Dhan was recently established to create a common discussion forum for institutions and to serve as the collective voice of microfinance administrators. One of Sa-Dhan's primary goals is to facilitate regulatory reform. In this way, Sa-Dhan is attempting to solve the collective problem of need for regulatory reform by gathering Indian MFIs for collective action.

Additionally, as commercial banks become involved in microfinance, the challenges related to the lack of technology infrastructure have become more of a private interest rather than a collective one. A bank providing bulk loans to MFIs for micro-loan disbursement affects a much greater portion of the microfinance sector than any single MFI. This involvement has the effect of consolidating the interest in technology infrastructure, transforming it from a collective challenge into a private

one. Technology infrastructure affects the viability of the banks' investment in microfinance as a market segment. Therefore, because the lack of technology infrastructure is becoming more of a private challenge, new efforts are developing to tackle this problem. ICICI Bank is one bank in India particularly active in this area. One of the primary initiatives of ICICI Bank's Social Initiatives Group is to plan and develop a common technology platform for India's microfinance sector (Ruchismita interview).

Thus, there is evidence of efforts to solve these collective challenges of regulatory reform and sector infrastructure by both creating collective action and transforming a collective challenge into a private one.

While current efforts in the sector address the incentive problem, this still leaves the problem of poorly understood perspectives.

Sa-Dhan currently has 139 MFI members of various sizes, and thus would seemingly have a good understanding of the perspectives and needs of local-level MFI administrators. However, according to the findings of this study, especially regarding the discrepancies between responses from local- and national-level practitioners, organizations with a national-level perspective such as Sa-Dhan have the potential to misrepresent local administrators. While the inconsistencies in responses were not major, it is critical that national-level decision makers clearly understand the intricacies and limitations of the MFIs they represent.

Commercial banks are partnered with a much smaller number of MFIs and hence have an even less complete view of the perspectives and needs of local-level microfinance administrators. Banks such as ICICI Bank working towards developing technology infrastructures solutions must be wary of this limited understanding. Without explicitly taking into account the perspectives and needs of local-level administrators, banks are at risk of creating technology solutions that are not applicable or useful to their MFI partners. For example, as operational costs

of practicing microfinance are already burdensome, it is critical to develop low-cost solutions. Furthermore, interview subjects revealed the limited training and capabilities of MFI staff as an important challenge. Thus, technologies should be developed with these limitations in mind; simple solutions that do not require much training to learn are essential.

Any microfinance sector faces challenges according to its stage of development. In India, the primary challenges are related to a need for regulatory reform and improved sector infrastructure. Further analysis of these challenges reveals problems around poorly aligned incentives. These are collective challenges that must be met either by collective action or by transforming the challenge into a private one. Initiatives led by Sa-Dhan and ICICI Bank show some promise in addressing this incentive problem. However, any solutions will not be successful if they do not also address the problem of poorly understood perspectives. These national-level parties working towards regulatory reform and improved sector infrastructure must very closely communicate with local-level microfinance administrators to fully understand their needs and perspectives in order to achieve successful solutions and the sustainable expansion of microfinance in India.

Appendix A

List of Interview Subjects

Local-level administrators

- P. Sai Gunarajan (interview) is a Manager at BASIX, an MFI operating in Andhra Pradesh. Mr. Gunarajan's primary focus is the insurance business at BASIX.
- Keerthi Kumar (interview and survey) is a Research Consultant for Spandana, an MFI operating in Andhra Pradesh.
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