Proposers: Cindy Huynh and Mollie Marshall
Advisor: Dr. Kira Bailey
Theory to Practice Grant
**A Look Into the Effects of Substance Abuse During Prenatal and Neonatal Development**

**Project Objectives**

1. Acquire the interview skills and laboratory techniques necessary for conducting research on the effects of prenatal alcohol and methamphetamine exposure on neurodevelopment in infants. In addition, learn about genetic predisposition to substance abuse and the role that gene-environment interactions play on developing substance use disorders.
2. Make long-lasting connections with professionals who are at the forefront of researching the genetic effects of alcohol and methamphetamine.
3. Create a documentary aimed at preventing substance use and abuse, especially among young women who are of childbearing age.

**Description**

The prevalence of substance abuse among pregnant mothers is increasing worldwide (LaGasse et al., 2011). In New Zealand, methamphetamine (METH) abuse among pregnant mothers has become more common than in the United States (US). The purity of METH in New Zealand has reached a high of 85 percent, allowing METH to become an extremely addictive drug in that country (Wouldes et al., 2013).

Although the purity of METH is lower in the US compared to New Zealand, METH abuse remains a significant problem, particularly among women of child-bearing age (Terplan et al., 2009). Research has been limited in the US but has taken off in New Zealand due to a few key factors. First, the healthcare system in New Zealand differs significantly from that of the US. For example, in New Zealand it is not mandatory to report mothers who have abused illicit drugs during pregnancy, which increases the likelihood that they will present for care. Second, New Zealand mothers receive free pre- and post-natal care and ongoing financial support when needed. Free healthcare also increases the number of mothers who will seek help and provides an opportunity to teach them about the effects of drug abuse on the child. The prevalence of METH abuse led the Werry Centre to conduct a longitudinal study to research the phenomenon. The Werry Centre, a research institute at the University of Auckland, is home to the Infant Development, Environment, and Lifestyle (IDEAL) study, which is the most comprehensive longitudinal study regarding METH-exposed children (Sowell et al., 2010).

For nearly a year, Cindy Huynh and Mollie Marshall have been in contact with Dr. Trecia Wouldes, a researcher and director of the Werry Centre teaching and the lead investigator of the IDEAL study. She has welcomed Huynh and Marshall to participate in the Werry Centre's studies from May 28, 2017 to August 11, 2017. Due to the complexity of this project, there must be adequate time allotted for the students to shadow research professionals while being trained

on the proper laboratory techniques. Following training, the students will need time to master those research techniques in order to perform them on their own.

The students were invited to help conduct a longitudinal study regarding METH exposed infants. In New Zealand, they will learn how to conduct interviews with mothers who use and abuse drugs, as well as how to analyze biological specimens, such as meconium, which reflect drug exposure during the pregnancy (Behnke et al., 2013). In addition, they will partake in the Prenatal Environment and Neurodevelopment (PEN) study, which investigates "prenatal alcohol exposure, genetic and epigenetic interplay and infant neurobehavioural development." (http://www.werrycentre.org.nz/news/pen-pilot-study) They will learn how to conduct proper maternal lifestyle interviews, collect DNA from the mothers and infants, draw blood from the umbilical cord for genome-wide methylation analysis, and screen for newborn blood spots to test for new biomarkers for prenatal alcohol exposure.

**Evaluation, Assessment, and Sharing**

Huynh and Marshall wish to bring back their findings in the form of a documentary and presentation. As they meet with different researchers and investigators during the 11 weeks at the Werry Centre, they will document their perspectives and work on the gene-environment interplay and developmental effects of prenatal exposure to substance abuse. They will also document laboratory skills, such as analyzing infants' biological specimens. They hope to educate students and faculty about the importance of the effects of substance abuse through this video and a presentation. Proposed forums for this presentation are the Summer Science Research Symposium, a Women in Science seminar series lecture, the Spring Research Symposium, or a Science Lecture Series seminar.

**Personal Statements**

Once a person becomes addicted to a certain substance, that addiction is extremely difficult to overcome due to the heavy reliance on the substance and highly negative withdrawal symptoms. Those who use and abuse drugs may not even realize what they are doing will have long term effects on them as well as their future offspring. As early as age 12, my father has been abusing tobacco for his whole life. Although smoking tobacco regularly was and is the norm in Vietnam, my father had no idea that it could affect me decades later when I was born. I had pale skin, light hair, and hazel eyes. It was as if every phenotype was the complete opposite of what it was supposed to be.

As I grew up, I began asking my doctors and biology teachers what may have caused my phenotypes to differentiate from the typical Asian characteristics that my family passed down for generations. Their answers were epigenetics, which is the study of changes due to the modification of gene expression, rather than the underlying genetic code. Epigenetics leads to the change in phenotype, without a change in the genotype. Tobacco use can result in DNA methylation, a chemical modification of DNA that regulates which genes are expressed.

I began to consider the genetic and developmental effects of substance use and abuse because of the possible epigenetic effects my father's tobacco use could have had on me. It is very disheartening to hear that mothers in New Zealand have been abusing METH at an extremely alarming rate. The effects of this abuse can be seen as early as prenatal and neonatal development. My strong interest in becoming a pediatrician with a focus in neonatology makes me extremely passionate about the current studies being conducted at the Werry Centre. I want to someday help young infants who will have to experience negative developmental and behavioral effects for the rest of their lives because of their mother's METH addictions.

Additionally at the Werry Centre, I will be given the opportunity to research the neurobehavioral effects of alcohol abuse among pregnant mothers. This is a really great chance to learn advanced genetic laboratory skills that I would not be able to learn in a Genetics course here at OWU. For example, I would be able to learn how to collect DNA from mothers and infants and screen for newborn blood spots in order to determine biomarkers for prenatal alcohol exposure.

**Preparation for Project**

Both Cindy Huynh and Mollie Marshall are currently undertaking a directed reading course with Dr. Bailey in order to prepare for this Theory-to-Practice Grant. The class is geared toward reading and discussing articles about genetic predisposition to substance abuse, gene-environment interplay, and neurodevelopmental effects of prenatal exposure. In particular, articles on studies conducted by Dr. Wouldes and the Werry Centre have been heavily discussed, as well as articles analyzing the gene-environment interactions of substance use disorders. Such articles focus on individual drug abuse as well as polysubstance abuse. Cindy has taken courses in General Chemistry I & II, Introduction to Cell Biology; and is currently enrolled in Organic Chemistry I, Introduction to Psychology, and Evolution, and will be enrolling in Genetics in Spring 2017. Mollie has taken courses in General Chemistry I & II, Introduction to Cell Biology, and Introduction to Psychology; and is currently enrolled in Introduction to Neuroscience and Organic Chemistry I. Most of these courses have strongly prepared the students in biological and genetic theory as well as important lab skills that will be needed for this project and that the proposed project will greatly help to develop into practical skills.

**References**


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LaGasse, L. L., Wouldes, T. A., Newman, E., Smith, L. M., Shah, R. Z., Derauf, C., & Lester, B. M. (2011). Prenatal methamphetamine exposure and neonatal neurobehavioral outcome in the USA and NZ. *Neurotoxicology and Teratology, 33,* 166-175.

Sowell, E. R., Leow, A. D., Bookheimer, S. Y., Smith, L. M., O'Connor, M. J., Ka,n E., & Thompson, P. M. (2010). Differentiating prenatal exposure to methamphetamine

and alcohol versus alcohol and not methamphetamine using tensor-based brain morphometry and discriminant analysis. *Journal of Neuroscience, 30,* 3876-3885.

Terplan, M., Smith, E. J., Kozloski, M. J., & Pollack, H. A. (2009). Methamphetamine use among pregnant women. *Obstetrics & Gynecology, 113(6)*, 1285-1291.

Wouldes, T. A., LaGasse, L. L., Huestis, M. A., DellaGrotta, S., Dansereau, L. M., & Lester, B. M. (2013). Prenatal methamphetamine exposure and neurodevelopmental outcomes in children from 1 to 3 years. *Neurotoxicology and Teratology, 42,* 77-84.

## Appendix

Email correspondence with Dr. Wouldes:

On Sep 13, 2016 9:32 PM, "Trecia Wouldes" <t.wouldes@auckland.ac.nz> wrote:

Dear Mollie,

We currently have two longitudinal research projects underway on substance abuse, one on alcohol and one on methamphetamine. I could possibly tailor a project around your interests or the focus of your course, if you gave me a little more information about your studies. Also, are you meant to complete a piece of work, such as an essay or written report.

Kind regards,

Trecia

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**From:** Mollie Marshall [memarsha@owu.edu]
**Sent:** Wednesday, 14 September 2016 12:57 p.m.
**To:** Trecia Wouldes
**Subject:** Ohio Wesleyan Student Research

Hi Dr. Wouldes,

This is Mollie Marshall, one of the three Ohio Wesleyan University students who spoke with you earlier in the year about spending the US summer in New Zealand. We are now in the process of actually writing our Theory-to-Practice grant and wanted to check in with you. We are curious as to what specifically we will be working on during our time with the Werry Centre. Currently, we've been researching articles related to the genetics of substance abuse and discussing them in a directed reading class. We're looking forward to working with you and the University of Auckland. Thanks so much!

Mollie Marshall

**Budget**

The budget includes expenses from May 28, 2017 to August 11, 2017. The trip will span 76 days and 11 weeks.

{1 USD = 1.38 NZD}

| | Cost per person | Explanation | Total cost |
|---|---|---|---|
| Meal Cost | $130/ week | The average cost of groceries for a family in NZ is $200.<br>The average cost of meal out for a person in NZ is $30. | $2,530 |
| Airfare | $1580 | $1400 round trip from Columbus, OH to Auckland, NZ.<br>http://book.statravel.com/staglobe/AirCalendarSelectionResult.do?followAction=AirCalendarSelection<br>$180 allotted to each student to travel to Columbus, OH. | $3,160 |
| Ground Transportation | $50 | $50 allotted to each student to travel to and from the airport and to different research facilities of the University of Auckland. | $100 |
| Housing | $1,177/ month | Huynh and Marshall will be staying in an Airbnb during their time in NZ (see link for representative housing unit, or something similar, dependent on availability)<br>https://www.airbnb.com/rooms/4625507?checkin=05%2F29%2F2017&checkout=08%2F11%2F2017&guests=2&s=NyloPC3k | $5,663 |
| Travel Insurance | $110 | Insurance required through the university to travel internationally. | $220 |
| Total | $5,840 | | $11,680 |