

Volume 9
Spring 2010

SURJ

Stanford Undergraduate
Research Journal



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Research Journal

Volume 9, Spring 2010

<http://surj.stanford.edu>

Stanford, CA 94305

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Editors' Note

The spring 2010 issue of the Stanford Undergraduate Research Journal marks the ninth consecutive year of publication of Stanford undergraduate student researchers. The scope of SURJ reflects the breadth of interest of our student researchers, while its focus remains dissemination of research work of highest academic standards. SURJ is a unique in its character. It is entirely run by undergraduate students from administration to editorship, selection and review to its final publication.

The journal remains focused on publishing research articles from Stanford students, while remaining open to submissions by undergraduate students elsewhere. We believe, this allows us to remain true to our character while raising the standards for everyone. The same can be said about the research-pool from which we draw our articles. While a majority of the articles is drawn from research at Stanford, the journal is open to publishing research performed anywhere in the country and beyond. Opening up our publication to outside expands our scope, improves our quality and widens our readership. We believe it is vital for promoting our journal and expansion of readership.

The mission of this journal will not be served without dedicated service of our editorial board and staff. While editorial, production and financial management rests ultimately on our staff, we are active in seeking out ideas and soliciting input from faculty who are well known in their respective fields. We solicit input from faculty representing the diversity of our academics from classics, social sciences to natural sciences, business and engineering. The faculty input is invaluable in formulating article selection strategy. The peer-review process varies across disciplines. We are cognizant of these differences and apply standards applicable within a discipline in selecting novel and sound articles that are interesting and contemporary in nature. The rigor in our selection process is deliberate and methodical.

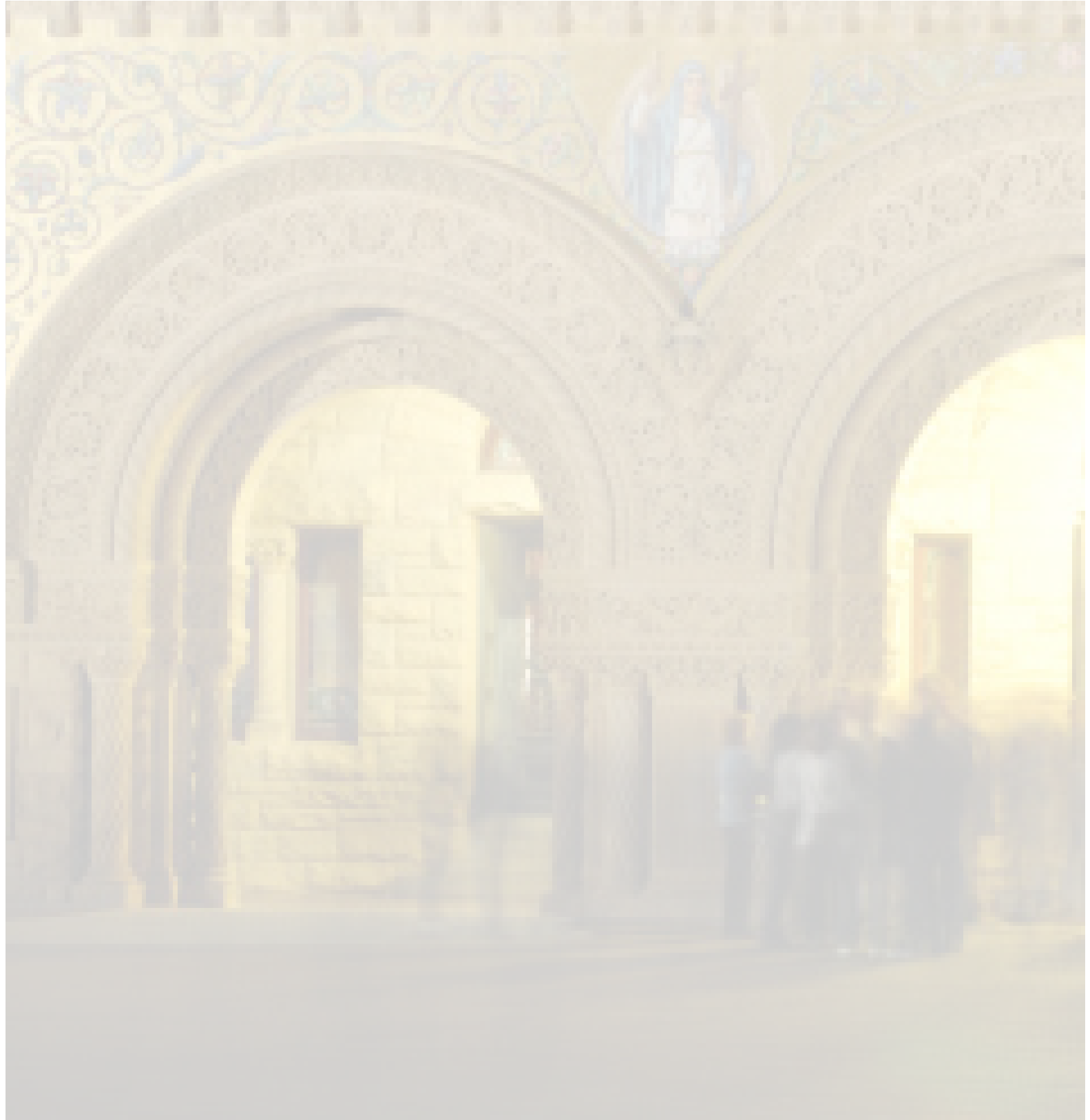
SURJ coordinates its activities with a number of campus organizations. The Undergraduate Admissions Office sends out our journal to high school students who are interested in research. This is of great benefit to SURJ as it helps build a pipeline of staff, editors and management personnel to carry the mission of SURJ forward. We hope our articles motivate students to explore research topics on their own, develop scientific methods of data collection and analysis.

On behalf of the entire 2009-2010 SURJ editorial and production staff, we thank you for your readership and interest. Without readership and the support from the Stanford community, we would not be able to sustain the pipeline of high quality articles, the breadth of our scope, the volume of publication and the distribution throughout our campus. We thank our faculty panel for their insight and mentorship. We also thank Stanford undergraduate dean's office for financial and technical support.

This journal celebrates the achievement of undergraduate research in our campus and beyond and nurtures a community of students in pursuit of their excellence. Please join us in congratulating our authors in celebrating their achievement.

Sincerely,

Shinjini Kundu
Karis Tang-Quan
Editors-in-chief



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Special Features: A Taste of Stanford's Intellectual Diversity

When the editors-in-chief asked us to write this letter, they suggested we unite the featured students under a single theme. After much deliberation, we could list only superficial similarities between the student researchers, who have a variety of academic passions, backgrounds, and post-graduate plans. However, we are happy that we could not find a major commonality, for it is actually this diversity that enriches the undergraduate research experience. In this installment of Special Features, we highlight the intellectual heterogeneity of our undergraduate student body.

We first feature junior biology major **Derek Lu**, who performed rodent brain surgery for his research into the pathways of learning and memory. Derek's preliminary results suggest that damaging a region of the hamster brain might make the animal smarter. We then present an article about **Bianca Carpeneti**, a senior majoring in classics and archeology. She investigated the design of the Great Tumulus Museum at the Grecian archeological site of Vergina. Through the help of the classics department and a UAR grant, Bianca was able to visit the site to interview local experts.

We also introduce physics major **Adair Gerke**, who spent the summer after his sophomore year building an instrument for measuring the electrical conductance of single molecules. We present junior **Shruti Tibrewala**, who dissected fish ovaries in order to learn how microRNAs affect female fertility. Finally, we feature **Meghan Vinograd**, a junior psychology major who examined the relationship between mental disorders and the body.

Perhaps the only commonality among these students is their tremendous passion for their research. We hope the stories of Meghan, Bianca, Derek, Adair, and Shruti inspire Stanford students of all class years and majors to pursue research at the undergraduate level.

Sincerely,

Jennifer Levy and John Lindsay
Editors, Special Features

Derek Lu: Investigating the Learning Pathway in Rodents

Jennifer Levy

Can ablating part of the brain make you smarter? This question is at the heart of on-going research by Derek Lu, a junior working in the lab of biology professor Dr. Craig Heller.

The recipient of a VPUE research grant, Derek spent the summer after his sophomore year inducing lesions in the brains of Siberian hamsters and measuring their cognitive abilities using various memory tests.

“The preliminary results were pretty cool,” Derek explained. “Hamsters whose brains were lesioned in a particular region showed increased learning and memory.”

Derek used an electrode to deliver current to the suprachiasmatic nucleus (SCN), a region of the hypothalamus. His hypothesis was that damage to this area of the brain would relieve inhibition on the hippocampus, the part of the brain responsible for certain types of learning and memory. The SCN is considered a GABAergic center, which means it releases the inhibitory neurotransmitter gamma-aminobutyric acid, or GABA. GABA acts through the septum, a membrane in the center of the brain, where it mediates effects on the hippocampus. Derek expects that damaging the SCN decreases release of GABA and, therefore, inhibition of the hippocampus.

Derek works with Siberian hamsters, animals whose circadian rhythms—the roughly 24-hour cycle that regulates biological activity—can be knocked out using non-invasive methods. A 5-hour shift in the light/dark cycle will cause the animals to lose their circadian cycle permanently, an ability that may be evolutionarily advantageous in the hamster’s far northern habitat.

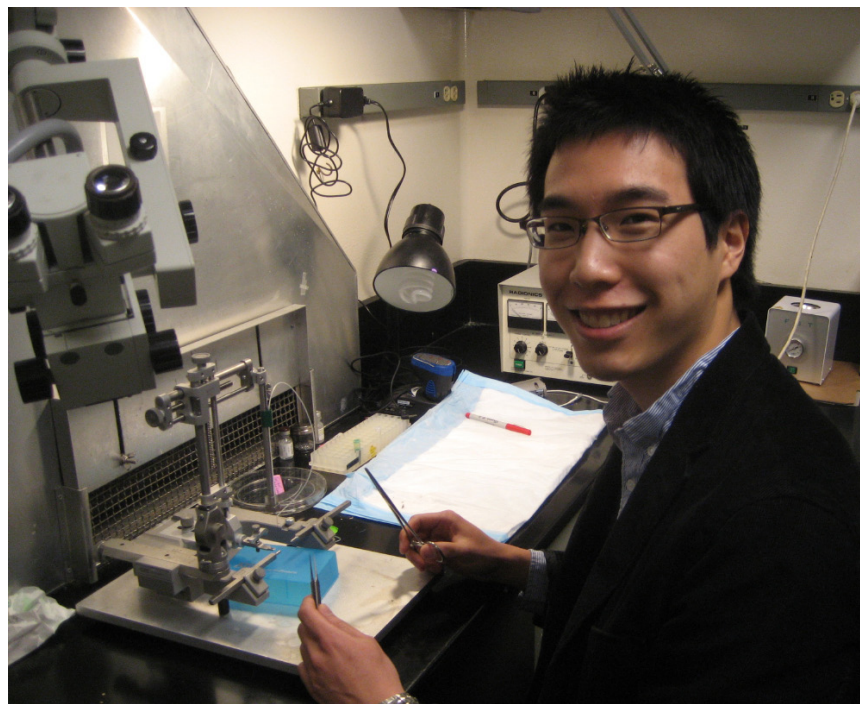
GABA release from the SCN is thought to be controlled by circadian rhythms, with each of approximately 20,000 neurons acting as a clock. In arrhythmic hamsters, the neurons are not synchronized, leading to chronic GABA release and

constant suppression of hippocampal activity. Although hamsters with normal circadian rhythms show decreased cognitive abilities at times during their daily cycles, arrhythmic hamsters demonstrate consistently low performance in tests of hippocampus-dependent spatial ability.

In order to test the cognitive ability of the hamsters, Derek uses novel object recognition (NOR) tests. In these tests, the hamsters are given the opportunity to explore two objects, one familiar and one novel. Hamsters are expected to spend more time exploring the novel object. However, animals with impaired memory will not recognize the familiar object and will spend a similar amount of time around each. The amount of time each hamster spends exploring each object gives Derek a quantitative measure of the cognitive abilities of the hamsters.

Derek also uses a T-maze task, based on a similar premise. The number of times the hamsters alternate between arms in the T allows him to measure their spatial ability.

Previous literature implicated GABA in this learning mechanism when it was found that arrhythmic hamsters treated with pentylenetetrazol (PTZ), a GABA



Derek Lu, a junior in the Biology department, studies the brains of siberian hamsters in order to understand the learning pathway.

antagonist, showed increased performance in memory tests. This led Dr. Norman Ruby, a senior research scientist in the Heller lab, to ask whether damaging the region of the brain that releases GABA would have chronic excitatory effects on the hippocampus. Derek, who found this project through the Summer Research in Biology program, was excited to explore this question under Dr. Ruby’s guidance.

Derek recalls the first time he performed brain surgery on the hamsters as a little nerve-wracking. “I didn’t really know precisely where in the brain to lesion or how much current to use. I basically had to figure it out as I went along,” he said.

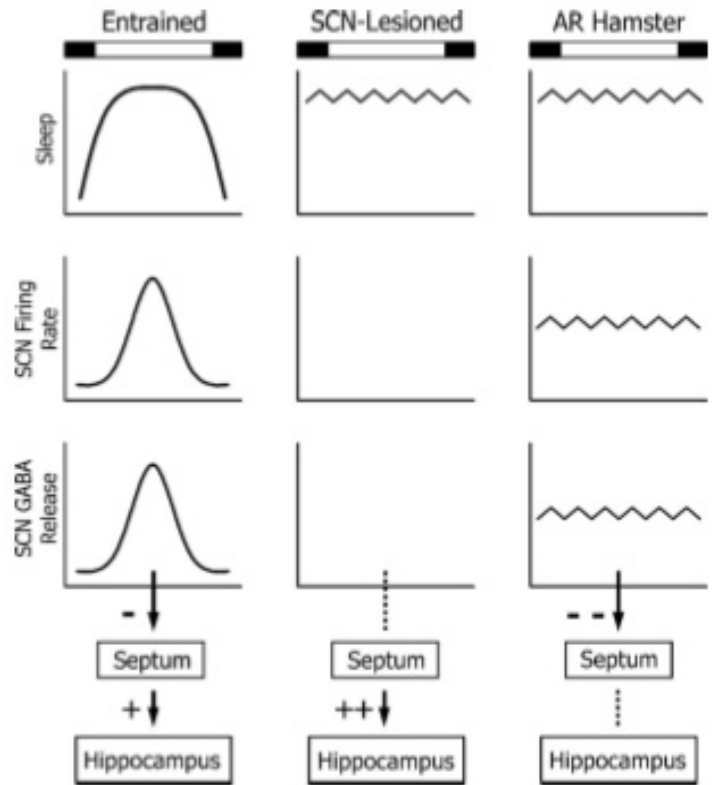
Derek spent months working to improve the spatial coordinates he used to navigate the hamster brain. He even constructed his own instrument—a grounding electrode made out of a syringe—to induce the lesions.

But despite the difficulty of the research, Derek could not be happier with his decision to take on the project, which he considers an important step to understanding how the brain works.

“It has broad implications for the study of circadian rhythms and learning and memory,” he explained. “This research may also reveal therapeutic targets for learning disorders or dementia.”

Derek plans to continue his research this summer and eventually turn it into an honors thesis.

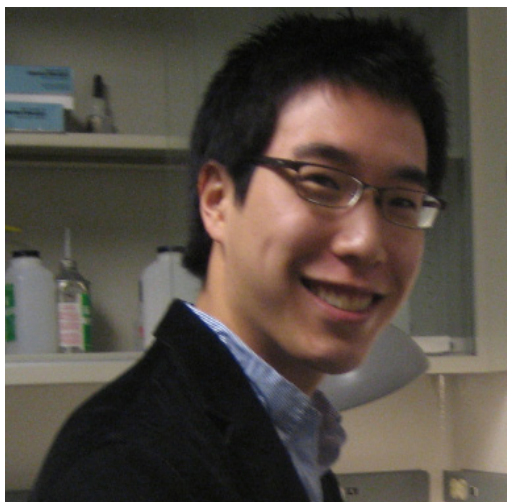
Derek’s first experience with research was with City of Hope Cancer Center in southern California, where he studied the mechanism of autophagy during



Derek’s preliminary data suggest that creating lesions in the suprachiasmatic nucleus of the brain can make siberian hamsters smarter by reducing inhibition on the hippocampus. Here, a schematic of the lab’s hypothesis.

hypoxia. Although his future plans are uncertain, Derek says his experience in the Heller lab has “kept research in contention” for a future career.

“I find it really exciting being on the frontier of science,” Derek said.



Derek Lu is a junior from Palos Verdes, California. In his free time, he likes to fence, read about obscure subjects, and watch comedy movies. He is also an R.A. in Trancos.

Bianca Carpeneti: Investigating the Visitor Experience at the Great Tumulus Museum of Vergina

John Lindsay

Vergina is a small town in northern Greece that hosts a rich archeological site. In the nineteen-seventies, the archeologist Manolis Andronikos excavated the site. He argued that it was the tomb of Philip II, father of Alexander the Great. The riches of Vergina transformed into a lodestone for Greek national pride. Architects later constructed the “Great Tumulus” Museum uniquely *in situ* or upon the original tomb of Philip II. It intimately presents the archeological finds. Last summer, Senior Bianca Carpeneti visited the site and explored the museum design.

Bianca is a Classics major interested in Archeology and Museum Studies. In my interview with her, she explained: “I took a lot of courses specifically on ancient Greece and Egypt.” She is also “very interested in working with museums.” When designing her senior Honors thesis, she wanted to explore an archeological site “in the context of museum studies.” Bianca chose to visit the unique Vergina museum.

She wanted to know what goals the architects had in mind when designing the museum. After research she hypothesized that they organized the site to reflect the “personage and personality of Philip II.” Philip II was a “very impressive leader” who “pulled together the Macedonian State which enabled Alexander the Great to conquer all of Persia and dominate the Classical world in the late fourth century [BC].” Looking at the historical Philip, Bianca envisioned him as “ruthless,...shrewd ... strong,...[and] powerful.” She expected the architects to have incorporated “who he was as a King and how his reign was conducted and how it ended...into the exhibition.”

To develop the necessary skills

to test her hypothesis, she independently researched ethnography methods with help from Lynn Meskell, Professor of Anthropology. She planned out her research objectives, including contacting local experts, under the guidance of her advisor Ian Hodder, Professor of Anthropology.

When Bianca arrived in Vergina, she first independently observed the site. She wanted an unbiased vision: “I first visited the site without talking...or meeting with anybody. I just went out there and I spent the morning wandering around and taking notes and sketches.” She used her observations to “contextualize” the information gleaned from her later interviews.

Bianca then interviewed local experts. She consulted Kostas Kotsakis, a well-known Greek archeologist at the Aristotle University of Thessaloniki. He explained the history and background of the site. She met archeologist Chrysoula Paliadeli, who “did her Doctoral thesis in the late 70s when she was excavating [the original finds].” Dr. Paliadeli “was still in charge of excavations at Vergina in the palace complex and the theater,” and so Bianca learned about past and present excavations. She met with Eva Kontogoulidou,



Bianca Carpeneti traveled to Vergina, Greece to study the design of the Great Tumulus Museum. Here, the entrance to the museum.

a museum-affiliated archeologist and Nikos Soulakis, the museum's interior architect. They explained the theoretical objectives behind the museum design.

Bianca discovered that her hypothesis was false. Philip's "personage" was not the prominent focus of the exhibitions. In one exhibit that showed the riches buried with Philip, "instead of focusing on Philip and why as a leader he merited such an ostentatious display of wealth, they focused on Alexander's grief and his tribute to his father."

From the interviews and site observations, Bianca discovered that the architects' objective was to appeal to the audience by increasing their emotional participation with the exhibition. Bianca learned that "the physical design of the space, the exhibit...and the materials," were organized to inspire "sentimental [visitor] participation." For the previous example of the Alexander's grief overshadowing Philip's wealth, she reasoned that because Alexander the Great is more famous, the exhibit's focus on him would better connect to the viewer.

Bianca argued that the exhibition simulated the experience of being present at the ancient burial of Philip II. She describes the ancient event: "There was a ceremony... and everybody was distraught that their leader has died. However, by burying him, [they] experienced this communal grief and [were able to] move beyond it in a ceremonial process."

Bianca observed that the "process" of the viewer through the museum matches the emotional "process" of the ancient mourner. To describe the visitor's museum experience, she said: "It is dark and you don't know what is going on...you are sort of scared, and there are imposing sights." Upon arriving at the end, "you know Philip's buried and you see all these goods and its sort

of, Woah. This is the explanation of what we've gone through,... to commemorate this phenomenal leader." The audience of the museum feels as if they attended Philip's burial, and feels apprehension and excitement. The exhibit causes a "Woah" effect.

For her senior Honors thesis she has continued to study the objectives of museum designers. In her Vergina study, she learned that the designers prioritized appealing to the audience. She agrees with the importance of engaging visitors. She stated: "museums are intellectual institutions; their purpose is to preserve, protect and present intellectual and material culture." At the same time, she is wary about over-prioritizing entertainment: "If we focus on drawing people in and keeping their interest, what's to stop us from becoming theme parks?" She sees the need to strike a balance in museum design between providing information and entertaining the public.

Working with Stanford Professor of Classical Archeology Michael Shanks, Bianca also investigates new ways to approach museum design. The recent collaboration between the Stanford Design Center and the design firm IDEO, which developed new "human-centered design methods," has influenced Bianca. This is an "entire new way of looking at a design problem and trying to solve it." She gave an example method of a "fifty-one card deck of ways to interview people."

Bianca appreciates all that her research taught her. It shaped her career plans: "initially I thought I wanted to be a curator in a museum, but my recent research has gotten me really excited about the design process." She adds: "I don't know exactly where this is going to take me, but it has given me a more nuanced perspective in terms of what's possible in a museum setting."

Bianca Carpeneti is a Senior who will graduate with a double major in Classics and Archeology. She will be applying to graduate programs in Museum studies in the UK. Born and raised in Juneau, Alaska, she enjoys anything outdoors and getting muddy, "which is why archeology is such a perfect fit!"



Adair Gerke: Using the Scanning Tunneling Microscope to Measure Diamondoid Conductance

Jennifer Levy

The information technology company IBM captured the world's attention in 1990 when it used individual atoms to construct its company logo in the smallest font ever written. Nearly twenty years later, the lab of physics professor Hari Manoharan broke a new world record by writing our university's initials, S.U., using electrons. This amazing work, featured in a January 2009 video on the university's main webpage, intrigued Adair Gerke, then a sophomore considering a major in physics. Later that year, Adair found himself at a pre-majors dinner talking to Professor Manoharan about joining his research group.

Professor Manoharan and his colleagues produced the subatomic writing using a scanning tunneling microscope (STM). This instrument uses an atomically sharp wire tip that scans surfaces to manipulate atoms and measure local electron density. The microscope produces an image of the atomic surface that allows scientists to determine the underlying structure. Adair spent the summer after his sophomore year rebuilding and calibrating the STM that will be used for the group's next project, measuring the electrical conductance of single molecules.

Adair's research will contribute to the field of "molecular electronics," which is becoming increasingly important as scientists and engineers look for ways to make small electronic components that can hold large amounts of

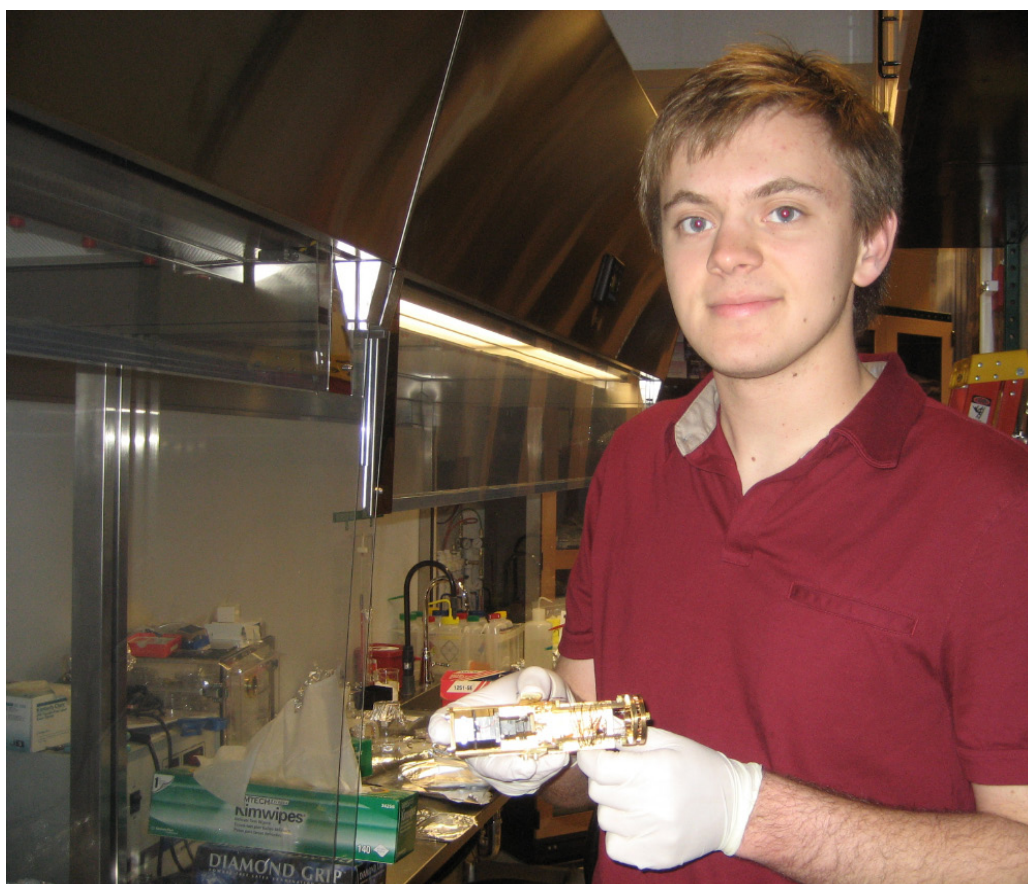
information.

"Currently, electronics are made out of crystals of semiconducting materials, such as silicon or gallium arsenide," Adair explains. "These are fabricated through the process of photolithography: the crystals are grown, the shapes of the devices are printed in a mask material using light, and unwanted semiconducting material not covered by the mask is etched away with strong chemicals."

The problem with photolithography is that it can be used to produce devices only as small as the wavelength of light used to create them. Therefore, scientists have begun looking into other methods, including the possibility of making electronics from organic molecules.

"It could greatly simplify fabrication to take advantage of organic molecules' ability to self-assemble into larger structures, as occurs in biological systems," explained Adair.

A candidate organic molecule is the diamondoid dumbbell, which consists of two fullerene (C_{60} buckyball) components connected by a diamondoid



Physics major Adair Gerke built this Scanning Tunneling Microscope (STM) to measure the electrical conductance of diamondoids.

(C₁₀H₁₆) bridge.

The next step for Adair will be to use the STM to measure the electrical properties of diamondoid derivatives. The group wants to learn which functional groups can be added to the molecule to maximize its potential use in electronic circuits. Adair plans to spend his second summer in the Manoharan Group investigating this topic under the guidance of Jason Randel, a graduate student in the Applied Physics department.

However, according to Adair, the most challenging part of his work is over.

“Rebuilding the STM, with its parts so tiny they had to be handled with tweezers, was very difficult,” he admitted. In addition to constructing the device, Adair spent much of last summer measuring the electrical conductance of gold, the atom that makes up the fine tip of the stylus, in order to calibrate the instrument.

Though challenging, the project provided Adair with invaluable skills that he expects to use in the future



Adair holds the STM he built last summer while studying molecular electronics in the lab of physics professor Hari Manoharan.

as he pursues a career in industry. “This project has helped me become familiar with custom electronics and mechanical parts. I also learned machining and how to write proposals,” he said.

Adair, whose previous research experience includes work in the Nanosystems Group at the MITRE Co. in McLean, VA., says he used an STM on occasion prior to joining the Manoharan Group. “But I never thought I’d be building one,” he added.



Adair Gerke is a junior from Great Falls, VA. In his spare time, he plays the horn in the Stanford Symphony Orchestra. He is also an active member of Phi Kappa Psi fraternity.

Shruti Tibrewala: Understanding the Role of miRNAs in Female Fertility

Jennifer Levy

The central dogma of molecular biology, once considered elegant in its simplicity, has recently become a lot more complicated. The original hypothesis, described by Francis Crick in 1958, holds that DNA encodes RNA and RNA encodes proteins. However, in 1993, researchers at the University of Massachusetts discovered microRNAs (miRNAs), short pieces of RNA that do not code for protein. Instead, they bind to other RNA molecules and inhibit their translation or target them for degradation by nucleases. Once considered “junk,” miRNAs are now known to play an extremely important role in the regulation of gene expression.

miRNAs were first implicated in developmental transitions between larval stages in the nematode *C. elegans*. They have since been found to control a large number of biological processes, including metabolism, growth, and cell death, in animals from fish to humans. It was the broad application of miRNA research that attracted current junior Shruti Tibrewala to her summer research project in the lab of Professor Russell Fernald.

Shruti is interested in how miRNAs control fertility and egg development in the African cichlid fish *Astatotilapia burtoni*. She has been collecting the gonads of female fish at three stages of development at four points in their monthly reproductive cycles. She plans to isolate the miRNAs and sequence the genes in order to identify interesting RNAs that could be involved in fertility.

“If a miRNA is expressed only at a particular time in the oocyte maturation cycle, or in fish of only a certain age, we can begin to hypothesize about its function,” Shruti said.

A. burtoni are mouthbrooding fish, which means that females hold the fertilized eggs in their mouths

while their young develop. After two weeks, the fry are released. The female fish are reproductively active after they have grown to approximately 30 mm, and their fertility decreases when they reach about 65 mm in length.

“Post-reproductive fish show atrophy of their gonads, and have very low gonad-to-body weight ratios,” explains Shruti. She hopes that her project will reveal the genes that might account for these differences between fertile and infertile females.

The fish that Shruti studies fall into three categories: juveniles, who have carried only one brood of eggs; experienced adults who have had several broods; and older fish that are likely reproductively inactive. She is collecting gonads from fish who have just released their fry and those who did so 4, 8, and 20 days earlier in order to learn how miRNA control egg development throughout a female’s cycle. Shruti is also looking at miRNA expression in fertilized eggs at the one- and two-cell stages to understand why embryos of older females may not be as viable as those of younger fish.

In addition to collecting the ovaries and eggs, Shruti is also measuring the hormone levels of the fish in order to see whether a correlation exists between gonadal miRNA expression and circulating androgens, the hormones involved in the reproductive axis.



Shruti Tibrewala studies *Astatotilapia burtoni*, an African cichlid species native to Lake Tanganyika.



Shruti performs dissections to retrieve the female gonads. She will isolate the miRNAs from the tissue samples and compare the sequences between fertile and infertile fish.

Shruti began working on this project under the guidance of postdoctoral scholar Dr. Rosa Alcazar during the summer after her sophomore year, as part of the Summer Research in Biology program.

“I knew I wanted to join this lab after taking the course Brain and Behavior with Dr. Fernald. I found

the social regulation of the brain really interesting and thought he was a great professor,” Shruti said.

She adds that she was also attracted to the lab by the wide range of topics that its members study. Research in the Fernald Lab includes projects about learning and memory, maternal care, aggression, and reproduction. “I was sure I would learn a lot from the other members of the lab,” Shruti said.

Shruti describes the most challenging part of her project as removing the gonads of the fish without leaving any eggs behind. The females range in size from 35 to 70 mm, and their ovaries are no more than 2 mm long.

“I’m also a strict vegetarian, so I had almost no contact with fish prior to my laboratory dissections. I think that made learning to perform fish surgery a little harder,” she said.

But despite the steep learning curve, Shruti now finds dissections to be one of the most rewarding parts of her project. She plans to continue working in the Fernald Lab this summer, and she hopes to turn her research into an honors thesis.

Shruti Tibrewala is a junior majoring in Biology and minoring in Psychology. Originally from Mumbai, India, she is a tutor and tutor coordinator for East Palo Alto Tennis and Tutoring. Shruti also volunteers at the VA Hospital.



Meghan Vinograd: Studying Cardiac Tone and Perception in Major Depressive Disorder and Social Phobia

John Lindsay

Major Depressive Disorder (MDD) and Social Phobia (SP) are widespread mental disorders. As they often occur in individuals with high amounts of stress, MDD and SP are relevant issues to many Stanford students. Meghan Vinograd, a Junior in the Psychology Department, completed a research project on these two disorders. She hopes that her work will lead to better treatments for people with MDD and SP. In my interview with her she stated that “it’s really important to examine these [two mental disorders] scientifically so we can make people’s lives better.”

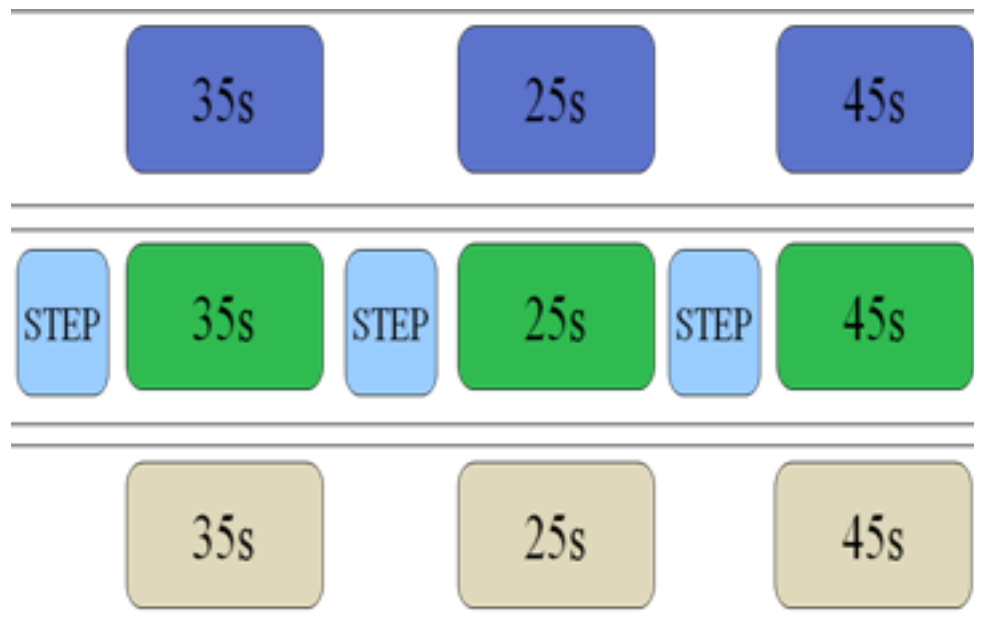
Last summer, Meghan investigated the physical experiences of patients with MDD and SP. She tested for differences in heart rate variability and heartbeat detection accuracy between participants with MDD and SP and those in a control group without the disorders. She said that according to previous studies, low heart rate variability is related to “mood disorders,...heart problems,... and increased likelihood of death following a heart attack.” In her study, Meghan hypothesized that participants with MDD would have a lower heart rate variability than controls and participants with SP. Other researchers had already identified an association between patients with depression and low heart rate variability, but Meghan’s experiment aimed to find the same result in a sample of individuals that clearly did not have any psychiatric comorbidities.

For heartbeat detection accuracy, previous studies suggest that anxiety is associated with an increased ability to detect one’s heartbeat. In accordance with the previous literature, she

hypothesized that participants with SP would have a higher heart beat detection accuracy than controls and participants with MDD.

In order to test her hypotheses, Meghan worked in the Stanford Mood and Anxiety Disorders Laboratory under the guidance of Ian Gotlib, Stanford Professor of Psychology, and graduate student Daniella Furman. Her sample included fifty-eight female participants: thirty control participants, seventeen participants with MDD, and eleven participants with SP.

To test for the participants’ heartbeat detection accuracy, research staff “hooked [the participants] up to an ECG machine.” She stated that “while the machine recorded their actual data, we had them count their heart beats for thirty-five, twenty-five, and then forty-five seconds.” After this baseline period at rest, the participants exercised on a step machine, “stepping up and down.” The participants’ counted their heartbeats during this exercise phase. Then in a recovery phase, the participants sat down and counted their heartbeats again. By comparing the participants’ counts of their heartbeats to the machine-recorded data, Meghan calculated the participants’ heartbeat detection accuracy. She used the ECG data to calculate the “variability of the time in between [her participants’] heartbeats,” in order to calculate their



Within each stage of Meghan’s three stage experiment, the participants count their heartbeats for thirty-five, twenty-five, and forty-five seconds. The participants use a step machine to raise their heartbeats in the middle stage.

heart rate variability.

The data supported Meghan's first hypothesis. She said that "MDD participants did show decreased heart rate variability at significant levels when compared [to] the SP participants and...the controls." As stated previously, past studies found that lower heart rate variability is associated with various psycho- and cardiac- pathologies. Meghan's experiment suggests that Major Depressive Disorder is related to decreased heart rate variability, and thus it may be a marker for mental and physical health problems.

Her data only partially supported her second hypothesis. Meghan said that "the SPs were significantly better at detecting their heartbeat than MDDs but not significantly better than controls." One explanation for the inconclusive results is that the "sample size was only 58." With a larger sample size, the data might show that SPs have higher heartbeat detection accuracy than controls. Her experiment thus may eventually extend the literature on introspective accuracy in social phobic individuals.

Interestingly, Meghan found that for both investigations into heart rate variability and heartbeat

detection accuracy, "the differences were only found at the baseline period, so when they were just sitting and doing the counting task." She is interested in exploring this phenomenon with further research.

In addition, Meghan wonders about "participants in the sample who have both MDD and SP." For these specific co-morbid patients, she questions whether there would be "some sort of leveling out" or "something completely different going on" for their heart rate variability and heartbeat detection accuracy.

Thus far, Meghan has presented her research at the Psych Summer Poster Session. For her senior Honors thesis, she plans to research a related topic. She said: "I'm really interested in looking at pain perception; it's related in the sense that how people perceive pain is similar to how one might perceive their heartbeat."

Overall, Meghan enjoyed her research experience in psychology. She said: "Honestly, I am in love with psychology. I find it fascinating to figure out why people do the things they do." The prospect of her research improving treatment for people with mental health disorders thrills Meghan. She adds: "That is why I love the Gotlib lab because it is the intersection of research and very practical implications."

Meghan Vinograd is a Junior pursuing a major in Psychology. She plans to earn a Ph.D. in clinical psychology. With her degree she wants to work in hospitals with children suffering from chronic illnesses and teach at the University level. Raised in Palo Alto, she is an avid Stanford sports and San Francisco Giants fan.



Differentiation of Light Sources Using Signal Analysis of a Photodarlington Circuit

Alborz Bejnood¹

Energy conservation is vital to ensure a continued high standard of living. One major source of waste is unnecessary lighting in homes and buildings. Distinguishing between situations where light energy is required and those where it is not can help reduce wasted energy. This project approaches the challenge by using a novel circuit to differentiate between fluorescent light and sunlight based on the properties of their light, as observed by a silicon phototransistor. Through the use of operational amplifiers, this circuit successfully differentiates between situations with no light, sunlight, and fluorescent light. This circuit can be used to reduce energy waste associated with maintaining fluorescent light in situations where enough external light is available.

Introduction

Over one-third of all lighting in the United States is wasted, at a cost of over U.S. \$2 billion each year¹. This paper describes a circuit that determines when a room would be sufficiently lit with sunlight alone. This would allow us to turn off fluorescent lighting to save energy.

Background

The key to determining the need for artificial light is being able to differentiate between sunlight and fluorescent light. The difference between the two forms of light comes from the nature of their sources; fluorescent lights use alternating current as a means for providing lighting, while sunlight is produced by nuclear fusion in a relatively constant amount. Fluorescent light produces an AC signal at 120 Hz, while sunlight produces a DC signal. While this difference is too subtle for a human eye to detect, more sensitive equipment may be used to differentiate between these two signals.

A phototransistor is the fundamental element in the light source characterization circuit. Sunlight does not constantly switch direction; therefore, sunlight incident on the phototransistor maintains

a constant state of low potential difference across the phototransistor. However, fluorescent light is sinusoidal in nature, leading to a regular change in the light intensity incident upon the phototransistor. This results in detectable changes in voltage across the phototransistor, in turn producing an AC signal.

These signals are typically small and need to be amplified in order to be detected. Operational amplifiers are one way to increase a signal's strength by up to several orders of magnitude. This effect is known as the voltage gain, defined as the ratio of an output-voltage change to an input-voltage change. By using the operational amplifier's property of gain, an alternating current signal obtained from a circuit can be increased in strength several orders of magnitude to an observable and measureable amount.

Methodology

To create a device capable of isolating this signal, several different elements were used. The primary element was a circuit to convert light to an

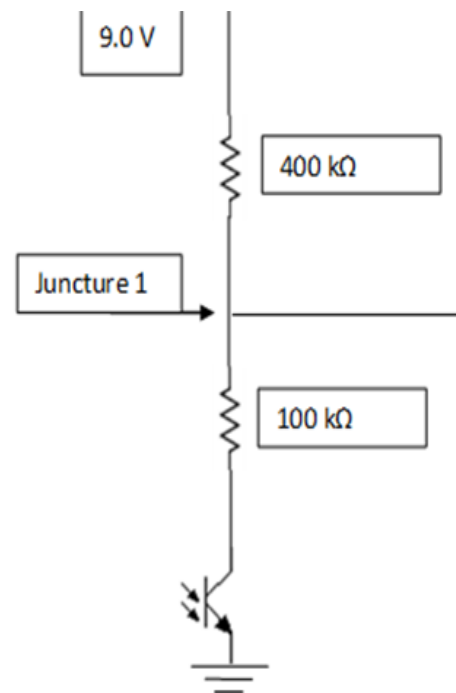


Figure 1 First segment of circuit. Bottom device (above ground) MAL12 Darlington phototransistor, used to obtain signal from light sources.

electrical signal, as seen in Figure 1. The bottom device shown is an MAL12 Darlington super alpha phototransistor, approximately ten times as sensitive to light as a normal phototransistor². This improves the

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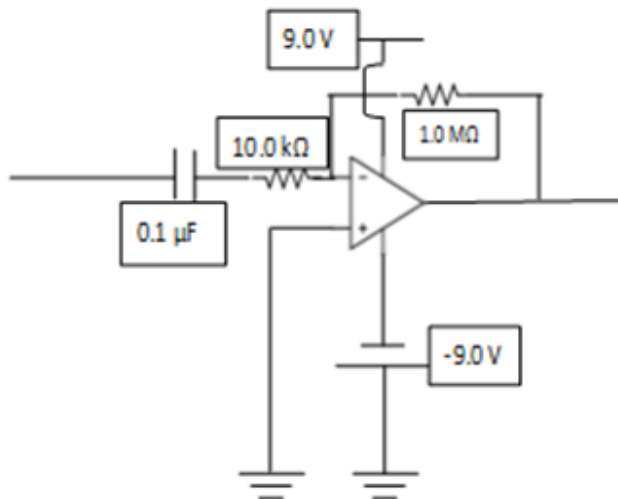


Figure 2 Second segment of circuit. Capacitor used to filter DC current; operational amplifier used to augment signal

response time to changes in stimuli. The resistance of the phototransistor decreases from approximately 1.0 MΩ in the dark to 30.0 Ω in bright light. The resulting effect is a change in the potential drop across the segment below the juncture given a light source, affecting the potential with respect to ground at juncture 1.

The first piece of this project focused on developing a method to distinguish between the presence of any form of light and darkness. This was done as illustrated in Figure 1. In the presence of a strong, incandescent light source, the potential was 0.0392 V; in the presence of fluorescent room lighting it increased to 0.512 V. In the absence of light, we measured a potential of 5.91 Volts.

Under fluorescent lighting, the signal at juncture 1 includes both an AC and a DC component, while under sunlight the signal produced has only a small DC value. In the dark, the signal at node 1 has a large DC value. Therefore it is necessary to separate and isolate the AC component from

the DC component of the signal. This was done with a capacitor in the second segment, as illustrated in Figure 2. A capacitor filters out a DC signal by exponentially reducing the current flow for a steady signal, moving while allowing an AC signal to pass.

The value of the capacitance chosen was determined by assuming a small reactance (the resistance of a capacitive or inductive circuit with an AC current passing through it) at 120 Hz relative to the 10 KΩ resistor at the input of the op amp. Assuming that the reactance is 0.1 of this resistor, the value of the capacitor may be found from the following equation:

$$0.1 * R = 1 / (C * \omega)$$

Here C is the capacitance, R is the resistance leading into the circuit, and ω is the angular frequency equal to $2\pi f$. Knowing the frequency of the “flicker” to be 120 Hz, the value for the capacitance was found to be $C = 1 \times 10^{-6}$ Farads (1 μF).

Sections two and three of the circuit, illustrated in Figures 2 and 3, respectively, make use of operational amplifiers to enhance the signal.

Thus, the total gain resulting from both operational amplifiers) was 600. This produced an AC signal with a maximum magnitude of approximately 100.0 mV (see Figure 4). While the amplified signal

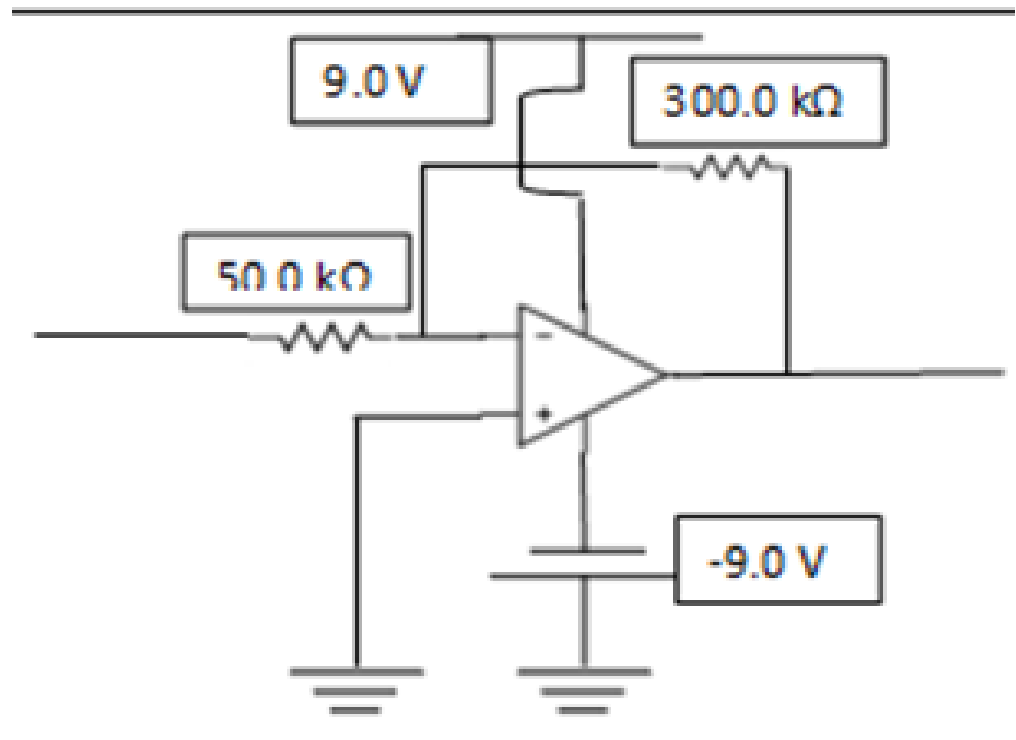


Figure 3 Second operational amplifier used; combined gain from second and first equal to 600.

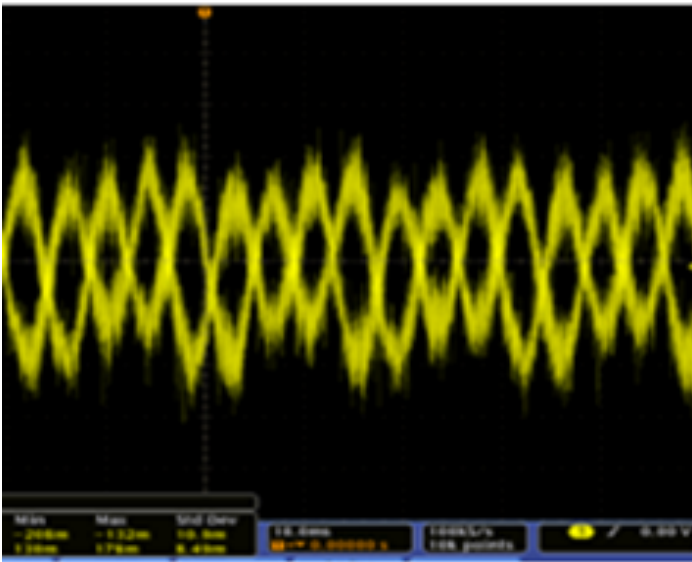


Figure 4 Oscilloscope image of AC current output. Maximum magnitude of 100 mV.

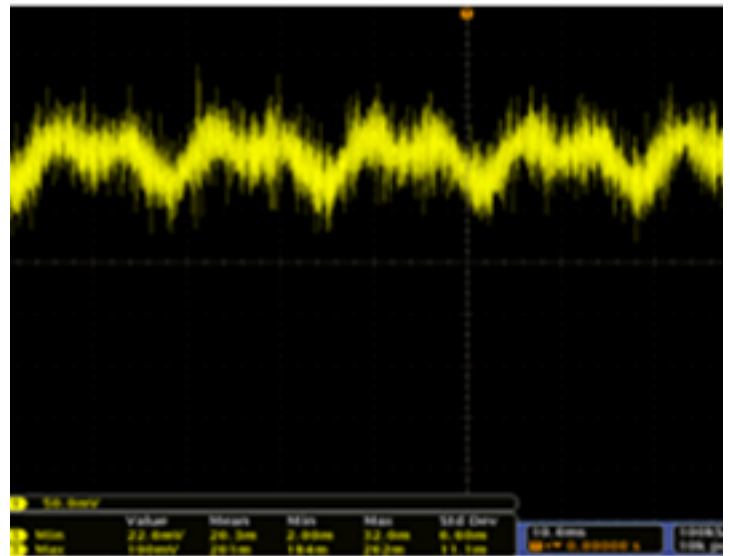


Figure 5 Oscilloscope image of noise output. Note DC offset at 70 mV, maximum signal magnitude of 50 mV.

produced a non-negligible signal, electromagnetic noise due to the discrepancy between the ideal and realistic nature of the circuit (a discrepancy that was also amplified by the circuit) also became significant. This noise had a maximum magnitude of approximately 50 mV, as shown in Figure 5. Additionally, the output signal had a DC offset of 70. The discrepancy was due in large part to the “leakage current” of the capacitor, as opposed to the idealized complete filter the capacitor is assumed to provide.

To resolve this, a comparator was used to discern between the true signal and the noise. The comparator’s reference point was set at 145.0 mV in order to block the noise while allowing the true signal through (see Figure 6), by accounting for the DC offset as well as the maximum noise magnitude. An LED was connected to the output of the comparator so that the behavior could be monitored with the naked eye. In the presence of just sunlight, the LED was off, while in the presence of fluorescent light, the LED was on.

Results

This design successfully discerned the difference between fluorescent light and sunlight. A signal was observed and amplified to a more significant and measureable strength, and was confirmed experimentally through use of an output LED. Figure 7 demonstrates the result of the AC current signal as output from the comparator in Figure 6. Note signal output switch for signal potentials over 75.0 mV to high output signal (approximately 9.0 V—see Figure 8 below). The final circuit design is shown in Figure 9.

Discussion

These results indicate that it is possible to successfully discern fluorescent light from sunlight. Future work and study can be done to optimize this process by

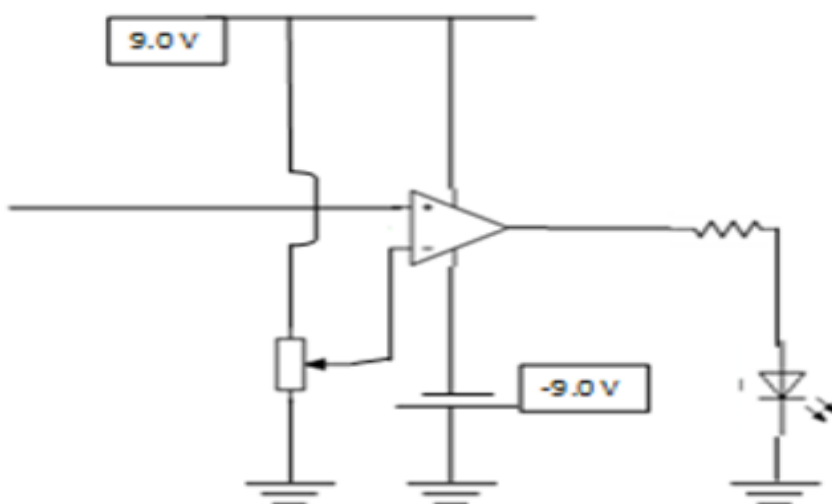


Figure 6 Comparator used to separate noise and true signal. Reference point made using potentiometer; set at 145 mV. LED on right end of circuit.

simplifying and improving the circuit design. Several directions can then be taken. One possible idea would involve merging this circuit with a motion sensor in order to determine human presence as well as situations with adequate light. Then, human presence would be used to activate a light switch providing fluorescent light, which will then be turned off again if the circuit detects enough sunlight or outside light. Similarly, the device could potentially be merged with an air conditioning system as a switch that activates air conditioning when detecting fluorescent light (and therefore, human presence), which would help conserve energy otherwise lost to unnecessary heating or cooling. The system may also be developed as an alarm to be placed inside a home or cabinet, which would be triggered if exposed to artificial light (as in the case of a thief or small child searching for a valuable) but immune to the dark inside its location or exposure from natural sunlight.

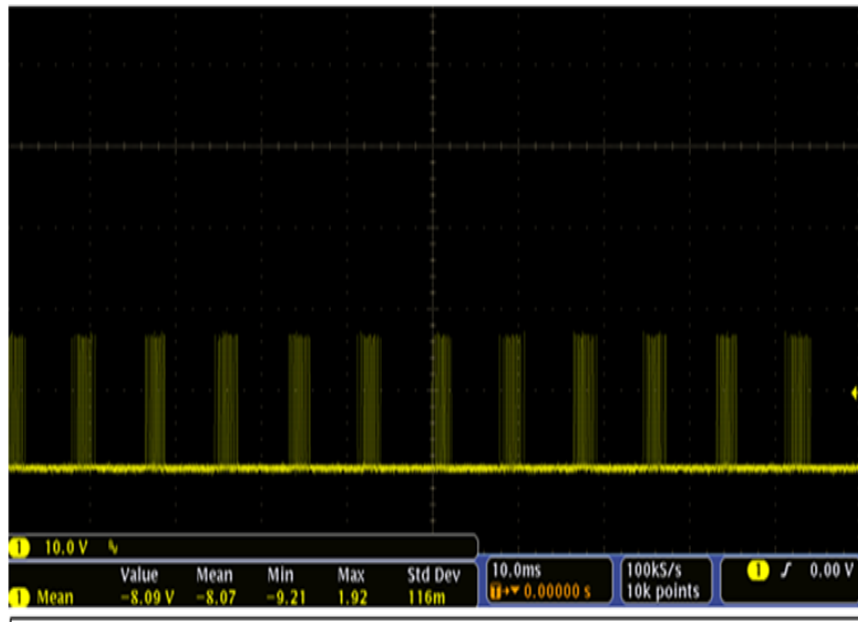


Figure 8 Oscilloscope image of signal output from comparator. Switches to 9.0 V for potential magnitudes over 75.0 mV approximately every 8.0 milliseconds.

Acknowledgements

I owe a great debt to my mentor, Dr. Kofi Korsah, for all the guidance and advice he has provided me throughout the course of this project. I am also grateful towards Dr. Roger Kisner, without whom the idea for the project as well as a great deal of help and advice would have been nonexistent. Also thanks to Oak Ridge National Laboratory, Sensor Science and Technology Group, for allowing me to use their facilities and building to work on the project. I am truly grateful to all for allowing me this opportunity to study and develop an interesting idea and project, and hope to again work on ideas and projects with the aforementioned mentors and facilities.

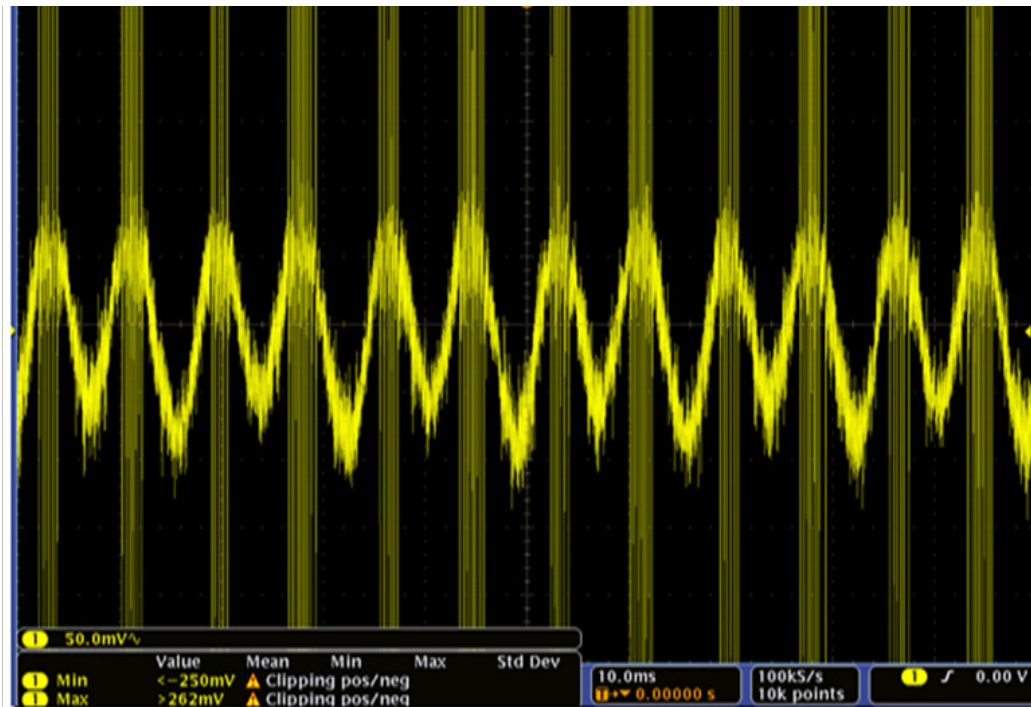


Figure 7 Oscilloscope image of signal output from comparator. Switches to high voltage for potential magnitudes over 75.0 mV.

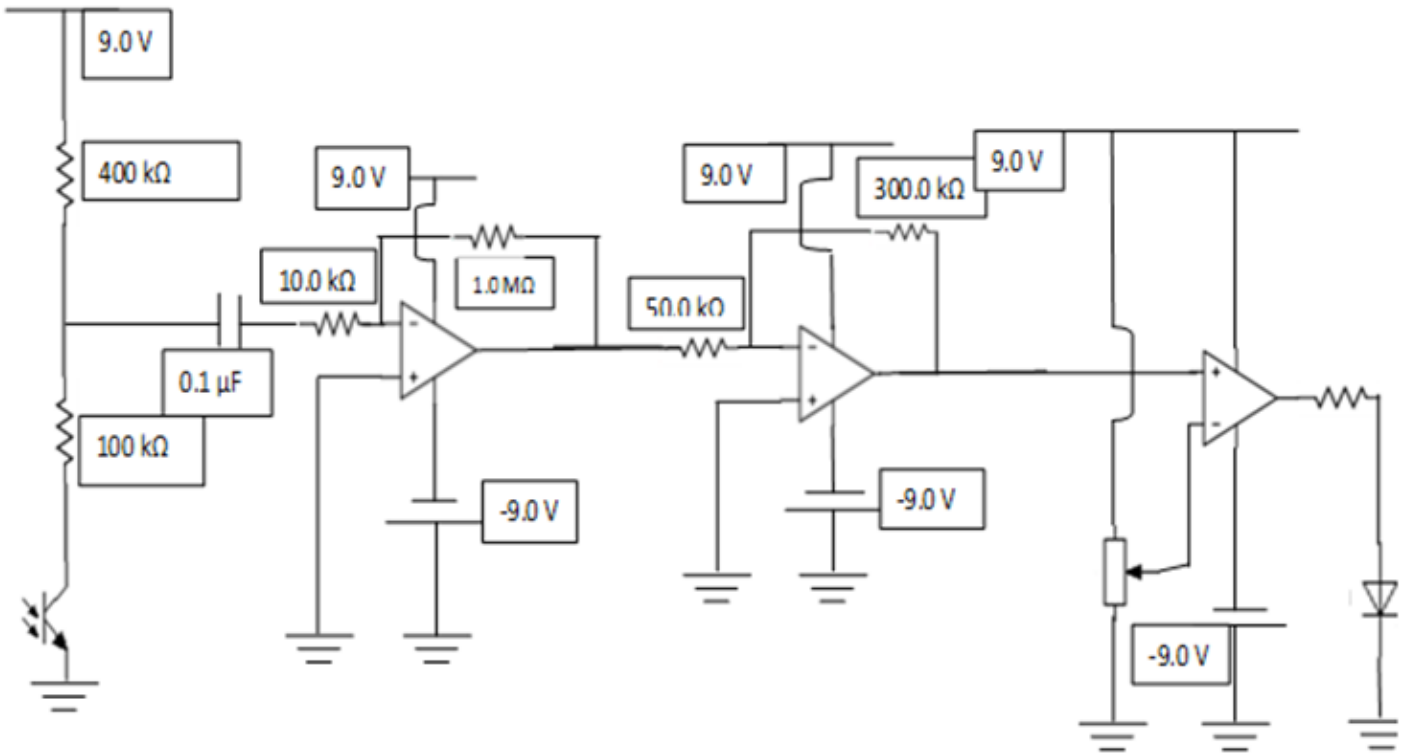


Figure 9 Overall circuit design created and used. Successfully discerns fluorescent light from sunlight.

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Alborz Bejnood is a Stanford freshman pursuing a major in Physics and minors in Astronomy and Math. He developed a passion for the topic at a young age from many discussions with his father. His other academic interests include international relations (perhaps a result of his childhood Risk games) and psychology. In his occasional spare time, he enjoys ultimate Frisbee, board games, and tennis, all of which he plays with more passion than talent but hopes to continue throughout his Stanford experience.



Predicting Outbreak Severity through Machine Learning on Disease Outbreak Reports

Rowan Chakoumakos¹

As the world continues to become more connected, diseases spread rapidly, as the 2009 H1N1 pandemic shows. Since medical resources are limited (especially in third-world countries) a challenge arises in selecting the outbreaks which are likely to become severe. To facilitate this decision, I present a machine learning system that aims to predict the epidemic potential of each disease outbreak report based on a combination of textual analysis of the individual ProMed-report, and geospatial data. The system exports the prediction along with the ProMed-report to Google Earth. The results show that the number of outbreak reports can be reduced based on severity with 80% precision and 63.3% recall.

Introduction

Manually accounting for all factors associated with a disease outbreak poses an intractable challenge. This research uses machine learning to these factors. The goal of creating this system is to aid in deciding whether an outbreak should get immediate attention. Based on the ProMed-mail disease outbreak reports and related data, I designed and implemented a machine learning system that aims to provide an instant indicator on the severity of an outbreak. In this paper, I will discuss the design and results of this machine learning system.

Background

Machine learning has two major components: the learner and the classifier. The learner, a mathematical algorithm, attempts to estimate the true class boundaries. Given the two classes (dot and square) shown in Figure 1, the learner

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divides them linearly based on the examples. This dividing line is the classifier, in this case the function $y=x$. If an unknown shape, called an instance, had an x-coordinate of 4 and a y-coordinate of 1, the instance would be correctly classified as belonging to the square class. As shown by the graph on the right in Figure 1, the prediction function does not match the true boundaries; rather it provides an estimate based on the limited examples available.

The System

The system can be divided into data collection, labeling, feature generation, learning, testing, and visualization (Figure 2). Essentially the system collects and parses various online data sets. The part of the collected data is then labeled. When an experiment is run, the features are dynamically generated from all available labeled data. A part of this labeled data is then used to generate a learner that is tested on the remaining labeled data. The results are then pushed to the visualization module. I will start by describing the various data sets that were parsed. Then I will discuss the methodology of labeling the data and generating features. After briefly discussing the visualization, I will present the experiments and their results.

The Base Dataset for Predicting

ProMed-mail¹, the Program for Monitoring Emerging Diseases, provides disease outbreak reports real-time. ProMed-mail comes from many sources including field doctors, clinics, international governments and the WHO. To ensure the validity of these outbreaks, all reports are moderated by a panel

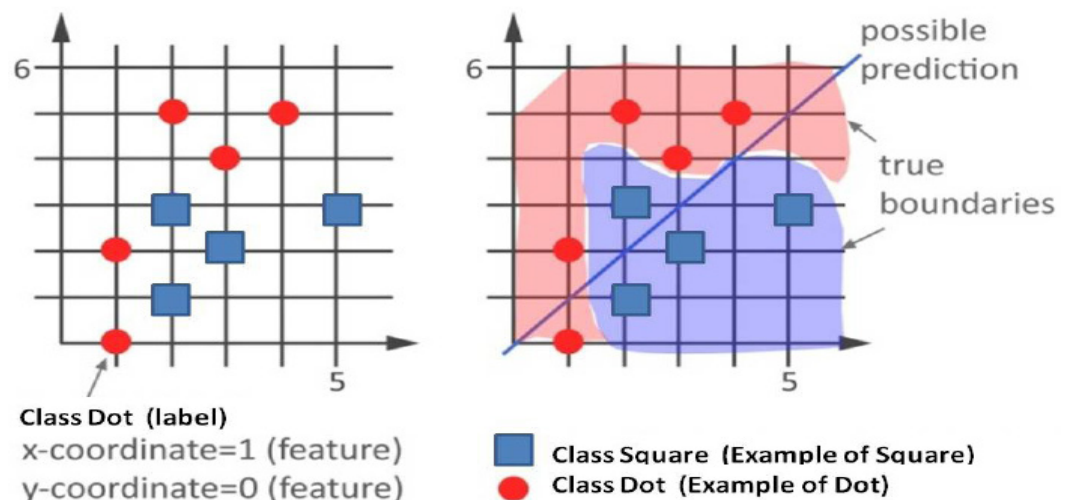


Figure 1 A simple example of machine learning in two-dimensional space.

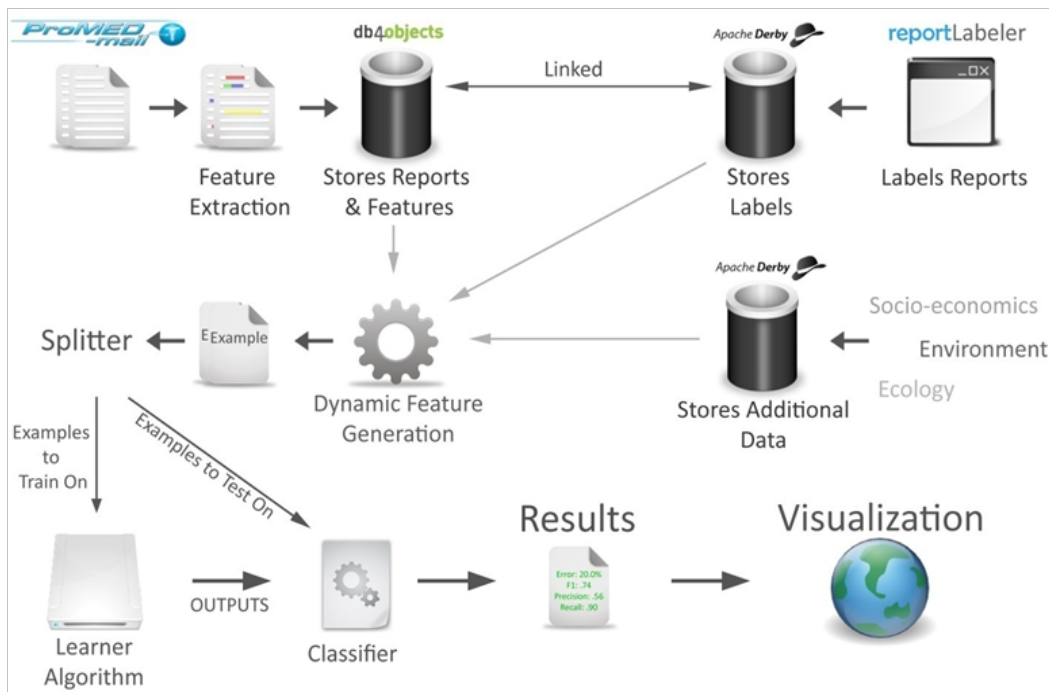


Figure 2 This diagram displays the general process of the system.

of experts before being published.¹ Reports unrelated to disease were removed from the extracted ProMed-reports. The most significant feature of ProMed-mail is that it receives outbreak reports well in advance of an epidemic, as shown in Figure 3. For instance, the first case of SARS was reported by ProMed-mail one month before WHO issued a warning.

Additional Data Sources for Predicting

Socio-economic data provides a wealth of information on a country's economy, education and health system. Over three hundred statistics were extracted from the Human Development Report (HDR) published by the United Nations Development Program. The HDR reports national data on over 170 countries. These statistics were general, ranging from GDP per capita to percent of population living below

the present were extracted because they represent epidemic-level outbreaks. Since the objective is to be able to predict the epidemic potential of an outbreak before it is apparent, the WHO reports could be reduced from 1,116 to 327 by ignoring WHO report updates which focus on epidemics which had already been declared. This dataset formed a set of epidemics that could be used to label the ProMed-reports.

Labeling the Dataset

The ProMed-mail reports were labeled in as either related or not related to a disease outbreak that developed into an epidemic. Several attempts were made to automatically label the ProMed-reports based on combined textual analysis of the ProMed-reports and the WHO reports. Unfortunately, automatic labeling performed poorly, so a manual labeling system had to

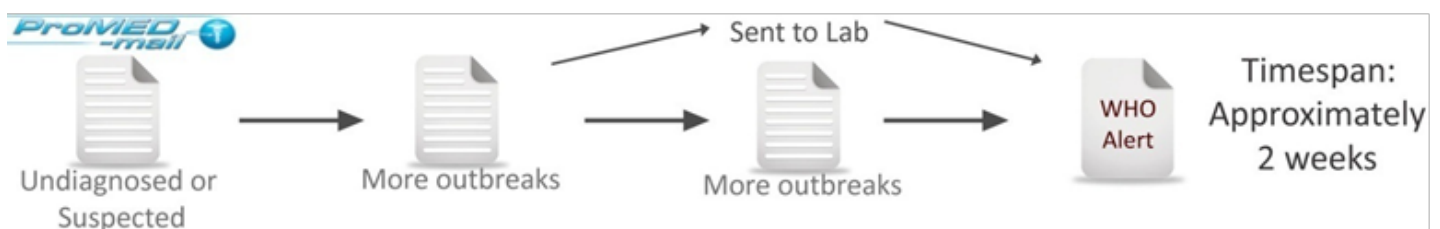


Figure 3 The generalized epidemic pattern in ProMed-mail.

\$1 a day. Because local health systems and water quality are also significant in outbreak development, additional data was extracted from the WHO Statistical System and Joint Monitoring Programme for Water Supply and Sanitation. Each of these sources provides national-level statistics that can be linked to the ProMed-report.

Dataset Used for Labeling

In order to have examples to train the learner, the WHO Disease Outbreak Reports from 2000 to

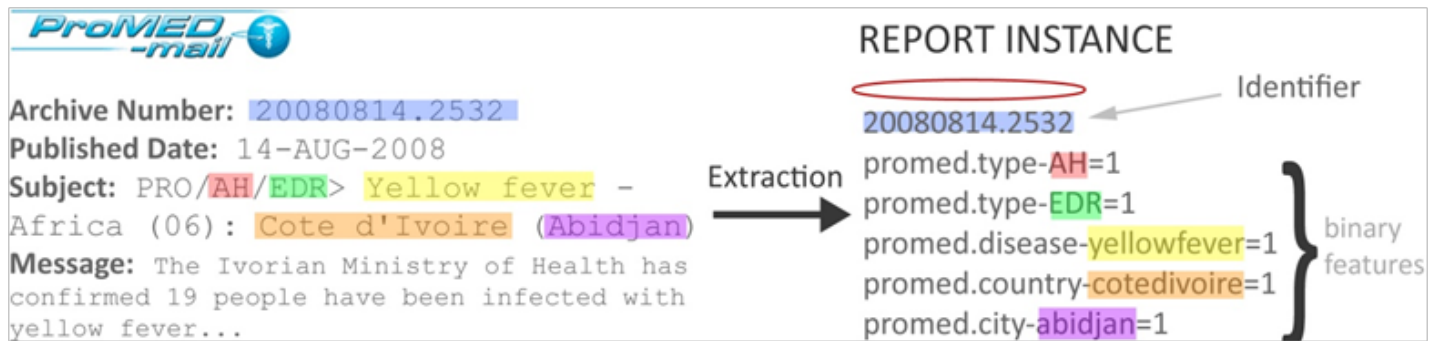


Figure 4 An example of the ProMed-report extraction process. Note that the published date is also extracted, however must go through further processing before being added to the report instance.

be created. I designed an internet application to label the ProMed-reports. The interface would display a WHO report and suggest possible related ProMed-reports. These possible related reports then would be manually verified as being actually related to the WHO report shown. The likely related ProMed-reports were chosen from reports whose extracted disease and location matched the WHO report. Unfortunately, not all of the ProMed-reports are associated with a known disease, meaning that all reports with unidentified diseases were also shown in the likely related list. To reduce the number of unrelated reports in the list, the final rule was that the ProMed-report had to be within the four months prior to the epidemic based on the observation that the vast majority of WHO reports would come out within at least two months of any ProMed-reports. I

was able to label just over 4,000 of the 22,000 ProMed-reports.

Feature Generation

Feature generation is a crucial task in machine learning. In order to produce an accurate classifier, the features must be representative of the true data. For the base dataset (referred to as “ProMed-Only”) in this machine learning model, only features that were directly taken from the ProMed-reports was used. The extracting process consisted of hundreds of regular expressions and lookup tables (abbreviations, misspellings, and etc.) that were manually optimized. This method was chosen because the ProMed-mail is relatively well structured allowing a high

accuracy to be achieved on this extraction process. (See Figure 4.) The baseline accounts for the following features extracted from the ProMed-report: disease, country, region/city, disease vector, type of report, and if the report is requesting information.

	ProMed-Only	Temporal-Geospatial	Statistics
Examples of Some Included Features	Disease	All Benchmark Features	All Benchmark & All Calculated Features
	Location (City, Country)	Report Density	GDP per capita from Extracted Country
	Type of Report	Distance from Last Report	Population living below \$1 a day (%)

Table 1 Comparison of the Different Feature Sets

Additional features were calculated from only the ProMed-reports. These features will be referred to as “Temporal-Geospatial.” Even though there has been no comprehensive study on the correlation of geo-spatial and temporal attributes of emerging infectious diseases,² the inherent nature of diseases forces a correlation. Each location extracted from the ProMed-reports was geo-coded. To capture the importance of location from the reports, a moving density average was calculated as shown in Figure 5. This function is maximized when there is high number of reports in a small area. Multiple

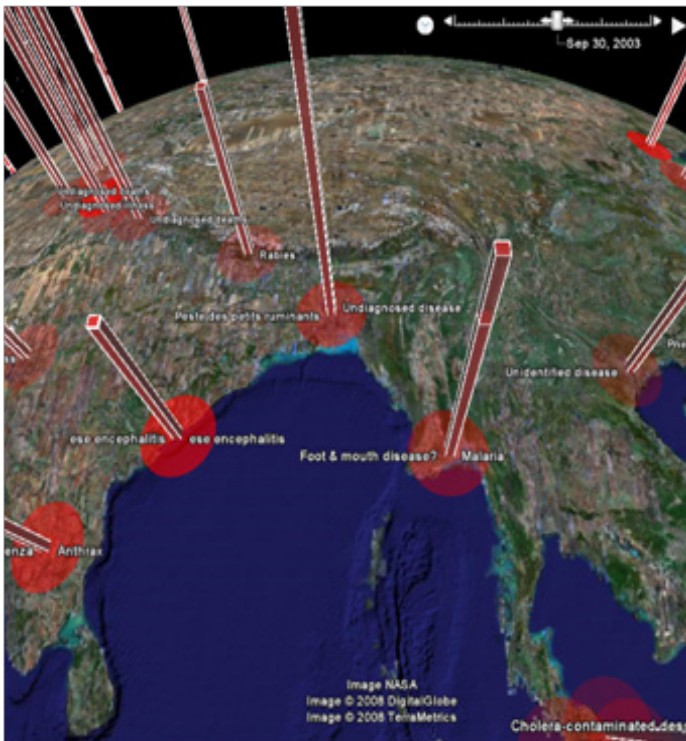


Figure 5 Visualization of predicted epidemics from ProMed-reports. This screenshot was taken from Google Earth.

moving density averages were calculated to account for both short and long-term effects, along with temporal effects.

Finally, the other datasets (socio-economics, etc.) were added to the datasets. This proved to be quite a challenging task as many of these features were not able to be processed raw. Thus, significant time was spent normalizing and translating these indicators into features that could be used in the model. These features will be referred to as the “Statistics” set. Table 1 provides examples from the various feature sets.

Visualization

To visualize the results, each ProMed-report and prediction was exported to Google Earth. A picture of this visualization can be seen in Figure 6. This representation was selected because it allowed clear display of both geo-spatial and temporal attributes. The prediction was represented by a scaled colored bar. The machine learning system updates the KML file in real-time as each ProMed-report is classified.

Methods

As stated before the features were divided into the following three sets: Benchmark, Temporal-Geospatial, and Statistics. Since no previous

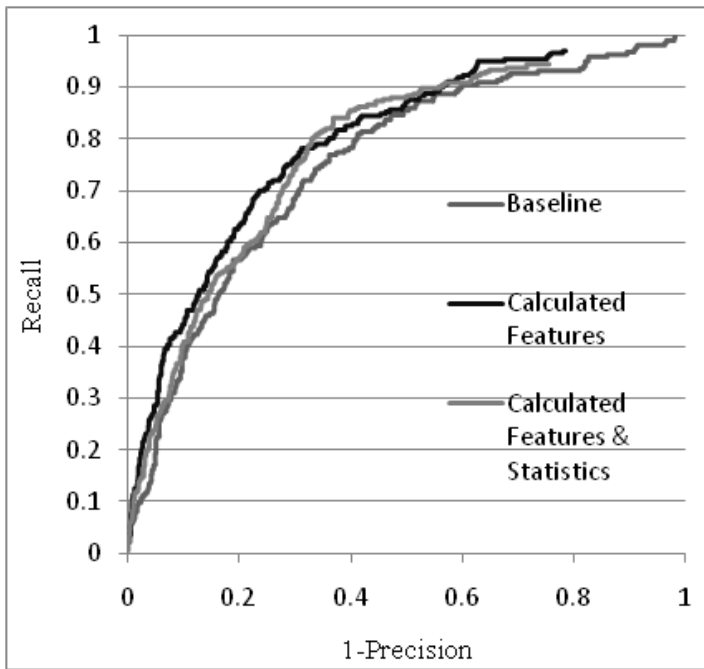
research has attempted to predict epidemic potential of an outbreak on this dataset, I established the ProMed-Only feature set as the benchmark to compare the addition of other features. The experiments were run on the following different machine learning algorithms: support vector machine (SVM), Naïve Bayes, and K-Nearest Neighbor learners (KNN) from the MinorThird library.³ A random fivefold splitter divided the examples into training examples and a test set (4 part training, 1 part testing). The training examples were used to train a learner that would then classify the remaining test set. In order to generate a percent likelihood of the outbreak in the ProMed-report developing into an epidemic, the confidence of the classifier was scaled and normalized based on all classified instances. The F-measure, the weighted harmonic mean of precision and recall, was used as an indicator of performance, along with the ROC.

Results

The results of these experiments can be seen in both Table 1 and Table 2. The highest F-measure obtained on the ProMed-Only feature set was .484 using the Naïve Bayes classifier. With the addition of the Temporal-Geospatial features, the Naïve Bayes once again had the highest F-measure of .513, a 6% improvement. The SVM had a significant improvement of 21%, when the Temporal-Geospatial features were added. To further validate that the Naïve Bayes was producing a statistically good classifier, the ROC area was calculated. The ROC area of .8 is considered to be generated by a good classifier, while .7 a mediocre. The highest ROC area achieved, .794, was on the Temporal-Geospatial feature set. Upon adding the Statistic features, there was a drop 2% in the ROC

Benchmark	SVM	Naïve Bayes	KNN - 2
Recall	0.284	0.500	0.468
Precision	0.527	0.469	0.398
F-Measure	0.369	0.484	0.430

Table 2 ProMed-Only in Different Learners



Graph 1 ROC of Naïve Bayes on Different Feature Sets

area. This drop can be accounted because the feature space more than tripled, yet the amount of labeled data did not change. Graph 1 shows the ROC curves of the Naïve Bayes algorithm on the different feature sets. As can be seen by the darkest line, this classifier achieved 80% precision with 63.3% recall.

Conclusion

I presented a machine learning system that could predict an outbreak's epidemic potential from the combination of a disease outbreak report and related data. Upon testing even the ProMed-Only feature set on unmodified machine learning algorithms, the classifier could reduce the set to a collection of more severe outbreaks. When adding the Temporal-Geospatial feature set, the improvement confirmed the assumption that these other features provided valuable insight. Thus, the results could be further improved by performing a more discriminating feature selection. (This research only tested adding all the features as a set.) The small decrease upon the addition of the

Rowan Chakoumakos, a freshman at Stanford University, is majoring in Mathematics and Computational Sciences with a focus on machine learning. He thanks his mentor Chris Symons from Oak Ridge National Laboratory for all his assistance. Rowan wants to launch a startup in the valley, with the larger goal of building a company or private research laboratory to seek solutions to the large problems facing society.

Statistic features suggests that more labeled data is needed. Since the majority of the time was spent building the infrastructure of the system and processing the different data, there is still significant optimization that can be applied to the machine learning algorithms themselves. Since the data has only a small population of positively marked examples, the SVM could be improved by optimizing on the f-measure instead of accuracy. With more labeled data and optimized algorithms, this type of machine learning system could assist in the decisions of which disease outbreak needs immediate attention based on the predicted severity of the respective outbreak.

Acknowledgements

This research would have not been possible without the amazing support and mentorship of Chris Symons for the past two summers at Oak Ridge National Laboratory. In addition, I would like to extend a special thanks to Benita Albert of Oak Ridge High School for her support. A portion of the work was performed at the Oak Ridge National Laboratory, which is managed by UT-Battelle, LLC under Contract No. De-AC05-00OR22725

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Carbon Dioxide Fluxes Along the Equatorial Pacific: Latitudinal Changes of Air-Sea Gas Exchange

Jessica Hinojosa¹

The equatorial Pacific is a key part of the global carbon system, serving as the world's largest natural source of CO₂. Understanding the dynamics that drive the flux of CO₂ from the atmosphere into the ocean is key in a rapidly changing world, where atmospheric CO₂ is rising faster than the ocean can adapt. This study observes in situ drivers of the CO₂ flux—pH, tDIC, and wind speed. An average regional efflux of approximately 1.14 mol CO₂/m²/yr was found for the transect from 15°S to 13°N. Flux out of the ocean peaked near the equator; where an equatorial upwelling system drives deep, CO₂-rich water to the surface, where it equilibrates with the atmosphere. This value is derived from a cubic dependence of flux on wind speed, though this relationship is sometimes expressed quadratically. Furthermore, the biological pump is not taken into account, as it is not expected to drive the system as much as wind speed.

Introduction

The equatorial Pacific is an extremely important component of the global carbon cycle, serving as the world's largest natural source of CO₂ to the atmosphere during a non-El Niño year. El Niño Southern Oscillation (ENSO) years present climatic anomalies that shift the balance of the global carbon cycle and are thus not normally taken into account in long-term

trends. Determining the magnitude of the flux depends greatly on the parameters used, and there exists some uncertainty about which parameters are necessary. Most models use wind speed as the most important driver of flux, though biological productivity is also often cited as an influence. However, observed iron limitation in the equatorial Pacific through the Joint Global Ocean Flux Study (JGOFS) by bottle incubations [3] and *in situ* fertilizations [2] would limit the biological pump's ability to have a large influence on the flux. Thus, for this analysis, rates of gas transfer will be determined by the equation:

$$\text{Flux} = K(p\text{CO}_2^w - p\text{CO}_2^a)$$

K represents the gas transfer velocity (k) multiplied by solubility (L) and $p\text{CO}_2^w$ and $p\text{CO}_2^a$ represent the partial pressure of CO₂ in the sea and air, respectively [6].

The ranges for CO₂ flux estimates within a particular region are often as large as 4 mol/m²/yr. The variability in the values is largely due to uncertainties about determining k . A recent study by *Boutin et al.* [1] used seven years of satellite wind data from the QuikSCAT scatterometer to refine the k - U relationship and determine a more accurate extrapolation of wind speed (U) to k , in order to calculate flux. Furthermore, there is disagreement over whether k is a cubic or

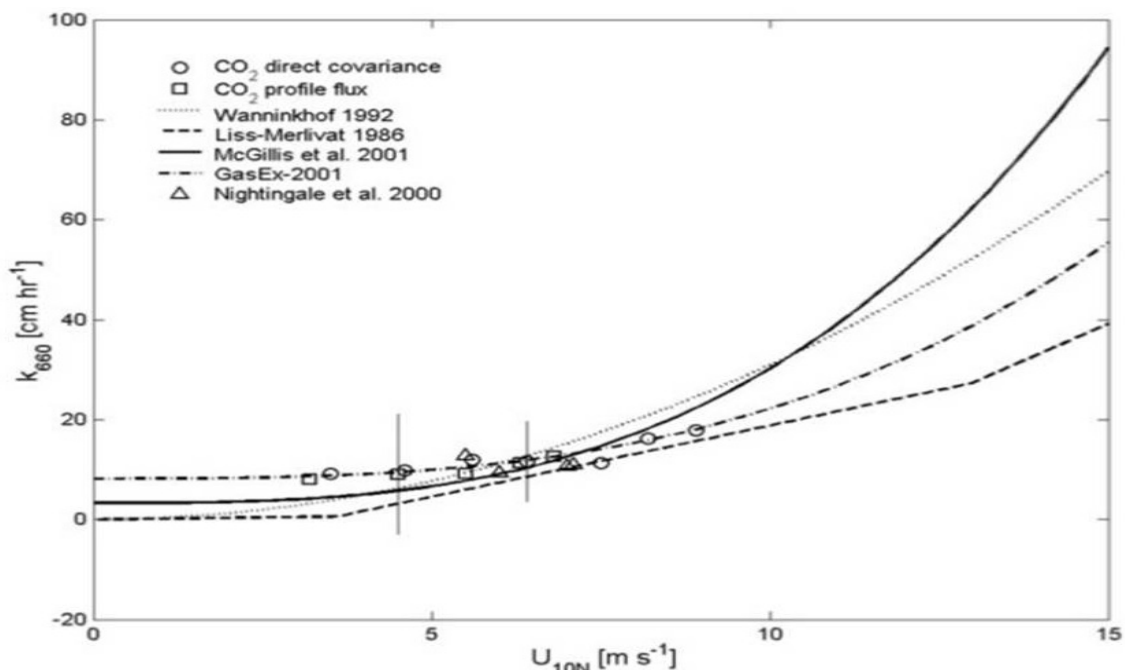


Figure 1 Several different relationships for k and U (wind speed). The solid line represents a cubic relationship, which is used in this paper [4].

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quadratic function of wind speed. Wanninkhof [4] presents an empirical relationship of $k = 0.39u^2 (Sc/660)^{-0.5}$, but Wanninkhof and McGillis [6] reestablish the relationship as $k = 0.0283u^3 (Sc/660)^{-0.5}$ due to the effects of surfactants and bubble-enhanced transfer. The Schmidt number (Sc) is defined as the kinematic viscosity of water divided by the diffusion coefficient of the gas, and in this paper is referenced to an average sea surface temperature of 28.6°C, producing a value of 437.27. There exist several other widely used k - U relationships, as seen in Figure 1 below from McGillis *et al.* [4].

The objective of this paper is to compare flux based on *in situ* measurements of pCO₂ and wind speed with the QuikSCAT satellite values for wind speed, and to quantify the amount of CO₂ effluxing from the region during an ENSO-neutral year. By collecting values for total dissolved inorganic carbon (tDIC) and pH in seawater and measuring wind speed with an anemometer,

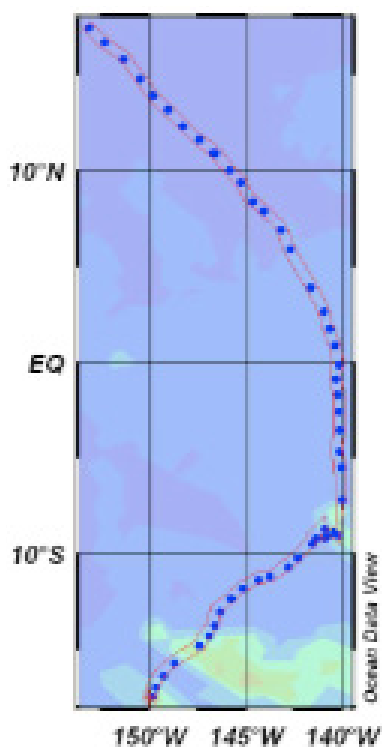


Figure 2 Transect of Robert C. Seamans cruise S223 during May-June 2009. Samples were taken at 25 stations along the cruise track to determine CO₂ flux.

regional fluxes can be derived. A cubic relationship for gas exchange is used. The *in situ* measurements were taken on the S223 cruise of the SSV Robert C. Seamans along a transect from Papeete, Tahiti to Honolulu, Hawaii.

It was expected that pCO₂ values would peak at the Equator due to equatorial upwelling, leading to a strong flux at that latitude with a lessening of the flux as latitudes increase and become farther away from the source of upwelling. Flux was also expected to be driven by the strength of winds along the

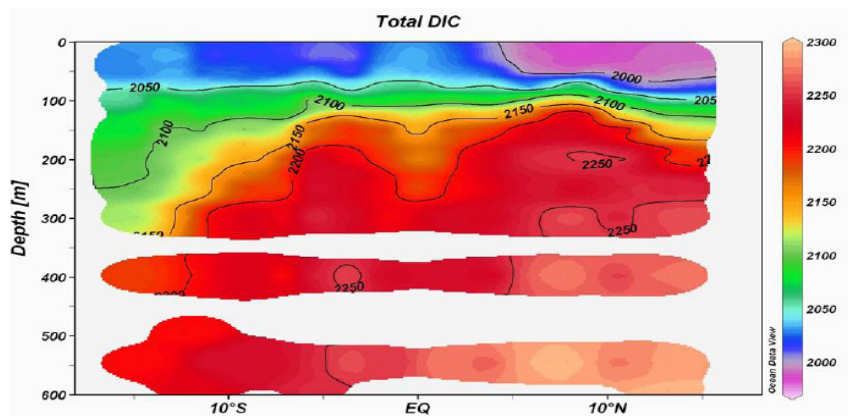


Figure 3 tDIC trends along the cruise track from sea surface to 600 meters depth. Areas of higher concentration are seen at depth in two plumes that border the equator. Levels at the surface are well-mixed. Blank bands represent depths at which no sample

track. It was expected that winds would slack at convergence zones, leading to a decreased flux value at those boundary. Strong, steady trade winds should lead to a steady flux, especially during ENSO-neutral years such as 2009.

Methods

Water samples were collected from 25 stations along the equatorial Pacific ranging from 15°S to 13°N and 140°W to 149°W (Figure 2) throughout the water column to depths of 600 meters. Samples were taken at significant oceanographic features, such as the South Pacific and North Pacific Gyres, the South and North Equatorial Currents, and the Equatorial Countercurrent. Hydrocasts were deployed at each location to collect water from layers of the water column. Samples from hydrocasts were tested for tDIC and pH.

To get tDIC, the samples were run through the LICOR 7000 CO₂/H₂O Analyzer. The LICOR analyzes the tDIC in seawater by acidifying the sample and causing the CO₂ to evolve into a gas. The machine then measures the absorbance of the gas to determine tDIC. This method was used for each of the twelve discrete samples collected per hydrocast.

The pH for the twelve discrete samples was taken with a Thermo pH electrode. The electrode was calibrated at the beginning of each run to prevent drift.

The pCO₂ was determined from pH and tDIC using the Excel program CO₂_SYS. The carbon system in surface water can be described by four main variables: pH, alkalinity, tDIC, and pCO₂. Given any two of the variables, the others can be calculated. The pCO₂ can be calculated given the following inputs: input salinity,

temperature, and pressure; output temperature and pressure; and tCO₂ and pH.

Wind speed was measured with an anemometer atop the foremast of the SSV Robert C. Seamans at approximately 40 meters. Wind speed used for the flux determination was an average of the one-minute true wind speed values for the half-hours before and after the hydrocast, creating a 60-minute average.

Next, the necessary parameters were input into the previously defined flux equation. The value for k was calculated using the equation $k = 0.0348u^3$ referenced to a Schmidt value of 437.27. Previous studies have used a normalized Schmidt number of 660 for CO₂ in seawater at 20°C. However, the number can be calculated for specific sea surface temperatures. For this cruise track, an average value of 28.57°C was used to calculate the Schmidt number using the following equation from *Wanninkhof* [5]:

$$Sc = A - Bt + Ct^2 - Dt^3$$

In this equation, t = temperature and the coefficients correspond to predefined values for CO₂ in seawater ($A = 2073.1$, $B = 125.62$, $C = 3.6276$, $D = 0.043219$).

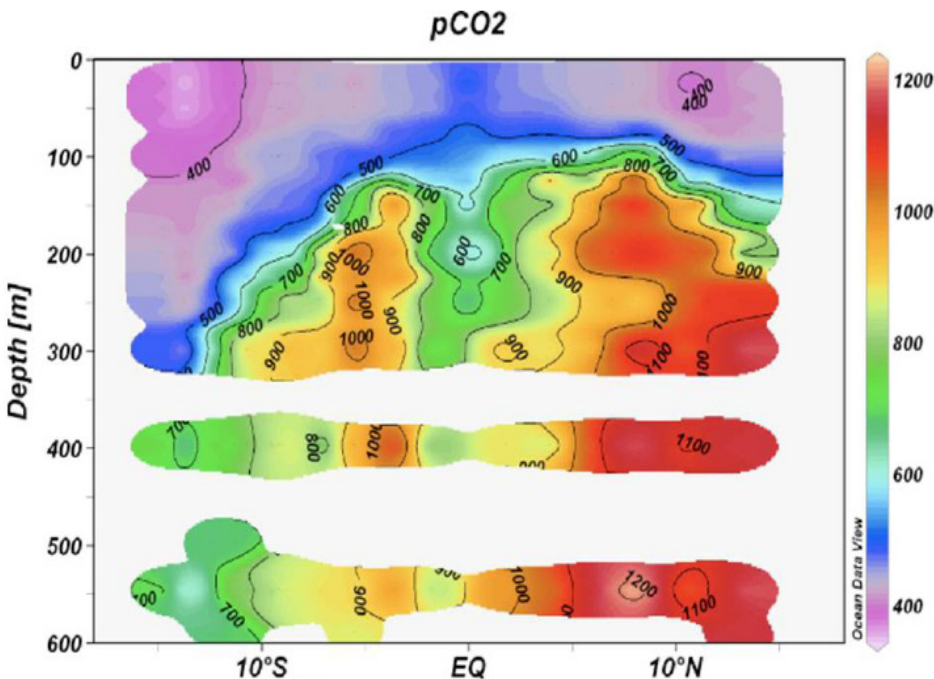


Figure 5 pCO₂ trends along the cruise track from sea surface to 600 meters depth. Highest values are found in the two plumes bordering the equator, with the plume in the Northern Hemisphere having higher partial pressures than the Southern Hemisphere plume.

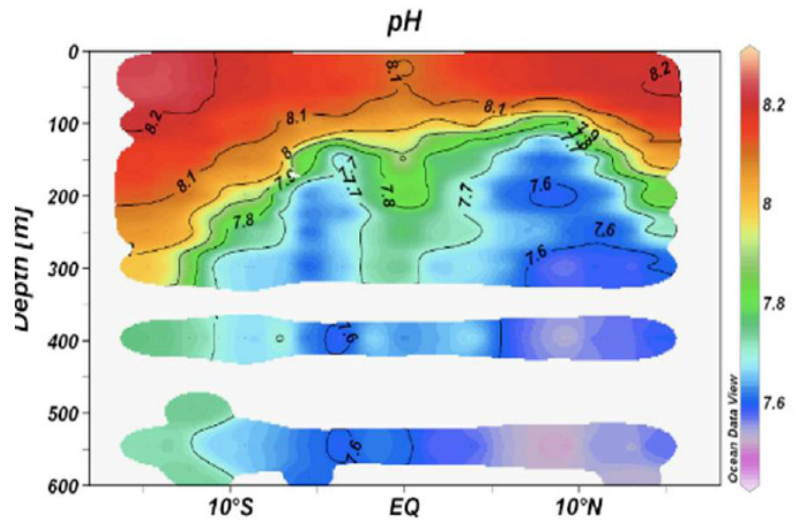


Figure 4. pH trends along the cruise track from sea surface to 600 meters depth. More acidic waters are found at greater depths in the two characteristic plumes around the equator. Blank bands represent depths at which no sample was taken.

The units for k are cm/hr; to get the units for flux, a conversion to K is required. This conversion can be made using the following equation from *Boutin et al.* [1]:

$$\frac{(K [mol m^{-2} yr^{-1} atm^{-1}])}{(k [cm hr^{-1}])} = 3.25 \times 10^{-3}$$

Multiplying the K value by the partial pressure difference between air and sea producing a flux of units mol m⁻² yr⁻¹. For this paper, an atmospheric pCO₂ of 386 ppm was used. To test the *in situ* flux values against QuikSCAT, a QuikSCAT flux for the 25 data sets was calculated using a $K = 0.05$, which was the average reported by *Boutin et al.* [1] for the region between 14°S and 14°N.

Results

The values for tDIC along the cruise track remained fairly constant at the surface, with values ranging from 1969.7 to 2040.4 um/kg. Beneath the well-mixed layer, tDIC concentrations increased in two plumes centered around the latitudes of 4°S and 8°N. A maximum value of 2315.1 um/kg was

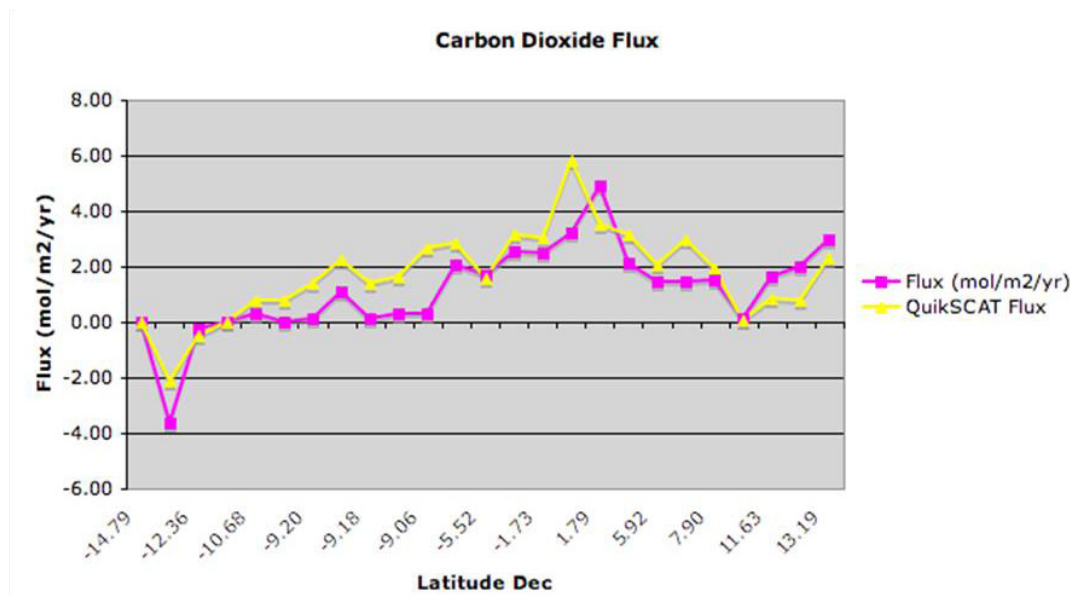


Figure 6 Flux magnitudes for the in situ calculated values and the values based on QuikSCAT seven-year satellite wind averages for the region between 14°S and 14°N.

collected at approximately 8°N x 144°W at a depth of 661 meters (Figure 3).

We saw similar trends between the pH and tDIC, with lower pHs observed in two plumes at the same latitudes. The lower pHs indicate more acidic water, which would correlate with a higher tDIC value and higher pCO₂. The pH at the surface ranged from 8.079 to 8.239. The lowest pH value seen was 7.493, at the same station and depth as the peak tDIC value. An upwelling plume of slightly more acidic water occurs directly at the surface water of the equator (Figure 4).

Given the two above parameters, pCO₂ followed the two-plume trend flanking the equator. At the mixed layer, values were near the atmospheric level of 386 atm, indicating an equilibration between air and surface ocean. Below that layer, values increase up to a maximum value of 1230.5 atm, which was observed at the same location of the lowest pH and highest tDIC but at a slightly higher depth of 546 meters (Figure 5).

Collected wind speeds ranged from 0.64 to 10.49 m/s, with an aggregation of high values between 11°N and 13°N. Using the *Wanninkhof and McGillis* [6] cubic k - U relationship, k values were calculated. These k values were then converted to K , which had a range of values from 0 (lowest wind speed) to 0.1305 (highest wind speed). Once K was determined, flux could be derived by multiplying K by the difference in partial pressures of CO₂ between the air and sea.

Calculated flux values ranged from -3.61 to 4.92 mol/m²/yr. There were two negative values, indicating a downward flux into the ocean, at latitudes 13°S and 12°S. North of this region of downwelling, the rate of efflux of CO₂ into the air increases, peaking at approximately 2°N.

Inputting the pCO₂ information along with the QuikSCAT seven-year average for the region between 14°S and 14°N ($K = 0.05$) [1], similar flux trends are observed (Figure 6). The two flux profiles have an $r^2 = 0.6565$, indicating a

decently strong covariance (Figure 7). Additionally, the QuikSCAT average includes seasonal variability and possible ENSO influence, which could decrease the covariance.

Discussion

The carbon system along the cruise track followed distinct trends across the parameters measured. The pH, tDIC, and pCO₂ were characteristic of equatorial upwelling, but an unexpected trend was seen as well. The divergence of low pH, high tDIC and pCO₂ waters at the equatorial surface could be a result of current dynamics in the equatorial water mass. A shoaling of the Equatorial Undercurrent was observed through the Acoustic Depth Current Profiler (ADCP), which could have depressed the mixed layer and prevented the upwelling from reaching the surface directly at the equator. As a response, the deep water mass split and shifted toward higher latitudes, where currents were not as strong and the mass could rise toward the surface.

The observed equilibration of pCO₂ with the atmosphere in the mixed layer was an expected trend, as mixing between that layer and the air is fairly rapid. The pH and tDIC values also were fairly uniform across the top 100 meters of the water column, delineating a boundary for the mixed layer. Below this well-mixed layer, isobars vary based on different parameters. The

$p\text{CO}_2$ increases with depth due to the higher presence of CO_2 in deep waters. In the shallower waters, this high level can be regulated by biological uptake, but below the photic zone the biological pump is restricted and cannot draw down CO_2 .

Furthermore, solubility increases with depth, which leads to higher tDIC and $p\text{CO}_2$ values. Within the mixed layer, a steady solubility value of 0.03 mol/kg/atm was observed, but the values increased to 0.05 mol/kg/atm down the water column. This observed trend correlates with the gradient of $p\text{CO}_2$ and tDIC. A corresponding decrease in pH was expected and observed as well. Higher tDIC occurred in conjunction with a declining pH, indicating more acidic water and a higher abundance of bicarbonate and aqueous CO_2 , which would correspond with higher $p\text{CO}_2$.

Latitudinally, the northern plume exhibited more extreme values for all three parameters: lower pH, higher tDIC, and higher $p\text{CO}_2$. The flux for the latitudes from the equator to approximately 12°N were steadily declining, perhaps due to weaker winds at the Intertropical Convergence Zone (ITCZ). The decreased gas evasion out of the ocean might have a top down effect in preventing the ascension of deeper waters. However, flux values at the higher latitudes in the Southern Hemisphere are also low, yet the plume does not seem as extreme. It is possible that there are other unexamined parameters, such as water mass movement, biological productivity, or solubility gradients that could be causing the difference in magnitude of the two plumes.

At the air-sea interface, the flux trends correlate with some observed wind trends. The dip in flux in the region north of the equator aligns with the ITCZ, where winds slacked due to convergence. The flux values begin to rise again as winds pick up further north, where the trade easterlies resume their normal strength. While wind speeds observed *in situ* produced K values of 0 to 0.14, the K value used from the QuikSCAT average was 0.05. The correlation of the trend lines indicates a well-averaged data set by *Boutin et al.* [1]. This paper ground truths the satellite estimates of air-sea

CO_2 exchange.

In order to streamline the observations and modeling in future projects, a single k - U relationship should become standard, along with standardized units. High variation in methods and expressions in carbon science adds confusion and uncertainty to a system that needs much clarity.

Further studies that would help the observation system would be 1) test *in situ* wind speed observation versus satellite observation for a discrete time sample, 2) test for other variables affecting the system, and 3) model the system to test responses to rising atmospheric CO_2 . The first study is necessary because this paper uses satellite wind data averaged over seven years, which includes ENSO abnormalities and seasonal fluctuations. The best way to test the accuracy of satellite wind observation would be to compare it with *in situ* collection over a discrete period of time. Second, the other parameters that affect flux should be monitored closely, especially the biological pump. While there may be some nutrient limitation that prevents a strongly influential biological pump, that part of the system should not be ignored in determining flux values. Finally, an eye toward the future could help to forecast possible responses of the equatorial Pacific to atmospheric CO_2 rise.

Conclusion

The *in situ* data collection along the transect

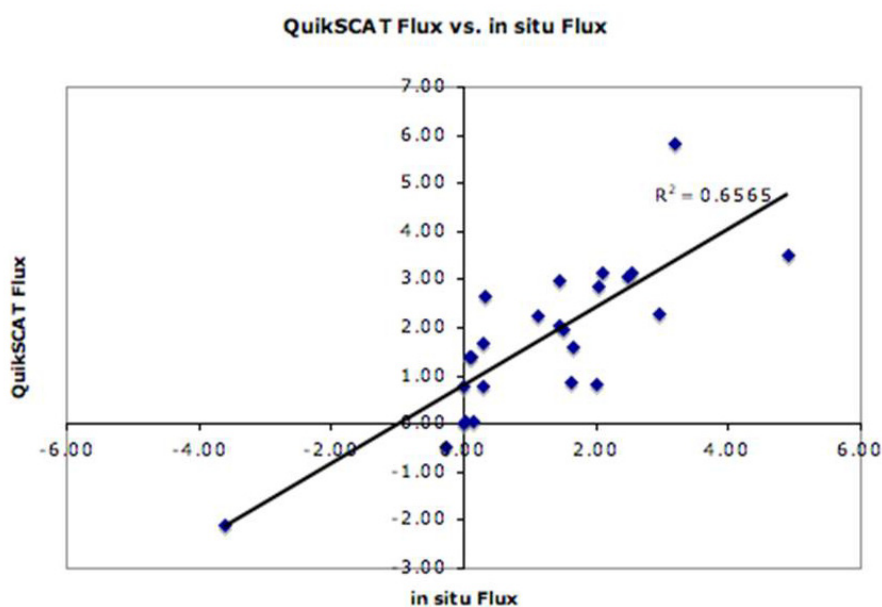


Figure 7 Scatter plot of QuikSCAT vs. *in situ* flux values. An $R^2 = 0.6565$ shows indication of covariance between the two data sets.

produced several clearly visible trends. First, there is a strong source of upwelling at the equator, and as this deepwater shoals, CO₂ effluxes into the atmosphere. Second, the flux is driven by wind trends in the region, and a peak in outgassing is seen at the equator. The flux dynamics currently in place correspond with previously observed dynamics and agree with what was expected. However, this system is largely based on equilibration with the atmosphere, which is a rapidly changing system.

As anthropogenic CO₂ continues to increase at a rapid pace, the partial pressure gradient between the air and sea changes, shifting the zones of sources and sinks. In order to track the evolution of the carbon cycle dynamics, constant and thorough monitoring is imperative, especially in key regions such as the equatorial Pacific. This paper shows that satellite data can be used for wind speed measurements, which helps to lessen the need for expensive and time-consuming *in situ* observation. Nonetheless, pCO₂ should be measured in the field. There exists an array of TAO buoys in the region that monitor the parameters of the carbon system along the water column, which is a strong initial infrastructure to begin to fully understand the carbon cycle in this region.

Most necessary is a continuous monitoring of the carbon cycle in the region and globally. The world's oceans serve as a net sink for CO₂, but a decreasing Revelle factor and a shifting partial pressure gradient are limiting the endless buffer capacity that is

often assumed to exist. Understanding the system as thoroughly as possible will help to determine future carbon system dynamics in a changing world.

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The Effect of NEDCR1 on Epidermal Differentiation

Grace E. Kim¹

The objective of this study was to investigate the function of a long non-coding RNA (lncRNA) termed NEDCR1 (non-coding epidermal differentiation complex RNA) as a regulator of differentiation gene expression and homeostasis of human epidermis. NEDCR1 expression was found to be dramatically higher in calcium-induced differentiating keratinocytes when compared to undifferentiated keratinocytes and human squamous cell carcinoma (SCC) samples. As a result, NEDCR1 expression was hypothesized to be necessary for proper epidermal differentiation, and thus, inhibition of NEDCR1 was thought to interfere with the differentiation of human epidermis. A loss of function experiment, using a small interfering RNA against NEDCR1 (siNEDCR1), was performed to knockdown NEDCR1 expression. Quantitative real time polymerase chain reaction (qRT-PCR) analysis revealed reduced fold expressions of NEDCR1 and the differentiation markers filaggrin and keratin1 in the knockdown skin when compared to the control. Immunofluorescence staining showed reduced levels of differentiation markers filaggrin, keratin1, and transglutaminase in the knockdown skin when compared to the control. These results indicate that the knockdown of NEDCR1 causes a reduction in differentiation, and thus, the amount of NEDCR1 present in keratinocytes plays a role in controlling epidermal differentiation.

Introduction

Only about 1.2% of the human genome encodes for proteins but at least 93% is transcribed into RNA^{1,2}. Until recently, it was unclear whether this large amount of non-coding RNA (ncRNA) played a biologically relevant role or represented mere transcriptional waste^{1,2,3}. Recent studies point to the functional significance of ncRNAs, which have been discovered to partake in a variety of important biological processes, including gene regulation, RNA processing, translational control, gametogenesis, stress response, and morphogenesis⁴. Functional studies in diverse organisms indicate that in

particular, certain long ncRNAs serve as key molecular mediators of gene regulation^{5,6}.

Given the rapidly increasing amount of evidence for the importance of ncRNAs as gene regulators^{5,6}, it is very probable that long ncRNAs play an integral role in the initiation and maintenance of tumorigenesis. For example, several long ncRNAs have recently been identified to exhibit tumor-related, altered expression levels in prostate cancer^{7,8,9} as well as lung, breast, and ovarian cancers¹⁰. In addition, a recent study demonstrated that a large number of ncRNAs showed altered expression in human leukemias and carcinomas, and that inhibition of one over-expressed ncRNA induced apoptosis in colon cancer cells¹¹. The biological function of ncRNAs stands as an emerging area of research that promises to prove valuable to our understanding and consequent treatment of carcinogenesis.

The major goal of this study was to elucidate the role that NEDCR1 plays in contributing to the regulation of differentiation gene expression as well as homeostasis of human epidermis. NEDCR1 is one of nine new ncRNAs identified within the epidermal differentiation complex (EDC) on chromosome 1q21 by members of the Khavari Lab. NEDCR1 is of special interest for several compelling reasons. It displayed dramatically different fold expressions in various epithelial tissues throughout the human body (*Figure 1*). NEDCR1 was not only expressed at substantially higher levels in skin compared to other tissues but

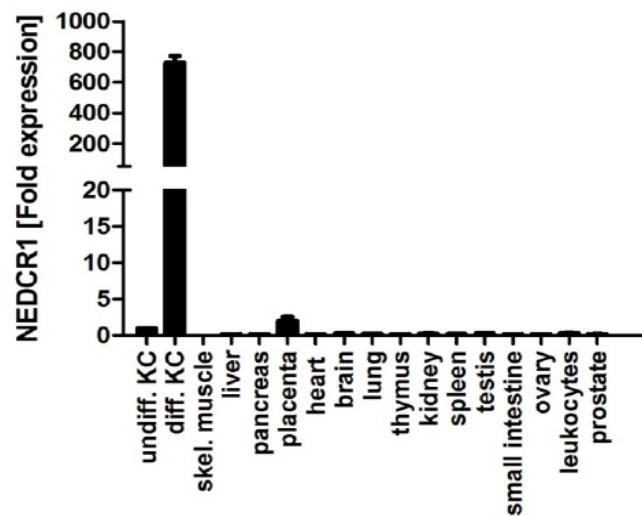


Figure 1 NEDCR1 is highly expressed in differentiating keratinocytes and barely expressed in undifferentiated keratinocytes and other epithelial tissues throughout the body.

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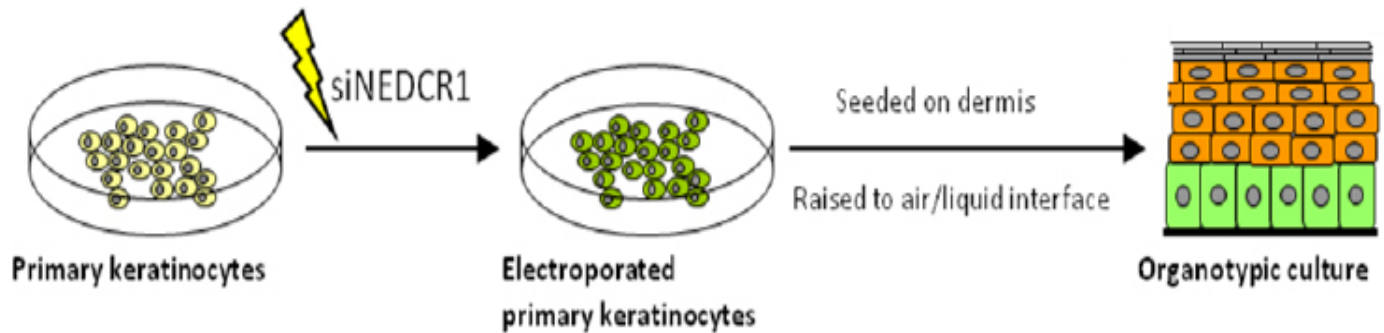


Figure 2 Primary human keratinocytes were nucleofected with siNEDCR1 and siControl and then seeded on devitalized human dermis.

actually appeared to be non-existent in most tested tissues (with the exception of very low expression in the placenta). In addition, NEDCR1 expression was altered by calcium-induced keratinocyte differentiation, suggesting that it may play a role in the physiologic control of differentiation. NEDCR1 is highly expressed in differentiating epidermal keratinocytes and is significantly suppressed in undifferentiated keratinocytes. Moreover, NEDCR1 displayed reduced expression in human SCC tumor specimens as opposed to normal control skin. This disparity indicates that NEDCR1 represents a marker, and potentially a functional regulator, of epidermal differentiation and tumorigenesis in spontaneous epidermal cancer. Through a loss of function experiment, this study set out to demonstrate that expression of NEDCR1 is necessary for proper epidermal differentiation. Consequently, inhibition of NEDCR1 was hypothesized to result in

differentiation defects in human epidermis.

Materials and Methods

Overview

To determine the functional impact of NEDCR1 on epidermal differentiation, a loss of function experiment was carried out to knock down the expression of NEDCR1. To achieve reduced expression of NEDCR1, a small interfering RNA was generated against NEDCR1 (siNEDCR1) and nucleofected into human keratinocytes, which give rise to the epidermis in human skin. By targeting and binding to the NEDCR1 transcript in keratinocytes, siNEDCR1 mediated cleavage followed by complete degradation of NEDCR1, thereby producing an efficient knockdown. In order to more accurately study the effect of reduced NEDCR1 expression, the knockdown was analyzed in organotypic skin cultures, which represent 3D human skin models. Human epidermal tissue was regenerated from the nucleofected keratinocytes on devitalized human dermis using methods developed and routinely used by the Khavari Lab¹². To compare the extent of epidermal differentiation in the control and knockdown skin, immunofluorescence staining against various differentiation markers in human skin was used. As a more quantitative measure, qRT-PCR analysis was performed to determine the relative amounts of differentiation gene sequences, including filaggrin, keratin1, and transglutaminase (TGM). In addition, the relative amounts of the NEDCR1 transcript were also measured to confirm the knockdown efficiency.

Nucleofection

The following procedure was done in biological triplicates for both the knockdown and control samples. 1.0 nmol of siNEDCR1 was nucleofected into 1 million primary human keratinocytes isolated from human foreskin. 1.0 nmol of a negative control

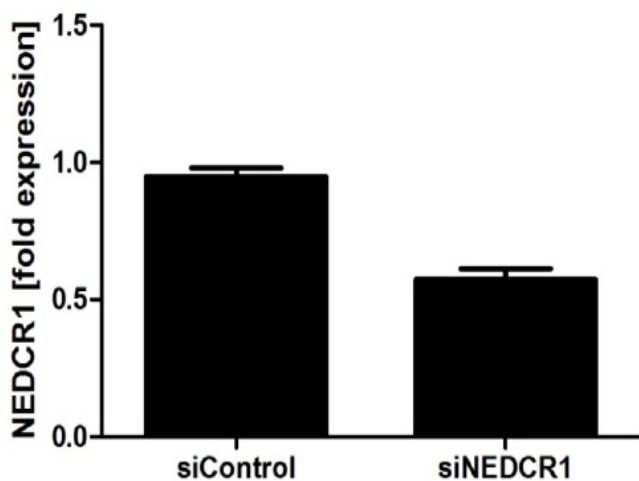


Figure 3 The siNEDCR1 produced a fold expression of 0.55 when compared to the control. The error bars represent small variations among the triplicates that were tested for the knockdown and control samples.

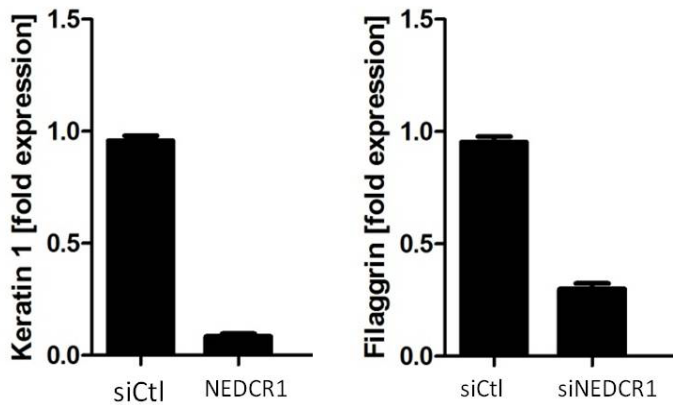


Figure 4 The knockdown of NEDCR1 produced a significant decrease in expression levels of filaggrin and keratin1 in the knockdown skin when compared to the control.

siRNA (siControl), which did not target any specific gene product, was also nucleofected into 1 million keratinocytes. The nucleofected keratinocytes were plated and allowed to grow overnight at 37°C in a low-calcium, serum-free growth medium supplemented with epidermal growth factor (EGF) and bovine pituitary extract.

Organotypic Skin Cultures

The keratinocytes were detached from the plates using trypsin. 300,000 control cells and 300,000 siNEDCR1 cells were each seeded on top of a square of devitalized human dermis suspended above keratinocyte growth medium (KGM) and raised to the air-liquid interface (Figure 2). These skin cultures were allowed to grow at 37°C for four days.

Quantitative Real Time Polymerase Chain Reaction (qRT-PCR) Analysis

After giving the primary keratinocytes four days to form epidermis on top of the dermis, the organotypic skin cultures were harvested. Half of the dermal/epidermal square was used to obtain RNA. RNA was isolated using the Qiagen RNeasy Mini Kit according to the manufacturer's instructions. 2 µg of RNA was purified by treating it with DNase, and 1 µg of the purified RNA was used to synthesize cDNA by incubating it with reverse transcriptase for 1 hour at 42°C. The resulting cDNA was used to perform a qRT-PCR analysis using the Brilliant SYBR Green QRT-PCR Master Mix Kit from Stratagene. Control primers for the L32 gene, primers that targeted filaggrin and keratin1, and previously tested primers that were known to target NEDCR1 were all used in the qRT-

PCR analysis.

Immunofluorescence Staining

The other half of the dermal/epidermal square that was harvested from the organotypic skin cultures was embedded in Tissue-Tek® O.C.T. compound for cryosections. 7-µm tissue sections were cut and adhered onto glass slides. The specimens were fixed with acetone or methanol and stained with Hoechst, which is blue under UV light, to help distinguish individual nuclei. The specimens were then subjected to primary antibodies against collagen VII, filaggrin, keratin1, and transglutaminase (TGM) followed by staining with fluorescent secondary antibodies. The slides were finally analyzed under the microscope, and photographs of representative areas of the skin were taken (Figure 5).

Results

The results of the qRT-PCR analysis displayed the knockdown of NEDCR1 (Figure 3). After the fold expression of NEDCR1 was normalized to the control to find the relative expression changes between the control and knockdown skin, the fold expression of NEDCR1 in the keratinocytes nucleofected with the siNEDCR1 was found to be an average of 0.55. In addition, the qRT-PCR analysis demonstrated the reduced expression of the differentiation markers filaggrin and keratin1 in the knockdown skin when compared to the control (Figure 4). After normalizing to the control, the fold expression of filaggrin and keratin1 in the knockdown skin were found to be 0.3 and 0.1, respectively.

The IF staining results provided a visible confirmation of reduced differentiation levels in the knockdown skin (Figure 5). The fluorescence intensities of all three differentiation markers filaggrin, keratin1, and TGM were clearly reduced in the knockdown skin compared to the control. Also, the proliferation and penetration of the fluorescence staining into the epidermis was less extensive in the knockdown skin.

Discussion

As expected for a knockdown, the siNEDCR1 successfully produced a fold expression of less than 1.0 after the control had been normalized to 1.0. This reduced expression indicates that the siNEDCR1 was able to effectively target and mediate the degradation of the NEDCR1 transcript in keratinocytes. The achieved knockdown efficiency of 0.55 was adequate enough to

produce both a quantifiable phenotype confirmed by qRT-PCR and a visible phenotype confirmed via IF staining. The qRT-PCR results demonstrated that reducing the NEDCR1 expression level by almost half caused a 70% reduction in filaggrin expression levels and 90% reduction in keratin1 expression levels in the knockdown skin compared to the control. Since both filaggrin and keratin1 point to the extent of differentiation, the knockdown skin with reduced levels of both differentiation markers was less differentiated than the control. The only variable was the amount of NEDCR1 present in the keratinocytes, and consequently, the knockdown of NEDCR1 can be concluded to be the cause of the observed reduction in differentiation.

The IF staining results provided further evidence for the decreased extent of differentiation in the knockdown skin. The staining revealed that filaggrin, keratin1, and TGM were present in a greater number of keratinocytes and penetrated deeper into the epidermis in the control skin (1 x NEDCR1) compared to the knockdown skin (0.55 x NEDCR1), indicating that differentiation in the knockdown skin was not as far advanced as in the control. In addition, the control had stronger fluorescence than the knockdown skin, suggesting a greater concentration of TGM, keratin1, and filaggrin in the control skin. Since all three markers indicate greater extent of differentiation, the control skin was further differentiated than the skin with reduced NEDCR1 expression. These IF staining results again confirm those of the qRT-PCR analysis in demonstrating that keratinocytes with reduced levels of NEDCR1 are less likely to differentiate.

In an attempt to minimize the effects of variability among keratinocytes and skin culture conditions, the experiment was performed in biological triplicates for both the knockdown and control. The lack of large differences in NEDCR1 knockdown levels and differentiation marker levels among replicates helped confirm the uniformity of experiment conditions. The NEDCR1 knockdown level of 0.55

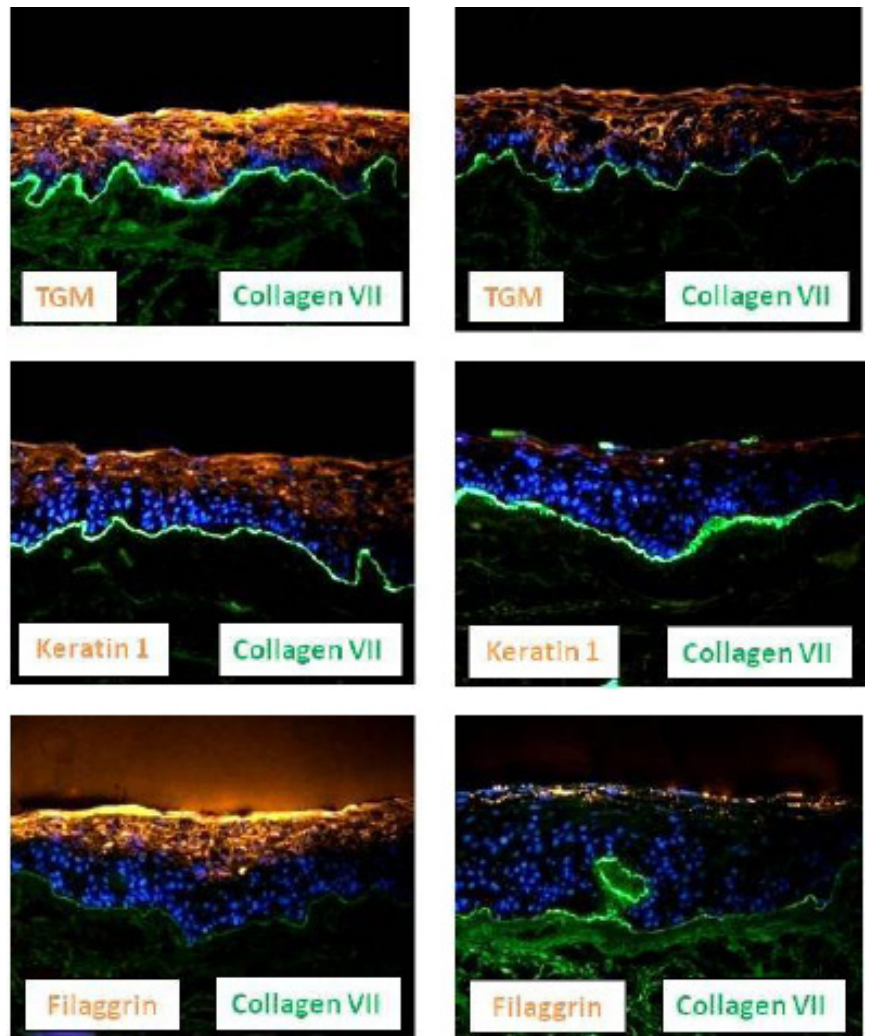


Figure 5 The knockdown skin displayed decreased levels and proliferation of TGM, keratin1, and filaggrin.

was adequate to produce a significant phenotype, but in the future, a more effective knockdown would be desired. In addition, future experiments should utilize multiple siRNAs against NEDCR1 to rule out the highly unlikely albeit feasible possibility of off-target effects as the cause of the observed reduction in differentiation. To further demonstrate the role of NEDCR1 in epidermal differentiation, gain of function studies that involve over-expressing NEDCR1 in keratinocytes would help confirm its importance.

Conclusions

The qRT-PCR analysis revealed a reduced fold expression level of 0.55 for NEDCR1 as well as decreased expression levels of 0.3 and 0.1 for filaggrin and keratin1, respectively, in the knockdown skin when compared to the control skin. IF staining also indicated visibly lower levels and reduced proliferation of filaggrin, keratin1, and TGM in the knockdown skin

when compared to the control. Together, these results demonstrate that the knockdown of NEDCR1 causes a reduction in differentiation. Consequently, the amount of NEDCR1 present in keratinocytes can be concluded to produce a substantial impact on the extent of epidermal differentiation. This study highlights the function of NEDCR1 as a gene regulator and by doing so, emphasizes the importance of lncRNAs as a worthwhile area of research that holds the potential to expand our understanding and treatment of carcinogenesis.

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Grace Kim is currently a junior majoring in Biology. As a member of the Khavari lab, she is studying the function of long, intervening non-coding RNAs (lincRNAs) and their relevance to skin cancer. After graduation, Grace hopes to pursue a career in academic medicine.

Limb Remote Preconditioning Inhibits Tim-3/galectin-9 Expression and Blocks Free Radical Generation after Focal Ischemia in Rats

Nicholas Chan¹

We recently demonstrated that limb remote ischemic preconditioning (LRP)—clamping and subsequent reperfusion of the femoral artery of the limb—protects against focal stroke, however, there is almost no research on mechanisms by which LRP distally offers cerebral protection. This study addresses how LRP affects the Tim-3/galectin-9 pathway and free radicals. Tim-3, a member of the T cell immunoglobulin and mucin domain (Tim) family, triggered by its ligand galectin-9, induces Th1 cell death and is expressed in neurons; whether it is an inducer of neuronal death is not known. Inducible nitric oxide synthase (iNOS), nitrotyrosine, and cyclooxygenase 2 (COX-2) are well-known free radical markers that contribute to ischemic injury. We assessed the hypothesis that LRP reduces Tim-3, galectin-9, iNOS, nitrotyrosine, and COX-2 protein expression. Stroke was generated by permanent occlusion of the left distal middle cerebral artery with 30 min occlusion of the bilateral common carotid arteries in male rats. LRP was generated by 5 or 15 min occlusion followed with the same period of reperfusion of the left hind femoral artery. Western blot showed that both Tim-3 and galectin-9 increased at 24h after stroke ($p < 0.001$). LRP blocked increases in both Tim-3 and galectin-9 at 24h ($p < 0.001$). iNOS expression increased at 1h, 5h and 24h in control ($p < 0.001$, 0.01, 0.05, respectively); with LRP inhibiting these increases at all time points ($p < 0.001$). Similar inhibition was found for

nitrotyrosine, but interestingly COX-2 overexpression was not inhibited. Immunostaining showed similar overexpression and inhibition. LRP may block brain injury by attenuating activities of the Tim-3/galectin-9 pathway, iNOS, and nitrotyrosine, while overexpression of COX-2 may not be a critical factor for ischemic injury.

Introduction

Inflammatory response is involved in the mechanisms of neuronal death after stroke; however, how inflammation after stroke is regulated is not clear. Many factors, including cyclooxygenase-2 (COX-2), inducible nitric oxide synthase (iNOS) and Tim-3, are implicated in inflammation. COX-2 and iNOS are well-known free radical generators. iNOS overexpression produces nitric oxide leading to products of nitrotyrosine, which is also a marker for inflammation. COX-2 is responsible for production of prostaglandins,

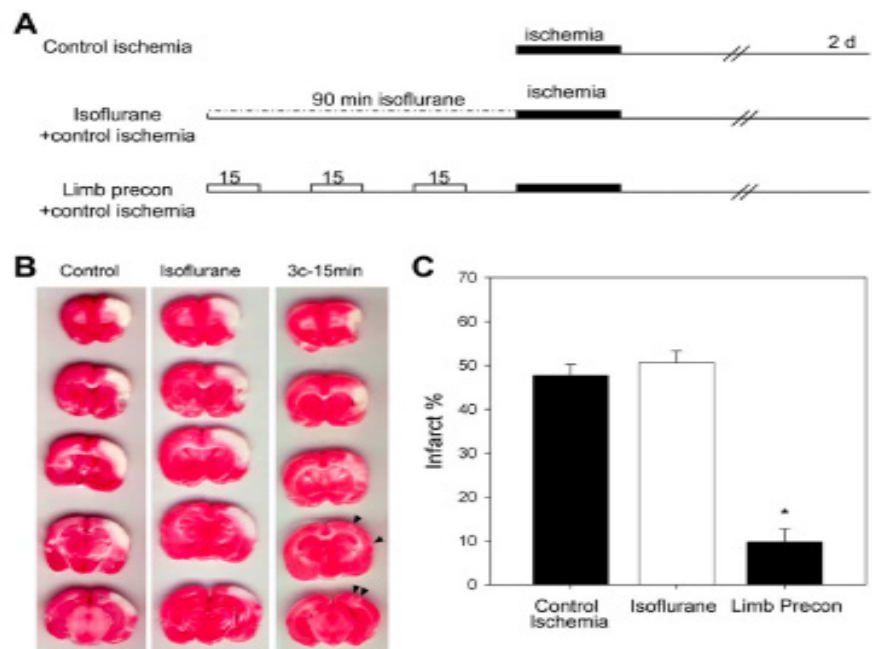


Figure 1 Rapid limb preconditioning reduced infarct size after stroke.

A. Surgery protocols. Two control groups, control ischemia only and isoflurane plus control ischemia, were studied. Limb preconditioning was induced by 3 cycles of 15 min occlusion/15 min reperfusion in the ipsilateral hind limb. B. Rats were killed 2 days after stroke and rat brains were chopped into 5 slices. Infarcts were stained by TTC, and infarct cortex of each slice was measured and normalized to non-ischemic cortex as a percentage. Representative infarcts stained by TTC from each group are shown. C. Bar graphs show the average infarct size of the 5 slices. Con-isc, control ischemia; Iso-isc, isoflurane of 90 minutes before ischemia onset; 3c-15 min, 3 cycles of 15 minutes. * vs each of

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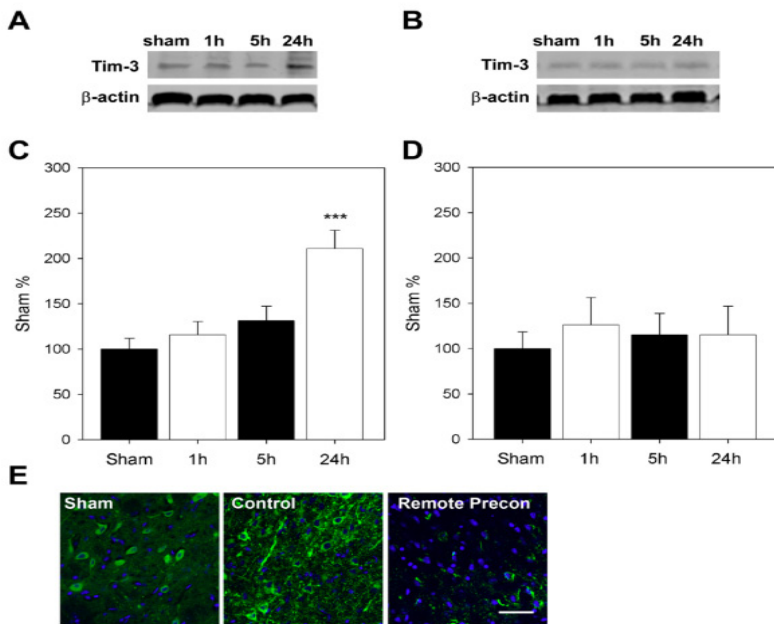


Figure 2 Tim-3 expression was increased after stroke, which was inhibited by remote preconditioning. Representative protein bands of Tim-3 and beta-actin are presented for rats receiving control ischemia alone (A) and ischemia plus remote preconditioning (B). The bar graph indicates that Tim-3 was immediately increased as early as 1h, reached a peak at 24h after stroke (C), which was inhibited by remote preconditioning (D). ***, vs sham, $P < 0.001$. $N = 6$ /group. The results were further confirmed by the study of immunofluorescent confocal microscopy in control ischemia and remote preconditioning 24h after stroke (E), whereby green fluorescence is Tim-3 staining.

which causes inflammation. Tim-3, a member of the T cell immunoglobulin and mucin domain (Tim) family, has double roles in regulating inflammatory response (Anderson et al. 2007). When it is expressed on CD4+T help 1 (TH1) cells, it is triggered and activated by its ligand galectin-9, which causes calcium influx and cell aggregation inducing TH1 cell death, therefore, it inhibits inflammatory response by eliminating Th1 cells (Su et al. 2008). However, when Tim-3 is expressed on macrophage, microglia and dendritic cells, it promotes inflammatory response (Anderson et al. 2007). Tim-3 is also expressed neurons in the brain (Gielen et al. 2005), but its role in the brain is not known.

Limb remote preconditioning, which refers to repetitive ischemia/reperfusion induced in a hind limb, reduces brain injury induced by stroke. Thus, a surgery done distally in the limb protects the brain after stroke. Such a surgical technique has promising clinical applicability, for example in surgeries where

the risk of brain ischemia is high. LRP research started in protection from myocardial infarction, and has been found to be clinically effective in protection from myocardial infarction during cardiac surgery, increasing patient post-operative outcomes (Venugopal et al., 2008; Kharbanda et al, 2009). The exact nature of signal transduction from limb to organ is not well studied, but evidence suggests remote preconditioning is multimodal acting on several pathways such as afferent signals from the remote organ and reducing inflammation (Schoemaker et al., 2000). LRP is also a good model for testing mechanisms of stroke injury. We have shown that remote preconditioning with limb ischemia reduces infarction after focal ischemia (Ren et al, 2008); the first goal of this project was to confirm these results. We then studied changes in galectin-9 and Tim-3 after stroke, and the protective effects of LRP on the galectin-9/Tim-3 pathway and on the production of COX-2, iNOS and nitrotyrosine. This study will address the translation of protection from limb to brain in terms of inflammation, and mechanisms of injury in stroke.

Materials and Methods

Focal cerebral ischemia

This is the experimental parallel to an ‘induced stroke’. Focal cerebral ischemia was generated in male Sprague–Dawley rats as previously described (Zhao et al., 2006), approved by the Stanford University Administrative Panel on Laboratory Animal Care. Anesthesia was induced by 5% isoflurane and maintained with 2% to 3% isoflurane during surgery and early reperfusion. Core body temperatures were maintained at 36.2–37.2 °C using a heating pad and light; blood pressure, heart rate, respiratory rate, blood glucose and pH, and PaO₂, PaCO₂ were monitored throughout surgery.

A ventral midline incision was made and the two CCAs were isolated. Snares were placed around the CCAs and the animal was placed on its right side. A 2-cm vertical scalp incision was made midway between the left eye and ear. The temporalis muscle

was bisected and a 2-mm burr hole was made at the junction of the zygomatic arch and squamous bone. The distal MCA was exposed and cauterized above the rhinal fissure. The CCA snares were tightened to occlude the CCAs for 30 min and then released, while the distal MCA remained occluded.

Limb remote preconditioning

This surgical ‘treatment’ was performed before focal ischemia surgery. Male Sprague–Dawley rats were anesthetized by isoflurane. Rats had the left femoral artery separated below the left groin ligament for induction of femoral artery occlusion. Rats were subjected to three cycles of 15 min occlusion/reperfusion of the femoral artery before the induction of stroke. After preconditioning in the limb, the rats were immediately subjected to the brain ischemia.

Immunofluorescence staining and confocal microscopy

Rats were perfused transcardially with normal saline followed with 4% paraformaldehyde. Sections were blocked in and incubated in primary antibodies overnight; antibodies were against Tim-3 (1:100; Santa Cruz Biotechnology; sc-30326), Galectin-9 (1:50; Santa Cruz Biotechnology; sc-19292), Cox-2 (1:400;

Cayman; 160106), Nitrotyrosine (1:50; Millipore (Chemcon); 92590). Neurons were stained with MAP-2 (1:200; Sigma; M4403); astrocytes were stained with GFAP (1:1000; Sigma). Sections were washed and incubated for 2h at RT in secondary antibodies, mounted, coverslipped and examined under a LSM510 confocal laser scanning microscope (Carl Zeiss, Thornwood, NY). Negative controls, in which the primary antibodies were omitted were run in parallel, and an isotype-matched negative control for staining was conducted.

Western blots

To determine protein expression of Tim-3, galectin-9, iNOS, Nitrotyrosine, Cox-2 at 1h, 5h, and 24h after stroke onset, brain tissues corresponding to the ischemic penumbra were used. Samples were lysed with RIPA buffer, extracts homogenized and insoluble debris removed by centrifugation. Protein concentration in the resulting supernatants was calculated using a Pierce protein assay kit according to the manufactures instructions (Pierce, IL, U.S.A.). Protein samples were loaded and separated using 4-15% SDS-polyacrylamide gel electrophoresis (Invitrogen, CA, U.S.A.) and transferred to nitrocellulose membrane. Membranes were scanned using Typhoon trio (GE Healthcare). We used primary antibodies against Tim-3 (1:500; Santa Cruz Biotechnology; sc-30326), Cox-2 (1:1000; Cayman; 160106), Nitrotyrosine (1:500; Millipore (Chemcon); 92590), iNOS (1:10000; BD Biosciences 610431), β -actin (1:10000; SIGMA; A3854-200 μ L). Band measurements were taken using ImageQuant software measurements of optical density.

Statistical analysis

Two-way ANOVA was used to compare the protective effect of LRP on protein bands from Western blots. Differences in protein bands within the same condition were analyzed using one-way ANOVA followed by Fisher LSD post-hoc test. All tests were considered statistically significant for P values <0.05. Data is presented as means \pm SEM.

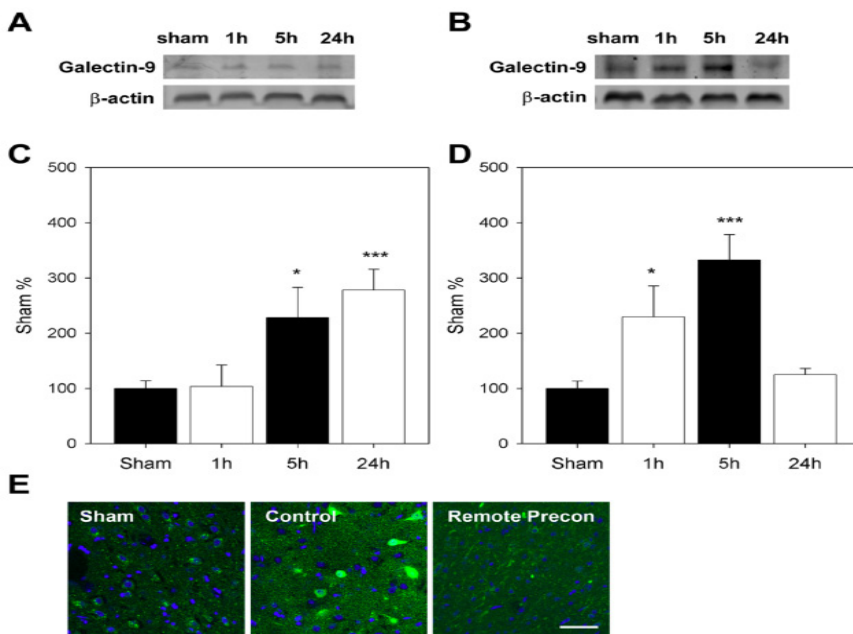


Figure 3 Remote preconditioning inhibited galectin-9 expression 24h after stroke. Western blot indicates that galectin-9 was increased after stroke; remote preconditioning did not block its expression before 5h, but inhibited it at 24h. The results of confocal microscopy indicate that galectin-9 was increased, and such expression was inhibited by remote preconditioning. Results presented as Fig. 2.

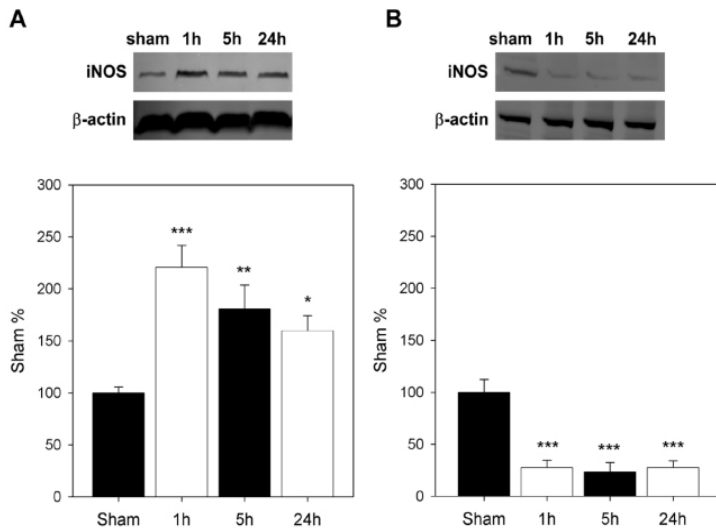


Figure 4 Remote preconditioning blocked iNOS expression after stroke. Representative protein bands of iNOS are shown: A, control ischemia; C, Remote preconditioning. Statistical results suggest that iNOS was increased from 1h to 24h after stroke in rats receiving control ischemia. Remote preconditioning inhibited iNOS expression. *, **, *** vs sham, $P < 0.05$, 0.01 , 0.001 , respectively. $N = 6$ /group.

Results

Rapid limb preconditioning reduced infarct size after stroke

Remote preconditioning in the femoral artery of the limb of rat reduced infarct size after stroke. (Fig. 1)

Tim-3/galectin-9 pathway was inhibited at 24h by remote preconditioning

From western blot analysis, both Tim-3 and galectin-9 expression showed similar increases in control ischemia, and decreases in LRP tissue. Tim-3 expression significantly increased at 24h vs. sham ($p < 0.001$) in control ischemia (Fig. 2A,C), levels of Tim-3 increased at 5h compared to sham, but not at significant levels. Galectin-9 increased at 5h and 24h in rats receiving control ischemia ($p < 0.001$) (Fig. 3A,C). LRP blocked the increase in both Tim-3 (Fig. 2B,D) and galectin-9 at 24h ($p < 0.001$) (Fig. 3B,D). Reductions in both Tim-3 and galectin-9 were also seen in immunostaining results (Fig. 2E, 3E)

iNOS and Nitrotyrosine were inhibited by remote preconditioning compared to control

iNOS expression increased at 1h, 5h and 24h in control ($p < 0.001$, 0.01 , 0.05 , respectively), reaching a peak at 1h (Fig. 4A). Western blot of iNOS clearly showed an increase in control ischemia compared to sham. Remote preconditioning decreased iNOS expression to 20% of sham at 1h, 5h, and 24h ($p < 0.001$), thus attenuating the increase found in control ischemia (Fig. 4B). Nitrotyrosine increased in control ischemia (Fig. 5A,C), and like iNOS, nitrotyrosine decreased to 10-20% of sham at 1h, 5h, and 24h ($P < 0.001$) with remote preconditioning (Fig. 5B,D). The increase in nitrotyrosine expression, thus, was also significantly attenuated with remote surgery.

COX-2 expression did not change significantly with remote preconditioning

COX-2 showed an increase at 24h in control ($p < 0.001$), (Fig. 6A,C) however, LRP did not block this increase at 24h (Fig. 6B,D). As seen in Figure 6, there is a distinct maximum of expression at 24h in both preconditioned and control rats. Confocal showed similar results (Fig. 6E) with no attenuation of COX-2 represented by the blue fluorescence between control and remote brain tissue.

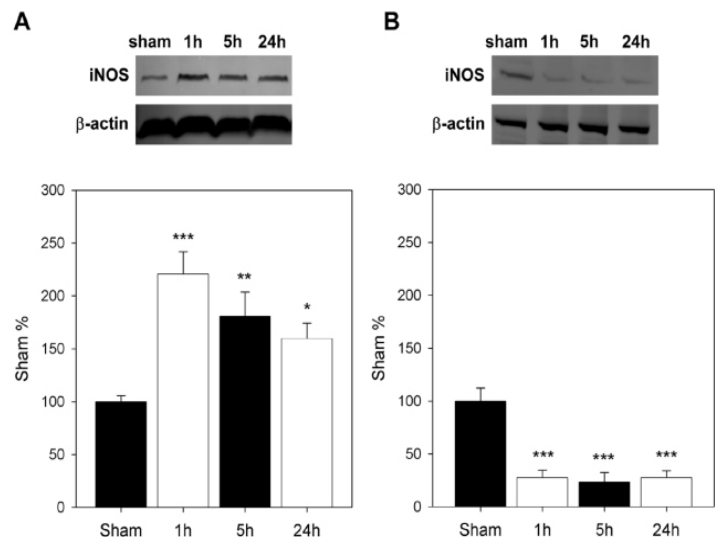


Figure 5 Remote preconditioning blocked nitrotyrosine expression. Both Western blot and immunostaining suggests that nitrotyrosine expression was increased from 1h to 24h after stroke in control ischemic rats, which was attenuated by remote preconditioning. *** vs sham, $P < 0.001$, respectively. $N = 6$ /group.

Discussion and Conclusions

This study begins to address how limb remote preconditioning is protecting the brain from ischemia. Though well established that inflammation is a primary cause of neuronal death (Brown & Nehar 2010), it is not known if remote preconditioning reduces inflammation in the brain, and if so, by which specific inflammatory agents. The simultaneous increase and

release and excitotoxicity, calling for inflammatory activated microglia and astrocytes to kill these neurons (Brown 2007). Nitrotyrosine is a known marker for damage caused by nitric oxide (2007). Despite COX-2's known major role in neuroinflammation and its implicated roles in neurodegenerative diseases like multiple sclerosis, Parkinson's, and Alzheimer's, and traumatic brain injury (Yang et al. 2008), this major inflammatory inducer was not reduced after remote preconditioning. Our results confirm that COX-2 is elevated after stroke, but does not contribute to the protective effects of remote preconditioning. This suggests that COX-2 does not play a major role in the brain damage after stroke, and/or LRP simply does not act on COX-2. Keeping the results of this study limited, there are three conclusions that can be drawn:

1. Remote preconditioning reduces infarct size after focal ischemia, confirming prior results. These surgeries were conducted using the same protocol as Ren et al. 2008, with different hands doing the surgery—however, the results were replicated.

2. Protein expression of Tim-3, galectin-9, COX-2, iNOS, Nitrotyrosine was increased after focal ischemia. Remote preconditioning blocked increases in Tim-3, galectin-9, iNOS and nitrotyrosine, but it did not affect expression of COX-2.

3. The Tim-3/galectin-9 pathway is involved in brain injury after stroke. Reduction in galectin-9, Tim-3, iNOS and nitrotyrosine may contribute to the protective effect of remote preconditioning.

The next step in this study would be to suppress the genes for specific pathways, like the Tim-3/galectin-9 pathway, using

siRNA, and test if infarct is reduced post focal cerebral ischemia.

Acknowledgments

We wish to thank Elizabeth Hoyte for figure preparation. This study was supported by AHA grant SDG 0730113N (HZ), NIH grant 1R21NS057750-01A2 (HZ), and the Irene and Simon Brain Research Foundation.

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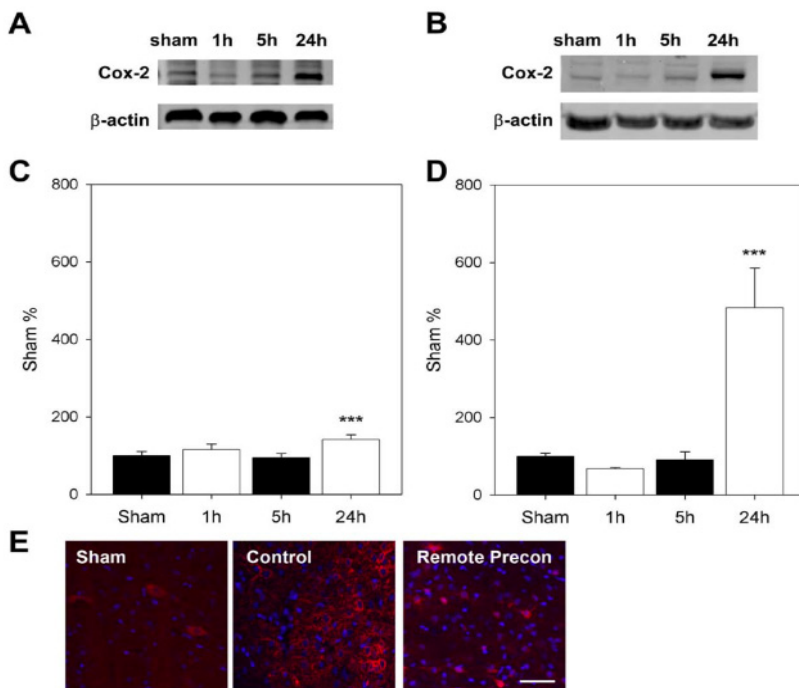


Figure 6 Remote preconditioning had no protective effects on COX-2 expression induced by stroke. Representative protein bands of COX-2 from Western blot are presented for control ischemia (A) and remote preconditioning (B). Statistics suggest that protein levels of COX-2 were significantly increased at 24h (C), which was not attenuated by postconditioning (E). The results of confocal microscopy indicate that COX-2 was expressed in the ischemic peri-infarct region after stroke (E), and remote preconditioning did not change its expression pattern (E). *** vs sham, $P < 0.05$, 0.001. $N = 6$ /group.

decrease of both players at similar timepoints suggest that the Tim-3/galectin-9 pathway contributes to damage after focal ischemia, and thus contributes to the protective effects of distal remote preconditioning. Similarly, iNOS and nitrotyrosine are two players in a similar pathway, both being reduced simultaneously in remote preconditioning. Nitric oxide (NO) from iNOS expression strongly synergizes with hypoxia to induce neuronal death; NO inhibits cytochrome oxidase in competition with oxygen, resulting in glutamate

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Community green: Comparing Individual and Social Financial Motivations in Energy Conservation

Stephanie Vezich¹

This field experiment demonstrates how individual financial and social motivation incentives to conserve energy can affect a community's electricity consumption patterns. Baseline measures of weekly consumption were taken in a faculty condominium community, followed by either a) no email, b) an email emphasizing an individual's chance to win a financial prize for conserving, along with conservation tips, or c) an email emphasizing a whole building's chance to share a financial prize for conserving, along with conservation tips. Individual feedback on consumption relative to baseline use was sent two weeks following the intervention email. Results indicate that social motivation is especially effective among baseline low consumers but elicits reactive effects among baseline high consumers. In contrast, individual financial motivation is especially effective among high consumers. Based on these findings, a theoretical explanation for the reactivity among high consumers in the social condition, along with suggestions for interventions tailored toward existing high or low consuming communities and educational interventions, is discussed.

Introduction

Background

Social norms have a powerful unconscious influence on behavior, despite conscious belief that they have little impact on personal choices.¹ Social comparison theory explains that norms are powerful because comparing oneself to the norm establishes the appropriate level of that behavior.² Uncertainty about how often to perform a behavior decreases, reducing cognitive load and putting people at ease. Nolan et al. found that although the belief that the majority conserves natural resources produced the most behavior change, participants rated normative beliefs as the least influential on behavior.¹ What the authors

didn't identify were potential steps between awareness of the norm and behavior change.

From Nolan and colleagues, we know it is important to include the perception that others are conserving.¹ The types of norms presented, however, can be just as significant. Descriptive norms refer to the perception of how common a behavior is; in contrast, injunctive norms refer to the perception of social approval of that behavior.³ Schultz et al. found that for people using higher levels of energy than average, descriptive norm information (i.e., "You use more energy than the average person") produced significant decreases in energy consumption.⁴ However, for people already consuming less than average, descriptive normative information actually resulted in greater consumption. The authors claim this boomerang effect results from the desire to grow closer to the norm from either direction (previous high or low consumption), further reinforcing the power of social influence. However, the boomerang effect was eliminated through the use of an injunctive norm—a smiling emoticon when people conserved and a frowning emoticon when they didn't—in addition to descriptive feedback. In this case, people who were consuming more than average decreased as much as in the descriptive condition, and people who were consuming less than average maintained their better-than-average behavior.

These findings also highlight the importance of feedback on performance, which establishes the social norm as a standard and sets up expectations for personal behavior. In Schultz's study on curbside recycling, personal norm feedback and group norm feedback were both effective in increasing recycling, while standard informational interventions and pleas failed to produce the same effect.⁵ Therefore, both personal and collective goals should be effective in increasing pro-environmental behaviors in a community-based conservation campaign.

One important aspect of the Schultz et al. findings is that in no condition did those already consuming less than average actually improve.⁴ Therefore, while normative influence is important, it may be incomplete. Siero and colleagues emphasize that creating a common group identity can increase collectively beneficial behavior change.⁶ In the context of energy conservation in faculty housing, membership in the campus community can serve as an automatic

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social tie among residents. Therefore, combining the norm that a particular community's residents conserve with some reminder of their social ties to one another and potential collective benefit of conserving could be particularly effective in motivating greater conservation.

In particular, Loersch et al. highlight the effect of goal contagion among members of the same social group.⁷ The authors define goal contagion as the motivation and pursuit of a goal as a result of identifying another person's goal-directed behavior. They conclude that goal contagion is especially likely when the behavior—directly observed or assumed—belongs to a member of a common ingroup. Therefore, identifying conservation as a common goal of community members may serve to increase goal contagion.

In order to truly assess the potentially powerful effects of ingroup-specific appeals, there must be a standard proven motivational appeal to produce more collectively beneficial behavior, in this case, energy conservation. Durant et al.'s review of motivational strategies toward higher productivity in organizations illustrates the effectiveness of lottery-based financial motivation, at least during the length of the experimental trial.⁹ Therefore, creating a financial motivation to conserve should be effective in eliciting more conservation behaviors in the short term and may provide a good basis to which to compare more social-psychological appeals.

Hypothesis

Based on the above evidence, several conclusions may be drawn. First, establishing either personal or social norms toward greater conservation is likely to produce increases toward conservation goals.⁵ Second, establishing a social norm to motivate conservation is likely to be especially effective if goal contagion can be produced, for instance, by establishing a norm of conservation to achieve a common community goal and emphasizing the specificity of that community.⁷ ⁸ Finally, the use of both descriptive and injunctive norms in the form of feedback on performance may help to alleviate the effect of mere gravitation toward the norm among both pre-existing conservers and high consumers.

Therefore, the present study predicts that members of a faculty housing community will be motivated to conserve energy both when a personal

goal toward conservation (via financial motivation to potentially win a personal monetary prize) and when a collective goal toward conservation (via financial motivation to win a collective prize and join in the community norm toward conservation) are presented. However, it is predicted that the social motivation will be more effective among pre-existing low consumers than pre-existing high consumers because a personal norm of conservation has already been established, so the social norm adds additional motivation. Additionally, the financial motivation condition should be effective among all participants because it establishes the possibility of a reward in the near future and does not require sustained changes in behavior. Finally, it is expected that a feedback reminder will help sustain effects of these treatments into the third week of post-manipulation measurement (whereas no additional messaging—not studied here—may cause a drop-off in conservation).

Method

Electricity consumption was tracked in 55 condominiums in a Stanford faculty housing community. Participants were recruited via an email forwarded from the homeowner's association president linked to an online consent form. Included in the online consent form was a survey assessing current attitudes and behaviors about conserving (e.g., Overall, how much of an effort do you feel you have already made to conserve energy in your home, for instance, by buying energy efficient products, turning off electronics, etc.?). Responses were marked on a 5-point Likert scale. In addition, this survey asked participants to estimate how many days they would be gone each week during a 6-week interval during the summer, during which time consumption readings would be obtained.

Approximately one month after gathering consent, three weeks of baseline measurement began. Measurements of kilowatt-hour usage were gathered from digital smart meters. Buildings were first categorized by square footage, and buildings within each category were randomly assigned to control, financial motivation, or social commitment motivation conditions. This procedure assured that there would be an equal distribution of building sizes in each condition.

In the control condition, the energy consumption of each condominium continued to be measured weekly for the next three weeks without any communication

to residents. In the financial motivation and social commitment conditions, residents received an email directly from the researcher on the day of final baseline collection. While both emails outlined the chance to win a condo's share of the building's \$1000 prize and provided the same tips on how to conserve, one emphasized the individual financial reason to conserve (the chance for a monetary prize) while the other emphasized the community value of conserving and emphasized how the prize could be used collectively rather than individually (see Appendix for complete text).

After sending emails to both groups, weekly consumption data was gathered for three additional weeks. Additionally, two weeks after the emails were sent, residents received emails with feedback on their recent consumption compared with their baseline consumption. Residents were divided into 4 groups based on the original email they received and on their recent consumption patterns: financial motivation/consumption decreased, financial motivation/consumption increased, social commitment motivation/consumption decreased, and social commitment motivation/consumption increased. There were no cases in which consumption didn't change at all, and in those cases in which consumption only changed marginally, participants were still divided according to their marginal increase or decrease. According to these categories, participants were sent one of four emails which first provided feedback on whether their households had increased or decreased consumption and included a smiling or frowning emoticon accordingly, then reminded participants of either the individual financial or social commitment motivation they had received originally (see Appendix for complete text).

After sending this booster email, consumption was tracked for one more week. Following the last week of measurement, buildings that had decreased consumption on average (even if certain condos within the building had increased) since the intervention email were entered into a random lottery for a \$1000 prize and one was selected. The selected building had 5 participating condos; therefore, a \$200 check was mailed to each one.

Results

3 units were removed from the final analysis. One unit reported that its residents had to move out due to a flood halfway through the study and thus had

atypical usage. The other two showed usage greater than 2.5 standard deviations from mean consumption at pre- and post-manipulation and were in the same treatment condition.

Variables corresponding to average weekly use were separated into pre-manipulation use (baseline data) for weeks 1-3, post-manipulation use for weeks 4-6, and post-booster use for week 6. The distinction between post-manipulation and post-booster was done to separate the effects of the original manipulation and the feedback email sent 2 weeks later. After removing the outliers, all variables were normally distributed and thus were not transformed.

Main effects of treatment vs. control and of each condition separately were tested first unadjusted for unit type and then adjusted. When adjusting for the participants who didn't report days gone, there was a main for post-booster use but not for post-intervention use in general ($p < 0.05$). More significantly, an interaction between standardized pre-use and post-use remained significant either way (post-manipulation and post-booster) for the social condition ($p < 0.01$; Figure 1).

When the data is divided into pre-existing high consumers (1 SD above mean baseline use) and pre-existing low consumers (1 SD below mean baseline use), the differences between the financial and social conditions become more apparent. Specifically, higher pre-use was associated with significantly greater post-use and lower pre-use with significantly lower post-use in the social condition relative to financial and control conditions. This effect held true when comparing social to control or social to both conditions combined. When comparing to the financial condition only, the pre-manipulation low users in the social condition did not use significantly less energy, but pre-manipulation high users did use significantly more. Additionally, the financial condition significantly lowered post-use (not only post-booster use) among baseline high consumers but not baseline low consumers.

Discussion

It was predicted that among all participants, the personal financial motivation and collective motivation conditions would be effective in eliciting lower consumption. Furthermore, it was predicted that social motivation would be more effective among baseline low consumers than baseline high consumers, whereas individual financial motivation would be more

uniformly effective. While the first hypothesis did not hold, the second one did to some extent. That is, when baseline usage was not controlled for, participants in the individual motivation condition significantly dropped usage after the manipulation and feedback email, whereas participants in the social motivation condition did not. The fact that the financial condition significantly lowered usage after the booster email supports the auxiliary hypothesis that feedback would sustain and perhaps even enhance the effects of the original treatment messages. However, when participants were split into high and low baseline consumers, the social condition but not the financial condition was effective among low consumers. Interestingly, among baseline high consumers, there seemed to be a boomerang effect in the social motivation condition, resulting in even higher consumption post-treatment. However, the individual financial condition was especially effective in this group.

Limitations and directions for future research

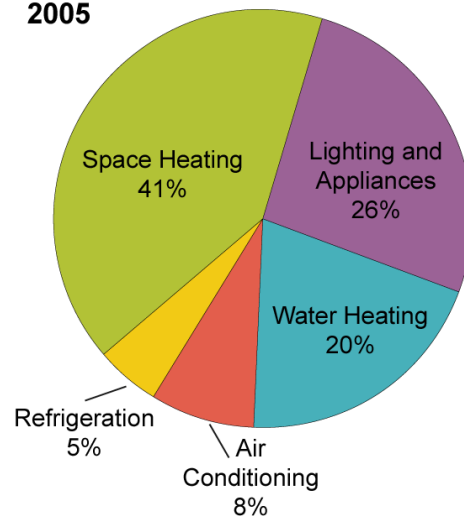
Several limitations of this study should be noted. First, the sample population chosen may be unrepresentative of general residential neighborhoods, as residence requires affiliation with the Stanford community. Therefore, future research should look into communities without a common identity marker (such as belonging to academia).

Second, all six data points were collected between the months of July and August, which may not have yielded appropriate variation in usage since academics could take trips for summer vacation (leaving vacancies) and since Americans typically use much more energy for heating than for cooling (Figure 1).¹¹ Because of greater room for variation in winter months, it will be useful in future studies to examine behavior over a wider range of seasons, or at least later in the year than the data gathered here.

Third, these analyses did not control for family size. In future measurements, researchers may wish to gather data in terms of usage per person instead of usage per household.

Finally, future investigations should broaden conservation appeals to include other resources such as gas or water. It may be that there are carryover effects; that is, by reminding people about electricity conservation, they may also be primed to be more mindful about conservation of gas or water. Conversely, moral credentialing effects could occur when only one

How Energy is Used in Homes, 2005



Source: Energy Information Administration, 2005
Residential Energy Consumption Survey.

Figure 1 Percentage break down of home energy usages.

type of conservation is brought to residents' attention: By making residents more mindful of one type of pro-environmental behavior, they may feel like they have sufficiently contributed to the environmental cause and thus licensed to exert less effort toward another.^{12, 13}

Implications

The fact that high consumers responded to individual financial motivation favorably but reacted against social motivation calls into question how pre-existing attitudes about energy usage may change construal of a persuasive message. Research suggests that persuasive messages may be more threatening to people for whom the message is most relevant; for instance, heavy coffee drinkers who read an article linking caffeine to breast cancer were more likely than light coffee drinkers to reject the message as untrue.¹⁰ The authors explain this finding as a threat to participants' self-image, which results in cognitive dissonance between the behavior they enjoy (drinking coffee) and an unhealthy consequence. This dissonance is then resolved by rejecting the message as untrue. Similarly, high consumers in the social condition may experience dissonance between a positive self-image and a message emphasizing the negative quality of their consumption and thus disregard the message to resolve this dissonance.

Why, then, didn't high consumers react against the individual financial motivation appeal? Perhaps construal was shifted in this condition from

a threatening, morally tinged message to simply the chance to win some money. Consequently, there is no threat to the self-image and thus no reactance. However, when a social norm is attached to conserving and the message implies that an individual would be letting down the entire building's chance of winning by not conserving, the individual could construe the situation as much more judgmental and threatening.

Typically, self-affirmations have proven successful in reducing reactance to threatening messages.¹⁰ However, the self-affirmation approach itself seems less applicable in this case. Rather, changing core attitudes about conservation or one's relationship to nature could reduce the threatening impact of the message.

One potential method to change attitudes about conservation could be perspective taking, a technique shown to increase empathy toward other people and concepts such as nature in clinical practice.^{14, 15} Persuasive messages could guide the reader to take the perspective of the environment by being written from the perspective of a natural resource, for instance. In line with Stern's Value-Belief-Norm (VBN) theory, attitudes of greater connectedness to nature could induce greater conservation because of a transition toward inclusion of nature in the self-concept.¹⁶ The question arises, however, how to put theory into practice in a wide scale campaign.

Advertising may not be the best way to change long-standing attitudes about nature and pro-environmentalism, but educational campaigns may be more successful. Attitudes about smoking changed dramatically in the United States due to major changes in educational strategy; similarly, if habitual conservation behavior is formed through pro-environmental behaviors fostered in school at an early age, national attitudes and consequential behaviors may change as well.¹⁷

Such widespread change is outside the scope of this study; however, these preliminary findings do suggest that social commitment motivation may be a promising technique to explore further in eliciting greater conservation behaviors. Previous studies have not been able to further decrease consumption among already existing conservers, whereas the present experiment illustrates that social commitment not only elicits this effect, but does so better than pure financial motivation.⁴ The differential reaction to a persuasive

appeal among baseline low and high consumers requires further attention to determine how policy may address groups who construe messages about environmentalism differently, but for now we at least know that certain groups of people may be motivated to conserve not purely out of self-interest but out of some commitment to community efforts. The next question, then, is how to broaden this motivation beyond pre-existing conservers for wider societal impact.

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Put Your Money Where Your Mouth Is: The Effects of Southern vs. Standard Accent on Perceptions of Speakers

Taylor Phillips¹

As Americans become increasingly mobile, the number of inter-regional interactions grows, therefore increasing the risk of regional clashes, particularly in employment opportunities. Despite the prevalence of American regional stereotypes, very few psychology studies have investigated regionalized social perceptions. Since accent often varies regionally and is salient in social interaction, accent may be an especially critical cue that activates regional stereotypes. Regional stereotypes, in turn, may lead to discriminatory acts in employment and other realms. Therefore, accent activated stereotypes are likely to be an important mechanism by which regional discrimination plays out in everyday social phenomena. This study investigates perceptions of voices and individuals based on regional accent variation. Southern American English is compared to a Standard American English accent. Given only a sound sample of individuals' voices, participants rate Southern accented individuals as less intelligent, less wealthy, and marginally more friendly than Standard accented individuals. These findings suggest that accent can trigger stereotypic perceptions and that low intelligence and low wealth are strong, common stereotypes associated with American Southerners.

Intensified economic globalization combined with recession can lead to increasing diversification in job applicants' geographic background. Technological advances allow job applicants to expand the radius of their hunt for employment. However, social psychological work on labor patterns suggests these changes may also leave more room for discrimination in the employment process. Stereotyping and resulting prejudicial behavior can significantly impact employment aspects, such as pay rate and even initial hiring.^{1, 2} Because stereotyped beliefs form the base on which discriminating and prejudicial behavior is

built, the study of stereotypes is particularly important.

Generally, American stereotype studies have focused on racial/ethnic and gender distinctions. Such literature is vast and has essentially proven the power of stereotypes to control attention, attribution, and perception, which go on to influence behavior.³ However, international psychology literature on stereotyping often highlights regional distinctions more than race. For example, Cairns and Duriez demonstrate that Irish-Catholic children are less likely to attend to and later remember information presented by an English teacher as opposed to an Irish teacher.⁴ Such studies have demonstrated the powerful influence of regional stereotypes on interpersonal attention, perceptions, and behavior.

In American studies, regional stereotypes (which often cross-cut race) are only rarely considered, despite the fact that such regional distinctions are salient in American culture. Stereotypes of American Southerners, for instance, are common in cultural media and artifacts, such as the cartoon "Li'l Abner," which suggests American Southerners are of low intelligence and wealth, and high aggression and friendliness.⁵ Although not the focus of their paper, Crandall, Eshleman, and O'Brien show that prejudice against white Southerners is twice as acceptable as prejudice against minority racial groups.⁶ However, the pervasiveness, strength, and even specific content of American South stereotypes have yet to be thoroughly explored empirically. Given that 1) over 100 million citizens qualify as American Southerners, 2) citizens in American South states often have lower income and job attainment outcomes when compared to citizens of other states, and 3) discriminatory stereotypes have been implicated as one factor contributing to unequal economic outcomes between other social groups, studying the potential influence of stereotypes against American Southerners becomes even more important.^{7, 8}

Our understanding of the specific American regional stereotypes that exist and pathways through which these manifest is incomplete. In racial stereotyping, it is not skin color or physical appearance per se that is stereotyped against, but rather the group category memberships that are (incorrectly) assumed to come with these salient perceptual markers. The cue is highly salient, easily accessed, and although arbitrary, conflated with stereotypical representations. But what

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cues specifically trigger regional stereotype activation? Accent may provide such a conspicuous marker.

Several international studies have suggested that not only language differences (lexicon, idioms, etc.), but accent differences alone (prosody, pronunciation) can trigger stereotype activation and subsequent social perception changes.⁹⁻¹¹ In American race studies, language has also been implicated. For instance, Carroll notes that teachers often favor white students' telling of stories over that of black students during classroom "share time," and that this is likely because of linguistic differences in narrative style.¹² Such language differences may themselves serve as triggers for other negative stereotypes that add to the teachers' dislike. Given the necessity of language in job interview processes, that accent activates stereotyping and discriminatory behavior implores more study of accent in labor processes. Might regional stereotypes in America, particularly stereotypes of the American South, be similarly triggered by accent?

Current Study

Although many stereotypes against American Southerners have been noted in other fields, psychological explorations have been generally limited to studies of aggression.^{13, 14} No study has yet focused specifically on the pathways through which American regional stereotypes manifest themselves, although several international studies suggest language could be such a path.^{4, 11} Accent alone may be as salient and arbitrary a personal characteristic cue as skin tone, making it potentially powerful. For instance, Tucker & Lambert show that Northern accents are evaluated more highly than are Southern accents.¹⁵ Can accent trigger regional stereotypes, and if so, what are the stereotypes activated and to what degree?

This study hypothesizes that Southern accented speakers will be perceived as more friendly, less wealthy, more aggressive, and less intelligent than Standard accented speakers. These hypotheses are based on Southern stereotypes prevalent in American cultural artifacts as well as on international studies showing that language alone can trigger stereotype activation.^{4, 13} Overall, these hypotheses take the theoretical approach of many race-based stereotype studies that suggest socially salient cues activate stereotypes, leading to perceptual shifts. In cases of regional stereotyping, accent alone may trigger such powerful social perceptions.

Methods

Participants

10 Stanford University undergraduates (age 18-22 years) volunteered to participate in the study. Gender was counterbalanced. Participants were American citizens living in California continuously since first entering middle school to reduce participants' differential accent exposure. Participant race reflected the Stanford undergraduate population.

Materials

The independent variable accent type was manipulated to create 2 conditions, making a 1 x 2 (Southern vs. Standard) within-subjects design. These manipulations used four distinct voices, pre-tested as discussed to ensure their perceived Southernness vs. Standardness. Voices were balanced by gender and accent, resulting in 1 male Southern, 1 male Standard, 1 female Southern, and 1 female Standard voice. Each person providing a voice recording was asked to read the descriptive violin passage as if "reading aloud in a classroom" and was given as many recording sessions as needed to capture a fluent reading. The intention of recording accented speech was not mentioned and accent as a topic was avoided so as to secure valid examples of accented speech without exaggeration or self-censoring.

To check manipulations, four independent judges listened to each of the four voices and then rated each voice's accent on a scale from 1-7, with 1 indicating no accent and 7 indicating a strong accent. Judges were all Stanford undergraduates who had lived in California continuously since entering middle school (2 male, 2 female). The results showed that the Southern voices ($M = 4.125$) were perceived as different from the Standard voices ($M = 1.125$), but that within the Standard and Southern categories, voices were not perceived as different. In an open response measure, all voices were distinguished as either "Southern" or "no accent," with one exception in which the female Southern voice was perceived as "no accent." Overall, the voice materials proved sufficiently valid (i.e., distinguishable) for this experiment.

Procedure

Participants were asked to "listen to some voices and then answer questions about them for a language study." They were then asked to familiarize themselves with a printing of the emotionally-neutral violin passage, to help limit any effects that may have

occurred due to differential familiarity with the passage between the first voice presentation and the three subsequent presentations. Participants were then given headphones and asked to listen carefully to the voice presented.

Immediately after the first voice was presented, participants were given a survey to complete. The survey was used to measure the effects of the independent variable, accent type (Standard American English vs. Southern American English), on participants' judgments of the target person, the main dependent variable. Friendliness, wealth, aggression, and intelligence were the four dependent constructs investigated. The survey gave a series of descriptions relating to the voice (smart, angry) and a series of statements relating to the person whose voice they had heard (this person is intelligent, this person is employable). Participants were asked to rate their agreement with each description on a scale ranging from strongly disagree (1) to strongly agree (7). In total, 23 statements and/or descriptions were tested. 14 statements related to friendliness, wealth, aggression, or intelligence. The final statements measured other descriptions such as "healthiness" to control for participants' truthfulness as well as to test unexpected stereotypes. Once finished, the second voice was presented, followed by a new copy of the survey. The experiment continued in this way until each participant had heard and responded to all four voices. Voice presentation order was randomized between participants to control any ordering confounds.

Results

The average difference between Southern and Standard voices within participants' friendliness ratings was .31 (SD=1.23; Southern minus Standard). This suggests that Southern accent alone might trigger small differences in social perception of friendliness. It also suggests that these differences are in the direction of the stereotype, but that either accent only has a weak influence or that the stereotype itself is weak. However, the average difference between Southern and Standard voices within participants' aggression ratings was -0.05 (SD=.92; Southern minus Standard). This suggests that Southern accent has no effect on perceptions of aggression.

Participants in the Southern condition reported a wealthy rating of 3.3 (SD=1.08) on average, while participants in the Standard condition had a mean wealthy rating of 4.7 (SD=.80). For this measure, a

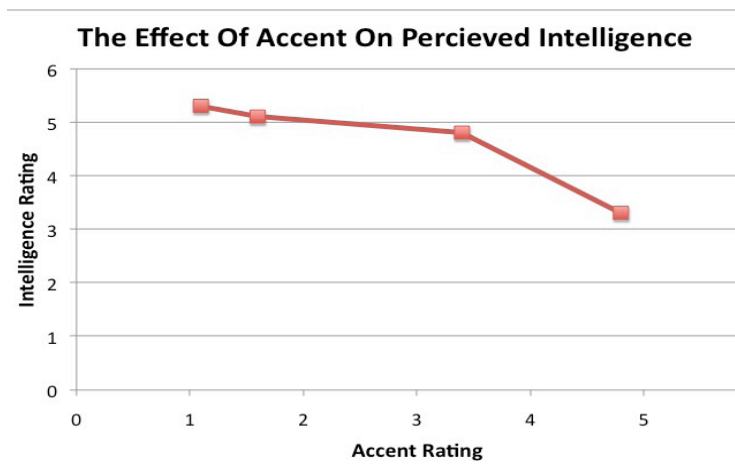


Figure 1 Voices rated the most standard/neutral were perceived as the most intelligent when participants were asked explicitly to rank the intelligence of the voices.

low rating indicated a low degree of perceived wealth. Participants' average difference in wealthy ratings between Southern and Standard voices was -1.4 (SD=1.02; Southern minus Standard), suggesting that Southern accents do trigger perceptions of less wealth when compared to the neutral condition.

Southern condition participants rated intelligence on average 3.2 (SD=1.36), while Standard condition participants rated intelligence on average 4.8 (SD=1.23). On the specific measure that asked participants explicitly to rank intelligence, the Southern voices received an average rating of 3.05 (SD=1.43), while Standard voices received an average rating of 5.25 (SD=1.16). The average difference between Southern and Standard voices within participants' intelligence ratings was -1.6 (SD=1.12; Southern minus Standard). For the explicit intelligence measure, this average difference increased to -2.2 (SD=1.18). This suggests that Southern accent does trigger differences in social perception of intelligence, and that these differences are both strong and in the direction of the stereotype. It also suggests that accent type has a larger influence on perceptions of intelligence and wealth than on friendliness or aggression.

Additional constructs measured show that a trend might exist in which Southern accent influences social perception of health and attractiveness, with Southern accented speakers being judged lower on both measures (M(South health) = 4.65, M(Standard health) = 5.4; M(South attractiveness) = 3.4, M(Standard attractiveness) = 4.53). Also noteworthy was the

difference in extent of accent's influence between voice description measures and interpersonal behavior measures. Across all constructs, measures that asked about willingness to engage with the speaker showed less disparity between accents, while measures that asked about perceptions of the speaker's voice showed more disparity. 10 of 13 descriptive perception measures (77%) showed differences between Southern and Standard accent conditions of greater than or equal to .5 rating points, while only 5 of 10 interpersonal measures (50%) showed rating differences of .5 or above. 3 of these 5 interpersonal measures with rating differences at or above .5 were related to intelligence (willingness to study together, etc.). This suggests that social perceptions might be more easily influenced by accent in descriptive contexts but that accent has less influence on social perceptions when interpersonal interaction is considered. It also suggests that interpersonal perceptions may be more influenced by accent only in the case of especially strong stereotypes, like Southerners' lack of intelligence.

Discussion

In general, the data show that Southern accent has a more significant influence on observers' perceptions of the speakers' intelligence and wealth than on friendliness, aggression, or other constructs. The data support previous findings that accent alone is a social cue strong enough to trigger shifts in the social perception of speakers. Data also support this study's second and fourth hypotheses, that Southern accented speakers would be perceived as less wealthy and less intelligent than Standard accented speakers. However, the first hypothesis, that Southern accented speakers would be judged friendlier than Standard accented speakers, was not supported significantly (although a weak confirming trend was observed). Finally, the third hypothesis, that Southern accented speakers would be perceived as more aggressive, was not supported.

Although the results show that some social perception differences are triggered by accent, some mechanism must be providing the content for the relationship between accent and social perception. The observed differences in social perception that were significant match the direction of common American South stereotypes. Therefore, these results imply that American South stereotypes might be this

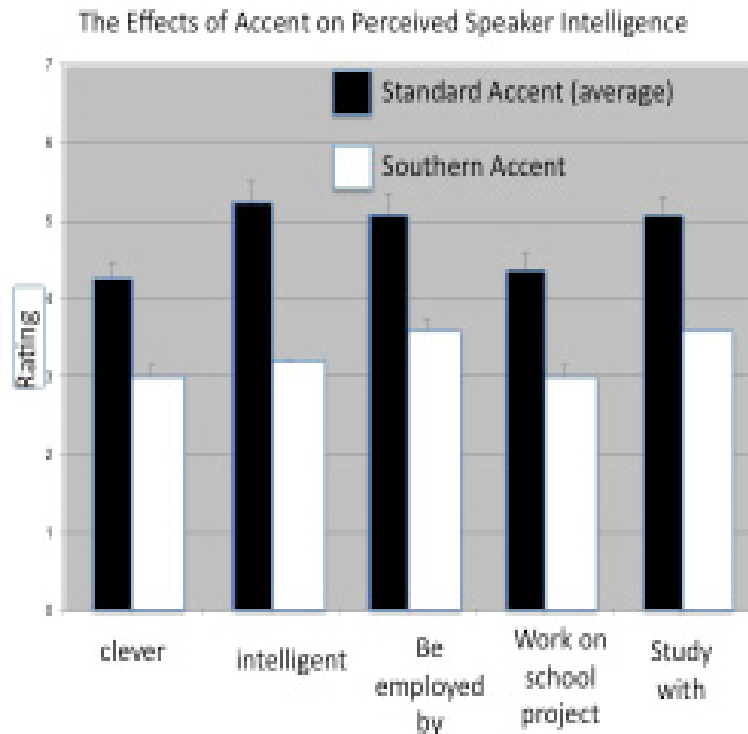


Figure 2 Southern accented voices were perceived as less intelligent than Standard accented voices on both descriptive and behavioral measures of intelligence.

mechanism, particularly the stereotype of Southerners' low intelligence. This study provides evidence that the single social cue of accent is salient and powerful enough to influence observers' social perceptions of speakers, serving as a path through which American South regional stereotypes can be triggered.

However, an interesting, unpredicted distinction in the modalities in which accent had an influence was also found. This study implies that interpersonal behavior perceptions are less influenced by accent than more purely descriptive perceptions. Therefore, the relationship between accent and social perceptions might be moderated by interaction context, which has interesting implications for the role of American Southern stereotypes in determining behaviors, such as willingness to employ. Imagined behaviors are not the same as enacted behaviors, and so the influence of accent on real behaviors in complex social situations may be different than is suggested by this study's results. More emotional and personal contexts may heighten the accessibility of stereotypes, so stronger effects might be expected in a more naturalistic accent stereotyping study (16). Future research should address these questions and further investigate generalizability by using more varied

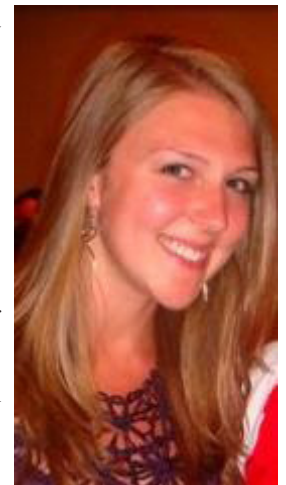
speakers in both the Standard and Southern conditions as well as a diversified participant pool (17).

All together, this study demonstrates the power of language to influence nonlinguistic modalities of thought, such as social perception, and suggests that accent might be more influential during certain types of social perception, like direct description. The findings suggest that, when triggered by accent, American South stereotypes can influence perceptions, implying that behavior based on these perceptions might also be influenced. Particularly, the negative perceptions of intelligence and employability suggest that having a Southern accent may in fact be an obstacle to successful interviewing. This study suggests that a social cue as arbitrary as accent may influence discrimination in the job market, since accent can activate stereotypes, negative social perceptions, and therefore behavior influenced by these social perceptions.

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The Hiroshima Maidens Project at the Margins of History: Quaker Facilitation of Spiritual Rebirth and Rejuvenation

Annie Devon Kramer¹

The Bomb

The United States unleashed unprecedented atomic force on the Japanese city of Hiroshima on August 6, 1945, bringing immeasurable shock and awe to the citizens of both countries. In Hiroshima, where Enola Gay co-pilots Robert Lewis and Paul Tibbets had dropped the atomic bomb in the morning hours, “unlucky” survivors emerged from the rubble to find that a virtual moonscape had replaced their city. Miyoko Matsubara, a Hiroshima survivor and 12-year-old school student at the time, recounts her experiences in vivid detail in “The Spirit of Hiroshima” (1999). After regaining consciousness and adjusting to the ominous “dark” wrought by the bomb, Matsubara stumbled home through a ground zero of material and human destruction, traumatic reminders of the bomb’s awesome force: “All of [the people] were almost naked and looked like characters out of horror movies with their skin and flesh horribly burned” (Matsubara).

A group of female students at the Hiroshima Commercial High School shared the terror and confusion of the cataclysmic bombing, described in detail by Rodney Barker in *Hiroshima Maidens: A Story of Courage, Compassion, and Survival*. Barker presents the story of Hiroko Tasaka, an “unlucky” survivor of the blast among the small group of students who were fortuitously protected in the high school basement at the time of the bombing. Hiroko suffered immediate physical and mental consequences from the atomic explosion, as “there was a searing white dazzle that prickled hotly and she [thought] she had been shot before she blacked out” (Barker 22). Suspended between life and death, Hiroko awoke to a Hiroshima in an altered state, with “the afternoon sun sink[ing] into a plume of purple smoke rising over [the city]” and the reality that “her fate was out of her hands...[and that] she had done everything she could to stay alive.” These sensations of helplessness and futility would

foreshadow her standing as a maimed survivor when the city began to regain its footing.

The Project

The plight of these survivors was disregarded until 1955, when Reverend Kiyoshi Tanimoto of Hiroshima joined forces with American philanthropist Norman Cousins to organize the “Hiroshima Maidens” project, named for the young, female participants who had been deemed inadequate for marriage by traditional Japanese standards. The project, a singular act of post-bomb redress, addressed both the functional deformities inflicted by the bomb and the “suspension” of survivors like Miyoko Matsubara and Hiroko Tasaka between “life”—joining in the rejuvenation of the city of Hiroshima—and immediate death from the force of the bomb. In peaceful defiance of mainstream American political and cultural impulses, Quaker civilians associated with the New York Friends Center (NYFC) and the Pendle Hill seminary in Wallingford, Pennsylvania, coordinated and financed this humanitarian undertaking—opening their hearts, homes, and institutions to the women by providing an “outpatient” community and a spiritual womb in between reconstructive surgeries¹ at the Mount Sinai Hospital on the Upper East Side of Manhattan in New York City.

The efforts to facilitate the physical and psychological rejuvenation of the Hiroshima Maidens between May 1955 and late 1956 come to life in scarcely referenced archival documents from the NYFC and from Pendle Hill, available at the Friends Historical Library at Swarthmore College in Swarthmore, Pennsylvania. The Maidens project that emerges from these documents indicates a natural, well-intentioned detachment, on the part of the Quakers, from political and cultural milieu in both countries: a) in Japan, peaceful disregard for the relegation of the young women to the margins of society on the basis of their visible deformities; and b) in the United States, defiance of both the American government in its tireless efforts to squelch “anti-nuclear” activities and of the press in its misinterpretations and misrepresentations of the project’s purpose and effects. The resultant dichotomy between the “manipulative opportunism” of the

¹ Mount Sinai physicians Arthur Barsky and William Hitzig performed over 125 surgeries on the twenty-five Hiroshima Maidens from June 1955 to June 1956. (Chisholm 99)

¹Stanford University

government and press and the “genuine altruism”² of the Quaker facilitators who offered love and hospitality to the Hiroshima Maidens thus highlights the Quaker community’s profound investment in this singular act of “people-to-people” democracy.

Cultural Contexts

Japan: The Maidens at the Margins of Society

Individual and systematic responses to the Hiroshima bombing materialized in numerous forms, reflecting the divisions in Japanese and American society: in Japan, a contrast emerged between the heart-wrenching accounts of Hiroshima survivors like Miyoko Matsubara and Hiroko Tasaka and the organized campaign for citywide rehabilitation and rejuvenation; and in the United States, a divide emerged between individual expressions of moral outrage at the deployment of atomic weaponry and the absence of full-fledged, national apology from the American government. Hiroshima Mayor Tadao Watanabe initiated a series of projects to realize “both the physical rehabilitation of Hiroshima and its [symbolic] promotion as a ‘peace city’” (Yavenditti 22), but the public focus on rebuilding the city readily eclipsed the individual needs of “unlucky” survivors. The construction of the downtown—and thus highly visible—Hiroshima Peace Memorial Park and Atomic Museum cemented communal aspirations for rebirth, “contribut[ing] to the image of Hiroshima as an ‘experiment’ in time of peace” and for transforming public, bomb-related traumas into a cogent call for amity and disarmament. But while the city of Hiroshima vigorously regained its footing, the stigmatization of the young women disfigured in the atomic explosion persisted as a societal trauma—an “unwelcome,” visual reminder of the 1945 bombings and a basis for exclusion from social conventions like employment and marriage. Anne Chisholm considers this stark incongruity in *Faces of Hiroshima*: “Along with a resurgent vitality there was a dark side to the rapid re-establishment of urban life in Hiroshima. Ambivalent, even hostile feelings [endured] towards people who were visibly damaged by the atomic explosion” (Chisholm 35).

The United States: Defensive and Offensive Vanguard of the Atomic Age

American responses to the dropping of the

2 Peter Schwenger introduces this terminology in “Hiroshima’s America, America’s Hiroshima.”

atomic bomb were equally divided; even in the midst of postwar calls for the abatement of nuclear buildup and the restoration of prewar conceptions of “humanity,” the American government maintained a definitive *modus operandi*: continue nuclear buildup, forgo the issuing of an official apology to Japan for the material and human destruction in Hiroshima and Nagasaki, and crush “anti-nuclear” commentary and activities in the United States. The government sustained this stance in response to the proposal for the Hiroshima Maidens project by Reverend Marvin Green of the Hiroshima Peace Center Associates³, Norman Cousins’ outreach organization. While the American Counsel in Kobe, Japan, cautioned that the project’s symbolism would undercut “our [the United States government’s] worldwide efforts to deemphasize the destructive effects of nuclear weapons” (Stier 127), the Eisenhower administration ultimately granted “implicit approval... as long as it [the project] was not billed as an [explicit] act of expiation or atonement for dropping the bomb, or confused with a form of government restitution” (Barker 73). This political framework left minimal room for any broad-reaching, national efforts to offer redress to the citizens of Hiroshima for the traumas inflicted by the bomb, thus laying the groundwork for the realization of the Hiroshima Maidens project as an act of “people-to-people” democracy.

Dissent and Deterrence:

Japan: From the Margins to the Centerfold

Undeterred by the “ambivalent, even hostile feelings” (Chisholm 35) towards *hikabusha*⁴ and seemingly immutable cultural standards in Japan, Reverend Kiyoshi Tanimoto, a Hiroshima survivor who had completed his theological training in the United States, moved to confront the marginalization of the “unlucky” female survivors who were forced to “live on as an involuntary symbol of the world’s first experience of nuclear war” (Chisholm viii). The formation of a spiritual support group for the young women who would later become the “Hiroshima Maidens” and of the Hiroshima Peace Center Foundation (Barker 58) cemented Reverend Tanimoto’s determination to transcend the values of “a society that placed such

3 The Hiroshima Peace Center Associates served as the American counterpart to Reverend Tanimoto’s Hiroshima Peace Center Foundation; the two organizations worked in cohort to advocate for the needs of the Hiroshima Maidens. (Barker 58)

4 *Hikabusha*: the widely-accepted term used in Japan to refer to “explosion-affected people” (Chisholm 35).

great emphasis on aesthetic presentation” (Barker 55). Linking his organization to the Hiroshima Peace Center Associates and thus to Quaker humanitarian Norman Cousins, Reverend Tanimoto defied prevalent, post-bomb attitudes by establishing a “position to initiate programs to help the walking wounded” (Barker 58)—those “unlucky” survivors seemingly suspended between life and death since the bombings of August 1945.

United States: Norman Cousins as a Bridge to and for the Hiroshima Maidens

Reverend Tanimoto’s appeals for outside assistance in his efforts to aid the maimed young women landed in the graces and capacities of Norman Cousins, establishing a partnership that would connect the Hiroshima Maidens to the NYFC and Pendle Hill members and thus render the project a uniquely Quaker undertaking on the basis of reigniting love and life in the bodies and souls of the maimed women. Cousins, the editor of *The Saturday Review of Literature* and a passionate, anti-nuclear activist, had marked his ground as a lone bastion for anti-nuclear commentary in the early post-bomb years. While Cousins had noted in *Who Speaks for Man?* (1953) that a recent visit to Hiroshima had defied his expectations, as he “expected resignation [and] found rehabilitation... [and] expected desolation [and] found rejuvenation” (Cousins “Who” 85), the journalist-cum-humanitarian hungered for further anti-nuclear, compensatory action. The compatibility of Tanimoto’s and Cousins’ appeals propelled the Hiroshima Maidens project into being, satisfying Tanimoto’s long-term desire to provide spiritual and physical rejuvenation for the young women and Cousins’ desire for unconditional, humanitarian action to allay a sense of “strong personal responsibility for the first atomic weapon to be used against human beings” (Cousins “Voyage”).

The Hiroshima Maidens Project: Quaker Spirit, Facilitation, and Accommodation

Preparations: Unquestioning Compassion

Responding to Tanimoto’s and Cousins’ appeals, the NYFC and Pendle Hill Quakers assumed full responsibility for facilitating the project by offering genuine love, hospitality, and cultural sensitivity to the fragile women during their stay in the United States. NYFC Chairman Frank C. Ortloff announced the potential project in a letter dated April 5, 1955, employing the language of a strong, service-oriented

community: “an opportunity for service has come to [the] Friends Center” (Letter “Ortloff” 5 April 1955). While Ortloff credits Norman Cousins with initial coordination of the project, he ultimately poses a rhetorical question revealing much about the Quakers’ unquestioning altruism and the NYFC’s ideal fit as a surrogate community for the Hiroshima Maidens. Chairman Ortloff asks whether “[we] shall undertake this responsibility,” but links the response to *logistical* capacities rather than *philosophical* ones—“Will you call the Center and report (1) if you *can* provide hospitality for two girls; (2) if your Meeting will take the Responsibility for a certain number of girls for the entire year” (Letter “Ortloff” 5 April 1955, italics mine). Ortloff’s manner of presentation establishes the compatibility of the Maidens’ needs and the Quaker community’s capacity to aid the young women’s spiritual rejuvenation.

This spirit of unquestioning altruism extended through the ranks of the NYFC, evident in a follow-up memorandum of April 15, 1955 that powerfully depicts the tight-knit, community infrastructure that facilitated the project. Echoing the tone of his initial letter, Ortloff frames the “offers of hospitality and general expressions of interest...[as] encouraging... [and] justify[ing]...proceeding with the project” (Letter “Ortloff” 15 April 1955), which is indicative of the Quakers’ prompt mobilization. Ortloff appeals in this second memorandum for further member involvement, thus announcing a forum for Monday, April 25, 1955 at which NYFC members could pose questions about the project since “we need the advice and council of all Friends...whether or not you can actively participate in any way.” Ortloff’s second memorandum consequently establishes the NYFC Quaker community as a peaceful “bulwark” against an intransigent American government wary of “anti-nuclear,” humanitarian activities, with his proposition of a forum to galvanize and unite “the support of many interested Friends...to carr[y] [out the project] successfully.”

B. Pendle Hill: A Spiritual Womb for the Hiroshima Maidens

Before their welcome into the NYFC community, the Hiroshima Maidens adjusted to life in the United States with a two-week-long stay at the Pendle Hill seminary in Wallingford, Pennsylvania. In a letter written on May 20, 1955 to the local *Chester Times*, Pendle Hill Director Dan Wilson articulated the

seminary's connection to and reception of the project: "They [the women] have been so jolly and eager and interested in everything and have fitted into life here... so completely and naturally that we feel it has been *our rare privilege* to have them with us" (Letter "Wilson" 20 May 1955, italics mine). Subsequent releases in the *Pendle Hill Bulletin* confirm the humane, spiritual environment provided by the seminarians and their kinship with the Maidens, evident in Wilson's public letter to Norman Cousins of May 25, 1955, in which he related his solicitude for the women's external, social desire "to be treated once more as women capable of living out women's functions" and their internal, spiritual desire "to feel wanted, needed, loved, and to *be all three*, perhaps for the first time [since the Hiroshima bombing]." The pervasive spirit of humanitarianism at Pendle Hill, communicated by Wilson's pronouncement that "...we have never received a more precious gift [than the Maidens]...[and] of course, being *human*, we thought to...invit[e] the girls to live us," thus endowed the Hiroshima Maidens with a spiritual womb and a calm period of adjustment to life in the United States.

Purpose—Love and Hospitality in the Interest of the Hiroshima Maidens

The NYFC subsequently received the Hiroshima Maidens at the end of May 1955, providing a "foster" community in which "[the Maidens] no longer dreaded to be seen" (Letter "Vaught" 25 October 1955) and some semblance of normalcy in their lives as patients and developing souls. NYFC correspondence from October 1955 and March 1956 suggest an honest, apolitical purpose in the Quakers' aid to the Maidens, beginning with Executive Director Arnold B. Vaught's expression of confidence in a letter of October 25, 1955 that "there is [so] much love and goodwill [that] I feel certain that the total result will be good." Executive Committee minutes from early 1956 reinforce these sentiments, first in the warning call on March 13th for "caution on publicity...for fear...[of] exploitation of the girls" (NYFC "Minutes" 13 March 1956). Annual Meeting Minutes from March 20th make explicit the genuine desire of the Friends Center to carry out the project "with the best interests of the twenty-five girls always in mind as the main goal" (NYFC "Minutes Annual" 20 March 1956), specifically the Maidens' "re-gaining the use of fingers and arms...[and consequent] improvement in their appearance."

Progress: Ida Day, Cultural Sensitivities, and Mutual

Endearment

A series of memoranda prepared by Ida Day, the NYFC member who spearheaded the NYFC's hospitality efforts, attest to this honest commitment in the interest of the women and provide logical explanations for their "endear[ment] to the families and communities where they had been staying" (NYFC "Hospitality" 19 June 1955). Conscious of cultural differences and the Maidens' reportedly timid dispositions, Ida Day offered the assurance in a memorandum of June 19, 1955 that "all of the [Quaker] homes ha[d] been carefully investigated for suitability," and that "only homes ha[d] been chosen which could offer comfortable space and where the mother of the family was at home during the day," thus providing a nurturing environment for the host "daughters." Ms. Day's "progress reports" from June 1955, October 1955, and April 1956 confirm the affectionate dynamic between the Maidens and their host families kindled by the diligence and cultural sensitivities of the NYFC community. Ida Day writes accordingly in her memorandum of June 19th: while "all [the Maidens] are eager to help and seize upon every opportunity to contribute their talents or assistance," the host families "want the girls to feel perfectly free to do as they wish...and not be influenced by what the host families do" (NYFC "Hospitality" 19 June 1955).

The progress reports from individual Friends meetings presented in the series of memoranda attest to all of the following: a) the implementation of this commitment; b) the inter-personal intensity of the project for the Quaker benefactors and for the Maidens; and c) the sensation of "this whole experience [as] a two-way project" (NYFC "Report" April 1956). Ida Day emphasized the balance sought between American and Japanese cultural activities at the conclusion of her June memo, reporting, "some girls want to go to the Japanese Church in N.Y. [while] some choose to go to the Methodist Church in their community." The host family in Plainfield, New Jersey, followed this balanced model, taking its daughters "sight-seeing in New York...up the Empire State Building and [then] to [a] Japanese restaurant." Responding to the differing interests and dispositions of its host daughters, the host family in Shrewsbury Red Bank, New York, organized activities like ping-pong and volleyball for the Maiden who was "very energetic and...interested in everything" and more solitary pursuits like sewing and cooking for the Maiden who was "more retiring."

The Hiroshima Maidens project depicted in the memoranda represented a successful effort to rejuvenate the beleaguered women with the consequent emergence of kinship between the families and their host daughters. Ida Day shared her perception in June 1955 that “all [the Maidens] give their hostesses the impression that they are well adjusted and of happy dispositions” (NYFC “Hospitality” 19 June 1955) and again in April 1956, that “they [the Maidens] have endeared themselves to us...[and] have accepted us and have developed a real feeling of belonging” (NYFC “Report” April 1956). The host families’ commitment in the April 1956 memorandum “to help in whatever we can to make their stay here as useful as possible” produced particularly notable results for Sayoko Komatsu, who stayed in Stamford, Connecticut, between surgeries and “opened out like a flower.” The Stamford family reported on Sayoko’s transformation, relating both the perceptions of Sayoko’s sister, who “felt a new Sayoko blossoming” and its sense of pleasure from Sayoko’s heartfelt interest in “growing as a person.”

A “Two-Way Project”: The Hiroshima Maidens and the American Quakers

Norman Cousins⁵ had indeed honored Reverend Tanimoto’s heartfelt dedication to the physical and spiritual rejuvenation of the Hiroshima Maidens in finding surrogate communities with the NYFC and Pendle Hill Quakers. The Swarthmore documents collectively challenge mainstream American political and cultural impulses by substantiating Ida Day’s April 1956 claim that “this whole experience has been a two-way project” (NYFC “Report” April 1956). The host family in Shrewsbury Red Bank, New York, reiterated this sentiment in the April 1956 memorandum, reporting on the dynamic of mutual affection that had materialized: “They came to us shy and timid, but in a loving spirit, and they were received in that which brought them—love.” Just as the Quaker host families valued their time and kinship with the Maidens, describing them as “a wonderful group of girls and...appreci[ating] the enrichment that they have brought into our lives,” the Hiroshima Maidens expressed mutual feelings when they reflected on the experience. Hiroshima Maiden Hideko Harata related

5 After the conclusion of the project, Norman Cousins “adopted” Hiroshima Maiden Shigeko Nimoto, welcoming her into his family since “it was...true that she was an intimate part of the family circle” (Barker 199).

these sentiments of kinship in a retrospective letter to Pendle Hill Director Dan Wilson: “I could not but feel that all of you were Japanese...that we are all brothers and sisters” (Letter “Wilson” 25 May 1955).

But despite these obvious exhibitions of genuine love, hospitality, and compassion, secondary interpretations of the Hiroshima Maidens project generally fail to achieve the following: a) to define the undertaking as a *necessary* enterprise to relieve the young women of their physical and psychological burdens *outside* the confines of Japan and thus freed from deeply entrenched cultural mores; and b) to characterize the NYFC and Pendle Hill as *ideal spiritual communities* to aid in the Maidens’ rebirth and rejuvenation rather than as aggressive advocates of American postwar, post-bomb values. Hiroshima Mayor Tadao Watanabe incidentally honored each of these truths in a letter of February 17, 1956 to the NYFC, writing the following in appreciation of the Quaker efforts: “We have no words...to express our appreciation to you...for your *highly humanistic deed* originating in your lofty religious belief...without which they [the Maidens] would have been forlorn and helpless” (Letter “Watanabe” 17 February 1956, italics mine). Even if the history of the Hiroshima Maidens project has been historically entangled with what University of Wisconsin scholar Paul Boyer considers a “disparity between the mythic past inscribed in popular memory and the past that is the raw material of historical scholarship” (Engelhardt), the NYFC and Pendle Hill documents at the Friends Historical Library provide ample material with which to interpret the historical truths of the project: the Quaker provision of apolitical and well-intentioned love, hospitality, compassion in the unselfish interest of facilitating the spiritual rebirth of the Hiroshima Maidens.

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“Why Such a Big Deal?”: The Didactic Function of Humor in Tibetan Buddhism

Manny Fassih¹

If we try very hard to build something tremendous, really meaningful, powerful—‘I’m really searching for something, I’m really trying to find my faults,’ or ‘I’m really trying to be good,’—then it loses its seriousness, becomes a paper tiger; it is extremely ironic...If you do try to treat life as ‘serious business,’ if you try to impose solemnity upon life as though everything is a big deal, then it is funny. Why such a big deal?

-Chogyam Trungpa [1]

In *Cutting Through Spiritual Materialism*, Chogyam Trungpa begins his inquiry into what a ‘sense of humor’ is by first examining what a sense of humor is *not*:

Lack of humor seems to come from the attitude of the ‘hard fact.’ Things are very hard and deadly honest, deadly serious, like, to use an analogy, a living corpse. He lives in pain, has a continual expression of pain on his face. He has experienced some kind of hard fact—‘reality’—he is deadly serious and has gone so far as to become a living corpse. The rigidity of this living corpse expresses the opposite of a sense of humor.

The ‘rigidity’ of this ‘living corpse’ is not unlike the traits identified in Vassilis Sarogolou’s research on religion and humor that characterize a ‘religious person’: “non-acceptance of nonsense in life”, “conservatism”, “respect for tradition and conformity”, “risk avoidance”, and “less openness to ideas”.² It would appear that from a psychological, and especially from a personality perspective, religion negatively associates with personality traits, cognitive structures and social consequences typical to humor.³ Indeed, as many scholars have explored, humor has had a checkered history with religion.⁴ To laugh at religion was to invite harsh criticism, ostracism—or worse.⁵

This ‘anathema’ is as much evidential in Buddhism as it is in other religious traditions.⁶ It was, after all the gloomy pronouncement of Gautama

Buddha that the First Noble Truth is the fact that we suffer. In framing his survey of comic traditions in India, Lee Siegel takes “startlingly simple yet utterly disturbing” rhetorical questions posed by the Buddha in the *Dhammapada* (“How can there be mirth or laughter when the world is on fire?”) as evidence that there is little, if any, humor in Buddhist traditions. Conrad Hyers identifies one of the early Buddhological debates concerned:

whether the Buddha laughed, and if so in what manner and with what meaning...There were those among the Buddhist scholastics who clearly would have preferred to believe that the Buddha never laughed at all, especially after his enlightenment experience at Bodhgaya. The Buddha’s wisdom and the Buddha’s mission seemed to require the ultimate in seriousness, gravity, and solemnity...The difficulty is that some sutras seem to suggest, if not state outright, that on such and such an occasion the Buddha laughed.⁷

To resolve the contradiction, this “laughter” of Buddha was considered to have been limited to the first (*sita*) of six types of laughter, using a classical scale derived from drama by Bharata, a faint smile, serene, subtle, and refined.⁸ While the Buddha may have smiled, laughter was something to steer away from. Michael Clasquin notes that for a Buddhist monk in ancient India, “to laugh out loud was an offence, a matter requiring confession and expiation in front of the entire assembly of fellow monastics.”⁹ Loud, boisterous laughter, and anything humorous that might cause it, was for the worldling, the unenlightened, *the fool*.

Though he may have only faintly smiled, the Buddha was not an existentialist; though the 1st and 2nd noble truths articulate a ubiquity of suffering that approximates a Sartrean nausea, the 3rd and 4th noble truths speak of a *release* from suffering. Buddhists throughout the centuries and across cultures have found many ways to incorporate humor into their religious lives.¹⁰ In the past few years, there has been growing theoretical interest into the role of Humor in Buddhism, especially Zen.¹¹ At a recent workshop held in Berkeley, CA (“Does Humor Belong in Buddhism?”; February 9, 2007), papers were presented on topics ranging from the unexpectedly robust comedy of the rules for monks and nuns¹² to the often-hilarious ‘trash talking’ that would infuse the rhetoric of Tibetan Debate.¹³ But very

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few ethnographic studies have been done examining the extant role of ‘sense of humor’ as it manifests in practice. Thus, in my research, I sought to answer the following question: What purpose does humor serve in Tibetan Buddhism and what, if anything, is its social function or philosophical value, apart from giving pleasure?

Understanding the Laughter: Methodology

Associate Supreme Court Justice Potter Stewart is known to have said that he couldn’t describe pornography, but he “knew it when he saw it”... One might try to say about humor that we know it when we laugh at it.

-Tom Armstrong¹⁴

Perhaps the first question is what ‘humor’ exactly means in the context of my paper. When theorists have studied humor, they have sought to outline necessary and sufficient conditions that are constitutive of humor (e.g. laughter), offering typologies that identify different motives for humor. For instance, Hobbes emphasized the use of humor to demonstrate our superiority over others. Theorists also point to humor’s postmodern virtues of ‘indefinite-ness’ and transgression.¹⁵ Although such approaches are interesting, they are beyond the scope of this essay.

Rather than working with or attempting to adduce a ‘general theory of humor’, I chose to recognize humor as *inherently relational* and *context-dependent*—no event, person or thing is intrinsically humorous. As Lafollette and Shanks argue, “it depends upon the circumstances, the teller (if any), the current beliefs of the listeners (or viewers) and the relationship (if any) between the teller and the listener.”¹⁶ Humor tends to be audience specific, and is conditioned by cultural assumptions and commonplaces. The question of how or why things come to be funny is similarly defined by culture. “If you’re dealing with yaks all the time,” Wendell, a 5th year student at Sarah College remarked, “you’re gonna find ways to laugh at them.”¹⁷

Nevertheless, humor proved to something eternally elsewhere during the early stages of my study. It was surely there, in all the smiles of the lamas and laughter of the Momo Ama-las of McLeod Ganj—but it could not be found when I wanted it. A pattern that was to solidify during my stay began to emerge during my initial interviews with people at my hotel: if I asked whether humor belonged in Buddhism, I was told ‘Yes, 100%’; if I asked what was humorous, I was told there

was a vital comic pulse to all of life, and nothing more. Yet in all the bookstores in Bodhgaya, Dharamsala, and Bir, I could find no humor section or humorous books. “There is no money in writing humor books,” one vendor informed me. “People are too busy. A man might read a joke book standing in the shop, but if he is going to spend good money on a book, money that he has worked hard to earn, it must be a book that helps you better yourself.”

All throughout McLeod Ganj, I began to be received by the eponym of the ‘boy looking for humor’—as if it provided a clue to my character—which prompted a smile in some, a quizzical, I-guess-you-can-study-anything-in-the-West look by most, and an ‘ahhhhh...yes’ by *tulkus*.¹⁸ And it soon dawned upon me (as it surely dawned upon Lee Siegel), that a study of society’s humor, done by an outsider, is too meddlesome a project, too invasive, too threatening: “it may appear to be but a masked attempt to study the society’s pettiness and ignorance, its cruelties and indecencies.”¹⁹

It is plainly unfair to ask someone to tell you a joke and give you an example of something that’s funny, especially with the subject of dirty jokes. Tibetans are not a bawdy bunch.²⁰ They may have a few neurotic obsessions about sex, and seem to enjoy ‘guy talk’ as much as the next culture, but they have a strong sense of shame.²¹ Tibetan ladies would look askance at the ‘liberated’ western girl, and blush at the mere mention of a sex joke. The Shechen Monastery lamas (in Bodhgaya) inordinately were embarrassed by even the milder Drukpa Kunley jokes that involved consumption of ‘chang’ or the deflowering of a *dakini* with his 12-foot penis.²² Dondhup conveyed that even laymen, who enjoy the sexual humor hugely, have an acute sense of time and place for these jokes, much of which comes from being inside a ‘circle of intimacy’.

Furthermore, the once-bubbling Tibetan humor appears to waning in the face of modernity. “Tibetan humor was something that was very strong,” Choegyal Rinpoche reminisced, “but it is now dissipating.”²³ When she first arrived at Tashi Jong in 1964, Tenzin Palmo was struck by the humor pulsing in the refugee camps: “Though they were extremely poor and traumatized, having lost everything, they was a lightness streaming through their eyes; they were just so jolly, not bitter, and laughing all the time.”²⁴ But now, with the onslaught of globalization, the new generation

seems to have lost this ‘sparkle’: “This generation has changed a lot. They are adapting to a modern world, and as such they have become confused: they can’t go back, it’s hard to go forward, and where they’re standing, there’s no meaning.”²⁵ Moreover, the living lineage that used to characterize the oral transmission of folktales and jokes has begun to fade with the rise of information technology: “it used to be teacher to student...now it’s man to computer, computer to man.”²⁶

So after a few days of ‘anthropological litmus-testing’, I began to accept my shortfall--that I would not be able to get as holistic a picture of humor that I wanted--and instead opted to examine the didactic function (if there was one) of humor as it manifested in four teachers (all Tibetan Buddhist): one literary, the patron-saint of ‘humor’ for Tibetans and beloved trickster Aku Tonpa²⁷; and three from whom I received teachings (Chokyi Nyima Rinpoche, Mingyur Rinpoche, and H.H. the Dalai Lama).²⁸ Thus, the study will be both *descriptive*, in its survey of the literary genres and forms which have lent themselves to the manifestation of the comic sentiment, as well as *functional*, inasmuch as I give consideration of the potential teleological, social and psychological functions of the experience of humor. From this, I hope to examine the underlying nature of their humor, a phenomenon historically and scholastically marginalized, and see if it bears a close relationship to authentic spiritual understanding.²⁹

Tibet’s Little Rascal: Aku Tonpa

You will not find a Tibetan who does not grin luminously when you simply mention the name ‘Agu Tonpa’
-Rinjing Dorje³⁰

Trickster figures seem to express contradictions in the societies from which they spring, their meddling, nonsensical or outrageous behavior, the result of competing cultural demands intersecting in the figure.³¹ In some cultures, the trickster has religious significance which manifests a didactic form.³² William Hynes sees the trickster as a necessary by-product of the social order: “Systems normally busy generating firm adherence to their beliefs also maintain within those belief systems, somewhat contradictorily, a raft of tricksters who perpetually invert and profane those same beliefs. In myth and ritual, tricksters seem to be officially sanctioned exception clauses by which belief systems regularly satirize themselves.”³³ Tricksters, then, provide an integral check on beliefs to prevent

people from becoming too secure in themselves. There is no order too rooted, no taboo too sacred, no god too high, no profanity too scatological that it cannot be broached or inverted by a Trickster. For Tibet, the most popular trickster of this variety is Aku Tonpa.³⁴ Not only is Aku Tonpa a trickster who came to make Tibetans clever—he is considered to be the earthly manifestation of Lord Avalokiteshvara (the same status, that is, as H.H. the Dalai Lama).³⁵

Anybody who believes that Tibetans have nothing but their religion, that they are a somber and inscrutable meditating bunch, obviously has not heard of Aku Tonpa. Rinjing Dorje’s above statement holds true in McLeod Ganj: the mere mention of ‘Aku Tonpa’ brought laughter and smiles of recognition to everyone, whether high lama or yak herder. Whether this may have been due to the welcome surprise of hearing an ‘outsider’ have awareness of one’s own cultural icon is a moot point. Tibetans cherish “this wily character that easily pokes fun at the rich, the miserly, and the gullible.”³⁶ ‘Aku’, a Tibetan avuncular term of endearment, reflects how close he is to the hearts of those who know, tell, and hear his stories.³⁷ His ribald tales add a humorous folkloric dimension to a richly entertaining storytelling tradition.

Storytelling is a hugely important aspect of traditional Tibetan oral culture.³⁸ Up until recent times in Tibet, Rinjing Dorje writes, “there were professional storytellers who traveled from village to village to tell stories and recite epics.”³⁹ However, ever since the invasion of Tibet by the People’s Republic of China, and the subsequent diaspora of the Tibetan people to far flung places across the globe, the old oral traditions have begun to slowly disappear.⁴⁰ Assimilation into new cultures has forced exiles to adapt accordingly: “Since they’re in India now, and they’re forced to learn three languages just to get around, they just start to forget the old proverbs and use Indian ones.”⁴¹

While some collections of Tibetan tales have been recovered in both the West and China, “many story cycles remain uncollected” and some have been “forever lost”.⁴² But through all of this upheaval and aural erasure, the ribald tales of Aku Tonpa endure for posterity. This is due largely in part to the efforts of Rinjing Dorje, whose *Tales of Aku Tonpa* stands as the first English edition of Aku Tonpa’s tales; and more recently Kalsang Khedup, whose three books (*Aku Tonpa Goes to a Nunnery*; *Aku Tonpa and the Golden*

Seed; Tales of Aku Tonpa) on Aku Tonpa, all bilingual (English and Tibetan) renderings, were written to promote language skills among younger generations: “If you want to excite people about reading, you want to do it with humorous stories...and every Tibetan loves Aku Tonpa.”⁴³

These efforts to preserve the trickster stories from both inside and outside of Tibet also speak to the appeal of the Tibetan trickster, independent of culture. Wendy Doniger, for example, has reflected:

*What charms me most about these stories is the way in which they flicker back and forth between the uniquely Tibetan and the universal. One such scene is when Aku Tonpa “says he is named ‘Vagina,’ anticipating the moment when his victim will want to call for help and will be misinterpreted and hence ignored (‘Vagina is hurting me’)” akin to the scene in Homer’s Odyssey in which Odysseus says he is named ‘Nobody,’ anticipating, in the same way, the moment when Cyclops would call for help and be misinterpreted and hence ignored (‘Nobody is attacking me’). [...] I suspect that what we’re dealing with here are some very basic human themes that cannot entirely be explained by historical contacts, even though they may have been enhanced by such contacts.*⁴⁴

But how well do these stories travel? I decided to see test Doniger’s claim during ‘Open Mic Night’ (November 23rd, 2009) at Khanna Nirvana restaurant in McLeod Ganj (and, at the same time, bring the oral tradition back). Obviously, something was being communicated that bore repeating. I chose one of the racier stories, “Aku Tonpa sells penises to a nunnery” (taken from Rinjing Dorje’s *Tales of Aku Tonpa*), and read it (in English) to an audience that included Tibetans, as well as Americans, Swedes, Russians, and Chinese people, mostly visiting for the teachings of His Holiness the Dalai Lama (which began the following day). Briefly, the story consists of Aku Tonpa finding a farmer despairing because his cursed field did not produce its normal crop—but rather a thousand penises! Aku Tonpa turns the situation into a highly profitable one by arranging to sell the penises to a Tibetan nunnery. Although it is forbidden for a nun to sleep with a man, nowhere is it written that she may not sleep with a penis.⁴⁵

Having registered for my talent as ‘Aku Tonpa’,

the MC (who was from New York) seemed somewhat baffled in his introduction (“I don’t know what this is, but I love your stage name (‘Mannyfesto’)”) and it was clear that the Western members of the audience weren’t sure what to expect. The Tibetans were already in-the-know; as with my previous experiences and informal interviews, just mentioning that I was going to read ‘Aku Tonpa’ produced a warm set of smiles and giddy giggles from the Tibetans in the crowd. When I announced the title, a shockwave rippled through the crowd—some grimaced into silence, some laughed, and some struggled to maintain their repose at the obscenity. There were, of course, nunneries not too far from the restaurant (though, I hope, not an earshot away!). So I began to read, and with every mention of the word ‘penis’, two Americans (likely in their mid-20’s) erupted into uproarious laughter. The Tibetans’ faces remained locked in the smile, unphased by the unabashed dirtiness of the plain sexual language.⁴⁶

At the conclusion of the story (when the nunnery’s abbess dies from shock), the smiles around the room communicated the near universal appreciation of the story (the MC even wisecracked that “[I] was going straight to the hell realms for that one”). After the open mic, multiple foreigners approached me to express their amusement with the story and asked where I’d found such a ‘naughty’ book. Some Tibetans in the area recognized me days after the reading, and would from then on refer to me as ‘Aku Tonpa’ whenever they spotted me in my academic gag show of a display.⁴⁷ This popular appeal and cross-cultural applicability was not only limited to the ‘unenlightened’; all of the *Rinpoche*’s, for example, recognized ‘Aku Tonpa’s’ name with a hearty laughter. One, Chokyi Nyima, requested that I recount a story⁴⁸; another, Mingyur, actually narrated one for me—and one rife with scatological effrontery no less!⁴⁹ In the story, Aku Tonpa tosses a frozen pile of excrement, dusted with lime, on a king’s (who was a ‘greedy tyrant’) lap, the dubious missile carries a so-called miraculous inscription which Aku Tonpa reads a lot to the illiterate king: “The shit is from Heaven. He is the luckiest king when it drops in his lap.” Immediately the pious king touches the excrement to his forehead in a gesture of respect, then nibbles a piece before placing the rest on his altar.⁵⁰ As opposed to the seamier side of his nunnery shenanigans, this is the side of Aku Tonpa who “is the advocate for justice, who uproots social

oppression and subdues landlords.”⁵¹ His bold gesture lays bare, more than political argument, the disparity between peasant and king.

While this appeal may have been universal in McLeod Ganj, one population was identified that seemed slightly repulsed by Aku Tonpa’s ‘sex’capades—feminists. It’s not hard to believe that many feminists are not amused by the total disregard for the feelings of the women whom Aku Tonpa rapes.⁵² In an interview with Jetsunma Tenzin Palmo, one of the leading Buddhist feminists, expressed her gentle disgust (and I emphasize gentle) at the sight of one of the Kalsang Khedup books (“Aku Tonpa goes to a nunnery—God help!” she jokingly commented). While she could appreciate the ‘stiffness’ parodied by tricksters like Aku Tonpa, she constrained that she cared little for such phallogocentric stories “written by men for men.”⁵³

So what can we learn from Aku Tonpa’s deployment of humor? Both within specific cultures and world-wide, the humor and laughter evoked by trickster myths “are never exhausted in a single telling.”⁵⁴ Why? As Hynes argues, “beyond the surface humor, there is a deeper type of insight, irony and transformation at work in the trickster myths.”⁵⁵ We may laugh, but a deeper unfolding is at work; one that, on reflection, I began to see in teachers I had (and would later) encounter.

References and Notes

1. Chogyam Trungpa. *Cutting Through Spiritual Materialism*. (Boston: Shambhala, 2002), 110-111.
2. Vassilis Saroglou. “Religiousness, religious fundamentalism, and quest as predictors of humor creation.” *International Journal of Humor Research* (9.10 2002): 177-88. It should be noted that the participants of this study were 72 adults, all living on the campus of the Catholic University of Louvain in France, though this did not necessarily correlate to any religious affiliation. Religiousness was assessed by a self-report questionnaire, with questions that included “the importance of religion in personal life” and humor creation was assessed by such scales as the “coping humor” scale.
3. Ibid. p. 177: Sarogolou lists these as being: incongruity, ambiguity, possibility of nonsense, low dogmatism and low authoritarianism, playfulness, playfulness, spontaneity, attraction to novelty and risk, lack of truthfulness and finality, affective and moral disengagement, loss of control and order as implied by emotionality and finally transgression, especially

transgressions of prohibitions related to aggression/dominance and sexuality. Ibid. p. 177

4. See, for example, Umberto Eco, *The name of the Rose*; Jacques Le Goff, *A Cultural History of Humor: From antiquity to the Present Day*; and Conrad Hyers, *And God created Laughter: The Bible as Divine Comedy*

5. Todd Leopold, “Is ‘religious humor’ an oxymoron?” *CNN.com* (19 Nov. 2002); Leopold cites a 17th century admonition that banned games, sports, plays and comedies ‘because they didn’t agree with Christian silence, gravity and sobriety’ and was met with an ‘unspecified penalty’.

6. Telephone Interview with Lee Siegel, 30 Nov. 2009; In an interview with Lee Siegel, I was encouraged to “consider the sacred and the comic anathema to each other and believe that the degree to which you are religious you have no sense of humor, and that to the degree that you have a sense of humor you can’t be religious”

7. Conrad Hyers, *The Ancient Zen Master as Clown-Figure and Comic Midwife*. *Philosophy East & West* (1970, 10) pp. 3-18

8. Sita is a common Pali word for ‘a smile’. The specific usage here as an almost imperceptible smile may have been restricted to Buddhist monastic circles. Donald S. Lopez, Jr., “What’s so funny about the laughing Buddha?” *Proc. of “Does Humor Belong in Buddhism?”*, University of California, Berkeley (2007)

9. Michael Clasquin, “Real Buddhas Don’t Laugh”. In *Social Identities*.(Web), pp. 97-98.

10. Personal Interview Jetsunma Tenzin Palmo, Director of Dongyu Gatsal Ling Nunnery, Tashi Jong, India, November 27, 2009.

11. Conrad Hyers (*Zen and the Comic Spirit*, 1975) seems to be the pioneer on this front.

12. See G. Schopen “The learned monk as a comic figure: on reading a Buddhist Vinaya as Indian literature” and S. Clarke “Locating Humor in Indian Buddhist Monastic Law Codes: A Comparative Approach”.

13. See G. Dreyfus, “We Will See Who Laughs Last: Dialectic and Rhetoric in Tibetan Debate and the Role of Humor”.

14. Tom Armstrong, “Laughing Your Way To Enlightenment”. In *Hundred Mountain*. (Web), p. 2.

15. Such an ‘incongruity theory’ of humor is traced by Simon Critchley, following John Morreal’s lead, to Francis Hutcheson’s *Reflections upon laughter* from

1750, through such influential thinkers as Kant, Schopenhauer, and Kierkegaard.

16. Hugh Lafollette and Niall Shanks, "Belief and the Basis of Humor". In *American Philosophical Quarterly*. (1993), p. 332.

17. Personal Interview with Wendell Hartford, 5th year student at Sarah College, McLeod Ganj, November 26, 2009.

18. I interviewed five recognized tulkus (reincarnated enlightened Buddhist masters): Chogyi Nyima Rinpoche, Choegyal Rinpoche, Tai Situ Rinpoche, Karmapa, and Mingyur Rinpoche. All reacted to the revelation of the object of my study in the same unmistakable (and uncanny) way.

19. Lee Siegel's project of finding humor in India (as it manifested in the Classical Sanskrit Literature as well as the then-contemporary India) in the 1980's formed the primary inspiration of this study. Lee Siegel, *Comic Tradition in India* (Chicago; University of Chicago Press, 1987) p. 414.

20. Personal Interview with Samten Dondhup, The Assistant Director of Tibetan Opera at the Tibetan Institute of Performing Arts (and Aku Tonpa actor), McLeod Ganj, November 25, 2009.

21. Ramaswami Mahalingam categorizes Tibet as an 'honor culture', in which he identifies three psychological factors that characterize it: (a) low tolerance of insults; (b) high value on honor and shame; and (c) salience of chastity. "Culture, ecology, and beliefs about gender in son preference caste groups." *Evolution and Human Behavior* (28.5 (2007)), pp. 319-29

22. Drukpa Kunley, also known as "The Divine Madman of the Dragon Lineage", was a great master of Mahamudra. He was well known for his crazy methods of enlightening other beings, mostly women, which earned him the title "The Saint of 5,000 Women". He taught his teachings in exchange for chang. See Keith Dowman, *The Divine Madman*.

23. Personal Interview with Choegyal Rinpoche, Tashi Jong, India, November 28, 2009.

24. Personal Interview Jetsunma Tenzin Palmo, Director of Dongyu Gatsal Ling Nunnery, Tashi Jong, India, November 27, 2009.

25. *Ibid.*

26. Personal Interview with Choegyal Rinpoche, Tashi Jong, India, November 28, 2009.

27. For example, William Congreve remarked that, "Men are to be laughed out of their vices in comedy....

the business of comedy is to delight as well as to instruct."

28. Due to length restrictions, I will limit this survey to Aku Tonpa alone.

29. From Jetsunma Tenzin Palmo's perspective, the stages of spiritual development represent a deep refining of the capacity for humor: "I've always thought sense of humor should be the 7th Paramita". The Paramitas, traditionally six in Mahayana Buddhism (generosity, conduct, diligence, honesty, concentration, and wisdom), are cultivated as a way of purification and helping the aspirant to live an unobstructed life on the way to enlightenment. Personal Interview Jetsunma Tenzin Palmo, Director of Dongyu Gatsal Ling Nunnery, Tashi Jong, India, November 27, 2009.

30. Rinjing Dorje, *Tales of Uncle Tompa: The Legendary Rascal of Tibet*. (San Rafael, CA: Dorje Ling, 1997), p. ix.

31. Claude Levi-Strauss, *Structural Anthropology*. (New York: Basic Books, 1963), p. 114.

32. Andrew Stott, *Comedy*. (New York: Routledge, 2005), p. 55.

33. William J. Hynes, *Mythical trickster figures contours, contexts, and criticisms*. (Tuscaloosa: University of Alabama, 1993), p. 163.

34. Of all the tricksters surveyed by Kevin Stuart, Aku Tonpa was the only one unanimously recognized. Dge legs, kun mchog, dpal ldan bkra shis, and Kevin Stuart, "Tibetan Tricksters." In *Asian Folklore Studies* (58.1 (1999)), p. 6.

35. Curiously, Choegyal Rinpoche disputed Aku Tonpa's tulku status, claiming that a teacher and textual legitimacy would be necessary for such a claim to be made. Personal Interview with Choegyal Rinpoche, Tashi Jong, India, November 28, 2009.

36. Rinjing Dorje, *Tales of Uncle Tompa: The Legendary Rascal of Tibet*. (San Rafael, CA: Dorje Ling, 1997), p. 4.

37. Marilyn Stabelein in Rinjing Dorje, *Tales of Uncle Tompa: The Legendary Rascal of Tibet*. (San Rafael, CA: Dorje Ling, 1997), p. 3

38. *Ibid.*, p. ix.

39. *Ibid.*, p. x

40. *Ibid.*, p. xi

41. Personal Interview with Wendell Hartford, 5th year student at Sarah College, McLeod Ganj, November 26, 2009.

42. Personal Interview with Kalsang Khedup, author of

children's Aku Tonpa books, McLeod Ganj, November 24, 2009.

43. Ibid.

44. Wendy Doniger in the "Preface" of Rinjing Dorje, *Tales of Uncle Tompa: The Legendary Rascal of Tibet*. (San Rafael, CA: Dorje Ling, 1997), p. 6.

45. This matches the Tynes trickster trait of 'situation inverter': "By profaning or inverting these beliefs, the trickster brings them into sharp relief to show how much society values them." William J. Hynes, *Mythical trickster figures contours, contexts, and criticisms*. (Tuscaloosa: University of Alabama, 1993), p. 172.

46. Samten Dhondup attested to this 'plainness of sexual language' as a common property of Tibetan jokes', a feature that seems quite odd in light of the apparent 'neurosis' they carry. Personal Interview with Samten Dondhup, The Assistant Director of Tibetan Opera at the Tibetan Institute of Performing Arts (and Aku Tonpa actor), McLeod Ganj, November 25, 2009.

47. With my notepad, blue folder, large backpack, Team Tibet Jacket, and 'Om' Hat, my appearance was a truly burlesque and farce-like imitation of an anthropologist.

48. I recounted the story of 'Aku Tonpa goes to a Nunnery', which Chokyi Nyima promptly corrected for detail and insisted that it was Drukpa Kunley who per-

petrated the 'violation'.

49. The question that prompted this retelling was: "Do you know Aku Tonpa?"

50. Personal Interview with Mingyur Rinpoche, Sherab Ling, India, November 31, 2009.

51. Stuart identifies two sides of Aku Tonpa; "One is the advocate for justice, who uproots social oppression and subdues landlords and tyrants. This Aku Tonpa assists the powerless populace and provides a role model in terms of resisting social oppression and striving for justice. The other side of Aku Tonpa is destructive towards religion and a clever swindler." Dge legs, kun mchog, dpal ldan bkra shis, and Kevin Stuart, "Tibetan Tricksters." In *Asian Folklore Studies* (58.1 (1999)), p. 9.

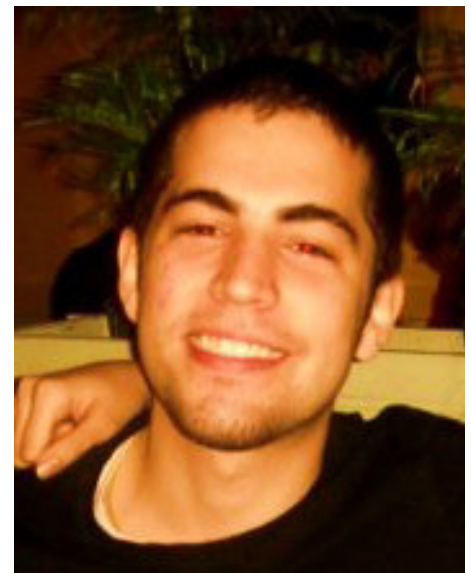
52. In the story referenced by Doniger, Aku Tonpa ultimately rapes the girl he has been coveting while she nonsensically cries "Vagina is raping me! Vagina is raping me!"

53. Personal Interview with Tenzin Palmo, November 27, 2009.

54. William J. Hynes, *Mythical trickster figures contours, contexts, and criticisms*. (Tuscaloosa: University of Alabama, 1993), p. 131.

55. Ibid. p. 132

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Baudelaire Squared: Beauty on the Poet's own Terms

Miles Osgood¹

*Between 1857 and 1861, the years of Charles Baudelaire's first two editions of *The Flowers of Evil*, the poet was nearly as busy at work in prose as he was in verse. In this fertile period, one essay printed and another conceived would change the face of art and literature, ushering in the modernist creed: *Philosophic art* (1858-60) and *The Painter of Modern Life* (published, eventually, in 1863). The essays condemned painters' reliance on antique ideas and forms, calling for the new artist to integrate an immediate, sensory, subjective aesthetic into his attempts at visual beauty. But Baudelaire's words were not for painters alone. In his 1857 poem "Beauty," Baudelaire himself had been guilty of portraying the beautiful only for its Platonic, eternal half. In 1861, readied by his new essays for a correction, he wrote "Hymn to Beauty," a dark, conflicted piece that made the synthesis of permanent and transient his own. This essay maps that transition, showing how the words of the critic became the words of the poet.*

With all of their incarnations, factions, and inter-reactions, the modernist and avant-garde poetry movements of the mid-nineteenth to mid-twentieth centuries shared at least one common trait: a desire to be understood on their own terms. More than any of the movements before them, the -isms of the modern era are inseparable from their manifestos, lectures, speeches, pamphlets, posters, and (in some memorable cases) even their own reference notes. As much as these artists wanted their creations to be self-sufficient, their audiences would often be lost without these explicit explanations. If Charles Baudelaire is to be called a father of European modernism, then there should be some suggestion that, as with his progeny, his criticism adds meaning to his poetry. Baudelaire wrote little about his own specific medium, but he does make sweeping remarks on art as a whole in his discussions of painting and drawing. By finding common subject matter between his art criticism and his own writing, one can determine whether Baudelaire believed in a

personal *ut pictura poesis*. If he did, then his philosophy on mimesis and poesis should unfold in the process. Baudelaire's writings on beauty, memorable in both his essays and his verse, provide a perfect case study. The portrayal of Beauty develops from "La Beauté" (*Les Fleurs du Mal*², 1857) to "Hymne à la beauté" (*Les Fleurs du Mal*, 1861) to reflect more accurately Baudelaire's later critical theories, themselves questioning the imitation of beauty and its philosophic rendering in art. Where "La Beauté"³ paints Beauty with an incomplete and didactic ethereality, "Hymne à la beauté"⁴ arrives at the conclusions of Baudelaire's later essays by adorning the subject with its transitory nature.

The best standard against which to hold up the two "Beauté" poems is Baudelaire's own, his depiction of the artistic ideal on the same subject, as pronounced in *Le Peintre de la Vie Moderne*⁵ (1863). In the very first chapter of the essay, in the midst of a discussion of fashion, Baudelaire writes,

This is in fact an excellent opportunity to establish a rational and historical theory of beauty, in contrast to the academic theory of an unique and absolute beauty; to show that beauty is always and inevitably of a double composition, although the impression that it produces is single—for the fact that it is difficult to discern the variable elements of beauty within the unity of the impression invalidates in no way the necessity of variety in its composition. Beauty is made up of an eternal, invariable element, whose quantity it is excessively difficult to determine, and of a relative, circumstantial, element, which will be, if you like, whether severally or all at once, the age, its fashions, its morals, its emotions. Without this second element, which might be described as the amusing, enticing, appetizing icing on the divine cake, the first element would be beyond our powers of digestion or appreciation, neither adapted nor suitable to human nature. I defy anyone to point to a single scrap of beauty which does not contain these two elements.
(Baudelaire, 3)

Although this essay was published in 1863, two years after his second and final poem on beauty, Baudelaire leads the reader to believe that he had arrived at the

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idea some time earlier. Presenting the argument first in the context of “an excellent opportunity” implies that the theory is nothing new for Baudelaire; it only needed a convenient home in which to be written out. As such, it could easily have influenced Baudelaire’s own artistic approach back in 1861, or even in 1857. The poet’s new rational and historical theory, in summary, is that beauty is composed of two parts, the eternal and the circumstantial. While the first may be the more important, the variable qualities of the moment must be present to decorate beauty and make its eternal elements appreciable. As a symbolist, Baudelaire certainly used particular, perceived details to speak to deeper truths in his poetry in general, but such a synthesis in his poems on beauty is far from apparent. Is this a flaw? Even if Baudelaire did have some belief in the correspondence of critical standards between painting and poetry, nothing in this essay’s proclamation requires him to infuse his verse with the eternal and the circumstantial. Nothing, in short, requires his poetry on beauty to be itself beautiful. However, if Baudelaire genuinely believed in bipartite beauty, then his representation of the character Beauty should bear that duality.

What one finds though, upon close inspection, is that “La Beauté,” for one, does not. Instead, Baudelaire depicts Beauty as solely ethereal and eternal. Baudelaire constructs the poem as a barely modified sonnet, a form that already carries centuries of wear. Beauty describes herself as unearthly and unattainable: as a dream (1), a queen in the sky (5), and an incomprehensible sphinx (5). The language she uses to illustrate her interactions with poets similarly distances her from their world, as the poets’ love for her and vision through her are not instantaneous or particular or circumstantial, but “éternel”⁶ (4, 14). The distance is not merely temporal, though. The phrase “Je trône dans l’azur”⁷ (5) creates a multi-dimensional separation, with “trône” serving the double-purpose of creating a spatial and hierarchical rift.

The quality of constancy in Beauty’s essence translates into her character. While poets may bruise themselves on her breast, Beauty’s heart remains as white as a swan (2, 7). She is not attached to their welfare. The narrative’s only action and sentiment—those qualities meant to adorn eternal verses with digestible, sensory images—belong not to Beauty, but to the poets. Beauty herself hates movement and betrays

no emotion (7-8). She is stable and stoic: her “grandes attitudes”⁸ (9) are not those of a human monarch, but of the proudest monuments (10). Finally, notice that she does not tame her lovers with attractive motion or even with her appearance; her snare lies in her mirroring eyes (14). Baudelaire has, in fact, stripped Beauty of almost any agency in the poets’ enchantment. Beauty may be fair (1), but her allure comes less from her features than from her ability to placidly and passively reflect. She is untouchable and she will not reach out. She will only ever be the removed study of her lovers’ “austères études”⁹ (11).

While Baudelaire’s choice of “miroirs”¹⁰ (13) for the final image is problematic for the interpretation of “La Beauté” as a purely metaphysical poem, his actual use of the symbol shows that he is far from committed to a circumstantial Beauty. Baudelaire could establish some relationship between Beauty and the world if he were to expand the mirror’s picture to specific places and times, but he does something quite different. Beauty’s eyes are not filled with worldly objects or feelings; they consist of “clartés éternelles”¹¹ (14). While the poets may see beautiful versions of their own worlds, the reader sees only another emblem of spirituality. Within the poem, then, Baudelaire’s presentation is consistent; the last impression he leaves is the one he creates throughout. Beauty remains an eternal light.

Of course, while Baudelaire seems to avoid as much as possible the connections between Beauty and the physical world in “La Beauté,” he inevitably falls into those similes and metaphors in other verses. However, even these more circumstantial images manage only to lend a greater sense of distance and permanence to the character of Beauty herself. The first of these instances appears in the opening line: “Je suis belle, ô mortels! comme un rêve de pierre”¹² (1, emphasis added). The simile has two functions in Baudelaire’s portrayal of ethereal beauty. First, in and of itself, its components put together the qualities of Beauty that will endure for the whole poem: “rêve” grants her spirituality, and “pierre” eternity. Any possible physical connotation of “pierre” is undermined by the syntactic manner in which Baudelaire makes stone part of the dream: “rêve de pierre.” Second, the simile describes Beauty’s fairness in terms foreign to the beauty of human experience: although the first sentence connotes a divine, feminine beauty, the

end of the line—like a dream of stone—defies the expectation of an idealized female description. The second line of the poem does the same: Beauty’s breast is introduced not by its allure, but by its violence (2). Because that violence might imply a worldly, transitory quality, Baudelaire uses a reflexive verb to turn the responsibility away from Beauty: the breast may inspire the poet’s love and perilous hurtling, but those motions are the lover’s, not the beloved’s. Similarly, the remaining images that Baudelaire conjures may add the variable element of beauty to his verse, but they only entrench the unilateral nature of his character Beauty. The sphinx is used for its mystery, the swan for its purity, and the monuments for their pride—hardly the “amusing, enticing, appetizing icing on the divine cake” that Baudelaire uses to describe transitory qualities in *Le Peintre de la Vie Moderne*.

“Hymne à la beauté,” on the other hand, deliberately takes on the task of combining the essay’s two facets of Beauty, beginning with the poem’s central question. The opening stanza, seeking Beauty’s astral origins, would appear to recognize only her metaphysical quality, but it soon shows how even these sources relate her to the sensory world. The poem begins, “Viens-tu du ciel profond ou sors-tu de l’abîme, / O Beauté?”¹³ (1-2). This line grants Beauty a celestial birthplace, but it also implies that Beauty has come from one of those foreign worlds to inhabit the Earth’s. In fact, each time that Baudelaire returns to the poem’s main question, he includes this added sense of arrival: “Sors-tu du gouffre ou descends-tu des astres?”¹⁴ (9), “Que tu viennes du ciel ou de l’enfer,”¹⁵ (21), “De Satan ou de Dieu”¹⁶ (25) (emphases added). Whenever the question of Beauty’s spiritual nature returns, so does Baudelaire’s reminder that she has traveled away from its sphere. This journey never appears in “La Beauté.”

The question’s resolution in “Hymne” also creates a combination:

*Ange ou Sirène,
Qu’importe, si tu rends,—fée aux yeux de
velours,
Rythme, parfums, lueur, ô mon unique reine!—
L’univers moins hideux et les instants moins
lourds?*¹⁷ (25-28)

Beauty’s identity may be unearthly—she is, after all, compared to an angel, a siren, and a fairy—but her effect is sensory. The poet is overwhelmed, at the end, not by the idea of Beauty, but by the sensations of Beauty:

the touch of a velvet gaze, the sound of her rhythm, the smell of perfumes, and the sight of her glow. She makes the eternal universe less horrifying at the same time as she makes lighter the transitory instants of life; she touches the two types of time. Baudelaire ends his poem on a very explicit note: this Beauty consists of both elements of the beautiful.

“Hymne” also uses physical imagery to portray the transitory nature that the goddess of “La Beauté” lacked. The first comparison that Baudelaire uses in the poem is that between Beauty’s effect on the human world—“le bienfait et le crime”¹⁸ (3)—and wine’s (4). As Baudelaire further describes in the next stanza, Beauty is first and foremost a drug. Even within that metaphor lie further clues to uncover her variable side: her eyes contain sunsets and sunrises (5), her perfumes are like a single stormy night (6), and her draughts create virtues and vices where they do not belong (7-8). These descriptions paint a Beauty who can flood the veins in an instant, but also one that can die down the next. Baudelaire makes his appeal to Beauty’s transitory nature even more explicit in the fifth stanza, when he uses the metaphor of the candle: “L’éphémère ébloui vole vers toi, chandelle, / Crépète, flambé et dit: Bénissons ce flambeau!”¹⁹ (17-18). Baudelaire does not stop at the metaphor between Beauty and the flame, an ephemeral symbol. He shows Beauty consuming ephemerality itself.

However, this is not to say that “Hymne à la beauté” denies Beauty’s duality by abandoning her eternal, invariable element. The conception of the poem as a hymn and the debate that opens and closes it make clear that Beauty is at least in part, if not at her very core, a divinity. Her dominion over capital-letter concepts, such as “Le Destin” (10), “l’Horreur” (14), and “le Meurtre,”²⁰ even exalts her as a queen above a panoply of gods. Baudelaire goes even further when he suggests briefly that, in fact, she governs everything (12). Finally, Baudelaire’s penultimate conclusion on her nature reveals that, while her effects on worldly fortunes may be largely transitory, she can also provide a window into eternity, just like her counterpart in “La Beauté”: “ton œil, ton souris, ton pied, m’ouvrent la porte / D’un Infini que j’aime et n’ai jamais connu”²¹ (23-24). This second poem’s Beauty may have traveled from another world to ours, but she is still a lens through which to watch all of time and space. “Hymne” here sings its own version of “clartés éternelles.” There can

be no question, then, that the eternal element, the first part of beauty in *Le Peintre de la Vie Moderne*, remains present in from “La Beauté” to “Hymne.”

While the significant difference between the Beauty of “La Beauté” and that of “Hymne à la beauté” becomes fairly clear under the essay’s criteria, the shift’s cause is less apparent. Even if Baudelaire had developed the concept of bipartite beauty some years before *Le Peintre de la Vie Moderne*, there is no evidence to prove that the idea took hold specifically between the 1857 and 1861 editions of *Les Fleurs du Mal*—as much as the contrast between the two poems might so suggest. Recourse can be sought, though, in a piece of Baudelaire’s art criticism that was written in those interstitial years: *L’art philosophique*²² (1858-1860).²³ In the essay, Baudelaire makes two relevant claims about the duties of art. He begins, “What is pure art according to the modern idea? It is the creation of an evocative image, containing at once the object and the subject, the world external to the artist and the artist himself” (Baudelaire, 205). On this count, both poems are about even: “La Beauté” describes the fate of the poet at the hands of the other-worldly Beauty, and “Hymne” describes the personal pangs, reliefs, and epiphanies of the speaker in the midst of a discourse on Beauty’s world governance. The essay goes on, however, to create a greater schism between the poems by declaiming against the pursuit and promotion of philosophy through art. According to Baudelaire, “every art ought to be self-sufficient” (Baudelaire, 211), and, as such, Philosophic Artists are heretics (Baudelaire, 212).

The reason that this tenet poses a problem for Baudelaire’s own poetry is that “La Beauté,” by failing to recognize the progressive bipartite theory of beauty, must, according to the rules of *Le Peintre de la Vie Moderne*, be in concord with the other, more philosophic definition: “the academic theory of an unique and absolute beauty.” This academic theory is certainly not from any recent academy; the French *lumières*, revolutionaries, and Romantics were generally skeptics as far as absolutes were concerned. Instead, the eternal, invariable Beauty is more likely Plato’s. The Form of Beauty is one of Socrates’ favorite examples; it appears throughout the Platonic dialogues, including *Phaedo*, *Phaedrus*, *Symposium*, and *Republic*. Whether Baudelaire was conscious of it or not, the Form also pervades “La Beauté,” and

thereby renders Baudelaire guilty of, in his own words, “the error of Philosophic Art” (Baudelaire, 206).

By framing the beginning and end of “La Beauté,” the Formal quality of Beauty adds weight to her ethereal and eternal nature. The poem seems to open with a redundancy, or at least with unnecessary obviousness, in the line, “Je suis belle, ô mortels!” (1), but more likely this exclamation serves to introduce Baudelaire’s philosophical stance. Beauty is beautiful by Platonic definition; she is the concept “beautiful.” By labeling her audience “mortels,” she also asserts her own immortality by contrast. Defined from the outset by the purest semantic description of her nature and by her eternality, Beauty establishes her identity in relation to the Forms. To further this association, Baudelaire writes that she sits as a mysterious sphinx (a classical image on its own) in her throne in the sky (5), as if waiting to be decoded by the austere studies of poets (11). In Baudelaire’s image, the poets have become Plato’s philosopher kings, consumed (11) in study of Beauty’s Form. Notice that Baudelaire even uses the same word, “austère,” that he uses in his poetry’s only allusion to the Greek philosopher: “Laisse du vieux Platon se froncer l’oeil austère”²⁴ (“Lesbos,” *Les Fleurs du Mal*).

“L’oeil” also happens to be the most Platonic piece of “La Beauté,” as it leaves the final impression of her metaphysical nature. Beauty has “De purs miroirs qui font toutes choses plus belles: / Mes yeux, mes larges yeux aux clartés éternelles!”²⁵ (13-14). The first line would be a contradiction but for a classical interpretation: the only way the mirror could be pure and still project a more beautiful picture is in the idea of the Form, the pure truth of Beauty through which the philosopher sees the fullest earthly beauty. The Beauty of “La Beauté” is the poet’s passage out of the cave (*Republic*, 513e-518b), into the light of “clartés éternelles.” In terms of *L’art Philosophique*, then, Baudelaire is not only guilty of creating a philosophic object, the Form of Beauty, but a philosophic subject, the poet.

Compare the frame of “La Beauté” to that of “Hymne à la beauté.” “La Beauté” opens by exclaiming a definite, definitional, eternal identity. The only relation the beginning of “Hymne à la beauté” has to Plato is its *aporia*: the new speaker, the poet, cannot tell what Beauty is. The pursuit of Beauty in “La Beauté” is a study (11), an act of the highest part of the Platonic

soul, reason (Republic, 401b-d, 441e). If Baudelaire meant for Beauty to be similarly Formal in “Hymne,” he would not have attributed her power to the lowest part of the soul, to the drugs, perfumes, and eros of the appetite (4, 6, 7, 19, 27). The philosophic contrast lasts through the conclusion of both poems. In the last lines of “La Beauté,” Beauty describes her mirror-eyes as open on eternal enlightenment. In the last lines of “Hymne,” Beauty can only temper the horror and depression of life. Only the first of these represents the philosophic pleasure of communion with the Good from Plato’s dialogues.

The tone of the last line of “Hymne” speaks to a greater overall difference, one that thoroughly removes its Beauty from the Platonic ideal: unlike “La Beauté,” “Hymne” is overwhelmingly negative. Beauty’s 1857 incarnation is, at worst, mysterious. She may be distant, but she bears a snow-white heart (6) and renders the universe beautiful—in short, again, she has the relationship with the Good that Plato ascribes to the Forms. Even in the most violent line of the poem, “Et mon sein, où chacun s’est meurtri tour à tour,”²⁶ the poet displaces blame onto her lovers: according to the reflexive verb, they are the ones who are at fault for bruising themselves. “Hymne à la beauté,” on the other hand, does not shy away from Beauty’s destruction. In fact, even though it proposes Beauty’s angelic and demonic origins as equally probable (1-3), only a few lines portray her benevolent aspect (8, 24, 26-8). On the other side, her gaze and her kisses are intoxicating (4-8), she tramples and mocks the dead (13), her jewels include Horror and Murder (14-15), and her attraction is that of a deadly flame (16-17), a tomb (20), and a monster (22). She may, as in “La Beauté,” open the door to the Infinite (24), but at what price? Her beneficent qualities are overshadowed by her terrible power.

Between 1857 and 1861, Baudelaire seems, then, to have taken his own artistic advice to heart. In re-examining his depiction of beauty, he did more than render the second, transitory element to his character in anticipation of *Le Peintre de la Vie Moderne*; he expunged Beauty’s philosophical strain to write a poem consistent with the current *L’art Philosophique*. While the eternal aspect had to remain, due to Baudelaire’s binary theory of artistic beauty, the depiction in “Hymne,” through new sensory detail, human voice, and a sinister tone, does everything possible to create a Beauty who is at least subjective and original (not in

the least bit Platonic). Out with Form, in with moral ambiguity. “Hymne à la beauté” then becomes not only more consistent with Baudelaire’s art criticism, but also with his other poetry. The hymn provides yet another exploration of the poet’s depression and unease, the genuine sentiments of *Les Fleurs du Mal*. By contrast, in a collection including “Au Lecteur” and “Spleen,” the holy aura of “La Beauté” rings false.

If “Hymne à la beauté” can then be read, in part, as a correction, what do we learn about Baudelaire’s creative process? While modern poetry, according to *L’art Philosophique*, may not call for the ancients’ philosophy, Baudelaire’s does not abandon philosophic significance altogether. Just as modernism as a whole re-asserts the poet’s subjective perception and subjective aesthetic, Baudelaire’s poetry promotes subjective philosophy. “Hymne à la Beauté” is not devoid of message; it questions the nature and the effect of Beauty just as it questions her portrayal. However, the philosophical foundation is no longer a set of classical tenets adopted by Baudelaire; the foundation is Baudelaire’s own. Baudelaire’s mimesis is a thorough imitation that derives truth from personal experience—thorough, by means of the eternal and the circumstantial; experienced, by means of the spiritual and the sensory. His poesis, then, is a synthesis of his unique understanding of the world and his unique interaction with the world. To put the craft in a few of his own terms, his creation combines the poet’s invariable perception of the eternal and his relative perception of the circumstantial. The sum produces poetic beauty—with or without a capital B.

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3. “Hymn to Beauty”
4. *The Painter of Modern Life*
5. Baudelaire, Charles. *The Painter of Modern Life and Other Essays*. Trans. Jonathan Mayne. New York: Phaidon, 1964. 1-41.
6. eternal
7. I’m enthroned in the sky
8. grand bearing
9. austere studies
10. mirrors
11. eternal clarities
12. I am beautiful, O mortals! like a dream of stone
13. Do you come from sky or leave the abyss,

/ O Beauty

14. Do you leave the gulf or descend from the stars?
15. That you come from the sky or from hell
16. From Satan or from God
17. Angel or Siren, / No matter, if you render—fairy of
velvet eyes, / Rhythm, perfume, glow, O my only
queen!— / The Universe less hideous and instants
less heavy
18. the good deed and the crime
19. The moth flies toward you, candle, / Crackles,
burns and says: Bless this flame!
20. Destiny, Horror, Murder
21. your eye, your smile, your foot, open for me the
door / Of an Infinity I love and have never known
22. *Philosophic Art*
23. Baudelaire, Charles. *The Painter of Modern Life
and Other Essays*. 205-13.
24. Let old Plato frown the austere eye
25. Pure mirrors that make all things more beautiful: /
My eyes, my large eyes of eternal clarities
26. And my breast, where each has bruised himself in
turn

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Problematic Issues of Objectification, Documentary and Art in *Blind Woman* from the region of Gondan, Mali, 1985 by Sebastião Salgado

Tiffany Quach¹

The caption of Sebastião Salgado's photograph *Blind woman* from the region of Gondan, Mali, 1985 reads, "With dead eyes worn out by sand storms and chronic infections, this woman from the region of Gondan has arrived at the end of her voyage". Without reading the caption, the viewer may be taken aback by the beauty of the photograph but not realize the gravity of the subject's situation. This effect of beauty in Sebastião Salgado's photographs has led to criticism of his tendency to aestheticize suffering. The power of aesthetics to shape the way we perceive anguish and adversity has proved to be a powerful representational and political tool. In this essay I will explore this particular photograph's aesthetic and formal elements and how they address complex issues of subject-object interactions, power relations, and problems plaguing socially committed photography.

Blind woman depicts a woman in contemplation, her right eye hidden by the shadow of her garment and her left eye revealed by the dramatic lighting that emphasizes her blindness. The portrait is made all the more haunting for the viewer with knowledge of her condition. Perhaps criticism of Salgado's work stems from his penchant for imbuing the tragic with beauty that transcends the reality of the situation, but at the expense of the viewer's immediate concern. The professional quality of the shot, one that could have been taken in a studio, also contributes to this sense of beauty obtained by subtle manipulations.

Roland Barthes' theories about the creation of meaning in photographs are useful in analyzing *Blind woman*. Barthes bases his argument on the photograph's ability to represent implied meanings without seeming to do so; our trust in mechanical reproduction makes it seem as if the photograph is pure and indisputable fact – What in the photograph is fact?

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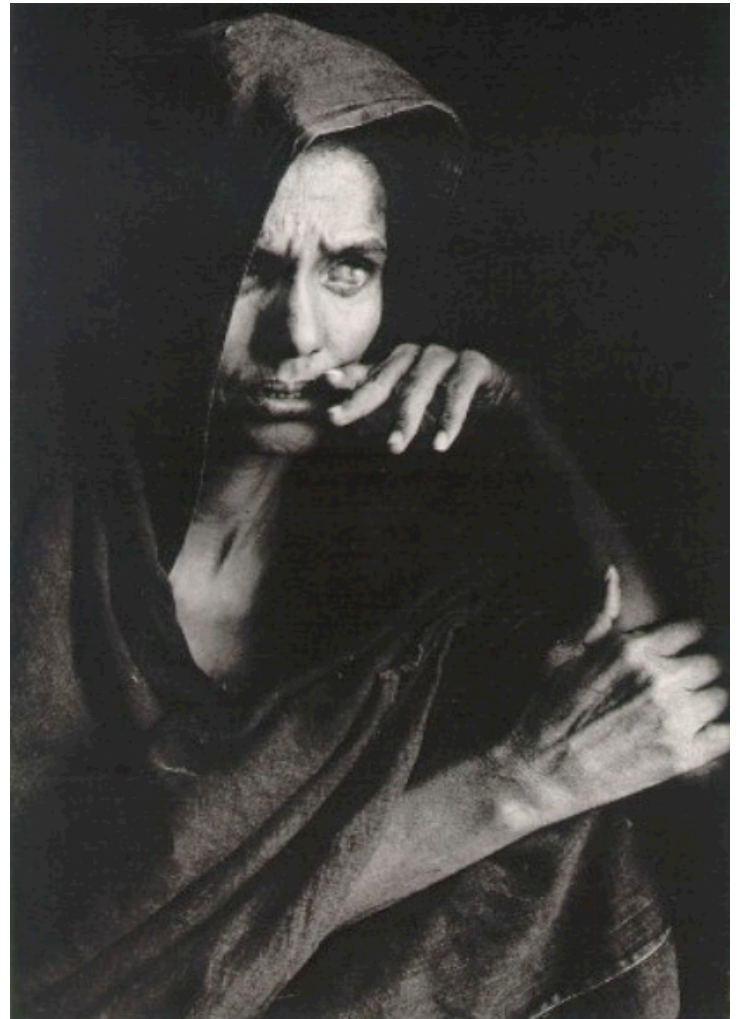


Figure 1 Sebastião Salgado, *Blind Woman*

The photograph's specious quality of factuality and supposed absence of a code leads to the assumption or mindset that the photograph was created without any involvement of a human hand when in fact there are issues of framing and aesthetics at work. The presence of the coded message is not immediately apparent, but upon closer inspection one realizes that the photograph is the most subtly deceiving/deceptive of all visual representations because it seems not to be a representation at all.

It is due to the photograph's seeming lack of code that it is necessary to emphasize the importance of the contextual framework of sociological, historical and cultural factors that inform the photograph's transmission and reception. The frame of reference around a photograph and its viewer determines its message and how it is received. This frame allows the photographer to create a message that transcends the image of the photograph itself. *Blind woman* utilizes

this mode of signification as the crux of the photograph lies not in the subject but the systems of understanding surrounding it, which house the code and connotations necessary for understanding the photograph's message. However, there are some difficulties in reconciling *Blind woman* with Barthes' analysis of the photographic paradox because he singles out the press photograph for analysis and deliberately excludes the art photograph. It unclear as to whether *Blind woman* was conceived as a documentary photography or an art photograph; much of Salgado's work straddles the line between the two disciplines. The photograph's many roles lead to an examination of how factors of connotation combine to produce such a striking effect in *Blind woman*.

Barthes' six visual procedures of connotation are very useful in describing how meaning is conveyed in *Blind woman* through methods of coding that impose a second meaning on the image. The photograph does not employ all six of these connotative methods but makes use of a significant amount of them. Barthes' definition of pose (the second of his six categories) refers to certain stereotyped postures or stances that are



Figure 2 Carravaggio, *St Jerome In Meditation*

readily recognizable to the viewer as signifying particular emotions and qualities. In *Blind woman* the subject's pose expresses her uncertainty about the future. She looks to the side and away from the viewer, revealing her unseeing eyes. Her blindness confers a sense of holiness that owes its origin to depictions of religious or spiritual figures. She simultaneously evokes feelings of pity and of veneration in the viewer. In this way, the subject's pose communicates a wealth of information about how the viewer is supposed to feel about *Blind woman*.

Connotation through the use of objects (the third category) also appears in *Blind woman*. Barthes speaks about objects as signifiers that confer on the photograph a certain symbolic meaning. The way the subject's garment drapes over her face and body recalls religious imagery of the Virgin Mary or saints. This visual association strengthens the characterization that the viewer has created of her and also heightens the overall visual impact of the photograph. The religious association in the photograph also raises questions about how much *Blind woman* owes to religious imagery in Western art, which ties into aesthetic connotation (the fifth category).

Barthes defines aestheticism in photography as incorporating painting, composition or similar visual means of depiction in a photograph. The photograph does so in order to either declare itself as art or "impose a generally more subtle and complex signified than would be possible with other connotation procedures." In the case of *Blind woman*, I believe that aestheticism is at work within the photograph for both of these purposes. This change in context and transmission results in an aestheticization of the image, which has profound implications on how the photograph should be viewed. Aesthetic considerations allow *Blind woman* to be seen in terms of art and art history, traditions that impart nuanced and complex shades of meaning to the photograph. The shadowing that Salgado employs in the photograph owes a lot to chiaroscuro and tenebrism, a style of painting in which light is used to focus the viewer's attention on a certain subject, resulting in the extreme contrast between light and dark. Caravaggio's *Saint Jerome in Meditation* is an example of tenebrism that begs comparisons to *Blind woman*.

Blind woman features a similar use of shadowing, and the subjects, in both photograph and painting, seem to emerge from the darkness,

dramatically illuminated by a single light source. Apart from obvious similarities between the formal elements of the photograph and the painting, similarities with respect to subject matter are also relevant as tenebrism was widely used (although not exclusively) to portray religious subjects. This kind of dramatic lighting imbued subjects with gravitas as if they were illuminated by some divine light. Blind woman's allusions to these art historical precedents imbue the photograph with aesthetic considerations that give it another dimension of meaning.

Blind woman also engages with connotation of photogenia (Barthes' fourth category). Photogenia refers to techniques of lighting, exposure, printing and cropping that direct the viewer's attention to particular aspects of the image. Blind woman is a highly stylized photographic image that uses lighting and shadowing to emphasize certain aspects of the subject's features. Salgado has also composed and framed the photograph in a certain way to focus on the subject's face and especially her eyes; this figures in the photograph in a very significant way as any alteration in framing or lighting changes the emphasis of a photograph. The photograph's exposure, cropping and lighting directs the viewer's attention to particular elements of the image, and these interventions of composition and framing all effectively belong to the plane of connotation.

These connotative meanings mainly focus on the subject's blindness or, rather, lack of vision. In *The Primacy of Perception*, Maurice Merleau-Ponty argues that humanity lies in self-viewing and self-consciousness in knowing that we are simultaneously objects and subjects. If sight is how we know of the world, a blind person is not only bereft of that ability to know but also of the possibility of subjectivity. Such a lack of subjectivity effectively renders the subject of Blind woman as an object. Though she is a human subject of a photograph, her blindness puts her in a position to be seen only as an object incapable of interaction with the viewer.

In this way her blindness has profound implications on the subject-object relationship, for a subject who is unable to look back at the viewer can only be an object. Her agency is rendered invalid by her blindness and resulting inability to transcend her situation and enter into the plane of the viewer. She is not participating in the experience of the photograph

and is completely at the whim of the photographer and the viewer. Although the following phrase of Jonathan Crary's is made in reference to the camera obscura, it encapsulates the relationship between subject and object in most portraiture photographs as "the relation of a perceiver and the position of a knowing subject to an external world." Blind woman challenges this understanding of subjectivity and objectivity as the lack of a knowing subject obliterates the subject-object relationship that is paradigmatic to the photographic mode of seeing in portraiture. In this sense, Salgado has objectified her completely by photographing her according to the aforementioned modes of connotation. The objectification of Blind woman is particularly relevant in relation to the photographic paradox, as it is very clear that the connotations are created by the photographer's hand and not by the subject. The subject of Blind woman probably did not have much say in her pose in the photograph, as she might not have been aware of her stance or even of being photographed.

Her blindness not only results in her complete objectification by the photographer, but also changes the idea of the observer as we know it. Blind woman enables the viewer who is able to see without being seen, a viewer who cannot avoid a sense of voyeurism. This effect is just one of many that seems to contribute to the sense of exploitation in the photograph. Blind woman lacks the pretense about power relations between subject and viewer that most portrait photographs imply. When viewing the photograph, it is very obvious that Salgado is the sole participant in the positioning and framing of the photograph (especially given Blind woman's resemblance to a staged fashion photograph made with studio lighting). Furthermore, her blindness means she will never be able to see the completed work and ties into another aspect of her exploitation. The aestheticization of suffering evident in this photograph also points to another dimension of objectification and exploitation. Ingrid Sischy, a critic of Salgado's work, emphasizes that he "is too busy with the compositional aspects of his pictures—and with finding the 'grace' and 'beauty' in the twisted forms of his anguished subjects....To aestheticize tragedy is the fastest way to anesthetize the feelings of those who are witnessing it. Beauty is a call to admiration, not to action." This kind of reaction from the viewers of Salgado's photographs comes from an uncomfortable and awkward realization of their voyeurism.

The sentiment of disapproval as articulated by Sischy is tied closely to the sense that Salgado is exploiting the subjects of his photographs and manipulating the viewers through aestheticization of suffering. Salgado's talent for making beautiful the ugly truth of reality presents moral and ethical issues about representation. Such aestheticization clashes with photojournalism and documentary's claims "to have a special relationship to the real; that they give us an accurate and authentic view of the world." Photography cannot live up to this claim so long as aesthetics govern the viewer's judgment of a photograph. Even in documentary photography or photojournalism (genres that purport to value representational veracity) aesthetics still dictate what is considered a good or successful photograph. Inherent in aesthetic considerations are the coding and connotations on which Barthes elaborates. This discussion of aesthetics leads to the question: Is *Blind woman* a work of art or a document of a particular moment of history? The fact that such categorizations are subject to the vagaries of time complicates this understanding of *Blind woman* in the context of art versus documentary. The same photograph viewed fifty years ago does not carry the same message as it does today due to differences in cultural attitudes. The code of the photographic message relies on the situation of the viewer and so changes with time and place, and the same applies to attitudes towards art. Therefore, it is helpful to move on to a discussion of the photograph's context to shed further light on its meaning.

The photographer's intentions and context can determine the message of the photograph to a certain extent, but it is also necessary to explore *Blind woman*'s context as a photograph. *Blind woman* was published in Salgado's book *Sahel: The End of the Road*, his 1984-1985 documentation of famine in the Sahel region of Africa. Salgado's work as a photojournalist for several photo agencies and the publication of the majority of his photography in books seem to place his work squarely in the field of documentary photography. However, Salgado's photographs are sometimes displayed in art galleries and museums, which calls into question the status of his work as documentary or art. Certainly, the highly aesthetic treatment of his subjects can categorize his photography as art. On the other hand, Salgado's photographs do have a concrete social role as portions of the profits of *Sahel: The End of the*

Road were donated to the not-for-profit organization Doctors Without Borders. This back and forth debate that characterizes the discussion of whether Salgado's work is art or documentary further complicates a contextual understanding of *Blind woman*.

The appearance of Salgado's work in art galleries or museums also raises questions about the way in which *Blind woman* simultaneously inhabits both documentary and artistic contexts. Susan Sontag expounds upon photography's tendency as a medium to be transformed into art: "Although the natural or naive status of subject matter in photography is more secure than in any other representational art, the very plurality of situations in which photographs are looked at complicates and eventually weakens the primacy of subject matter...photography, though not an art form in itself, has the peculiar capacity to turn all its subjects into works of art." In Salgado's case, the problem is compounded by the fact that he does occasionally exhibit his work much like an artist. The photographic image in particular has this ability to be made into art to such an extent and with such ease because of its lack of a message or code. According to Barthes, the act of reappropriation relies on the status of the photograph as a message without a code. This mode of signification relies on the opposition of the coded and non-coded iconic messages. The coded iconic message, which consists of a series of discontinuous signs, uses signifiers to symbolize certain elements or characteristics. The non-coded iconic message (the literal visual message) is the photograph which repeats rather than transforms the coded iconic message. It is important to emphasize the photograph's reiterative function and its resulting support of the coded iconic message, for it is this particular function of the photograph that allows it to shift its message when applied to different contexts. The photograph itself lacks any code or inherent meaning and reinforces only the symbolic messages. When the viewer takes into consideration Barthes' theories of photographic reappropriation, the power of the art label becomes clear.

The label of art can completely change the message of a photograph that seems to be a document, or vice versa. It affects socially committed photography by emphasizing the focus on the photograph itself and not the subject depicted. This tendency can be detrimental to socially committed photography that has

reform purposes, as the subject of the photograph loses even more of its power. This effect is made especially evident in *Blind woman* with respect to the subject's lack of vision, objectification and exploitation by the photographer.

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Tiffany Quach is a Stanford junior double majoring in English and Studio Art (with an emphasis in photography and digital media). She studied abroad in Oxford at Corpus Christi College, where she took a tutorial incorporating art theory, aesthetics, theories of vision, perspective and photography. “Blind Woman” was her final tutorial paper, a synthesis and culmination of many of the ideas addressed in the course.



Using Shannon Entropy to Improve the Accuracy of Repeat Masking during Automated Genome Annotation

Kelsey Moody¹

In the present study, we designed computational tools for calculating Shannon Entropy (SE) for repetitive and non-repetitive protein sequences and compared SE to other values including sequence length and EST and protein alignment support. Our goal was to test SE as a potential filter for removing low-complexity sequences from consideration during the genome annotation process. We then examined the consequences of removing low SE sequences from the repeat identification and genome annotation process. We found that by excluding sequences with low SE (SE < 3) and low sequence length (length < 15 amino acids), the total repeat count decreased from 120 to 66, the average length of each sequence decreased from 1037 amino acids to 811, and the number of nucleotides masked per megabase decreased from ~77775 to ~33453.

Introduction

A term originally coined in a 1978 publication by Paulien Hogeweg, bioinformatics refers to the application of computer science to a wide range of biological fields ¹. A major use of bioinformatics is genome annotation, which is a computational method that identifies the locations of genes and coding regions on a given sequence. Sequencing is distinctly different from annotation, as it refers to the process of identifying the type and order of base pairs in a genome. In information systems lingo, sequencing provides data while annotation converts data into information (applicable knowledge). Full genomic sequencing of a human-sized genome for less than \$1,000 is on the horizon, creating a need for accurate, rapid annotation technologies ²⁻⁵. Current measures to computationally annotate sequence data rely heavily on the software package BLAST (Basic Local Alignment Search Tool), which was originally created by the National Center for Biotechnology Information

(NCBI) ⁶. Though noted for powerful, reliable, and fast performance, BLAST derived annotation pipelines are known to have difficulty aligning low complexity sequences, which are characterized as sequences with high frequencies of tandem or dispersed repeats, and/or short sequences. These sequences tend to give rise to numerous, spurious alignments to the target genome because they violate some of the underlying assumptions of BLAST's Karlin-Altschul statistical paradigm ⁶. Thus further methodologies are needed to filter and exclude low complexity sequences from these annotations ².

Shannon entropy (SE), as it relates to information theory, is a calculation of the amount of randomness associated within a given string of variables ^{7,8}. Its equation,

$$H = - \sum_{i=1}^n p(x_i) \log_2 p(x_i)$$

is typically expressed in bits. In protein and DNA analysis, sequences with high frequencies of amino acid or nucleotide repeats (respectively) will have lower SE values. This observation is highlighted in figure 1, where sequence 1 has no repeats (high entropy), and sequences 2 and 3 have repeats (both low entropy). SE

#	Sequence	SE
1	ARNDCEQGHI	3.3 bits
2	MTAATAATAA	1.3 bits
3	MAAAAAAAAAA	0.4 bits

Figure 1 Examples of sequences and their corresponding Shannon Entropy. Three hypothetical sequences shown in column two and their corresponding entropies, column three.

calculations can be applied to sequences of DNA or protein. We hypothesized that a SE threshold exists, beneath which sequence data can be excluded for purposes of annotation.

Methods

We designed a tool to parse a multi-FASTA file (a standardized file structure for sequence information), calculating the SE for each sequence. A second tool was developed to parse FASTA outputs from MAKER

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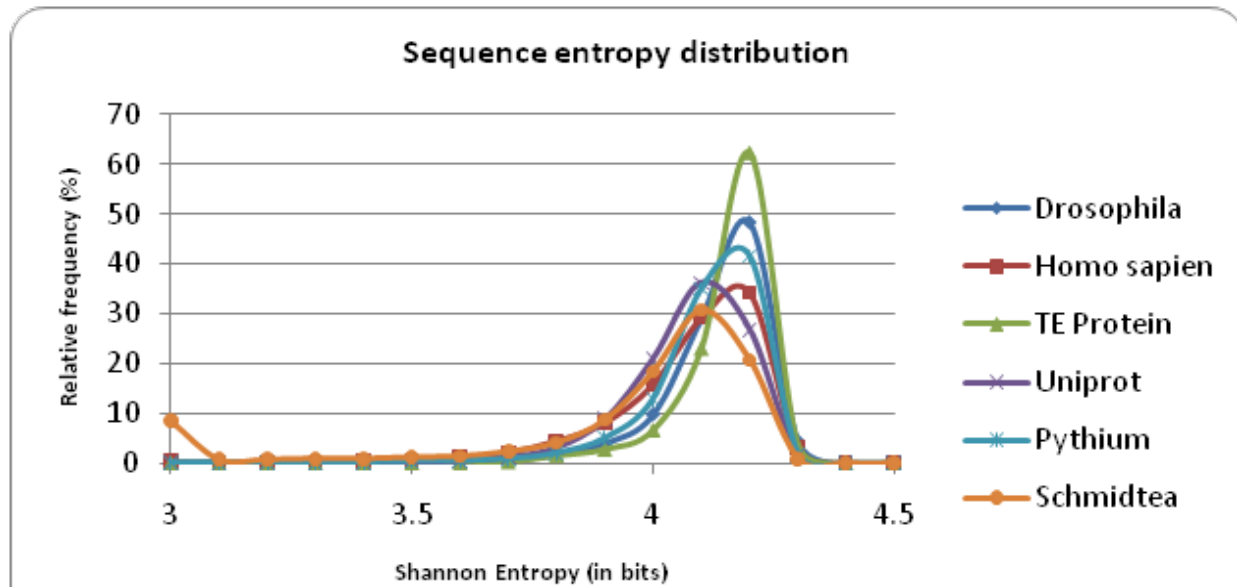


Figure 2 Distribution of sequence entropy for selected protein sequence databases. SE graphed against the percentage of sequences having a given entropy. Sequences with SE < 3 were rejected because they constituted less than 10% of the sequence in all instances.

annotations, identifying the amount of EST and protein alignment support for each annotated sequence². A third tool was produced to analyze a FASTA file and return a new file, eliminating sequences as per user defined specifications (sequence length and SE). Lastly, we designed a script to identify the frequency, total length, and average length of sequence repeats within a GFF3 file. These programs were modified to create a variety of specialized modules for data analysis. All software was written in *Perl* programming language.

Results

Sequence composition as a factor of SE was graphed for six collections of protein sequences including *Drosophila melanogaster*, *Homo sapien*, TE protein, UniProt, *Pythium ultimum*, and *Schmidtea mediterranea*, which were acquired from flybase.org, R. Buell, uniprot.org, uniprot.org, smedgd.org, and smedgd.org respectively. Uniprot (formerly Swiss-Prot) is a comprehensive listing of all known manually annotated protein sequences⁹. TE protein is a listing of transposon and retroviral protein sequences¹⁰. The *Drosophila melanogaster*, *Homo sapien*, *Pythium ultimum*, and *Schmidtea mediterranea* files are compilations of all known protein sequences for each respective organism. Figure 2 suggests a universal trend that most sequences have SE values between 3.75 bits and 4.25 bits. TE protein had the greatest high entropy composition, a noteworthy observation which will be addressed in the discussion section.

SE frequency (in percent) was then matched against frequency of EST and protein alignment support for *Schmidtea Mediterania* for SE < 4, and SE > 4. Our results (figure 3) suggest little distinction between supporting evidence for differing entropy levels. Sequence length was then plotted against SE for *Pythium ultimum* (figure 4) for *Homo sapiens* (figure 5).

The TE protein file is used as a repeat masker for genome annotation. We found that many of the low-complexity sequences it masks are actually valid protein sequences. To improve the accuracy of repeat masking during automated genomic annotation, we produced a modified TE protein file which excludes short amino acid sequences (length < 15) and sequences with an SE value less than 3. Use of the latter file over the former resulted in a repeat count decrease to 66 from 120, with a mean repeat length decrease from 1037 to 811.

Discussion

Results from the percent sequence composition vs. SE graph (figure 2) were as expected, with the vast majority of SE values falling between 3.75 bits and 4.25 bits, indicative of high information content within most sequences. We expected the TE protein collection to have lower SE than the others because it contains more repeat derived sequences, but it actually had an elevated percentage of high SE sequences. Thus, even though mobile elements such as retro-transposons,

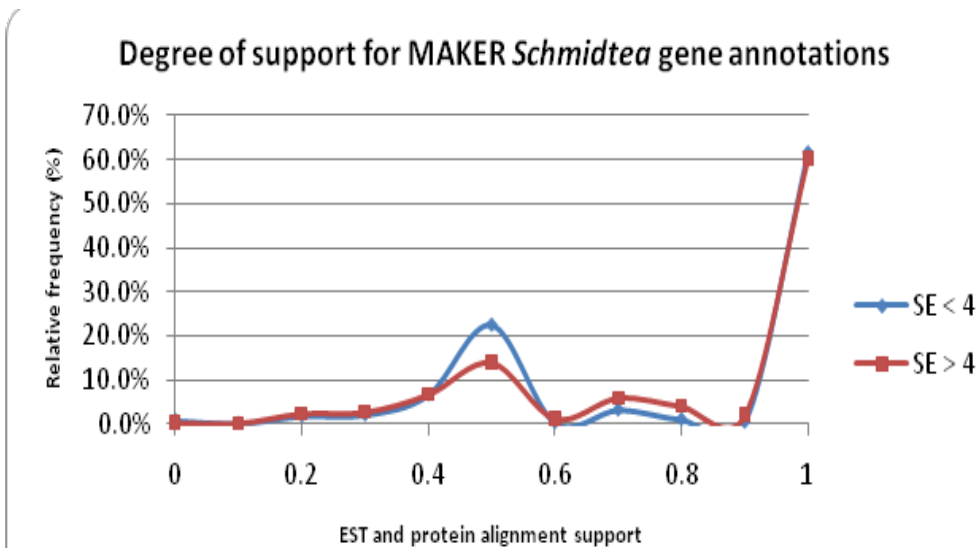


Figure 3. Degree of support for MAKER *Schmidtea* gene annotations compared to SE of the proteins they encode. Frequency of EST and protein alignment support graphed against SE frequency (in percent) for SE < 4, and SE > 4.

are strictly speaking, ‘repetitive elements’, this result shows that the proteins they encode are not necessarily low complexity; in fact, they tend to be more complex than most host nuclear genes. Additionally, current literature supports many of the low SE sequences we acquired as viable annotations of real nuclear genes which encode low complexity proteins.

Next, we wondered if in general, poorly supported genome annotations might have a tendency to encode proteins with low SE values. To investigate this further, we analyzed SE frequencies against empirically derived expressed sequence tag (EST) and protein alignment support for *Schmidtea mediterranea*. We expected poorly supported sequences to be more prevalent when SE < 4, and less prevalent when SE > 4. Figure 4 shows mild differences between the two data series, with low SE sequence frequency peaking at roughly 50% supported, and trailing just below high SE sequence frequency from 60% - 90% supported. However, this data fails to provide a suitable threshold for sequence exclusion, based solely on SE.

We then analyzed the *Pythium ultimum* sequence collection by plotting sequence length against SE (figure 4). We found the expected positive correlation between string length and SE, as was the basis of our original hypothesis. We repeated our measures using the *Homo sapiens* protein file and acquired similar results.

Lastly, we examined the implications of

modifying the TE protein file for automated genome annotations. Our criteria for manufacturing the new file were to exclude sequences with amino acid strings less than 15 nucleotides in length, and any sequences with a SE value less than 3. We then annotated a sample ~1.6 mega-base Oomycete (*Pythium ultimum*) contig with MAKER annotation software using both the original TE protein file, and our modified file. We found that the modified file had a total of 66 repeats with an average length of 811, well below the original file’s 120 repeat total and average length of 1037.

The number of nucleotides

masked per megabase decreased from ~77775 to ~33453. While the difference between the two TE protein files is a mere 67 sequences, this small change has a profound impact, yielding a 45% decrease in identified repeats.

Conclusions

We tested the utility of SE as a simple filter of short ‘junk’ sequences during automated annotation. To our surprise we discovered that these sequences have, on average, higher SE values than actual coding sequences of similar size. As SE is simply a mathematical measure which is independent of biology, this relationship occurs entirely by chance. Because SE cannot be applied to the problem it was intended to solve, it has yet to demonstrate significance in the development of automated genome annotation pipelines. Therefore, alternate approaches for filtering short ‘junk’ sequences will have to be pursued.

Acknowledgements

We would like to acknowledge Mark Yandell, Karen Eilbeck, Barry Moore, Chris Conley and the University of Utah’s Summer Undergraduate Research Program (SURP) for providing the resources, support, and guidance to make this project possible. We would also like to thank the authors of Bio::Perl, Statistics::Descriptive, and Getopt::Long, modules which we used in the design of our programs and the compilation of our data.

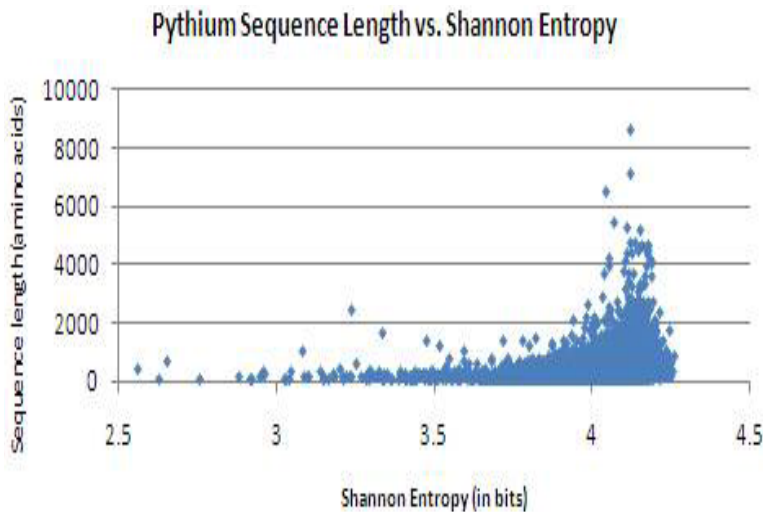


Figure 4 Sequence length is positively correlated with SE only for short sequences in *Pythium*. Graph shows x,y plot of SE versus sequence length for all MAKER derived *Pythium* protein sequences.

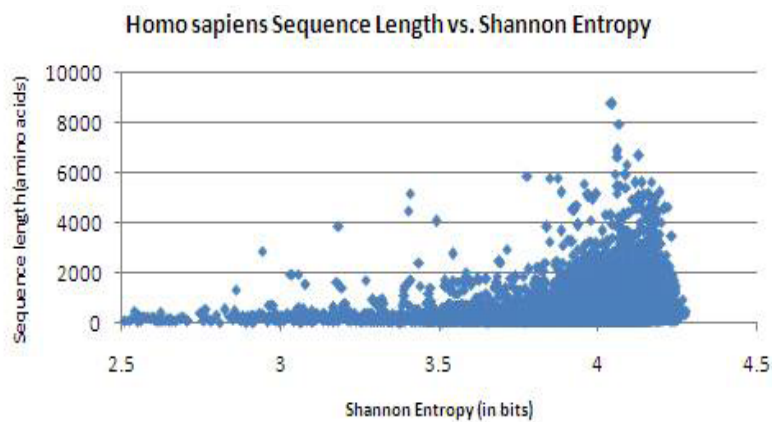
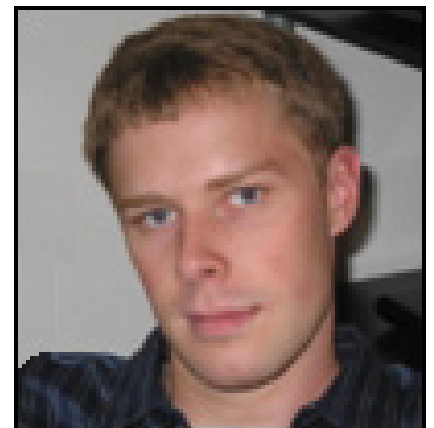


Figure 5 Sequence length is positively correlated with SE only for short sequences in *Homo sapiens*. SE vs. sequence length for homo sapiens.

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Questions of Compendium Authorship: A Comparison of Wikipedia and the Encyclopédie

Zane Smith¹

The *Encyclopédie ou Dictionnaire raisonné des sciences et des métiers* is an encyclopedia published during the Enlightenment by Jean le Rond d'Alembert and Denis Diderot. The *Encyclopédie* consists of 17 volumes of text and 11 volumes of plate illustrations that correspond to 74,000 articles compiled by its editors in a project that lasted from 1751 to 1772. Wikipedia is an encyclopedia created by Jimmy Wales and Lawrence Sanger available through the Internet. The French-language version of Wikipedia is updated daily and accrues articles regularly; it currently contains more than 930,000 articles.

The two encyclopedias distinguish themselves editorially and by the media through which each communicates its information; the heavy tomes from the 18th century work are distinctly different from the modern work's website. However, they both emerged in similar circumstances. Advances in the printing press facilitated the sharing of knowledge, discoveries, and opinions in books and pamphlets. Diderot and d'Alembert created a work that amalgamates the burgeoning knowledge of the 18th century. By comparison, Wikipedia is the result of the infinite space that is the Internet. The site aims to distinguish good information from the superfluity that exists online in the 21st century.

I propose that Wikipedia is a conceptual evolution of the *Encyclopédie* because of shared perceived editorial obligations. I argue that each holds a different approach with respect to the question of authorship. The articles *Wikipédia* and *Encyclopédie en ligne* (online encyclopedia) from Wikipedia and the *Discours Préliminaire* (Preliminary Discourse) by d'Alembert and the article *Encyclopédie* (encyclopedia) by Diderot of the *Encyclopédie* define the editorial aspects of each work.

In the *Discours Préliminaire*, the editor d'Alembert addresses the purpose of the *Encyclopédie* project, how it would be achieved, and how articles were to

be organized. He identifies two primordial goals: "As the *Encyclopédie*, it must expose, as much as possible, the order and concatenation of human knowledge; as a *Dictionnaire raisonné des sciences, des arts et des métiers*, it must contain, in each science and in each art, be it liberal or mechanical, general principles that form their foundations, and the most essential details that make up the core and the substance" (18)..” The author devotes the first part of this introduction to explain the filiation of knowledge and how it is incorporated in the *Encyclopédie*'s entirety.

The article *Wikipédia* from Wikipedia, by comparison, begins with a sentence that defines the site as “a multi-lingual encyclopedia, universal, freely distributed... written by internautes [internet users].” The article describes the history of Wikipedia and its success, its fundamental ideas, its characteristics, and what it attempts to attain as a comprehensive encyclopedia. According to the article, Wikipedia's objectives are “to reflect, in as exhaustive a manner as possible, all of human knowledge” and “to give the most people possible access to knowledge.” Furthermore, Wikipedia intends to be “free.” The article proposes that this means that the site adapts to reflect the multitude of human knowledge.

These two pieces demonstrate that the dissemination of information is a critical component of Wikipedia and the *Encyclopédie* because editors demand that their works be thorough and accessible. The detailed account of information organization forwarded by d'Alembert and Wikipedia's stated purpose to render information readily available demonstrate a shared desire to educate.

Wikipedia and the *Encyclopédie* launched their projects by taking ideas and texts already available and adapting them to their proprietary projects. At its origin, the *Encyclopédie* followed the *Cyclopaedia, or Universal Dictionary of Arts and Sciences* of Ephraim Chambers. This encyclopedia, published in English in London in 1728, composed of just two volumes, created the framework for the *Encyclopédie* project. The ideas of the *Encyclopédie* evolved from preceding intellectuals as well as contemporary discoveries and the editors are quick to recognize their academic predecessors. For example, d'Alembert makes sure to credit the root of his organization of knowledge to Sir Francis Bacon. “The Encyclopedia seeks to know, by our own discoveries, and by the discoveries

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of other men; we stand to benefit from their research” (Discours Préliminaire, 26). The original content of Wikipedia was conceived by Internet users outside of Wikipedia and incorporated into the site, with entire texts lifted from outside websites and published with the standardized presentation of the Wikipedia website. Both works hold the perspective that knowledge should be concrete and not speculative. D’Alembert tells us, “Let us not imitate the philosophers of whom Montaigne speaks; those who, when asked about the principles of human action, ask further whether there exist humans” (22). Similarly, “Personal or original projects do not have a place in Wikipedia” (Wikipédia). The two encyclopedias argue that they are based on reputable sources and ideas.

The Encyclopédie is the “work of a society of men of letters” composed of more than 140 educated individuals who redacted articles. They are referenced at the end of the Discours Préliminaire where d’Alembert enumerates the authors and their specializations. The editors chose to indicate authors with corresponding symbols, while retaining anonymity in some articles. Of the collaborators, Diderot explains, “It is in the execution of this extended project, not only the different objectives of our subjects, but in all the branches of human knowledge, that an encyclopedia should relate; a work that will execute itself only by a society of men of letters and artists, separated, each occupied with his part, and united only by the general interest of the human genre, and by a reciprocal sentiment of goodwill” (Encyclopédie, 5:636).

Wikipedia assigns the same responsibilities of goodwill and independent contributions to its work, saying “Every person who modifies Wikipedia’s content is expected to present the principle opinions of an article’s subject with impartiality” (Encyclopédie en ligne). Contrastingly, whereas the Encyclopédie outlines qualifications for its authors, anyone can edit Wikipedia. “One of the originalities of this type of encyclopedia is the creation of a voluntary participation open to the public. As such, whoever can write whatever on Wikipedia.” Each of the encyclopedias uses articles from authors who are purported to not know one another. The Encyclopédie speaks of “having gathered a large-enough group of colleagues who, without knowing one another, seem to friendly pursue the production of a common work” (Encyclopédie, 5:645). At Wikipedia, “The rules of

writing aim to appeal to rational persons, even if they do not share the same opinion” (Wikipédia).

A large distinction between the Encyclopédie and Wikipedia emerges in the appropriation of information. In the Encyclopédie, there exists a traditional stratification between editors, authors, and readers. Wikipedia is founded on equality and interchangeability among these roles; the reader can act as an editor and as an author. “The distinction between the reader and the author tends to disappear in a wiki.” This fundamental difference between authors of the two encyclopedias gives context to the perspectives in articles.

The editor’s role is to compile articles in a manner consistent with the division of disciplines. “In a word, each of our colleagues has made a Dictionary of the part for which he is responsible and we collected all these Dictionaries together” (Prospectus, 127). At the end of the Discours Préliminaire, d’Alembert writes, “It is for the reading public to judge us: we believe we should distinguish them from those who are speaking” (154).

In Wikipedia, the reading public speaks. Technology has facilitated “laissez-faire as a model of organization, creating an equal right of participation for all, without regard to age, competence, or origin” (Wikipédia). There is no arbiter responsible for editing Wikipedia’s content because of the inherent equality between authors and their peers. The objectives of Wikipedia are available to everyone in articles; however, these articles can be adapted to reflect ulterior interests. The juxtaposition between the articles Wikipédia and Encyclopédie en ligne dichotomizes Wikipedia’s exploits and the unattained neutrality. Encyclopédie en ligne discusses Wikipedia’s faults with candid irony. Wikipédia proposes that the site is a comprehensive encyclopedic triumph and, as such, is largely ignorant of the other article’s deprecation. Diderot and d’Alembert form different perspectives throughout their work; the article Encyclopédie, being published in the fifth volume, addresses issues surrounding the project’s implementation whilst the Discours Préliminaire brings to bear the aspirations of the project. However, where Diderot’s discourse complements the goals expressed by d’Alembert, the Wikipedia articles are disjunctive. Diderot references the Discours Préliminaire in his article; d’Alembert, likewise, includes the Prospectus, prepared by Diderot,

in the *Discours Préliminaire*. There is a premeditated development and cooperation in the *Encyclopédie* absent from the Wikipedia articles discussed here.

Wikipedia contends that it is a neutral source with articles of high quality. “The articles are systematically re-read, completed and corrected, by groups of volunteers passionate about the subject and mostly of a good level of specialization” (Wikipédia). Furthermore, there are five incontestable rules of Wikipedia that are available on the site. The claimed quality and the unwavering rules do not present themselves in the articles, as attested to by politicized accounts and misinformation that have kept scholars and universities from acknowledging the site as a legitimate source. According to the article *Encyclopédie en ligne*, “The projects are less and less professional and diverse articles appear.” This portends that Wikipedia’s quality declines as articles as recurring edits and tangential articles are published.

Both works attempt to improve the availability of information by providing credible and coherent articles to a large audience. Both rely on a constructive reciprocity in publication. However, each achieves disparate results. The equality of the contributors and their anonymity devalue the legitimacy of Wikipedia as an academic source. I will now examine how the author’s identity, known or unknown, relates to concepts on which the editorial texts extrapolate.

Wikipedia experiences a daily evolution. Compared to Wikipedia, the *Encyclopédie* is a stagnant work that represents knowledge up to the end of its publication. Nonetheless, we see that the *Encyclopédie*’s approach changed during its evolution and that articles address the public or a specific individual. For example, at the beginning of the *Discours Préliminaire*, d’Alembert explains, “apparently, we should have responded in advance to a crowd of people who asked how two individuals could speak to all the sciences and all the arts” (18); Diderot even insults his critics, saying, “It remains to be seen whether our enemies, after having so far given fairly strong proof of ignorance, will not resolve to demonstrate cowardice” (5:NA14).

The *Encyclopédie* was published as civil society accrued knowledge in the sciences, expanded theories in philosophy and in all areas of study, and experienced heightened contempt for the royal government. There was an enormous sum of ideas

that circulated among nobility, the bourgeoisie, and those who bore the title of “men of letters”. During its publication, the *Encyclopédie* was distributed to people with subscriptions; a new volume appeared in alphabetical order for the duration of the project. In effect, the *Encyclopédie* was a way of expressing ideas which circumvented censorship.

Wikipédia points out the site’s biggest difference with the *Encyclopédie*. “Wikipedia is distant enough from the *Encyclopédie*, by its volition to present neutral information.” As such, its claim of neutrality elicits problems in its development. “Wikipedia envelops itself in a frequent evolution; at each instance, changes in its evolution bring the neutrality it aims for into question” (Wikipédia).

To attain this neutrality, “Wikipedia would operate by consensus.” This consensus is achieved by a transition between diverse perspectives, but the consensus does not necessarily represent the truth or neutrality because Internet users are not all equally qualified to discuss a subject. According to *Encyclopédie en ligne*, “The only principle [of Wikipedia] is the ‘neutrality of point of view’, that authorizes it to put all points of view on the same level.”

The mentality that the voice of the majority takes precedence on Wikipedia brings into question its impartiality because it states that a ubiquitous perspective takes precedence. According to the article Wikipédia, the evaluation of an article passes under three steps of review to control the quality of articles, imbuing the encyclopedia with a homogenization of knowledge. The *Encyclopédie* controlled article quality but it indicates frankly that it is not a neutral text; this accommodates the flagrant opinions shared and allows for anonymous texts because they are ultimately still the responsibility of editors. Wikipedia is an allegedly neutral encyclopedia albeit impeded by the premise of complete anonymity and the associated absence of accountability. As Diderot explains, “A worker who dares ask that his name not be placed at the end of one of his article, concedes that he finds it poorly realized, or at least not worthy of his attribution” (*Encyclopédie*, 5:645).

Authorship is a large rupture between the encyclopedias, where the *Encyclopédie* supports a proposal that is amenable to the project’s execution. In the *Encyclopédie*, opinions in articles are presented by

cross-references, the use of the first person in writing, and the use of an essay format where the author states his argument and its composition. We also see a subversive criticism in articles expected to be devoid of opinion. Diderot informs us, “The cross-references will oppose notions; they will contrast principles; they will attack, shake, secretly refute some ridiculous opinions that we would not dare openly insult” (*Encyclopédie*, 5:NA13). Research conducted by the University of Chicago confirms that *Encyclopédie* articles with references are more detailed. “The average length of an article with at least one reference (568 words) is distinctly larger than that of articles that do not have any (just 158 words)” (Blanchard and Olson, 53).

Wikipedia insists that a reader can return to a source to verify an idea included in an article. For this reason, each article plays on the idea of references. “[Authors can redact their knowledge] on the condition that they think to add ‘according to so and so’ and ‘according to such and such’ and not forget to cite some sources (whatever they may be)” (*Encyclopédie en ligne*). Wikipedia presents information in a consistent manner, where speculative declarations and facts mix in a uniform presentation and texts of poor quality are adjacent to higher quality work. This idea returns to the enormous sum of knowledge obtainable on the Internet. Wikipedia attempts to filter this knowledge, but sometimes loses itself in the information at its disposal.

This work considered the similarities and differences between Wikipedia and the *Encyclopédie* at epistemological and editorial levels. The stated purposes to summarize and disseminate human knowledge permeate the two works. Wikipedia represents a paradox between neutrality and complete authorial and editorial anonymity. The observations made by editorial pieces in the *Encyclopédie* reveal this conclusion and vouch for the importance of editorship in maintaining a work’s credibility.

Wikipedia is an excellent project that transcends the *Encyclopédie* and changes how we obtain information. The *Encyclopédie* was a project of intellectuals available only to privileged individuals. The fourth edition of the *Encyclopédie* (1777) had only 253 registered subscriptions (Lough, 467); Wikipedia shares information with millions of people. However, like today’s Wikipedia, “for the 18th century public, the *Encyclopédie* represents a model of coherence”

(Darnton, 401). Wikipedia is the result of extended works that sought to summarize human knowledge. Its prevalence in contemporary society must be met with an equivalent level of quality. Diderot observes, “If it is necessary to consult good works, it is not unnecessary to browse bad ones. A good book provides one or many excellent articles; a bad book helps to improve” (5:NA16). Negative contributions diminish the quality of an article and have repercussions for all of Wikipedia because it is a collective project but, if used correctly, can help ultimately improve the site.

Diderot extrapolates on the problems he sees in his encyclopedia. He indicates corrections he would like to have made that Wikipedia integrates in its foundations and he highlights problems that Wikipedia also hopes to resolve. For example, “The exact citation of sources would be highly useful; we should impose it is a rule” (5:NA16). Wikipedia attempts to be as specific as possible about its sources. Additionally, he says “It is better that an article is poorly written, than not written at all. Nothing chagrins a reader more than to not find the word he is looking for” (5:644). Wikipedia has many short articles but their existence represents the project’s continued development paralleled with our continued discoveries.

The idea that all persons are afforded the opportunity to edit Wikipedia is both its strongest asset and its greatest obstacle. We must be cognizant of the power of the reader and recognize that a constantly evolving project needs direction to achieve the objectives we have looked at. These will be accomplished when articles are the work of educated people who see the enormous opportunity Wikipedia offers in the exchange of knowledge. Diderot summarizes this idea best in the article *Encyclopédie*. He opines, “The *Encyclopédie* could easily improve; it could also easily deteriorate. But the primary danger to obviate that we would have predicted, is that the care of the subsequent editions must not be abandoned to the despotism of a society” (5:NA16).

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This paper is based on an independent research project in French conducted under the direction of Dr. Sarah Benharrech, Professor of French at the University of Maryland, College Park.

This paper is an abridged version of the original. Please send requests for the complete paper to zsmith@umd.edu. It is available in French and in English.

Zane Smith is a senior at the University of Maryland pursuing a major in Economics and minors in French and Spanish. His research paper, *Questions of Compendium Authorship: a Comparison of Wikipédia and the Encyclopédie*, is a translated version of an essay he prepared in French. The work serves as part of an independent project completed during his junior year studies in the language. Zane's interest in the *Encyclopédie* began while studying at Macalester College in Saint Paul, MN where he had an opportunity to read an original copy of the 18th century encyclopedia, available at the college's library.



Lingo, Loyalty, & Lambaste: The French Hacker Scene via Its Early E-Zines

Kevin Gotkin¹

“This is our world now...the world of the electron and the switch, the beauty of the baud.”

—The Mentor

Introduction

Shortly after his arrest in 1986, “The Mentor” wrote a short piece for the American hacker e-zine, Phrack, entitled “The Conscience of a Hacker.” We can only assume the writer is a man, however, because his penname masks everything about his true identity, including the arrest that apparently led him to write the article. In the piece, he tells stories of his childhood, of discovering the computer, and of reading newspaper articles about amateur hackers getting arrested. The piece is very short, with only a handful of paragraphs that barely stretch to a second printed page, but at the end of each paragraph he repeats five words taken from the admonishing voices he hears all around: “Damn kids. They’re all alike” (1). Through his piece, The Mentor allows us a glimpse into some of the most personal parts of a hacker’s mind.

Yet his article illustrates some of the most complex external factors about the life of a hacker, too. It shows us the subcultural relationship to the perceived authoritative normal, the strong bonds between hackers via their e-zine medium, and the interplay of identity and anonymity that define the hacker space. On a grander scale, the genre of hacker e-zines can teach us about the significance of the subculture historically and today. This paper examines the e-zines of hackers in another place and time: those of France in the 1990s. Via a close reading and critical contextual analysis of these e-zines, we find that the early French hackers developed their scene in ways both very similar and very different from those around the globe.

France and the Unknown: Hacking in a Vacuum?

The e-zines of the French hackers do not speak entirely for themselves. Their context is of equal importance to their content. The 80s in France saw

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```
Last login: Mar 12 07:03:29 on console
Welcome to os4!
> telnet -a -b ABSOLUT 192.168.100.1:8080
> enter login: #####
> enter passw: #####
> invalid passw ERROR (retype)
> retype passw #####
> OK you are SUCCESSFULLY logged in
> cd /usr/.ABSOLUT/SECRETS
> ls -l -a BACKDOORVIRUSES
-rwxr-xr-- TROJANHORSE#BF1 - 306 Mar 7 20:55
-r-xr-xr-- TROJANHORSE#CA0 - 1026 Mar 11 00:13
-r-xr-xr-- TROJANHORSE#CB9 - 716 Mar 5 14:15
-rwxrw-r-- TROJANHORSE#CFE - 4865 Feb 9 22:06
-r-xr--r-- TROJANHORSE#D2C - 48 Jan 28 17:24
-r-xr--r-- TROJANHORSE#D8A - 512 Mar 2 02:22
-r-xr-xr-x TROJANHORSE#DA6 - 512 Mar 7 04:46
-r-xr--r-- TROJANHORSE#DD7 - 642 Feb 13 01:58
-r-xr--r-- TROJANHORSE#DF2 - 1784 Dec 31 11:33
-rwxr--r-- TROJANHORSE#EA3 - 1256 Mar 4 14:56
-rwxrw-r-- TROJANHORSE#EB4 - 2873 Mar 5 08:17
-r-xr--r-- TROJANHORSE#ED8 - 255 Feb 17 10:45
-r-xr--r-- TROJANHORSE#FA3 - 207 Feb 17 10:57
> sudo -sP TROJANHORSE#D2C
System is about to reboot
Killing all processes .....
```

ABSOLUT HACKER.

ABSOLUT COUNTRY OF SWEDEN VODKA & LOGO, ABSOLUT, ABSOLUT BOTTLE DESIGN AND ABSOLUT CALLIGRAPHY ARE TRADEMARKS OWNED BY VIN & SPRIT AB. THOSE WHO APPRECIATE QUALITY ENJOY IT RESPONSIBLY. THIS AD WAS MADE BY FIXY 2003.

Figure 1 Internet meme, unverified official Absolut ad.

the election and reelection (from 1981 to 1994) of its only Socialist president, François Mitterrand. With his 110 Propositions for France, Mitterrand brought about big changes in the role of government, including better social services, more public jobs, and the reduction of the workweek (“1981”). Despite this political climate, however, few acts of government affected the work of early hackers who were operating in the great unknown of the time. Before the early 1990s, Internet was not a household reality and there were few laws regarding the specific activities that occurred there. Serious regulatory laws would not even come about until seminal court cases were tried in early 2000 (Trumbull 83). In a sense, it would have taken psychic ability to write effective laws about technologies that were only just beginning to proliferate.

At the same time, the French government knew that major technological advances were taking place in the United States and Britain. As Gunnar Trumbull explains in his book *Silicon and the State: French*

Innovation Policy in the Internet Age, France was quick with its rhetoric supporting the Internet and made several attempts to fund French innovation through many tax incentives for new start-up companies (68-74). What ensued was what Hugh Dauncey calls a “cultural battle” over the spread of new technologies (“A Cultural Battle”).

Dauncey was referring to the competition between American Internet and the French Minitel system, a nationwide videotex information infrastructure. Minitel was originally devised as a way for the French government to increase telephone traffic since the French telephone system was often referred to as the “joke of Europe” (Cats-Baril and Jelassi 3). The system was introduced to its first test market in July 1980 and by 1994 it reached six and a half million homes (Dauncey 74). The system allowed customers to use their phone lines to access information like stock prices, telephone directory, and even certain consumer product information via a screen and keyboard machine in their homes. As Dauncey explains, the success of the Minitel system came under serious threat from the more expanded American Internet services, leading to a major cultural standoff that was deeply political (83).

On the underground level, however, where curious and smart young hackers were happening upon loops in the new systems, these events were rather irrelevant. The early French hackers were working as any other type of hacker around the world: on the cutting edge of what they could find. While there was a small lag because the Internet arrived in France slightly after it originated in the United States, it is still safe to say that the most elite hackers in France were operating far above the level of average technological understanding.

This idea of the vast unknown, the elusive arena of hackerdom, is a concept that underpins all discussion of hackers. It was this aura of the unknown that caused public panic since hackers were thought to be anywhere, seeing anything they chose to. It was also what united the members into the tight subculture since it was only the lonely elite that found it was conversing on the highly technical systems they came to master. Paranoia and pride are the two main by-products of this vast unknown that marked the 80s and 90s of the early Internet Age.

Hackers as Hebdigean

Another important way to think of the French

hackers is in the sociological terms coined by Dick Hebdige in his celebrated book, *Subculture: The Meaning of Style* in 1979. In it, Hebdige lays out some of the foundational aspects of subcultures. Most important is the perceived dominance of a “normalcy” over a “forbidden identity” that acts as the glue to bind distinct members of society into one subversive identity (5-17). Although French hackers were extremely varied in their tasks and variations, they were united by a sense of adventure to poke holes in the technologically normal as a way to combat the unnecessary surveillance and power of authority.

Hebdige also writes an ode to the “mundane objects” of these subcultural groups (2). He dissects the motorcycle, the pointed shoe, and the tub of Vaseline. The hacker e-zine is like the safety pin. It can be studied for aesthetic, symbolic meaning, appropriation, and perhaps unlike the safety pin, content. Although the dichotomy between culture and subculture with hackers is not as easily defined as it is with the other case studies Hebdige uses, this creates an even more complex situation to unpack. As Hebdige explains, although subcultures are veiled in the air of chaos at times, their structure is extremely ordered. In this way, the use of e-zines by French hackers was very homological, symbolically representing the connection between lifestyle and values (113). For hackers, the use of the e-zine represented the way they interacted with each other as well as the principles by which they lived, but for the curious outsider, the e-zines serve as dissectible historical remnants offering a glimpse into the interaction between society and its technology.

The Birth of French E-Zine

An inevitable development in the hacker subculture in France was the spreading and sending of technical information in a similar way that trade publications are inevitable among people who work in the same industry. They were a way to share tips and secrets and to build reputations within the community. Before the widespread proliferation of the Internet, e-zines were distributed as text (.txt) files via the electronic bulletin boards that were usually run by groups of hackers themselves (Thomas 90) or else shared physically by floppy disk (Interviews with Members of TMP Lab). Because it took a significant amount of time to send and receive these files, by the time an article reached the larger underground, it was already obsolete or at least heavily dated, owing

both to the slow rate of exchange and the fast evolution of new hacking techniques. Although the e-zines themselves constituted differences between groups of hackers, there was also an extensive network of hackers who met in person to share information (Interview with Members of TMP Lab).

In France, the very first known e-zines before 1990 were not very successful as they faced serious distribution obstacles. Only two e-zines are mentioned in existing accounts of the history of the French publications: Hackito and Chaos, neither of which were highly regarded (NeurAlien 3). But after 1990, there were about seventy-seven e-zines that came into existence with many different flavors and objectives. This approximation reflects only what can be found on various archival sites today and are not necessarily the full extent of what was being circulated since there were also many e-zines that contained such sensitive material that they were protected from mass circulation. The first major e-zine, N0 Way, was edited by a famous hacker named NeurAlien who went on to found France's first Internet Service Provider, WorldNet (Ankara 1). It lasted only a few months through the summer of 1994 and was followed by NoRoute, the first French e-zine to deal directly with Internet hacking. MJ13 became known for its technical precision in 1997 and HVU, a radio phreaking e-zine, continued publication from 1996 all the way to 2003.

While the list of different e-zines goes on, this does not mean that they were well written, well made, or even well read. In fact, interviews with today's Parisian hackers show that these e-zines were not highly circulated at all. They were often written by "phreakers," amateurs who did not, in fact, infiltrate deep into systems but instead attempted less technical and less successful means of poking holes in different media (Interview with Members of La Suite Logique). The content of these e-zines is also overwhelmingly dominated by poor translations of major English language e-zines like Phrack or writing about low-level technical skills. The best hacking was done either in small groups or in very closed-door personal meetings, where the danger of being caught by authorities was low (Langlois). But the fact that the e-zines were not representative of what was considered the "best" hacking does not mean that they were

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-----> SUPPORT NO WAY ! <-----
                /\
NO t1m3 2 w8 !  Wake up wif NO WAY !
                /\

'n' nuffin can stop us
-----

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Figure 2 Taken from N0 Way, Vol. 1, No. 1

irrelevant to the hacking subculture. In fact, it might be the predisposition of modern hackers to pity their ancestors as a knee-jerk reaction to experiencing the massive evolution in technology since that time. Even the amateurs who became the face of hackers via these e-zines say something very important about the larger role of hackers in the French information society.

Introductions: Faces of the Subculture

The introductions of the French e-zines, particularly those of the first issues in existence, have much in common. First of all, they all address a very wide audience. If the later content is increasingly specific, this is only in contrast to the catchall quality of the initial address from editor to reader. This is explained by the want of amateur hackers to become the face of the subculture (Ankara 1) and also by the amount of competition between the e-zines, hence the relatively high number of French e-zines for the community. Although they ostensibly speak to other hackers, all the introductions address non-hacker outsiders who would happen to come upon the magazine, illustrating that the e-zines were an important first primer for any novice hacker, therefore giving him his first glance into the hacker subculture.

Each e-zine's introduction also defined the subculture in their justification for starting publication. For example, N0 Way's first edition defines its community as "little representatives of generation X," but goes on to say they are trying to "counterbalance... Big Brother" (Vol. 1, No. 1). It also uses a quasi-motto on its first page: "nuffin' can stop us," which further illustrates the idea of a collective that permeated the minds of the e-zine's editors (see Fig. 2). MJ13 explains that the magazine wants to be "ultra liberal" (Issue #2). NoRoute specifically designed itself, at least at the outset, for "newbies" (No. 1). While each e-zine describes itself differently in relation to the perceived normal, it is important to note that they all have a similar disposition that distinguishes them from any

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Cette publication ,lectronique peut contenir des informations, donn,es et articles interdits dans certains pays. Si les informations de cette publication sont interdites dans un pays, il est du devoir du lecteur de v,rifier qu'il a bien le droit de poss,der et de lire (ahahahaha :-) cette publication. Les auteurs et ,diteurs ne sont en aucun cas responsables d'une mauvaise utilisation des informations publi,es. Pour les attaques en diffamation et autres conneries bonne pour les censeurs, allez voir qui vous croyez ^tre l',diteur... Pour la simple et bonne raison que de responsable de la publication et d',diteur il n'y en a pas!!! Les informations fournies dans cette publication sont ... titre informatifs uniquement. Nous ne vous garantissons rien et si ca vous plait pas allez lire autre chose! Hahahahahahahahaha...

Figure 3 Taken from N0 Way, Vol. 1, No. 1

other kind of subculture. On the pages of the e-zines, normalcy is only an imagined idea. Unlike the punks or the skaters who physically interact with authority, the hackers must dream them up without having direct contact. Hackers are already isolated in front of their screens and therefore they have the power to create the image of what they are subverting. This is the cause for the radical and polemical nature of the e-zines' content.

Not far before or after the introduction is usually a disclaimer about the e-zine, an unexpected occurrence in a publication that flaunts its illegality. N0 Way's disclaimer is particularly interesting. It begins by explaining, "This electronic publication may contain information, data, and articles that are prohibited in certain countries." But then it goes on to say it is the responsibility of the reader to verify he is not violating any laws, followed immediately by: "(ahahahaha :-)." It continues to oscillate between a serious urgency to exonerate itself for any wrongdoing and poking fun at the authorities that might be reading it. It concludes by saying, "We don't guarantee you anything and if you want you can go read something else! Hahahahahahahahaha..." (Vol. 1, No. 1) (see Fig. 3). The disclaimer norm might be due to a habit that became commonplace among all e-zines, but it still demonstrates a real threat of being caught, even if the merit of the disclaimer never came to be challenged in court.

Many of the e-zines use the singular, informal "tu" as opposed to "vous" when speaking directly to the reader. It shows a relaxed nature between writer and reader, but it also assumes that the reader is

alone, indicative of the larger subcultural bond that all hackers are destined to be reading and working alone. In interviews with Parisian hackers, almost all greeted friends and strangers alike with the equally informal "salut," further proof of the assume bonds between hackers (Interview with members of La Suite Logique).

Aesthetic

The visual elements of the e-zines are also important in understanding the significance of the publications. Since the issues were first written in .txt formats, the only available font was the Courier one. Even after font choice was diversified, however, editors still chose to use the old-fashioned font, which is also overwhelmingly used in mainstream media's depictions of the hacker culture (see Fig. 1). A Hebdigean reading of this finds it to be "intentional communication," since the hackers found and claimed their stake to a style that acts to distinguish and unify the subculture. The font has become synonymous with the perceived stereotypes of hackers.

Many e-zines also reference their own typos ("des fauts d'orthographe"), which were accepted as a common part of e-zine writing. Not only were many e-zine articles poorly translated into French from English, the French writing itself was full of spelling errors, a forgivable fault since hackers unified themselves around supporting each other's weaknesses (and because being too conscious of spelling mistakes is reminiscent of the school teachers many of the hackers reference as quashing their creative intelligence). Interestingly, even in the French e-zines, many writers inserted tidbits of English in parentheses, usually at the end of their writing (and even some German in one

issue of the e-zine 13). For example, N0 Way's first issue included many English insertions: "shame on u!", "READ IT NOW & GET STONED !", "greeting for CSA: 'FUCK!'". As these quotes demonstrate, English was a way for writers to say even more shocking and damning statements than they would in French. The "greeting," written by NeurAlien, was to France's media regulation body, the Conseil Supérieur de l'Audiovisuel.

Similarly, emoticons are used closely with English phrases. Smileys were just making their debut in these magazines and often the art of creating whole pictures or illustrations out of ordinary letters or symbols was being created in the e-zines themselves, where hackers could show off their skills to others (see Fig. 4). Where print magazines have advertisements and physical pieces of paper to separate between articles, e-zines have section dividers, which are sometimes uniform and sometimes elaborate and creative.

Anonymity

Returning to the idea of the perceived normalcy of society, we can ask in what other ways does the solitude of being a hacker manifest itself. An obvious answer is in the anonymity found in the virtual pages of the e-zines. Logically, the ability to mask one's identity on the Minitel system or on early Internet systems allowed for hackers to invent a new identity. This concept has not gone away; we see it in virtual world sites like Second Life and even on social networking sites where the opportunity to craft a virtual profile allows people to color outside the lines of their real identity.

Anonymity is also the root of the profanity and mature content found in the e-zines in the way it is the root of vulgar and derogatory terms found in the stalls of public restrooms. Profanity is less of a problem in the American e-zine, Phrack, which was widely read and carried a particular kind of prestige. But the French e-zines had far fewer readers, many of whom were unknown to the editors and thus, the urge to spew and say anything was greater. For example, a writer named "Sick Alien" depicted a penis and a vagina in symbols before beginning a rather crude article about sexual engineering (Vol. 1, No. 1) (see fig. 5).

The most obvious manifestation of the anonymity, however, was in the names of the writers and editors, who created fake aliases (and many editors,

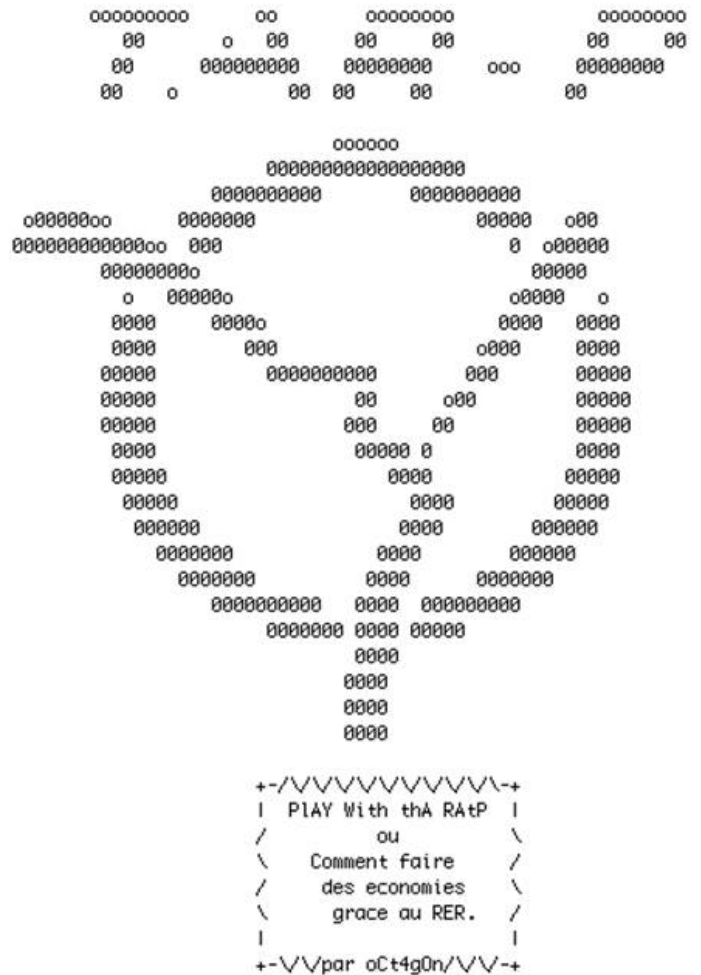


Figure 4 Taken from N0 Way, Vol. 1, No. 1

book in 2004 *The Hacker Manifesto*, which expanded each point of the Ethic and added many more (Wark). Harper's Magazine, in 1990, organized a group of famous global hackers to answer whether there still exists a Hack Ethic. Most said that indeed, the Hacker Ethic is not only an ode to the founding fathers of hackerdom, but simply logical (Hitt & Tough). Many of the tenets of the original Ethic can be seen even in France, notably the activist approach to keeping information free, as demonstrated in Bruce Sterling's seminal book *Underground*, which is available entirely free online (Langlois).

Yet, there seems to be a new principle that has emerged from modern hacking. In his article, "Hacking Goes Pro," published in February 2009, Nils Gilman writes, "What's driving the growth and transformation of the hacker industry? In a word: globalization"



Figure 5 Taken from N0 Way, Vol. 1, No. 1

(1). What he means is that since the same technology has been used by diverse people all over the world beginning with hackers in the 80s, we have developed similar traits that make us able to communicate with distant people. Of course, this was an idea borne out of the early e-zines of hacker culture, for, as The Mentor writes in “The Hacker Manifesto:” “We exist without skin color, without nationality, without religious bias” (1). While technology began globalizing hackers, hacker also began globalizing technology. Perhaps the most important thing we can take away from the early French e-zines is this foreshadowing of a global logic. In the ways that they created patterns and relationships to spread information, we see the foundation being laid for a larger societal interaction with new technology.

Conclusion

The subcultural analysis of the early French hackers says many things about the media society of the time. In most cases, technologies are closely dependent on the social, political, economic, and cultural atmosphere in which they were developed. The printing press being developed in Germany, for example, has led to very high levels of professionalism in media careers there (Hallin & Mancini 170-178). Hacking, as its own form of media, however, is divorced of its contexts in ways that newspapers and radio and television cannot be. The hacker objective is to subvert the normalcy of society through a hobby of poking holes. Illegality on the underground cannot, therefore, be tied to a certain context. Hacking has, and will continue to be, an activity on the periphery.

While e-zines have become blogs and closed-door meetings have become open-door free culture rallies, the fundamental nature of hacking remains the

same. There is a saying within the hacking community: *hackito ergo sum*, which is a play on the traditional: *I hack, therefore I am*. As real as hacking was in the 1980s and 1990s, it will continue to push the limits of technology and innovation today. Along with it, of course, will be the subculture and their publications.

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