



JOURNAL OF
EMERGING INVESTIGATORS

10 2012
YEARS
2022

10 Year
Collection
Editor's Choice Articles

Table of Contents

Effectiveness of Biodegradable Plastic in Preventing Food Spoilage Authors: Catherine R. Zhang and Jill Carter	3-4
The Effect of Font Type on a School's Ink Cost Authors: Suvir Mirchandani and Peter Pinko	5-6
A Simple Printing Solution to Aid Deficit Reduction Suvir Mirchandani and Peter Pinko	7-8
Ant Colony Optimization Algorithms with Multiple Simulated Colonies Offer Potential Advantages for Solving the Traveling Salesman Problem and, by Extension, Other Optimization Problems Authors: M. Evan Wildenhain and Ian Sacco	9-10
Comparing the Effect of Stent Geometry on Blood Flow Rate of Curved Coronary Artery Stenosis Authors: Ethan Z. Levy and Yair Levy	11-12
The Effect of Sunglass Price on Ocular Exposure to Ultraviolet Radiation Authors: Elizabeth M. Larson and Jeffrey R. Wehr	13-14
Reducing Crop Damage Caused by <i>Folsomia candida</i> by Providing an Alternate Food Source Authors: Kelly Tamura and Joseph Moché	15-16
Cathodal Galvanotaxis: The Effect of Voltage on the distribution of <i>Tetrahymena pyriformis</i> Authors: Christy Zheng and Michael Edgar	17-18
People's Preference to Bet on Home Teams Even When Losing is Likely Authors: Matthew Weng and Russel Golman	19-20
The effects of different modes of vocalization and food consumption on the level of droplet transmission of bacteria Authors: Audrey Wong and Michael Tran	21-22
Spectrophotometric comparison of 4-Nitrophenyl carbonates & carbamates as base-labile protecting groups Authors: Selin Kocalar, Alice Zhou, Aylin Salahifar, Edward Njoo	23-24

Effectiveness of Biodegradable Plastic in Preventing Food Spoilage

Catherine R. Zhang (1) and Jill Carter (1)

(1) Shrewsbury High School, Shrewsbury, Massachusetts

ABSTRACT

The purpose of this study was to compare 100% polylactic acid (PLA) biodegradable plastic to a low-density polyethylene plastic (LDPE) in terms of their effectiveness against food spoilage. The interests of this study were: 1) the type of plastic that is more effective in preventing food spoilage, and 2) the materials' properties, which are key factors in preventing food spoilage. Three trials were conducted testing the two plastics, in which an apple half was wrapped in either 100% biodegradable plastic, LDPE plastic, or no plastic at all (control). Over a period of 11 days, the daily mass of the apple was measured to determine the type of plastic that was more effective in preventing food spoilage. The results showed that in the long term (11 days), the LDPE plastic was more effective in preventing food spoilage than the biodegradable plastic. By day 11, the apples in LDPE plastic lost about 4.84% of their original mass, the apples in biodegradable plastic lost 18.25% of their mass, and the control apples lost about 56.11% of their mass. However, in the short term (1-3 days), both the apples in LDPE plastic and the apples in the biodegradable plastic lost a similar amount of their mass (2-4%) while the control apples lost about 20% of their mass. The results demonstrate that the biodegradable plastic can prevent food spoilage as effectively as the LDPE plastic in the short term. Hopefully, this will increase the appeal of biodegradable bags to consumers due to its ability to reduce the amount of trash in landfills.

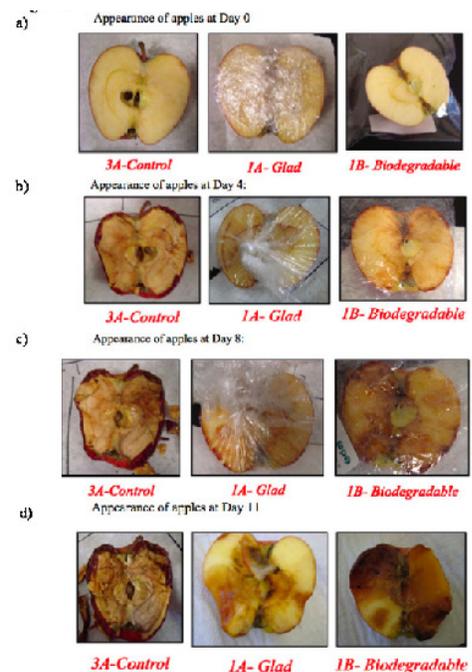


Figure 2: Pictures of the apples in the 3 testing conditions at: a) Day 0; b) Day 4; c) Day 8; d) Day 11.



Stephanie Jehl, Ph.D.
*Stephanie Jehl, Founding
member, 2011-12*

In this study by Zhang, et al., the authors investigate the utility of biodegradable plastic wrap compared to common household low-density polyethylene (LDPE) plastic wrap in the prevention of food spoilage. With plastic use being a significant contributor to landfills, and with plastic wraps in particular being a difficult material to recycle, this paper addresses an important environmental concern.

In the study, Zhang and colleagues ran a well-controlled experiment to quantitatively measure the rate of mass loss of an apple wrapped in either biodegradable or LDPE plastic, or an unwrapped apple. Although the authors found that biodegradable plastic did not prevent food spoilage measured by mass loss as effectively as LDPE over the course of the 11-day experiment, biodegradable plastic did effectively prevent mass loss as well as LDPE through Day 3. The authors used their findings to further calculate the water vapor transmission rate (WVTR) of the two plastics, in which the permeability of the biodegradable plastic was determined to be higher compared to the LDPE, or more likely to permit gas exchange and thus encourage food spoilage. Zhang and colleagues note that, commercially, plastics are often evaluated for efficacy against food spoilage based on their WVTR; they argue, however, that there could be large customer appeal for a biodegradable product that protects food in the short term (1-3 days) and keeps non-degradable plastics out of landfills. While acknowledging the limitations in the data interpretations, this paper is forward-thinking in its subject matter and logically researched and presented.

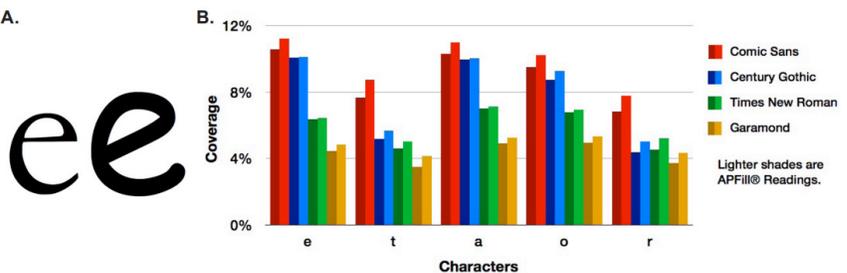
The Effect of Font Type on a School's Ink Cost

Suvir Mirchandani (1) and Peter Pinko (1)

(1) Dorseyville Middle School, Pittsburgh, Pennsylvania

ABSTRACT

Ink costs are a large, recurring expense for school districts worldwide. Moreover, ink production, usage, and disposal have a detrimental effect on the environment. Decreasing the amount of ink used can therefore have a positive impact on a school district's budget and on the environment. This study identifies fonts that use ink most efficiently and estimates the amount of money a single school and a school district can save on ink by choosing efficient fonts for student handouts. From a carefully selected sample of handouts used by the school's teachers, the frequency distribution of character usage was determined. Based on these data, a document modeling an "average" school handout in terms of character frequency was created. This document was replicated with different fonts reflecting the current preferences of the teachers in the school. APVSoft APFill® Ink Coverage Software was used to estimate the ink usage for each of these font types (i.e., the percentage of a printed page that contained ink). A novel experiment was performed to verify these findings by cutting out enlarged shapes of the most frequently used letters in the most preferred fonts; the masses of these cutouts were then determined in order to estimate the relative difference in ink usage for different fonts. Based on the analysis, it was concluded that a switch to Garamond, the most efficient font, would reduce ink consumption by 24%, thereby decreasing environmental damage and saving the school district approximately \$21,000 per year.





Chris Wells
Former Editor-In-Chief

“The Effect of Font Type on a School’s Ink Cost” by Suvir Mirchandani and Peter Pinko. The first reason is admittedly a personal bias as I remember helping with the review of this article! Three additional reasons I love this article: 1) an interesting question / hypothesis that is clear, testable, and something that anyone with a printer can relate to 2) the authors display creativity and thoroughness in their approach, including the use of two different methods to test / confirm the finding 3) this is a nice example of “translational” research that leads to a direct real-world recommendation (switch to a font that uses less ink!).

A Simple Printing Solution to Aid Deficit Reduction

Suvir Mirchandani (1) and Peter Pinko (1)

(1) Fox Chapel Area Senior High School, Pittsburgh, Pennsylvania,
 (2) Dorseyville Middle School, Pittsburgh, Pennsylvania

ABSTRACT

The printing-related expenditure that is budgeted in 2014 for U.S. Federal agencies is \$1.8 billion. A sample of five publically available documents produced by various federal agencies is analyzed and the cost savings arising from a change in font type are estimated. The analysis predicts that the Government's annual savings by switching to Garamond are likely to be about \$234 million with worst-case savings of \$62 million and best-case savings of \$394 million. Indirect benefits arising from a less detrimental impact on the environment due to lower ink production and disposal volumes are not included in these estimates. Times New Roman is not as efficient as Garamond, and the third federally-recommended font, Century Gothic, is actually worse on average than the fonts used in the sample documents.

		Total Federal, State and Local Savings (\$ in millions)		
		% Ink Cost Relative to Total Printing and Reproduction Expenditure		
		20%	25.96%	32%
Percent Coverage Decrease	10%	62	80	99
	15%	92	120	148
	20%	123	160	197
	25%	154	200	246
	29.24%	180	234	288
	35%	216	280	345
40%	246	320	394	

Figure 6. A sensitivity of the savings in the ink costs as the two assumptions with the lowest degree of confidence change. The blue column corresponds to the base assumption that the ink costs are 25.96% of the printing and reproduction costs. The yellow row (29.24%) corresponds the percentage coverage decrease of 29.24% by changing the font to Garamond found in the experimentation.

Original	Garamond
<p>During the Cold War, ordinary Americans used the telephone for many local calls, but they were cautious about expensive "long-distance" calls to other area codes and were even more cautious about the especially expensive "international" phone calls. Many people today, by contrast, treat the idea of "long-distance" or "international" calls as a relic of the past. We make international calls through purchases of inexpensive phone cards or free global video services. International e-mails are cost-free for users.</p>	<p>During the Cold War, ordinary Americans used the telephone for many local calls, but they were cautious about expensive "long-distance" calls to other area codes and were even more cautious about the especially expensive "international" phone calls. Many people today, by contrast, treat the idea of "long-distance" or "international" calls as a relic of the past. We make international calls through purchases of inexpensive phone cards or free global video services. International e-mails are cost-free for users.</p>
Times New Roman	Century Gothic
<p>During the Cold War, ordinary Americans used the telephone for many local calls, but they were cautious about expensive "long-distance" calls to other area codes and were even more cautious about the especially expensive "international" phone calls. Many people today, by contrast, treat the idea of "long-distance" or "international" calls as a relic of the past. We make international calls through purchases of inexpensive phone cards or free global video services. International e-mails are cost-free for users.</p>	<p>During the Cold War, ordinary Americans used the telephone for many local calls, but they were cautious about expensive "long-distance" calls to other area codes and were even more cautious about the especially expensive "international" phone calls. Many people today, by contrast, treat the idea of "long-distance" or "international" calls as a relic of the past. We make international calls through purchases of inexpensive phone cards or free global video services. International e-mails are cost-free for users.</p>

Figure 2. A sample paragraph in the original font with the three test fonts. No change was made in the font size. The fact that the fonts require different amounts of ink to convey the same content is visually apparent. This difference was analyzed quantitatively in the study to determine the cost savings.

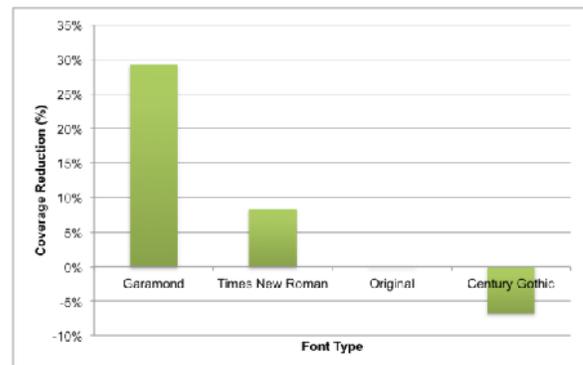


Figure 4. A comparison of the estimated savings by switching from the original font to the three federally-recommended fonts.



Lincoln Pasquina, PhD.
*JEI co-founder, Editor,
Editor-in-Chief from
2012-2014. Board
Member 2014 - present*

Suvir Mirchandani's article titled "A Simple Printing Solution to Aid Deficit Reduction," published in 2014, is a premiere example of student-led research. This article asked a simple question with grand implications: how much ink could it save the US Federal Government if it changed fonts, and what savings could result? The research concludes that it is an amazing amount: over \$200 million. It starts with a survey of five official documents to establish a baseline amount of ink usage, and illustrates what a change in font would mean visually. It then describes a computational estimate on how the amount of ink would change for these documents. The authors were careful to document their confidence in certain estimates, and provided a sensitivity analysis to show the range of results that are within reason. A broad range is described, but an estimate of saving \$200 million or more is reasonable from the data.

This article was special in the early days of JEI. The entire editorial staff was excited about the clarity of the investigation. It turned out that the broader news media loved the overall narrative, both findings and the fact that the research was conducted by a high school student. It was written up in the Washington Post, CNN, The Atlantic, and Time. Personally, I was invited as a guest on a radio show in Australia to discuss the story. It generated enough buzz that some experts dissected the analysis to point out flaws. Though it meant the savings might not be realized, this back-and-forth is exactly why research should be published. The important aspect is not only that the research was echoed in major news outlets. More important is that this coverage prompted discussion and a still more refined description of the pros and cons of changing fonts. That public discussion would not have happened without the authors asking this question.

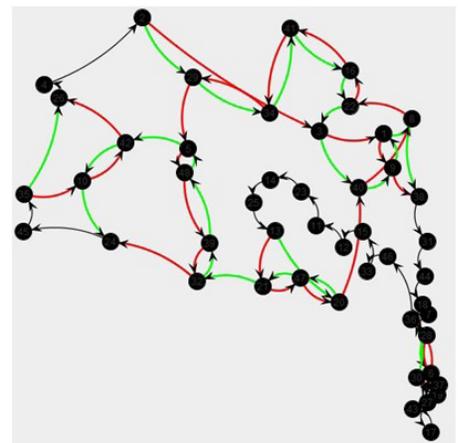
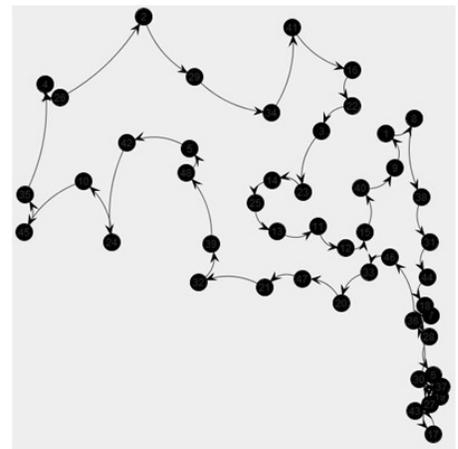
Ant Colony Optimization Algorithms with Multiple Simulated Colonies Offer Potential Advantages for Solving the Traveling Salesman Problem and, by Extension, Other Optimization Problems

M. Evan Wildenhain (1) and Ian Sacco (1)

(1) Scripps Ranch High School, San Diego, California

ABSTRACT

The traveling salesman problem (TSP) is a classic problem in optimization, frequently used for measuring the performance of optimization algorithms. The goal in solving the TSP is to determine the lowest-cost circuit through a set of cities on a graph. Ant colony optimization (ACO) algorithms, inspired by nature, use simulated ants that modify their environment through laying and removing pheromone, represented by weights on the edges of the graph connecting each city. In this study, a novel algorithm is developed, Multi-Colony System (MCS), which uses multiple colonies of simulated ants in combination to produce superior solutions to the TSP. In comparison with Ant Colony System (ACS), a standard well-performing ACO algorithm, MCS has displayed improved performance, producing tours up to 19.4% shorter than those of ACS in the same amount of time. The performance of MCS in this study presents potential advantages in applications beyond the TSP, including the ability of multiple colonies to both develop a greater number of solutions simultaneously and to more efficiently avoid local maxima in the search space.





Rebecca K. Reh, Ph. D.
2012-2015
Board Member

While the concept of computer algorithms inspired by nature is not new, it is an idea that, with the possible exception of neural nets, is not widely known by the public. I chose to highlight the article “Ant colony optimization algorithms with multiple simulated colonies offer potential advantages for solving the traveling salesman problem and, by extension, other optimization problems”, by M. Evan Wildenhain and Ian Sacco, in part because I find such biologically inspired computational science approaches genuinely cool, as well as accessible to those unfamiliar with computational modeling in general. While the novice reader may encounter some terms they are unfamiliar with, the paper is a prime example of the power of JEI’s iterative review process to improve the clarity and logical flow of a manuscript; the authors do an excellent job framing the problem and explaining the computational logic behind the algorithms they employ. I loved how the authors tie in the concept of exploration versus exploitation when setting up their experimental comparison, demonstrating how concepts developed in biology can be utilized across disciplines. Finally, the chosen paper highlights one of JEI’s core beliefs: that interesting and meaningful experiments do not necessitate scientific equipment found only in the University setting.

Comparing the Effect of Stent Geometry on Blood Flow Rate of Curved Coronary Artery Stenosis

Ethan Z. Levy (1) and Yair Levy (2)

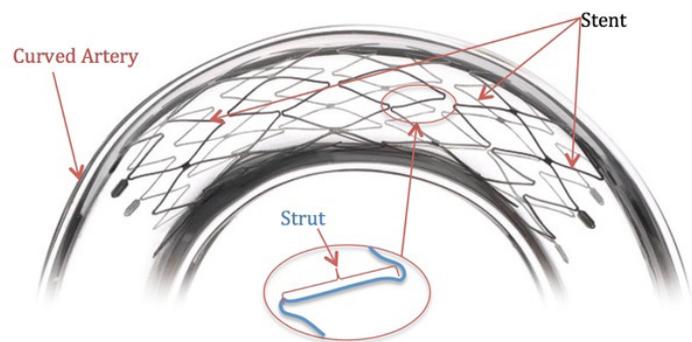
(1) Aventura Waterways K-8 Center, Miami, Florida, (2) Nova Southeastern University, College of Engineering and Computing, Ft. Lauderdale, Florida

ABSTRACT

One of the world's leading causes of death is Coronary Heart Disease (CHD); it has been implicated in about 12% of all deaths globally. Plaque accumulation within the heart's arteries causes CHD and leads to fatal complications including heart attack and stroke.

Currently, the treatment for moderate plaque levels in CHD is placing a stent to hold plaque back from interfering with the blood flow and to deliver preventative drug treatment. Stents are constructed from longitudinal segments called

struts, commonly having 8, 10, or 12 struts. Stent struts can change the amount of surface area available for drug delivery and also affect the blood flow rate. Recently, to maximize surface area, researchers have considered stents having a square instead of round strut cross-section. While the new square cross-section provides more surface area, its shape does not appear to be as efficient for the blood flow rate. However, limited investigations have been done on the relationship between the number of struts and their cross-section geometry on the blood flow rate. In this study, we tested the effect of strut design on simulated blood flow rate in a designed artificial heart. The results of this study showed that the 12-strut round cross-section had a higher blood flow rate than the other stent geometries. More research is still needed to investigate additional stent geometries to ensure both the added surface for the restenosis-prevention drug and a maximum blood flow rate are achieved simultaneously.





Alyssa Becker, Ph.D.
2014 - Present
Reviewer

There were many great articles to choose from in 2016, spanning molecular biology, engineering, ecology, and human behavior- it was difficult to pick just one! I chose this article for a few reasons, first I found the question they were asking to be interesting and important for the application of stents. My work is also in the cardiovascular field, and we frequently run across similar questions at the interface of device design, fluid dynamics, and drug release. I was one of the reviewers for this article, and was also impressed by how creative the authors were in using resources available to them. Many people may think you need a lot of equipment and a fancy lab, but that's not always true. As this article demonstrates, you can investigate really interesting questions with items you can find in a hardware store, plus some hard work and innovative thinking.

The Effect of Sunglass Price on Ocular Exposure to Ultraviolet Radiation

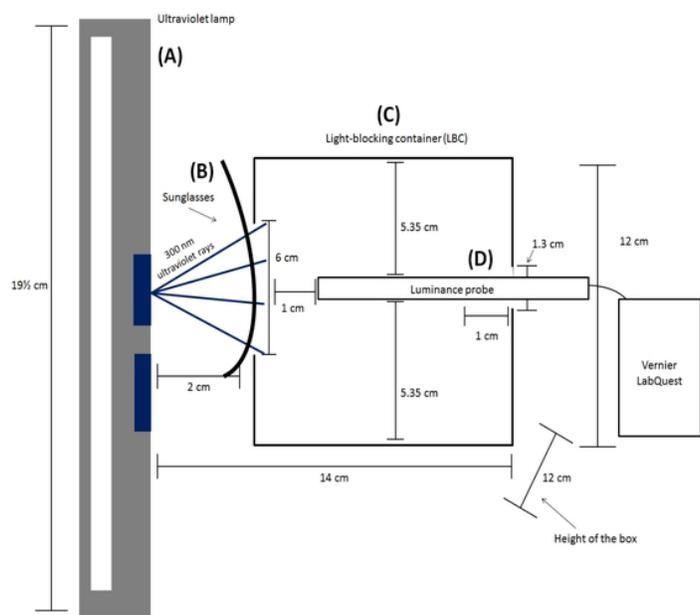
Elizabeth M. Larson (1) and Jeffrey R. Wehr (1)

(1) Advanced STEM Research Laboratory, Odessa High School, Odessa, Washington

ABSTRACT

Exposure to ultraviolet waves has been linked to skin cancer, sunburns, and ocular diseases, such as cataracts, macular degeneration, and pterygium. While sunglasses are readily encouraged, many do not wear sunglasses, or do not check the protection offered prior to purchase. One possible reason behind this is people consider price to be an indicator of the sunglasses' quality. The purpose of this experiment was to test if the cost of sunglasses

correlated with the amount of ocular protection from ultraviolet radiation provided. An ultraviolet emitting lamp (300 nm), natural sunlight, 20 sunglasses, and an illuminance probe were used to test this theory. No sunglasses and experimental groups of sunglasses ($\leq \$10$ or $> \$10$) were tested in front of both light sources. Data was taken directly in front of a light source, at 45 degrees to the light source, and at 315 degrees to the light source, in order to test light passage from different angles. There was no significant difference between the protection offered from $\leq \$10$ and $> \$10$ sunglasses. The results of this research can be useful in occupational work. Although employers are not required to pay for an employee's sunglasses, a low-income employee can purchase less expensive sunglasses for their occupation, while still safely protecting their eyes.





Nico Wagner
Associate Editor
2014-present
Outreach Coordinator
2016-2019

I chose “The Effect of Sunglass Price on Ocular Exposure to Ultraviolet Radiation” to be the featured article for a few reasons. Firstly, this research paper is written in a very accessible manner. Not much jargon is used and the manuscript can be understood by a broad audience. The methods themselves are also very repeatable by anyone who has access to an illumination probe. Secondly, this paper poses a simple, yet interesting, question. More broadly speaking, I often times ask myself ‘is something better simply because it’s more expensive?’ This paper does just that, looking at the effectiveness of more and less expensive sunglasses in blocking UV light. As a follow-up, I think the answer to the question is equally intriguing! I have personally found that quite often, there is little to no correlation between the cost and effectiveness of a product. While there might be a prestige factor to having a more expensive product or name brand product, the functionality is not necessarily better. Here the authors nicely and simply show that when it comes to UV exposure, there is no significant difference between the more and less expensive sunglasses. Lastly, there are broader implications to this research that make it interesting to a wide audience. Often times, safety measures are skipped due to affordability reasons, which more severely impacts individuals of lower socioeconomic standing. Here, the authors considered protecting the eye against UV rays, which is important for both outdoor work and for leisure activities. By showing that less expensive sunglasses are just as efficient as their more expensive counterparts, the authors make an argument that anyone should be able to have equitable access to eye protection against UV rays.

Reducing Crop Damage Caused by *Folsomia candida* by Providing an Alternate Food Source

Kelly Tamura (1) and Joseph Moché (1)

(1) Hale Charter Academy, West Hills, California

ABSTRACT

Collembola (*Folsomia candida*), hexapods found in nearly every land environment on earth, have been shown to be a crop pest. Researchers who culture Collembola in the laboratory often use yeast as a food source. A series of tests was conducted to 1) verify that *F. candida* would feed on lettuce seedlings; and 2) determine if the availability of yeast as a food source would reduce damage to lettuce seedlings caused by feeding Collembola. The tests confirmed that *F. candida* will feed on lettuce seedlings. Results strongly suggest that the availability of yeast as a food source significantly reduces damage to lettuce seedlings caused by feeding activities. There is a strong suggestion that *F. candida* prefers yeast to lettuce seedlings



Figure 3. A photo of yeast pellets. These yeast pellets are the standard size of the pellets used in the experiments.



Figure 2. A photo of a feeding injury on a lettuce seedling. This photo is presented as a representative of a damaged seedling.



Figure 1. A photo of healthy lettuce seedlings. This photo is presented as a standard of a healthy lettuce seedling.



Tori Osinski
2015- Present
*Reviewer, Proofing
Editor, Head Proofing
Editor*

I selected the article titled Reducing Crop Damage Caused by *Folsomia candida* by Providing an Alternate Food Source by Kelly Tamura because I thought the experiments conducted were very thoughtful and thorough. Additionally, the questions addressed in the study are relevant to the agricultural field: we are constantly in need of new methods to optimize crop growth and maintenance and this study provided another great idea for preventing pest consumption of crops. The authors rationalize their experiments very well. Basic knowledge about the soil arthropod *Folsomia candida* (Collembola) and its food sources is outlined and then they carefully describe a prior science fair project addressing similar questions from the year prior. This review of the project highlights the approach, the outcomes, and an explanation for why this study could be repeated with an improved approach. Their hypothesis was that Collembola would prefer yeast as a food source over lettuce seedlings. The authors explain their approach and how each experiment addresses a specific question very effectively. I also like this study because each experiment they conduct builds on the prior to expand their findings and more fully describe the feeding behaviors of Collembola. Using multiple approaches to address the same question strengthens the conclusions that can be made about a hypothesis. The authors use multiple combinations of seedlings, yeast, and Collembola (sometimes removing one variable) to fully quantify the changes in each food source plus seedling injuries each time. They then add in an experiment in which they quantify which food source Collembola are closer to and they found that Collembola generally localize nearer to yeast. These multiple approaches all them to more confidently conclude that Collembola prefers yeast to lettuce seedlings. I felt this was a carefully-conducted study with important implications for crop maintenance. I would highly recommend checking it out if you haven't!

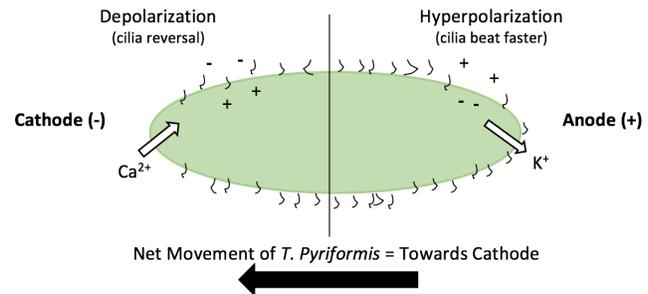
Cathodal Galvanotaxis: The Effect of Voltage on the distribution of *Tetrahymena pyriformis*

Christy Zheng (1) and Michael Edgar (1)

(1) Milton Academy, Milton, Massachusetts

ABSTRACT

Tetrahymena pyriformis are unicellular eukaryotes with thousands of hair-like structures called cilia on the surface of their bodies that aid in cell motility and food consumption. The similarities between their cilia and that of humans, particularly in the human respiratory and olfactory track, are why they are model organisms for investigating cell movement and cilia functionality. Further research may help scientists better understand how cilia are affected by common ciliopathies, genetic disorders caused by the abnormal formation or function of cilia. The objective of this experiment was to investigate the effect of voltage on the distribution of *T. pyriformis* across a capillary tube. *T. pyriformis*-filled capillary tubes were connected to a power supply for one minute. We calculated the percent distributions at the anode and cathode of the capillary tube by counting *T. pyriformis* with a hemocytometer. Our results indicate that cathodal galvanotaxis is induced at 4V and that, despite increases in voltage from 4–30V, the percent distribution of *T. pyriformis* at the cathode remained constant at approximately 80%. These data suggest that while calcium and potassium voltage-gated ion channels are mediated by graded potentials and are triggered at specific thresholds, further increasing voltage above that threshold had little effect.





Kari Mattison, Ph.D
2020 - Present
Editor in Chief

The authors of this paper wanted to look at what effect voltage would have on the movement of a small organism called *Tetrahymena pyriformis*. A process known as “galvanotaxis” was used in this paper which measures the movement of an organism or cell in response to electrical stimulation. *T. pyriformis* are unicellular organisms that have cilia all around their exterior to aid in movement. Using a simple, but effective setup the authors were able to look at the movement of *T. pyriformis* along a tube when different voltages were applied across the tube. What they found was that galvanotaxis towards the cathode (negative terminal) started around 4V, but that once you got to 10V there really was no significant difference in the amount of galvanotaxis that occurred.

I picked this article partially because I was one of the Reviewers for it, but also because I think it’s a really nice example of science that could be done at home, in school, or in an established lab. I enjoyed getting to re-read this work again and really see what changes I had suggested and work into their final manuscript. I also like how they explained what the limitations of their experiment were without discrediting the work they showcased in their publication - this is something that can be hard to do!

People’s Preference to Bet on Home Teams Even When Losing is Likely

Matthew Weng (1) and Russel Golman (2)

(1) Loomis Chaffee School, Windsor, Connecticut, (2) Carnegie Mellon University, Pittsburgh, Pennsylvania

ABSTRACT

One intriguing phenomenon is when people make bets that seem to go against their better judgement. This can be seen in sports betting. In this paper, we report a survey-driven study that investigates if people bet more on their home teams, both in scenarios where the team is leading and scenarios where the team is likely to lose. We asked participants to imagine betting with \$10,000 on different scenarios. We compared how much they bet on their home teams versus how much they bet on neutral teams in the same circumstance. On average, participants bet slightly more on their home teams than a neutral team when their home team was leading. Participants, however, bet significantly more on their home teams than the neutral teams when their team was facing a large deficit. This study can help explain some more impulsive betting behaviors that might be due to information avoidance.

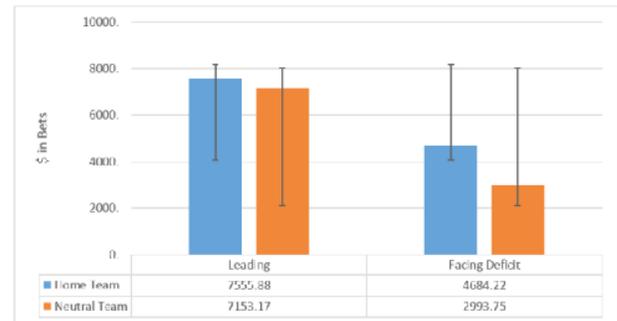


Figure 1: Bets from All participants. Participants (n=119 from 5 cities) were surveyed and average dollar amount that participants were willing to bet on home and neutral teams under leading and facing deficit circumstances was determined. Error bars represent the standard deviation which is the average difference between a value of the bet and the mean bet.

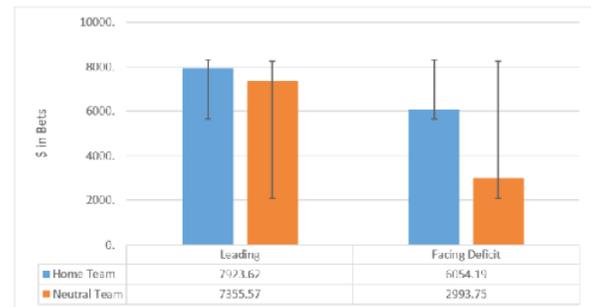


Figure 3: Bets from Boston-based participants. Participants (n=21 from Boston) were surveyed and average dollar amount that participants were willing to bet on home and neutral teams under leading and facing deficit circumstances was determined. Error bars represent the standard deviation which is the average difference between a value of the bet and the mean bet.



Brandon Sit
2016-Present
Served as Reviewer,
Associate Editor, Senior
Editor, Managing Editor,
Editor-in-Chief, Executive
Director

This article is a really interesting study that used an online survey tool to ask people in different cities around the US how much they would bet on home versus neutral sports teams in different game scenarios. The authors found that even when facing a huge deficit, people favored betting on their home team over a neutral team, and the size of this home team bias seemed to vary by the city of the participant. This was especially cool because it seemed that this bias might correspond to the overall success of athletic teams in the city. For example, participants in Boston, which has had a lot of sports success recently, had the biggest home team bias. I picked this paper not only for its interesting results, but also because it represents just one of the many ways in which our scientist authors can perform research that involves participants from across many different geographical locations. With the rise of "virtual everything" starting in 2020, we've seen a lot more students use tools like online surveys as part of their studies and the scope and power of these types of projects is constantly growing. This is very similar to how professional scientists at all levels have had to adapt to an increasingly remote and virtual world, but also one that is now more connected and online than ever.

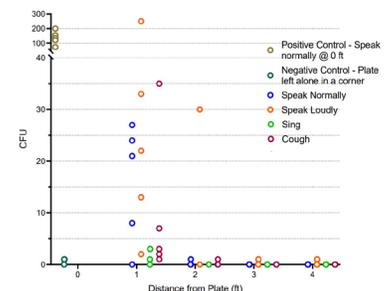
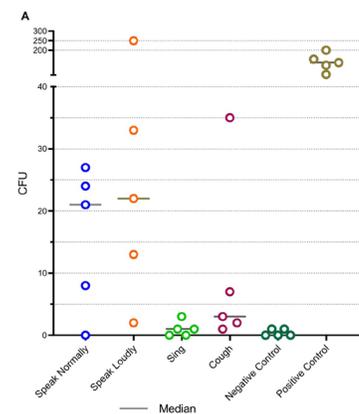
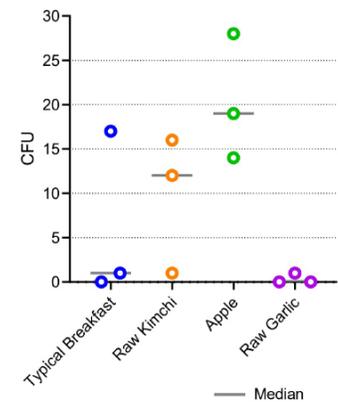
The effects of different modes of vocalization and food consumption on the level of droplet transmission of bacteria

Audrey Wong (1) and Michael Tran (1)

(1) Arnold O. Beckman High School, Irvine, California, USA

ABSTRACT

Expulsion of microbes through vocalization represents an important means by which pathogens are transmitted between individuals. Based on the current CDC guideline, a distance of three feet is considered to be sufficient to prevent transmission of microbes. In this study, we specifically focused on droplet transmission of bacteria expelled through the mouth, capturing microorganisms on Petri dishes set at different distances during various activities. Our goal was to assess how the mode of vocalization and the type of food consumed impact the level of bacterial transmission. By measuring the bacterial count in Petri dishes after each activity, we determined that, in fact, transmission of bacteria is significantly impacted by the type of vocal activities and the food consumed prior to vocalization. Additionally, our results are consistent with the CDC three-foot physical distancing guideline for droplet transmission of bacteria. Our study also informs on the types of activities that are associated with greater transmission of oral bacteria, such as speaking loudly and sneezing. Food types that increased bacterial transmission include raw kimchi and apples, whereas consuming raw garlic reduced transmission.





Julien Grimaud
Reviewer
2016 - Present

During the COVID-19 pandemic, one word was on everybody's lips—and in their breath—"droplets". Respiratory droplets are small particles of mucus or saliva, which are expelled when we sneeze, cough, talk, and more generally every time we exhale. Many pathogens can spread through respiratory droplets, including SARS-CoV-2, the virus responsible for COVID-19 – hence the current CDC guidelines such as wearing a face mask and maintaining a distance of at least three feet between individuals.

However, different modes of vocalization create varying quantities of respiratory droplets, which are expelled at different speeds. How would the mode of vocalization affect the droplet transmission of bacteria? This is one of the questions that Wong and Tran investigated in their 2021 article titled "The effects of different modes of vocalization and food consumption on the level of droplet transmission of bacteria". In this study, the authors asked participants to produce different sorts of vocalization (e.g., talking, singing, or coughing) in front of a Petri dish placed at chin level. Bacterial spread was then quantified through colony counts. The scientists also tested how food consumed prior to vocalizing would affect their results.

Overall, the article has everything I enjoy in scientific literature: a simple yet relevant scientific question, a clever experimental design, thorough analysis of the data, and beautifully crafted figures. While the authors reported many interesting results (e.g., eating raw garlic reduces the amount of bacteria spread vocalizing), the finding that garnered the most attention lies in Figure 1. The authors report how the distance between the subject and the Petri dish changes colony counts. Interestingly, transmission beyond 2ft was almost completely eliminated, in strong support of CDC guideline of 3ft distancing. However, I'd like to know when CDC will update their guideline and advise us to chew raw garlic as part of our morning routine!

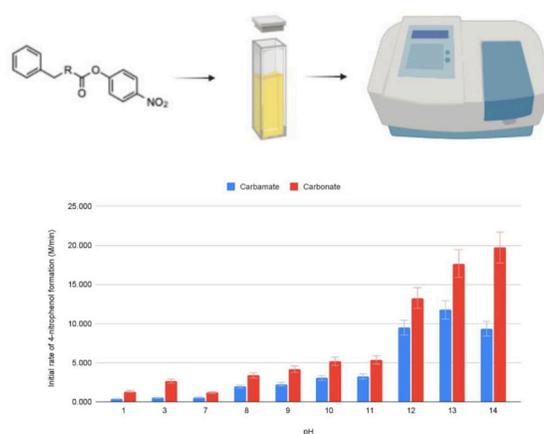
Spectrophotometric comparison of 4-Nitrophenyl carbonates & carbamates as base-labile protecting groups

Selin Kocalar (1), Alice Zhou (2), Aylin Salahifar (3), Edward Njoo (4)

(1) Leigh High School, San Jose, CA, (2) BASIS Independent Silicon Valley, San Jose, CA, (3) Carlmont High School, Belmont, CA, (4) Department of Chemistry, Biochemistry, & Physical Science, Aspiring Scholars Directed Research Program, Fremont, CA

ABSTRACT

In organic synthesis, protecting groups are derivatives a) of reactive functionalities that play a key role in ensuring chemoselectivity of chemical transformations. To protect b) alcohols and amines, acid-labile tert-butyloxycarbonyl protecting groups are often employed but are avoided when the substrate is acid-sensitive. Thus, orthogonal base-labile protecting groups have been in demand to enable



selective deprotection and to preserve the reactivity of acid-sensitive substrates. To meet this demand, we present 4-nitrophenyl carbonates and carbamates as orthogonal base-labile protecting group strategies. These protecting groups are relatively stable in aqueous and acidic solution yet cleaved and irreversibly decarboxylated in mild basic conditions. We showed that deprotection can be monitored spectroscopically, as hydrolysis yields 4-nitrophenol, a bright yellow compound with an optical readout at 413 nm. Finally, we demonstrated that the use of 4-nitrophenol as an effective leaving group allows for deprotection to be carried out in mild conditions. We protected benzyl alcohol and benzylamine via acylation by 4-nitrophenyl chloroformate, yielding substrates that were subsequently subjected to hydrolysis in various pH conditions. The release of 4-nitrophenol was monitored spectroscopically and the reaction kinetics were derived from absorbance data, yielding that hydrolysis was accelerated only in basic conditions and was most effective in pH 12 and above. These results inform the feasibility of our protecting group in organic synthesis and open avenues toward new synthetic routes by broadening the spectrum of effective protecting group strategies.



Aleksandar Radakovic
3rd year JEI volunteer
Managing editor
2022 – current
Reviewer 2020 – current
Associate editor 2020 –
2022

Protecting groups are the workhorses of synthetic organic chemistry. Hidden behind the scenes and often taken for granted, their development is not trivial and requires careful consideration of not only the present but also the future needs of chemists. Once a good protecting group is identified, the chemistry wheels start churning. Thousands of chemists use it daily to synthesize important household materials, life-saving medications, and new molecules whose synthesis wasn't possible before the new protecting group appeared on stage.

In this elegant study, Kocalar et al. demonstrated that 4-nitrophenol carbonates and carbamates are effective protecting groups for alcohol and amine functionalities, respectively. As a biochemist, I was pleased that a team of high school students took on such a hard chemistry problem, but what really made me pay attention was the authors' clever way of assessing the stability of the protecting group. Once the protecting group falls off the molecule, the 4-nitrophenyl portion of it colors the solution yellow. The authors used this property to quickly and easily measure the rate of deprotection – i.e., the recovery of the alcohol and amine. And voila! At acidic and neutral pH, the alcohol and amine were protected. But as the authors increased the pH, the solution became yellow, indicating that the 4-nitrophenyl carbonates and carbamates can indeed be used as true base-labile protecting groups.

Among all the papers that I handled as an associate and managing editor in 2022, it is the craftiness and clarity that made me enjoy this one the most. The crux of the experiment depended on a simple visual read-out, without relying on complicated and expensive instruments. Seeing such accessible science in action is what makes working with budding scientists at JEI a special experience.