

# Undergraduate Research Symposium May 18, 2012 Mary Gates Hall

## Online Proceedings

---

### POSTER SESSION 1

Balcony, Easel 87

12:00 PM to 1:30 PM

#### **Oxygen Consumption in Rats before and after Administration of Morphine**

*Tim Kruse, Senior, Biochemistry*

*Mentor: Gregory Terman, Anesthesiology and Pain Medicine*

*Mentor: Michael Emery, Anesthesiology and Pain Medicine*

Opiates have long been a useful tool in medicine due to their potent analgesic properties. Although there has been a significant increase in prescribed use of opioids in recent years there has also been a large increase in deaths related to prescription opioids that may involve abnormal control of ventilation. Opiate effects on ventilation have largely been considered to be due to depression of respiratory chemosensitivity (sensitivity to carbon dioxide and/or acid-base balance), but another effect may include decreased oxygen consumption and therefore decreased production of carbon dioxide. In this study, we are using a whole body plethysmograph and a respirometer to measure the rate of oxygen consumption levels in juvenile rats (18-23 days) during sleep - before and after administration of morphine at varying dosages (5mg/kg to 45mg/kg). Our initial findings show no decrease in oxygen consumption and surprisingly instead demonstrate increases up to 50% following opioid administration. These unexpected findings illustrate the need for additional investigation on possible causes of prescription opiate associated deaths. Increased oxygen consumption (and therefore increased carbon dioxide production) in the presence of drug induced decreased sensitivity to carbon dioxide may interact to lead to dangerous compromises in the control of ventilation in patients taking a broad range of opiates doses in the community.

### POSTER SESSION 2

Commons East, Easel 78

2:00 PM to 3:30 PM

#### **Studies Comparing Tolerance to Morphine-induced Respiratory Depression with Tolerance to Morphine-induced Analgesia**

*Chen Shi, Senior, Bioengineering, Electrical Engineering*

*Mary Gates Scholar*

*Mentor: Gregory Terman, Anesthesiology and Pain Medicine*

*Mentor: Michael Emery, Anesthesiology and Pain Medicine*

Opiates are considered an effective treatment of severe pain for a long time. However, repeated exposure to opiates induces analgesic tolerance, which has been correlated with an increase in opiate associated deaths due to respiratory depression. This project aims to compare and contrast tolerance to opiate-induced analgesia and tolerance to opiate-induced respiratory depression. We hypothesized that the rate of development of the former tolerance phenomenon occurred faster than that of the later tolerance phenomenon. In such a case, patients may be more likely to develop respiratory depression as the dose of opiate is escalated in an attempt to provide continued analgesia. To date, animal tests have been conducted to look at effects on nociception and ventilation produced by various doses of opiates in opiate naive and opiate experienced rats. The nociception testing was conducted through paw withdraw experiments, where the time for rats to move their paws under a hot light indicated analgesic effects, and the ventilation testing was conducted using whole body plethysmography, where ventilation signals of rats were conveniently and accurately measured and recorded. In the ventilation testing, rats' responses to different ambient carbon dioxide concentrations up to 5% were measured. From the collected data, a potential therapeutic window for morphine was found to be between 5 mg/kg to 15 mg/kg, under which no obvious respiratory depression was observed while above which severe respiratory depression happened and almost no respiratory response to carbon dioxide was noticed. Future results may indicate the relative large discrepancy between the magnitudes of tolerance to opiate-induced analgesia and that of tolerance to opiate-induced respiratory depression. This may further indicate the different mechanisms mediating these two opiate-induced tolerance phenomena, a better understanding of which may allow treatments that make opiates safer for patients with chronic pain.

### POSTER SESSION 2

Commons West, Easel 43

2:00 PM to 3:30 PM

## **The Struggle to Control the Story of the Everett Massacre**

*Matthew P. (Matthew) Anderson, Senior, History  
Zesbaugh Scholar*

*Mentor: James Gregory, History*

*Mentor: Ileana Rodriguez-Silva, History*

In the aftermath of the 1916 Everett Massacre, the Industrial Workers of the World (I.W.W.), the City of Everett, and local newspapers struggled to control the story of this armed confrontation, and the ensuing trial of I.W.W. member Thomas Tracy. There has been a great deal written about the Massacre and trial, but limited research on the attempts of labor, political parties, industrialists, and the local community to control the story. To research this topic, I have examined a number of books, along with the *Seattle Daily Times*, the *Everett Daily Herald*, and various regional labor publications. I have also conducted archival research in various documentary sites, as well as conducting informal interviews with archivists, and people in Everett. I argue that the rhetoric used by the attorneys at the trial, the I. W. W. literature, along with coverage in the local periodicals, provides an example of the larger battle waged for the control of the production of stories and historical memories. This paper uses the depictions of the massacre by various groups to raise broader questions about how memory is produced, and the lengths to which people will go to further their cause, and to have their views elevated to the story of history.

## **POSTER SESSION 2**

**Commons West, Easel 31**

*2:00 PM to 3:30 PM*

### **Taxonomic Diversity of Oligo-Miocene Gophers (Mammalia: Rodentia: Geomyidae: Entoptychinae) using Geometric Morphometrics**

*Jennifer W Glusman, Senior, Biology (Physiology)*

*Mentor: Gregory Wilson Mantilla, Biology*

*Mentor: Jonathan Caledo*

The fossil record in western Montana and central Oregon of the late Oligocene-early Miocene period, about 20-30 million years ago, presents a rich fauna of gophers (Geomyidae) of the subfamily Entoptychinae. These burrowing creatures may represent up to 25% of the mammalian fauna of certain fossil assemblages. Understanding the ecology of this large population is thus important for interpreting community-wide ecological changes. Prior to investigating their ecology, it is necessary to understand the taxonomic and morphological diversity of these fossil gophers. Previous attempts have been made to differentiate these gophers by using cranial and dental material. However, skulls and dentaries of such small rodents are rarely preserved. Isolated teeth are sometimes the only material available for identification. As a consequence of their abrasive diet, geomyids wear down their teeth over

time, erasing potentially diagnostic features of the occlusal surface of the tooth. Therefore, several authors have suggested that differences in the shape of the teeth could be used as a means of species differentiation. This hypothesis has yet to be quantitatively tested. Geometric morphometrics allows such analysis of shape independently of size. This method involves the statistical comparison of geometric coordinates of landmarks placed on an object of interest. I will apply this method to the enamel band of the last premolar and last molar of 140 fossil geomyids. The goal of this study is to test the hypothesis that the shape of Entoptychine teeth can be used as a tool for species differentiation. Preliminary results of the analysis of M3s reveal statistically significant differences between genera. More specifically, the angles of the tooth (tilted anteriorly or posteriorly), its shape (rectangular versus square), and the proximity of its two lophs, appear taxonomically diagnostic. This analysis will allow me to distinguish between gopher taxa, and allow the investigation of their ecology and potential roles in the community.

---

## **SESSION 2D**

---

### **PLASTICS TO PLANTS TO TEETH: READING EARTH'S HISTORY**

*Session Moderator: Caroline Stromberg, Biology*

**Mary Gates Hall 238**

*3:30 PM to 5:00 PM*

\* Note: Titles in order of presentation.

### **Convergent Evolution of Blade-Like Teeth in Mammals: Correlating Dental Complexity with Diet in Plagiaulacoid Taxa**

*Abby Renee Vander Linden, Senior, Biology (Ecology,  
Evolution & Conservation)*

*Mary Gates Scholar*

*Mentor: Gregory Wilson Mantilla, Biology*

The evolution of a complex structure in organisms that share only a distant evolutionary history provides an opportunity to study the phenomenon of convergent evolution. One such convergent structure is a particular kind of laterally compressed blade-like shearing tooth in mammals known as a plagiaulacoid molar or premolar. Plagiaulacoid dentition has evolved independently in at least four clades of mammals: the rodent-like Mesozoic multituberculates, early primates known as carpolestids, modern and extinct South American shrew opossums, and several families of Australian diprotodont marsupials, including modern and extinct kangaroos, possums, and others. To understand the selective forces that led to the independent evolution of this specialized trait in multiple lineages, I correlated measures of tooth complexity with the known diets of modern plagiaulacoid marsupials, using this data to then infer diet in extinct taxa and compare

trends in complexity among these distantly related groups of mammals. To quantify dental complexity I created 3-D digital models of the lower cheek teeth of representative taxa and used custom GIS software to generate orientation maps of the tooth surfaces. Contiguous pixels with the same orientation were then grouped into patches that approximate the number of different shearing surfaces available to mechanically process food. Orientation Patch Count (OPC) is a measure of complexity that allows me to place mammals into broad dietary categories based on the amount of plant material in the diet. This framework can be used to infer the feeding ecology of extinct mammals from digital models of fossil teeth. If the plagiulacoid phenotype is an adaptation to similar selective pressures, I expect to find a similar range of OPC values and a similar amount of variation in complexity between plagiulacoid clades, indicating comparable dietary range even though these groups vary widely in geographic location, temporal distribution, and evolutionary history.

energy was negative over the periods both prior to and after 1994, implying that an increase of aggregate energy prices led to a decrease in aggregate energy intensity. The impact of energy prices on aggregate energy intensity was asymmetric over two periods, prior to 1994 and after 1994. The magnitude of own-price elasticity of aggregate energy was larger after 1994 than before that date, indicating the price effects on energy intensity strengthened after the energy price reforms. Although raising energy prices seems to be an effective policy tool to improve energy efficiency, other implications, such as social instability, should also be considered.

---

## SESSION 2P

---

### BUSINESS IN A DYNAMIC ENVIRONMENT

*Session Moderator: Altaf Merchant, Business, UW Tacoma*

**Mary Gates Hall 171**

*3:30 PM to 5:00 PM*

\* Note: Titles in order of presentation.

#### **The Asymmetric Impact of Energy Prices on Energy Intensity: Evidence from China**

*Xiaohan (Thomas) Yan, Senior, Statistics, Applied & Computational Mathematical Sciences (Mathematical Economics), Economics*

*Mary Gates Scholar*

*Mentor: Gregory Ellis, Economics*

In Economics, increasing energy prices is considered as a main factor contributing to the improvement of energy efficiency. China has experienced a constant increase in both energy prices and energy efficiency since the energy price reforms in the early 1990s. The question of interest is whether the impact of energy prices on energy efficiency was asymmetric before and after the energy price reforms. Energy intensity, defined as units of energy consumption per unit of GDP, is used to quantify energy efficiency. In this study, I assess the impact of changes in energy prices on aggregate energy intensity in China between 1985 and 2010, and identify the asymmetric impact of energy prices on energy intensity prior to and after the energy price reforms of the early 1990s. I used time series data to estimate energy price elasticity for aggregate energy, and compared the values of elasticity before and after the energy price deregulations. Empirical results showed that: the own-price elasticity of aggregate