

University of Washington Bothell

# The CROW

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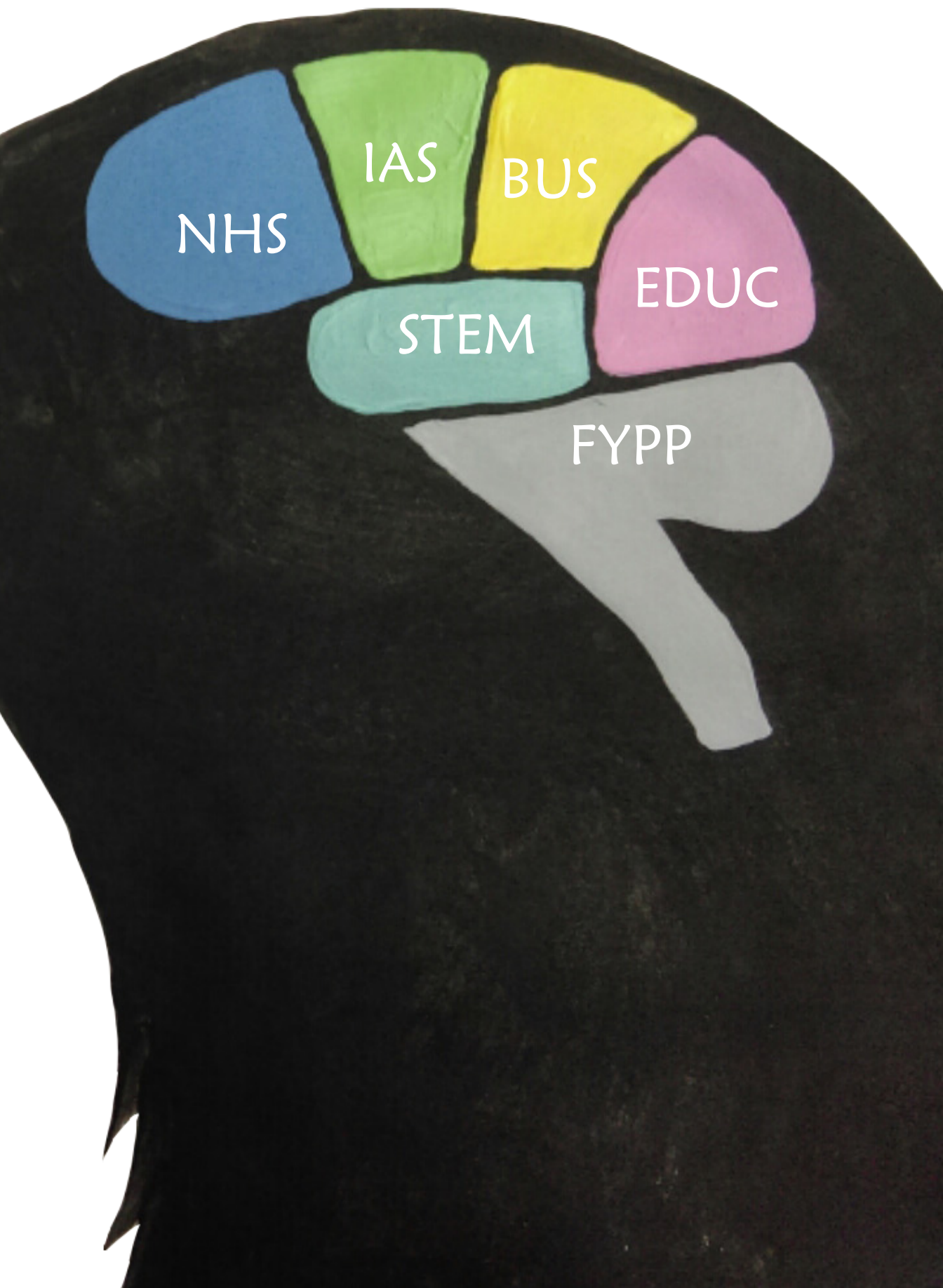
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## LETTER FROM THE EDITORS



*The CROW* highlights the incredible dedication of students at the University of Washington Bothell to conduct, analyze, and synthesize their own research investigations. As the reader, you will discover a myriad of topics ranging from Science and Technology to the Interdisciplinary Arts and a few in between. The variety of submissions received showcase the diverse styles and research subjects that will attract readers from all backgrounds. The act of conducting research is proven to be a highly impactful learning practice that engages students outside of the classroom setting and allows them to think more critically about the topics they wish to discover. Students present their ability to showcase and preserve their work, while also using it as a way to redesign and bring prospective to future academic research and endeavors. By taking the initiative to submit their work to be reviewed and critiqued by their peers, the authors in this journal have taken steps towards becoming active contributors to the academic discourse of their particular field of study. The Editorial Board was delighted to have the opportunity to carefully review the overwhelmingly positive and well written submissions we received this year. We want to praise all the students for the hard work they put into their research and to everyone who submitted their work for review. We also want to thank the faculty and staff mentors who foster students' passions and talents, while working with them to develop into becoming published researchers.





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# AYURVEDA: AN ANCIENT SCIENCE FOR THE MODERN WORLD

Karina Syrova

*ABSTRACT: This editorial dives into the applications of Ayurveda to manage stress and anxiety, which include the benefits of oil massage, Shirodhara, yoga, and meditation. In the past few decades, pioneers of this system such as Harish Johari, Dr. Vasant Lad, David Frawley and also scientific research present that Ayurveda can be a complementary medicine to Western medicine. Ayurveda, known as the “Mother of All Healing” despite being an ancient healing art, has many uses today when searching for mental balance.*

## Introduction

Ayurveda is translated from Sanskrit as “the science of life and longevity”, a system originating from ancient Vedic scriptures dating back 5,000 years. Its purpose is to maintain quality and longevity of life through practical, daily habits (Lad, 2002). In today’s world where we encounter experiences that give us stress and anxiety, Ayurveda provides tools to manage our body and mind, such as massage, oil treatments like Shirodhara, yoga, and meditation. While Western medicine focuses on pathology, trauma, and emergency care. Eastern medicine deals with living from a philosophical and physical standpoint. This does not mean that Ayurveda replaces Western medicine. On the contrary, it can be complementary to allopathic medicine. Integration can be pursued in fields of allopathic medicine such as internal, family, and preventive medicine.

According to Ayurveda, every individual is a special phenomenon with their own chemical blueprint. This is known as the tridosha theory, which encompasses three bodily humors—vata, pitta, and kapha. The fundamental tridosha theory is how Ayurveda categorizes different types of energies in our body. Vata being energy of movement- like blood circulation, pitta the digestive system and homeostasis, and kapha our tissues, ligaments, the “glue” that holds us (Lad,

2016). Similar concepts are found in areas of medicine. For example, Hippocrates, the father of Western medicine separated the three bodily humors as blood, bile, and phlegm respectively (Shanbhag, 1994). These are basic attributes that are used in Ayurveda to understand one’s constitution and how to maintain balance.

Ayurvedic oil massage is a simple remedy for anxiety and stress that accumulate in our system (Johari, 1998). When in stress, the acidity in our body increases and exhausts us. As a result of constant stress and tension, this acidity is a precursor to premature aging. However, oil massages establish an alkaline blood chemistry and restores electrochemical balance within our bodies. Therapeutically, massages with oil are used for insomnia, headaches, arthritis, mental disorders, and many other conditions. A regular self-massage increases circulation of the blood, lymphatic fluids, and reduces physical and mental fatigue (Johari, 1996). Even a simple foot massage with oil before bedtime induces deep sleep and decreases fatigue (Johari, 1996). Therefore, daily massages also increase life span through relaxation of the body.

During Shirodhara a person has oil poured continually over the forehead while lying on their back. Sustained oil flow to the forehead is beneficial for general stress management, as it can promote sound-sleep, relieving stress and

anxiety (Frawley, 2012). Shirodhara is also said to be helpful for sinus headaches, migraines, neck pain, and balancing the cerebro-spinal fluid in the body (Lad, 2012). One study concluded that Shirodhara initiates a relaxation response and reduces anxiety, balancing respiration rate, systolic, and diastolic blood pressure. Patients who had multiple treatments of Shirodhara were observed to have reduced tensions and anxiety within one month (Kuriyama et al., 2008). This suggests that Shirodhara can be used as a solo or complementary therapy for stress management (Lad, 2012).

Traditionally, yoga was used by Hindu sages to release tension in the body before beginning meditation practice. Referencing “The Yoga Sutras of Patanjali” the second sutra states: “the restraint of the modifications of the mind is yoga”, meaning yoga practices are firstly for balance of the mind before perfecting and toning our physical body (Satchidananda, 1990). Now, yoga is a renowned practice globally. It is recognized as a complementary treatment for anxiety and other depressive symptoms by institutions such as the Canadian Network for Anxiety Treatments and Veterans Health Administration (Showroneck, 2014). Studies have shown that consistent yoga exercise reduces anxiety for people from flood survivors and patients with chronic illnesses to people working in finance (Showroneck, 2014). Even the Anxiety and Depression Association of America recommends yoga as a tool to manage anxiety and stress (ADAA, n.d.).

Meditation is the art of unifying our body, mind, and consciousness, a discipline of the mind to no effort and no concentration (Lad, 1998). Although one could imagine meditation as a monk sitting in the lotus pose with their eyes closed in the Himalayas, it is a practice that can be incorporated into any aspect of our lives. This could be in writing, painting, or Tai Chi (Johari, 1998). Meditation is a great anxiety and stress reliever, as studies have observed a reduced stress response, increased experience of

joy and gratitude, and a more positive outlook on life (Oman, 2008). From children in elementary school to students and the elderly, meditation contributes to a calmer mindset, minimizing depression and anxiety. On a cellular level, one technique such as prolonged practice of mindfulness meditation has been discovered to preserve nerve fibers between the brain and spinal cord which supports longevity (Laneri, 2016).

Ayurveda is a medicine that guides each individual through all stages of life. From our deepest questions of “who am I? What is my purpose?” to the most down-to-earth thoughts of “how do I heal my sore throat?” Ayurveda has answers that are realistic and meaningful (Lad, 1998). Living in a fast-paced world, Ayurveda teaches us to read the language of our body to maintain our health. The principles of massage, Shirodhara, yoga, and meditation can become valuable to improve our mental well-being and minimize stressors and anxiety. In quote from Harish Johari, “those who wish to live happy, healthy, and inspired lives can benefit from the wisdom Ayurveda holds” (Johari 1996).

## References

- Anxiety and Depression Association of America. (n.d.). *Tips to Manage Anxiety and Stress*. <https://adaa.org/tips-manage-anxiety-and-stress>.
- Dr. Frawley, David. (2001). *Ayurvedic Healing: A Comprehensive Guide*. Lotus Press.
- Dr. Vivek Shanbhag. (1994). *A beginner's Introduction to Ayurvedic Medicine*. Keats Publishing Inc.
- Johari, Harish. (1998). *Dhanwantari A Complete Guide to The Ayurvedic Life*. Healing Arts Press.
- Johari, Harish. (1996). “Ayurvedic Massage.” *Traditional Indian Techniques for Balancing Body and Mind*. Healing Arts Press.

- Kuriyama, Hiroko., Watanabe, Satoko., Nakaya, Takaaki., Shigemori, Ichiro., Kita, Masakazu., Yoshida, Noriko., Masaki, Daiki., Tadai, Toshiaki., Ozasa, Kotaro., Fukui, Kenji., Imanishi, Jiro. (2005). Using a Healing Robot for the Scientific Study of Shirodhara. *IEEE Engineering in Medicine and Biology Magazine*. 24(2), 69-78. 10.1109/MEMB.2005.1411351.
- Lad, Vasant. (2012). *Textbook of Ayurveda General Principles of Management and Treatment*. The Ayurvedic Press.
- Lad, Vasant. (2016). *Ayurveda A Brief Introduction and Guide*. The Ayurvedic Institute. [https://www.ayurveda.com/pdf/intro\\_ayurveda.pdf](https://www.ayurveda.com/pdf/intro_ayurveda.pdf).
- Laneri, D., Schuster, V., Dietsche, B., Jansen, A., Ott, U., & Sommer, J. (2016). "Effects of Long-Term Mindfulness Meditation on Brain's White Matter Microstructure and its Aging." *Frontiers in aging neuroscience*. (14)7, 254. 10.3389/fnagi.2015.00254.
- Oman D., Shapiro SL., Thoresen CE., Plante TG., Flinders T. (2008). "Meditation lowers stress and supports forgiveness among college students: a randomized controlled trial." *Journal of American College Health*. 56(5), 569-78. 10.3200/JACH.56.5.569-578.
- Showroeck, Belle., Mounsey, Anne., Handler, Lara. (2014). "Can Yoga Reduce Symptoms of Anxiety and Depression?" *Journal of Family Practice*. 63(7), 398-407.
- Sri Swami Satchidananda. (1990). *The Yoga Sutras of Patanjali*. Integral Yoga Publications.



# 30 PPT YIELDS HIGHEST RATE OF LIMB REGROWTH IN *LUIDIA CLATHRATA*

Jakob Johnson

**ABSTRACT:** *Sea stars have the ability to self-amputate limbs in the presence of danger (known as autotomy). How quickly those limbs can be regrown is vital to their survival, since having fewer limbs compromises sea stars' ability to hunt. Donachy (1987) illustrates that variations in salinity impact a sea star's ability to regrow shed limbs. Since 1950, average salinity fluctuations have increased by 5.3% on a global scale, becoming more extreme in both directions, probably due to climate change (Skirris et al. 2014). In light of this, the effects of salinity on limb regrowth is becoming a more and more urgent subject of research. For reference, salinity is a quantification of the percentage of salt (normally sodium chloride) present in water, measured in parts per thousand (ppt). This paper will research the question: What salinity yields the highest rate of limb regrowth in starfish (specifically Luidia clathrata). This comparative study looked at two research papers testing how variations in the surrounding salinity affect the amount (length, mass, dry weight) of limb regrown (Kaack and Pomory 2011; Honeycutt and Pomory 2019). The studies tested salinities of 20, 25, and 30 ppt; both studies found that 30 ppt yielded the most limb regrowth per unit time and, consequently, the highest rate of regrowth. Kaack and Pomory (2011) recorded 1.6 mm/week, and (Honeycutt and Pomory (2019). 2.0 mm/week for a 30 ppt treatment. The more oceanic salinity veers from the average of 35 ppt, the slower regrowth will occur; making hunting and healing slower and more difficult for these animals, compromising starfish survival.*

**Keywords:** *Salinity, limb regeneration, Luidia clathrata, comparative study, regrowth*

## Introduction

Being relatively slow-moving animals, starfish often will utilize autotomy when defending themselves from predators, so regeneration is crucial for recovery (Kaack and Pomory 2011; Wilkie 2001). If salinity levels fluctuate excessively from normal (35 ppt), that regenerative property can be slowed or entirely arrested. Regeneration is the vital second half to autotomy, and without the ability to regenerate shed limbs due to a hypo/hypersaline environment, sea stars could shed body parts until there is nothing left (Wilkie 2001). Starfish are vital to the oceanic ecology, being keystone predators. Their presence maintains crucial diversity among the seafloor residents, keeping one species from dominating the others (Checon et al. 2019).

As global warming statistics rise and surface ice continues to melt, oceanic salinity fluctuations are increasing (Liu et al. 2019; Skirris et al. 2014). Especially in areas where freshwater mixes with saltwater (such as coastal regions), salinity is deviating more from previously recorded averages (Liu et al. 2019). Starfish largely reside in these areas of costal mixing (Kaack and Pomory 2011). Like many other members of the echinoderm phylum, starfish can regenerate their limbs, but that process is influenced by environmental factors like salinity (Honeycutt and Pomory 2019). Understanding the relationship between limb regrowth and salinity can allow aquariums and other artificial environments to manipulate the surrounding salinity to promote natural recovery at its optimal rate for injured animals.



Scientists have typically used starfish as a research model for echinoderm regeneration and have looked in-depth at the specific mechanisms involved. Ferrario et al. (2017) studied the specific chemical processes of limb repair, looking step by step at how the wound closes and the new arm emerges. Cortes et al. (2014) examined gene expression and sediment preference in two species of *Luidia*, finding that *Luidia* tend to prefer soft, muddy soil to sand or loose stones. Lawrence and Pomory (2008) examined the rates of regrowth in *Luidia clathrata*, exploring the relationship between how much limb was cut off and how much limb was regrown over a standard period of time. They discovered that when more limb was cut off, the limb would grow back faster; so if only a tip of an arm was cut off, it would grow back slower than if an entire arm was removed. The University of West Florida has frequently investigated *Luidia clathrata*, examining the effects of salinity on arm length (Kaack and Pomory 2011) as well as the effects of salinity and food availability on arm regrowth (Honeycutt and Pomory 2019), finding in both studies that near 30 ppt is the best salinity to foster regeneration. Interestingly, in hyposaline environments, there is no significant difference between an excess or a dearth of food for starfish; the rate of regrowth is the same (Honeycutt and Pomory 2019).

All this aside, we still do not know how oceanic changes caused by climate change will affect limb regeneration. How will rising temperatures and/or ocean acidification impact limb regrowth? Considering everything, from reproductive success to hunting speed, and especially internal mechanisms (such as limb repair), there are plenty of unanswered questions which scientists are just beginning to explore.

My goal was to conduct a comparative study looking specifically at the role of salinity and its effect on arm regeneration. Already there is extant data studying the impact of various salinities on regrowth (Kaack and Pomory 2011; Honeycutt and Pomory 2019), and the relationship between salinity and arm regrowth. I took those data sets, looked for trends across the experiments, and

found the optimal salinity to foster limb regrowth. This will enable us to manipulate the environment of a starfish to maximize arm regrowth, but more importantly, create a model allowing us to predict and potentially counteract the effects of fluctuations in oceanic salinity.

## Methods

I retrieved two peer-reviewed articles on starfish using the Web of Science, and compared the two most relevant articles as my results. Using the phrase “‘starfish’ and ‘regeneration\*’ and ‘salinity,’” I searched all topics in the entire timeframe and through all indexes in the main search bar of Web of Science. From this, I garnered five results (see Table 1).

To evaluate, I first removed all duplicate papers published from the same study. (Two results offered by Web of Science [Honeycutt and Pomory Jun 2019; Honeycutt and Pomory Jan 2019] were conducted by the same scientists, had the same title, and were published within months of each other, so I eliminated the earlier published option). For this experiment, I limited the results to only those published after 2000, eliminating Donachy (1987) from consideration, being too out of date. Likewise, many of the results tested other factors as well as the effects of salinity on arm regrowth (such as Cortes et al. (2015)); for simplicity, I removed any articles dealing with three or more variables. By process of elimination, two articles remained that dealt predominantly with salinity-dependent regeneration, were published since 2000, and were not from the same study: Honeycutt and Pomory (2019) and Kaack and Pomory (2011).

Honeycutt and Pomory (2019) tested seven salinity treatments ranging from 15 ppt to 45 ppt in 5 ppt increments, and for each treatment, used four specimens of *Luidia clathrata*. Note: all animals from the 45 ppt treatment died immediately, so that data is not included in the results. Likewise, all the animals in the 15 ppt group did not regenerate any limb at all, although they remained alive, and that treatment's data is still included in the results. Kaack and Pomory (2011) tested three salinities ranging from 20 ppt to 30 ppt in 5 ppt increments,



**Table 1:** Results from Web of Science using Above Key Words

	<b>Abridged Title</b>	<b>Author(s)</b>	<b>Date Published</b>	<b>Starfish Species Tested</b>
<b>1</b>	Effects of salinity and feeding on arm regeneration in the starfish <i>Luidia clathrata</i>	Nicholas Honeycutt, Christopher Pomory	Jun 2019	<i>Luidia clathrata</i>
<b>2</b>	Effects of salinity and feeding on arm regeneration in the starfish <i>Luidia clathrata</i>	Nicholas Honeycutt, Christopher Pomory	Jan 2019	<i>Luidia clathrata</i>
<b>3</b>	Sediment preference, salinity tolerance and COX-1 genetic differences in two purported species of <i>Luidia</i>	M. Cortes et al.	May 2015	Two species tested
<b>4</b>	Salinity effects on arm regeneration in <i>Luidia clathrata</i>	Katrina Kaack, Christopher Pomory	2011	<i>Luidia clathrata</i>
<b>5</b>	Effect of Salinity Stress and Arm Regeneration On Na, others In <i>Asterias-Forbesi</i>	J. Donachy	1987	<i>Asterias forbesi</i>

and for each treatment, used eight specimens of *Luidia clathrata*. Since both experiments used the same genus of starfish and tested comparable salinities, the data were reasonably equivalent, and I utilized these sets for my results. However, Kaack and Pomory's (2011) experiment lasted 12 weeks, and Honeycutt's and Pomory's (2019) experiment was conducted over 10 weeks, so I created a second figure comparing the rates (mm of regrowth divided by the amount of time in weeks) of regrowth for each salinity treatment (Figure 2).

## Results

Out of all the salinities that Honeycutt and Pomory (2019) tested, they found the 30 ppt treatment to be the most successful, enabling the most arm regeneration over the ten-week period. Salinity <30 ppt experienced a sharp decline in the amount of limb regenerated, and, as stated, none of the animals from the 15 ppt treatment regenerated at all. As salinity was increased above 30 ppt, the amount of limb regrown was also less, but it

tapered off more gradually (see Figure 1). Kaack and Pomory’s (2011) data also demonstrates that 30 ppt is the most ideal salinity for limb regrowth, regenerating an average of nearly 25 mm of limb over the 12-week period (see Figure 1). For the other treatments (20 and 25 ppt), the length of limb regrown was again less, decreasing sharply near the 20 ppt point.

Statistical analyses were provided by the authors, demonstrating how consistent the data points were. Honeycutt and Pomory (2019) used a one-way ANOVA regression line for their statistical analysis, yielding an  $F_{2,18}$  value of 27.63 and a  $p$ -value of 0.000003. Kaack and Pomory (2011) also used a one-way ANOVA regression line for their analysis, yielding an  $F_{2,21}$  value of 1.12 and a  $p$ -value of 0.35.

Discussion

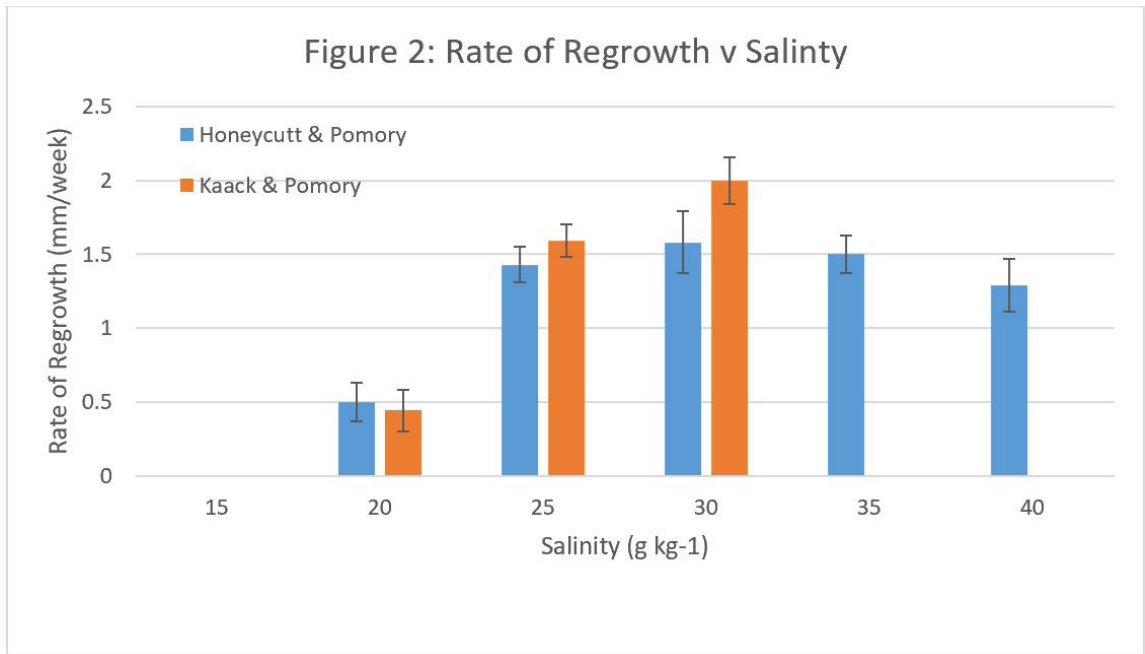
There were slight discrepancies in the two studies. Kaack and Pomory’s (2011) data, on average,

yielded higher rates of regrowth for all salinities tested. For example, for 30 ppt, Kaack and Pomory’s data showed a regrowth rate of 2 mm per week, as opposed to Honeycutt and Pomory’s which only yielded 1.58 mm/week. But Kaack and Pomory also tested their specimens over a longer period of time (12 weeks versus of Honeycutt and Pomory’s 10 weeks) which could account for an inflated rate. As noted by Honeycutt and Pomory (2019), 30 ppt is (curiously) lower than average oceanic salinity of 35 ppt and higher than the salinity of the bay during collection, 27 ppt. That is quite interesting, since it would be reasonable to suspect that sea stars would either prefer the salinity of their natural environment or the native salinity of the ocean, so there is potentially more to be tested as to why 30 ppt tests as the optimal salinity. Cortes et al. (2014) tested salinity preference using a righting test (how long it takes a starfish to flip itself after being turned upside down) and their findings concur that *Luidia clathrata* are most active in salinities near 30 ppt.

**Figure 1.** This figure depicts the length of each arm regrown (in mm) by the animal in each treatment, with an error bar showing the standard deviation. Note that Kaack and Pomory tested salinities over a period of 12 weeks, while Honeycutt and Pomory tested over a period of 10 weeks.



**Figure 2.** This figure shows the rate of regrowth (in mm per week) per each salinity treatment with an error bar of the standard deviation.



Although not the same as regeneration, this shows that *Luidia clathrata* are most active in similar salinities.

This study connects multiple years of research done at the University of South Florida (Kaack and Pomory 2011; Honeycutt and Pomory 2019), and compares it with other research done in linked fields (Cortes et al. 2014). Looking at all three of these studies, it appears that regeneration is not a separate function of starfish (i.e., not requiring a unique salinity to operate different from that required for regular functioning). However, this finding is not surprising. Other research has been done into the effects of salinity on starfish functioning; Allen et al. (2017) found that decreasing the salinity environment of the Crown-of-Thorns sea star delayed hatching times and reduced fertility in those specimens. Talbot and Lawrence (2002) found that lowering salinity slowed the respiration and regenerative ability in *Ophiophragnus filigraneus* (a fellow echinoderm). Therefore, it is

not surprising that decreasing salinity slows down limb regrowth in *Luidia clathrata* as well.

It must be noted that this experiment has a number of limitations. My conclusions are confined to *Luidia clathrata*, speaking only for that particular species of starfish, rather than the whole genus. And being a relatively obscure topic, there are almost no data sets relating salinity to arm regeneration in starfish. The ones I did manage to find (Kaack and Pomory 2011; Honeycutt and Pomory 2019) come from the same university, test the same species, and most importantly, their data ranges do not fully overlap. Kaack and Pomory (2011) only tested salinities from 20 to 30 ppt (in 5 ppt increments) and Honeycutt and Pomory (2019) tested a range from 15 to 45 ppt (in 5 ppt increments). Further, Kaack and Pomory (2011) tested regeneration over a 12-week interval, while Honeycutt and Pomory (2019) tested over ten weeks. Dividing the length of the arm by the timeframe can yield a comparable rate, but that is only under the assumption that

arms regrow in a linear fashion, which may not be the case, and could affect my analysis. There are plenty of further questions for study. Instead of just testing *Luidia clathrata*, the question could be posed, how does salinity affect regeneration across different species? Do different species of starfish have different relationships with salinity and regeneration? What regression model does regeneration follow? What are the rate-determining factors of regeneration? These questions are the next step in understanding the qualitative attributes of limb regrowth in echinoderms.

As global salinity fluctuations increase with climate change, these keystone predators will become slower and slower, and will not heal as quickly when wounded, impacting the marine ecosystem in ways we have yet to understand.

### Acknowledgements

I'd like to thank and acknowledge the contributions of Dr. Christopher Pomory, who has done the lion's share of research about limb regeneration and salinity in *Luidia clathrata*. Without his decades of research, this comparative study would not have been possible.

### References

- Allen JD, Schrage KR, Foo SA, Watson SA, Byrne M. (2017). The effects of Salinity and pH on fertilization, early development, and hatching in the Crown-of-Thorns Seastar. *Diversity Basel*. 9(1):13
- Checon HH et al. (2019). The importance of embayed coastal areas for the lifecycle of two sympatric starfish species (Echinodermata, Asteroidea). *Estuarine, Coastal and Shelf Science*. 219(1):128-138
- Cortes MP, Chung HM, Pomory CM. (2014). Sediment preference, salinity tolerance and COX-1 genetic differences in two purported species of *Luidia* (Echinodermata: Asteroidea). *Journal of the Marine Biological Association of the United Kingdom*. 95(3): 551–559.
- Donachy J. (1987). Effects of Salinity Stress and Arm Regeneration on Na, K-ATPase, Ca<sup>2+</sup>-ATPase and Alkaline-Phosphatase in the Starfish *Asterias forbesi*. *American Zoologist*. 27(4): A51-A51.
- Ferrario C, Khadra YB, Czarkwiani A, Zakrzewski A, Martinez P, Colombo G, Bonasoro F, Candia Carnevalia MD, Oliveri P, Sugni M. (2017). Fundamental aspects of arm repair phase in two echinoderm models. *Developmental Biology*. 433(2018):297-309.
- Honeycutt NR, Pomory CR. (2019). Effects of Salinity and Feeding on Arm Regeneration in the Starfish *Luidia clathrata* (Say, 1825) (Echinodermata: Asteroidea). *Marine and Freshwater Behaviour and Physiology*. 52(1):37-51.
- Kaack KE, Pomory CR. (2011). Salinity Effects on Arm Regeneration in *Luidia clathrata*. *Marine and Freshwater Behaviour and Physiology*. 44(6):359-374.
- Lawrence JM, Pomory CM. (2008). Position of arm loss and rate of arm regeneration by *Luidia clathrata* (Echinodermata: Asteroidea). *Cah. Biol. Mar*. 49(2008): 369-373.
- Liu C, Liang X, Ponte RM, Vinogradova N, Wang O. (2019). Vertical redistribution of salt and layered changes in global ocean salinity. 10:3445.
- Skliris N, Marsh R, Josey SA, Good SA, Liu C, Allan RP. (2014). Salinity changes in the World Ocean since 1950 in relation to changing surface freshwater fluxes. *Clim Dyn*. 43:709–736.
- Talbot TD, Lawrence JM. (2002). The effects of salinity on respiration, excretion, regeneration, and production in *Ophiophragnus filigraneus* (Echinodermata: ophiuroidea). *Journal of Experimental Marine Biology and Ecology*. 275(1):1-14.
- Wilkie IC. (2001). Autotomy as a Prelude to Regeneration in Echinoderms. *Microscopy Research And Technique*. 55:369–396.

# MEN AND MASCULINITIES: A CASE STUDY OF MASS SHOOTINGS IN THE UNITED STATES

Elisabeth Schnebele

*ABSTRACT: Research suggests there may be a link between mass shootings and the values imposed by hegemonic masculinity. The vast majority of the men who commit mass murder adhere to strict gender norms that prove to be unsustainable. Consequently, the men in this study resort to violence as a way to reassert their masculinity and prove their status. While hegemonic masculinity does not directly cause mass murder, studies have proposed it is present within the factors that exacerbate it. Primarily rape culture's willingness to dismiss violence against women. While many of the mass shooters in the US fit this pattern, this paper explores the cases of Seung Hui-Cho, Robert Dear and Elliot Rodger; focusing on how hegemonic masculinity can lead men to commit gratuitous acts of violence. Since mass shootings in the United States have become more common, it is important to explore what may be causing them so as a society, we can become more equipped to prevent them.*

***Warning: the following essay contains some explicit language and potentially sensitive and/or disturbing ideology. These elements are inherent to the original sources referenced, however, and are not reflective of the author's own words or views. The Editors have made the decision to not exclude these expletives in order to preserve the reality of such a difficult subject. Please know that the following material is not intended to be triggering or exclusive.***

## Introduction

As a society, we are currently at a loss in that no one can definitively say what is causing mass shootings. In fact, the only thing we know for certain is that this is a complex issue with no simple answer. However, this is also why it's so important to begin researching and thinking about the differing patterns that emerge from the data behind mass shootings. Primarily as understanding why they have become such an epidemic within society will help us become more equipped to prevent and minimize their occurrence in the future. Research suggests that there may be a connection between the values imposed by hegemonic masculinity and the mass shooters' constructed identities. In other words, many of the men that commit mass shootings adhere to strict gender norms and uphold the values imposed by hegemonic masculinity. The purpose of this paper, then, is to further examine

hegemonic masculinity within the case studies of Seung Hui Cho, Robert Dear and Elliot Rodger so that we can better understand not just how we move forward, but what we begin to do now.

In order to interpret the case studies, it is important to have a basic understanding of what hegemonic masculinity and rape culture consist of and represent. The first part of the paper will outline these concepts while the second part will work to frame them in relation to mass shootings by drawing on previous scholars' studies as well as an analysis of previous men who have perpetrated mass shootings. A pattern seemed to emerge between the stressors that trigger mass shootings and hegemonic masculinities characterized by power, authority, and physical strength. However, the most striking feature of this study, was that each of the mass shooters had a documented history of violence or violent ideation against women before



they committed their crime. Consequently, the studies suggest that patterns of domestic violence or hatred towards women may serve as indicators of larger, homicidal crimes in the future.

### **Hegemonic Masculinity and Rape Culture: Framing Mass Murder**

#### **Hegemonic Masculinity**

The concept of hegemonic masculinity was formulated two decades ago and has significantly influenced current academic thought surrounding men, gender and social hierarchy. When the term was created, it was understood as the pattern of practice that allowed men's dominance over women to continue. Furthermore, it represented the most honored way of being a man and required all other men to position themselves in relation to it (Connell and Messerschmidt 829).

There is considerable evidence to sustain a given pattern of hegemony requires the policing of men, as well as the exclusion or discrediting of women (Connell and Messerschmidt 844). Based on this, some scholars argue that there are two versions of hegemony, external and internal. Demetrious (2001) defines "external hegemony" as the institutionalization of men's dominance over women, whereas "internal hegemony" refers to the social ascendance of one group of men over all other men. This becomes problematic as hegemonic masculinity is a structure built upon the subordination of women. As a result, men who reject it remain at risk of losing power and status, placing them at the bottom of the social hierarchy with women. Jefferson (1994) argues that this can lead boys and men to instead choose discursive positions of masculinity to ward off anxiety and avoid feelings of powerlessness (in Connell and Messerschmidt 842). A good example is Lea and Auburns (2001) study of the story told by a convicted rapist in a sex offender program which illustrated how the offender moved between conflicting ideologies of sexual interaction to justify and reduce his responsibility for the rape (in Connell and Messerschmidt 842).

Moreover, research in criminology demonstrates how patriarchal patterns of aggression can be linked

with hegemonic masculinity, not as a mechanical effort for which hegemonic masculinity was a cause, but through the pursuit of hegemony. In fact, most data reflects that men and boys perpetrate more of the conventional and serious crimes than do women and girls (Connell and Messerschmidt 833). McMahon's (1993) analysis demonstrates how through the lens of hegemonic masculinity, men's behavior becomes refined in a concept of masculinity that then, in a circular argument becomes the explanation and the excuse for the behavior (Connell and Messerschmidt 840). In this way, it can be manifested as an institutionalized problem rather than an individual's fault.

A study done by scholars Denise Kennedy-Kollar and Christopher A.D. Charles illustrates how hegemonic masculinity influences mass murder. By gathering biographical information for 28 men who have committed mass murder in the US since 1970, the scholars found a pattern emerging between the perceived affronts that triggered the mass murders and a hegemonic construction of the perpetrators' masculine identities. One component of the hegemonic masculine identity was the ability to maintain gainful employment and economic independence, infringement upon which prompted a significant number of the men in these studies to go on a rampage. In fact, 71% of the men in Kennedy-Kollar and Charles' sample experienced financial stressors in the form of unemployment, debt, financial loss and poor job performance or a work-related reprimand (Issa 689). While financial strain is largely unavoidable for both men and women, it is important to acknowledge the relationship between income and masculinity to help frame these findings. Historically, men are expected to be the sole providers for their families. Considering that income largely dictates a person's status, men may feel pressured to reach a certain level of financial success in order to demonstrate their masculinity. Consequently, if they are unable to do so they may experience a heightened sense of shame. When taking these perspectives into consideration, it is easier to acknowledge how failing to reach a certain level of economic success could be especially challenging for men. In this light, mass shootings

could be “shows of status, a way to tell the world that they are still important, authoritative and accomplished” (Issa 689), especially if hegemonic masculinity is teaching men that violence is an effective way to affirm masculinity.

### **Rape Culture**

Hegemonic masculinity may also be linked to rape culture. In order to illustrate this, it's important to look at how sexuality impacts men at a young age. While the preferred signifiers of masculinity may vary by subgroup and context, many groups of men in our culture signal masculinity through demonstrations of heterosexuality. Not doing so puts boys and men at risk of being viewed as unmanly, feminine or homosexual (Sweeney 370). Pascoe (2007) used the term “compulsive heterosexuality” to refer to a range of pretentious displays of heterosexuality and male dominance that she observed in an ethnographic study of U.S. high school students (in Sweeney 370). She found that most of these “compulsive behaviors” represented boys’ attempts to starve off threats to their manhood, largely from other boys, and their attempts to dominate girls and control their bodies (Sweeney 371). Similarly, Richardson (2010) argues that dominant cultural discourse and male peer group networks compel young men to adopt restricted masculinities founded upon the sexual objectification of women, often in contradiction to their private feelings and preferences (in Sweeney 371). In this way, boys can be taught that sexual assault or rape is an appropriate display of manhood. Since society tends to uphold male dominance, even at the expense of a woman’s wellbeing, men may not see rape the same way women experience it.

For men in college, the social pressures are similar. Sociologist Michael Kimmel refers to this as “guy land” a period in which boys want to be men but only have each other to follow so they teach one another the “guy code.” This enforces a sense of entitlement amongst these men; that they deserve women, jobs to dominate and the campus space (Essig 2). These often become the men who create rape culture, even if they themselves don’t rape. They don’t stop it; don’t report it. While the

rapists ought to be held accountable for their actions, it’s also important to call out the institutions that are aware of the epidemic yet chose to turn a blind eye in fear of alienating donors, sports fans and frat alums. In doing so, they are allowing hegemonic masculinity to damage the cultures and ideals that most students of today and alumni of tomorrow cherish. For as a result, rape culture continues to spread at a national level.

Rather than looking at the larger factors that may be supporting rape culture, such as hegemonic masculinity, the focus often shifts towards women. Primarily, what women can do to avoid it; don’t drink, travel in groups, dress wisely. Not only does this teach men that rape is excusable but it also perpetuates rape culture by blaming women for men’s assaults. One common trait among rapists is that they do not think that they are the problem. They provide excuses such as acting under pressure to have sex, or giving into their naturally overwhelming desires, or being young and not knowing what they are doing or are confused because they think the woman made herself available (Sheffield 2017), all of which exhibit the fact that they are avoiding personal blame. Ultimately, this toxic version of manhood suggests sexual conquest is tied to masculinity, that male sexual desire is stronger than females, and obtaining it is more important than a woman’s well-being (Sheffield 2017). Posadas (2017) suggests that rape culture is the mechanism that channels hegemonic masculinity into specific, socially-legitimized practices of sexual violence. Therefore, if we want to eradicate sexual violence, we must transform the structures which subjectify boys into toxically masculine men.

Interestingly recent studies based on mass shootings in the US have found a link between mass shootings and domestic violence, indicating there may be a connection between rape culture and mass murder. Everytown for Gun Safety conducted a comprehensive analysis of FBI data and media reports of every mass shooting that took place between January 2009 and December 2016 in the United States. It revealed that in the nearly 8-year period there have been 156 mass shootings. In at least 85 of the cases (54%), the perpetrator’s victims

included a current or intimate female partner or other family member (Isa 678).

Everytown for Gun Safety's findings are further corroborated by a study performed by Mayors Against Illegal Guns. The study reviewed the mass shootings in the FBI's Supplementary Homicide Reports and scoured the media for additional details about those incidents. The result was a comprehensive analysis of every mass shooting that occurred in the US between January 2009 to January 2013. The report covered 43 mass shootings and in at least 17 of the cases the perpetrators killed a current or former intimate partner. Furthermore, at least 6 of those perpetrators had a prior domestic violence charge (Issa 679). The translation of these statistics implies that a majority of the men who commit mass murder also have a history of violence towards women.

This ties into the second component of the hegemonic masculine identity in that 61% of the men within the sample of mass shooters experienced social stressors such as bullying, social isolation and racial or ethnic harassment (Issa 689). Again, varying degrees of oppression exist within every subset of society meaning one cannot claim that any one of these factors could directly cause someone to commit mass murder. However, if studies continue to find patterns amongst mass shooters it remains imperative that they not only be examined but taken seriously. Perhaps if men are not able to gain respect from fellow men or gain a sense of authority amongst their peers, they will demand it from women.

### Methods

In order to examine the men within the case studies, I first reviewed secondary literature on hegemonic masculinity and rape culture. Next, I selected the men with whom to include within the case studies based upon the amount of reliable information made available to the general public. In order to analyze these men and substantiate my claims, I examined their manifestos (for the men who had written them) as well as watched the Youtube videos that detailed their manifestos. The case studies are largely framed in relation

to the scholarly articles that were previously reviewed. They are my own analysis shaped by the information I have gathered surrounding hegemonic masculinity and rape culture. Additional scholarly articles and the opinions of sociologists were also incorporated. However, the intent is to not bring up new information but rather to apply the theories to actual mass shootings.

### Case Evidence

In this section I present three of the mass murderers of the past two decades to illustrate the connection between hegemonic masculinity, rape culture and mass shootings. The cases are presented in chronological order.

#### *Seung-Hui Cho*

Seung-Hui Cho perpetrated the Virginia Tech shooting, killing 32 people and wounding 17 others with two semi-automatic pistols on April 16, 2007.

The language Cho used when writing his manifesto parallels the belief system that supports rape culture. Cho stated, "You [women] could be at home right now eating your fucking caviar and your fucking cognac, had you not ravenously raped my soul (page 2)." The first part of this sentence reflects the internalized values of hegemony. He is speaking to women with the presumption they have wealth. This implies that he views them as superior within the gendered hierarchy. Additionally, by choosing the word "rape" to describe the effect women had on his soul, Cho is emphasizing that he feels powerless. Generally rape is associated with female victims and those who experience it often carry a sense of shame. As a result, the implication is that Cho feels dominated by women and consequently, emasculated.

Moreover, Cho's language also displays how entitlement and revenge impact men. For instance he goes on to state, "For every action, there is an equal and opposite reaction. Can you [women] feel the pain that you fucked us in, you Descendants of Satan? Well, can you feel it?" (page 3). This statement connects to what scholars believe transforms the aggrieved into mass murderers, a sense of entitlement, a sense of using violence



against others, making others hurt as you might hurt. Aggrieved entitlement inspires revenge for those who have wronged you. It is the compensation for humiliation (Kalish and Kimmel 454). In this way, aggrieved entitlement is a gendered emotion, a fusion of that humiliation that stems from a perceived loss of manhood and the moral obligation and entitlement to get it back.

Furthermore, Cho's commentary regarding women reveals how he conflates women who are sexually liberated to be rapists. He remarks, "It's grand for you to fuck us 24/7 for fun, but we can't have a single minute of harmless playtime, only suffer. It's dandy for you to rape us, but we're not allowed to even speak, only be raped? Fuck you... You fucked us, now we fuck you, now we kill you." In this way, Cho is completely brainwashed by rape culture and is intimidated by women's sexuality. His language speaks to how oblivious he is to the gendered power imbalance within society as he views women as perpetrators and men such as himself, as victims. Research recognizes that many mass shooters suffer from deep seated frustration stemming from victimhood that results in a desire to gain power and control (Kimmel, 2013, 2014). Rather than extending empathy to women who have actually been raped, Cho labels women as rapists and men who aren't further pursued by women after sex as victims. By creating his own narrative and labeling himself as a victim, Cho likely felt entitled to violence.

### ***Robert Dear***

On November 27, 2015, a mass shooting occurred in a Planned Parenthood clinic in Colorado Springs, Colorado, resulting in the deaths of three people and injuries to nine. A police officer and two civilians were killed; five police officers and four civilians were injured.

In November 2015, Robert Dear arrived at a Planned Parenthood facility wearing a homemade ballistic vest crafted of silver coins and duct tape, carrying four Soviet-style SKS semi-automatic rifles where he shot from inside the clinic at propane tanks he planned to use as improvised bombs. Inside

of his car, he had an additional two handguns, a rifle and a shotgun (Fausset 2015). By the time he was finished, he had killed three people and wounded nine others. The victims included a police officer, an army veteran and a mother, all of whom left behind grieving families. However, what is most horrific is that this tragedy likely could have been prevented.

Dear had a detailed history of violence that clearly outlines a hatred towards women. Two decades before the attack in 1992, Dear was arrested for raping a woman at knifepoint. Just one year later in 1993, his second wife came forward with allegations stating that he once "threw her around the room by her hair" and "beat her head against the ground" (Issa 682). Then in 1997, the pattern repeated itself as police responded to a domestic violence call from Dear's third wife. She reported that Dear had taken her keys and locked her outside of the home. Once she gained entry back into the residence, he hit her and pushed her through a window (Issa 682). However, despite this he was a free man. He had the freedom to shoot upwards of nine people at a Planned Parenthood facility. Dear went unpunished for sexually and physically abusing multiple women, however it wasn't until he posed a threat to the larger, male based society that he was convicted of a crime.

### ***Elliot Rodger***

On the evening of May 23, 2014, in Isla Vista, California, 22-year-old Elliot Rodger killed six people and injured fourteen others near the campus of University of California, Santa Barbara, before killing himself inside his vehicle.

Elliot Rodger's manifesto illustrates that he experienced lifelong resentment towards women. He writes, "My six year old self was playing with girls, unbeknownst to the horror and misery the female gender would inflict upon me later in life. In the present day, these girls would treat me like the scum of the earth; but at the time, we were all equals. Such bitter irony" (7). This connects back to external hegemony which states that men should be superior to women. In adulthood, Rodger feels like he is beneath women because he is a virgin at 22.

Desperate to restore the hierarchy, he constructed a plan to punish and kill women for the “crime” of depriving him of the love and sex he “deserves.” The following is what I consider to be the thesis of his plan:

As the phrase that I coined goes: If I cannot join them I will rise above them; if I cannot rise above them I will destroy them. I have been trying to join and be accepted among the beautiful, popular people all of my life, but it was to no avail. They have always treated me like scum. Girls have always deemed me unworthy of their love and sex... At this point, the thought of overthrowing them seemed hopeless. The final solution to triumph over my enemies was to destroy them, to carry out my Day of Retribution, to exact my ultimate and devastating vengeance on all of the popular people who never accepted me, and against all women for rejecting me and starving me of love and sex (112).

This provides a disturbingly clear demonstration of rape culture as Rodger plots to kill women for not having sex with him. Prior to this, in the Spring of 2013 Rodger came across an INCEL [Involuntary Celibate] site on the dark web. He stated that “it was a forum full of men who were starved of sex, just like me... Many of them share my hatred of women.. Reading the posts on the website only confirmed many of the theories I had about how wicked and degenerate women really are... it shows how bleak and cruel the world is due to the evilness of women” (117). This ties into what was discussed earlier, the toxic version of manhood that suggests that having sex elevates masculinity, that male sexual desire is stronger than females, and obtaining sex is more important than a woman’s wellbeing. Since Rodger is a virgin he feels like less of a man and believes the only way to compensate for that is to kill women.

Rape culture is further displayed when he claims, “Women should not have the right to choose who to mate and breed with. That decision should be made for them by rational men of intelligence... Women have more power in human society than they deserve, all because of sex. There is no creature more evil and depraved than the human female. Women are like a plague. They don’t deserve any

rights. Their wickedness must be contained in order to prevent future generations from falling to degeneracy. Women are vicious, evil, barbaric animals, and they need to be treated as such” (117). Clearly, Rodger has manifested an extreme hatred towards women. Inside he feels so inadequate that he is desperate to make himself and others see that he can be powerful. Through punishing women, making them less than human, stripping them of their rights and exposing their “evilness,” he is trying to make the world believe that it’s not his fault that he is a virgin, that there is instead something wrong with women. If he could convince himself and others of this, he wouldn’t be inferior rather he would be the enlightened, superior man. This illustrates his internal battle against conforming to rape culture and hegemonic masculinity. He hates women because they wouldn’t have sex with him and at the same time, he feels like there is nothing he can do to change that. What he thinks he can change, is how that is perceived. He believes killing women and writing this manifesto is the only way he can become an “alpha male” without having sex.

Rodger concludes his 141-page manifesto by proposing a new government to completely abolish sex and women. He recommends that women be quarantined in concentration camps where they would be starved to death. While he would oversee this, he would imagine thinking to himself, “If I can’t have them, no one will” (137).

### Conclusion

Despite having histories of violence against women, many men are still able to acquire weapons and maintain their freedom to function within society. This gap within the system seems to dismiss women’s safety and right to justice while also leaving the larger population susceptible to violence. My hope for this paper is that it advances the conversation surrounding masculinity and male violence. When such a pattern emerges from decades of data, it is time to reflect on what may be causing this so we can learn from our mistakes and take appropriate and useful measures to intervene.

Moving forward, it is important to additionally look at the roles race, religion, mental health and

gun laws have in perpetuating mass shootings. However, no matter what personal beliefs or opinions an individual occupies, the hope is that this paper, at the very least, could help expand one's thinking and simply encourage alternative explanations to this epidemic. Ultimately, the goal is for new and diverse perspectives to continue to grow until we can fully understand what is causing mass shootings and how we can stop them, ensuring the safety of all those who live in our country and occupy the public space.

### References

- Canetto, Silvia Sara. "Meanings of Gender and Suicidal Behavior during Adolescence." Wiley Online Library, John Wiley & Sons, Ltd (10.1111), 30 Dec. 2010.
- Cho, Seung Hui. "Seung Hui Cho's 'Manifesto.'" School Shooters. Info, Peter Langman, 29 July 2014, [www.schoolshooters.info/sites/default/files/cho\\_manifesto\\_1.1.pdf](http://www.schoolshooters.info/sites/default/files/cho_manifesto_1.1.pdf).
- Connell, R.W., and James W Messerschmidt. "Hegemonic Masculinity: Rethinking the Concept." *Gender and Society*, vol. 19, no. 6, 2005, pp. 829–859.
- Demetriou, Demetrakis Z. "Connell's Concept of Hegemonic Masculinity: A Critique." *Theory and Society*, vol. 30, no. 3, 2013, pp. 337–361.
- "Suicide Rising across the US." Centers for Disease Control and Prevention, Centers for Disease Control and Prevention, 7 June 2018, [www.cdc.gov/vitalsigns/suicide/index.html](http://www.cdc.gov/vitalsigns/suicide/index.html).
- Essig, Laurie. "Hate Crimes Won't End Until Toxic 'Bro' Culture Is Reformed." *The Chronicle of Higher Education*, 2018, pp. The Chronicle of Higher Education, Apr 8, 2018.
- Fausset, Richard. "For Robert Dear, Religion and Rage Before Planned Parenthood Attack." *The New York Times*, The New York Times, 1 Dec. 2015.
- Farr, Kathryn. "Adolescent Rampage School Shootings: Responses to Failing Masculinity Performances by Already-Troubled Boys." *Gender Issues*, vol. 35, no. 2, 1 June 2018, pp. 1–25.
- Girard, Chris. "Age, Gender, and Suicide: A Cross-National Analysis." *American Sociological Review*, vol. 58, no. 4, 1993, pp. 553–574.
- Grimes, David A, et al. "Unsafe Abortion: the Preventable Pandemic." *Sexual and Reproductive Health*, vol. 368, no. 4, 25 Nov. 2006, pp. 1908–1919.
- "Guns and Violence Against Women: America's Uniquely Lethal Intimate Partner Violence Problem." *Everytown For Gun Safety*, 17 Oct. 2019.
- "Gun Violence Archive." *Gun Violence Archive*, 2019.
- Humphreys, Adrian. "Toronto Danforth Mass Shooter's Long Dark Obsession with Death, Violence and 'Incel' Ideology." *National Post*, 21 June 2019.
- Issa, Yasmine. "'A Profoundly Masculine Act': Mass Shootings, Violence Against Women, and the Amendment That Could Forge a Path Forward." *California Law Review*, vol. 107, no. 2, 2019, pp. 673–705.
- Jefferson, Tony. "Theorizing Masculine Subjectivity." *Just Boys Doing Business? Men, Masculinities and Crime*, London: Routledge, 1994, pp. 1–22.
- Jeltsen, Melanie. "We're Missing The Big Picture on Mass Shootings," *HUFFINGTON POST* Sept. 15, 2015.
- Kalish, Rachel, and Michael Kimmel. "Suicide by Mass Murder: Masculinity, Aggrieved Entitlement, and Rampage School Shootings." *Health Sociology Review*, vol. 19, no. 4, 2010, pp. 451–464.
- Kaplan, Sarah. "'I'm a Warrior for the Babies' Planned Parenthood Suspect Declares in Court." *The Washington Post*, WP Company, 3 May 2019.
- Kennedy-Kollar, Deniese, and Christopher A.D. Charles. "Hegemonic Masculinity and Mass Murderers in the United States." *The Southwest Journal of Criminal Justice*, vol. 8, no.2, Jan. 2012, pp. 62–71.
- Kiesel, Laura, et al. "Don't Blame Mental Illness for Mass Shootings; Blame Men." *POLITICO Magazine*, 17 Jan. 2018.
- Kimmel, Michael. *Guyland: The Perilous World Where Boys Become Men*. Harper, 2008.
- Kirkey, Sharon. "Toronto Mass Shooter Faisal Hussain Suffered from Psychosis. Could More Have Been Done to Stop Him?" *National Post*, 25 July 2018.

- Lea, Susan, and Timothy Auburn. "The Social Construction of Rape in the Talk of a Convicted Rapist." *Feminism & Psychology*, vol. 11, no. 1, Feb. 2001, pp. 11–33.
- Lipo, Sarah. "LIPO: Ending the cycle of toxic masculinity crucial to decreasing gun violence." UWIRE Text, 9 Apr. 2019, p. 1.
- Marganski, Alison J. "Making a Murderer: The Importance of Gender and Violence against Women in Mass Murder Events." *Sociology Compass*, vol. 13, no. 9, 2019, p. n/a.
- Mass Shootings since January 20, 2009, Mayors Against Illegal Guns 1, 2013.
- McMahon, Anthony. "Male Readings of Feminist Theory: The Psychologization of Sexual Politics in the Masculinity Literature." *Theory and Society*, vol. 22, ser. 5, 1993, pp. 675–695. 5.
- Sheffield, Emily. "Before We Can Understand Why Some Men Rape, We Need to Tackle Toxic Masculinity." *The London Evening Standard* (London, England), 2017, p. 15.
- Oyewumi Oyèrónké. "Colonizing Bodies and Minds: Gender and Colonialism." *Postcolonialisms: an Anthology of Cultural Theory and Criticism*, by Gaurav Gajanan. Desai and Supriya Nair, Rutgers Univ. Press, 2005, pp. 339–362.
- Pascoe, C. J. *Dude, You're a Fag: Masculinity and Sexuality in High School: with a New Preface*. University of California Press, 2012.
- Pleck, Joseph H, and William Pollack. "The Gender Role Strain Paradigm: An Update." *A New Psychology*, edited by Ronald Levant, New York: Basic Books, 1995, pp. 12–28.
- Posadas, Jeremy. "Teaching the Cause of Rape Culture: Toxic Masculinity." *Journal of Feminist Studies in Religion*, vol. 33, no. 1, 2017, pp. 177–179.
- Prentzel, Olivia. "Planned Parenthood Shooter Again Deemed Mentally Unfit to Stand Trial." *Colorado Springs Gazette*, 5 Nov. 2019.
- Richardson, Diane. "Youth Masculinities: Compelling Male Heterosexuality." *The British Journal of Sociology*, vol. 61, no. 4, 2010, pp. 737–756.
- Rodger, Elliot. "My Twisted World: The Story of Elliot Rodger ." pp. 1–14, doi:DocumentCloud.
- Royster, Hayden. "Recent Mass Shootings: Is Religion the Problem?" *LightWorkers*, 8 Aug. 2019.
- Sweeney, Brian N. "Masculine Status, Sexual Performance, and the Sexual Stigmatization of Women." *Symbolic Interaction*, vol. 37, no. 3, 2014, pp. 369–390.
- Walters, Barbara, and Peter Rodger. "The Secret Life of Elliot Rodger ." 20/20, ABC, 27 June 2014.

# SUSTAINABLE VINICULTURE: GIVING SALMON A CHANCE TO THRIVE FOR FUTURE GENERATIONS

April Oertle

*ABSTRACT: Seldom are vineyards considered significant polluters to the environment or inhibitors to life. However, conventionally farmed vineyards actually use excessive amounts of water and chemicals, coupled with extravagant bottling and labeling processes. The practice of vineyard farming is responsible for harmful environmental practices, unbeknownst to the public. Their negative environmental impacts include chemical runoff and soil erosion, which kill vulnerable salmon eggs incubating in satellite streams and rivers. Salmon populations in the Salish Sea have declined dramatically since first recorded in 1984. To improve the situation, multiple international universities have identified viable agricultural techniques for creating sustainable vineyards that tread lightly on the surrounding environment and can preserve water, lessen the need for chemical pesticides, and prevent soil erosion. An additional benefit is vintners do not have to spend money on these items, thereby increasing profit margins. From an ethical standpoint, vineyards should adopt these agricultural methods particularly since recent surveys revealed consumers are willing to pay more money to buy sustainably produced wines. Thus, how might vineyards implement certain sustainable agricultural practices to protect and mitigate damage to wild salmon populations?*

## Introduction

Walking through an American grocery store, one is likely to stumble through a section of shelves lined with exquisite bottles of wine with artistically designed labels. Most are bottled in heavy, unrecycled, virgin glass. A huge market for wine in America exists; however, there is a profound lack of information among consumers regarding the environmental impact of vineyards. This research essay will introduce the importance and value of salmon, which populations are staggering due to current viniculture practices. It will then discuss the differences between sustainable and conventional vineyards, before analyzing authentic and financial viability of producing sustainable wines and lastly, identifying the connection between salmon populations and soil erosion caused by vineyards. Thus, the essay will be organized in a methodological fashion: examined through the scientific and biological

disciplines. Due to the practicality of producing sustainable wine, all vineyards should practice sustainable agricultural methods. Specifically, vineyards should prevent soil erosion to protect fragile wild salmon populations.

## Discussion: Salmon as a Valuable Resource

The value of wild salmon cannot be quantified. To the Pacific Northwest Tribes, salmon is an essential part of their rich cultural identity and provides a spiritual livelihood. “Without salmon returning to our rivers and streams, we would cease to be Indian people” (“Tribal Salmon Culture”). This powerful statement shows how salmon is the ancient lifeblood for indigenous peoples of the Northwest. In 1915, Chief Yakima stated, “my strength is from the fish; my blood is from the fish, from the roots and berries” (“Tribal Salmon Culture”). Not only is salmon important to tribal peoples, and has been for generations, but its fisheries contribute more than \$175 million to Washington’s economy



every year (“Harvest”). Thus, a healthy salmon supports multiple peoples in attaining their livelihoods.

Additionally, modern recreational salmon fishing provides the government and private sector with income. The recreational value of a single salmon has been calculated to exceed \$200 when one takes into account of fishing licenses and ancillary items such as equipment, local lodging, and guides., etc. (Whitelaw 1). Unfortunately, salmon populations have been rapidly declining, and the ongoing loss of wild oceanic salmon represents an economic and environmental tragedy. In the Salish Sea, slightly less than 500,000 Chinook salmon were reported in 2010, which is a 60% reduction in the population since salmon population tracking began in 1984 (“Chinook Salmon”). This recent and drastic reduction is an outright environmental emergency which needs immediate remedial action to contain the salmon population losses. While there are multiple threats to current populations of wild salmon, those posed by neighboring conventional vineyards can be resolved quickly and inexpensively.

### **Discussion: Threats Posed to Salmon Populations by Current Vinicultural Practices Include Runoff**

Agricultural runoff, in the form of pesticides, fertilizers, and animal waste are major threats to vulnerable salmon populations. However, farms do not necessarily need to use chemicals in order to keep their crops safe and plentiful. Farmers are beginning to move away from harmful pesticides in favor of more natural means of eliminating destructive insects, such as planting catnip between rows of crops (Schneider 1). By utilizing catnip or other natural insect repellents, harmful pesticides and herbicides will not leech into the streams or riverbeds where the nurseries for salmon eggs are located. All types of farmers are rethinking the use of pesticides due to health risks, environmental damage, and huge surpluses which drop the value of their commodities making their financial

situation inviable and unprofitable (Schneider 1). Pesticidal use by large-scale commercial farming operations can also cost billions of dollars each year (Schneider 1). Refraining from the use of pesticides is no longer just limited to small farms or personal vegetable growing. In 1987, out of the United States’ 2.1 million farmers, up to 100,000 of them had changed their farming methods to exclude use of pesticides (Schneider 1). Not using pesticides is becoming mainstream in America. Therefore, vintners near salmon sensitive areas can easily switch their agricultural practices to exclude the use of pesticides which is better for the environment and their pockets. From an ethical standpoint, all vineyards should reduce or not even use pesticides/herbicides in their growing practices in an effort to preserve the health of the environment and safeguard salmon from the dangers of chemical residue.

### **Discussion: Soil Erosion**

Another danger to salmon eggs is soil erosion brought on by conventional agricultural practices. Soil erosion occurs when the top layers of agricultural soil shift and displace due to the movement of water. Soil erosion is a threat to vulnerable salmon eggs which nestle in the false safety of riverbeds. Eggs cannot survive if they are crushed and soil erosion crushes eggs nestled in sandy river bottoms, leaving streams without fish.

A stark example is found in Idaho where Chinook salmon spawning areas were severely damaged from soil erosion attributed to the logging industry (Platts 230). Agricultural soil is generally comprised of a mixture of fine and coarse sands. Sudden increases in sediment loads into river systems can induce intolerable changes by the sizes of particles settling into the salmonid spawning areas (Platts 235). Reducing soil erosion will save salmon populations because eggs will have ample time to incubate. To aid the protection of salmon populations, eggs must be viable in order to complete the reproductive cycle.

### **Discussion: Alleviating Threats to Salmon Populations by Use Of Mulch to Protect Soils' Water Retention Abilities**

While vineyards cause high rates of soil erosion, the effects can be significantly mitigated by simple changes in the fields. A feasible and inexpensive solution was proposed by Dr. Massimo Prosdocimi, who has a Ph.D. in viniculture and is a university professor in Italy. He discovered a sustainable way to decrease agricultural runoff and soil erosion simultaneously, which poses the largest threat to salmon populations. Due to the dry and hot climate grapes must be cultivated in, water cannot penetrate the surface of the baked soil, thereby predisposing conventional vineyards to the highest rates of soil loss among all cultivated agricultural sites (Prosdocimi 323). Dr. Prosdocimi proved barley straw mulch reduced rates of soil erosion and, hence, soil runoff from vineyards into nearby salmon habitats. Dr. Prosdocimi's experiment entailed placing barley straw mulch over the vineyard plots for protection from the sun and to retain water in the earth. In the barley straw mulch experiments "the median water loss decreased to 39.27% of the total rainfall" and the "median total sediment detached from 70.34 to 15.62g" (Prosdocimi 324). Additionally, straw mulch is inexpensive and abundant, making it easily obtainable to vintners. The straw mulch will reduce the amount of water needed for their vines and the amount of water lost to evaporation. The straw mulch will lessen the need to plow and till fields because the soil will be displaced much less, saving farmers great amounts of time and money. All these factors will decrease the cost of operating the vineyard, hence allow for positive impacts on profits.

### **Discussion: Water Conservation**

In the summer months, the expense of water increases dramatically with its scarcity. Additionally, moisture does not easily penetrate sunbaked soil, demanding a larger volume of water during these hot days when water is at

its highest price. Thus, reducing the need for this limited resource will decrease operating expenses of the vintner while preserving a precious resource. Concerns of vineyard water consumption preventing successful salmon runs can be partially alleviated (Grismer 144). For example, a parched land, such as California, cannot sustain riverbeds for salmon to return to spawn and irrigate vineyards simultaneously. Unfortunately, in California the indigenous oak woodlands and savannas have increasingly been converted into vast vineyards (Grismer 144). The production of wine grapes provides a huge source of revenue for the California economy, making vineyards more financially viable than natural landscapes (Grismer 144). California notoriously suffers from parched land and vineyards fail to alleviate this condition. Paralleling this conversion of land, there are increases in rates of annual runoff by at least 50% (Grismer 144). Moisture does not soak into the soil and there is a significantly large increase in water runoff, conversely increasing rates of decline in native salmon populations. By using Dr. Prosdocimi's method of applying barley straw mulch, the rates of water runoff and soil erosion decrease. Salmon populations could thrive if every vineyard near waterways incorporated straw mulch, a sustainable method in their viniculture practices.

### **Discussion: Characteristics of Conventional and Sustainable Vineyards**

There is a significant difference between conventional and sustainable vineyards, which are outlined in a research paper entitled "Ecological Footprint analysis applied to the production of two Italian wines" by Dr. Valentina Niccolucci, PhD. Niccolucci analyzed the difference of two vineyards, one conventional and one sustainable, located in the same region and growing the same grapes. While the wines both vineyards produced cost the same on the shelf, their production philosophies and methods were entirely different. These studied differences can be applied to all vineyards

similarly operated.

### **Discussion: Management Styles of Vineyards**

The sustainable vineyard is denoted as being primarily run by the efforts of occasional workers, overseen by the management of a singular family; most of the work would be performed by hand stemming from local tradition (Niccolucci 163). The sustainable vineyard is starkly different than the conventional one which was portrayed in an iniquitous manner. The operation being mostly industrial and utilizing chemical fertilization and pesticides (Niccolucci 163). While the sustainable vineyard sells the wines locally, the conventional vineyard bottles their wines and ships them globally for a larger consumer market (Niccolucci 163). A bottle of wine from the conventional vineyard has an increased carbon footprint due to its long journey to its final marketplace before consumer consumption; wines from conventional vineyards are exported all over the world via plane, cargo ship, and truck. Whereas the sustainable bottle of wine is enjoyed locally with a minimal carbon footprint.

### **Discussion: Selective Harvesting Techniques**

As with management and product transportation, sustainable vineyards also require smaller acreage than conventionally managed farms. Interestingly, conventional vineyards require 50% more land than sustainable vineyards (Niccolucci 164). This is due in part, to the conventional vineyard's assiduous and methodological selection of grapes to produce the finest wines (Niccolucci). Whereas, sustainable vineyards were not as selective in their grape harvesting, picking grapes as they become available within certain parameters (Niccolucci 165). Thus, sustainable vineyards require smaller vineyards than conventional to produce sufficient grapes for harvest. Sustainable vineyards conclusively waste fewer grapes than conventional vineyards.

### **Discussion: Use of Recyclable Materials**

Another major difference between the two types of vineyards is observed during the packing phase when the wines are bottled and labeled. The conventional vineyard consistently uses only the foremost products available in all phases of wine production. Even the glossy bottles themselves are of heavy, nonrecycled glass (Niccolucci 165). Instead of virgin weighted bottles, the sustainable vineyard management purposely uses lighter bottles that featured recycled glass to decrease waste (Niccolucci 165). Thus, even the manufactured components of the winemaking process have different environmental impacts. The sustainable vineyard generates significantly less waste than the conventional vineyard and even reuses recycled materials, which environmentally conscious consumers appreciate.

### **Education of the Consumer**

Expanding consumers' recognition of agriculture's environmental responsibility spurred the practice of sustainable agriculture. However, even with increased awareness of the importance of sustainable agriculture in the face of climate change, there is a large knowledge gap existing between wine production and the consumer. With the overwhelming supply of bottles in grocery stores, it is time-consuming for the consumer to navigate the quantity of products to select one aligning with their values. Gary Zucca, a viniculture expert and famed winemaker performed a survey of over 300 participants who identified as wine consumers. In Dr. Zucca's research, approximately 95% of consumers were unable to identify a single vineyard that practiced sustainable viniculture (Zucca 193). However, nearly 90% of participants in his study believed in sustainable viniculture and indicated they would purchase wine from these farms (Zucca 193). Interestingly, of these participants only 7% were able to discuss examples of sustainable agriculture practices (Zucca 193). Helping consumers identify sustainable agricultural



products, such as through a certification process which could include a final stamp of approval on labels, will create demand for sustainable wine.

### **Salmon Safe Certification**

Recognizing the need to assist in consumer education and recognition of sustainable wines, Washington, Oregon, and British Columbia have created a private “Salmon-Safe Certification”, which has certified over 350 vineyards. This certificate is proudly included on the labeling of salmon-safe wines. This program makes sure not only the vineyard is salmon-safe but also ensures the nearby water quality of the river systems and habitat are able to support and increase biodiversity around vineyards (“Salmon Safe Vineyard Certification”). The certification requires vineyards to plant trees on nearby streams to prevent soil erosion and create shade, as well as to grow cover crops, such as catnip, to control water runoff and use only sustainable methods to control pests and weeds (“Salmon Safe Vineyard Certification”). The wines sold with this label are sought out by consumers, who care about their environment and want to make ethical choices when buying wines. The wine-producing industry is taking notice of this newfound consumer demand. Due to demand, wellbeing of the environment and sacred importance of healthy salmon populations, “Salmon Safe Vineyard Certification” should be legally required of all vineyards in the proximity of salmon habitats.

### **Conclusion**

For vineyards to truly match the public’s perception of long rows of lovely greens flourishing in the sun, the winemaking industry must sacrifice its conventional methods of growing grapes and bottling its products. Conventional methods of growing grapes lead to excessive consumption of water, chemicals leeching into the water supply, and soil erosion. Soil erosion is a major factor in the decreasing population of salmon, as soil particles suffocate

and crush the incubating eggs. Sustainable farming methods utilize innocuous materials, like straw mulch and cover crops, to preserve moisture levels in the soil, thus maintaining water in the root zones and preventing erosion. All of these practices eliminate or reduce the negative impact to salmonid spawning sites. Consumers have proven they are willing to be part of the solution and pay a premium for sustainably produced wines. Universities have identified practices encouraging benevolent wine production and consumers are demonstrating environmental ethics when seeking out these wines. Now that vintners have the knowledge to produce sustainable wines without increasing production costs, it remains to be seen whether they will take the ethical steps to veer towards sustainable agricultural techniques, as discussed herein, to become important contributors in remedying the wrongs wrought on our environment, including salmon populations.

### **Literature Review**

Grismer, Mark and Caitlin Asato. “Converting oak woodland or savanna to vineyards may stress groundwater supply in summer.” *California Agriculture*, vol. 66, no. 4, 2012.

In this research article, Grismer developed a model for ground water retention in the soil and applied it specifically to Sonoma County vineyards formerly covered with native oak trees. Grismer argues California’s groundwater supply in the summer will be under more pressure than ever due to the increasing number of vineyards in the Central Valley and the corresponding deforestation of oak woodlands. Without the shade or complex root structures of oak trees, the vineyards are exposed to constant sun, which further dehydrates the land. Grismer explains the hydrologic cycle in oak woodlands as well as irrigated vineyards. Grismer utilizes graphs and mathematical calculations to explain water balance in soil.

Niccolucci, Valentina, Alessandro Galli, Justin Kitzes, Riccardo Pulselli, Stefano Borsa,

and Nadia Marchettini. "Ecological footprint analysis applied to the production of two Italian wines." *Agriculture, Ecosystems and Environment*, vol. 128, no. 3, 2008.

Niccolucci's paper compares the Ecological Footprint between two vastly different approaches to Italian wine making: sustainable or organic methods and the conventional. The sustainable method utilized small acreages run by family, most work done by hand and bottling in recycled lightweight glass.

Platts, William and Walter Megahan. "Time Trends in Riverbed Sediment Composition in Salmon and Steelhead Spawning Areas: South Fork Salmon River, Idaho." *Wildlife Management Institute*, 1975.

This research article discusses the negative impact on salmon spawning sites resulting from soil erosion and particle loads in rivers triggered by logging and road construction. Specifically, the study is directed at the South Fork Salmon River in Idaho, with a resident Chinook salmon population, though has applicable principles to any rivers adjacent to disturbed areas. Where soil is disturbed by logging or road construction, the large amount of fine soil particles rapidly washed into the watershed created intolerable changes to salmonid spawning areas. This article relies on data collected utilizing permanent reference points at selected spawning areas, cross-sections perpendicular to the center line of the stream at 50-foot intervals, over a 9-year time span.

Prosdocimi, Massimo, Antonio Jordan, Paolo Tarolli, and Saskia Keesstra. "The immediate effectiveness of barley straw mulch in reducing soil erodibility and surface runoff generation in Mediterranean vineyards." *Science of the Total Environment*, vol 547, 2016.

In this 2016 article, Prosdocimi analyzes a common problem in agriculture of soil erosion and water loss. His article goes a step farther and concentrates specifically on the context of vineyard management. Prosdocimi conducted

actual field studies in the arid climate of Eastern Spain. Through a series of specific calculations, he found immediate calculable benefits in the prevention of water loss and soil erosion by utilizing a covering of barley straw mulch over the bare ground. To arrive at this conclusion, Prosdocimi utilized an experiment simulating typical rainfall over 40 plots of vineyards, 20 bare ground and 20 covered with mulch. Prosdocimi also detailed his findings graphically, illustrating the dramatic decrease in the runoff of detached soil particles.

Schneider, Keith. "Farming Without Chemicals: Age-Old Technologies Becoming State of Art." *The New York Times*, the New York Times, 23 Aug. 1987.

This article discusses farming without chemicals and how over 2 million U.S. farmers are reducing or eliminating chemical use (either fertilizers or pesticides) and moving back to a more natural method of raising crops. Such "sustainable" methods of agriculture include the use of natural insect repellents such as planting catnip between vegetable rows, eggplants in potato fields, or marigolds in pepper crops. This article relies on farmer interviews, U.S. Department of Agriculture statistics, University of Minnesota studies, and agricultural publications.

Whitelaw, Ed, Ernie Niemi and David Lindahl. "Salmon and the Economy." *Salmon Economics Handbook*, 1999.

This handbook was written to summarize the ways rebuilding healthy salmon populations impacts the economies of Washington and Oregon. It discusses the potential economic benefit in salmon conservation, noting the recreational, employment, and business opportunities resulting in such efforts. The existing problems salmon face are discussed, including the impact of sediment originating from agricultural lands and running into streams, as well as the impact of diverting water from streams for irrigation. The handbook

Table 1. Literature Review Matrix.

Author and Title of Works	Publication Year and Database	Purpose
Grismer, Mark and Caitlin Asato. "Converting oak woodland or savanna to vineyards may stress groundwater supply in summer." <i>California Agriculture</i> , vol. 66, no. 4, 2012, pp 144- 152.	2012: Retrieved from Google Scholar with search terms "Soil Erosion" and "Vineyards"	The purpose of this article is to develop appropriate water use in vineyards to produce the proper characteristics of grapes desired by the wine maker. To do this, the impact of losing native woodlands to vineyards is analyzed.
Nicolucci, Valentina, et al. "Ecological footprint analysis applied to the production of two Italian wines." <i>Agriculture, Ecosystems and Environment</i> , vol. 128, no. 3, 2008.	2008: Retrieved from Google Scholar with search term "Sustainable wine"	The purpose of this article is to scientifically measure the ecological footprints of sustainable organic wine production and the commercial conventional method across the four phases of production: agricultural, winery, packing, and distribution. Other than human labor, conventional methodology of wine production consumed more enumerated resources and, hence, had a greater ecological footprint.
Platts, William and Walter Megahan. "Time Trends in Riverbed Sediment Composition in Salmon and Steelhead in Spawning Areas: South Fork Salmon River, Idaho." <i>Wildlife Management Institute</i> , 1975.	1975: Retrieved from Google Scholar with search terms "salmon" and "soil erosion"	The purpose of this article is to analyze the effect of soil erosion on the spawning areas of salmonids adjacent to disturbed land, caused by logging activity. Specifically, fine particles in the sediment suddenly deposited in a stream system can kill the salmon eggs leading to a decrease in salmon populations.
Prosdocimi, Massimo, Antonio Jordan, Paolo Tarolli, and Saskia Keesstra. "The immediate effectiveness of barley straw mulch in reducing soil erodibility and surface runoff generation in Mediterranean vineyards." <i>Science of the Total Environment</i> , vol 547, 2016.	2016: Retrieved from Google Scholar with search terms "vineyard" and "soil erosion".	The purpose of this article is to identify an immediate solution to the problems caused by soil erosion and water loss specifically encountered in the practice of viniculture in arid climates. Thereby, this article offers cost-effective solutions to increase sustainable practices in vineyard management.
Schneider, Keith. "Farming Without Chemicals: Age-Old Technologies Becoming State of Art." <i>The New York Times</i> , the New York Times, 23 Aug. 1987.	1987: Supplemental journal article from New York Times, retrieved from general Google search on pesticide free agricultural practices	The purpose of this article is to chronicle the movement away from chemical use in agriculture and back to more natural means of crop production. This includes the use of certain insect repellent plants such as catnip, marigold and eggplants in fields next to target crops.
Whitelaw, Ed, Ernie Niemi and David Lindahl. "Salmon and the Economy." <i>Salmon Economics Handbook</i> , 1999.	1999: Retrieved from Google Scholar with search terms "economic benefit" and "salmon"	The purpose of this handbook is to comprehensively summarize the extensive evidence of economic impacts of restoring native salmon populations in Washington and Oregon. Salmon conservation can have positive effects on the economy without being so burdensome as commonly believed; several ideas are presented to start the process of salmon habitat restoration.
Zucca, Gary, and David Smith. "Sustainable viticulture and winery practices in California: What is it, and do customers care?" <i>International Journal of Wine Research</i> , vol. 20, no. 2, 2009.	2009: Retrieved from Google Scholar with search terms "sustainable viniculture" and "consumer".	The purpose of this article is to predict the trends of sustainable wine growing and consumer awareness of this particular product. As consumer demand for sustainably produced wine grows, the wine producing industry is taking note, and even considering a certification program. Evidence shows consumers are willing to pay for sustainably produced wines, but do not know how to define the term "sustainable wine".



notes the importance of educating consumers about salmon-safe practices and stimulating demand for salmon-friendly technologies. The handbook represents a comprehensive summary of economic evidence regarding the implications of proposals to restore the salmon habitats in Washington and Oregon.

Zucca, Gary, and David Smith. "Sustainable viticulture and winery practices in California: What is it, and do customers care?" *International Journal of Wine Research*, vol. 20, no. 2, 2009

This article discusses the perceptions of wine consumers of sustainable practices in the wine industry against the backdrop of the need for product differentiation by the producers. Zucca defines sustainability by three overlapping principles: environmentally sound, economically feasible, and socially equitable in the production of wine. Zucca notes that while certification programs are yet to be developed by the industry, growing consumer awareness exists. While consumers are willing to pay more for sustainably produced wines, they are confused by what is meant by the term. Zucca's article relies on industry generated writings and data reports. He surveyed 300 wine customers, who underwent a structured personal interview process.

## References

"Chinook Salmon." EPA, Environmental Protection Agency, 14 Dec. 2018, [www.epa.gov/salish-sea/chinook-salmon](http://www.epa.gov/salish-sea/chinook-salmon).

"Economic Benefits of Salmon Restoration." NOAA Fisheries, 2014. [https://www.westcoast.fisheries.noaa.gov/publications/education/factsheet-pcsrf\\_050514.pdf](https://www.westcoast.fisheries.noaa.gov/publications/education/factsheet-pcsrf_050514.pdf)

Grismer, Mark and Caitlin Asato. "Converting oak woodland or savanna to vineyards may stress groundwater supply in summer." *California Agriculture*, vol. 66, no. 4, 2012, pp 144-152.

"Harvest." Washington Department of Fish & Wildlife, 2006. <https://fortress.wa.gov/dfw/score/score/harvest/harvest.jsp>

Niccolucci, Valentina, Alessandro Galli, Justin Kitzes, Riccardo Pulselli, Stefano Borsa, and Nadia Marchettini. "Ecological footprint analysis applied to the production of two Italian wines." *Agriculture, Ecosystems and Environment*, vol. 128, no. 3, 2008, pp. 162-166.

Platts, William and Walter Megahan. "Time Trends in Riverbed Sediment Composition in Salmon and Steelhead Spawning Areas: South Fork Salmon River, Idaho." *Wildlife Management Institute*, 1975, pp. 229-239.

Prosdoci, Massimo, Antonio Jordan, Paolo Tarolli, and Saskia Keesstra. "The immediate effectiveness of barley straw mulch in reducing soil erodibility and surface runoff generation in Mediterranean vineyards." *Science of the Total Environment*, vol 547, 2016, pp 323-330.

"Salmon-Safe Vineyard Certification." Salmon Safe, 2018 <https://salmonsafe.org/certification/vineyards/>

Schneider, Keith. "Farming Without Chemicals: Age-Old Technologies Becoming State of Art." *The New York Times*, *The New York Times*, 23 Aug. 1987, <https://www.nytimes.com/1987/08/23/us/farming-without-chemicals-age-old-technologies-becoming-state-of-art.html>

"Tribal Salmon Culture." Columbia River Inter-Tribal Fish Commission, 2015 <https://www.critfc.org/salmon-culture/tribal-salmon-culture/>

Whitelaw, Ed, Ernie Niemi and David Lindahl. "Salmon and the Economy." *Salmon Economics Handbook*, 1999, pp 1-35. [http://www.wildriverscoastalliance.com/wp-content/uploads/2015/04/salmon\\_handbook.pdf](http://www.wildriverscoastalliance.com/wp-content/uploads/2015/04/salmon_handbook.pdf)

Zucca, Gary, and David Smith. "Sustainable viticulture and winery practices in California: What is it, and do customers care?" *International Journal of Wine Research*, vol. 20, no. 2, 2009, pp 189-194.

# FENTANYL FOR RESPIRATORY DISTRESS MANAGEMENT IN HOSPICE SETTINGS

Jessica Heitzman

*ABSTRACT: OBJECTIVE: To determine whether fentanyl has greater efficacy compared to morphine for management of respiratory distress in adult patients with terminal illness in hospice settings. METHODS: This nonsystematic literature review considers the efficacy of morphine and fentanyl for relief of dyspnea and respiratory distress. RESULTS: Fentanyl delivers faster onset for relief of symptoms and it offers diverse administrations routes. Additionally, fewer side effects were noted that are commonly associated with opioid medications; these include neurocognitive changes, drowsiness, dizziness, and nausea. CONCLUSIONS: With greater than fifty percent of patients experiencing dyspnea at the end of their life, it is important to address dyspnea and respiratory distress to promote adequate management of these common symptoms. Dyspnea can severely limit the quality of life of individuals with a terminal illness. Although there is evidence to support fentanyl's efficacy in managing dyspnea, more studies are necessary to quantify the significance and potential for this drug compared to other opioid medications.*

## Introduction

Dyspnea and respiratory distress are common symptoms for patients at the end of life and can severely impact the quality of life in patients with a terminal illness. According to Afolabi, Nahata, and Pai (2017), more than fifty percent of patients will experience dyspnea at the end of their life. The prevalence of episodic breathlessness, dyspnea, and respiratory distress identifies a need in this population for respiratory symptom management. Whether prognosis for life expectancy is limited to days, months, or years there is an immediacy for patients and family to find quality and comfort with end of life care. Life limitations for patients with breathlessness in terms of limiting activity and quality can be significant (Simon et al., 2016). Adult hospice is a setting in which patients can seek end of life symptom management and find a coordinated way to maintain quality of life. While morphine is the drug of choice in many institutions for end of life symptom management, fentanyl has a faster onset compared to morphine and more diverse administration routes.

Respiratory symptom severity and onset can vary widely among patients depending on the illness. Cabezón-Gutiérrez et al. (2016) states, “prevalence

of dyspnea varies depending on underlying disease; it ranges from 90 to 95% in chronic obstructive pulmonary disease (COPD), is approximately 78% in lung cancer (LC), ranges from 60 to 88% in congestive heart failure (CHF), and is almost 100% in neuromotor diseases. Dyspnea also causes physical and psychological discomfort, anxiety, and depression” (p. 4045). Anxiety can exacerbate respiratory distress, but proper management at onset of symptoms, regardless of disease, will help alleviate shortness of breath in this population. Opioids are commonly used for end of life symptom management and have proven to be effective for managing pain and dyspnea.

Respiratory symptom management for patients with terminal illness could be improved if the efficacy of fentanyl and morphine are taken into consideration as well as the various administration routes. Consideration for various routes of administration are important for end of life symptom management. Although oral administration continues to be most common and easily accessible, additional research to determine the most appropriate and economic routes for delivery will enhance patient care. Majidinejad, Ebrahimi, Heydari, Ahmadpour, and Esmailian (2019) state, “many patients are unable to take

oral medications. Nebulized morphine provides an alternative route of opioid administration to patients who are unable to use oral medications or those who prefer the convenience of an inhalation medication” (p. 6). Fentanyl and morphine are both available to be nebulized for administration but there are other routes that can be considered for dyspnea relief including oral transmucosal, intravenous, subcutaneous, and transdermal. Intravenous and subcutaneous routes for medication delivery are generally specific to hospitalized patients and are common delivery routes for opioid medications. Outpatients will more likely consider oral transmucosal buccal tablets, nebulized fentanyl, and topical fentanyl (patches). It is important to differentiate hospitalized patients from outpatients (Cabezón-Gutiérrez et al., 2016). This expands the use of these medications to more settings and makes opioid administration increasingly accessible for inpatient and outpatient hospice. After a review of literature, fentanyl has greater efficacy compared to morphine for management of respiratory distress in adult patients with terminal illness in hospice settings.

### **Review of Literature**

Through a review and synthesis of literature, there are important distinctions that were clarified when comparing fentanyl and morphine. Hospice populations deserve special consideration for routes of medication delivery; accessibility to certain routes will depend on inpatient or outpatient settings. Although inpatient and outpatient were not looked at independently of one another for the purposes of this review, fentanyl has multiple modalities for administration that are favorable in comparison to morphine. Studies included were from a search of the following databases: CINAHL, PUBMED, and The Cochrane Library. Five studies were included with a rating of at least 3 or greater on the Level-of-Evidence Hierarchy.

Capper et al. (2010) utilized quantitative methods to study the pharmacokinetics of subcutaneous fentanyl. The population consisted of 9 male volunteers in good health which was determined by their medical history, a physical, and laboratory

examination. This study determined that while the rapid absorption rate of subcutaneous fentanyl was similar to subcutaneous morphine, the half-life for fentanyl was substantially longer: ten hours compared to about 2 (Capper et al., 2010). Additionally, blood concentrations do not vary greatly among the two opioid drugs when other routes, except intravenous, were used. The sample size was small for this study, but the controls were well employed. The selection process was not entirely randomized because they were volunteers, but the subjects fit a specific criteria. One volunteer was excluded from the final results for taking an antihistamine which could interrupt results of the pharmacokinetics of fentanyl.

In a systematic review, Simon et al. (2013) regarded fentanyl for the relief of breathlessness. There were 88 patients considered across 622 references and included the following diseases: the majority of patients had lung cancer and chronic obstructive pulmonary disorder (COPD), one patient with interstitial lung disease (ILD), and one patient with cystic fibrosis (CF). The review endorses that fentanyl is promising for providing relief of breathlessness, but more trials are needed to definitively determine this. This systematic review is a valuable study that focuses clearly on the fentanyl use for breathlessness relief, included relevant studies, and was led by experts in breathlessness following high quality methods for conducting a literature search.

Simon et al. (2016) performed a pilot phase II clinical trial involving a randomized, active-control (morphine) to determine the effects of treating episodic breathlessness with transmucosal fentanyl. This trial consisted of adults aged 18 years or older with incurable cancer. The population of the study consisted of 10 individuals on initiation, but only 6 individuals completed the study. Unfortunately, 2 were deceased prior to the conclusion of the study and 2 dropped out due to disease progression. This was a high quality study, . it was conducted thoroughly for a pilot clinical trial. Ultimately, the study describes relief of episodic breathlessness via transmucosal fentanyl as faster and greater than

morphine and validates further evaluation would be beneficial through a more comprehensive study.

Hui et al. (2019) conducted a parallel, double-blind randomized placebo-controlled trial to determine the efficacy of the prophylactic administration of fentanyl. First, a walking test was performed to determine baseline breathlessness measured by a numerical scale. Then a fentanyl buccal tablet or a placebo was given prophylactically, followed by another walking test to determine efficacy. The population consisted of 20 patients with an active diagnosis of cancer. This study size was small but supported the prophylactic administration of fentanyl. While larger trials are necessary, the conclusion described that fentanyl buccal tablets were associated with a reduction of exertional dyspnea and well tolerated by the participants.

In a retrospective study, Benitez-Rosario, Rosa-González, González-Dávila, and Sanz (2019) analyzed fentanyl for dyspnea relief at the end of life. The population was 72 patients with advanced cancer and non-cancer patients from a Palliative Care Unit that endorsed dyspnea at rest. This study explored intravenous and subcutaneous fentanyl and the data suggests that it does provide relief from dyspnea although it recommends further research to confirm findings.

To summarize, the quality of the body of literature presented here is generally good being sufficiently high on the Level-of-Evidence Hierarchy. Across the studies there is a theme that fentanyl provides relief from dyspnea and breathlessness. Additionally, many of the studies indicate further exploration and trials are warranted to truly explore the potential of fentanyl.

### Argument

There are several clinical advantages to fentanyl because it has a faster onset compared to morphine and more diverse administration routes. According to Simon et al. (2013), fentanyl onset takes place within as little as 7 to 16 minutes, while morphine onset is 20 to 30 minutes. Respiratory distress can begin quickly and build as patients feel anxiety

from dyspnea and episodic breathlessness. Considering this, it is important for symptom relief to be achieved as quickly as possible. In terms of administration routes, some will inevitably be faster than others, but the diversity of routes make fentanyl a valuable tool for hospice patients. Hospice seeks to accommodate a wide variety of settings and as such, deserves circumstantial consideration for diverse administration routes. Simon et al. (2013) explores diverse routes of fentanyl administration available such as oral transmucosal, intravenous, transdermal, intranasal, and nebulized. Clearly, variety in administration routes in addition to rapid onset, create an important pathway for fentanyl as a primary drug choice for respiratory distress symptom management in the terminally ill. Additionally, subcutaneous fentanyl creates an ease for administration that avoids the need for vascular access or use of complex pumps (Capper et al., 2010). The oral transmucosal method includes the fentanyl buccal tablet which Simon et al. (2016) concluded in 61 episodes of respiratory distress, the fentanyl buccal tablet showed a faster onset of action and helped relieve more symptoms than morphine. Symptom management is possible to achieve given the route diversity and fast onset fentanyl offers.

In addition to the clinical advantages described above, fentanyl also has less fewer side effects than morphine because it works directly on breathing and pain receptors. Opioid drugs are powerful analgesics and are used regularly for pain management. Unfortunately, the strong analgesic effects can often be accompanied by unwanted side effects including dizziness, hypotension, neurocognitive changes, respiratory depression, and buildup of the drug due to poor excretion in individuals with organ failure. While morphine and fentanyl are both opioid derived analgesics, there are important distinctions to be made regarding the individual drugs. Afolabi et al. (2017) states, “some institutions may prefer to nebulize fentanyl due to the lack of histamine release and decreased potential for bronchospasm when compared with morphine or hydromorphone” (p.1060). This is especially important deciding appropriate interventions for



respiratory distress. Bronchospasms can further exacerbate respiratory distress which is undesirable given the intention behind the drug administration is to diminish and ease respiratory symptoms. Another study added that there were minimal to no neurocognitive effects which is an important consideration for patients desiring symptom relief without the euphoria and associated high that can accompany opioid drugs (Hui, 2017). Capper et al. (2010) endorses that fentanyl may be safer for certain organ functioning stating, “fentanyl is thought to offer a safer alternative to morphine for patients with renal impairment (because of its lack of renally excreted active metabolites) or for those who are allergic to, or intolerant of, morphine” (p. 241). This could potentially reduce the risk of buildup of the drug leading to respiratory suppression, changes in behavior, and encephalopathy associated with some opioid derivatives. Fentanyl provides less devastation to multiple organ systems in addition to the fewer side effects; the lack of neurological changes is cathartic for many patients and families who welcome lucidity and time with their loved one for as long as possible.

While there may be hesitation adopting the use of fentanyl more commonly from a business position regarding cost and time, it is a fiscally responsible and time conservative option. As far as cost, fentanyl often requires fewer doses to achieve adequate symptom relief which is cost effective when comparing prices on a timeline. This can be partially attributed to some routes, including bolused subcutaneous fentanyl, having a substantial half-life of up to 10 hours (Capper et al., 2010). Additionally, fewer doses improves the time management and efficient workflow for healthcare providers and leads to longer lasting comfort for the patient. Fleischman et al. (2010) affirmed, “the costs of the two drugs are similar, with an average wholesale price of \$0.71 for 10 mg of morphine versus \$0.83 for 100 µg of fentanyl, our results show no compelling argument for the use of one drug over the other” (p. 173). In light of the minimal cost difference, and fewer doses required to achieve symptom relief, healthcare workflow and patient comfort are improved.

Another potential concern for the wide adoption of fentanyl is from a public health perspective related to overdose deaths, and the stigma that carries. Fentanyl awareness in the public has recently been associated with fear as there are continuous reports of overdose deaths in the media. However, in the hospice setting, fentanyl dosing is regulated and assessed after each administration. In their study, Benitez-Rosario et al. (2019), specified that there were no expedient deaths with the administration of fentanyl for breathlessness as recorded by physicians caring for the patient participants. Cost, timing, and stigma are important considerations but do not outweigh the potential benefits of fentanyl for symptom management in this patient population.

## Discussion

Fentanyl is recommended as a primary choice for end of life respiratory distress symptom management when considering its benefits: faster onset, diverse administrations routes, and fewer side effects. Oral routes are commonly used but not always ideal for managing respiratory symptoms. This is especially true because increased oral secretions is an end of life symptom, and while aspiration of the drug may not be concerning at this point, it could increase discomfort of the dying individual. Many hospice settings will not have intravenous access available for medication delivery. Patients, families, and healthcare providers will all appreciate the efficacy and alternative routes fentanyl provides. Protocols by these facilities and individual physician preference may dictate the frequency of fentanyl ordered, but there is evidence that fentanyl may be more effective than morphine (Simon et al., 2016). Previously mentioned, side effects commonly associated with opioid medications can be burdensome. These include neurocognitive changes, drowsiness, dizziness, and nausea. Providing comfort and symptom relief at the end of life is very important and fentanyl is an appropriate alternative to certain options that are commonplace, like morphine. Education on better management for symptoms utilizing medications with fewer side effects are ideal for all stakeholders. The plan of action for recommending fentanyl as



a primary treatment option can be synthesized through Larrabee's Change Model for Evidence-Based Practice. This change model is widely recognized by healthcare providers and can be used to determine appropriate steps when making an evidence-based practice change. Stakeholders are pivotal for practice change and include hospice agencies, healthcare providers, families, and patients.

First, options for disseminating fentanyl will logistically depend on the inpatient or outpatient hospice setting. While intravenous and subcutaneous may be more accessible in inpatient settings, transmucosal buccal tablets and transdermal fentanyl will be exceptionally reliable outpatient alternatives. This will make accessibility easy and provide relief to all end of life sufferers of respiratory distress. Stakeholders will appreciate the interventions as they will provide more consistent relief to their patients and improve workflow. Family and patients will value the prioritization of comfort while they experience a difficult time in their lives.

Next, exploring the literature has guided this recommendation for practice change, to use fentanyl as a first line therapy for respiratory distress and dyspnea relief. It may be difficult to convince all stakeholders, but with more use in practice, fentanyl's efficacy will be more readily apparent and accepted as a positive, evidence-based practice change. This change in practice is feasible in hospice settings because current evidence maintains fentanyl as a great alternative to morphine due to the multiple modalities available for administration and the fewer instances of side effects.

Practice change is best achieved when all stakeholders are working towards a common goal and are effectively informed. Education will be necessary to indicate the usefulness of fentanyl for better respiratory distress symptom management. This will include advocacy for individual patient conditions with the most ideal delivery and absorption for individual patients. Evaluating the effectiveness of implementing fentanyl will be

slightly different whether the hospice setting is inpatient or outpatient. Chart auditing for symptoms prior to medication administration and reassessment for effectiveness of symptom relief will be a reliable measurement tool. Gathering surveyed data from healthcare providers on how well patients tolerate the medication change will also indicate its efficacy. Suggestions from stakeholders for improvement are always valuable and welcomed.

## Conclusion

Compared to morphine, fentanyl has greater efficacy for management of respiratory distress in adult patients with terminal illness in hospice settings. Fentanyl is a reliable treatment for dyspnea and respiratory distress in patients who are terminally ill. With its range of routes, fewer side effects, and quicker onset, fentanyl is superior to morphine for end of life symptom management and can be widely applied in inpatient and outpatient hospice settings. More studies are necessary to quantify the significance and potential for fentanyl, but the recommendation is that fentanyl should be a first choice intervention.

## References

- Afolabi, T. M., Nahata, M. C., & Pai, V. (2017). Nebulized opioids for the palliation of dyspnea in terminally ill patients. *American Journal of Health-System Pharmacy*, 74(14), 1053–1061.
- Benitez-Rosario, M. A., Rosa-González, I., González-Dávila, E., & Sanz, E. (2019). Fentanyl treatment for end-of-life dyspnoea relief in advanced cancer patients. *Supportive Care in Cancer*, 27, 157–164.
- Cabezón-Gutiérrez, L., Khosravi-Shahi, P., Custodio-Cabello, S., Muñoz-González, F., Cano-Aguirre, M., Alonso-Viteri, S., ... Cano-Aguirre, M. D. P. (2016). Opioids for management of episodic breathlessness or dyspnea in patients with advanced disease. *Supportive Care in Cancer*, 24(9), 4045–4055.

- Capper, S. J., Loo, S., Geue, J. P., Upton, R. N., Ong, J., Macintyre, P. E., & Ludbrook, G. L. (2010). Pharmacokinetics of fentanyl after subcutaneous administration in volunteers. *European Journal Of Anaesthesiology*, 27(3), 241–246.
- Fleischman, R. J., Frazer, D. G., Daya, M., Jui, J., & Newgard, C. D. (2010). Effectiveness and safety of fentanyl compared with morphine for out-of-hospital analgesia. *Prehospital Emergency Care*, 14(2), 167–175.
- Hui, D., Kilgore, K., Frisbee-Hume, S., Park, M., Liu, D., Balachandran, D. D., & Bruera, E. (2017). Effect of prophylactic fentanyl buccal tablet on episodic exertional dyspnea: A pilot double-blind randomized controlled trial. *Journal of Pain and Symptom Management*, 54(6), 798-805.
- Majidinejad, S., Ebrahimi, M., Heydari, F., Ahmadvour, M., & Esmailian, M. (2019). Comparison of analgesic effects of nebulized morphine with fentanyl transdermal patch and oral methadone for cancer patients in terminal stages: A double-blind randomized controlled study. *Advanced Journal of Emergency Medicine*, 3(3), 1-7.
- Simon, S. T., Kloke, M., Alt-Epping, B., Gärtner, J., Hellmich, M., Hein, R., ... Voltz, R. (2016). Effendys—Fentanyl buccal tablet for the relief of episodic breathlessness in patients with advanced cancer: A multicenter, open-label, randomized, morphine-controlled, crossover, phase II trial. *Journal of Pain & Symptom Management*, 52(5), 617–625.
- Simon, S. T., Köskeroglu, P., Gaertner, J., & Voltz, R. (2013). Fentanyl for the relief of refractory breathlessness: A systematic review. *Journal of Pain and Symptom Management*, 46(6), 874-886.

# ‘LIKE’ AND THE CROSS-GENERATIONAL COLLOQUIAL CONUNDRUM: THE RISE OF HIEROGLYPHS IN COLLOQUIAL LANGUAGE

Grace Boulanger

*ABSTRACT: Language barriers are found between generational groups more often than not, even when each group speaks the same language. Each generation adapts their language to suit their needs, which are influenced with a variety of factors including the technological landscape and social norms. Colloquialisms are a characteristic in English which connote a general idea between individuals. They play a key role in understanding the tone and mood of a conversation. However, in the last thirty years colloquial phrases used by Millennials, such as “like”, have brought about a resurgence of hieroglyphs, the antiquated concept of a picture standing in for a mood, tone, or a series of phrases. By reshaping language to suit new communication needs Millennials and Generation Z have created a new type of language barrier between themselves and Generation X. Tracing new uses of the word “like” in social situations, writing, and spoken communication can determine where Generation X and the two newest groups are crossing wires, and help us gauge community ties and communication strength within youth culture.*

## Introduction

Communication in society is essential for strong and effective social relations, especially between older and younger generations. As younger generations learn how to use language, communication between generations can become difficult. Examining different styles of communication and the different features of the two newest generations can help determine how language shifts are affecting communication in interpersonal relationships across generations.

New generations learn to use language differently and it affects work and personal relationships in the private and business world. I argue that the Net Gen has come to rely on social media and tech to learn new colloquial phrases, and consequently leaves a linguistic void between themselves and the previous generation. Whereas Millennials learned linguistic features primarily from their parents, the Net Gen did not, solidifying their position as

the first internet-tech fluent generation. Further, because the Net Gen relies on social media to learn new words, they are fully fluent in verbal and non-verbal communication which has led to a rise in hieroglyphs beginning with the term “like”. To look at how this operation has come to pass, we first need to examine the two types of communication at the focal point of human relationships: verbal and non-verbal. After that, I will examine the specific case of the word “like” to demonstrate how colloquialisms are being created by new generations. Next, I will examine how the word “like” has led to a rise in hieroglyphic terminology. Finally, I will analyze how this creates a communication void between Baby Boomers and the Net Gen.

Communication is a daily activity everyone participates in both consciously and unconsciously. Reliance on a common language is the cornerstone of social relationships. The short definition of communication is to “exchange...thought by oral, written, or

nonverbal means” (Waltman 85). People communicate easily everyday even though it is a complicated process that relies on several different factors. The purpose of all forms of communication is to translate an idea from a sender to a receiver. To exchange an intangible object of analysis the sender, the creator of the thought, must create a physical way to transmit an idea (Waltman 85). This takes several different forms. Verbal and non-verbal communication is the fastest way to transmit an idea because it is immediate. Written communication can come in different forms such as an office-memo or a college research paper. Texting and email also fall under this category. Non-verbal communication is different from written and oral communication because it lacks linguistic features (Waltman 85). It relies on facial expressions and body language. In his article “A generational approach to using emoticons as nonverbal communication,” Franklin Krohn explains that non-verbal indicators are heavily relied upon in social situations because they are “commonly assumed to be unintentional” (321). This means they are easy for a receiver to interpret. People communicate most effectively when the receiver correctly interprets the sender’s message. Once the sender has translated the thought, the receiver’s job is to interpret those thoughts and give feedback (Waltman 85). According to Waltman, effective communication is characterized by how well the receiver perceives the message being sent. Being able to communicate effectively is important in social situations because it allows overt and covert messages to be translated to , especially in face-to-face interactions and more recently technology-based ones.

There are several ways people communicate quickly and effectively today. Direct ways to communicate in an internet-saturated culture are through verbal expression and technology. Outside the dome of technology, one of the most prominent ways humans communicate is through “non-verbal” indicators such as tone, facial expressions and gestures (Krohn 321).

Social networking websites using non-verbal communication have become more prominent as technology improves. In today’s culture of expanding technology, texting and social media are some of the fastest ways to spread information. This type of communication is found on sites such as Twitter and Facebook. Instead of tone and gestures, text and emoticons replace these non-verbal indicators found in a face-to-face interaction (Krohn 321). Emoticons are used to improvise facial expressions through modern technological means of communicating. They are a non-verbal indicator expressing a feeling the same way a facial expression or physical gesture would. They are a useful tool for the internet-fluent generations because they “are more believable” than written or verbal cues (Krohn 321). This is important because it is a relatively new way to express a thought or idea. A “pictograph” imitating a human face is easily translatable to the brain (Krohn 321).

An important feature of language and modern communication is the use of colloquialisms. A colloquialism is considered an informal part of speech reserved for everyday use (Fitzmaurice 54). But this term is not just reserved for certain phrases or words. Colloquial, as explained by Susan Fitzmaurice in her article from *American Speech*, can be applied to any form of conversation that is “traditionally reserved for informal interpersonal communication” (54). This means that colloquial is a casual form of verbal expression that is its own dialect. Anyone can use colloquialisms. Colloquial language has traditionally been used in casual, informal settings, but makes its way into formal settings frequently. Fitzmaurice found that across urban and rural demographics the use of the colloquial dialect levels people who are supposed to be speaking in a formal setting with those in informal conversations; it’s a linguistic leveling tool (54). Colloquial language has found its way into formal settings such as television news reports (Fitzmaurice 54). This is important because the colloquial register is derived from its spoken, grammatical construction.

The spoken colloquial form of expression is acceptable in formal and informal conversation, but lines between formality and informality become blurry when an expression is transferred to a written form. Different generations, such as millennials and Generation Z, use different parts of speech to express their feelings to their peers. This is where generational differences in written communication begin to emerge.

How people communicate information impacts interpersonal relationships outside the scope of technology. Different forms of communication, verbal and non-verbal, affect face-to-face interactions. It can also affect the perception of information that is presented. According to Joann Montepare, non-verbal communication on Facebook and within “the digital social environment” can create issues in the perception of information (409). Montepare points out that when information is presented on social media such as Facebook, it is “manipulated” and manicured without the actual elements of an interpersonal interaction (409). The manicured messages that appear on Facebook do not allow for a transferal based on stream of consciousness. The removal of the base, human interaction of passing on information detracts the value of the transferal. Without non-verbal indicators the information that is passed along lacks substance because it does not have a human element to it. As mentioned before, Krohn observed that non-verbal indicators are “more believable,” especially in uncomfortable social situations (321). Verbal and non-verbal communications rely on feedback from the receiver, or whoever the information is sent to. By taking away non-verbal indicators used to transmit new information social media distorts the receiver’s perception of the information because they cannot see the non-verbal cues, or body language, of the sender (Waltman 85). In other words, effective communication relies on the combined efforts of verbal and non-verbal cues. This is where linguistic markers such as “like” and hieroglyphs become an important part of the colloquial dialect that is still shaping

the Net Gen.

Every new generation has defining features that contribute to how they interact with other generations in society. Members in different generations often distinguish themselves by their time period. The most recent generation gap that exists is between millennials and members of Generation Z. This generation gap actually overlaps with these two generations which often causes misconceptions about which age groups are part of which generation. Millennials are the group born between 1977 and 1994 and are characterized by being primarily middle-class (“The Generations” 5). In 2012 millennials “spanned the ages of 18 and 35” (“The Generations” 5). Millennials make up one of the largest age demographics in the United States and are second only to their predecessors, the Baby Boomers, although in recent years this statistic has changed (“The Generations” 5). Generation Z, also called the Net Generation, is the name given to the group of children “born from 1993 and 2005” (Turner 103). Z-Generation is the first generation to be born into a culture of complete globalization due to the emergence of the internet and new social communication (Ilin 500). Unlike millennials, Gen-Z is characterized by its reliance on networking and connectivity to form bonds; millennials are still characterized by living in a social hierarchy (“The Generations” 5).

Millennials are the generation on the cusp of the digital age. They make up the group of people born between 1977 and 1994 (“The Generations” 5). They are the generation after the Baby Boomers but before Generation Z (Turner 103). Millennials cover a larger time frame compared to Z-Generation. This means there are more millennials and they are getting older. Most millennials have finished college and are starting their working lives at this point in time (Turner 103). Unlike Generation Z, millennials were not born into new technology. Adapting quickly to technology is what sets them apart from their predecessors and successors. A



study by Eddy Ng at the *Journal of Business and Psychology* shows that technological affluence is not the defining feature of this generation (281). Even though this generation is considered internet-fluent, work-lives and interpersonal relationships shaped by work are what set this generation apart (Ng, Schweitzer, and Lyons 281). According to Ng, Schweitzer and Lyons, millennials make their work life a priority (281). Satisfactory occupations influence the quality of their social lives and interpersonal relationships (Ng, Schweitzer, and Lyons 281). Communicating well at work and on an interpersonal level is important to millennials because their communication skills are excellent indicators of their adaption to internet-culture. Millennials are older so they have had more time to play with the English language than Gen-Z has. “The totes amazesh way millennials are changing the English language” by John Guo describes how millennials are verbally expressing themselves to each other. Communication on twitter and other social media sites has given older millennials the opportunity to create a virtually new style of spoken and written English, which have since wormed their way into dictionaries and mommy-blogs. Millennials can readily claim the beginning of the digital language shift as their own. But it is Generation Z who is carrying on the tradition thanks to their technological fluency. Millennials bridged the divide allowing Gen-Z children to add another method of communication to social interactions: hieroglyphs.

Researchers have not completely identified what sets Generation Z apart from millennials for the simple reason that they are too new. But there are a few obvious characteristics that set Generation Z apart. Most of these are caused by environmental factors. The first is their time period. The second is the connectivity of the world they were born into. Gen-Z is the first generation to be born into a globalized, internet culture (Ilin and Shestova 500). This means they are the first group to grow up with the internet and

easy access to instant communication services. Anthony Turner refers to members of Gen-Z as “internet natives” (Turner 103). Turner points out that while the preceding generation might look at Gen-Z’s use of technology excessive they are simply doing what comes naturally. This generation was born acclimated to a wired globe. Millennials sometimes consider the use of unlimited technology a privilege, but Turner finds that access to the internet or a smartphone is a constant across most environments (103). In other words, Gen-Z does not consider unlimited access a privilege. Knowledge rests at their fingertips, and that’s how it ought to be. Reliance on immediate access to a smartphone can cause anxiety in unpleasant social situations since members of Gen-Z know how to escape rather than face a social challenge (Turner 103). This is one of the known psychological features that sets Z-Gen apart from millennials. Presumably, one new change researchers should find soon is the development and reliance on visual culture as a method of communicating not only full ideas, but feelings associated with them. Since social media is a medium of non-verbal communication, Gen-Z figured out how to emote independent of emoticons provided by Myspace, Instagram, and Facebook. It seems obvious in retrospect, but the simple emoticons don’t connote the full range of feelings a person may go through when sending or receiving information. Millennials attempted to bridge this gap with the word “like,” as a grammatical indicator of metaphor. But Gen-Z mastered it-- by disposing of it.

As stated before, colloquial phrases are their own dialects of verbal expression. They are an important feature of spoken language because they transfer a common idea in a traditionally casual way. Several colloquial expressions are commonly attributed to millennials and z-generation even though they had no hand in coining any of them (Hitchens). Neither generation has invented entirely new expressions but their prominent use of colloquialisms in verbal and written communication puts them at



the forefront of recent language shifts. Standing out significantly is the word “‘like’...the idiom of the youth,” as put by Christopher Hitchens in *Vanity Fair*. It has been a casually used expression since the sixties, but if you go and talk to a teenager between the years 2000 and 2010, and you will hear it being uttered anew (Hitchens). “Like” is considered a filler word that takes up space in long sentences that could be much shorter. The word is very important word in Millennial and Gen-Z vernacular. “Like” has a few functions in today’s speech that are often cast off as bad grammar. It is a filler-phrase, a pause and a verbal “colon” (Hitchens). As a filler-phrase it can be followed by any “number of expressive sounds” (Hitchens). This is important because it allows for verbal and non-verbal modes of communication to follow it, making it versatile. As a pause it indicates that the speaker needs to take a moment to solidify their next sentence. As a verbal colon it can connect two seemingly unrelated phrases. Paired by “like,” they can become a hyperbolic statement: “the trip was like, life changing,” if you’ll pardon my example (Hitchens). The most important function of like is that it is a slang word and a pause; it impresses upon the receiver of the verbal signal how the sender perceived another verbal signal (Guo). This is significant because it is complicated, but it is a possible way to communicate between three people. “Like” allows someone to express how they felt about another person’s signal to receiver different from the original sender. The sender acts as a medium, connecting three trains of thought, and inviting the new receiver to participate in the verbal and non-verbal parts of the conversation.

As a colloquial signifier, “like” serves several positive functions in everyday English. Since the meanings of words and signifiers are recoded continuously, “like” can serve multiple purposes verbally and non-verbally. As stated before, “like” is a word that can be followed by “any number of expressive sounds” or phrases (Hitchens). Non-verbal cues following “like” are easily translatable. Messages being

sent to the receiver prefaced by “like” have a built-in signifier that already exists in the receiver’s lexicon. Important messages can be easily perceived and interpreted (Waltman 85). In English, signifiers are a feature of communication that signal to the receiver that an idea should be associated with a similar idea in order to evoke a feeling about the object being described. Metaphors and similes are created using “like.” Messages sent with “like” as a signifier achieve this goal because they have a built-in metaphorical signifier. Fluency in non-verbal communication allows millennials and Z-Gen to instinctively not take messages sent with “like” literally. As Jeff Guo explains, it is a “systematic” way “to effect a certain tone.” Communicating this way distinguishes Z-Gen and millennials from Baby Boomers and beyond. In his article in *Language and Communication*, Daniel Suslak explains how “youth and maturity” are directly linked to “linguistic variants” (199). “Like” is important in everyday language because it is used by the youth “as markers of age identities” (Suslak 199). Communicating through colloquialisms, especially “like,” is how millennials and generation-z identify each other. It does not mean the English language is decaying; simply that new speakers are using it to carve a linguistic identity.

The biggest change “like” has undergone in the last decade is its disappearance. Spoken and written communication still use the term as an indication that there is more to come, but Generation-Z has slowly been disposing of it without replacing it. “Like” is very useful, and it helped an entire generation figure out how to create a tri-way communication loop that included emotional feedback. Generation-Z realized something only the most reflective writers realized: you don’t need a metaphorical indicator (Pathak and Bansal 2019). Colloquial phrases that make our mothers gasp don’t have the same effect on the youth, because there is an intuitive sense of hyperbole and metaphor. For example, I may be relaying to my mom that I was worried about Tyna who was so tired

she fell asleep walking to the next bar. I know that's a metaphor for how tired Tyna is, but my poor mom thinks I left Tyna asleep in a bar somewhere. The visual picture I have painted for my mother is lost on her, but my Friend B understands immediately, because I have created a pictograph for her, a verbal summation of the facts, and the emotional experience: a hieroglyph. Hieroglyphics are "a system of writing that uses pictures instead of words" (Pathak and Bansal 2019). The hieroglyph is a pictorial, a dictation, of what someone is trying to express verbally and emotionally all at once (Pathak and Bansal 2019). "Like" is a grammatical pause, an indicator that there is more to come. But you don't need it. A picture can express the emotional range that we may feel but our language does not accommodate for. Even though "like" is an important phenomenon, it is the harbinger of a return to an ancient form of communication the Egyptians and Mayans used (Pathak and Bansal 2019). It should be noted that although there is fear about pictures and slang replacing language, I have it on good authority that Millennials and Gen-Z love language and don't intend to replace dictionaries with picture books.

Ultimately what this tells us is "like" was a verbal bridge to a creative, visual culture that relied on everyone being in the know. My mother doesn't understand why I like sending her gifs of Kermit the Frog, but my friend Tyna sees them, interprets them, and can respond to the expressed emotion. It's important to remember Pathak and Bansal's comment that "communication is too vast a topic to be covered under one definition" (2019). Language changes and adapts to the user's needs. If we refer back to the psychological differences between Millennials and Gen-Z, we should be able to surmise that pronounced anxiety requires further outlets of expressions. For millennials it was creating a feedback loop; for Gen-Z it is highly specialized colloquial knowledge that establishes context, players, and mood, all liberated of grammatical shackles.

Communicating with colloquial expressions can have a negative impact on relationships between older and younger generations. The frequent use of colloquial expressions reveals a deeper social issue that explains the emergence of this new language shift. In "The Sociolinguistic problems of generations" Daniel Suslak explains that linguistic features are passed down from generation to generation (199). Suslak also notes that every succeeding generation has fewer features to pass on (199). The issue is that millennials and Generation-Z are not being fed enough verbal features to communicate effectively with their predecessors. Finding an identity in non-verbal cues is second nature to younger generations (Suslak 119; Turner 103). Social backlash comes from older generations who take "purist stances toward linguistics" (Suslak 199). Suslak explores how communication styles are affected by age differences (199). Most social backlash about language shifts originates from the linguistic features of "youth culture" being regarded as "hybrid" forms of communication (Suslak 199). Using "like" colloquially is an indicator of "youth culture" (Suslak 199). This instantly establishes a communication barrier between older and younger generations (Suslak 199). The communication barrier does not originate from a lack of understanding; it comes from disapproval from linguistic "purism" (Suslak 199). This is understandable and can be troubling for English teachers and parents who still don't know that an ellipse is not a replacement for a full stop, but language shifts cannot be avoided.

Communication is a complicated system that relies on factors outside conscious control. By looking at the newest generations and how they communicate, it is easy to see how communication between generations can become foggy. It also reveals the positive impact of a generation creating an identity for itself out of something as ageless as language. By examining how technology and generational differences influences communication it is easy

to see how people carve identities out of their linguistic features. The end result is having a positive outlook on how the newer generations are going to continue changing language to suit their future needs.

### Works Cited

- Fitzmaurice, Susan M. "The Great Leveler: The Role of The Spoken Media In Stylistic Shift From The Colloquial To The..." *American Speech* 75.1 (2000): 54. Academic Search Complete. Web. 9 May 2016.
- Guo, Jeff. "The Totes Amazesh Way Millennials Are Changing the English Language." Editorial. *Washington Post* 13 Jan. 2016: n. p. The Washington Post [ProQuest]. Web. 22 May 2016.
- Hitchens, Christopher. "The Other L-Word." Editorial. *Vanity Fair* 13 Jan. 2010: n. p. Vanity Fair. Web. 22 May 2016.
- Ilin, I., and T. Shestova. "Z-Generation." Value Inquiry Book Series 276. (2014): 500. Academic Search Complete. Web. 1 June 2016.
- Krohn, Franklin B. "A generational approach to using emoticons as nonverbal communication." *Journal of Technical Writing and Communication* 34.4 (2004): 321-328.
- Montepare, Joann. "Nonverbal Behavior in the Digital Age: Explorations in Internet Social Communication." *Journal of Nonverbal Behavior* Dec. 2014: 409+. Academic Search Complete. Web. 11 May 2016.
- Ng, Eddy SW, Linda Schweitzer, and Sean T. Lyons. "New generation, great expectations: A field study of the millennial generation." *Journal of Business and Psychology* 25.2 (2010): 281-292.
- Parry, Emma, and Peter Urwin. "Generational differences in work values: A review of theory and evidence." *International Journal of Management Reviews* 13.1 (2011): 79-96.
- Suslak, Daniel F. "The Sociolinguistic Problem of Generations." *Language & Communication* 29.3 (2009): 199-209. Academic Search Complete. Web. 2 May 2016.
- "The Generations." American Generations: *Who They Are and How They Live*. 8th ed. Amityville, NY: New Strategist Press, 2013. 5-32. American Consumer Series. Gale Virtual Reference Library. Web. 22 May 2016.
- Turner, Anthony. "Generation Z: Technology And Social Interest." *Journal of Individual Psychology* 71.2 (2015): 103-113. Academic Search Complete. Web. 1 May 2016.
- Waltman, John L., and Marcia Simmering. "Communication." *Encyclopedia of Management*. Ed. Marilyn M. Helms. 5th ed. Detroit: Gale, 2006. 85-89. Gale Virtual Reference Library. Web. 17 May 2016.



# “PULL YOURSELF UP BY YOUR BOOTSTRAPS” AN AMERICAN MYTHOLOGY

Gabrielle Fox

*ABSTRACT: In the United States an individual success does not equate a heightened level of effort on their part, nor is success more likely if one works harder. In short, we do not exist in a meritocracy, but we like to pretend we do. Phrases such as “pull yourself up by your bootstraps” are one such example of this pervasive and damaging mentality. These idioms are antiquated manifestations of systemic oppression primarily directed at communities of color. This ideology is damaging due to the fact that it masks itself as harmless encouragement, when in actuality it perpetuates systems of victim blaming, racial and gendered stereotypes and invalidates the lived experience of those effected by these systems of oppression. The ideology of “working harder” as expressed within the bootstrap mentality is an invalid solution for overcoming systematic adversity in the United States due to poverty’s cyclical nature, a discrepancy in quality of and access to education, and the existence as well as impact of racial and gender wage gaps.*

## Introduction

“Pull yourself up by your bootstraps!”, “All you have to do is put yourself out there!”, “If you just work hard enough you can achieve anything!” These American idioms all express the same ideology, that we exist in a meritocracy. A meritocracy is a society that operates in a vacuum void of systematic oppression. If anyone, anywhere merely works hard enough the seemingly cemented hardships of poverty, discrimination, illness, etc. become malleable and one can craft the life they wish. This is not our reality. Systematic oppression not only exists, but resoundingly impacts the lives of countless minoritized individuals. For these individuals, “working harder” is not a viable solution and the meritocracy is a hollow savior. The data to debunk this mythology exists, but we must first connect the dots of institutionalized oppression.

The validity of a meritocracy is founded in the assumption that we are all either one, on an even playing field from birth, or two, that equity can be attained once one reaches an age of independence from their adolescent socioeconomic situation. These are invalid

assumptions for dealing with systematic adversity in the United States due to poverty’s cyclical nature, a discrepancy in quality of and access to education, and finally the existence as well as impact of racial and gender wage gaps.

## Unlivable Sums

In order to understand why the bootstrap mentality is damaging, it is critical that we pinpoint who it is damaging. Generally, this phrase is directed at three main demographics: those in poverty, people of color and women, especially women of color. Individuals are additionally targeted by this mentality if they exist in more than one of the aforementioned categories. A significant amount of statistical evidence demonstrates that merely putting more effort in is not a viable solution for raising oneself out of poverty or overcoming racial and gender-based barriers.

The United States Census Bureau determines whether or not one is “impoverished”. An individual is considered in poverty if “a family’s total income is less than the family’s threshold...” (United States Census Bureau, 2019). A “poverty threshold” is the minimum amount the Census Bureau deems necessary

for an individual to provide oneself with basic necessities annually. The Census Bureau uses the poverty threshold as a “statistical yardstick”, meant to generally reflect a family’s yearly economic needs. (United States Census Bureau, 2019.) According to the University of Michigan’s article *Poverty in the U.S.*, the 2018 poverty threshold for a single individual under 65 years of age was \$13,064 per year. This sum is meant to cover all of the individual’s needs i.e. housing, utilities, food, water, transportation, clothing, health care, education, etc. Everything one needs within the span of a year is not to exceed \$13,064. In order to determine whether or not one is impoverished, the Census Bureau subtracts this number from the individual’s income.

It is important to note that the amount of income the Census Bureau uses for this calculation is the pre-tax total. Meaning the amount of money one actually receives after federal and state income tax is taken is not the number they are using to calculate poverty thresholds. If the sum is any amount over their calculated threshold, the individual is not considered in poverty. This categorization does limit one’s options for governmental financial assistance.

Poverty thresholds nominally increase as children or adults are added to households. The 2019 Census Bureau poverty threshold for a two-person household is a combined pre-tax income of \$17,120. For a two-person household with one child ranging anywhere from 0-18 years of age the poverty threshold only increases by \$502, to a combined annual income of \$17,622. (United States Census Bureau, 2020.) Additionally, the Census Bureau does not include every U.S. citizen in their poverty census. On their website they state, “Poverty status cannot be determined for people in: Institutional group quarters (such as prisons or nursing homes), college dormitories, military barracks, living situations without conventional housing ...[and] foster children... under age 15.” (United States Census Bureau, 2019.)

Thus, the vast majority of the homeless population is not counted in the U.S. poverty census. Nor are those living on college and university campuses, foster children under the age of 15, or those in institutionally controlled housing such as nursing homes, hospitalized individuals, prisons, etc. This is exceptionally problematic due to the fact that those who occupy the lowest level of economic standing in this country are not being counted. Therefore, all data concerning the economic health of U.S. citizens is invalid because we are not counting those who suffer the most.

When examining the demographics of individuals who do meet the Census Bureau’s criteria for poverty, we also see patterns. According to the University of Michigan, “poverty rates for Black and Hispanic people greatly exceed the national average. In 2018, 22.5% of Black people and 18.8% of Hispanic people were poor... and 10.8% of Asian people.” (University of Michigan, 2020.) While Black and Hispanic poverty demographics were given on the U.S. Census Bureau website, there was no quotable information to be found regarding current percentages of Native American poverty proportions. However, an article published by Pew Research Centers in 2014 states that “Native Americans have a higher poverty and unemployment rate when compared with the national average... About one-in-four American Indians and Alaska Natives were living in poverty in 2012” (Krogstad, 2014). This would make Native Americans the most impoverished demographic in the United States, with a poverty rate of 25%. However, this cannot be confirmed, as their data is not given.

It is inescapably clear that the monetary sums that qualify for the U.S. poverty level are unlivable. One needs significantly more money when adding a child to their household, considerably more than the \$502/year that the Census Bureau deems necessary. It is evident that if a two-person household is only collecting a yearly pre-tax income anywhere in the



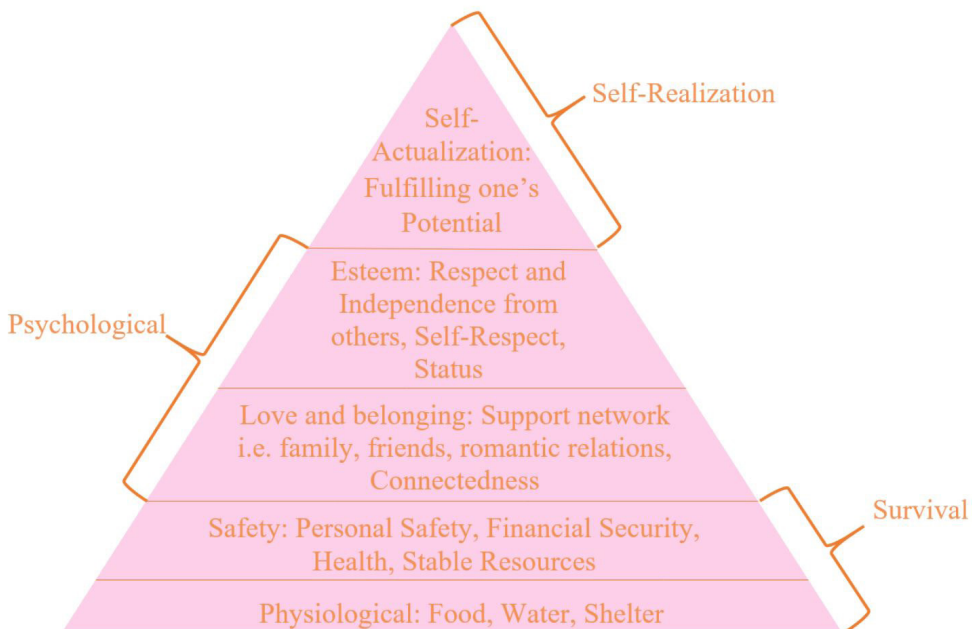
neighborhood of \$17,120, they are struggling. (United States Census Bureau, 2019). Instead of collecting data and examining the actual reasons for these issues continue to exist, society chooses to blame the victim. “They’re just lazy.” “They don’t work hard enough.” “They’re just relying on government handouts.” Those in poverty are frequently accosted with these ignorant remarks who according to the data, are predominantly people of color. This is not to say that all people of color are poor. However, according to the data if one is struggling with poverty, they are more likely to be of color than white. This level of subjugation did not just happen overnight but has been enforced and perpetuated for centuries due to the system’s cyclical nature.

### Unveiling Cyclical Poverty

Pulling yourself up by your bootstraps, or rather “working harder” is not a viable or even relevant solution for those struggling with poverty. Given the unlivable sums previously stated we can deduce that an individual receiving nominal wages has no financial autonomy. Thus, they do not possess the financial security

that would allow them to leave said positions in order to pursue upward mobility in society. When one is struggling to secure food, shelter, or other basic necessities for themselves as well as their dependents, walking away from a source of income is not an option. This theory is further supported by Maslow’s Hierarchy of Needs.

In 1943 the American psychologist Abraham Maslow published a paper called “A theory of Human Motivation”. In the paper he defined the five major levels of human need, where each level must be satisfied and built upon if one is to optimally move to the next (Maslow, 1943). The first two levels outline physiological necessities including food, water, shelter, and security. Those who live in poverty endeavor to provide these resources for themselves as well as their dependents with inadequate funds. As a manifestation of survival instincts, they exert themselves exceptionally hard to secure a consistent source of income. This fact flies in the face of the Bootstrap mentality. Teetering on the brink of stability as well as survival draws one into cyclical poverty, regardless of how hard they are working.



*Maslow's Hierarchy of Needs (1943). Image: Gabrielle Fox.*

## Knowledge is Power

Moving forward with the understanding that poverty is cyclical we are forced to question, what strategies do proponents of the Bootstrap mentality cite as making such adversities malleable? Primarily, education and money are referenced as solutions. It is commonly said that knowledge has the power to liberate. Whether that be a financial, mental, or emotional liberation remains to be seen. However, in terms of finances, the U.S. Bureau of Labor Statistics estimates that those with less than a high school diploma have a median earnings estimate of \$520/week. While those with at least a bachelor's degree have a median earnings estimate of \$1,173/week (Torpey, 2018).

While the evidence does support the conclusion that higher education levels lead to higher income amounts, there is data to also demonstrate a discrepancy in quality of and access to education in the United States. Realistically, how accessible is higher education for those struggling with adversity? Furthermore, does the K-12 education system equally and equitably prepare each individual for higher education opportunities?

In order to examine the quality of education U.S. institutions provide their students, it is worth knowing how much funding they are able to spend on their students, staff, and materials in the first place. Public schools are funded through three main avenues: federal, state, and local funding. According to an article published by NPR in 2016, public school funding on average is 45% local money, 45% state and 10% federal (Turner, 2016). Essentially the federal government contributes only 10 cents of every dollar that public schools receive. In turn, state funding relies heavily on their sales and income tax. The discrepancy of funding and further the discrepancy in quality of education, comes into play with the amount gathered by the local governments, which are reliant upon property taxes. This amount accounts for nearly half of a school's funding.

“The problem with a school-funding system that relies so heavily on local property taxes is straightforward: Property values vary a lot from neighborhood to neighborhood, district to district. And with them, tax revenues” (Turner, 2016). Thus, if one lives in a low-income neighborhood, their district schools are also low-income. Schools such as these have significantly less ability to provide quality materials, update buildings, and provide livable wages for teachers and staff, etc. based on the amount of funding received. Again, we are forced to consider Maslow's Hierarchy of Needs. These institutions are meant to educate students, but they too must prioritize necessities in order to keep themselves afloat. The nominal funding they receive must be first put towards their bills, teachers, and staff. They must provide food for students as well as educational materials. Given that nearly half of their funding comes from the surrounding neighborhood, it becomes obvious that this amount is not nearly enough. Poverty is cyclical and institutions that reside within these neighborhoods are no exception to their monetary struggle.

The ability of public schools to successfully prepare their students for higher education, as well as provide quality fundamental knowledge is reliant upon the funding they receive. Can we realistically expect one to pull themselves up by their bootstraps, when the quality of primary education they receive has not given them the basic tools required to succeed? Further, with the cost of higher education steadily growing, how is one supposed to accommodate a massive financial undertaking, when their access to basic necessities is insecure? Where is this money supposed to come from when it is obviously not coming from the federal government, and local governments have nothing more to give? The notion of liberating oneself through education only holds true for those who receive the proper resources and information in order to attain this goal.

## Wage Gap

Attaining the monetary resources to lift oneself out of adversity is the last pillar of the Bootstrap myth and perhaps, the farthest out of reach. First, let's suspend reality and pretend an individual in a low-income neighborhood received a primary school education that prepared them for college and beyond. Second, this individual was given the financial advice and tools required to navigate the financial aid system that made the four+ year endeavor moderately feasible. Third, they will need to receive their degree and find stable employment post-graduation. Even if all these hoops are jumped through, the individual will still find themselves in a world where minoritized groups do not earn the same amount of money as white men do in the workplace.

Pew Research Center published an analysis of income levels in 2016 called Racial, gender wage gaps persist in U.S. despite some progress. This article analyzes the 2015 median hourly wage data given by the U.S. Bureau of Labor Statistics. Pew found a discrepancy of wages earned based off of race as well as gender in comparison to white men. In descending order:

1. "Asian women earned...87 cents per dollar."
2. "White women earned 82 cents per dollar."
3. "Black men earned 73 cents for per dollar."
4. "Hispanic men earned 69 cents per dollar."
5. "Black women earned 65 cents per dollar."
6. "Hispanic women earned 58 cents per dollar."

It is also notable that there has been "no progress in narrowing the wage gap...[for] Black and Hispanic men since 1980." (Patten, 2016.)

While these particular wage discrepancies can partly be attributed to level of education, we still find racial and gendered wage gaps among college educated persons. This wage discrepancy is as follows: "Black and Hispanic men earn 80%... White and Asian women earn 80%... [and] Black and Hispanic women earn

70%..."of what similarly educated white men earn.(Patten, 2016.)

Across race and gender differences there is a consistent underpaying of minoritized people. The fact that the aforementioned studies found little to no progress in decades is exceptionally troubling. It speaks to the level of effort society, institutions, and the government as a whole have invested in this issue. We know that this monetary disparity considerably and generationally impacts the lives of those who are discriminated against. Yet, society appears to be uninvested in creating and enforcing permanent solutions, for this struggle which spans centuries.

## Conclusion

How can we realistically expect minoritized groups to lift themselves out of adversity, when even with the attainment of the Bootstrap myth's "solutions", monetary resources are still not equitably distributed? The answer is we cannot. Society has repeatedly and consistently placed institutionalized walls in front of minoritized groups, which ensure a pattern of hardship. A pattern which those in power have little intention of supplying aid to overcome, other than to spout meaningless and frankly inflammatory idioms such as "pull yourself up by your bootstraps." What was not anticipated however, was that these adversities would force minoritized groups to develop an unparalleled level of resiliency. We have made it our mission to pull ourselves out of darkness, as no one else will. It has been our responsibility to cultivate this resiliency, generation after generation for survival. The survival of our people, our voices, our stories, and our inner strength is what will ultimately and has already created change. A professor of mine once said, it is the job of those who benefit from a system of oppression to dismantle it. It is then our job, to make it inescapably clear that the system was broken to begin with.

## References

- Krogstad, Jens. One-in-four Native Americans and Alaska Natives are living in poverty. Pew Research Center. June 2014.
- Maslow, Abraham. A Theory of Human Motivation. *Psychological Review*. 1943.
- Patten, Eileen. Racial, gender wage gaps persist in U.S. despite some progress. Pew Research Center. 2016.
- Torpey, Elka. Measuring the Value of an Education. Career Outlook. U.S. Bureau of Labor Statistics. April 2018.
- Turner, Cory. Why America's Schools have a Money Problem. National Public Radio (NPR). Pub. April 2016.
- United States Census Bureau. How the Census Bureau Measures Poverty. Aug.2019.
- United States Census Bureau. Poverty Thresholds by Size of Family and Number of Children 2019 Data. Jan 2020.
- University of Michigan. Poverty in the U.S. Poverty Solutions – University of Michigan. 2020.

# POLICY BRIEF: MANDATORY VACCINATIONS FOR PUBLIC HEALTH

Jessica Heitzman

*EXECUTIVE SUMMARY: Once considered a triumph of public health, immunizations have fallen victim to rumor and skepticism while scientific evidence takes a back seat; Washington state legislation needs to take action and eliminate all non-medical exemptions for vaccinations. Recently, Washington has reacted to a nationwide measles outbreak by tightening exemptions on the measles, mumps and rubella (MMR) vaccine to exclude personal and philosophical reasons, but still allows for religious and medical reasons (Caron, 2019). However, will this be the case for every disease outbreak, a reactionary response? We can choose to act now and save lives and costs by eliminating all but medical exemptions from immunizations for public and private schools as well as early childcare. “Vaccines can prevent infectious diseases that once killed or harmed many infants, children, and adults. Without vaccines, your child is at risk for getting seriously ill and suffering pain, disability, and even death from diseases like measles and whooping cough” (Centers for Disease Control and Prevention [CDC], 2019). The dangers of not instituting stricter requirements include outbreaks of preventable contagious diseases among healthy individuals, susceptibility of the medically vulnerable, and extraordinary healthcare costs. In a single year the economic burden of diseases in the United States that are preventable with vaccines are estimated at \$9 billion (Ozawa et al., 2016). The focus for vaccination needs to begin with public schools, private schools, and childcare centers because they are not only a potentially vulnerable population, the individuals are in close proximity to one another and the environments are perfect vectors for transmission of contagious diseases. Additionally, requiring immunizations of the young will target whole generations and substantiate a foundation for disease eradication.*

## Background & Significance

Vaccines trace their origin to the late 18th century and since then have been studied, improved, and developed to eliminate debilitating and deadly diseases, improving public health and quality of life for millions across the globe. Unfortunately, in the late 1990s a physician published a study that linked vaccinations to autism; this has since been debunked and the physician stripped off his medical license. While skepticism has been around since the origin of immunizations, this effectively sparked the fire that has raged into the anti-vaccine movement scientists are up against today. This movement, and activists that support this, make false claims about the science and ingredients of vaccines. If children

are unable to attend school because they are suffering from a preventable disease, that grossly impacts education for many and can in turn impact quality of life. The fearmongering and uncertainty for parents adds to their stress when seeking the right decisions for their children's health; the anti-vaccine movement has even gone so far as to target certain minority groups (Caron, 2019). Due to the decline in vaccination rates the World Health Organization has listed this among the top 10 greatest global health threats (Berg, 2019).

Currently the Washington Administrative Code requires that a child be vaccinated against or show proof of immunity for eleven preventable diseases: Chickenpox (Varicella), Diphtheria, German Measles (Rubella),



Haemophilus influenzae type B disease, Hepatitis B, Measles (Rubeola), Mumps, Pneumococcal disease, Polio (Poliomyelitis), and Whooping cough (Pertussis) (Washington State Legislature [WSL], 2014). However, parents can choose to exempt their children from any vaccine except MMR (only religious or medical) for personal, philosophical, or religious reasons (Washington State Department of Health [WSDOH], n.d.). This does not cast a wide enough net of protection for the health of the general public. Some diseases have been completely eradicated from parts of the world and now we see a resurgence as fewer people are being vaccinated. The Centers for Disease Control and Prevention (CDC, 2019) reports, “The United States has had more than 1,000 cases of measles in 2019. This is the greatest number of cases reported in the U.S. since 1992 and since measles was declared eliminated in 2000.” Protecting the entire population from infancy with legislative measures for this public health initiative should be a high priority and action must be taken promptly.

### **Opposing Arguments**

Loopholes currently exist to vaccination regarding religion, personal beliefs, and philosophical beliefs which are compounded by theories that vaccines themselves or certain ingredients are unsafe. Also, there is the concern that there are plots between pharmaceutical companies and government entities that drive mandatory vaccine legislation (Gutierrez, Luna, & Myers, 2019). The anti-vaccine movement has a lot of power behind it with adamant political opponents and celebrities. Even a google search with the word vaccine yields conflicting results. Another challenge with creating mandatory vaccination legislation is the cost to low income families, a problem for which the CDC has already developed a solution.

Religious groups condone the risk versus benefit approach to vaccination, accepting what is best for all. If there are components that are

not generally acceptable, such as ingredients containing pork in Islamic law, but there is not an acceptable alternative to the vaccine, the vaccine supports the greater good and health of the community and is thus acceptable to receive (Pelčić et al., 2016). According to McNeil (2019b), “[r]eligious authorities have meticulously studied how vaccines are made and what is in them, and still have ruled that they do not violate Jewish, Islamic or Catholic law.” While Catholic law represents a large Christian denomination, others including Mormons, Episcopalians, Lutherans, and others endorse vaccinations including requiring that school children be vaccinated and affiliated hospitals distribute them (McNeil, 2019b). To this end, it can be surmised that personal opinions exist among individual factions, not the religious body, and does not justify the risk to population health. As Pelčić et al. (2016) states, “[t]he majority of religions respect life as a basic value and therefore oppose the use of vaccines derived from aborted human fetuses (Catholicism) or any form of life (Buddhism). But if these vaccines serve to protect many more lives they are permitted” (p. 520). The biggest concern with religious exemptions is the potential for a disease to spread among unvaccinated communities. For example, a measles outbreak in New York in 2019 was attributed to Orthodox communities, who widely dispel vaccination. This is the same year Members of the community had traveled to Israel and contracted the highly contagious disease, allowing their communities to be vectors for the wider population (McNeil, 2019a).

Careful improvements and changes to vaccinations over more than two centuries have helped to ensure the safety and availability of vaccinations. Adverse reactions to vaccinations are very rare and closely monitored by the CDC. In fact, the chances of having a serious reaction to a vaccine are 1 in a million, and the reportedly dangerous ingredients in vaccinations are commonly found in everyday items or exist in similar quantities inside our own bodies (CDC,

2019).

Furthermore, while there may be benefits for pharmaceutical companies if there is a surge in vaccinations, the benefits are undoubtedly more favorable for the public and are cost effective. The cost to receive a vaccine is substantially lower than the cost of medical care after contracting a preventable disease. To this end, insurance companies cover the cost of most vaccinations, but the CDC has the Vaccines for Children Program (VFC). The VFC covers the cost for kids who are under 19 years of age and fall under any of the following: Medicaid-eligible, uninsured, underinsured, and American Indian or Alaskan Native (CDC, 2016).

### Implications & Recommendations

Vaccinations are a safe, effective, fiscally responsible solution to potential outbreaks of preventable diseases that can have life limiting and lethal consequences. Mandating immunizations for public schools, private schools, and childcare centers, and eliminating all non-medical exemptions for required vaccines establishes an essential foundation for the future of public health. Allowing the anti-vaccine movement to continue to gain momentum and permitting accessibility to loopholes can propagate a healthcare crisis, just like the measles outbreak in Washington in 2019, can occur at any time. If there is an opportunity to potentially eradicate vaccine-preventable diseases the time is now, before another outbreak has us wishing we would have done something sooner.

### References

- Berg, S. (2019, November). Restoring trust in vaccines. *American Medical Association Moving Medicine Magazine*, 13-18.
- Caron, C. (2019, June 14). Vaccine laws are changing. Here's what you need to know. *The New York Times*. Retrieved from <https://parenting.nytimes.com/health/vaccine-exemptions-measles>
- Centers for Disease Control and Prevention. (2016). About VFC. Retrieved from <https://www.cdc.gov/vaccines/programs/vfc/about/index.html>
- Center for Disease Control. (2019). Making the vaccine decision: Addressing common concerns. Retrieved from <https://www.cdc.gov/vaccines/parents/why-vaccinate/vaccine-decision.html>
- Gutierrez, M., Luna, T., & Myers, J. (2019, September 22). The hidden battle over California's new vaccine law. *Los Angeles Times*. Retrieved from <https://www.latimes.com/california/story/2019-09-21/sb276-california-vaccine-law-fight-gavin-newsom-legislature-how-it-happened>
- McNeil, D. G. (2019a, April 24). Measles outbreak infects 695, highest number since 2000. *The New York Times*. Retrieved from <https://www.nytimes.com/2019/04/24/health/measles-outbreaks-us.html>
- McNeil, D. G. (2019b, April 26). Religious objections to the measles? Get the shots, faith leaders say. *The New York Times*. Retrieved from <https://www.nytimes.com/2019/04/26/health/measles-vaccination-jews-muslims-catholics.html?module=inline>
- Fombonne, E. (2009). Epidemiology of pervasive developmental disorders. *Pediatric Research*, 65(6), 591-598. doi:10.1203/pdr.0b013e31819e7203
- Ozawa, S., Portnoy, A., Getaneh, H., Clark, S., Knoll, M., Bishai, D.,...Patwardhan, P. D. (2016). Modeling the economic burden of adult vaccine-preventable diseases in the United States. *Health Affairs*, 35(11). doi: 10.1377/hlthaff.2016.0462
- Pelčić, G., Karačić, S., Mikirtichan, G. L., Kubar, O. I., Leavitt, F. J., Tai, M. C.,... Tomašević, L. (2016). Religious exception for vaccination or religious excuses for avoiding vaccination. *Croatian Medical Journal*, 57, 516-521.
- Washington State Department of Health. (n.d.). School and childcare immunization. Retrieved from <https://www.doh.wa.gov/CommunityandEnvironment/Schools/Immunization#laws>



# RACIAL DISPARITIES IN ACUTE MYELOID LEUKEMIA SURVIVAL RATES: A MIXED METHOD ANALYSIS OF CONTRIBUTING FACTORS

Aaron Davis

*ABSTRACT: In the United States leukemia cancer patients of color continue to have lower overall survival outcomes compared to Caucasian leukemia patients, yet existing research does not detail what factors are contributing to a disparity in survival. This proposal aims to explore the impact variables such as transportation access, insurance status, and stage of cancer at diagnosis have in various populations ability to survive the cancer. Using a mixed method longitudinal study design with online survey elements, the proposal asks demographic questions, patient behaviors questions, along with socioeconomic status assessment, and utilizes qualitative narrative interviewing. The patients receiving active care for leukemia will be selected randomly from four chosen cancer treatment centers in the Greater Seattle area, those who agree to participate will continue with the study for five years. The results of the proposed study are expected to yield a greater understanding of factors that decrease the rates of leukemia survival in populations of color, with the intent of influencing better care and outcomes for those populations. It is imperative that we continue to investigate the underlying factors that lead to disparities in survival and we believe this proposal is an important step in advocating for equitable care.*

## Introduction

The prevalence of leukemia related cancers is on the rise, along with the death rates. The United States' annual estimated leukemia related death toll in 2015 was 22,840 people (LaRussaA, 2015). An estimated 60,300 new cases occurred in 2018, with the resulting death toll of 24,370 (Kandola, 2018). Leukemia is a progressive type of blood cancer in which the bone marrow produces abnormal platelets, white and red blood cells. The disease limits the patient's ability to fight and recover from infections. There are four common types of leukemia: acute myeloid leukemia (AML), chronic myeloid leukemia (CML), acute lymphocytic leukemia (ALL), and chronic lymphocytic leukemia. This study will be focusing on acute myeloid leukemia (AML), though background research referenced may include leukemia subtypes. The general survival rates for leukemia patients are not always favorable, and further review of survival rates shows that some demographics are less likely to survive than others for reasons not yet fully

understood. The proposed study aims to research and answer questions regarding the underlying factors that may be contributing to lower rates of survival for leukemia patients of color compared to their Caucasian counterparts. The research hypothesizes that if a leukemia patient is a person of color, then they will have a lower survival rate than that of a Caucasian leukemia patient. Such contributing factors this research will consider are the stage of diagnosis, family structure, and distance from treatment centers.

To understand the depth of these survival disparities, peer-reviewed studies were referenced in the development of this proposal. Much of the literature reviewed contained similar results, supporting that people of color statistically have lower blood cancer survival rates than Caucasian populations. According to the American Association of Cancer Research, African Americans have a seventeen percent increased risk of cancer-related death when compared to Caucasians, and Hispanics have a twelve percent increased risk

(AACR, 2011). Many of the studies referenced pulled data from the SEER database (Surveillance, Epidemiology, and End Results), a program of the National Cancer Institute (NCI) and a repository source of epidemiologic information on incidence and survival rates of cancer in the United States. This research has the potential to reshape how professionals approach treatment plans, health interventions, and attempts in promoting health equity with the goal of improving the survival outcomes for marginalized communities.

In looking specifically at how AML patient survival outcomes can change over time, a Plos One journal article, which studied the United States population between the years of 1973 to 2014, was referenced to get a baseline understanding of the disparities in the survival of adult leukemia patients (Utuama, et al., 2019). The longitudinal study collected data from the SEER database with the results stratified by the race, age, and sex of the patients. The outcome of this study showed that African Americans had the lowest rate of leukemia survival among races (Utuama, et al., 2019). The data also concluded that Asian populations had the greatest improvement in survival over the course of the study. This data prompted further questions into why African American populations have not had the same level of improvements in overall survival despite medical advancements.

Additional longitudinal research that provided perspective included a cohort study which tracked the trends in survival and incident rates of leukemia patients. The study reported: 66,404 cases from 1972 to 1998 found that African Americans had a lower prevalence of leukemia diagnosis than Caucasians (Xie, et al., 2003). A study published in Clinical Lymphoma Myeloma and Leukemia also concluded lower survival rates among racial minorities but looked at patients specifically with hairy cell leukemia, a slowly progressing blood-borne cancer (Giri, et al., 2015). Findings from these studies support the idea that survival rates vary by race, with each study acknowledging a lack of understanding into why. This is an opportunity to explore contributing factors that have likely been overlooked.

## Research Question and Hypothesis

“The cancer death rate for African-Americans is 25 percent higher than Caucasians, and Hispanics and Latinos are more likely to be diagnosed with cancer at a later, and more dangerous, stage of the disease” (Blakemore, 2018). The question this study aims to ask is: what factors are leading to racial disparities in acute myeloid leukemia patient survival? The research hypothesis is: if a leukemia patient is a person of color, then they will have a lower survival rate than that of a Caucasian leukemia patient, with the independent variable being race, and the dependent being survival. The present study examines possible contributing factors such as socioeconomic status, stage of diagnosis, age, race, and transportation barriers that could affect the survival gap.

## Background

The stage of diagnosis and the age of patients at the time of diagnosis are variables of great interest due to the impact diagnosis timing has on overall survival. The SEER database was used in a study published in Scientific Reports journal which looked at the stage and age of diagnosis among races with leukemia subtype cancers. The study reviewed data from predominant United States races (African American, Native American, Asian/Pacific Islander, Hispanic, Caucasian) and showed that significant differences existed between race and age of the patients at the time of diagnosis (Zhao, et al., 2018). African Americans were more likely to be diagnosed at a later age and stage of cancer, with associated lower overall survival rates. An additional peer-reviewed study researching diagnosis in races presented alternative outcomes, stating that African American patients with a leukemia diagnosis at a younger age had worse survival rates when compared to that of Caucasian patients (Shenoy, et al., 2011). Upon reviewing this supplemental research, it appears that confounding factors and additional variables need to be studied to further understand the causes of survival disparities. The proposed research will examine the association between diagnosis time frame and survival outcomes.



Transportation is a contributing factor that may also have significance in survival outcomes by affecting the number of treatments a patient can attend. In a review of articles about healthcare accessibility and utilization, a qualitative study of reported attitudes and behavior trends with a population of 1,059 households in North Carolina was considered. This study presented by the Journal of Rural Health addressed concerns of patients having little transportation access to utilize healthcare in rural areas (Arcury, et al., 2006). The results found that patients who used public transportation or had access to a vehicle had a higher chance of using the healthcare provided in that area. This information was taken into consideration since cancer patients receiving active treatment are typically very weak and may need to rely on others to get them to their appointments. An opportunity exists to review the relationship between transportation accessibility and survival.

The role of insurance in impacting survival rates for AML is another relationship of interest. A population-based study published in the Cancer scientific journal describes how a patient's insurance status at the time they were diagnosed affected the overall survival of that individual (Perry et al., 2017). The five-year-long longitudinal study involving 5,784 patients concluded that patients 65 years old and on Medicaid had a significantly lower survival rate than those who had private insurance. Patients who were younger than 65 or who did not have insurance also had a lower survival rate when compared to those with insurance. With the costs of insurance rising and wages stagnating, it is important to consider how those that are in a lower socioeconomic status may have different health outcomes; "80% of the racial life expectancy gap between Black and Caucasian men could be attributed to socioeconomic factors" (Carlson, 2019). The study population will be reviewed to see which racial groups may have a higher likelihood of being uninsured, or in low socioeconomic status.

The supplemental and background research used in the development of this study supports the existence of race-based disparities in leukemia survival. The proposed research will expand the lens

by which practitioners view diagnosis, treatment, and survival outcomes in different populations, and promote equitable care solutions. This proposal will go through a methodology of how the study will be conducted safely and ethically. Peer-reviewed journals have assisted in establishing a general understanding and direction for the research to focus on, as well as significant gaps that need addressing.

## Method

### Study Design

A mixed method study design shall be used incorporating cross-sectional, longitudinal, quantitative, and narrative approaches. A cross-sectional design is most appropriate for this proposal since the aim of the study is to record and track patient behaviors and attitudes concerning health outcomes annually over a five-year extended period. This design allows the research to address both qualitative and quantitative data. Utilizing a convergent mixed method approach, this study will allow researchers to establish a patient baseline regarding the stage of diagnosis, prognosis, access to transportation, insurance status, socioeconomic status, and immigration status using a survey. The quantitative patient-reported data will be analyzed and then used to generate more targeted questionnaires and research directions. Qualitative narrative interviews with individually selected patients from a smaller sample of the larger population will also be conducted to discuss their experience with cancer treatment, progression, and survival.

The longitudinal approach is needed for this study to accurately assess disparities in survival among racial groups. The relative rate for cancer survival is set at five years from the time of diagnosis (NCI, 2019), which makes the longitudinal method most appropriate for the research purposed. For the collection of quantitative data using the total population of participants, a survey will be utilized due to the cost-effective nature, standardization, and convenience for both participants and researchers to discuss the behaviors and assign a numeric value to the trends. The survey will be multiple choice and contain structured questions that are open and

closed-ended. A website will be created to house the survey and permission gathered to collect the response data. Researchers will follow participants for five years after collecting the initial baseline data. Baseline questions will be asked again annually along with annual narrative interviews of the patient experience.

### **Sampling and Population**

This convergent mixed-method study will have 3000 adult participants between the ages of 20-50, whom all are currently diagnosed with acute myeloid leukemia (AML). The participant racial backgrounds will be a mix of persons of color and Caucasian people. Additionally, the participants will all be in active treatment at one of the four following Greater Seattle cancer treatment centers/hospitals: Lifespring Cancer Center, Seattle Cancer Care Alliance, UW Medical Cancer Center, Swedish Medical Oncology. The research sampling will include subgroups representative of the predominant United States racial groups which include African/African American, Native American, Hispanic, Asian/Pacific Islander, Caucasian, the sex of participants and socioeconomic status.

### **Proposed Sample & Sampling Techniques**

In the selection of participants, a combination of cluster sampling and quota sampling techniques will be utilized. Researchers will be targeting the group of acute myeloid leukemia patient populations within the chosen oncology centers databases. Recruiting will take place within the treatment centers via advertisements on posters and the clinic websites that contain the study information and objectives. Clinic support groups, promotions from physicians, and an email campaign for those subscribed to the clinic's mailing list will also be utilized to reach potential participants. The pool of individuals willing to participate will not include anyone who has previously had any other form of cancer. The participants will be broken into clustered groups distributed by race (African/African American, Native American, Hispanic, Asian/Pacific Islander, Caucasian). Additional quota sampling will be applied second to ensure the cluster samples include each sex (male, female), and economic

status variation; those above 2018 Seattle median income of \$93,500, and those below (Guy, 2019). The outcome will be population groups of different races that contain both sex groups and levels of economic status. Random selection will take place from these clustered groups, and confidentiality applied to those selected. The clustered quota sampling will allow for equal opportunity among the larger available population while ensuring researchers have enough diversity to represent the larger population with just 3000 participants. For the selection of participants who will take part in the narrative interview, judgment-based sampling will be done so that researchers can identify patients who can answer interview questions with reduced risk of traumatization or distress.

### **Operationalization and Measurement**

For this study, the independent variable is the race of the participants; defined as African/African American, Native American, Hispanic, Asian/Pacific Islander, and Caucasian. The dependent variable is survival (the continued state of living or existing by medical standards) after five years from the original diagnosis; while death may occur, it cannot be attributed to another disease. Other possible variables being considered include immigrant status, stage of cancer, stage and age of diagnosis, insurance status, family type, and distance from treatment centers. This study will define acute myeloid leukemia as a type of rapidly progressing cancer that results from the bone marrow producing abnormal white blood cells, red blood cells, and platelets.

The participants will be asked to complete an annual survey over the course of 5 years that will contain multiple-choice close-ended and open-ended questions. The survey will ask self-identifying demographic data such as participant age, family status, race, insurance status, and immigration status, in addition to diagnosis-related questions like the age and stage of the acute myeloid leukemia diagnosis, and prognosis. The multiple-choice questions will ask about access to transportation and socioeconomic status. The initial survey will be used to establish a baseline for each patient and

assess current health status, accessibility, and any further confounding variables to consider.

In addition to an annual survey given over five years, judgment selected patients from the cluster samples will be allowed to provide a narrative interview with researchers. These interviews should help provide qualitative data on participant attitudes and behavior trends. Example questions that might be asked in the interviews include, “how likely are participants to miss a treatment/appointment?”, “how reliable is patient transportation to appointments?”, “Is the cost of treatment concerning or challenging?”, etc. The narrative interview answers will be measured using a 4-point rating system, with secondary questions as needed. An example of the rating will go as follows: How likely are you to miss an appointment due to transportation challenges? Answers: very likely (1 point), somewhat likely (2 points), somewhat unlikely (3 points), not likely (4 points). Score data will be charted and assessed whether the participant has more positive or negative health behaviors that may influence survival; scores <50 will indicate more positive behaviors, while >50 will indicate more negative behaviors. Data from the selected treatment centers will also be collected and reviewed to record the annual status of the patient’s survival, in addition to any changes in prognosis or diagnosis. Clinical data such as progression/regression of the disease, treatment plan, and missed appointments will also be recorded for review.

### **Data Collection**

The data for this research will include collections from the cancer treatment centers databases, self-reported surveys, and narrative interviews. The data will be collected for the duration of five years from an initial patient cancer diagnosis. Participants will be given full disclosure of the research project, the data that will be collected, the purpose and benefits of the research, and the future use. Participants will also be given a full informed consent form, and they will reserve the right to leave the research study at any time. Once researchers have obtained consent forms, participants will be given annual self-reported surveys that speak to diagnosis, status, and

access challenges. Researcher selected participants from cluster groups will be interviewed in-person to provide personal experiences. The narrative interviews will assess patient behaviors, attitudes, and trends concerning acute myeloid leukemia treatment and survival. The narrative interview answers will be measured using a 4-point rating system using the following example guideline: very likely (1 point), somewhat likely (2 points), somewhat unlikely (3 points), not likely (4 points). Data will be scored and reviewed alongside survey data and treatment centers data collected to see if relationships between self-reported behaviors and attitudes, diagnosis progress, access, and overall survival correlate.

### **Analysis**

In this study, we will be using multivariate analysis to look at underlying factors such as transportation, socioeconomic status, and insurance to the survival of acute myeloid leukemia in different race populations. A combination of self-reported interview data such as behaviors, understanding, attitudes, and trends, alongside surveys and clinical data on attendance, treatment progress, and cancer stage, will also be analyzed. Qualitative data will be analyzed using applied coding. Researchers will use coding categories such as emotion, frequency, money, family, choices, causes, and sequence, to organize narrative interview responses. The coding will allow for organization and a better understanding of the trends and attitudes. Researchers will be assessing if there are stand-out factors among racial groups that may be influencing the survival of acute myeloid leukemia. With this combination of qualitative and quantitative data, we expect to find factors such as lower socioeconomic status, which statistically impacts people of color in higher numbers (Williams, 2016), influencing a patient’s ability to surpass the 5-year survival mark. We expect to find patients with self-reported survey scores of 50 points or greater to have more factors impacting their ability to survive the diagnosis than those with lower scores; those scores should also represent the impact among racial groups.

## Ethical Considerations

For the cross-sectional study, ethical considerations will be accounted for. Full informed consent will be obtained from participants and educational material distributed regarding what researchers will be collecting, how we will protect their data (secure databases with limited access, clinical records, confidentiality agreements, privacy clauses), and what we plan to use the data for along with why. HIPPA regulations will be followed for the storage and protection of all health data of participants, along with any additional rules in place at the cancer treatment facilities. Institutional Review Board approval will also be sought in terms of research plan approval and survey questions for participants to ensure the rights of participants involved during the study are protected. This study will also consider the potential for the emotional distress of participants during the narrative interviews. Therefore judgment-based selection will occur so that researchers who have established trust with the participants can gauge which individuals would be best to include. Interview participants will also be given the freedom to stop the interview at any time. While participants will not be encouraged by researchers to change their behaviors, precautions shall be taken regarding the wellbeing of the patient's health. If researchers and medical staff at treatment centers notice a trend in health decline and associated behavior, there will be an intervention and full disclosure of findings. In addition, the study will not continue with the participant.

## Discussion

### Significance

Acute myeloid leukemia (AML) is a broad category of cancers that affect white blood cells, with the survival rate depending on several factors. An estimate of 60,300 new cases occurred in 2018, with a resulting death rate of 24,370 (Kandola, 2018). These numbers are significant because they demonstrate that almost half of these new cases of AML resulted in death. The racial disparities in acute myeloid leukemia survivors in the greater Seattle area between the age groups of 20 to 50 years old were chosen as the target study

population for the study. The sample population consists of 3000 people with an equal set of males and females from each major American race group (African American/ African, Native American, Asian American Pacific Islander, Hispanic, and Caucasian). Participants sampled will contain diverse income levels and access to healthcare services. Different race groups with factors impacting survival such as stages of AML, socioeconomic statuses, the distance from treatment centers, and access to transportation to their treatment centers will be examined. This proposal holds significance due to documented differences in acute myeloid leukemia survival rates between people of color and Caucasian people. Existing studies have looked at the racial differences and survival rates amongst groups of patients, however, this study attempts to fill in persistent knowledge gaps by looking further into possible contributing factors.

The findings from this study will benefit society by adding to awareness of the racial disparities that are affecting the outcome of acute myeloid leukemia patients. Increased awareness may help address the disparity by providing steps for action and bringing additional preparedness in the treatment process. This would ideally contribute to the prevention of low survival rates in identified racial groups. Additional awareness and understanding of contributing factors may help in the development of population targeted public health programs aimed to assess and educate early-on. For example, a policy implementing education programs that provide resources such as insurance, immunization, childcare, screenings, and other health opportunities for disadvantaged people. Such a program could help medical professionals catch diseases earlier, educate patients about risks and behaviors, and have treatment plans with better overall health outcomes.

One of the main factors discussed in this proposal that has historically received little consideration is the effects of unreliable transportation on health outcomes. One study found that "Transportation barriers are often cited as barriers to healthcare access. Transportation barriers lead to rescheduled or missed appointments, delayed care, and missed or delayed medication use" (Syed, et al., 2014).



Improvement in transportation availability, especially in low-income areas at a lower cost may help patients attend their treatment sessions on time and regularly at their treatment centers. Applying similar research methods to other types of cancers or chronic illness with a lens that includes contributing factors such as transportation and access barriers could assist in understanding survival disparities for those illnesses as well.

## Limitations

Some possible limitations for this proposed study would be the loss of follow-ups. Participants that are no longer reachable could cause a gap of data in our research from a certain population of people. If 500 or more out of the people that were enrolled for this study choose to opt-out, there would be an impact in data collection. A patient's death before the five-year mark may also lead to insufficient data collected. This may result in the research not having enough well-rounded data to support the contributing factors for the racial disparity in acute myeloid leukemia survivors. Recall bias is also a possible limitation, due to participants not being able to remember information or past experiences accurately. This could result in false information being submitted on surveys or interviews. Additionally, there may be language barriers or challenges in obtaining correct diagnosis dates and experiences if the patients have been diagnosed in other countries. A lack of interpreters would limit researchers from recording data and shared stories from participants who do not speak English as a first language, therefore resulting in misinformation being recorded.

Immigration status could also be an issue, due to the detainment and deportation practices of the United States. Undocumented patients may be too afraid to get diagnosed when they know they are sick due to this barrier. An article from Health Affairs mentions that undocumented immigrants can apply for Medicaid coverage, however, the benefits are not as generous as they would be for a U.S. citizen. The article goes on to say that the immigrant's coverage is restricted to emergencies such as labor and long-term care (Goldman et al., 2005). We may

not be able to follow up with patients due to these coverage restrictions, which can result in data not being collected as thoroughly. The patient's stage of diagnosis could also be a limitation if a person is diagnosed in a later stage, their assessment of their health behaviors and attitudes going forward might not have an impact due to the advance spread of the disease. There is a chance that the participants of this study may not complete surveys annually which limits our data analysis. The patient's death before the five-year mark can lead to insufficient data collected. Lastly, generalization could be a limitation because the results we find within the Seattle area may not apply to a different city or state.

## Future Directions

Future research can be done to look more into the causes of racial disparities in Leukemia survivors. We focused on factors such as patients missing their appointments or treatments due to transportation barriers, stage of diagnosis, and age of diagnosis when compared with the race of patients to determine if those variables had an impact on Leukemia survival rates. Research in the future could investigate immigration status and how that affects Leukemia patients who are afraid or have limitations to access health treatments. Future studies can also focus on early Leukemia diagnosis at younger ages and compare their survival rates. Finally, larger sample size can be used for future studies to get more information as to why there are racial disparities from a wider range of people in various regions. Research from this study can be used as secondary information to help solve unanswered questions.

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## References

- American Association for Cancer Research. (2011, September 19). Death rate higher in minorities with acute leukemia, study finds. *ScienceDaily*. Retrieved November 24, 2019 from [www.sciencedaily.com/releases/2011/09/110919163952.htm](http://www.sciencedaily.com/releases/2011/09/110919163952.htm)
- Arcury, T., Preisser, J., Gesler, W., & Powers, J. (2006, June 06). Access to Transportation and Health Care Utilization in a Rural Region. Retrieved March 22, 2020, from <https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1748-0361.2005.tb00059.x?sid=nlm%3Apubmed>
- Blakemore, E. (2018, August 20). Why are Black and Latino Kids More Likely to Die of Certain Cancers? Retrieved from <https://www.npr.org/sections/health-shots/2018/08/20/640284696/why-are-black-and-latino-kids-more-likely-to-die-of-certain-cancers>.
- Carlson, R. (2019, March 8). The Racial Life Expectancy Gap in the U.S. Retrieved from <https://www.thebalance.com/the-racial-life-expectancy-gap-in-the-u-s-4588898>.
- EndPlay. (2017, February 11). 150,000 unauthorized immigrants live in Seattle area, Pew study finds. Retrieved from <https://www.kiro7.com/news/local/150000-unauthorized-immigrants-live-in-seattle-area-pew-study-finds/493101940>.
- Giri, S., Shrestha, R., Pathak, R., & Bhatt, V. R. (2015). Racial Differences in the Overall Survival of Hairy Cell Leukemia in the United States: A Population-Based Analysis of the Surveillance, Epidemiology, and End Results Database. *Clinical Lymphoma Myeloma and Leukemia*, 15(8), 484–488. doi: 10.1016/j.clml.2015.03.001
- Goldman, D. P., Zuckerman, S., Stimpson, J. P., Derose, K. P., Ku, L., Matani, S., ... Pourat, N. (2005, November). Legal Status And Health Insurance Among Immigrants. Retrieved from <https://www.healthaffairs.org/doi/full/10.1377/hlthaff.24.6.1640>.
- Guy, G. B. / F. Y. I. (2019, October 7). Seattle median household income soars - but wealth doesn't reach everyone, census data shows. Retrieved from <https://www.seattletimes.com/seattle-news/data/seattle-median-income-soars-to-93500-but-wealth-doesnt-reach-everyone-census-data-shows/>.
- Kandola, A. (2018, September 5). Leukemia survival rates by age. Retrieved from <https://www.medicalnewstoday.com/articles/322990.php>.
- LaRussaA. (2015, March 3). Facts and Statistics. Retrieved from <https://www.lls.org/facts-and-statistics/facts-and-statistics-overview/facts-and-statistics>.
- National Cancer Institute. (2019). NCI Dictionary of Cancer Terms. Retrieved from <https://www.cancer.gov/publications/dictionaries/cancer-terms/def/relative-survival-rate>.
- Perry, A. M., Brunner, A. M., Zou, T., McGregor, K. L., Amrein, P. C., Hobbs, G. S., ... Fathi, A. T. (2017). Association between insurance status at diagnosis and overall survival in chronic myeloid leukemia: A population-based study. *Cancer*, 123(13), 2561–2569. doi: 10.1002/cncr.30639
- Shenoy, P. J., Malik, N., Sinha, R., Nooka, A., Nas-toupil, L. J., Smith, M., & Flowers, C. R. (2011). Racial Differences in the Presentation and Outcomes of Chronic Lymphocytic Leukemia and Variants in the United States. *Clinical Lymphoma Myeloma and Leukemia*, 11(6), 498–506. doi: 10.1016/j.clml.2011.07.002
- Social Determinants of Health Series: Transportation and the Role of Hospitals: AHA. (2017). Retrieved from <https://www.aha.org/ahahret-guides/2017-11-15-social-determinants-health-series-transportation-and-role-hospitals>.
- Syed, S. T., Gerber, B. S., & Sharp, L. K. (2013, October). Traveling towards disease: transportation barriers to healthcare access. *J Community Health*. 2013;38(5):976–993. doi:10.1007/s10900-013-9681-1.
- Utuama, O., Mukhtar, F., Pham, Y. T.-H., Dabo, B., Manani, P., Moser, J., ... Luu, H. N. (2019). Racial/ethnic, age and sex disparities in leukemia survival among adults in the United States during 1973-2014 period. *Plos One*, 14(8). doi: 10.1371/journal.pone.0220864
- Williams, D. R., Priest, N., & Anderson, N. B. (2016). Understanding associations among race, socioeconomic status, and health: Patterns and prospects. *Health Psychology*, 35(4), 407–411. doi: 10.1037/hea0000242
- Xie, Y., Davies, S., Xiang, Y., Robison, L., & Ross, J. (n.d.). Trends in leukemia incidence and survival in the United States (1973-1998). *Cancer*, 97(9), doi: 2229-2235.10.1002/cncr.11588
- Zhao, Y., Wang, Y., & Ma, S. (2018). Racial Differences in Four Leukemia Subtypes: Comprehensive Descriptive Epidemiology. *Scientific Reports*, 8(1). doi: 10.1038/s41598-017-19081-4

# THE EFFECT OF NEUROTOXINS IN VACCINES AND PREGNANCY FACTORS ON AUTISM SPECTRUM DISORDER

Tyler Youn

*ABSTRACT: This study proposal aims to evaluate the relative strength of associations of the neurotoxin exposure from vaccinations and the parental health factors with the risk of autism spectrum disorder in offspring. The prevalence of autism spectrum disorder has recently increased in the U.S. Infants aged up to 6 months old in the U.S. have 14.7 to 49 times greater neurotoxin exposure than the U.S. safety limits from parental aluminum-adjuvanted vaccines. The thimerosal exposure from vaccines for healthy infants younger than 7 months increased from 75 µg in 1990 to 187.5 µg in 1999 and healthy children younger than 2 years had thimerosal exposure increased from 100 µg in 1990 to 237.5 µg in 1999. A 74% increased risk of autism spectrum disorder in offspring was found from pre-gestational diabetes. Children of overweight mothers indicated a 28% higher risk of autism spectrum disorder and children of obese mothers showed a 36% higher risk relative to children of mothers at normal weight based on body mass index. An 18% higher risk of autism spectrum disorder in offspring for every ten year increase in maternal age and a 21% higher risk for increase in paternal age were found. A case-control study design will be implemented evaluating non-probability convenience sampling from three hospitals in Washington State. A sample of 120 children with autism spectrum disorder and 180 children without autism spectrum disorder will be studied. Autism spectrum disorder is mostly acquired as early as 2 years of age and children between 2 and 5 years of age will be included in the study. Controls will be matched to cases on gender, birth weight, and residence in order to accurately measure the associations of the parental health factors and neurotoxin exposure with autism spectrum disorder for public health planning and implementation of autism etiology.*

## Introduction

Autism spectrum disorder (ASD) is a group of developmental disorders that involves repetitive patterns of behavior, cognitive dysfunction, and social impairment (Mohamed et al., 2015). Fombonne (2009) found that the prevalence of ASD in the U.S. has increased significantly in recent decades. The number of recommended pediatric vaccinations in the U.S. increased from 10 shots in the late 1970s to 32 shots in 2010 (Tomljenovic, 2011). As the prevalence of ASD and the number of recommended vaccinations has increased during the same period, the causal relationship between vaccines and ASD has been debated over time.

Aluminum, a commonly used vaccine adjuvant in hepatitis B vaccine, is a neurotoxin that may cause abnormalities during brain development in infants and children (Tomljenovic & Shaw, 2011b). Higher risk of ASD diagnosis was found among male neonates that received hepatitis B vaccines in the U.S. (Gallagher & Goodman, 2010). Similar to aluminum adjuvants, thimerosal preservatives in measles-mumps-rubella (MMR) vaccine was intensively debated due to neurotoxicity of thimerosal. However, many studies have revealed no significant association between MMR vaccination and ASD (Mrozek-Budzyn, Kiełtyka, & Majewska, 2010).

On the other hand, studies indicated that pregnancy factors may increase the prevalence of ASD. Maternal diabetes may play a significant role in ASD in offspring (Xu, Jing, Bowers, Liu, & Bao, 2014). An increased risk of ASD in offspring was reported for overweight and obese mothers (Wang, Tang, Xu, Weng, & Liu, 2016). An increase of ASD prevalence was found in advanced parental age groups (Wu et al., 2016).

Washington State had a pertussis epidemic in 2011 and 2012 with one of the highest vaccine exemption rates in the U.S. largely influenced by parents' fear of vaccine adverse effects such as ASD (Wolf, Opel, Dehart, Warren, & Rowhani-Rahbar, 2014). Therefore, this proposal aims to provide mixed research findings about neurotoxin exposure and describe how pregnancy factors play a role in prevalence of ASD. This proposal's research question is how are neurotoxin exposure and pregnancy factors associated with ASD in Washington State? The hypothesis is that a combined influence of neurotoxin exposure and pregnancy factors are positively associated with ASD in Washington State.

## **Background**

### **Neurotoxin Exposure**

Thimerosal preservatives that contain a neurotoxin, ethyl mercury, were commonly used in vaccines including MMR vaccine; the U.S. Public Health Service agreed to remove thimerosal preservative from pediatric vaccinations in 1999 (Schechter & Grether, 2008). Madsen et al. (2002) demonstrated that no positive association between MMR vaccination and ASD was found. Furthermore, Mrozek-Budzyn et al. (2010) found a lower risk of ASD among children vaccinated with MMR compared to children not vaccinated with MMR. On the other hand, there are studies that indicated possible evidences for the association of ASD with aluminum- adjuvanted vaccines such as hepatitis B vaccine.

Cumulated aluminum exposure from pediatric vaccines and ASD prevalence in the U.S. had a remarkably positive linear correlation from 1991 to 2008 (Tomljenovic & Shaw, 2011b). Tomljenovic and Shaw (2011b) showed that ASD prevalence was also highly correlated with the number of aluminum-adjuvanted vaccines given to infants aged 3 to 18 months old in Western countries including U.S., UK, Canada, Australia, Sweden, Iceland, and Finland. A significantly lower blood aluminum concentration was found in typically developed children compared to autistic children in Jamaica (Rahbar et al., 2016). Similarly, research revealed a lower level of aluminum in the hair of typically developed children compared to children with ASD (Mohamed et al., 2015).

Research indicated that newborns and infants are highly vulnerable to neurotoxins during early development of the central nervous system (CNS) (Tomljenovic & Shaw, 2011a). Based on the U.S. immunization guideline, infants aged up to 6 months old in the U.S. have 14.7 to 49 times greater aluminum exposure than the U.S. Food and Drug Administration safety limits from parental aluminum-adjuvanted vaccines such as hepatitis B (Tomljenovic & Shaw, 2011a). Gallagher and Goodman (2010) found that male neonates in the U.S. who received hepatitis B vaccines during the first month of life had a three times higher risk of an ASD diagnosis compared to boys who did not receive it. However, research not only suggested that the benefits of vaccination outweigh the risks of ASD but it also did not find the causal relationship between hepatitis B vaccine and ASD due to an insufficient sample size and missing vaccination records (Gallagher & Goodman, 2010).

Cumulative dose of thimerosal exposure from pediatric vaccines in the U.S. continued to increase and was greater than safety standard by 1999 (Schechter & Grether, 2008). The thimerosal exposure from recommended vaccines for healthy infants younger than 7 months increased from 75 µg in 1990 to 187.5

µg in 1999 (Schechter & Grether, 2008). Similarly, healthy children younger than 2 years had thimerosal exposure that increased from 100 µg in 1990 to 237.5 µg in 1999 (Schechter & Grether, 2008). After thimerosal was removed from or reduced in all pediatric vaccines, healthy infants younger than 7 months had less than 17.9 µg in 2004 while healthy children younger than 2 years had less than 40.2 µg (Schechter & Grether, 2008). Despite the exclusion or reduction of thimerosal in pediatric vaccines, the prevalence of ASD in 3- to 5-year-old children continued to increase from 1990 to 2004 (Schechter & Grether, 2008).

### **Pregnancy Factors and Confounders on ASD**

Xu et al. (2014) revealed a significant association between maternal diabetes and ASD in offspring. Research found a 74% increased risk of ASD for pre-gestational diabetes and a 43% increased risk of gestational diabetes respectively (Xu et al., 2014). Research suggested that exposure to hyperglycemia caused by maternal diabetes may cause hypoxia in the fetus (Eidelman & Samueloff, 2002). As a result, oxygen supply for fetus may be insufficient and may cause a higher risk of ASD in offspring (Burstyn, Sithole, & Zwaigenbaum, 2010).

Based on body mass index (BMI), Wang et al. (2016) found a 28% higher risk of developing ASD among children of overweight mothers and a 36% higher risk for children of obese mothers compared to children of mothers at normal weight; in contrast, research showed no evidence for the association between maternal underweight and risk of ASD. Additionally, Anderson et al. (2005) suggested that maternal obesity may increase neurodevelopmental disorders associated with the CNS birth defects in offspring from abnormal metabolism due to insulin resistance and hyperinsulinemia. Wu et al. (2016) revealed a positive association between advanced parental age and risk of ASD through meta-analysis. Research found an

18% higher risk of ASD in offspring for every ten-year increase in maternal age and a 21% higher risk for increase in paternal age (Wu et al., 2016). Younger mothers had a 10% reduced risk of ASD in offspring, while younger fathers had a 20% reduced risk of ASD in offspring (Wu et al., 2016). Durkin et al. (2008) indicated that mothers over 35 years old and fathers over 40 years old are more likely to have children with ASD. Additionally, older mothers had a 41% increased risk of ASD in offspring and older fathers had a 55% increased risk of ASD in offspring (Wu et al., 2016). Higher rate of abnormal fetal growth and preterm birth in advanced maternal age was associated with increased risk of ASD (Abel et al., 2013).

Mrozek-Budzyn et al. (2010) indicated potential confounders on ASD. Mothers of children with autistic symptoms took medication such as antibiotics and antihypertensive drugs more often during pregnancy compared to mothers of typically developed children (Mrozek-Budzyn et al., 2010). Autistic children had significantly more prenatal injuries than children without ASD (Mrozek-Budzyn et al., 2010). Gestation time less than 38 weeks was found significantly more often among autistic children (Mrozek-Budzyn et al., 2010).

### **Concerns of Early Childhood Vaccination in Washington State**

Henrikson et al. (2017) found that 42.2% of mothers at their baby's birth and 33.8% of mothers of toddlers at 24 months in Washington State were concerned about severe side effects from early childhood vaccination. In 2015, 34.2% of mothers of newborns and 24.9% of mothers at their children age 24 months in Washington State were concerned about safety of early childhood vaccination (Henrikson et al., 2017). Research indicated that 27.4% of mothers of newborns and 22.8% of mothers of children age 24 months were concerned whether a vaccine would be effective in preventing the disease (Henrikson et al., 2017).



It appears that the public's distrust of vaccinations in Washington State caused low vaccination rates in past years. Also, studies indicated that there are pregnancy factors and potential confounders associated with ASD. Therefore, this research aims to address how neurotoxin exposure and pregnancy factors are associated with ASD in Washington State through a case-control study design.

## **Methods**

### **Study Design**

This proposal will conduct a case-control study with a group of children diagnosed with ASD and a group of children without diagnoses of ASD and other disorders with symptoms similar to ASD. This research design will provide an adequate assessment of ASD prevalence in children by evaluating parental health factors and the level of neurotoxin exposure from childhood immunizations.

### **Participants and Sample Design**

A state-wide sample of 120 children diagnosed with ASD and 180 children without any symptoms or diagnoses of ASD in Washington State between 2 and 5 years of age will be studied since most cases of ASD are acquired as early as 2 years of age (Martínez-Pedraza & Carter, 2009). ASD signs or symptoms before 2 years of age will be considered congenital dysfunction and those participants will be excluded from the study in order to accurately measure the outcome potentially influenced by neurotoxin exposure from vaccines. The parental health factors in both cases and controls will be evaluated and compared with neurotoxin exposure to determine the relative strength of associations with ASD. The sampling method will be non-probability convenience sampling from two hospitals in King County and one hospital in Snohomish County. Cases and controls will be recruited from those three hospitals and controls will be matched to cases on gender, birth weight, and residence. Those three hospitals will be contacted for data collection.

## **Ethical Considerations**

Participation in this proposal will be voluntary and freedom of choice will be assured for all participants. More importantly, children are a vulnerable population and informed consent forms will be provided to parents of all participants to ensure beneficence and confidentiality. Consent forms will be reviewed and signed by parents prior to participation and any questions regarding this study will be thoroughly explained to parents along with the review of consent forms. Additionally, all researchers and assistants in this proposed study will receive certified Health Insurance Portability and Accountability Act (HIPAA) training prior to conducting research. All information and collected data will be confidential and strictly used for the purpose of this research. This proposal will be reviewed by the Institutional Review Board from hospitals and funders.

## **Measures and Variables**

This proposal aims to determine the relative strength of associations of the level of neurotoxin exposure from vaccination and the presence of parental health factors with prevalence of ASD in young children. Immunization records of cases and controls will be evaluated and ASD symptoms or diagnoses will be assessed by reviewing healthcare providers' comments in participants' medical records. Parental health factors will be assessed by reviewing parents' medical records during pregnancy. The diagnoses of diabetes, BMI, age and medication history of parents will be evaluated to determine pregnancy factors. This proposal has a multivariate analysis with independent, dependent, and other important variables. The independent variables are neurotoxin exposure from vaccines and pregnancy factors while the dependent variables are ASD symptoms or diagnoses. There are other important variables to consider such as neurotoxin exposure from parents' occupation and participants' residence areas. Parents will be contacted via phone and emails for HIPAA authorization for surveys



regarding occupation information. Parents will be followed up via phone and emails and surveys will be provided through emails or delivered to parents' healthcare providers' offices for physical pick up. Surveys will be collected electronically via emails, by mail, or at healthcare providers' offices. Surveys will have an open-ended question such as, "Could you please describe your job title and duties?" Any responses associating with potential risks of neurotoxin exposure, such as a factory manager position with duties of manufacturing heavy metal equipment, will be considered to have influences on the outcome. Data regarding participants' residence areas will be assessed by reviewing participants' addresses in medical records. Geographical data collected such as zip codes will be used to indicate any potential neurotoxin exposure from environment such as nuclear facilities in the area.

### **Procedures and Analysis**

This proposal will have multivariate analysis with aforementioned variables. The medical record departments of all three hospitals will be contacted via phone, email, and in-person visits. Upon approval by the hospitals, participants' medical records will be examined. Based on participants' age, this research will assess 2 to 5 years of medical records up to 10 times within 6-month intervals for each assessment. The level of neurotoxin exposure from each vaccine will be assessed by analyzing the list of the vaccine excipient provided by the Centers for Disease Control and Prevention (cdc.gov, 2011). The total amount of accumulated neurotoxin in each participant will be measured and this data will be added to pregnancy factors of corresponding participant to indicate which independent variable is more positively associated with dependent variables. A combination of both quantitative and qualitative analyses will be used in this proposal. The majority of medical record reviews will be quantitative analysis, and the review of healthcare providers' and parents' comments regarding ASD symptoms and diagnoses will be qualitative analysis.

## **Discussion**

### **Significance**

Thimerosal preservatives and aluminum adjuvants in vaccines can be toxic to CNS and potentially contribute to various forms of disorders. While thimerosal preservatives were mostly removed from vaccines, aluminum adjuvants are continuously used in many different types of vaccines. Due to neurotoxicity of aluminum adjuvants that may associate with neurological complications, the continued use of aluminum adjuvants in pediatric vaccines may be considered of great concern.

Pregnancy complications such as advanced parental age, maternal diabetes and obesity may also have a positive influence on ASD. Therefore, it is important to study a combined influence of pregnancy factors and neurotoxin exposure from vaccinations and aforementioned environmental factors. The findings in this research will help provide a more in-depth understanding of rapidly increasing ASD prevalence for healthcare providers and parents. This research will further establish better patient education and vaccine safety in public.

### **Limitations**

This research has some important limitations to consider. Since most data will be collected and analyzed based on participants' medical records retrospectively, any errors or misrepresentation in medical records will contribute to inaccuracy and unreliability of data analysis. Surveys will have open-ended questions and it may take a greater amount of time and effort to have data comparisons and statistical analysis. Furthermore, this research will have a non-probability convenience sampling method in order to acquire a large number of medical records. Therefore, data may not be fully generalized to the entire population of Washington State. However, this limitation may not significantly affect the overall evaluation of data, since data will be collected from three hospitals in two of the most densely populated counties in Washington State.

## Future Research

Neurotoxin and other harmful chemical exposure may come from food consumption, breast milk, and reproductive technologies, but most previous studies did not provide a combined influence of various environmental factors. There are other predictors to consider such as maternal smoking and genetic risk factors. Additionally, cultural and religious factors may play a role in vaccination rates and pregnancy factors. Since this proposed study is solely focused on the population of Washington State, a larger population or different geographical areas are also considered for future research. Therefore, future research could explore the aforementioned potential risk factors and a larger population with broader social aspects to provide a more in-depth analysis for ASD.

## References

- Abel, K. M., Dalman, C., Svensson, A. C., Susser, E., Dal, H., Idring, S., . . . Magnusson, C. (2013). Deviance in fetal growth and risk of autism spectrum disorder. *The American Journal of Psychiatry*, 170(4), 391-398. Retrieved from [http://alliance-primo.hosted.exlibrisgroup.com/UW:all:TN\\_medline23545793](http://alliance-primo.hosted.exlibrisgroup.com/UW:all:TN_medline23545793)
- Anderson, J. L., Waller, D., Canfield, M. A., Shaw, G. M., Watkins, M. L., & Werler, M. M. (2005). Maternal obesity, gestational diabetes, and central nervous system birth defects. *Epidemiology*, 16(1), 87-92. Retrieved from [http://alliance-primo.hosted.exlibrisgroup.com/UW:all:TN\\_jstor\\_archive\\_2920486004](http://alliance-primo.hosted.exlibrisgroup.com/UW:all:TN_jstor_archive_2920486004)
- Burstyn, I., Sithole, F., & Zwaigenbaum, L. (2010). Autism spectrum disorders, maternal characteristics and obstetric complications among singletons born in Alberta, Canada. *Chronic Diseases in Canada*, 30(4), 125-134. Retrieved from [http://alliance-primo.hosted.exlibrisgroup.com/UW:all:TN\\_proquest1112239486](http://alliance-primo.hosted.exlibrisgroup.com/UW:all:TN_proquest1112239486)
- Centers for Disease Control and Prevention. (2011, February 22). *Ingredients of vaccines - fact sheet*. Retrieved from <https://www.cdc.gov/vaccines/vac-gen/additives.htm>
- Durkin, M. S., Maenner, M. J., Newschaffer, C. J., Lee, L., Cunniff, C. M., Daniels, J. L., . . . Schieve, L. A. (2008). Advanced parental age and the risk of autism spectrum disorder. *American Journal of Epidemiology*, 168(11), 1268-1276. Retrieved from [http://alliance-primo.hosted.exlibrisgroup.com/UW:all:TN\\_pubmed\\_central2638544](http://alliance-primo.hosted.exlibrisgroup.com/UW:all:TN_pubmed_central2638544)
- Eidelman, A. I., & Samueloff, A. (2002). The pathophysiology of the fetus of the diabetic mother. *Seminars in Perinatology*, 26(3), 232-236. Retrieved from [http://alliance-primo.hosted.exlibrisgroup.com/UW:all:TN\\_sciversesciencedirect\\_elsevierS0146-0005\(02\)80059-3](http://alliance-primo.hosted.exlibrisgroup.com/UW:all:TN_sciversesciencedirect_elsevierS0146-0005(02)80059-3)
- Fombonne, E. (2009). Epidemiology of pervasive developmental disorders. *Pediatric Research*, 65(6), 591-598. doi:10.1203/pdr.0b013e31819e7203
- Gallagher, C. M., & Goodman, M. S. (2010). Hepatitis B vaccination of male neonates and autism diagnosis, NHIS 1997–2002. *Journal of Toxicology and Environmental Health, Part A*, 73(24), 1665-1677. doi:10.1080/15287394.2010.519317
- Henrikson, N., Anderson, M., Opel, D., Dunn, J., Marcuse, E., & Grossman, D. (2017). Longitudinal Trends in Vaccine Hesitancy in a Cohort of Mothers Surveyed in Washington State, 2013-2015. *Public Health Reports*, 132(4), 451-454.
- Madsen, K. M., Hviid, A., Vestergaard, M., Schendel, D., Wohlfahrt, J., Thorsen, P., . . . Melbye, M. (2002). A population-based study of measles, mumps, and rubella vaccination and autism. *The New England Journal of Medicine*, 347(19), 1477-1482. doi:10.1056/NEJMoa021134
- Martínez-Pedraza, F. de L., & Carter, A. S. (2009). Autism spectrum disorders in young children. *Child and Adolescent Psychiatric Clinics of North America*, 18(3), 645-663. doi:10.1016/j.chc.2009.02.002
- Mohamed, F. E., Zaky, E. A., El-Sayed, A. B., El-hossieny, R. M., Zahra, S. S., Eldin, W. S., . . . Youssef, A. M. (2015). Assessment of hair aluminum, lead, and mercury in a sample of autistic Egyptian children: Environmental risk factors of heavy metals in autism. *Behavioural Neurology*, 2015, 1-9. doi:10.1155/2015/545674

- Mrozek-Budzyn, D., Kiełtyka, A., & Majewska, R. (2010). Lack of association between measles-mumps-rubella vaccination and autism in children: A case-control study. *The Pediatric Infectious Disease Journal*, 29(5), 397-400. doi:10.1097/inf.0b013e3181c40a8a
- Rahbar, M. H., Samms-Vaughan, M., Pitcher, M. R., Bressler, J., Hessabi, M., Loveland, K. A., . . . Boerwinkle, E. (2016). Role of metabolic genes in blood aluminum concentrations of Jamaican children with and without autism spectrum disorder. *International Journal of Environmental Research and Public Health*, 13(11), 1095. doi:10.3390/ijerph13111095
- Schechter, R., & Grether, J. K. (2008). Continuing increases in autism reported to California's developmental services system: Mercury in retrograde. *Archives of General Psychiatry*, 65(1), 19-24. Retrieved from [http://alliance-primo.hosted.exlibrisgroup.com/UW:all:TN\\_ama482546](http://alliance-primo.hosted.exlibrisgroup.com/UW:all:TN_ama482546)
- Tomljenovic, L. (2011). Aluminum and Alzheimer's disease: After a century of controversy, is there a plausible link? *Journal of Alzheimer's Disease*, 23(4), 567-598. doi:10.3233/JAD-2010-101494
- Tomljenovic, L., & Shaw, C. A. (2011a). Aluminum vaccine adjuvants: Are they safe? *Current Medicinal Chemistry*, 18(17), 2630-2637. Retrieved from [http://homeoint.ru.91-194-77-203.web10.garmtech.net/pdfs/Aluminum\\_adjuvants.pdf](http://homeoint.ru.91-194-77-203.web10.garmtech.net/pdfs/Aluminum_adjuvants.pdf)
- Tomljenovic, L., & Shaw, C. A. (2011b). Do aluminum vaccine adjuvants contribute to the rising prevalence of autism? *Journal of Inorganic Biochemistry*, 105(11), 1489-1499. doi:10.1016/j.jinorgbio.2011.08.008
- Wang, Y., Tang, S., Xu, S., Weng, S., & Liu, Z. (2016). Maternal body mass index and risk of autism spectrum disorders in offspring: A meta-analysis. *Scientific Reports*, 6(1). doi:10.1038/srep34248
- Wolf, E. R., Opel, D., Dehart, M. P., Warren, J., & Rowhani-Rahbar, A. (2014). Impact of a pertussis epidemic on infant vaccination in Washington state. *Pediatrics*, 134(3), 456-464. doi:10.1542/peds.2013-3637
- Wu, S., Wu, F., Ding, Y., Hou, J., Bi, J., & Zhang, Z. (2016). Advanced parental age and autism risk in children: a systematic review and meta-analysis. *Acta Psychiatrica Scandinavica*, 135(1), 29-41. doi:10.1111/acps.12666
- Xu, G., Jing, J., Bowers, K., Liu, B., & Bao, W. (2014). Maternal diabetes and the risk of autism spectrum disorders in the offspring: A systematic review and meta-analysis. *Journal of Autism and Developmental Disorders*, 44(4), 766-775. doi:10.1007/s10803-013-1928-2



# EFFECTIVENESS OF CLINICAL DRUG TREATMENTS FOR ALZHEIMER'S DISEASE IN SLOWING PROGRESSION OF MEMORY LOSS & COGNITIVE FUNCTION LOSS

Allen Lewis

*ABSTRACT: The effectiveness of Alzheimer's Disease drugs is crucial to knowing what drugs can be used to treat Alzheimer's Disease and which ones do not. Currently, Aricept, Ebixa, Exelon and Lamivudine are the drugs used to slow the progression of Alzheimer's Disease. These drugs are used to slow the symptoms of memory loss and cognitive function loss. In this proposal, I will be investigating the effectiveness of these drugs in slowing the progression of memory loss and cognitive function loss through administering memory tests, cognitive tests, surveys, PET scans and CT scans to Alzheimer Disease patients. The drugs tested will be considered effective if there is evidence of a slow in memory loss and cognitive function loss.*

## Background & Introduction

Alzheimer's Disease also known as AD, is a neurological disease that diminishes the brain's ability to memorize and process daily tasks. The first case of AD was identified in 1901 from Dr. Alois Alzheimer in a woman named Auguste Deter (Hippius et. al, 2003). This woman later died in 1906 with one of the classic symptoms of memory loss. The doctor conducted an autopsy of the deceased and found she had brain plaques and neurofibrillary tangles, which are classic indicators of AD (Hippius et. al, 2003). In 1906, Dr. Alzheimer's findings go public and the term "Alzheimer's Disease" becomes the term used to describe said disease. AD affects a person's social and behavioral skills as the disease progresses. AD has no cure because no drug has been able to reverse the brain damage done at the neuron level. Research into treatment for AD is expensive and scientists still don't know what causes AD. However, there are medications currently being used to deal with the symptoms of the disease. In the United States alone, 5.8 million people have AD and deaths due to AD have increased 145% (Alzheimer's Association, 2019). It is important that scientists find effective treatments for AD to decrease the symptoms and to decrease the medical costs associated with AD.

AD patients tend to live between 4 and 20 years after their diagnosis. The disease has four stages and is mostly common in elderly adults. Stage 1 of AD, known as the pre-dementia stage, has the symptoms of short-term memory loss, decreased attention span and decreased awareness. This stage lasts seven years and affects the Medial Temporal Lobe of the brain, which is responsible for memory (McMaster University, 2018). Stage 2 of AD, known as the mild stage, has the symptoms of learning impairment, language difficulties and poor sense of direction. This stage lasts two years and affects the Temporal Lobe, which is responsible for language, hearing, facial recognition and visual processing. It also affects the Parietal Lobe, which is responsible for processing and interpreting sensory information, visual information, language and mathematics (McMaster University, 2018). Stage 3 of AD, known as the moderate stage, has the symptoms of long-term memory loss, loss of urinary and bowel control, behavioral changes, short attention span and poor judgment skills. This stage lasts two years and affects the Frontal Lobe of the brain, which is responsible for controlling emotions, memory, language, judgement, sexual behaviors and problem-solving skills (McMaster University, 2018). Stage 4 of AD, known as the



severe stage, is the stage in which a patient loses the ability to feed themselves, loses speech function, has problems with vision and eventually dies. This stage lasts three years and affects the Occipital Lobe of the brain, which is responsible for processing visual information such as facial recognition, memory formation and depth perception (McMaster University, 2018).

A person who has AD will start developing plaques and tangled bundles of fibers that will later cause loss of neuron transmission. Neuron transmission is vital to the brain because neurons transmit signals from the brain to other parts of the body and is important, when it comes making memories. If neuron transmission stops then body parts lose functionality, signals and nutrients for systems. AD begins in the hippocampus, which is the part of the brain responsible for short-term and long-term memories. As the disease progresses, the brain shrinks to the point where the brain has irreversible damage.

AD research is currently looking at how to slow the progression of the disease. The common drugs used to treat the symptoms of AD are Aricept, Ebixa, Exelon and Lamivudine. All of these drugs are FDA approved. When it comes to AD, drug effectiveness is key to slowing the progression of the disease. In this proposal, we will be comparing the effectiveness of AD drugs Aricept, Exelon, Ebixa and Lamivudine in slowing the symptoms of memory loss and cognitive function loss in the brain. Each drug's effectiveness will be tested through memory tests, brain scans and surveys. These tests are used to see what parts of the brain are affected by the drugs, what can the patients remember, how are they affected socially and behaviorally from these drugs and how has the treatment affected them overall.

When it comes to the drug treatments Aricept, Exelon, Ebixa and Lamivudine each of them performs different roles for people with AD. Aricept, also known as Donepezil, is a drug used to treat dementia. The drug acts as an enzyme blocker in the brain by restoring the balance of neurotransmitters

(WebMD, 2019). This is important because Alzheimer's Disease is the degradation of neurons and loss of neuro transmission. Without neurotransmitters being stimulated, messages between neurons would be lost and brain function for various jobs would decrease. This drug has been shown to be effective in slowing the progression of the disease, when it comes to memory loss (Graber et. al, 2011). The second drug we will be investigating in this proposal is Exelon. Exelon commonly known as Rivastigmine or Rivastigmine Tartrate, is a cholinesterase inhibitor that prevents the degradation of neurotransmitter acetylcholine (Flavell, 2019). This neurotransmitter is responsible for memory, motivation, cognition, attention and arousal. This drug when paired with Ebixa and individually has been proven effective in slowing the symptoms of memory loss and cognitive function loss in people, who have AD in the two studies (Frolich et. al, 2012) and (Onor et. al, 2007).

The third drug that'll be investigated in the proposal is Ebixa. Ebixa commonly known as Memantine or Namenda, is a treatment for patients with moderate to severe forms of Alzheimer's Disease. This drug acts as a blocker for N-methyl-D-aspartate (NMDA) receptors that neurotransmitter glutamates bind to (Alzheimer Society of Canada, 2008). As this drug blocks NMDA receptors, it increases neurotransmission which decreases complications associated with AD. This drug in the two studies (Molino et. al, 2013) and (Rountree et. al, 2013) was shown to be effective in treating people with AD, when it was paired with Aricept and when Ebixa was tested individually up against other treatments. The fourth drug that'll be investigated in the proposal is Lamivudine. Lamivudine is a known antiretroviral drug used in HIV treatment. However, Lamivudine has been shown to have significant effectiveness on patients with AD in the area of epigenetic targeting (Chatterjee et. al, 2018). Epigenetic targeting is a drug that targets gene expression of a disease without altering the DNA of the individual.

## Hypothesis & Research Question

Based on information provided from each drug, if AD patients report or show signs of a slowing in memory loss and cognitive function loss then the drug is effective in treating people who have AD because it showed a significant effect in the brain of individuals with AD. If the drug passes the memory tests, shows significant signs on a CT scan and PET scan, or shows positive correlation in survey data then the drug is effective in slowing the symptoms of memory loss and cognitive function loss in people with AD. We will select 1,000 people with AD, give them the AD drugs and put them into groups to organize results, to see variation in results and to track how effective these drugs are in the brain. After they take the drugs, they will take a CT scan, a PET scan, memory tests, cognitive tests and surveys. These tests will be our indicator if these drugs are effective. Our research question for this proposal is how effective are the AD drugs Aricept, Exelon, Ebixa and Lamivudine compared side by side, when it comes to slowing in the progression of the disease for the symptoms of memory loss and cognitive function loss in the brain?

## Research Approach

A longitudinal study design will be used for this proposal because we are looking to see if the drugs are effective in patients that have AD. This requires us to look over the course of 6 months to 5 years. We are looking this long because we have a large population to study and AD can last for many years with the symptoms of memory loss and cognitive function loss. We are also looking this long because we want to know what changes occur in the brain as a result of taking these drugs for AD, meaning do these drugs work or not in slowing memory loss and cognitive function loss. This proposal will also be required to be a randomized control trial because participants will be followed over time to look for the see the effectiveness of the drugs for AD patients and also because the patients in the proposal will be randomly assigned to a group of 250 people to test the effectiveness of the drugs on the symptoms of cognitive function loss and memory loss. The

population of 1,000 people is broken down into a group of 250 people, to see if there is any variation in results for each person taking the drugs. For this proposal, patients with AD, who are assigned to a group, will take the drugs. Then, over the course of 6 months to 5 years, researchers will observe to see, if there are any changes in the brain via PET scans and CT scans and see if the symptoms of memory loss and cognitive function loss were slowed in progression. Over the course of time while these patients take these drugs, effectiveness of the drugs will be tested via memory tests, cognition tests and surveys to see what has changed since taking the drugs.

## Population & Sampling

This proposal's target population is patients with AD nationally who are between the age of 45 and 90 years old. This age range is chosen because this is the typical age range people could be diagnosed with AD. There is no difference with early onset AD that could be a confounding variable, when it comes to effectiveness of the treatment. Since this proposal involves a population that is geographically spread out, cluster sampling will be used to analyze these populations that are pre-defined. In this case, since the population is national, this proposal requires a large population of individuals to have a proper representation of people who have AD across these ages. This proposal requires a large population to see how each person responds to the drugs and to see variation in data results. For this proposal, 1,000 people nationwide would be needed to see if the drugs are effective in slowing the symptoms of memory loss and reduced cognitive function for AD. This study needs 1,000 people because every person will receive the four drugs and each drug will be taken individually spread out over the course of weeks to see the effects. When it comes to each group, each person will receive the four drugs to test effectiveness and to see if there is any variation in results. The data will be collected until the patients have completed the study for each drug or until the patient is unable to participate in the study anymore. Data for this study will be periodically collected to see the effectiveness of the drug over the course of months to years in the brain.

## Operationalization & Measurement

Effectiveness of the drugs will be measured through memory tests, cognition tests and surveys, PET scans and CT scans. Effectiveness in this case is defined as treatment that works in slowing progression of the symptoms of cognitive function loss and memory loss in AD patients. This will be done by seeing if the drugs work in these patients. PET scans and CT scans will be used to see what parts of the brain are affected as a result of taking the drugs. Positron Emission Tomography also known as PET scans are image tests used to help see how tissues and organs are functioning. Computerized Tomography also known as CT scans are a series of x-ray images used to see cross-sectional images of the brain, bones, soft-tissues, blood vessels and other parts of the body. This will allow researchers to see what parts of the brain are affected, as a result of the drugs and in-turn will explain what symptoms are seen and which ones are not for AD patients. It will also allow researchers to see the progression of the disease and its effect on slowing the symptoms of memory loss and cognitive function loss.

When it comes to this study, the independent variable for this will be the AD drugs themselves which are Aricept, Exelon, Ebixa, Lamivudine. Based on this each drug will be taken individually spread out over the course of weeks to see the effects of the drug on the brain. The dosage for Aricept is between 5 mg and 23 mg (FDA, 2012). The dosage for Exelon is between 6 mg and 12 mg (FDA, 2013). The dosage for Ebixa is between 5 mg and 20 mg (FDA, 2013). The dosage for each of the drugs mentioned earlier for this study will depend on the drug. Some of the drugs require a low dosage to be effective and some require a high dosage to be effective. Overall, the dosage will increase to see the effectiveness of the drugs and to see if dosage affects the effectiveness of the drugs for these patients with AD. Dosage will be monitored for each person because it's understood that not everyone can handle the recommended dosage for AD patients. Also, this is to ensure that the patients are safe when it comes to the drugs. The dependent variable for this study will be effectiveness of the

AD drugs in slowing the progression of memory loss and cognitive function loss for AD, which will be done through cognitive tests, memory tests, surveys, PET scans, and CT scans.

## Data Collection

For this study, data will be collected through memory tests, brain scans, surveys and cognition tests. The memory test will be done each time an AD patient takes the drugs to see if their memory has changed since taking the drug and to monitor the symptom of memory loss. The memory test will consist of researchers asking the patient if they remember a set of items presented or a set of answers to questions. This test will be visual and auditory. PET scans and CT scans are used to see if there are any changes in the brain, to monitor the progression of the disease and to see the effects of the drugs on the brain. This will be done throughout the course of the study with each drug. The surveys will be done to see if the patients have experienced any changes since taking the drugs. This test will consist of asking the patient their experience since taking the drug and any symptoms they have experienced since taking the drugs. The cognition test will be done to test intelligence and decision-making skills. This test will be visual, auditory and written. This test will involve the researchers asking simple mathematic and reading questions and providing a common-sense scenario to the patients. Data will be collected weekly. These tests are valid because other studies like (Valcour, 2011) have used these tests to see the effectiveness of a drug.

## Analysis

The data in the study will be analyzed using a quantitative method. This method will be useful for this study because we are looking to see, which drugs are effective. This is done through the memory test and cognitive test data. If the patients score high on these tests after receiving the drug, then it will show they are effective. This would match with what is expected for the hypothesis. If they score low on these tests after receiving the drug, then it will show they are not effective. The PET and CT scan data will also be important, when it comes to

quantitative data because it will be looking at how many regions of the brain are affected by the drug, which will be important in determining if the brain is affected by the drug and if it slows the symptoms. In all multivariate statistical analysis will be used to compile all this data to see, which drugs are effective in slowing the progression of memory loss and cognitive function loss. This will be done by looking at multiple variables like scores on memory and cognitive tests to see, which drugs had the highest test score data.

### **Ethical Considerations**

The ethical considerations to consider when it comes to this proposal are the side effects of these drugs. The drug Aricept has side effects like trouble with sleeping, nausea, vomiting and muscle cramps. The drug Exelon has side effects like diarrhea, dizziness, headaches and nausea. The drug Ebixa has side effects like dizziness, hypertension, headaches and somnolence. The drug Lamivudine has side effects like headaches, belching, heartburn and depression. The last ethical consideration for this study will be anonymity of the patients involved in this study. These ethical concerns can be addressed by not sharing the identity information of the patient, letting the patients know ahead of time the drug side effects through informed consent and not denying treatment to the patients who are in the study. Getting informed consent from the participant or a caretaker to participate in this study is important because we want that patients to be treated fairly. When it comes to this study, patients have the option to dropout and caretakers have the option to discontinue the study for the patient. If one drug is doing better than another one, then the study will not stop. Once all the drugs have been tested then the study will stop. The study will go through the IRB review for approval.

### **Discussion & Future Directions**

#### **Significance**

Alzheimer's Disease is a disease that affects millions of people worldwide. Alzheimer's Disease still has no cure. This study is important because it

could open doors into what AD drugs are effective and which ones still need more testing. This study is also important because researchers and scientists are looking at what drug treatments are effective in slowing the progression of the disease and its symptoms. This study is also important because it can open the doors for combination therapy and help lay the foundation for non-human studies that look at disease.

#### **Limitations**

When it comes to this study, one of the limitations is cost. As the study continues from months to years, it will be expensive to keep up. The way to overcome this limitation is through having sponsors to fund this research and having drug companies pay for expenses. Also, the drugs are expensive to keep providing to the patients over the course of the study. The second limitation of the study is that there will be possible loss to follow up because AD has no cure. AD has medicine to treat the symptoms, but no drug currently has been able to cure someone of AD completely meaning death is expected, when it comes to AD patients. One way to overcome this limitation is to segment the study into consecutive time segments. The third limitation for the study is that on one of the drugs they were not able to identify all the target areas in the brain when it comes to the drug and that some of the pathways may have been restricted. The last limitation of this study is taking these drugs over a long period of time, may affect the effectiveness of the drugs in AD patient. The patients will be monitored by doctors, when it comes to this.

#### **Future Directions**

This method of testing effectiveness could be used when testing other AD drugs. This research in the future could provide insight into why some drugs affect different parts of the brain. When it comes to this research, it could help scientists and researchers better understand why these particular drugs slow the progression of the disease and others don't. The proposal could be useful, when it comes to combination therapy because combination therapy is huge part of AD treatment and seeing, which



treatments are effective and work well together can be useful in treating symptoms. This proposal could provide some groundwork for non-human studies like (Zhang et. al, 2018), when it comes to starting phase 1 and phase 2 of FDA clinical testing, because the drug BPN14770 was proven, to be effective in treating humanized mice with AD as a laboratory study and may provide some promise in humans, if it passes phase 1 and phase 2 of FDA clinical testing.

## References

- Alzheimer's Association. (2019). Facts and Figures. Retrieved December 11, 2019, from <https://www.alz.org/alzheimers-dementia/facts-figures>.
- Alzheimer Society Of Canada. (2008, April). Ebixa. Retrieved December 11, 2019, from [https://alzheimer.ca/sites/default/files/files/national/drugs/drug\\_ebixa\\_2008\\_e.pdf](https://alzheimer.ca/sites/default/files/files/national/drugs/drug_ebixa_2008_e.pdf).
- Casey, D., Antimisiaris, D., & O'Brien, J. (2010). Drugs for Alzheimer's disease: Are they effective? *P & T : A Peer-reviewed Journal for Formulary Management*, 35(4), 208-11.
- Chatterjee, P., Roy, D., & Rath, N. (2018). Epigenetic Drug Repositioning for Alzheimer's Disease Based on Epigenetic Targets in Human Interactome. *Journal of Alzheimer's Disease: JAD*, 61(1), 53-65.
- FDA. (2012). Aricept (donepezil hydrochloride) Label. Retrieved December 12, 2019, from [https://www.accessdata.fda.gov/drugsatfda\\_docs/label/2012/020690s035,021720s008,022568s0051bl.pdf](https://www.accessdata.fda.gov/drugsatfda_docs/label/2012/020690s035,021720s008,022568s0051bl.pdf).
- FDA. (2013, October). Exelon (rivastigmine tartrate) oral solution. Retrieved December 12, 2019, from [https://www.accessdata.fda.gov/drugsatfda\\_docs/label/2015/020823s032,021025s0221bl.pdf](https://www.accessdata.fda.gov/drugsatfda_docs/label/2015/020823s032,021025s0221bl.pdf).
- FDA. (2013, October). Namenda (memantine HCl). Retrieved December 12, 2019, from [https://www.accessdata.fda.gov/drugsatfda\\_docs/label/2013/021487s010s012s014,021627s0081bl.pdf](https://www.accessdata.fda.gov/drugsatfda_docs/label/2013/021487s010s012s014,021627s0081bl.pdf).
- Flavell, L. (2019). Exelon (Rivastigmine). Retrieved December 11, 2019, from <https://alzheimersnewstoday.com/alzheimers-disease-treatment/approved-drugs/exelon-rivastigmine/>.
- Frolich, L., Monsch, A., Kressig, R., Downs, P., Caputo, A., & Strohmaier, C. (2012). Comparisons of patient characteristics in subpopulations of the Optimising Transdermal Exelon In Mild-to-moderate Alzheimer's disease (OPTIMA) study. *Alzheimer's & Dementia: The Journal of the Alzheimer's Association*, 8(4), P603.
- Graber, M., Dachs, R., & Darby-Stewart, A. (2011, March 15). Donepezil to manage Alzheimer disease: New vs. standard dosing. *American Family Physician*, 83(6), 742-4.
- Hippius, H., & Neundörfer, G. (2003, March). The discovery of Alzheimer's disease. Retrieved October 12, 2019, from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3181715/>.
- McMaster University. (2018, January 25). What is Alzheimer's Disease? Retrieved December 11, 2019, from [https://wiki.mcmaster.ca/LIFESCI\\_4M03/group\\_4\\_presentation\\_3\\_-\\_alzheimer\\_s\\_disease](https://wiki.mcmaster.ca/LIFESCI_4M03/group_4_presentation_3_-_alzheimer_s_disease).
- Molino, Ivana, Colucci, Luisa, Fasanaro, Angiola M., Traini, Enea, & Amenta, Francesco. (2013). Efficacy of memantine, donepezil, or their association in moderate-severe Alzheimer's disease: A review of clinical trials. *The Scientific World Journal*, Vol.13.
- Onor, M. L., Trevisiol, M., & Aguglia, E. (2007). Rivastigmine in the treatment of Alzheimer's disease: an update. Retrieved December 12, 2019, from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2684084/>.
- Rountree, S., Atri, A., Lopez, O., & Doody, R. (2013). Effectiveness of antimentia drugs in delaying Alzheimer's disease progression. *Alzheimer's & Dementia: The Journal of the Alzheimer's Association*, 9(3), 338-345.
- Valcour, V. G. (2011, December). Evaluating cognitive impairment in the clinical setting: practical screening and assessment tools. Retrieved December 12, 2019, from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6148899/>.
- WebMD. (2019). Aricept Oral : Uses, Side Effects, Interactions, Pictures, Warnings & Dosing. Retrieved December 11, 2019, from <https://www.webmd.com/drugs/2/drug-14335/aricept-oral/details>.
- Zhang, C., Xu, Y., Chowdhary, A., Fox, D., Gurney, M. E., Zhang, H.-T., ... O'Donnell, J. M. (2018, August 14). Memory enhancing effects of BPN14770, an allosteric inhibitor of phosphodiesterase-4D, in wild-type and humanized mice. Retrieved October 12, 2019, from <https://www.nature.com/articles/s41386-018-0178-6>.



# DSHS CARE TOOL MENTAL HEALTH ASSESSMENT ANALYSIS: IS IT ADEQUATE IN WASHINGTON STATE?

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*ABSTRACT: The Comprehensive Assessment Reporting and Evaluation (CARE) Tool is a large-scale holistic assessment that is currently being used by Washington State's Department of Social and Health Services (DSHS). The CARE tool serves as a way to determine the care eligibility for people who may need to become involved in long term community services such as skilled nursing facilities or rehabilitation facilities. However, some people have difficulty with being able to access these long-term community services even though they need help with their Activities of Daily Living (i.e. eating, bathing, getting dressed, and mobility). To be more specific, people who have acquired traumatic brain injuries is an example of a patient population who have experienced hardship with being able to access long term community services, despite the CARE tool being in place.*

*That being said, it was found that the CARE Tool is not as sensitive to the psychological signs and symptoms that are present when someone is first diagnosed with traumatic brain injury in the hospital setting. The CARE Tool only assesses patients in the hospitals based on the day of the assessment and seven days prior to the assessment date. In other words, it is not designed to predict potential significant changes or needs that a patient may end up desperately needing in the next 1 to 2 years.*

*Based on this issue of assessment tool sensitivity, a literature review was conducted and it was found that there are multiple other behavioral and mental health assessment tools that can be used in lieu of the current behavioral and MMSE that are more sensitive to milder psychological signs and symptoms. In conclusion, it was found that the CARE Tool behavioral and MMSE assessments that are found within the CARE Tool needs to be changed by enacting policy change.*

## Problem Statement

The Comprehensive Assessment Reporting and Evaluation (CARE) Tool is a large-scale holistic assessment that is currently being used by Washington State's Department of Social and Health Services (DSHS). The CARE tool serves as a way to determine the care eligibility for people who may need to become involved in long term community services (Northwest Justice Project, 2018). Long term community services include health care that may be needed for 6 months or longer such as skilled nursing facilities, assisted living facilities, or rehabilitation facilities. Sometimes, an individual may need to access these long-term community

services for the rest of their life which can be costly. This is especially true if an individual needs to access these community services on a daily basis. That being said, a certain number of hours is determined as a maximum amount of hours that the state will pay for an individual. This certain amount is based on a person's results from the CARE tool, which may or may not be accurate.

Washington State Legislation gives the notion that the CARE tool may not be accurate because of the ability to apply for an Exception to Rule process (Northwest Justice Project, 2018). The Exception to Rule process gives the opportunity for individuals to ask Washington State Legislation for more hours

allotted per month for individual one-on-one care if an individual feels that they need more help than the state originally thought they needed. For example, some individuals may only be eligible for fifty to one hundred hours per month of one-on-one care upon initial assessment with the CARE tool. However, the individual may later find that they need more hours of one-on-one care down the road, when medical and psychological conditions get worse. Worsening medical and psychological conditions would be evident when the individual cannot perform their Activities of Daily Living (ADLs) anymore such as independently dressing or eating.

The Exception to Rule process also brings to light that care related to mental health as a consequence of a chronic injury may not be reflected in the CARE assessment tool. The CARE tool only assesses what has happened with an individual over the last seven days from the day of the assessment (Northwest Justice Project, 2018; Washington State Department of Social & Health Services, 2003). That being said, the CARE tool is not able to analyze worsening medical and psychological conditions over time. The CARE tool is only able to provide higher numbers of one-on-one care hours if the medical and/or psychological conditions are presented as worsening over the course of the last seven days from the day of the CARE tool assessment. This may not be realistic depending on what medical and/or psychological conditions the individual may have. This is where the logistics behind how the number of care hours are determined for each individual can get confusing because a lot of psychological or mental health issues can be presented as very subtle when first diagnosed.

When looking at the logistics behind how the number of care hours are determined for each individual, mental health status and behaviors are rated lower than those who are considered clinically complex. Washington State Legislation determines that those who are clinically complex and who also have a higher score on the cognitive and behavioral scales are given about one hundred more hours per month, as compared to those who may not be

clinically complex and still have cognitive and/or behavior issues that greatly affects their ability to complete Activities of Daily Living (ADLs) (Washington State Legislature, 2005a; Washington State Legislature, 2005b; Washington State Department of Social & Health Services, 2017). For example, someone who may need hemodialysis and has mild dementia that does not currently affect their ADL completion (and will not for multiple years) automatically gets more one-on-one care hours as compared to someone who is relatively healthy but has a moderate-level traumatic brain injury that the individual has been told will get significantly worse as time goes on. In other words, the individual with only the moderate-level traumatic brain injury is known to have a worsening psychological condition that will eventually affect their ADL completion, but the CARE tool cannot assess for this expected worsening psychological condition because it is not designed to continuously assess the individual. It is basically designed as an initial assessment to get individuals introduced to the long term care system in Washington State.

Taking all of this into account, it is best to analyze an example of a population of patients that continues to struggle to get adequate one-on-one care hours approved by Washington State Legislation. A population of patients who may be greatly affected by not getting enough hours for individualized care are those who have acquired traumatic brain injuries (TBI). TBIs are complex medical issues that can affect everything about an individual from ADL completion ability to the quality of cognitive and behavioral health. A more formal definition of TBI involves damage to the brain that occurs after birth as a result of an external force (Dams-O'Connor, Landau, Hoffman, & St De Lore, 2018). However, TBIs are not listed in the clinically complex list of medical issues found within the CARE tool, even though the conditions that are listed in the clinically complex list are diseases that often require frequent hospitalizations over time. That being said, multiple studies have found that TBI falls under the World Health Organization's definition of chronic health conditions because of the functional decline that can occur over time (Dams-O'Connor et al.,

2018; Harrison, Hunter, Thomas, Bordy, Stokes, & Kitzman, 2017). Concerning symptoms that individuals living with TBIs may have include balance issues, extremity weakness, memory issues, hallucinations, changes in the sensory systems of the body, dizziness, and vision changes. All of these can cause an inability to complete ADLs over time even if it is not seen immediately after acute care discharge (Dams-O'Connor et al., 2018; Harrison et al., 2017). A common issue that these patients have is that they see these concerning symptoms over time, yet the number of hours that have been approved by the state's government system is usually not consistent with the progression of the condition that individual sees (Harrison et al., 2017). In other words, the individual is not being approved for a higher number of care hours when they notice that their symptoms are worsening.

That being said, the CARE tool is by all means comprehensive overall. Still, adult TBI patients may not be adequately assessed for behavioral and cognitive care needs through the current use of the CARE tool because both assessments that make up the behavioral and cognitive (Mini-Mental State Examination) components of the CARE tool requires more information than what the current CARE behavioral and Mini-Mental State Examination (MMSE) assessments can provide.

### Literature Review

Although no studies currently exist that examine the CARE tool specifically, a small group of studies were found regarding the use of different types of behavior and cognition assessments that could be incorporated into the CARE tool. That being said, it is important to mention that this literature review had the aim of figuring out what other behavior and cognitive assessments currently exist and are in current use. This literature review was conducted through a CINAHL Complete database search. Search terms included "behavioral assessment," "cognitive assessment," and "Traumatic Brain Injury." All studies included were limited to a 2015-2020 publication date and were peer-reviewed. A review of the literature revealed a mixture of

qualitative and quantitative studies. This included: nonrandomized two group comparisons (Kelly, Simpson, Brown, Kremer, & Gillett, 2019; Schwartz, Averbuch, Katz, & Sagiv, 2016), a longitudinal crossover study (Zhang et al., 2016), an observational cross-sectional study (Tran et al., 2018), a secondary analysis study (Zarshenas & Cullen, 2018), and a focus group qualitative assessment development study (Juengst, Terhorst, Dicianno, Niemeier, & Wagner, 2019).

Looking at one of the two nonrandomized two group comparison studies first, Kelly et al. (2019) conducted a study consisting of a mixed brain injury (MBI) group and a primary brain tumor (PBT) group with the majority of MBI participants being diagnosed with TBI. The MBI group consisted of 34 participants from two healthcare agencies in Australia. The main study outcome measures included Observational Behavior Scale-Adult (OBS-Adult) scores and Observational Behavior Scale- Self Report (OBS-SR) scores to see if self-reporting of potentially challenging behaviors would produce similar scores of the OBS-Adult assessment for behavior and cognition. Kelly et al. (2019) found that the MBI group had a statistically significant result when it came to differences in scores between the participant and trained observational assessor in scores for cognition and challenging behaviors, where variations in scores increased. This is important because the MBI group thought that their presenting symptoms were different than how the assessors were scoring their symptoms, whereas the PBT group showed no significant difference in scores. Limitations to this study included having different trained observational assessors for each group and not considering the severity of each brain injury (Kelly et al., 2019).

In the second of the two nonrandomized two group comparison studies, Schwartz et al. (2016) conducted a study consisting of 25 participants in the TBI group from inpatient and outpatient units at the Lowenstein Rehabilitation Hospital, and 25 participants in the healthy control group (no TBI diagnosis). Both groups had 19 men and 6 women and were between 18-50 years old. The main

study measures were the Functional Lowenstein Occupational Therapy Cognitive Assessment (FLOTCA) and a combination Functional Independence Measure (FIM) and Functional Assessment Measure (FAM) to see if there were any correlations between baseline demographic data and the scores for each measure. Schwartz et al. (2016) found that there was a negative correlation between average number of days unconscious in the hospital and total FLOTCA scores and a positive correlation between Glasgow Coma Scale (GCS) scores and total FLOTCA scores, with an over 95% confidence interval for both findings in the TBI group. The discovery of the positive and negative correlation in the TBI group is especially important because those who have been diagnosed with TBI can have a range of cognition scores and still have the diagnosis of TBI, which can affect ADL completion. The limitations to this study were that this was not a randomized control research design and the sample size was small in both groups, with unequal gender representation (Schwartz et al., 2016).

The next study involves a longitudinal crossover research study by Zhang et al. (2016). Zhang et al. (2016) conducted a study consisting of a TBI group of 103 participants and a stroke group of 127 participants, all who were selected by diagnosis from the China Rehabilitation Research Center based on American diagnostic criteria. The average age of participants was 35 in the TBI group, and the overall study had a majority of male participants. The measures of the study included MMSE scores and Montreal Cognitive Assessment (MoCA) scores to see if participants would have a normal score on one assessment and an abnormal score on the other assessment. Zhang et al. (2016) found that 87% of TBI group participants had normal MMSE scores but an abnormal MoCA score indicating that the MoCA assessment may be more sensitive than the MMSE. This finding has a huge impact on the current use of the cognitive component of the CARE tool because this study shows that the MMSE assessment that is found in the CARE tool is less sensitive to TBI symptoms as compared to the MoCA assessment. Limitations to this study

included the exclusion of severely cognitive impaired TBI patients (Zhang et al., 2016).

Taking into account the previous studies above, another study that is observational cross-sectional in nature was identified for analysis. Tran et al. (2018) conducted a study consisting of 36 TBI participants who were diagnosed with severe TBI and recruited from 3 brain injury rehabilitation units in Sydney, Australia. The average age of participants was 36 years old with an average GCS score of 6.5 (Tran et al., 2018). The measures of the study included Functional Assessment of Verbal Reasoning and Executive Strategies (FAVRES) assessment scores and the Sydney Psychosocial Reintegration Scale Version 2 (SPRS-2) questionnaire scores to assess if there was a correlation between lower FAVRES scores and lower psychosocial scores on the SPRS-2. Tran et al. (2018) found that 72% of participants had difficulty completing the FAVRES assessment at 12 months post injury and 100% of participants had some degree of psychosocial change as compared to pre-injury status which was shown by the SPRS-2 questionnaire. This is important to consider when assessing TBI symptoms because this study shows that TBI symptoms do get worse with time and that there needs to be ongoing cognitive and behavioral assessment of the patients who have been diagnosed with TBI. The fact that over half of the participants in this study had difficulty in completing a FAVRES assessment indicates that their ability to complete ADLs may be affected overtime because the FAVRES assessment includes ADL completion components. The study indicates that limitations include having a smaller sample size and not assessing levels of aphasia or language impairments (Tran et al., 2018).

Next, a secondary analysis by Zarshenas and Cullen (2018) was identified for review. Zarshenas and Cullen (2018) conducted a study consisting of 65 participants who were 18 years old or older and diagnosed with TBI who had been admitted to the Toronto Rehabilitation Institute between 2008 and 2011. The measures of the study included cognitive ability scores via the Cogstate Brief Battery (CBB) assessment tool mixed with the cognitive and motor



components of the FIM. These measures were used to see if cognitive and motor functioning varied in scores depending on if the CBB components were used or not. Zarshenas and Cullen (2018) found that the introduction of the CBB increased the variation of scores for cognition by about 48%. The addition of the CBB component, which is a cognitive assessment, increased the variation of the overall cognitive and motor components of the FIM scores because the CBB was able to pick up on subtle variations of cognitive ability scores for individuals with TBI. This additionally takes into account the fact that having an improved cognition improves the ability to complete motor components on the FIM assessment which can be linked to ADL completion. Zarshenas and Cullen (2018) indicated that their limitations in their study was having a small sample size and no data on comorbidities of participants.

Lastly, a focus group qualitative assessment development study was identified for review by Juengst et al. (2019). Juengst et al. (2019) conducted a study consisting of an expert panel of 6 TBI trained health professionals and two focus groups. The TBI participants were between 50-60 years old and 100% male in the first group with the second group being between 25-68 years old and 40% male (Juengst et al. 2019). The measurements of the study included expert panel scoring for clarity and relevance of assessment questions, content validity index, and focus group feedback on clarity of assessment questions (Juengst et al., 2019). Juengst et al. (2019) found that the Behavioral Assessment Screening Tool (BAST) assessment may decrease observer bias because it asks questions about participant behaviors at a level that is clear to them. This is an important finding because observer bias can impact how a person is scored on behavioral and cognitive assessments. For example, an individual with TBI may not be able to fully understand the questions that are asked on behavioral or cognitive assessments. This is important when considering the CARE tool assessment because this study demonstrates that lack of consideration for observer bias can greatly affect cognitive assessment scores. This shows that observer bias should be taken into

further consideration within the CARE tool, since the numbers written in the CARE tool assessment becomes the guideline for allocating the number of individualized care hours a person will be getting each month. In other words, the individual being assessed does not get to see the numbers listed on the CARE tool until the application has been officially processed by the state. Juengst et al. (2019) mentioned that there were several limitations to their study which includes the consideration of participant self-awareness of behaviors, only looking at a two week time frame, small sample size, and lack of test items sensitive to exaggerated claims by participants.

In consideration to the above-mentioned studies, it has been made clear that other assessments focusing on behavior and cognition exist. A lot of these assessments are currently in use and have successfully identified behavior and cognitive impairments that TBI patients may encounter in their recovery process. However, the majority of research studies found were qualitative in nature and no randomized controlled studies were found. All studies were limited in terms of having small sample sizes and bias could be present with the assessments involving self-reporting. There is still a major gap in research on reliable behavior and cognition assessments because there seems to be an interest in self-reported scores of TBI participants where bias and lack of self-awareness is an issue.

### Argument

As was mentioned in the problem statement, the current CARE behavioral and cognitive assessments may require more information than what is currently found on the CARE assessment forms. In particular, behavioral assessments that involve patient self-reporting along with an external observer report of TBI patient behaviors could be incorporated to better describe the TBI patient's overall mental health status, rather than relying solely on subjective observations of behavior. Mental health assessments involve external and internal information from each individual patient who is seeking care. However, some patients with



poor mental health might be viewed by health care professionals as not being able to adequately provide valid information. Therefore, patients may need someone or something to help validate their mental health status whether it be another health professional, family member, or a medical record. That being said, the opinion representation of the validation material should not be valued higher in assessments as compared to direct patient verbalizations of experiences.

Mental health has to take into account the internal information of an individual which can only be described by the individual, much like how descriptions of pain are measured via individual verbalizations. Therefore, self-reporting mental health habits such as engaging in certain behaviors should be documented and assessed with equal value to the opinion of an external observer. There are a few assessment tools that are currently in use which assess self-reports of TBI patient's behavior alongside an external observer assessment of the same TBI patient's behavior. For example, Kelly et al. (2019) utilized the OBS as a behavior assessment tool to assess and monitor for challenging behaviors, and they came to the conclusion that patients living with TBI may be more aware of challenging behaviors if they are given examples of the behavior during the self-reporting portion of the assessment. This indicates that TBI patients may not be completely aware of descriptions of the challenging behaviors that the CARE tool screens for, especially if the behaviors that are assessed in the CARE tool are not explicitly defined for the patient during the CARE assessment. Kelly et al. (2019) also reported statistically significant results in regards to differences in the scoring of self-report and external observation for cognition and challenging behaviors. This indicates that self-reporting should not be the only thing that is relied upon for assessing challenging behaviors.

The most difficult part of a self-reporting assessment is getting reliable and valid results, which can lead other healthcare professionals away from not wanting to include self-reporting in behavioral assessments. However, Juengst et al. (2019) has

been working on a new screening tool called BAST. This tool is which designed to decrease external observation bias by the way questions are worded about certain challenging behaviors. This tool also includes a more comprehensive assessment of support systems and potential stressors that could be triggering challenging behaviors. Incorporating tools like BAST could help long term care programs become more educated on items that could trigger certain behaviors. This could allow these care programs to perhaps become more accepting of these patients with challenging behaviors, once triggers have been identified.

In addition to the discussion of mental health, cognitive assessments for people who live with TBI is an essential assessment for this population because it can help with accurately getting their care needs met so that successful rehabilitation can occur. Specifically, cognitive rehabilitation should be a major focus for this patient population because care needs for TBI patients typically involve ways to cope with cognitive decline over time (Juengst et al., 2019; Kelly et al., 2019; Schwartz et al., 2016; Tran et al., 2018; Zarshenas & Cullen, 2018; Zhang et al., 2016). For example patients living with TBI may not have immediate memory or communication deficits, but may have difficulty in higher cognitive activities such as applying a list of instructions to a physical activity. There are assessments that exist to assess higher cognitive activities and detect more subtle changes in cognition. Zarshenas and Cullen (2018) have developed an integration of the CBB into an already utilized functional assessment tool to involve a deeper cognition assessment for disability measures. With the integration of the CBB components, it was found that TBI patients had difficulty in identifying common objects and in the completion of short-term learning tasks, which correlated with lower cognitive scores (Zarshenas & Cullen, 2018). Schwartz et al. (2016) developed the FLOTCA assessment tool to measure higher cognition based on sequencing logical steps in unfamiliar environments and found that GCS scores and FLOTCA scores correlated with each other. Tran et al. (2018) developed the FAVRES assessment to assess cognition with communication

skills. This tool asked participants to describe their rationales behind the steps that they take to complete a task and found that the participants had difficulty in completing the FAVRES about one year post injury as compared to immediately after acute care discharge.

All of these assessments show that some aspect of decision making can be difficult for TBI patients. These deficits can only be found if higher cognition assessments are completed. Time is of the essence, and it has been noted that healthcare professionals who complete comprehensive assessments such as the CARE tool for patients may not want to add another assessment into the fifty plus page assessment forms. However, it should be duly noted that all assessments mentioned previously are designed to take less than 5 minutes (Juengst et al., 2019; Kelly et al., 2019; Schwartz et al., 2016; Tran et al., 2018; Zarshenas & Cullen, 2018; Zhang et al., 2016).

As mentioned previously, the CARE tool currently utilizes the MMSE for assessment of cognition. However, the MMSE may not be sensitive enough to capture more subtle deficits such as those that may be found in higher cognition activities. The MoCA assessment tool has been found to be more sensitive to identifying deficits of higher cognition in comparison to the MMSE. Zhang et al. (2016) found that 87% of TBI participants had normal MMSE scores but abnormal MoCA scores when the same assessor completed the two assessments together on a single participant. This indicates that the MMSE may not be as comprehensive as one may think, because the MoCA involves scoring items that have a unique focus on higher cognition items.

## Discussion

The CARE assessment tool is comprehensive in its entirety when looked at as a whole, and this paper was not in any way claiming that the CARE tool should be thrown out completely. However, there is clear evidence from Washington State Legislation that states the number of care hours allotted per month for those living with mental

health issues are being distributed unevenly as compared to those who have physical and mental health conditions together (Washington State Legislature, 2005b). Furthermore, the findings from the various studies that were mentioned in the literature review section have all shown that there are other existing assessments that better assess various severities found in mental health issues. For example, the studies that were presented in the previous literature review section looked at mental health assessments that were able to pick up on more subtle symptoms, giving the participants a higher score on these assessments. This indicates a higher need of additional help for these individuals that scored higher. This also means that individuals who may have subtle symptoms of a mental health condition upon initial CARE tool assessment can potentially score higher for the number of one-on-one care hours, if any of these cognitive or behavioral assessments were to be added into the CARE tool. In other words, the addition of a more sensitive cognitive or behavioral assessment in the CARE tool would help adjust the scoring to be fairer towards those who present mental health issues that can worsen as time goes on.

Still, it should also be noted that there were common limitations with each of the studies that were presented in the literature review section. These included: some sort of discordance between how the participants viewed their symptoms and how the observers scoring the participants viewed the participants' symptoms, some studies only assessing very mild and very severe TBI symptoms or not considering severity of TBI symptoms at all, small sample sizes, and only observing a specific mental health condition which makes the studies non-generalizable to other mental health issues that are not related to TBI.

That being said, the issue now revolves around the politics behind the CARE tool. Just because there has been an identified need for a change to the CARE tool, does not automatically make the CARE tool able to be changed right away. There is an extensive process to this involving state governed politics at the Legislative level. Individuals can

submit a petition form to the DSHS to recommend changes to the CARE tool through the Washington State Legislation website (Washington State Legislature, n.d.). This can make the issue known to DSHS directly, although this action alone may not be enough. Washington State Legislators can also influence state agencies such as the DSHS to look into topics of concern and have the ability to change the wording of the laws related to Washington State health policies. So, the best thing to do would be to make this issue known to local state legislators who can notify both private and public groups to legally support a change in current health policies. An ideal response from State Legislation would be the appearance of a CARE tool rule change proposal posted in the biweekly Washington State Register. There, the public could view and comment on the proposed change, although the state governor would have the final determination of signing the revision of the rule change into law (Washington State Legislature, 1998).

There are a few steps in the process of trying to get state legislation to support a CARE tool rule change. The first step is to always find the desire and passion to bring up an issue to anyone involved in influencing state government lawmakers, such as an elected official within the State Legislature (Maryland & Gonzalez, 2012). If the elected official finds the issue important and is willing to listen to why the issue is important, the elected official can bring it up to their colleagues at DSHS, for example, to gain support on the issue (Maryland & Gonzales, 2012). If an issue gains enough support, especially from well-respected individuals such as nurses, the state governor may become aware of the issue and be influenced to consider the issue in favor of the groups in support (Maryland & Gonzalez, 2012).

Taking this into consideration, the policy change process can be long. The key here is to be patient when trying to enact policy change. Nurses have the capability to bring light to the CARE tool's hours per month allocation because it is often common for lawmakers to be unaware about healthcare policies (Maryland & Gonzalez, 2012). Therefore, it is up to nurses to stand up and say something about health

issues because nurses see these issues on a daily basis in their practice.

## Conclusion

Although the CARE tool is comprehensive in addressing care needs overall, adult TBI patients may not be adequately assessed for behavioral and cognitive care needs through the current use of the CARE tool. This is because both assessments require more information than what the current CARE behavioral and MMSE assessments can provide. The discoveries of other assessment tools, such as those analyzed previously, show that there are alternative methods which pay more attention to mild cognitive and behavioral signs and symptoms that could potentially require extensive care in the community over time. The current cognitive and behavioral assessments that are included in the CARE tool puts more emphasis on catching the behavioral and cognitive signs and symptoms that are immediately apparent at the point of discharge from the hospital setting. The current CARE tool also lacks the ability to consider psychological changes over time outside of the hospital setting, due to the nature of the cognitive and behavioral assessments included in the tool. The best way to go about changing the CARE tool behavioral and cognitive assessments would be through enacting policy change because the biggest stakeholders in this issue would be the elected officials in the Washington State Legislature and the Washington State Governor. Mental health is a big issue for the state of Washington that is frequently talked about in the media, and providing needed care to those with declining mental health is of utmost importance. However, Washington State Legislation will not provide as many state funded care hours to those with mental health issues as compared to those who have physical medical and mental health conditions together.

## References

- Dams-O'Connor, K., Landau, A., Hoffman, J., & St De Lore, J. (2018). Patient perspectives on quality and access to healthcare after brain injury. *Brain Injury*, 32(4), 431-441. doi: <https://doi.org/10.1080/0269905.2018.1429024>
- Harrison, A.L., Hunter, E.G., Thomas, H., Bordy, P., Stokes, E., & Kitzman, P. (2017). Living with traumatic brain injury in a rural setting: Supports and barriers across the continuum of care. *Disability and Rehabilitation*, 39(20), 2071-2080. doi: <http://dx.doi.org/10.1080/09638288.1217081>
- Juengst, S.B., Terhorst, L., Dicianno, B.E., Niemeier, J.P., & Wagner, A.K. (2019). Development and content validity of the Behavioral Assessment Screening Tool (BAST). *Disability and Rehabilitation*, 41(10), 1200-1206. doi: <https://doi.org/10.1080/09638288.2017.1423403>
- Kelly G., Simpson, G.K., Brown, S., Kremer, P., & Gillett, L. (2019). The Overt Behaviour Scale-Self Report (OBS-SR) for acquired brain injury: Exploratory analysis of reliability and validity. *Neuropsychological Rehabilitation*. 29(5), 704-722. doi: <https://doi.org/10.1080/09602011.2017.1322523>
- Maryland, M.A., & Gonzalez, R.I. (2012). Patient advocacy in the community legislative arena. *The Online Journal of Issues in Nursing*, 17(1), Manuscript 2. doi: 10.3912/OJIN.Vol17No01Man02
- Northwest Justice Project. (2018). Understanding your CARE tool assessment. [PDF file]. Retrieved from [https://www.washingtonlawhelp.org/files/C9D2EA3F-0350-D9AF-ACAE-BF37E9BC9FFA/attachments/39238CBB-C1BC-0DDE-B315-E830D530DB2B/5420en\\_care-tool-8x11.pdf](https://www.washingtonlawhelp.org/files/C9D2EA3F-0350-D9AF-ACAE-BF37E9BC9FFA/attachments/39238CBB-C1BC-0DDE-B315-E830D530DB2B/5420en_care-tool-8x11.pdf)
- Schwartz, Y., Averbuch, S., Katz, N., & Sagiv, A. (2016). Validity of the Functional Lowenstein Occupational Therapy Cognitive Assessment (FLOTCA). *The American Journal of Occupational Therapy*, 70(1), 7001290010p1-7001290010p7. doi: <http://dx.doi.org/10.5014/ajot.2016.016451>
- Tran, S., Kenny, B., Power, E., Tate, R., McDonald, S., Heard, R., & Togher, L. (2018). Cognitive-communication and psychosocial functioning 12 months after severe traumatic brain injury. *Brain Injury*, 32(13-14), 1700-1711. doi: <https://doi.org/10.1080/02699052.2018.1537006>
- Washington State Department of Social & Health Services. (2017). Report to the legislature: Medicaid assisted living facility rates methodology workgroup recommendations, chapter 1, laws of 2017, SSB 5883, section 206. [PDF file]. Retrieved from <https://www.whca.org/files/2017/12/Final-Report-AL TSA-Assisted-Living-Facility-Rates-Methodology.pdf>
- Washington State Department of Social & Health Services. (2003). Comprehensive assessment reporting evaluation (CARE). [PDF file]. Retrieved from [http://www.advancingstates.org/sites/nasual/files/hcbs/files/158/7878/QF\\_CAREAssmtTool.pdf](http://www.advancingstates.org/sites/nasual/files/hcbs/files/158/7878/QF_CAREAssmtTool.pdf)
- Washington State Legislature. (2005a). How does the CARE tool measure clinical complexity? (WAC 388-106-0095). Retrieved from <https://apps.leg.wa.gov/WAC/default.aspx?cite=388-106-0095>
- Washington State Legislature. (2005b). How does CARE use criteria to place me in a classification group for in-home care? (WAC 388-106-0125). Retrieved from <https://apps.leg.wa.gov/WAC/default.aspx?cite=388-106-0125>
- Washington State Legislature. (1998). Petition for adoption, amendment, repeal – agency action – appeal. (RCW 34.05.335). Retrieved from <https://app.leg.wa.gov/RCW/default.aspx?cite=34.05.330>
- Washington State Legislature. (n.d.). Petition for adoption, amendment, or repeal of a state administrative rule. [PDF file]. Retrieved from <https://www.ofm.wa.gov/sites/default/files/public/legacy/reports/petition.pdf>





# OBSTETRIC OUTCOMES AMONG WOMEN OF THE NAVAJO NATION: A MIXED METHOD STUDY EXPLORING CULTURAL HUMILITY AND MATERNAL HEALTH WITHIN INDIAN HEALTH SERVICES

Angelina Phoebe Keryte & Dacia Wagnon

*ABSTRACT: American Indian/Alaskan Native (AI/AN) women are the first people of North America and yet often the first to be overlooked when it comes to maternal health; due to a complicated history of broken treaties and the long-lasting impacts of colonization. A telling sign about the overall health of the AI/AN population, is that their life expectancy is over five times less than that of the U.S. population (IHS, 2019). Little research exists regarding the factors influencing these health disparities, especially with regards to maternal health outcomes.*

*We will use an exploratory sequential design to build a baseline for maternal health in the Navajo Nation. For the quantitative analysis, data on 2019 births will be pulled and de-identified via electronic hospital records from four IHS hospitals on the Navajo Nation. The qualitative analysis will involve interviewing ten Navajo women about their experience with childbirth and medical personnel along with transcript coding for common themes. A limitation to this research is the inability to represent a causal relationship as it is a cross-sectional study. There is also the potential for confounding variables influencing the state of maternal health during the research year; such as lack of access to transportation. We encourage follow-up research to better determine the education and training that IHS staff undergo. As our research will involve a vulnerable population, many cautious considerations will be taken into account in order to support and empower Navajo women by ensuring that their voice is heard.*

## Introduction

### Overview of American Indian/Alaskan Natives (AI/AN)

Maternal health and obstetric outcomes for Navajo women are vastly different than those of the white majority population in the United States. Looking beyond the influence of racial health disparities, how does non-indigenous practitioner trust and cultural humility effect obstetric outcomes among Navajo Women? The disparities in American Indian/Alaskan Native (AI/AN) communities have been severely impacted through their health, traditions, and historical events of cultural assimilation brought on by the United States Government. Historical trauma continues to persist within tribes by way of broken treaties and health inequities. These health disparities are

represented in western medicine, and can be seen through high rates of obesity, heart disease, and substance abuse (IHS, 2016). As health disparities widen, we want to explore the influence that the lack of cultural humility among health care providers has on indigenous populations, specifically women of the Navajo Nation.

According to the National Conference of State Legislatures, there are a total of “573 tribes federally recognized” in the U.S. who have the rights to receive health care services through Indian Health Services (IHS, 2016). Individual tribes are recognized by the U.S. Government as sovereign nations and honored through a trust known as the Federal Indian Trust Responsibility - a legal obligation under which the United States, “has charged itself with moral obligations of the highest responsibility and trust’ towards Indian Tribes”

(Seminole Nation v. United States, 1942). These Federal Indian Policies are a form of protection for the Indigenous population of this country and are used to ensure that the United States Government abides by all treaties. The long-term outcomes of colonization have immensely impacted the health care system within Indigenous communities. These treaties regarding human rights given back to tribal communities are often overlooked, thus resulting in the current health inequities faced by indigenous communities today. Furthermore, these treaties are limited and ambiguous with regards to addressing quality health care for AI/ANs – leaving the AI/AN population unarmed and underserved. The health care sector and the unequal division of resources to the AI/AN population is just one area among many, where this past historical trauma and aftermath of unmet treaties has seeped into.

### **History of Navajo Nation**

The Indigenous people of the Southwest, The Diné, translates into “The People,” also known as Navajo. The Navajo Nation is located primarily in the Four Corners and is the largest tribe in the United States, “consisting of more than 25,000 contiguous square miles and three satellites communities, and extends into portions of the states of Arizona, New Mexico, and Utah” (IHS, 2016). On the Navajo reservation there are five federal service units (FSU). Of those five there are four hospitals that provide healthcare to AI/ANs. The United States Census Bureau states the average median income on the reservation per household is 26,862 dollars, which is half the average income at the local level for the state of Arizona, 50,448 dollars, and on the reservation the poverty rate is 38% as compared to the state of Arizona is half the rate of 15% (Center for New Media & Promotion & US Census Bureau, 2017).

Since time immemorial Diné (Navajo) women have led and carried the families. “Traditionally, the Navajos are a matriarchal society, with a descent and inheritance determined through one’s mother. Navajo women have traditionally owned the bulk of resources and property, such as livestock” (IHS,

2016). The resilience that each generation carries comes from the women of the tribe. Culturally, Navajo women have always been the leaders and caretakers of the children. There is strong connection carried through pregnancy, which has been impacted by non-indigenous physicians and western medicine. In this particular qualitative study, “American Indian women who were interviewed were uncomfortable seeing a male physician for anything having to do with pregnancy or prenatal and felt it was embarrassing and inappropriate to have a male physician during pregnancy” (Hanson, J.D., 2012). Women should not feel uncomfortable nor discouraged from sharing their experience with practitioners about the health of the well-being of their future child. As this research shows, if Navajo women don’t have access to female practitioners, then their patient-practitioner trust could be greatly impacted. It is a vital and important skillset for medical practitioners to have cultural humility when working with vulnerable populations. Maternal

### **Health in the Navajo Nation**

For maternal healthcare on the Navajo Reservation, many barriers stand in the way when it comes to receiving adequate prenatal, perinatal, and postnatal care. “Women who fail to present for prenatal care entirely are at high risk for adverse pregnancy outcomes and are more likely to be non-White” (Bryant et al, 2010). Past research shows gestational diabetes, low birth weight, and little to no prenatal care as common risk factors among AI/AN women. Social determinants are contributing to these barriers, such as socio-economic status, level of education, income, access to healthcare, and family support. In the New Mexico Epidemiology PRAMS Report on, New Mexico Navajo Mothers and Their Infants, 2005-2011, stated “42% Navajo mothers did not receive prenatal care at the beginning of their first trimester and only 49% received adequate prenatal care” (Navajo Epidemiology Center & New Mexico PRAMS/Maternal and Child Health Epidemiology Program, 2011). In multiple studies there are shared themes for Indigenous women, that the lack of care results in higher outcomes of low-birth weight and infant mortality - important health

outcomes that should be addressed, especially in a matriarchal society. The primary caretaker of the family should not be the one to receive the worse quality of care.

The trust that tribal individuals hold with healthcare providers has been influenced by historical trauma, thus maternal health and future generations have been impacted. The AI/AN community is greatly underrepresented and underserved. One can only assume that historical oppression and lack of cultural humility in practitioners has exacerbated the health disparities of this population. In a qualitative study, First Nation individuals shared “their experiences with traditional health care to western health care, and described barriers to care that they had experienced in accessing medical doctors (e.g., racism, mistrust), as well as the benefits of traditional healing (e.g., based on relationships, holistic approach)” (Auger, Howell, & Gomes, 2016). This study was created for the Urban Indigenous population in Vancouver, British Columbia. The findings suggested that the health inequities they faced were from a lack of quality care and cultural understanding. Many had identified the lack of cultural awareness and mistrust with their practitioners thus receiving poor quality care, indicating a need in health care for practitioners to establish trust with tribal individuals. To establish a foundation of trust with a patient, practitioners must be culturally sensitive when providing health services. Limited research on certain tribes throughout the North American continent has limited the amount focus on Navajo Nation Women. The research that could relate and create a foundation in the research study is Disparities in Risk Factors and Birth Outcomes Among American Indians in North Dakota, “Racial disparities existed in education, teen births, tobacco use during pregnancy, and breastfeeding initiation. Disparities widened for inadequate prenatal care, illegal drug use during pregnancy, and infant mortality from 2007-2009 to 2010-2012 and narrowed for sexually transmitted infections and alcohol use during pregnancy” (Danielson et al, 2018). Danielson et al., also found, that the infant mortality rate was three times higher for AI/AN

women when compared to white women in North Dakota; identifying AI/AN women as a vulnerable and disadvantage population.

The future AI/AN generations will not succeed if maternal health continues to be neglected. Understanding the cultural and historical background of the Navajo People is vital for all healthcare practitioners, especially non-Indigenous ones, if they are to positively impact maternal healthcare. It is important that healthcare providers understand the cultural history and values that a matriarchal society holds. We believe that this foundational difference contributes largely to a lack of cultural humility among medical practitioners, resulting in poor patient-practitioner trust and negatively impacted obstetric outcomes/experiences of indigenous populations.

### **Research Question and Hypothesis**

There are huge health disparities between non-indigenous and indigenous (American Indian and Alaskan Native) populations in the United States. This is true to the extent that the overall life expectancy of the American Indian and Alaskan Native (AI/AN) population is over five years less than that of the entire U.S. population life expectancy (IHS, 2019). Research is greatly lacking on AI/AN populations in the U.S., especially with regards to maternal health disparities (Anderson, Spicer, & Peercy, 2016). Past research suggested that “disparities in birth outcomes are important markers of population health,” because they provide insight on the state of maternal and child health within a community (Dennis, 2018). Our mixed methods research will explore the relationship that cultural humility of healthcare practitioners has with maternal health and obstetric outcomes in the Navajo Nation. Our research is founded on this question: how does non-indigenous practitioner trust and cultural humility influence obstetric outcomes among Navajo Women? We suspect that lack of cultural humility among medical practitioners and poor patient-practitioner trust negatively impacts the obstetric outcomes/experiences of Navajo Women.

Research Methodology

Design Summary

We will be using a mixed methods research design, which we selected because of the insight that it can provide statistically and culturally. In order to get a baseline for the current state of maternal health in the Navajo Nation and better understand the role of cultural humility on maternal health outcomes, an explanatory sequential study design was determined to be the best fit. Many studies show that “health disparities contribute to racial/ethnic variation in morbidity and mortality in the United States, with many minority populations frequently experiencing greater prevalence of poor health outcomes compared to non-Hispanic whites” (Anderson et al., 2016). However, multiple studies agree that little research has been done to understand why these disparities persist and what factors contribute to their continuation, especially in the U.S. AI/AN populations (Anderson et al., 2016; Danielson et al., 2018; & Dennis, 2018). One of the main goals of our research will be to create a snapshot of maternal health in the Navajo Nation and to gain an understanding of how cultural humility (or lack thereof) within IHS negatively influences overall maternal health by way of obstetric outcomes for Navajo women. We propose to do this by first pulling data from the four existing IHS hospitals on the Navajo Nation. We will follow with a narrative approach, wherein we will partner with tribal community members and interview ten

women who self-identify as AI/AN, utilize IHS, and have had adverse obstetric experiences.

There is no golden standard or set of universal indicators for the measurement of positive or negative obstetric outcomes nor what qualifies as adverse because “few agreed-upon measures of quality of obstetrical care currently exist for evaluation of disparities in care quality” (Bryant, Worjolah, Caughey, & Washington, (2010). Due to this lack of consensus, we selected measurements that we felt, from our literature research, would provide a more multidimensional view of maternal health in the Navajo Nation. All data set findings will be compared to the white U.S. population for measurement since it is the majority ethnic group that most maternal health research is based on. Data will be pulled via electronic hospital records with help from IHS. We expect to find that there is a lack of cultural humility and training among IHS health practitioners, especially non-indigenous ones, and that this deficit in cultural understanding combined with historical trauma and lack of patient-practitioner trust, negatively influences overall maternal health and obstetric outcomes/experiences of Navajo women.

Population

The target population for data collection will be the four IHS hospitals that service the Navajo Nation: Chinle Comprehensive Health Care Facility, Crownpoint Health Care Facility, Gallup Indian Medical Center, and Northern Navajo

Table 1. Data collection.

Maternal Health	Cultural Humility
• Maternal mortality.	• Number of OBGYN’s employed by each hospital.
• Infant mortality.	• Number of years each skilled provider has worked at that hospital.
• Emergency C-section.	• Cultural humility training required by hospital.
• NICU Admission.	• Provider’s association with tribal community.
• Age of Mother.	• Average number of on-call practitioners each day of the week.
• Gravida (number of pregnancies).	• Number of certified nurse’s working during each labor.
• Number of pre-natal visits.	• Gender of skilled practitioners on shift.



Medical Center (IHS, 2019). For the narrative section of our study, we will find our sample of ten participants who are self-identifying AI/AN Navajo Native Females, through judgmental sampling via a community member. Participants must meet the following criteria in order to be eligible for the study: a) be between the ages of 14-45, b) have given birth at any of the four IHS hospitals on the Navajo Nation during the years 2018-2019, and c) have had a labor experience that they consider to be unplanned and/or unfavorable.

## **Sampling Techniques and Data Collection**

### *Quantitative Phase*

We will pull data from four IHS hospital's electronic health records. Data will be de-identified by IHS, in order to maintain confidentiality with all the data sets. First, we will look at the number of births that took place in the year 2019 at each hospital. The data in Table 1 will then be collected on each birth to measure what we deem (since there is no one consensus in research) to be maternal health and practitioner cultural humility indicators.

After the above data is collected on each birth, it will then be analyzed quantitatively and put into percentages of the type of outcome that the birth resulted in.

### *Qualitative Phase*

For the qualitative data analysis, we will ask ten women of Navajo descent open-ended questions that will focus on their experience with labor, delivery, and interactions with medical personnel. The interviewer will prepare questions ahead of time and have pre-set tools to help prevent bias and any loaded questions from being asked. The goal of each interview will be to hear and collect the participant's stories about her experience with delivery and medical personnel interactions. In order to specifically assess perceived trust between patients and practitioners we will delve into interviewees relationships with medical professionals, exploring whether they felt in control of the medical decisions being over their

bodies as well as if they felt heard, understood, and listed to by their doctors. Furthermore, we want to know if they believe that medical providers both understand and will advocate for their health. All interview questions will be open-ended and serve as an unbiased guide for the interviewer. Interviews will be recorded for transcript coding to identify common themes, outcomes, or mindsets.

This sample will be found through community-based participatory research by contacting the executive staff of The Changing Women Initiative (a non-profit organization seeking to "renew cultural birth knowledge to empower and reclaim indigenous sovereignty of women's medicine") (Changing Women Initiative, 2019). Through this organization we will find a community leader to initiate sampling, specifically, the snowball sampling effect, by reaching out to executive staff of The Changing Women Initiative and the founder herself (who is a tribal member of the Navajo Nation), and gain participants through their community relationships. This method was chosen because there is a lack of reporting on pre-natal care in this population, and we want to hear about their personal experiences in order to give the hospital data humanity.

## **Ethical Considerations**

In order to maintain culturally appropriate ethics throughout our research, in addition to IRB approval, we will be submitting our proposal to be reviewed by the Navajo Nation Human Research Review Board. As stated above, all data pulled from the four IHS hospitals will be de-identified prior to reaching the research team. Any statistical data shared with the public from this research will be presented as collective sums so as to remain confidential on an individual basis. For the narrative section of the study, all interviewees will be found through community-based participatory research.

Since this is a historically oppressed population, we decided that no incentives would be given to participants for fear of appearing coercive. Each participant will be provided with a list of interview questions beforehand, so that they may prepare for



the interview in advance. Participants will be asked to provide both written and verbal consent before the interview is conducted. Participants may opt out of answering any questions that they see fit and will be encouraged to share their story and describe their obstetric experiences without researcher agendas. Before beginning the interview, the interviewer will remind the participant that responses are confidential, stories will be made confidential for the rest of the research team, and only themes from stories will be shared with the general public. Ultimately, individual participants will have control over their narrative when it comes to publishing and will furthermore have the ability to read and/or veto their manuscript. The research interviewer will be an individual of AI/AN descent who affiliates with the Navajo Nation Community in order to account for cultural awareness and sensitivity. The interviewer will remove all names and identifiable information from the interview findings for the rest of the research team in order to maintain individual participant confidentiality.

### **Discussion and Future Directions**

#### **Significance**

“The United States spends more on maternity care than any other country in the world, yet the US maternal mortality and infant mortality rates are among the highest of all industrialized countries” (Howell & Zeitlin, 2017). As we stated earlier, these high rates of mortality are seen most in underrepresented and marginalized groups. Research conducted on the health of Navajo women is not only vital to the tribal community, but is an important piece in the greater maternal health issue in the U.S. As suggested by Howell & Zeitlin (2017), acknowledgement of the impact that racial/ethnic disparities have on obstetric outcomes exists, but research with causal links have yet to be conducted. Our research would have the opportunity to address missing gaps in knowledge regarding quality of care and racial/ethnic health disparities.

#### **Limitations**

As with all cross-sectional studies, the greatest limitation is timing and the inability that one point in time has to represent a causal relationship. Additionally, there is potential for confounding variables that influence the state of maternal care during the selected research year (e.g. the opioid crisis, natural disaster, etc.). According to Ho et al. (2018), lack of access to transportation, healthcare services, and resources within tribal healthcare systems are current barriers for AI/AN populations. Any of these could be confounding variables to the data that we would pull from IHS health records. A limitation specific to the narrative approach is the potential impact that any outsiders or non-indigenous researchers could have on the data that they are collecting via interviews. We acknowledge the oppression of the Navajo Nation as well as other AI/AN communities in the U.S. which have undergone colonization, historically involving the violation of human rights. We would address this by collaborating with community partners, and by having a researcher who affiliates with Navajo Nation, is of AI/AN descent, and identifies as a female, conduct the interviews.

#### **Innovation**

We believe that the lack of generalizability with our study is a strength because it advocates for community specific research rather than assuming that all like-minded populations face the same health barriers. This way of thinking is innovative and necessary for past and future research analysis. We acknowledge that every tribe is different, and therefore has different health needs as a community that should come with customized research when creating solutions to those needs. Since our research would be restricted to the Navajo Nation, the results of it will be specific to the Navajo community and should not be applied as likeness to other AI/AN populations or reservations, but instead used as a foundation to initiate reservation-specific research.

## Future Directions

Follow-up research is encouraged to assess the education and training of healthcare practitioners within IHS and test the implementation of community-based cultural humility training. “Today, Navajos traditional lifestyle is under the substantial stress brought about by rapid change in their society.” (IHS, 2019) As this transition takes place, research on the AI/AN population is incredibly crucial. If further research is not conducted, then the health disparities between the indigenous and non-indigenous communities will only widen. Cultural understanding and practitioner sensitivity will be a critical step as further Westernization takes place in AI/AN populations. This study could encourage future research on the effects that culturally incompetent practitioners have on other health outcomes among AI/AN communities, such as diabetes or chronic illness. Long term, we hope that this research project would promote future research of AI/AN communities, and thus create public and scientific advocacy for a population that should have been fought for, and not against, a long time ago.

## References

- Anderson, K. G., Spicer, P., & Peercy, M. T. (2016). Obesity, Diabetes, and Birth Outcomes Among American Indians and Alaska Natives. *Maternal and child health journal*, 20(12), 2548–2556.
- Auger, M., Howell, T., & Gomes, T. (2016). Moving toward holistic wellness, empowerment and self-determination for Indigenous peoples in Canada: Can traditional Indigenous health care practices increase ownership over health and health care decisions? *Canadian Journal of Public Health*, 107(4-5).
- Beavis, A. S., Hojjati, A., Kassam, A., Choudhury, D., Fraser, M., Masching, R., & Nixon, S. A. (2015). What all students in healthcare training programs should learn to increase health equity: perspectives on postcolonialism and the health of Aboriginal Peoples in Canada. *BMC medical education*, 15, 155.
- Bryant, A. S., Worjolah, A., Caughey, A. B., & Washington, A. E. (2010). Racial/ethnic disparities in obstetric outcomes and care: prevalence and determinants. *American journal of obstetrics and gynecology*, 202(4), 335–343.
- Center for New Media & Promotion, & US Census Bureau. (2017, March 7). My Tribal Area. Retrieved from <https://www.census.gov/tribal/?aianihh=2430>.
- Changing Woman Initiative 460 Saint Michaels Dr. Ste 804, Santa Fe, NM 87505. (n.d.). Retrieved November 27, 2019, from <http://www.changingwomaninitiative.com/>.
- Danielson, R. A., Wallenborn, J. T., Warne, D. K., & Masho, S. W. (2018). Disparities in Risk Factors and Birth Outcomes Among American Indians in North Dakota. *Maternal and Child Health Journal*, 22(10), 1519–1525.
- Dennis J. A. (2018). Birth weight and maternal age among American Indian/Alaska Native mothers: A test of the weathering hypothesis. *SSM - population health*, 7, 004–4.
- Disparities: Fact Sheets. (n.d.). Retrieved from <https://www.ihs.gov/newsroom/factsheets/disparities/>.
- FastStats - Health of American Indian or Alaska Native Population. (2017, May 3). Retrieved November 27, 2019, from <https://www.cdc.gov/nchs/fastats/american-indian-health.htm>.
- Goodkind, J. R., Gorman, B., Hess, J. M., Parker, D. P., & Hough, R. L. (2015). Reconsidering culturally competent approaches to American Indian healing and well-being. *Qualitative health research*, 25(4), 486–499.
- Hanson JD. Understanding prenatal health care for American Indian women in a Northern Plains tribe. *J Transcultural Nursing*. 2012;23(1):29–37. doi:10.1177/1043659611423826
- Ho, J., Bachman-Carter, K., Thorkelson, S., Anderson, K., Jaggi, J., Brown, C., ... Shin, S. (2018). Glycemic control and healthcare utilization following pregnancy among women with pre-existing diabetes in Navajo Nation. *BMC Health Services Research*, 18(1).
- Howell, E. A., & Zeitlin, J. (2017). Quality of Care and Disparities in Obstetrics. *Obstetrics and gynecology clinics of North America*, 44(1), 13–25.

Indian Health Service (IHS). (n.d.). Retrieved from <https://www.ihs.gov/navajo/>.

Navajo Epidemiology Center, & New Mexico PRAMS/Maternal and Child Health Epidemiology Program. (2011). *Report On New Mexico Navajo Mothers and Their Infants. Report On New Mexico Navajo Mothers and Their Infants* (pp. 1–40). Albuquerque, NM: University of New Mexico.

Seminole Nation v.s. United States. (n.d.). Retrieved October 11, 2019, from <https://www.law.cornell.edu/supremecourt/text/316/286>.

Niklund, A. (n.d.). Retrieved from <http://navajopeople.org/navajo-history.htm>.

Walkup, J. T., Barlow, A., Mullany, B. C., Pan, W., Goklish, N., Hasting, R., ... Reid, R. (2009). Randomized controlled trial of a paraprofessional-delivered in-home intervention for young reservation-based American Indian mothers. *Journal of the American Academy of Child and Adolescent Psychiatry*, 48(6), 591–601.

Williams, Emanuel, Kimpo, Leisenring, & Hale. (1999). A population-based cohort study of the relation between maternal birthweight and risk of gestational diabetes mellitus in four racial/ethnic groups. *Pediatric and Perinatal Epidemiology*, 13(4), 452–465.

## AIRTIME

Cliff Watson

### *Airtime*

*Come, Sleep, and with thy sweet deceiving  
Lock me in delight awhile;  
Let some pleasing dreams beguile  
All my fancies; that from thence  
I may feel an influence  
All my powers of care bereaving.  
Though but a shadow, but a sliding,  
Let me know some little joy!  
We that suffer long annoy  
Are contented with a thought  
Through an idle fancy wrought:  
O let my joys have some abiding!*

*- John Fletcher, 1607<sup>1</sup>*

### Introduction and Abstract

The hum of the machine at my bedside is audible, if barely, at 21dB. A 6' heated tube runs from the machine to the short, even more flexible tube of a mask consisting of a lightweight frame, elastic head strap, and cushioned nasal "pillow" that fits directly onto the nose. The machine contains a heated water reservoir and delivers a constant, sufficiently high pressure of humid air through the tubes and pillow into my nose to prevent my throat from collapsing while I sleep.

This device, a ResMed AirSense 10 AutoSet, delivers a Continuous Positive Airway Pressure (CPAP) for the treatment of sleep apnea, an unfortunate condition whereby my airway collapses due to relaxation of the throat muscles, resulting in the interruption of the flow of air to the lungs. My doctor tells me I have an almost perfect throat geometry for sleep apnea – lucky me! – and based on the results from a two-night sleep test, he prescribed an air pressure level commensurate with the severity of my condition. Without the CPAP device, when sleep apnea strikes, my body wakes me up 15

times every hour because of the lack of oxygen getting to my system, causing explosive snores and gasps and depriving me of a full night's deep sleep and REM sleep. I am completely unaware of this happening. While tethered to the CPAP device, the constant air pressure keeps my throat open, and I have only 0-2 airflow change events per hour, those episodes being mild and not disruptive to sleep.

In this paper, I will show that certain continuous assaults on individuality by the technologies of the medical-industrial complex's surveillance state can be overcome, or at least mitigated, by rejecting conformity and reclaiming the self through a methodology orthogonal to the attack. I start by discussing practical and physical aspects of CPAP usage, including treatment alternatives, living with the device, social impacts on others, and general impacts of sleep – or lack thereof – on fatigue and general health. I explore aspects of gamification, control, and privacy involving the transition of intimate data to a corporate or public environment. I compare the personal impacts of the CPAP device to personal impacts in existing non-CPAP

<sup>1</sup> John Fletcher's (1579 - 1625) song "Sleep" is from the stage play, *The Woman Hater*, first published 1607.

device studies. I then expand the discussion of airflow aesthetically and metaphorically to include alternative airflows such as dreaming and singing, both comparing and integrating the airflows of the CPAP and singing in a performative aspect. I conclude with a creative intervention to retain some personal autonomy and identity for myself, the individual.

### **Alternatives and Resignation**

There are alternatives to using the CPAP device. One can wear an expensive, custom mouthguard that pushes the jaw forward, creating extra space in the throat and reducing the likelihood of sleep apnea occurrence. The cost of this appliance is approximately the same as a CPAP device (ASA). An additional downside is that it introduces jaw muscle tension. Since I have had to wear a nightguard for years to ease jaw tension, I rejected this option outright.

A second option is airway surgery, with all the risks one normally associates with surgery. As a singer, I am wary of touching the area around a musical instrument I have spent much time developing over my life. I rejected this option.

The last option to consider is doing nothing, and coping with sleep deprivation on my own. Based on my experience for the last 8 years or so, this would mean being sleepy in the morning after 7-8 hours of sleep, and drinking coffee to get going. I would get sleepier in the afternoon and feel unsafe driving for longer distances, needing to actively will myself to stay awake. Sometimes I would need to put my head down on my desk for a while in my office; however, having drunk coffee, I would be wired and unable to sleep. As I considered my options, I noted that my evening graduate classes would soon be starting, requiring late-day concentration and driving back home in the dark. Doing nothing was not an option.

With all of these complicated decisions, one interesting aspect is that I am witness to none of sleep apnea's immediate effects. While I feel the after effects of sleep deprivation, I must rely

completely on my wife's observations during the night, binding her as witness and data collector to inform my seeking of treatment. This role as witness is not innocent, for she is periodically awakened by explosive snores as my body craves oxygen, reducing the fulfillment of her own REM and deep sleep requirements.

Others are impacted by my sleeping success. In fairness, my coworkers require that I contribute proportionally to job requirements, juggling tasks, making decisions. This is only consistently possible with quality rest. Similarly, my fellow MFA students should be able to depend upon me to participate fully in class discussions, for to not do so would cheat them out of the full cohort experience. Sleep is the vital ingredient that lubricates our minds' thoughts and dreams, and the loquacious wagging of our tongues.

Using the CPAP device has been a multi-dimensional learning experience, requiring several adjustments on my part. I received an introductory training session on how to use the machine, a mask fitting session, I arranged space at home for the device, and had a follow-up office visit to see how well everything was working. I also had to relearn some mechanics of "how to sleep" to achieve proper airtime.

### **Personal and Data Pipelines**

Sleeping with a long tangle of tubes requires some adjustment. With the tubes pulled fully onto the bed, they can get tangled in bedsheets, and an unfortunate roll risks pulling the device off the side-table. When the tubes are minimally on the bed, their hanging weight pulls downwards on the mask which is both bothersome and more likely to unseat the mask from its most effective position. A compromise solution was leaving enough slack in the tube to reduce the danger of yanking the device to the floor, and threading part of the tube under a sheet to keep it from slipping entirely off the bed.

More so than the tubes, the mask has been fundamental in adjusting my sleeping position. I used to spend some of the night sleeping on



my side. However, my mask's nasal pillow can get bumped out of place by the pillow and leak air if I am on my side, so I have had to re-train myself to sleep almost entirely on my back.

Additionally, the mask dictates bedtime verbal communication parameters with my wife. Rather than discussing the day's events until we are ready to drift off, we must decide when we are ready to sleep. Only then do I put the mask on, which fills my throat and mouth with a constant flow of air. Speaking then means fighting the airflow, drowning in air, and makes clear speech challenging. In broadcast lingo: airtime is being off-the-air.

I had to set up an online account to monitor and log airflow data that the device records. My air-time data is sent over-the-air via a cellular unit embedded within the device to an online database. Reports based on that data are used to justify health insurance coverage of some of the cost of the device and accompanying supplies, for they will only pay if my measurements of compliance are "good enough" by their yardstick. I can access a data summary from a dashboard on the device manufacturer's website<sup>2</sup>, as well as device tips and tricks. An array of colorful web charts tracks my actual airtime usage, mask seal quality, and other data over time. My doctor can access a more detailed version of that data, along with controls to adjust my airflow settings from his browser. To encourage me to wear the device, and not be discouraged if a night on the device doesn't go well, I receive twice weekly emails from ResMed congratulating me for good sleep practice. For example, September 17th I received the following message<sup>3</sup>:

Congratulations on earning the SILVER badge! You've earned this badge because you've used your machine for at least four hours a night for five days in a week. Using therapy consistently takes a lot of hard work and dedication.

Be proud of your accomplishment and know that using your therapy can have a significant impact on your quality of life.

...

81% of people with OSA who use CPAP for more than seven hours a night have less daytime sleepiness after three months.

If you like you can log in to myAir now to share your accomplishment with family and friends on Facebook and Twitter.

...

Sleep well!

The myAir Team

The first tidbit of note from the email is the prompt to broadcast my airtime accomplishments on social media. The gesture seems a strange combination of patient-positive normalizing of CPAP machine usage, and guerilla marketing. I can imagine a social media posting: "New Post from Cliff and ResMed – how's your breathing? Click here to learn more!" [Note: this is not an actual post.] Indeed, commercial airtime for the brand, using my airtime.

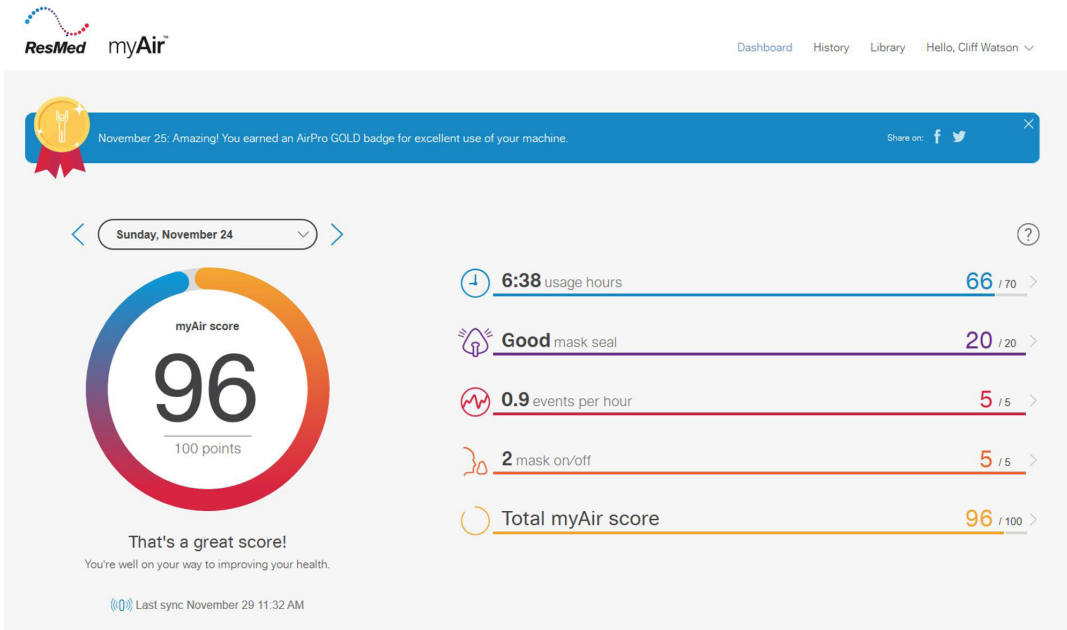
Badges in the above email, and encouraging banners like "November 25: Amazing! You earned an AirPro GOLD badge for excellent use of your machine."<sup>4</sup>, also appear on the dashboard as seen in Figure 1.

These gamification tools, with points and awards, are to excite and incite me to keep using the device and, of course, continue to buy more device supplies (filters, tubes, et al.) It is interesting that both a corporation, and my doctor whom I only see by rare appointment, for he is booked out months in advance as there is heavy demand for sleep doctors, have greater access to and control of my data and device functionality than I do. The keys to my airtime, my energy flow, controlling the nighttime airflow for my lungs, are in the hands of big business and a mysterious seldom-seen wizard, who twiddles

<sup>2</sup> The ResMed MyAir Dashboard, a separate login is required for each customer.

<sup>3</sup> Personal email from myAir noreply@myair.resmed.com, September 17, 2019. Only a portion of the email is included.

<sup>4</sup> Dashboard data accessed November 29, 2019 9:05 PM.



the airflow controls with secret method and arcane touch. So, my airtime has a longer-scale arc, a slow drift of adjustments over months. If my humid airtime is my sleep weather, then the gross adjustments are climate control. It seems like a form of body control, for I have lost some autonomy. Because of this, prescribing an airtime machine seems more loaded with meaning than prescribing medication. When you fill that Rx, you're using a device that provides a (mechanized) internal impact to you via airflow, like a breathing medication could, yet also maps onto your body a new powered breathing space, a cyborg-like extension that changes your insides while still connected outside. Additionally, you're filling a prescription for extending yourself into a living digital identity, for through a dose of surveillance, with a "live connection" to big business and the medical establishment, the boundary is blurred between key parts of your personal identity, such as the rhythm of your breathing, and the synchronized digital world. To paraphrase the Borg, the all-powerful alien civilization from *Star Trek*, you have been assimilated.

### Research – from Fatigue to Dreams

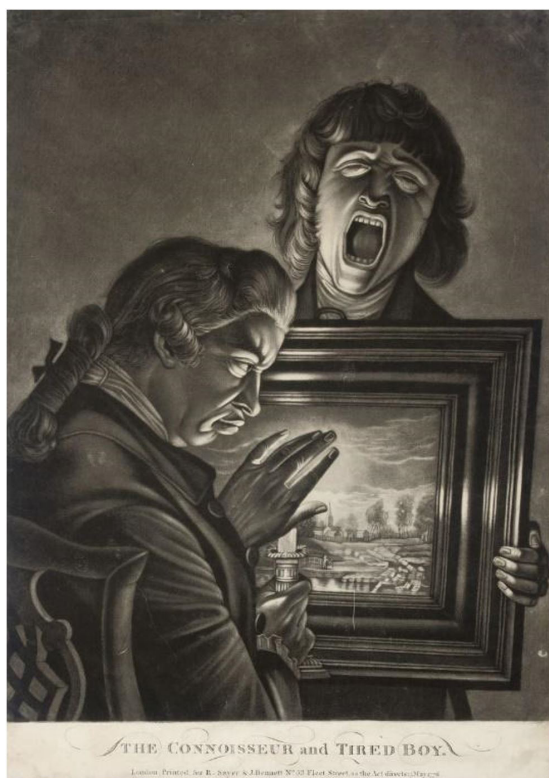
Of course, if that is the price that I have to

pay, then I am paying it... for now. Fatigue will not help me to achieve any personal goals. As summarized in the Sleep Research Society's journal *SLEEP*, poor sleep is party to all kinds of health problems, including coronary heart disease, depression, diabetes, et al. (Buysse 9-17). Interestingly, one strong motivator for research on fatigue is – airtime! That is, keeping aviators awake behind the controls of an aircraft. Apropos, sleep experts quoted for the guide *Fatigue in Aviation: A Guide to Staying Awake at the Stick* estimate 95% of fatigue incidents result "either from sleep deprivation or undiagnosed, untreated sleep disorders rather than boredom, monotony, stress, or unclearly defined biological processes" (emphasis mine) (Caldwell 15).

On the artistic side, consider fatigue's open-mouthed youth in *A Connoisseur and Tired Boy*, engraved by Philip Dawe (British, 1745? –?1809). Boredom, a long day, fatigue from holding the painting, poor sleep, could all lead to an impertinent yawn before the Italian art buyer. And a yawn is the momentary intersection of airflow with fatigue. But consider another possibility: he could be expressing a mournful or weary song, the spontaneous intersection of

fatigue, airflow, and improvisatory musicality, thereby giving much for the art buyer to consider visually and aurally. The impetus behind a sleep- or fatigue-induced airflow experience is not always obvious, and this complexity inhabits both our sleeping and waking lives.

Besides the physical airtime of the CPAP, when sleep is achieved there may be a corresponding airy drift in the world of slumber. Floating between wakefulness and sleep, in and



{{PD-US}}: [https://commons.wikimedia.org/wiki/File:The\\_Connoisseur\\_and\\_Tired\\_Boy.jpg](https://commons.wikimedia.org/wiki/File:The_Connoisseur_and_Tired_Boy.jpg)  
 Template:PD-US

out of sleep's phases, drifting into dreamland. In particular, the airtime of dreamland is known as a flying dream, a category of what Bulkeley in *Big Dreams* calls mystical dreams that focuses on "physical power and individual freedom" (11). In flying dreams, the body creates "a vividly realistic experience of liberation from gravity and from all that gravity represents", often with great personal metaphorical significance. In the United States, the highest incidences of flying

dreams occur in the 30-49 age range, when 58% of American women and 50% of American men have them (Bulkeley 4). While I am in that age demographic, as far as I am aware, I am not a flying dream participant for I cannot remember a single personal-gravity-defying dream. Perhaps as a child I internalized Casey Kasem's popular weekly Top40 admonition, "Keep your feet on the ground and keep reaching for the stars" (Am. Top40)?

While pondering in dreamland, a quick aside. Consider what it means to be restless. The urge to move and follow your dreams. Or, to be lacking rest, to be rest-less. Dreams can't be fulfilled when one is without rest, for according to Fox, et al., in *Frontiers in Human Neuroscience*, "both daydreaming and dreaming ... and their associated subjective content, are strongly correlated with the "resting state" and REM sleep, respectively" (2). This word contradiction requires a well-slept-restlessness for the rest-less individual to be fully enabled for dream-chasing. There are dreams that would never have existed had I not been enabled for successful rest by starting CPAP therapy this fall. In a way, the CPAP device is an imagination generator, producing complex metaphoric fantasies from a little bit of airflow, like the proverbial gentle breeze from the flap of butterfly wings leading to a rainstorm. Perhaps some of my dreams will be flying dreams, and in my airtime I will swoop over UW Bothell clad in black, keeping the crows company.

### A Different Kind of Airtime

While I may not recall flying dreams, I have dreamt about a different kind of airtime: singing, my voice flying over an orchestra in live performance, or recording a song for airtime play. I have done these things in real life as an opera singer, in a musical role, or in a choir, but the dreams generally have a different twist: I'm a last-minute replacement in a show I haven't rehearsed, or my costume is wrong, or someone hands me unfamiliar music. As always, the show must go on.

Singing is a full-being activity, engaging your physical core, your musical intellect, and your emotional/dramatic impulses. I have had professional voice lessons since the early 1990s<sup>5</sup> and from those lessons, and singing in the theatre, I have a good understanding of the skills necessary to produce beautiful, sustained, and emotive song. The physicality of singing involves balancing appropriate levels of support from the diaphragm, sound placement, relaxation of muscles (in the throat, tongue, et al.), and clarity of enunciation. Layered on top of that is the musicality to sing the song as desired stylistically, and the emotiveness appropriate to the character of the piece or stage character you are inhabiting. Essential to this process is proper airflow whereby the amount of air passing through the vocal cords is sufficient to enable phonation, but not so great as to require back-pressure/tension in the throat to keep the vocal cords in place. And, of course, the air-time, for duration of notes and accuracy of musical attack.

I have two “special” aspects of air-at-different-times: singing and “CPAPing”. What happens if I bring them together, bridging night and day, so that the time drops out of the air equation? Or perhaps the time becomes the temporally defined Venn diagram intersection of night/day (dawn and dusk?), singing/CPAPing, phonating/trying-to-not-phonate [snore]. They are opposite activities in some ways, for one promotes optimal free sound resonance, while the other promotes silence via lack of snoring, a side-effect of sleep apnea. One is usually performed standing, the other lying down. One is performed in a fully aware state, the other rooted in a land devoid even of dreams. Indeed, while singing can be done privately in the shower, it is generally regarded as a public, performative act, while CPAP usage is most definitely regarded as an intimate, private event conducted in one’s bedroom.

The two activities are related in other ways. The focus of both is to keep an open throat devoid of excess tension, in one case to produce a free sound, in the other to prevent oxygen-deficiency and snoring. Singing has the flexibility to incorporate some aspects of CPAPing in interesting ways. I performed<sup>6</sup> in the duet scene Barcelona in Stephen Sondheim’s *Side by Side* by Sondheim while lying horizontally on the stage, pretending to be in bed while my stewardess lover, to my chagrin, agrees to stay with me rather than fly away to Barcelona (she chose non-airtime). While not my specialty, drunken singing is probably a bit closer to the fuzzy state of a sleepy person (although I’m guessing this case may introduce excess throat tension due to performer exuberance).

The participants in the ethnographic studies in Turkle’s *Inner History of Devices* had to exist in transitional periods and spaces as they adjusted to new ways of living with medical (and other) devices such as dialysis machines or prosthetics, living with the ambivalence of how they experienced life events and existed with those events internally afterwards, and listening deeply to their bodies and minds for clues on how to cope (38, 145). There is surely no right or wrong way to approach the liminal CPAP-singing state other than making sure I listen and react to what my body does as airflows collide, and to the sounds I produce. The health stakes are low in this endeavor, but the artistic stakes are as high as I choose.

The performance/experiment consisted of three parts, all executed and recorded in my living room. First, I sang “Sleep” by Ivor Gurney to piano accompaniment<sup>7</sup> twice, once using the CPAP device and once without. Second, I recited the Shakespearean sonnet “The other two, slight air and purging fire” while using the CPAP device. Third, I recorded ambient CPAP noises, including breathing on the device and the air noise from the mask when it is not

<sup>5</sup> Erich Parce, my voice teacher, 1992 – present, from personal communication/instruction.

<sup>6</sup> Cast member of “*Side by Side* by Sondheim” by Stephen Sondheim. Second Story Repertory. Redmond, WA. January 19 – February 10, 2007.



worn but rather blowing near the microphone. I determined how I wanted the audio tracks mixed and two recordings were produced with the gracious assistance of my personal audio engineer<sup>8</sup>.

The first recording, approximately 1 minute long, combines all of the sounds into an overlapping sound collage with poem recitation in the foreground.

The second recording, approximately 3 minutes in duration, allows more space between elements with some overlap. It includes two offset tracks of CPAP breathing, and splits the song performances in half (first without, then with the CPAP) around the poem recitation. It omits the air-blowing track.

The recordings are available here: <https://soundcloud.com/cliffwords/sets/airtime-technological-autobiography/s-FHezx>.

In the recording process, it immediately felt strange to share the CPAP device in the less-intimate space of the living room, out-of-place close to the piano and sofa, and odd to wear the mask before uncovered windows. The socialization of my relationship with this usually intimate device continues with the exposure of my performative state and sounds with the device through recordings, listened to “live” with my classmates. Some may be reticent to so expose what others might perceive as a “flaw”. I am not embarrassed by such activity, however, for I’ve discussed the device publicly on multiple occasions, and normalizing medical devices helps others who may benefit from learning about treatment options. Perhaps the next logical step is a “live” concert so that the audience can experience musical and airflow trials and tribulations first-hand.

There were definitely non-optimal aspects of singing and reciting text while wearing the device. The airflow from singing was generally

sufficient to overcome pressure from the incoming CPAP flow. Some minor challenges arose when more “difficult” parts of phrase arose, such as near the top of my vocal range, or when making a gentle cutoff of a quiet sustained note. Having a mask in my nostrils made me sound like I had sinus-congestion. Reciting was definitely harder, and I frequently felt like I was drowning in air, fighting to get words out. For both reciting and singing, gentle moments and ending syllables of words/phrases were more challenging for the airflow balance felt most out-of-whack. With some practice I think I could do a better job with vocal support to obviate some difficulties.

Besides the vocal challenges mentioned, I was also suffering from a cold during the recording session with coughing and asthmatic wheezing. Airtime with a CPAP, plus illness, gives us a sub-par performance: err time.

While far from an impartial observer, aesthetically the background of breathing sounds under the voice/piano recording sends me alternately to the coast, the ocean crashing upon the shore, and flying through roiling clouds, billowing ever greater with the device’s crescendo of air. My throat catches as I hear the sonnet read, remembering the conflict within my air column that halted smooth delivery. Ending the recording with the sounds of breath, vocalizations complete, restores order once more to the essential cycle of intake-release.

### Intervention and Conclusion

Subjecting my very life to the whispers of CPAP technology incurs the costs of the whims of mechanism, and the invasiveness of a corporation. My time is no longer my own, for my freedoms are regulated by a device, an airtomoton that determines when I socialize with my spouse, when I am a good boy, when I am to serve it by regularly cleaning its components, all while piping pieces of my existence at the

<sup>7</sup>Lili Kung, my spouse and favorite accompanist.

<sup>8</sup> Lili Kung mixed the tracks using Audacity software.



most vulnerable, most intimate period of my day into the corporate cloud. But I protest, and I won't go down without a fight – or at least a song. CPAPing a tune allows me to repossess my airflow and expand my artistic presence into new dimensions. I expand my artistic expression in the physical world through new forms of emotive song and recitation. I also expand the measure of my digital artistic identity, for my personal information, previously cut-and-dried in content and contention, that is headed to their cloud, a digital domain with unclear boundaries of space and influence, is now foggy with my artistic performance data, and is enshrouded with unexpected originality. I am creating my unique voice by challenging the CPAP status quo, usurping its agenda through artistry in flagrant disregard of its intentions to script my behavior and manage my compliance. I claim back my airtime identity in the name of creativity, of art, of music, of individuality.

Airtime is not merely a participatory experience. It is an emotion, a tie that binds the sleeper to success in the waking hours, the dreamer to mystical visions, the singer-actor to his audience, an essential component for a healthy life. One of the most glorious feelings is to wake, well rested, after a satisfying night's sleep. Let's start there.

### Acknowledgement

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### References

- "American Top 40 July 7 1984 Casey Kasem." YouTube, uploaded by American Top40, 27 June 2017, [www.youtube.com/watch?v=vaQKyWBX0pQ&feature=youtu.be&t=3157](https://www.youtube.com/watch?v=vaQKyWBX0pQ&feature=youtu.be&t=3157).
- ASA Authors & Reviewers. "Oral Appliance for Sleep Apnea Dental Device Therapy." American Sleep Association, <https://www.sleepassociation.org/sleep-disorders/sleep-apnea/oral-appliance-for-sleep-apnea/>.
- Bulkeley, Kelly. "Mystical." *Big Dreams*, Oxford University Press, 2016, *Big Dreams*, Chapter 12, pp. 4-11, DOI: 10.1093/acprof:oso/9780199351534.001.0001.
- Buyse, Daniel J. "Sleep Health: Can We Define It? Does It Matter?" *Sleep*, vol. 37, no. 1, 2014, pp. 9–17, <https://doi.org/10.5665/sleep.3298>.
- Caldwell, John A., and J. Lynn Caldwell. *Fatigue in Aviation: a Guide to Staying Awake at the Stick*, Routledge, 2003. ProQuest Ebook Central, pp. 15, <https://ebookcentral.proquest.com/lib/washington/detail.action?docID=4817203>.
- Dawe, Philip. *A Connoisseur and Tired Boy*. Nov 22, 1773. The Metropolitan Museum of Art, New York, [www.metmuseum.org/art/collection/search/363548](http://www.metmuseum.org/art/collection/search/363548). Mezzotint, Plate: 19 1/2 × 13 11/16 inches, Sheet: 26 1/2 × 19 inches.
- Fletcher, John. "Come, Sleep, and with Thy Sweet..." *LiederNet*, [www.lieder.net/lieder/get\\_text.html?TextId=5673](http://www.lieder.net/lieder/get_text.html?TextId=5673). Accessed 29 Nov. 2019.
- Fox, Kieran C. R., et al. "Dreaming as Mind Wandering: Evidence from Functional Neuroimaging and First-Person Content Reports." *Frontiers in Human Neuroscience*, vol. 7, 2013, pp. 1–18, doi:10.3389/fnhum.2013.00412.
- Gurney, Ivor (Bertie). *Sleep from Five Elizabethan Songs*, no. 4. Fayetteville, AR: Classical Vocal Reprints, 1920.
- "ResMed MyAir Dashboard." ResMed MyAir, [myair.resmed.com/Dashboard.aspx](http://myair.resmed.com/Dashboard.aspx). Accessed 29 Nov. 2019.
- Shakespeare, William. "Sonnet XLV: The Other Two, Slight Air and Purging Fire." *Shakespeare's Sonnets*, Oxquarry Books Ltd, [www.shakespeares-sonnets.com/sonnet/45](http://www.shakespeares-sonnets.com/sonnet/45). Accessed 29 Nov. 2019.
- Sondheim, Stephen, et al. "Side by Side by Sondheim." *Sondheim.com*, [www.sondheim.com/shows/side\\_by\\_side](http://www.sondheim.com/shows/side_by_side). Accessed 29 Nov. 2019.
- "Star Trek: First Contact." Wikipedia, Wikimedia Foundation, 18 Mar. 2020, [en.wikipedia.org/wiki/Star\\_Trek:\\_First\\_Contact](https://en.wikipedia.org/wiki/Star_Trek:_First_Contact).
- Turkle, Sherry. *The Inner History of Devices*. MIT Press, 2008, pp. 38, 103, 107, 145, 152.

# MYTHS AND GENDER IN AVATAR: THE LAST AIRBENDER

Katie Sue Eichner

*ABSTRACT: This exploration of the show Avatar: The Last Airbender (2005-2008) analyzes several characters to discover how they accept and reject the norms associated with their gender. By using signs to explain how viewers determine each character's gender, attention is called to the norms associated with certain gender identities. Among other social issues, the lens of fourth wave feminism values the pluralism of gender identity which expands beyond a traditional womxn-man binary. In looking at how each character interacts with the world around them despite their gender, we can determine how those actions align with (and stray from) the norms associated with their gender.*

Kids' shows are often one of the first socializers available for children. The purpose of the show drastically affects the teachings that children will take away from it; shows such as Dora The Explorer emphasize multilingualism while a show such as Wonder Pets displays the advantages of teamwork. Granted, these two examples are geared towards younger children who are still entering society. So how do shows create learning moments for children who aren't kids anymore? When children turn into adolescents who may already be multilingual or an effective group member, what can TV shows offer other than entertainment? While there are many ways to teach children, adolescents, and adults, one major proponent for learning is through the characterization captured by the cast, whether animated or live-action. As an agent of socialization, cast representation can be viewed as a means for self-identification when viewers see characters they relate to (Karniol, Reichmann, Fund 2000). For example, viewers of a show may feel a particular connection with a character because they see themselves reflected in that character. For the purpose of this argumentative essay, I used a lens of fourth wave feminism to analyze how different womxn characters from the

show Avatar: The Last Airbender (2005-2008) present feminine gender norms, as represented through signs and metaphors in relationship to social myths, and how their actions in the show create multifaceted characters from whom viewers can learn. Through these methods, I've found that pluralism of gender representation exists in a variety of characters, from the most androgynous to the most feminine of characters, in and outside of the dual realm of gender binary. In this way, it provides characters in the show that can stand as role models of gender expression for viewers of the show.

For some background information, Avatar: The Last Airbender (shortened to AtLA) first aired in 2005 and provided three seasons of content until the show ended in 2008<sup>1</sup>. During that time, we follow the quests and adventures of characters who can manipulate, or bend, four basic elements of the world: fire, water, air, and earth. Only one character, called the Avatar, can bend all four elements. The premise of the show begins 100 years after the start of a world war initiated by the Fire Nation (a militaristic nation of firebenders) who, a century ago, launched a genocide against the Air Nomads (a peaceful community of airbenders), eradicating them all. Fast forward to where the show begins, and

<sup>1</sup>Seasons and episodes will be noted in shorthand, such as S2E12 for season 2 episode 12.

two of the main characters discover the only remaining airbender in the world: the Avatar named Aang. The show follows Aang and his growing list of friends (the “Gaang”) as they set forth to bring peace to the world by stopping the Fire Nation before they can wipe out any other race of bender.

Before we analyze the show, please make a note about the concepts and values of fourth wave feminism. Although the metaphor of the wave is flawed (Nicholson 2010), I’ll be using it because of its wide-spread acceptance and understanding of how to distinguish various generations of feminism. Different feminist values take the forefront in each wave because feminism and gender equality is an ongoing process. In this case, the fourth wave’s desire for inclusion in gender and LGBTQ+<sup>2</sup> rights takes the forefront (Rampton 2008). Values of gender equality expand beyond the traditional binary of man and womxn, including transgender and nonbinary individuals. Because of this, I intentionally use womxn instead of woman or women because of its exclusion of man and men from the word to emphasize inclusivity of transgender, nonbinary, and genderqueer individuals<sup>3</sup> (Paradis 2018). An important aspect of identity to keep in mind while reading this essay is that sex and gender are two different aspects, where sex refers to reproductive organs while gender refers to the embodiment and representation of masculinity, femininity, or neither that society has placed on one’s sex (Wade and Ferree 2015). Similarly, society relies on tying gender roles and identities closely to masculinity and femininity, womxn and men. Without the distinctions of traditional gender assignments, there is nothing othering about the bodies or identities of transgender, nonbinary, and genderqueer bodies to deem different. These key notes about gender and

transcending traditional gender binaries, identities, and norms are the primary concepts of fourth wave feminism that I’ll be using to look at the characters from AtLA.

As viewers, we rely on dominant ideology and societal norms to make meaning; otherwise it is impossible for us to make sense of the show without dominant ideological signs to reinforce gender norms (such as relying on traditional gender assignments to determine transgender bodies as other). As with any show, meaning is created when communication is achieved. The produced meaning in the show must be received by an audience that understands the ideologies being represented. Signs are a form of visual communication which rely on a fixed, denotative meaning, but through connotation and interpretation can mean different things to different people (Hall 512). In other words by Turton-Turner, “although not obvious at the literal level of meaning, the subtleties of gendered language remain active as the message is inferred. Our subjective interpretation of that message is meant to complete the communicative process” (Turton-Turner 2013). An example of this might be identifying someone as a womxn because they have large breasts, or assigning masculinity to physical strength and combat. Making meaning of a sign isn’t fixed, which is why it’s important to analyze such things as kids’ show characters to understand how meaning changes over time and viewership to have a deeper meaning of shows’ content. How do the characters adhere to or flout popular ideology? What is the responsibility of writers, artists, and creators to add that layer of depth to their show? If meaning is unstable, then how do interpretations of a show change over time and audience? Those are some of the questions I’ll be looking at as I analyze the signs assigned to the characters of AtLA.

<sup>2</sup>Shorthand for Lesbian, Gay, Bisexual, Transgender, Queer, with + indicating a nonexhaustive list of sexualities and gender orientations, and identities.

<sup>3</sup>Transgender, nonbinary, or genderqueer individuals are those whose gender identity does not correspond with their sex assigned at birth.

Avatar: The Last Airbender presents to us a mythic world filled with magical powers and mystical creatures. But what about the myths of this show? Where do the creators draw the line between creating ideologies within the show and imposing ideologies from outside the show— ideologies from the real world? Because myths reinforce the social norms by creating the normalcy of an event, people often accept them without so much as blinking an eye. By identifying myths within the show and determining whether they align with popular Western (American) ideologies regarding gender, or transcend the screen and become the myths necessary for the narrative, we can properly evaluate each character's words or actions and how they relate to accepted gender norms. For example, AtLA adopts a cisgender patriarchal view of society, a myth which comes from the real world. But a myth produced by the show would be society's acceptance that humans have the ability to manipulate a piece of rock or produce fire out of nothing. As Griffin says, myths "go without saying. They don't explain, they don't defend, and they certainly don't raise questions" (Griffin 337). It will be up to my analysis to explain, defend, and raise questions about the selected characters' actions and words to help readers understand why those actions and words are defying or reinforcing feminine gender norms— within the context of the show.

Given the above, the first character to analyze is named Smellerbee. Her first appearance is in S1E10, titled "Jet". To be clear: Smellerbee is not a main character. Her presence in the show is sparse, but incredibly important because she is the most androgynous character, both in appearance and in reference as no other characters use any pronouns to refer to Smellerbee until she reappears later in S2E12, "The Serpent's Pass". But a bold statement is made in S2E12 when someone misgenders her,

claiming her name is strange for a young man. This mistake is made because she lacks the typical signs of femininity, such as a large bust and wide hips: there are no physical signs to denote Smellerbee as a womxn, so therefore she must be a man. Smellerbee tells them, angrily, "maybe it's because I'm not a man. I'm a girl!" (DiMartino and Konietzko 2006). Outburst aside, this instance displays an alliance with Western ideals of femininity and what a womxn "should" look like, leading to the misgendering of a character who appears more masculine in physique. Smellerbee, with her short, shaggy hair and flat chest as designated signs, doesn't align with the myth of feminine beauty standards. She goes on to be comforted by her friend, who reminds her that "as long as I'm confident with who I am, it doesn't matter what other people think" (DiMartino and Konietzko 2006). The writers make a statement with this scene because its existence in the episode doesn't progress the plot; the reminder that adhering to gendered beauty norms regarding appearance is apparently important enough to state explicitly even though it takes up airtime in an episode only 24 minutes long.

As Jackson states about AtLA, "the series debunks the gender dichotomy and upholds Third-Wave Feminism's concept of gender fluidity by depicting genderbending characters of both sexes who do not present polarized perceptions of gender in accordance with traditional gender stereotypes" (Jackson 14)<sup>4</sup>. Here, Jackson utilizes the fan-centered practice of changing a character's gender (genderbending) and creates a pun about the show's elemental bending. However, Jackson points out that AtLA produces characters who somewhat genderbend on their own without a fan's reinterpretation of the character. This quote accurately represents Smellerbee's presence in the AtLA universe; an important character to have, as it shows that characters,

<sup>4</sup>Although Jackson utilizes a lens of third wave feminism as opposed to fourth wave, it is in consensus with the feminist values I'm using to analyze characters.

especially womxn, do not have to fall in line with their gender's prescribed ideals of beauty to identify with that gender. In some cases, when meaning changes over time, viewers will read Smellerbee's character differently. To me, when I watched the show as a kid, Smellerbee was simply a "tom-boy" character who didn't display feminine beauty traits. However, in comments along the web, some fans of the show read her character as transgender, as seen in the AtLA subreddit strand titled "Smellerbee transgender?" which was published April 2019, 11 years after the show ended. While not confirmed, this provides an excellent example of how time, awareness of LGBTQ+ folks, and inclusion of feminist values can create new meaning for older content.

To further support the notion that the creators and writers of the show intentionally create characters who choose not to adhere to Western ideals of beauty, we'll analyze Toph. As a main character in the show, Toph's presence is important for a variety of reasons. An entire essay could be written on Toph's character, but I will only be focusing on two of her specific attributes. As with Smellerbee, Toph is short, flat-chested, and actively takes on more of a "tom-boy" presence and persona. She also happens to be blind, one of the few characters who is differently-abled. The episode "The Tales of Ba Sing Se" from season two produced multiple short vignettes that follow various main characters, but the episode as a whole isn't meant to propel the plot. The vignette follows Toph and Katara (who, for the record, does follow and adhere to many Western ideals of beauty and femininity) as the two girls have a spa day. At the end, when they're leaving the spa wearing heavy make-up, Toph finds herself being bullied by a group of strangers, girls who, like Katara, are tall, curvy, and clearly care about their physical appearance, signified by their makeup and hairstyles. Toph handles the situation with the support of Katara, and afterwards confides in her friend, saying "one of the good things about being blind is I don't have

to waste my time worrying about appearance. I don't care what I look like. I'm not looking for anyone's approval. I know who I am" (Estoesta and Wahlander 2006). With body image functioning as a dominant ideology, the signs which reinforce this myth of the feminine body are large chests, tiny waists, and wide hips. With fourth wave feminism in mind, traditionally gendered body types become irrelevant and instead place someone's personal identity at the forefront. A person could identify as nonbinary while still displaying a traditionally "feminine" body type. Bray explains this separation of gender identity and bodily integrity, saying "we are better served by the subject's prerogative to designate the body she requires without necessarily having recourse to her identity" (Bray 2015). This idea applies to Toph as well, by displaying her acceptance of her physique and her identity as a womxn. The immediate content to unpack is the indication that Toph is aware that there's more to her than meets the eye, and that more is what she prioritizes in her life. She's aware of the other aspects of her personality that precede her non-feminine womxnness, such as willpower, fighting and bending ability, and the advantages of her blindness.

This idea is further reinforced in season three during the episode "The Ember Island Players". In this episode, the Gaang goes to watch a play that is made about them. Each character finds themselves being dramatized for the sake of the show: Aang finds himself being played by a girl (another statement about gender that I won't be unpacking in this essay), Katara is portrayed as overly emotional, and Sokka's caricature tells bad jokes and is always hungry. Toph tells them "I know it must hurt, but what you're seeing up there on that stage is the truth" (Hedrick, Hamilton, O' Bryan 2008). Later, Toph waits in anticipation for her appearance in the play. Her caricature's introduction is "my name's Toph, because it sounds like tough, and that's just what I am!" (Hedrick, Hamilton, O' Bryan 2008). Despite her initial confusion at being portrayed on stage as a giant, enormously buff man, Toph is



overjoyed at her portrayal, reassuring the Gaang “are you kidding me? I wouldn’t have cast it any other way!” (Hedrick, Hamilton, O’ Bryan 2008). By re-appropriating Toph’s character and portraying it (even if humorously) as the exact opposite in physique, the writers reassure us of Toph’s feelings for herself: although she doesn’t fit in with a Western beauty ideal, even if it means being caricatured as a large, buff man, she’s happy with who she is. Fourth wave feminism (and Bray’s) interpretation would validate this masculine physique, however, by accepting that someone with such a body type could still identify closely with other feminine traits, such as gendered clothing or makeup and hairstyles. A person with a massively buff physique can also be a womxn, by fourth wave feminism’s understanding, and counters Western beauty standards that womxn must be sleek and curvy. Toph positively reacting to such a portrayal of herself displays this acceptance, as she is a womxn but happy to have a buff, traditionally-masculine body type.

Though I skipped ahead to mid-season two, the embodied masculinity in Toph is presented right off the bat when we meet her in S2E6, “The Blind Bandit”. After facing some relational hardships with her parents, Toph chooses to come clean about her fighting experience, telling her father “the obedient little helpless blind girl that you think I am just isn’t me. I love fighting. I love being an earthbender, and I’m really, really good at it” (DiMartino 2006). Here, fighting and being an earthbender are associated with both masculinity and ableism, demonstrated by pitting “helpless blind girl” against “fighting” and “earthbending”. Girl, here, is shown in direct contrast against fighting and creates a clear meaning for viewers to understand that fighting and elemental bending are assigned to men and masculinity. An external example of combat associated with masculinity to support this

notion would be Mixed Martial Arts (MMA), in that “this masculine archetype typically involves strength, toughness, competitiveness, risk taking, muscularity, and, above all else, the ability to dominate others—characteristics typically considered central to constructions of hegemonic forms of masculinity” (Channon & Matthews 2015). However, viewers don’t feel as if that’s a bad thing due to Toph’s acceptance of herself, masculine traits and all. This isn’t the first time elemental bending is associated with masculinity, which I’ll follow up with next. As an influential character in the show, Toph represents proud acceptance of masculinity while retaining her womxnness, creating a multifaceted character for viewers to draw from and learn that you don’t need to be either feminine or masculine, but that you can pull from both femininity and masculinity to form your own sense of identity, no matter what gender you identify with or express<sup>5</sup>. This understanding for viewers is an important alignment with fourth wave feminism’s goals of debunking traditional gender identity and expression because it allows viewers to see that they don’t have to strictly follow a single iteration of their personality and identity, but that they can fluidly exist in the world. Viewers who may be questioning their identity could find the presence of a character like Toph (or Smellerbee) validating or reassuring.

Earlier, it was established that Katara embodies feminine physical traits, signified by her long hair, large chest, and wide hips. She is caricatured in “The Ember Island Players” as being hopeful in the face of adversity as well as tearfully overcome by emotions all the time. This portrayal of womxn as being overly emotional is reoccurring rhetoric often used to delegitimize womxn as being unfit to hold positions of power, rhetoric so commonly used, as seen in Gleason, Jones, and Mcbean’s study of

<sup>5</sup>This optimism should be taken with a grain of salt, however, as womxn who embody or embrace masculine mannerisms also face backlash for behaving outside their realm of gender norms, as seen in both Manne and in Gleason, Jones, and Mcbean.

gender in the Supreme Court. This is yet another example of an external myth being placed within the show. So why is it important to analyze Katara's character as defying gender norms? As mentioned earlier, the show's universe functions in a patriarchal society, which is precisely where Katara comes in. The first season of the show follows the Gaang as they travel from the tiny village in the Southern Water Tribe, where Katara is the only waterbender, until they reach the booming dominion of the Northern Water Tribe. When they arrive, both Katara and Aang are excited to learn more complex waterbending skills from the master waterbender, Pakku. However, both are enraged to discover that in the Northern Water Tribe, womxn who possess waterbending abilities are relegated to become healers, and are barred from learning combative waterbending skills (DiMartino 2005). Her caricature as hopeful in the face of adversity proves true when Katara literally fights the patriarchy to earn the right to learn combative waterbending.

Phrases such as "you have disrespected... my entire culture", "I'm waiting, little girl", and "go back to the healing huts with the other women where you belong" (DiMartino 2005), all used by Pakku in the episode "The Waterbending Master", indicate the level of normalcy associated with the sexism in the Northern Water Tribe. These phrases display the myths of misogyny often associated with a patriarchal society and depend on the viewer's knowledge of such misogyny to make sense, even if the misogyny is coded in the universe of AtLA. Even the phrase "go back to the healing hut" exists in parallel with other, real world examples of gender being assigned to certain areas, such as womxn belonging in domestic spaces like homes and kitchens. Rhetoric and attacks such as this are used when womxn try to leave such domestic spaces, and are mirrored by Katara attempting to use waterbending for fighting (a masculine use of the ability) instead of healing (a feminine use of the ability). Katara, as put by Rampton, "challenges the 'cult of domesticity'"

(Rampton 2008) and challenges the entire Northern Water Tribe's understanding of gendered waterbending practices. Subsequently, "women who resist or flout gender norms and expectations may consequently garner suspicion and consternation, which has less to do with their challenging gendered norms per se, and more to do with their challenging entrenched norms simpliciter" (Manne 61). Although there isn't official closure on this specific fight, the episode closes with Katara arriving to a combative waterbending practice unchallenged. Despite Katara fighting and losing the battle with the patriarchy, she eventually goes on to win the war against sexism. Not only ready to fight for what she believes, Katara also possesses ambition to learn and to fight, just as Toph does. Although the two characters are different in their expressions of gender and femininity, both rely on the same hunger for combat and skills associated with masculinity. Just as with Toph, Katara demonstrates a duality of femininity and masculinity that viewers can learn from and embody.

By analyzing these three characters, Smellerbee, Toph, and Katara, we understand how they challenge gender norms and societal myths about gender. But why is that important? Why should we bother ourselves with better understanding of characters from an animated kid's show? It is in understanding the characters that we can understand how they influence the viewers. The details of Smellerbee's gender identity don't have to matter, but to someone who's questioning their own identity, just the existence of an androgynous person like Smellerbee could be enough to validate that viewer's own existence. A viewer who expresses femininity in adherence to Western beauty ideals (large chest, long hair, tiny waist, etc) may find themselves in college receiving an engineering degree (a male-dominated degree path), and find comfort in seeing Katara fight the patriarchy. A viewer who finds themselves torn on how to express their gender identity can look to Toph and see duality and pluralism and

know that the same multitude of expressions can exist in them. We look for characters that could mirror a viewer's existence because we don't know who's watching this show.

As I said at the beginning, one of the goals of this essay was to explain, defend, and raise questions about the selected characters' actions and words to help readers understand why those actions and words are defying or reinforcing feminine gender norms. Explaining how characters challenge Western concepts of gender expression and body type helps us to understand that feminine gender norms are becoming more and more fluid all the time, especially with fourth wave feminism influencing society's perception of gender expression for the past twenty to thirty years. Defending the characters' choices and validating their existence and identity helps us to understand that pluralism of gender can exist in everyone, and questioning a character's identity can lead to different conclusions (such as Smellerbee: tom-boy or transgender?), but those conclusions don't have to matter. Gender identity, expression, and actions both do not have to matter and need to be validated. By exposing the myths of the show, whether superimposed or not, we can understand how these identities, expressions, and actions exist and challenge. Would any of the chosen characters be read the same had they not existed in a cisgendered patriarchal society? Probably not, because, as established earlier, a cisgendered patriarchal society relies on the enforcement gendered embodiments assigned to birth-sex. Nothing about the selected characters would raise a red flag if they existed in a universe without patriarchy, misogyny, or a gender binary—without the basis of a womxn/man binary, there is not otherness to set genderqueer characters apart. However, because the creators made a world that does display the myths of patriarchy, misogyny, and gender binary, the actions of Smellerbee, Toph, and Katara stand out as different, contrasting society's understanding of gender norms and roles.

As we established with fourth wave feminism, gender fluidity, pluralism, and acceptance are key traits that feminists believe are worth fighting for. As Rampton says, “feminism is part of a larger consciousness of oppression along with racism, ageism, classism, ableism, and sexual orientation” (Rampton 2008). It is important for people of all ages to have access to entertaining content that displays an awareness of these issues, as we see in AtLA. The signs that designate acceptance or denial of gender norms are but one of the ways this show addresses topics of gender. As an agent of socialization, characters who are multifaceted, pluralistic, or just plain comfortable being themselves could be the next best thing to meeting an actual person who embodies those traits. Although I've analyzed characters who specifically challenge or uphold gender norms, there are many other characters out there from whom viewers can learn from and identify with, not just in the universe of Avatar: The Last Airbender. A well-written character is a well-written lesson that can be taught, episode after episode.

## References

- Bray, Sean. “Gender Dysphoria, Body Dysmorphia, and the Problematic of Body Modification.” *The Journal of Speculative Philosophy* 29, no. 3 (2015): 424-36. Accessed March 30, 2020. doi:10.5325/jspecphil.29.3.0424.
- Channon, Alex, and Christopher R Matthews. “‘It Is What It Is’: Masculinity, Homosexuality, and Inclusive Discourse in Mixed Martial Arts.” *Journal of Homosexuality* 62, no. 7 (2015): 936-56.
- DiMartino, M. D. (Writer), & Konietzko, B. (Director). (2006) “The Serpent's Pass.” Avatar: The Last Airbender. Paramount Pictures.

- DiMartino, M. D. (Writer), & Spaulding, E.(Director). (2006) "The Blind Bandit." Avatar: The Last Airbender. Paramount Pictures.
- DiMartino, M. D. (Writer), & Volpe G. (Director). (2005). "The Waterbending Master." Avatar: The Last Airbender. Paramount Pictures.
- Estoesta J., Wahlander, L. (Writers) & Spaulding, E.(Director). (2006) "The Tales of Ba Sing Se: The Tale of Toph and Katara." Avatar: The Last Airbender. Paramount Pictures.
- Ghulsether. "Smellerbee transgender?" *r/TheLast Airbender*. Reddit. April 6, 2019. Web. <[https://www.reddit.com/r/TheLastAirbender/comments/bab48j/smellerbee\\_transgender/](https://www.reddit.com/r/TheLastAirbender/comments/bab48j/smellerbee_transgender/)> Accessed November 17, 2019.
- Gleason, Shane A; Jones, Jennifer J; and Mcbean, Jessica Rae. "The Role of Gender Norms in Judicial Decision-Making at the U.S. Supreme Court: The Case of Male and Female Justices." *American Politics Research* 47, no. 3 (2019): 494-529.
- Griffin, Em. "Semiotics of Roland Barthes." *A First Look at Communication Theory*. McGraw-Hill, 2012, New York.
- Gurney, Hel. "XVI. From the Beginning". *Feminism & Psychology*, vol. 25, no. 1, Feb. 2015, pp. 90–94, doi:10.1177/0959353514563584.
- Hall, Stuart. "Encoding and Decoding in the Television Discourse." *Centre for Cultural Studies*, University of Birmingham, 1973. Pages 507-517.
- Hendrick, T., Hamilton, J., O'Bryan, J. (Writers), & Volpe G. (Director). (2008) "The Ember Island Players." Avatar: The Last Airbender. Paramount Pictures.
- Jackons, Megan E. "(Gender)Bending in the Animated Series Avatar: The Last Airbender". *Film matters*. 2013. Issue 2, pages 11-16.
- Karniol, R., Reichman, S., & Fund, L. (2000). "Children's Gender Orientation and Perceptions of Female, Male, and Gender-Ambiguous Animal Characters". *Sex Roles*, 43(5-6), 377-393.
- Manne, Kate. "Ameliorating Misogyny". *Down Girl: The Logic of Misogyny*. New York, NY: Oxford University Press, 2018. Pages 55-77.
- Paradis, Crystal. "A note on inclusive language: intersectionality, feminism, womxn, cis, non-binary, etc." *Feminist Oasis*. January 2, 2018. <<https://feministoasis.com/inclusive-language-womxn-cis-nonbinary/>> Accessed February 29, 2020.
- Rampton, Martha. "Four Waves of Feminism". *Pacific Magazine*. Fall 2008. Accessed November 17, 2019. <https://www.pacificu.edu/about/media/four-waves-feminism>
- Smellerbee. AvatarWiki. Fandom. <<https://avatar.fandom.com/wiki/Smellerbee>> Accessed November 6, 2019.
- Turton-Turner, Pamela. "Villainous Avatars: The Visual Semiotics of Misogyny and Free Speech in Cyberspace." *Forum on Public Policy: A Journal of the Oxford Round Table*, 2013.
- Wade, L., & Ferree, Myra Marx. (2015). "Introduction". *Gender : Ideas, interactions, institutions* (First ed.). New York: W.W. Norton & Company.
- Zack, Naomi. *Inclusive Feminism: A Third Wave Theory of Women's Commonality*, Rowman & Littlefield Publishers, 2005. ProQuest Ebook Central, <https://ebookcentral.proquest.com/lib/washington/detail.action?docID=1501777>.

# POKÉMON GO: THE UNKNOWN TRUTH ABOUT PLAYERS WITH A MENTAL OR PHYSICAL DISABILITY

Emily Person

***ABSTRACT:** Pokémon GO is an augmented reality mobile game where players must physically move around in populated areas to catch Pokémon and find Pokéstops for digital rewards to help the player compete more competitively. This study looks at whether there is a difference in terms of hours played each week between players who have a physical or mental disability versus those who do not. A t-test was run using hours played as an independent variable and disability or no disability as the dependent variable. Rejection of the null hypothesis did support my prediction that Pokémon GO players who have a disability play less hours each week. The null hypothesis was rejected due to the significantly low p-value. Due to the lack of information between these two variables, future studies should explore comparing other restrictions involving people with disabilities versus people who do not have a disability. The purpose of this study is to analyze any restrictions Pokémon GO players with a mental or physical disability encounter while playing this game. If this is the case, further information should be included to help create an augmented reality game where everyone is able to be successful with no restrictions.*

*Key words: Pokémon GO, augmented reality, mental disability, physical disability*

## Introduction

In 2010, almost 61 million Americans or 1 in 4 U.S. adults had a disability that impacts major life activities. Further, about 12.3 million people six and older needed assistance with at least one activity performed in their daily lives (Brault 2012). Also, about 67 percent of people living in the United States played some sort of video game in 2012 (Eklund 2013). Since disabilities are common in our society, along with video games, there should be an augmented reality game that accounts for any restrictions people with disabilities have while playing. There is little information about this topic, but it seems to be becoming more popular. This study focuses on weekly hours played comparing people who have a disability to those who do not. Lack of accessibility, motivation, and lack of knowledge are some barriers that can restrict people with disabilities from playing augmented reality games (Mason 2018). To address these problems, the team researched

if there is a correlation between the number of hours one plays Pokémon GO and if a player has a disability or not.

Pokémon GO is an augmented reality mobile game where the main goal is to catch as many Pokémon as possible. This involves actually walking or running in various areas of a city or town to seek out Pokémon which is unlike many other video games where players sit on a couch and play. Pokémon are most present in cities where buildings and landmarks are present. Another key component of Pokémon GO is walking in order to make eggs hatch. These eggs have Pokémon in them which can help add to a player's collection. Lastly, Pokéstops are located at most landmarks where items can be collected. Without receiving these items from the Pokéstops, it would be difficult to succeed in this game. Having a physical or mental disability would make this virtually impossible to win the game.



In this paper, I test the hypothesis that Pokémon GO players who have a mental or physical disability play less hours weekly than players who do not have a disability.

Materials and Methods

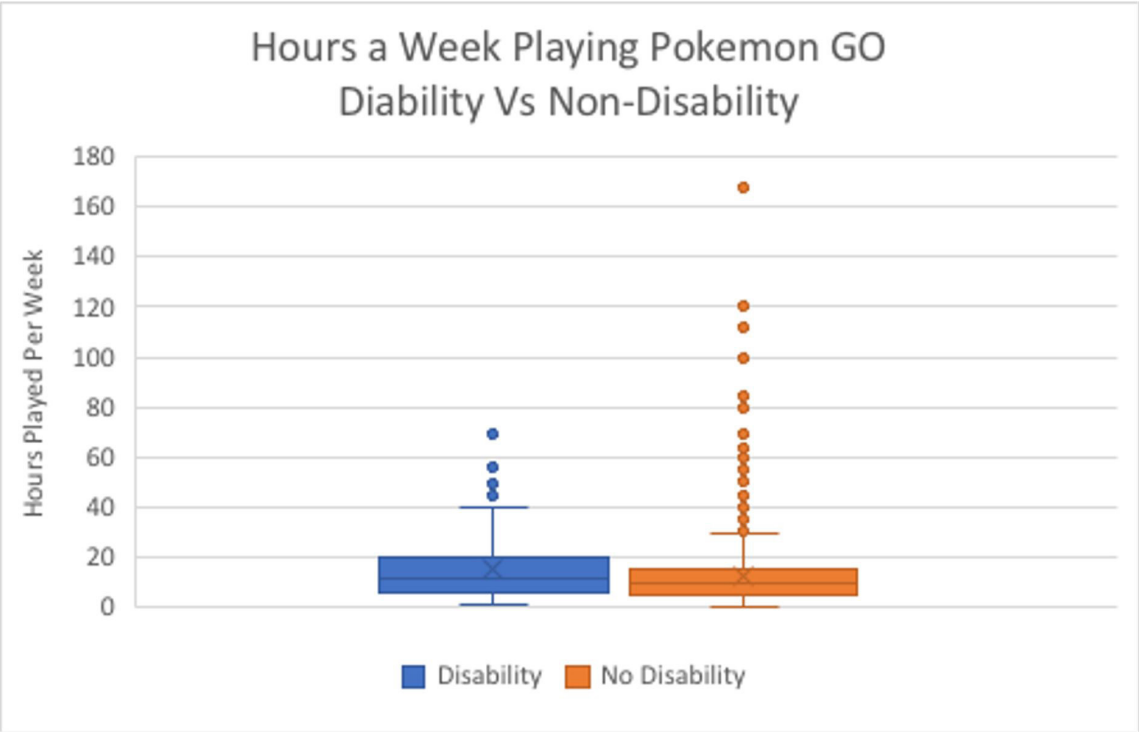
Data on hours played and if one had a disability or not were downloaded from the Pokémon GO data set provided by Professor Windleharth, a professor at the University of Washington. This data included conducting surveys to more than 5,000 people in the community in order to get the best data possible because larger the sample the more accurate the results. Unrealistic or blank data were excluded from the data set to improve calculations.

A t-test was conducted in Excel using hours played as the independent variable and disability or no disability as the dependent variable. The

significance level chosen for this data was 0.05. The null hypothesis is that there is no significant relationship between these variables which was further rejected.

Results

A t-test was performed to determine the significance between how many hours per week Pokémon GO players who have a mental or physical disability play compared to those who do not have a disability. The significance level used in this calculation was 0.05. The t-test provided a *p-value* of 0.00729 indicating that there is a statistical significance difference between these two means. The *p-value* was smaller than 0.05; therefore, the null hypothesis was rejected. Figure 1 shows how many more hours each week players with no disability play versus people who do have a disability play. The hours played each week are significantly higher for players with no disability.



**Figure 1:** Testing the statistical significance between Pokémon GO players who have a disability vs people who do not, and comparing that with the hours played each week. The *p-value* is 0.00729 which shows there is a statistical significance between the two means.

## Discussion

In my results, the t-test showed a *p-value* of approximately 0.007 which is an extremely small *p-value*. The research hypothesis was that Pokémon GO restricts the amount of hours a person with a disability is able to play each week. Furthermore, my results indicate that the null hypothesis for these specific populations was rejected. Therefore, there is a statistical significance between the two means. The small *p-value* calculation means that there is a significant difference between the two variables which suggests that people with physical or mental disabilities play less hours of Pokemon than those without a disability. Although these results concluded that in this data set, there is a significant difference between the two means, there is still a lack of information on Pokémon GO players with a physical or mental disability. Pokémon GO is an augmented reality mobile game where the player walks around while catching different Pokémon. Pokémon GO can be restrictive because the game requires movement to different locations in order to catch the most Pokémon. Motion-based games create a barrier for players who have a physical disability (Mason, 2019). There has been a small increase in research relating to motion-based gaming, but people who rely on wheelchairs are still limited to access and unable to achieve the maximum goals in these types of games. Mason's study relates to the current study because if people with a disability have restrictions when playing video games, then they should be addressed in the future.

Other studies, however, explain that Pokémon GO can potentially help improve mental disabilities. To catch the most Pokémon, players are forced to play where foot traffic is inevitable (Tateno, et al, 2016). In this way, Pokémon GO has had a positive influence on some people with a mental disability. Pokémon GO is a distraction in some cases that improves social anxiety (Tateno et al, 2016). This article by Tateno et al provides evidence that rejects my

hypothesis because in some ways Pokémon GO may improve disabilities.

Because the amount of data regarding this topic is so little, further research is needed to truly understand the impact of disabilities on video game playing. All players should be able to successfully play this game without facing any restriction. Further research could help improve any barriers shown in Pokémon GO that restricts people from playing. The lack of information on this topic makes it difficult to understand if and what type of restrictions people with disabilities face when playing reality mobile games. Future studies should focus specifically on people with disabilities, and surveys or interview questions should be conducted to help understand what type of restrictions these people face when playing Pokémon GO.

## Acknowledgments

I would like to thank Professor Travis Windleharth for providing Pokémon GO data and helping me understand what the data is implying. I would also like to thank my dear friend Jonathon. He influenced me to research this topic in an effort to acknowledge people who do have a disability. Jonathon also encouraged me to research ways to help improve these reality games to help benefit this population in the future.

## References

- An, J.-Y., & Nigg, C. R. (2017). The Promise of an Augmented Reality Game—Pokémon GO. *Annals of Translational Medicine*, 5(S1). doi: 10.21037/atm.2017.03.12
- Brault, Matthew W. *Americans with Disabilities*: 2010. Washington, DC: US Department of Commerce, Economics and Statistics Administration, US Census Bureau, 2012.
- “CDC: 1 in 4 US Adults Live with a Disability.” *Centers for Disease Control and Prevention*, Centers for Disease Control and Prevention, 16 Aug. 2018, [www.cdc.gov/media/releases/2018/p0816-disability.html](http://www.cdc.gov/media/releases/2018/p0816-disability.html).

- Eklund, Lina. "Family and Games: Digital Game Playing in the Social Context of the Family." *Multiplayer*. Routledge, 2013. 182-191.
- Mason, L. (2018). Playful Interactive Systems to Support Physical Activity Among Wheelchair Users. doi: 10.14236/ewic/hci2018.196
- Mason, L., Gerling, K., Dickinson, P., & Angeli, A. D. (2019). Design Goals for Playful Technology to Support Physical Activity Among Wheelchair Users. *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems - CHI 19*. doi: 10.1145/3290605.3300262
- Tateno, M., Skokauskas, N., Kato, T. A., Teo, A. R., & Guerrero, A. P. (2016). New Game Software (Pokémon Go) May Help Youth with Severe Social Withdrawal, Hikikomori. *Psychiatry Research*, 246, 848–849. doi: 10.1016/j.psychres.2016.10.038

# AUGMENTED REALITY GAMES AND ACCESSIBILITY

Lindsey McCormick

***ABSTRACT:** With the rapid growth of the gaming industry, it is vital to focus on whether or not all games being produced are accessible to players with disabilities. Players with physical disabilities struggle to use game dynamics designed for individuals with full visual-motor coordination. As well, players with mental disabilities have not been considered in the research of accessibility of video games. Augmented reality (AR) games, which integrate computer-generated images and interactions into real world context, are riddled with physical tasks as a part of game dynamics. This study looks at whether the social interactivity dynamics of the AR game, Ingress, are accessible to players with physical and mental disabilities. A chi-squared test was run comparing the observed and expected player responses to 7 questions evaluating their social interactivity in the game. The null hypothesis, was not rejected because of a high p-value of 0.3481. Due to this lack of significant difference between observed and expected responses, I conclude that the AR game Ingress has adequate accommodations for players with mental and physical disabilities. Further research can help conclude if Ingress can be used as an example for further game development.*

***Keywords:** Augmented Reality, Physical Disability, Mental Disability, Visual-Motor Coordination, Accessibility*

## Introduction

A disability is a physical or mental condition that limits an individual's movements, senses or activities. These limitations can obstruct an individual's ability to perform daily life and leisure activities (Bierre, 2005). 97% of children and adolescents in the US spend at least an hour everyday playing video games (Granic, 2014). Logically, the gaming industry has placed an importance on providing accessible games for those hindered by such ailments (such as hearing and vision impairments). In doing so, adaptable software has been designed to make game play more accessible, such as alternative pointing devices, on-screen keyboards, speech recognition, screen readers, and screen magnifiers (Bierre, 2005). In other cases, games have been designed specifically as therapeutic techniques for players who have developmental disabilities (DD). Exergames, which incorporate physical activity into game

play, have shown to improve visual-motor coordination within adults with DD, through exercises and repetition which improves their aimed-limb movement (Caro, 2018).

Although interest in accessibility is growing within the game industry, the interaction between disability and social interactivity within games is unstudied. As well, we do not have a clear understanding of the accessibility of video games for players with mental disabilities. This study aims to provide insight into the augmented reality game Ingress, and whether social interactivity between players is limited for those with disabilities. It is key to focus on augmented reality games because they require a level of physical activity and social interaction that can be restrictive for a large portion of players. Our sample includes both players with mental and physical disabilities.

Materials and Methods

Data on the answers to the 7 questions used to evaluate player social interactivity and disabilities of the players, was taken from an online survey distributed on platforms, such as reddit, and at events for gamers. Of the population of gamers who play Ingress, a sample of 2546 people were taken. From that sample, we selected participants who provided legitimate answers to all 8 questions totaling to 2476 subjects. Of these, 2315 subjects reported no disability, 138 reported having a physical disability, and 23 reported having a mental disability.

Figures 1 and 2 were used to run the statistical test. A chi-squared test was ran in Excel using the proportions of responses from non-disabled players to calculate the expected responses in disabled players. These were then compared to the observed responses from disabled players, to determine if there is a significant difference. A significance level of  $\alpha=0.05$  was used for this test. My research hypothesis was that players with disabilities have statistically significantly lower player interactivity levels, than those with

no disability. Meaning there are significantly lower ‘yes’ responses from those with disabilities, to the questions, compared to those without disabilities. The null hypothesis was that there is no statistically significant difference in the expected and observed responses from disabled players. At any  $p$ -value greater than  $\alpha$  we fail to reject this hypothesis.

Results

A chi-squared test was performed to determine if there is a significant difference in Ingress player social interactivity between players with a disability and those without. The results of this test yielded a  $p$ -value of 0.3480992, indicating the probability of acquiring these results by random chance if the statistical null hypothesis is correct is 0.3480992. Therefore, I fail to reject the null hypothesis, concluding there is not a statistically significant difference in player social interactivity between the two groups. Figure 3 displays the clear lack of difference in proportion of answers to the 7 questions about social interactivity between abled and disabled players.

Figure 1. Table of count and proportion of responses to 7 questions on social interactivity of abled players.

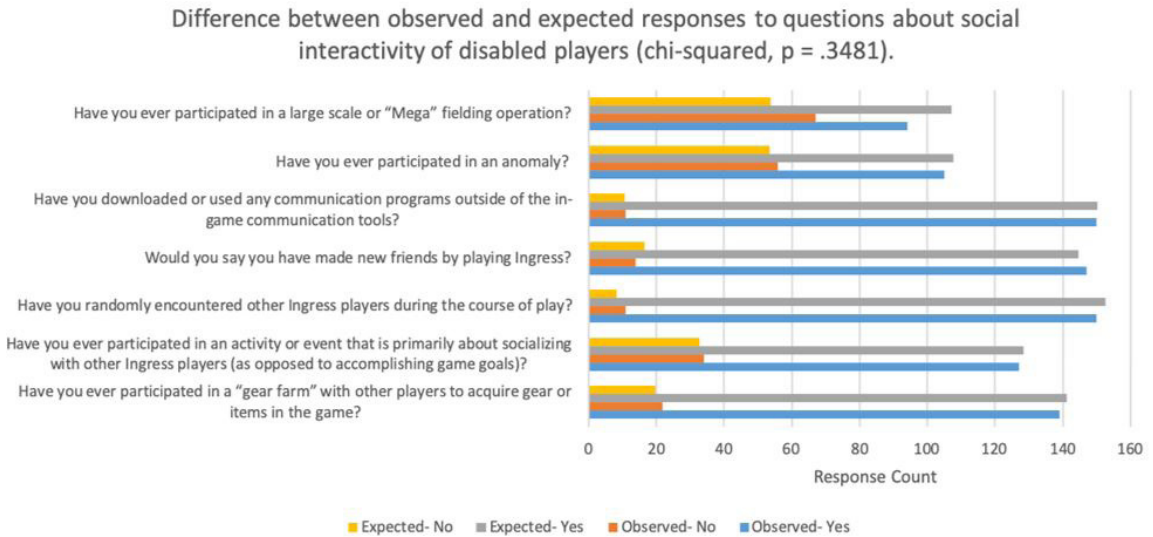
	Q1	Q2	Q3	Q4	Q5	Q6	Q7
NO DISABILITY							
Count							
Yes	2031	1844	2195	2077	2160	1547	1541
No	284	471	120	238	155	768	774
Total	2315	2315	2315	2315	2315	2315	2315
Proportion							
Yes	0.87732181	0.79654428	0.94816415	0.89719222	0.93304536	0.66825054	0.66565875
No	0.12267819	0.20345572	0.05183585	0.10280778	0.06695464	0.33174946	0.33434125

Figure 2. Table of observed and expected responses to 7 questions on social interactivity of disabled (mentally and physically) players.

	Q1	Q2	Q3	Q4	Q5	Q6	Q7
DISABILITY							
Observed- Yes	139	127	150	147	150	105	94
Observed- No	22	34	11	14	11	56	67
Total	161	161	161	161	161	161	161
Expected- Yes	141.248812	128.243629	152.654428	144.447948	150.220302	107.588337	107.171058
Expected- No	19.7511879	32.7563715	8.34557235	16.5520518	10.7796976	53.4116631	53.8289417



**Figure 3.** Comparison of proportion of abled and disabled Ingress players and their social interactivity in the game based on 7 questions. Chi-squared test concluded there is not a statistically significant difference between the groups ( $p$ -value = 0.3481).



## Discussion

From the results of the chi-squared test, we failed to reject the null that there is no statistically significant difference in social interactivity levels of Ingress players with and without disabilities ( $p$ -value = 0.3481). These results suggest adequate accommodations in AR games for players with mental and physical disabilities. Currently, Ingress is allowing players with disabilities to engage fully in the social dynamics of the game. This is vital for future game development, as awareness to the lack of accessibility within the game plays a key role in guiding developers in their work. By creating links between the questions posed in this study to actual components of gameplay, we can narrow the focus of future research.

Problems posed by a lack of accessibility within games include lacking proper feedback responses, the ability to determine in-game responses, and the ability to use input devices required for game play (Yuan 2011). The latter of these problems stems from the lack of suitable assistive technologies and alterability of game dynamics (Bierre 2005). The available assistive technologies are often either designed

for disabilities but not games, or designed for games but not disabilities (Bierre, 2005). It is very possible that the results of our study were affected by the use of outside assistive technologies, not created specifically for Ingress. Some responses mentioned the use of assistive technology, but no question directly asked about the use of outside assistance, therefore analysis of such phenomena cannot be done with this data. In this case, Ingress itself may not be adequately accessible, but there may be technologies that pair with the game to close the gap of inequality. With further study and identification of the use of assistive technology with Ingress, game developers can begin to understand how to create games that pair with already existing technology, and which technologies are important to AR gameplay accessibility.

We must acknowledge the unequal sample sizes between groups, with 2,315 abled players and 161 disabled players. It is possible the disproportionate number of disabled players is responsible for the lack of significance in results. As well, the data for this study was gathered using convenience sampling methods.

Meaning players with more severe limiting disabilities may not have been truly accessed. Thus, these results have limitations to the population in which they can be generalized. With further sampling, we could determine more conclusively if the difference in social interactivity is significant.

### Acknowledgements

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### References

- Bierre, K., Chetwynd, J., Ellis, B., Hinn, D. M., Ludi, S., & Westin, T. (2005, July). Game not over: Accessibility issues in video games. In Proceedings of the 3rd International Conference on Universal Access in Human-Computer Interaction (pp. 22-27).
- Brederode, B., Markopoulos, P., Gielen, M., Vermeeren, A., Ridder, H. (2005). pOwerball: the design of a novel mixed-reality game for children with mixed abilities. In Proceedings of the 2005 conference on Interaction design and children. Retrieved from <http://dx.doi.org/10.1145/1109540.1109545>
- Caro, K., Morales-Villaverde, L., Gotfrid, T., Martinez-Garcia, A., Kurniawan, S. (2018). Motivating Adults with Developmental Disabilities to Perform Motor Coordination Exercises using Exergames. Proceedings of the 4th EAI International Conference on Smart Objects and Technologies for Social Good. Retrieved from <https://doi.org/10.1145/3284869.3284914>
- Gotfrid, T. (2016). Games for People with Developmental Disabilities. ASSETS '16 Proceedings of the 18th International ACM SIGACCESS Conference on Computers and Accessibility. Retrieved from <https://doi.org/10.1145/2982142.2982148>
- Granic, I., Lobel, A., & Engels, R. C. M. E. (2014). The benefits of playing video games. *American Psychologist*, 69(1), 66–78. Retrieved from <https://doi.org/10.1037/a0034857>
- Lu, T., Foo, E., Rajaratnam, B., Kannappan. (2013). Configurable augmented virtual reality rehabilitation system for upper limb disability. Proceedings of the 7th International Convention on Rehabilitation Engineering and Assistive Technology (i-CREAtE '13).
- Mulloni, A., Wagner, D., Schmalstieg, D. (2008). Mobility and social interaction as core gameplay elements in multi-player augmented reality. Proceedings of the 3rd international conference on Digital Interactive Media in Entertainment and Arts Retrieved from <https://doi.org/10.1145/1413634.1413718>
- Szykman, A., Gois, J., Brandao, A. (2015). A Perspective of Games for People with Physical Disabilities. Proceedings of the Annual Meeting of the Australian Special Interest Group for Computer Human Interaction. Retrieved from <https://doi.org/10.1145/2838739.2838765>
- Vickers, S., Heron, M., Istance, H. (2013). Accessible Gaming for People with Physical and Cognitive Disabilities: A Framework for Dynamic Adaptation. CHI '13 Extended Abstracts on Human Factors in Computing Systems. Retrieved from <https://doi.org/10.1145/2468356.2468361>
- Yuan, B., Folmer, E. & Harris, F.C. (2011). Game accessibility: a survey. *Univ Access Inf Soc* 10: 81. Retrieved from <https://doi.org/10.1007/s10209-010-0189-5>

# SEARCHING FOR TRENDS IN THE ATMOSPHERES OF EXOPLANETS

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*ABSTRACT: The field of exoplanets has been experiencing rapid growth alongside the technological advances that have been made since exoplanets were first discovered in the 1990's. More than 4,100 exoplanets have been confirmed, and that number will only continue to grow (NASA Exoplanet Archive). Several of these exoplanets have had their upper atmospheres probed with transmission spectroscopy. The goal of our research is to gather previously published transmission spectroscopy data in order to characterize trends relating exoplanets physical properties to their atmospheric compositions. We have studied hot Jupiters with periods of less than 3.5 Earth days and with radii between one and three times the radius of Jupiter. There were 191 planets within this parameter space. We will present our results on the 24 exoplanets with spectral data in the wavelength range of 3000 - 9000 Å.*

## 1. Introduction

In 2001, sodium was detected in the atmosphere of the exoplanet HD 209458b, making it the first planet outside our solar system for which an atmospheric measurement had been made (Charbonneau et al. 2002). This detection confirmed theoretical models which predicted sodium to be present in the atmosphere of this exoplanet (Seager & Sasselov, 2000).

Since this detection, a limited but growing number of the more than 4,100 exoplanets we have confirmed to date have published atmospheric data. These data are acquired through transmission spectroscopy. As an exoplanet transits its host star, the radius of the planet will appear to be larger at the particular wavelength where that element is being absorbed, because more stellar radiation is being blocked by the planet. We can directly measure the radius of a transiting exoplanet through transit photometry, collecting the total amount of light coming from a planet-star combination while the planet is transiting, and

when the planet is being eclipsed by its host star. The dip in total flux caused by the transit of the exoplanet can be used to directly calculate the radius of an exoplanet. When we know the radius of the planet independent of wavelength, we can then use transmission spectroscopy.

As an exoplanet makes its transit, passing between the Earth and its host star, stellar radiation passes through the thin upper atmosphere of the exoplanet, allowing the spectral features of the planet to appear where the emitted stellar radiation is absorbed by the exoplanet's atmosphere passes through the planet's atmosphere. A spectrum is taken of the planet-star combination. Then, as the exoplanet is eclipsed by the star, a spectrum of the star alone is obtained. The planet's spectrum will show in the difference between the in-transit spectrum and the eclipse spectrum. This transmission spectrum shows how the radius of the planet changes with respect to the radius of the star:  $R_p/R_*$ , which changes as a function of wavelength. If a particular element is present

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in the atmosphere of an exoplanet, light passing through the exoplanet's atmosphere at that wavelength will be absorbed: it will not reach the observer on Earth. Thus, we can know the composition of an exoplanet by measuring it with transmission spectroscopy.

Although the number of atmospheric characterizations is growing, few studies have been conducted with the purpose of analyzing the available data to determine if there are any trends relating exoplanet atmospheric compositions to their physical and orbital properties (Sing et al. 2016; Wellbanks et al. 2019). This is the goal of our research.

Our research so far has focused on hot Jupiters. Hot Jupiters are gas giant exoplanets which have a mass roughly greater than or equal to the mass of Jupiter, and are located close to their host star (Seager, 2010). This generally means that the planet is less than 0.1 astronomical units (AU; the average distance from the Earth to the sun), which also means hot Jupiters have very short periods (Seager, 2010). The period of an exoplanet is the time it takes to make a full orbit of its host star, measured in Earth days; hot Jupiters typically have periods of less than 10 days. Due to their close stellar proximity, hot Jupiters have very high temperatures. This combination of large mass, stellar proximity, and hot temperature also means that these exoplanets have bloated atmospheres; these atmospheres allow large amounts of stellar radiation to pass through. The more stellar radiation that can pass through an exoplanet's atmosphere, the more apparent the planet's absorption features will be, meaning hot Jupiters are ideal planets for transmission spectroscopy.

In this paper, we describe the results of our search for trends relating their physical and orbital properties to the presence of sodium and potassium in their atmospheres. In section 2, we describe the physical and orbital parameters we are interested in, how we obtain our data,

and the planets we have worked with. In section 3 we present our analysis and results; we will discuss which of the planets in our search showed absorption, and present an analysis on our results. Section 4 provides a discussion of how our results fit into the broader picture of the field of exoplanets. In section 5, we will present our conclusions and plans for future work.

## 2. Methods and Data

### 2.1 The Habitable Zone Gallery

The Habitable Zone Gallery (HZG), created by Dr. Stephen Kane and Dr. Dawn Gelino, is a website which gathers names and physical parameters (such as mass, orbital period, radius, eccentricity and argument at periastron) from the NASA Exoplanet Data Explorer (EDE) and it calculates (1) the extent of the habitable zone around each star, (2) the percentage of time each planet spends in its stars' habitable zone, and (3) the equilibrium temperatures for the planet at periastron (when it is closest to its host star) and at apastron (when it is furthest away from its host star), either assuming the atmosphere is completely efficient at redistributing heat (the 'well-mixed' model), or assuming it is completely inefficient at redistributing heat (the 'hot-dayside' model; Kane & Gelino 2012). These calculations can be completed as long as the luminosity of the host star is known, and the planet-star separation is known. Stellar luminosity can be approximated with the stellar radius effective temperature; planet-star separation can be found with the semimajor axis and eccentricity of the planet's orbit.

### 2.2 Planetary Information

For the purpose of our search, the planetary physical properties we are interested in are: mass, radius, density, period, and temperature.

Planetary mass, radius, and density are all defined in terms of Jupiter:  $1 M_j$ ,  $1 R_j$ , and  $1 \rho_j$  are equal to the mass of Jupiter, the radius of Jupiter, and the average density of Jupiter,

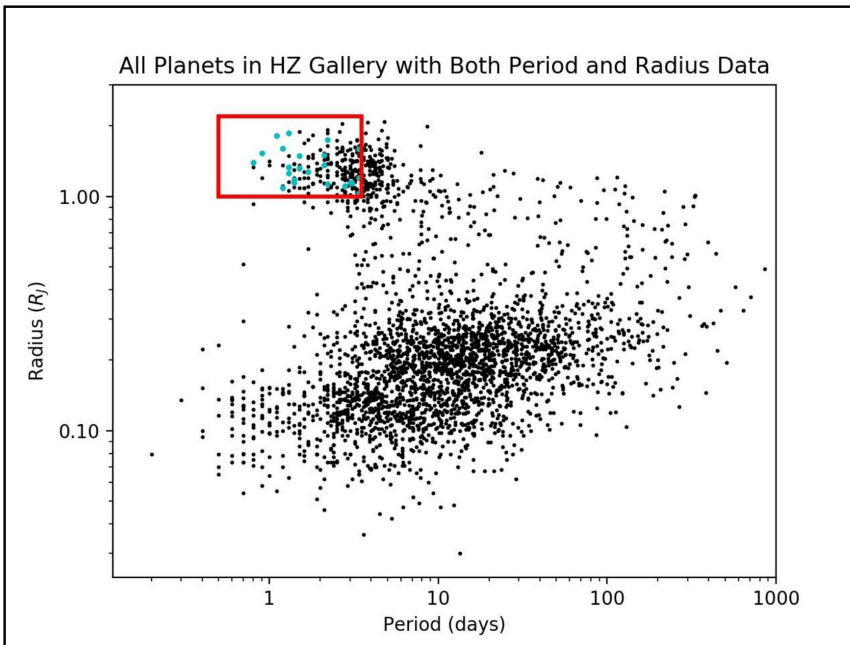
respectively. Exoplanet mass can be directly measured or estimated as a minimum mass from, which can be calculated from orbital parameters and the mass of the host star. The mass values provided in the HZG are those for which the NASA EDE has provided an actual mass, so for the planets in our search we have only used actual mass. Average density is a straightforward calculation; for this physical parameter, we have written a code which takes each planet's  $M_j$  and  $R_j$  and returns a value for the average density of the planet in terms of the average density of Jupiter,  $\rho_j$ .

The HZG calculates the four equilibrium temperatures mentioned in section 2.1, measured in Kelvin. The differences between the four temperatures is not very large. For the planets in our search, we used the equilibrium temperature calculated at periastron using the hot-dayside model. We expect this temperature to provide the best approximation for the conditions of the exoplanet atmospheres when they are being observed via transmission spectroscopy.

## 2.3 Data

A Python script, written by Troy Maloney and Cassandra Weber, takes HZG data and returns the names and physical information of the planets within the desired parameter space (Weber et al. 2019). In the original data set, we searched for planets with radii from 1 - 2  $R_j$ , and with periods of up to 3 Earth days. There were 78 planets in this data set, which used the updated HZG data from February 2017 (Weber et al. 2019). For all of the planets in our study, the percentage of time they spend in it's stars' habitable zone is zero since they are hot Jupiters.

We conducted a comprehensive literature search for published data on the atmospheric compositions of the 78 planets in our data set. Of those 78 planets, only 15 had published transmission spectroscopy data, and only 8 had published that data in the overlapping wavelength range of 4800 - 9000 Å (Weber et al. 2019). One out of the 8 planets with usable spectra had detected atmospheric sodium absorption; WASP-52b. However, one data



**Figure 1.** All planets in the habitable zone gallery, with the planets in our search lying within the red box. The 24 planets with published spectra from 3000 - 9000 Å are colored blue.



**Table 1.** 24 planets with overlapping spectral data, with physical parameters from the HZG included.

Planet	Period (Days)	Radius (Rj)	Mass (Mj)	Temperature (K)	Average Density (pj)
CoRoT-1b	1.5	1.49	1.03	1741	0.31137
HAT-P-23b	1.2	1.09	1.34	2057	1.03473
HAT-P-32b	2.2	1.86	0.83	1782	0.12899
HD189733b	2.2	1.13	1.13	1203	0.78315
Qatar-1b	1.4	1.143	1.294	1418	0.86655
Qatar-2b	1.3	1.254	2.494	1348	1.26475
TrES-3b	1.3	1.336	1.91	1640	0.80097
WASP-4b	1.3	1.33	1.18	1670	0.50156
WASP-6b	3.4	1.03	0.37	1185	3386
WASP-12b	1.1	1.82	1.183	2582	0.19623
WASP-19b	0.8	1.392	1.069	2100	0.39633
WASP-31b	3.4	1.549	0.478	1574	0.12861
WASP-33b	1.2	1.06	1.17	2649	0.98235
WASP-36b	1.5	1.327	2.361	1738	1.01038
WASP-45b	3.1	1.14	1.04	1197	0.70197
WASP-46b	1.4	1.174	1.91	1639	1.1804
WASP-48b	2.1	1.5	0.8	2032	0.23704
WASP-49b	2.8	1.11	0.37	1370	0.27054
WASP-52b	1.7	1.27	0.46	1299	0.22457
WASP-74b	2.1	1.36	0.72	1916	0.28623
WASP-96b	3.4	1.2	0.48	1286	0.27778
WASP-98b	3	1.144	0.922	1170	0.61582
WASP-103b	0.9	1.528	1.49	2508	0.41765
WASP-121b	1.3	1.865	1.183	2354	0.18237

point is not sufficient for determining a trend, thus no trends could not be characterized in this search (Weber et al. 2019).

Our present work has expanded the search space to include planets with periods of up to 3.5 Earth days, and we have used the updated HZG data from February 2019. There are 191 planets in this data set. Of these 191 planets, 27 had published spectral data, and 24 of those planets had published spectral data in the wavelength range of 3000 - 9000 Å. Figure 1 shows the 24 planets colored in blue; a list of the planets and their parameters has been included in Table 1.

2.4 Limitations

With respect to our methods, the main limitations come from how we conduct the literature search. We are looking for published papers with transmission spectroscopy data for every planet in our search box; to accomplish this, we must use several search terms which

cover the range of ways the planets might be written in the abstract. For instance, when searching for papers for the planet WASP-103b, we had to include search terms for every way the planet name might be written (WASP-103b, WASP 103b, or WASP-103 b) as well as a search term for each of the different ways the author might indicate the use of transmission spectroscopy (transmission spectroscopy, transmission spectra, transmission spectrum, etc.). However, if an author does not include any of these terms in their abstract, we might miss papers with information about some of the planets in our sample.

In terms of the data found in the literature, there are a number of factors which limit the study of exoplanet atmospheres, which in turn limits our research. First, many of the studies suffer from low spectral resolution, and the resulting data are not clear enough to make a conclusive detection (Mancini et al. 2013;

Huitson et al. 2013; Louden et al., 2017; Delrez et al., 2018; Evans et al., 2018; May et al., 2018). Second, the dynamic natures of the exoplanet atmospheres themselves act as limitations, as seen with the atmosphere of HD 189733b, for which sodium detections can be made only when time-varying hazes are not obscuring the sodium feature (see section 3.1.1). Just like our own atmosphere has changing weather patterns and cloud covers due to varying atmospheric conditions, time-evolving conditions in the hot Jupiters we study can determine whether or not a feature can be observed.

### 3. Analysis & Results

#### 3.1 Previously Published Data

Below, we present our results for the nine planets out of the 24 with published transmission spectra in our wavelength range of interest which show potential or definite sodium and/or potassium absorption. To conclude definite absorption, we follow the conclusions made by the authors who published the transmission spectroscopy data we have used. When there are multiple papers available for a planet, we take the conclusions of each author into account, and assign the most weight to the most recently published paper.

In a transmission spectrum, sodium absorption can be seen around 5890 Å; potassium absorption can be seen around 7665 Å. For a detection of either element to be seen in the transmission spectrum, the planetary radius must be larger than the radius found via transit photometry. However, a planet may have an increased radius around these wavelengths without resulting in a detection; transmission spectroscopy is frequently low in resolution, and there is often noise contaminating the data. There are many different sources which can create noisy data, including instrumental errors and variability of the host star. For a detection to be made, the signal from the planet must be stronger than the noise.

To determine the significance of a detection we use sigma ( $\sigma$ ), which represents the signal to noise ratio. A large value for  $\sigma$  means that the signal from the exoplanet atmosphere was stronger than the sources of noise, indicating that the detection is more significant. Error bars for the values of  $R_p/R_*$  are typically given at the  $1\sigma$  level. For a detection to be made, the radius of the planet at the wavelength of interest must be elevated at least  $1\sigma$  above the surrounding points; to be significant, the radius should be even greater than just a  $1\sigma$  increase.

Of the 24 planets with previously published atmospheric data, 9 show potential or definite absorption. The planets are as follows:

- Definite sodium and definite potassium: WASP-103b
- Definite sodium and potential potassium: HD 189733b, WASP-19b, WASP-52b, and WASP-96b
- Potential sodium: WASP-4b and WASP-121b
- Definite potassium: WASP-31b
- Potential potassium: WASP-6b

Below we discuss how these classifications were made based on the information in the literature for the planets with definite or potential absorption:

##### 3.1.1 HD 189733b

This exoplanet shows conclusive sodium absorption and potential potassium absorption, at least at times since at other times hazes prevent absorption.

Sodium: Pino et al. combined high-resolution and low-resolution spectroscopy to study the atmosphere of this exoplanet in more depth, and found evidence for definite sodium absorption (2018). Previously, Redfield et al. made the first detection of sodium in this planet's atmosphere (2008), however later, Sing et al. found that the transmission spectrum of HD 189733b was dominated by a global haze obscuring any alkali metal absorption features (2011). Huitson et al. also found sodium in HD 189733b's atmosphere

at a significance of  $9\sigma$  (2012). Pont et al. found a relatively flat transmission spectrum; however, they noted that a strong core of sodium could be seen (2013).

**Potassium:** Pino et al. did not make a detection of potassium, though they mentioned this feature may be present in the spectrum, smeared out due to the low resolution of the Advanced Camera for Surveys, an HST instrument, at that wavelength (Pino et al. 2018). Pont et al. found a relatively flat transmission spectrum, noting that a strong core of potassium was possible (2013).

### 3.1.2 WASP-4b

This exoplanet shows potential sodium absorption.

**Sodium:** Huitson et al. found evidence for sodium absorption at a significance of  $2\sigma$ : too low to be a conclusive detection, but significant enough to suggest potential sodium (2017).

### 3.1.3 WASP-6b

For exoplanet WASP-6b, there is potential sodium absorption

**Sodium:** Nikolov et al. specified that while there is no indication of wide absorption features of sodium, there is tentative evidence for potential sodium at a significance level of  $1.2\sigma$  (2015). Previously Jordan et al. found no evidence for sodium absorption, and concluded that higher resolution observations would be needed (2013).

### 3.1.4 WASP-19b

This exoplanet shows definite sodium absorption and potential potassium absorption.

**Sodium:** Most recently, Sedaghati et al. reported a  $3.9\sigma$  detection of sodium in the atmosphere of WASP-19b (2017). Previously available literature featured data which were too low in resolution, or had too many uncertainties, to make a detection of sodium (Mancini et al. 2013; Huitson et al. 2013; Sedaghati et al. 2015).

**Potassium:** Sedaghati et al. determined that potassium was moderately favored by the data, but could not make a detection (2017).

### 3.1.5 WASP-31b

This exoplanet shows conclusive potassium absorption.

**Potassium:** Potassium in WASP-31b was first detected by the Hubble Space Telescope in 2015 (Sing et al.). This detection was made at a significance of  $4.3\sigma$  (Sing et al., 2015). In 2017, Gibson et al. presented a different method for concluding potassium absorption (2017). Using the ground-based Very Large Telescope (VLT), the potassium absorption recovered by the HST was ruled out. Instead, Gibson et al. combined the transmission spectrum produced by the HST with the spectrum they obtained using the VLT; in doing so, they were able to conclude a  $2.2\sigma$  detection of potassium (2017).

### 3.1.6 WASP-52b

The exoplanet WASP-52b has definite sodium absorption and potential potassium absorption.

**Sodium:** In 2018, Alam et al. was able to detect sodium at a significance of  $2.3\sigma$  in the atmosphere of WASP-52b. This exoplanet's first detection of atmospheric sodium came from Chen et al. in 2017. May et al. and Loudén et al. searched for this feature, but could not conclude a detection due to the low resolution of their data (2018; 2017).

**Potassium:** Chen et al. found potassium at a significance of  $2.2\sigma$ , which they determined was not high enough to make a conclusive detection, but is still suggestive of potential potassium (2018).

### 3.1.7 WASP-96b

We can conclude definite sodium and potential potassium for this exoplanet.

**Sodium:** Nikolov et al. could clearly resolve sodium in their transmission spectra, and determined the element to be present in the atmosphere of WASP-96b (2018).

**Potassium:** Nikolov et al. made a small detection of potassium, at a level just below statistical significance; thus, no definite conclusion of potassium could be made (2018).

### 3.1.8 WASP-103b

This planet shows definite sodium and definite potassium absorption.

**Sodium:** In 2017, Lendl et al. were able to find strong signs of potassium in the atmosphere of WASP-103b. Because of WASP-103b's large mass, the amplitude of the sodium feature was expected to be small; despite this, Lendl et al. were able to detect a signal of sodium that was even larger than the predicted value (2017). Delrez et al. also observed the atmosphere of WASP-103b and found some evidence for sodium absorption, but not enough to make a conclusion; they indicated that data of a higher resolution would be necessary to confirm the presence of sodium (2018).

**Potassium:** Along with the sodium detection, Lendl et al. detected definite potassium absorption in the atmosphere of WASP-103b, again with a larger signal than that which had been predicted (2017). For Delrez et al., some evidence of potassium absorption was present in the data, but further observations would be necessary to make a conclusive potassium detection (2018).

### 3.1.9 WASP-121b

The exoplanet WASP-121b has potential sodium absorption.

**Sodium:** Sodium is weakly favored in data obtained by Evans et al. (2018). Observations of a higher resolution would be needed to confirm this feature, but an increased value for  $R_p/R_*$  can be seen at the wavelength expected for sodium absorption.

## 3.2 Analysis & Results

To begin with, we conducted a Kolmogorov-Smirnov test (K-S test) for each of the individual parameters, to test if there is a connection between planets which show absorption and any of the individual physical and orbital parameters. To conduct this test, we create two lists; a list of the masses of the 9 planets with absorption, and a list of the masses of all 24 planets. The K-S

test determines the probability that these two lists came from the same population. Testing for a significance level of 0.03, we would conclude a trend if the probability that the two lists came from the same population was less than 3%.

By conducting this test, we found no trends relating the presence of sodium and/or potassium in an exoplanet's atmosphere to their mass, radius, average density, period, or equilibrium temperature. For most of the physical properties, there is more than an 89% probability that the 9 planets with absorption are a random sample, drawn from the same population of all planets in the HZG with both period and radius data. In other words, any of the planets in our search could have been found to have potassium/sodium absorption; there is nothing significant about the individual physical properties of the 9 planets which showed absorption.

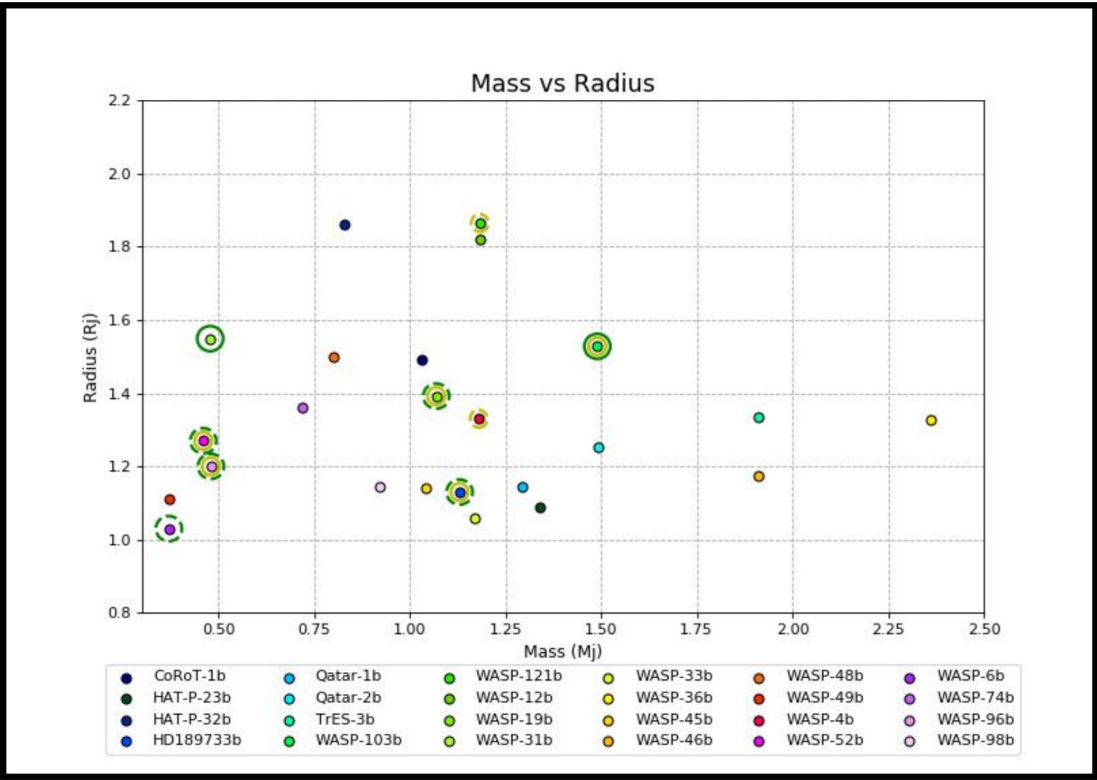
Beyond trends relating potassium/sodium absorption to a single parameter, we wanted to see if we could find a trend relating absorption to a combination of parameters. Figures 2 - 11 show plots comparing the different parameter combinations. Only planets with definite or potential absorption are circled: planets which show definite sodium/potassium absorption have a solid yellow/green circle, respectively; planets which show potential sodium/potassium absorption have a dashed yellow/green circle.

We are looking for trends which relate the planets which show potential and/or definite absorption to a certain part of the parameter space. For instance, do planets which show absorption all have the smallest radii and the largest periods? Does any planet with an average density of less than one times the density of Jupiter, and a radius of between  $1.5 R_J$  and  $1.7 R_J$  show potential potassium absorption?

Looking at the plot of mass vs. radius (figure 2), we see no trends relating these two parameters to the presence of sodium and/or potassium. 18 of the 24 planets have masses of less than  $1.5 M_J$  and radii of less than  $1.6 R_J$ .



Figure 2. Plot of mass vs. radius of the 24 planets.

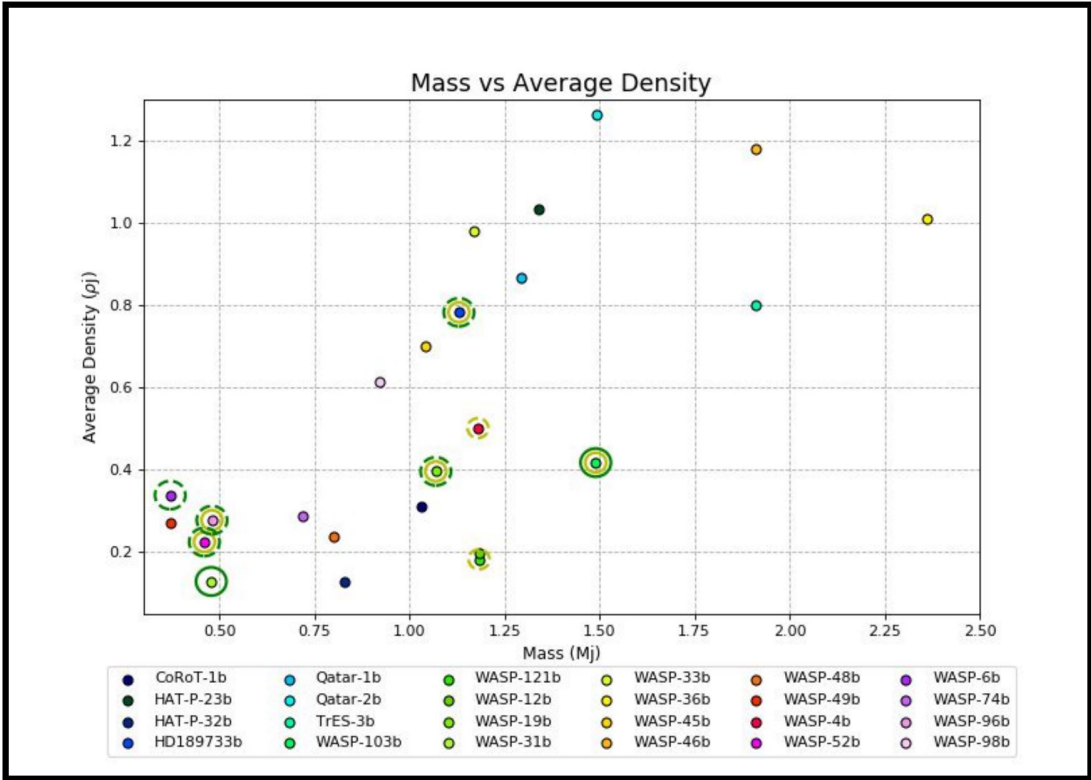


From the 6 planets that have a mass greater than  $1.5 M_J$  or a radius greater than  $1.6 R_J$ , only one (WASP-121b) shows absorption. In the space containing planets with masses of less than  $1.5 M_J$  and radii of less than  $1.6 R_J$  there are 8 planets with absorption, and they occupy every corner of this subspace. From figure 2, there is no evidence that planets with absorption are related by a combination of mass and radius.

Figure 3 shows a plot of mass vs. average density. We see that all 9 planets with absorption have average densities of less than  $0.8 \rho_J$  and masses of less than  $1.5 M_J$ . This might be interesting, were it not for the fact that 19 of the 24 planets also exist in this part of the parameter space. If we were seeing a trend relating planets with absorption to low average densities and low masses, we would expect this to be a less populated part of the parameters space. Because most of the 24 planets share these same characteristics, we do not see any trends in figure 3.

Even more so than the previous plots, the plot of mass vs. temperature (figure 4) shows that the planets with absorption exhibit a wide range of temperature and mass values. It is becoming even more apparent that the 9 planets we found to have absorption do not share a unique combination of parameters; only 3 planets exist outside the main group in this plot, none showing absorption. From the 21 planets that are spread randomly in the temperature range of 1100 - 2700 K with masses of less than  $1.5 M_J$ , 9 show absorption. WASP-103b has the highest temperature and largest mass of all the planets with absorption, the fourth highest mass and third highest temperature of all 24 planets; WASP-6b, which also shows absorption, has the second lowest temperature and is tied for lowest mass of all 24 planets. In between WASP-103b and WASP-6b, the other 7 planets with absorption are distributed randomly throughout the space, and we cannot conclude any trends by analysing this plot.



**Figure 3.** Plot of mass vs. average density of the 24 planets.

We are again unable to see any clear trends in the plot of period vs. mass (figure 5). The 9 planets which show absorption share the same general spread of period and mass combinations as the planets which do not show absorption. It is interesting that the three planets with the longest periods (WASP-6b, WASP-31b, and WASP-96b) and mass values of less than  $0.5 M_j$  all show absorption. However, this is not enough to determine a trend.

Figure 6 shows the plot of period vs. radius. In this plot, the 24 planets are divided almost evenly into four quadrants. If we were seeing a trend, we would expect most of the planets with absorption to be relegated to a single quadrant, and we would expect very few of the planets which don't show absorption to be present in this quadrant. Instead, figure 6 shows us the planets with absorption are divided almost equally, just the same as the planets which do not show absorption. We see that the two planets which have the shortest periods (WASP-103b

and WASP-19b) and the three planets which have the longest periods share the same range of radius values from  $1 R_j$  to  $1.6 R_j$ , and planets in between these two endpoints are not grouped by whether or not they show absorption.

There is an interesting feature in figure 7, which shows the plot of period vs. average density. This plot shows that all 7 planets with densities greater than  $0.8 \rho_j$  also have periods between 1 and 1.5 days; none of the 7 planets in this subspace show absorption, so we cannot conclude any trends from this, but it is interesting nonetheless. The 17 remaining planets which have densities less than  $0.8 \rho_j$  show a broad spread of period values; among them, the 9 planets with absorption mirror that spread. Thus, we cannot conclude any trends relating a combination of period and average density to the presence of sodium and/or potassium in an exoplanet's atmosphere.

Figure 4. Plot of mass vs. temperature of the planets

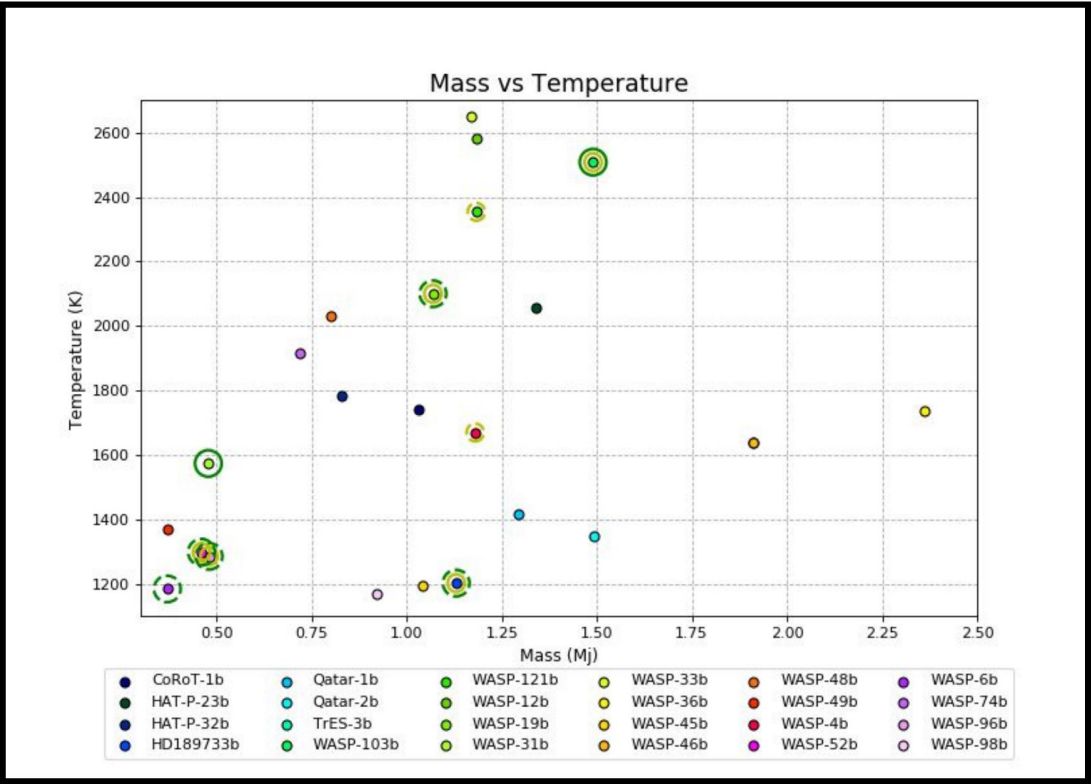


Figure 5. Plot of period vs. mass of the 24 planets.

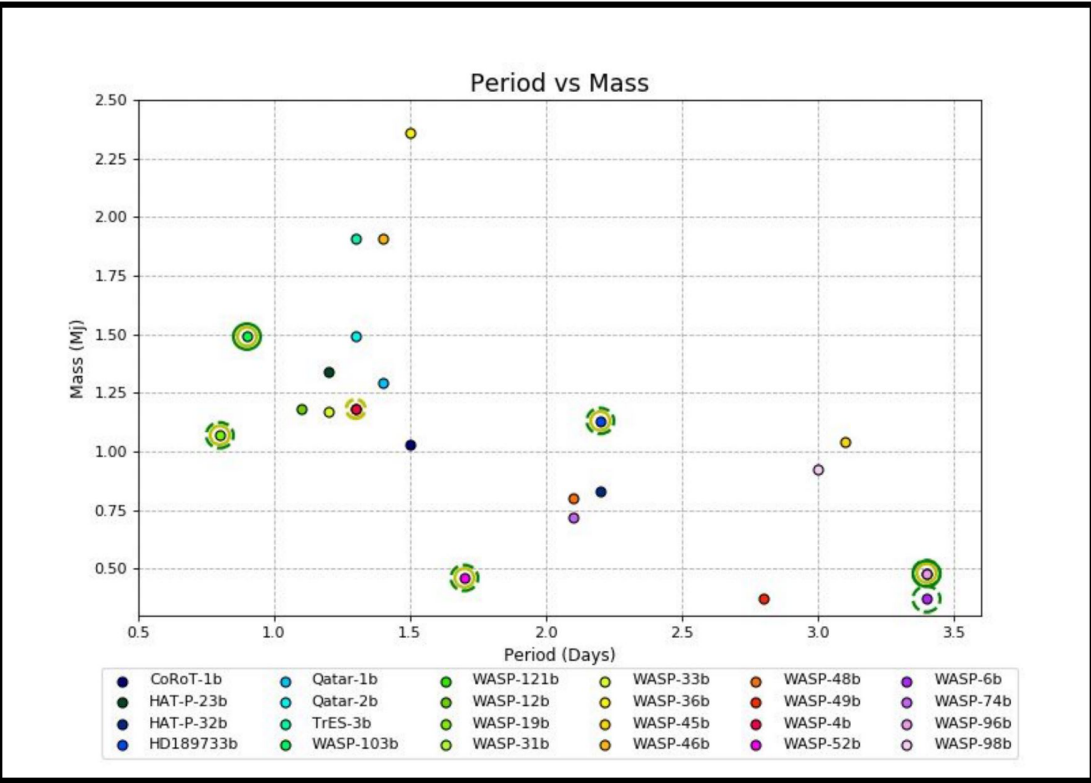


Figure 6. Plot of period vs. radius of the 24 planets.

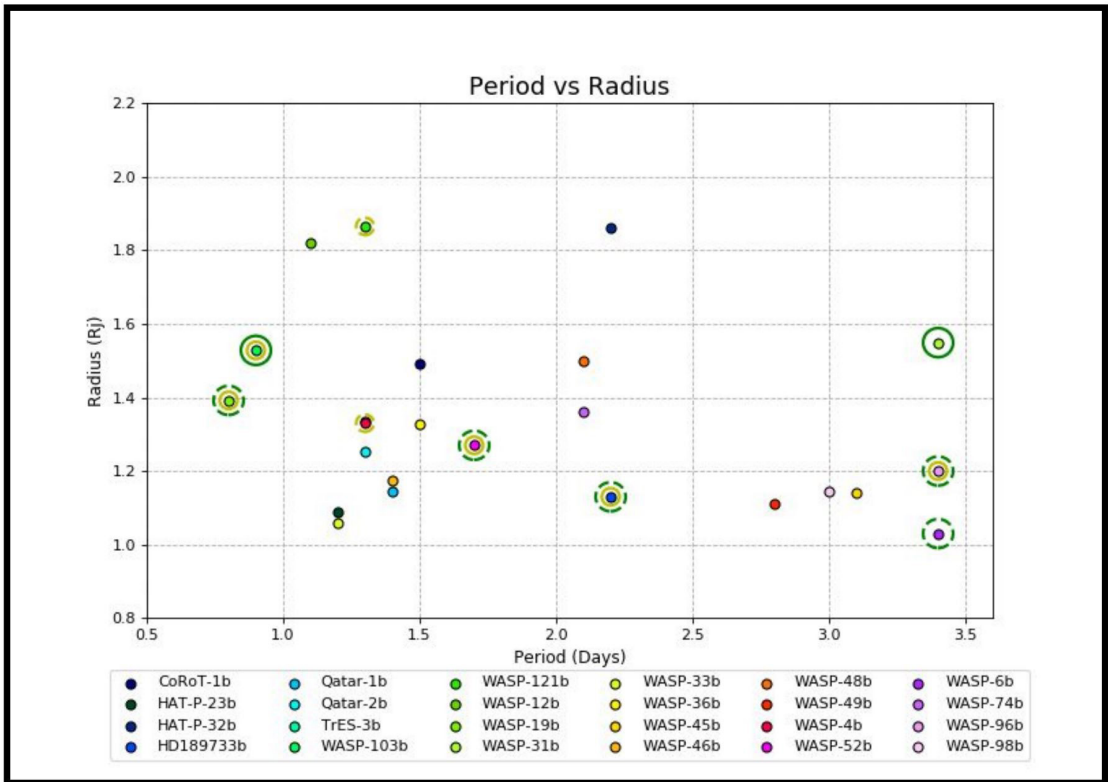


Figure 7. Plot of period vs. average density of the 24 planets.

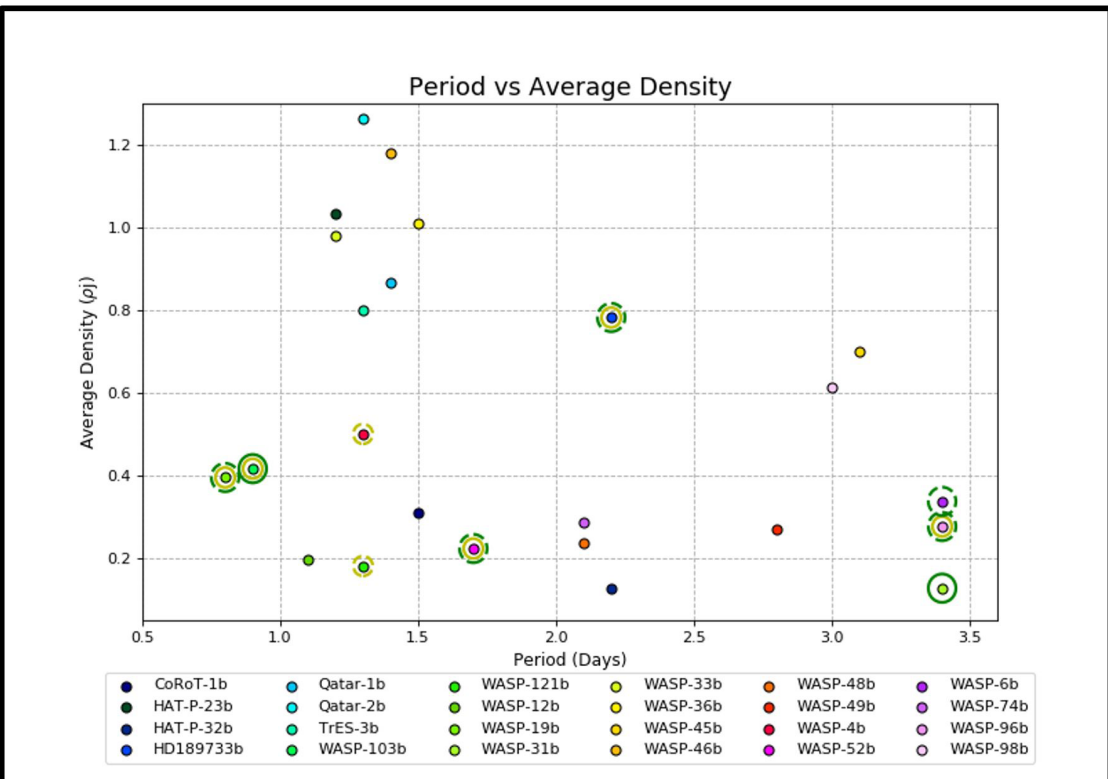


Figure 8. Plot of period vs. temperature of the 24 planets.

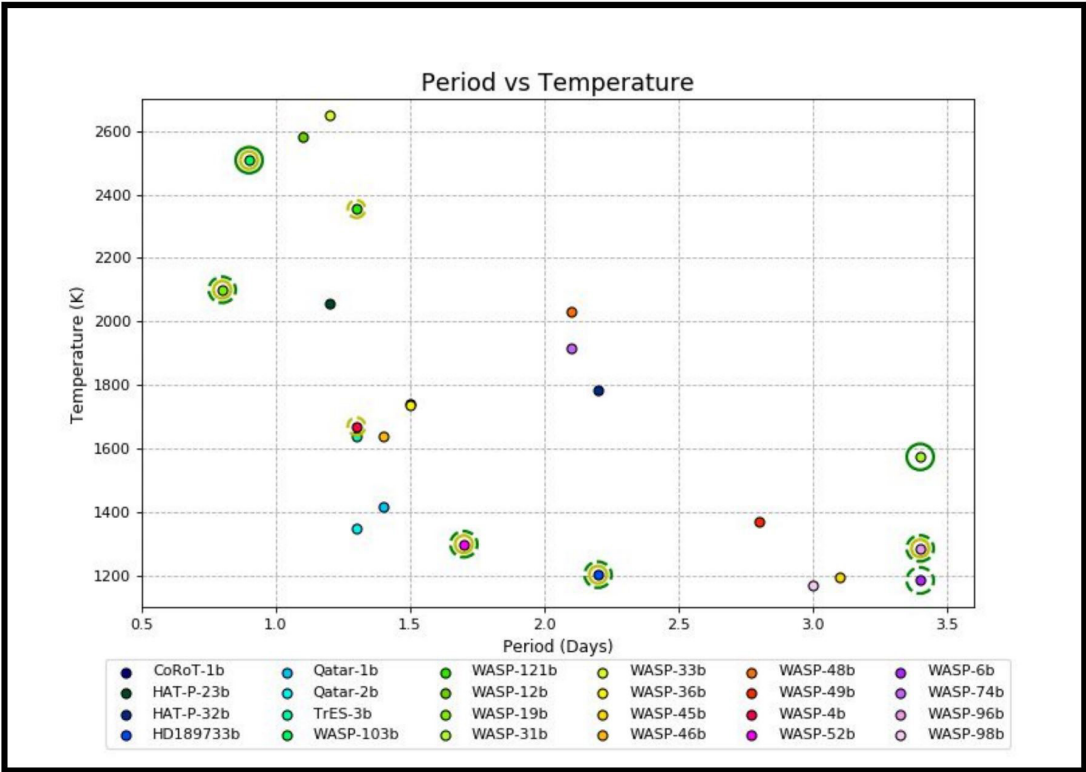
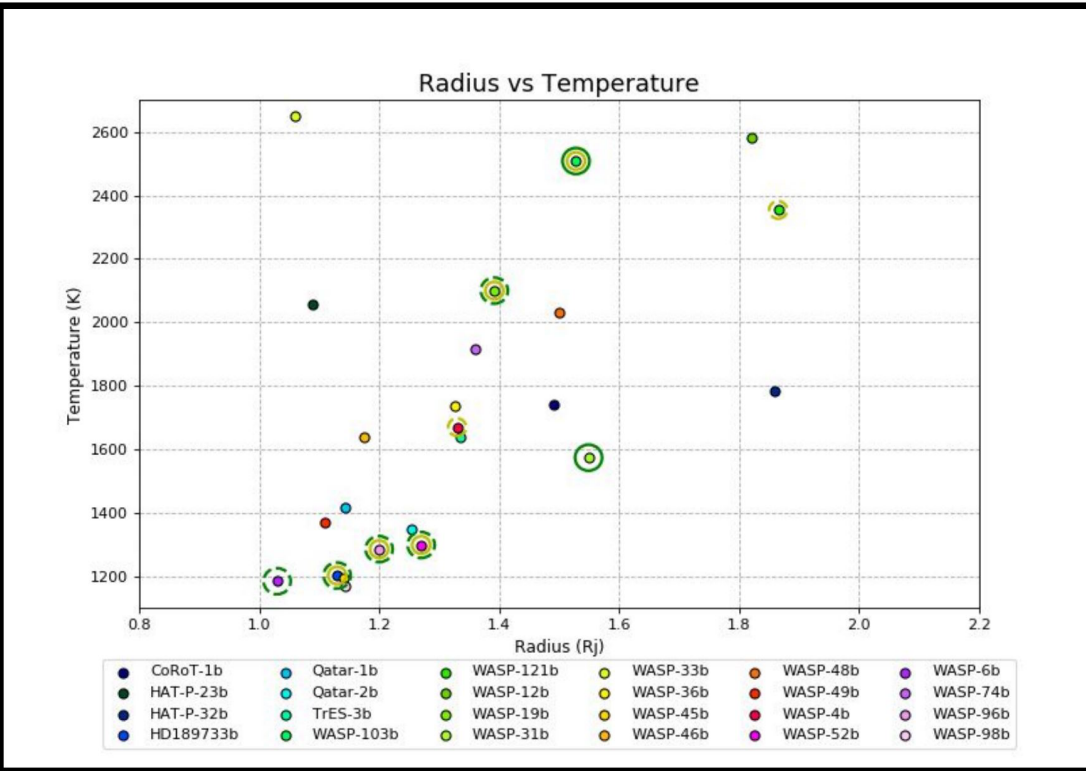


Figure 9. Plot of radius vs. temperature of the 24 planets.



We find no trends in the plot of period vs. equilibrium temperature (figure 8). We see that planets with high temperatures and short periods appear just as likely to show absorption as planets with low temperatures and long periods. Exemplifying this observation, WASP-19b, WASP-103b, and WASP-121b, all showing absorption, are three planets out of six with temperatures greater than 2000 K and periods shorter than 1.5 days. On the other end of the spectrum, WASP-6b, WASP-31b, and WASP-96b are three planets out of six with periods longer than 2.5 days and temperatures less than 1600 K. The other three planets which show absorption are evenly spread between these, mixed among the remaining 9 planets which do not show absorption.

Figures 9 and 10, which respectively show plots of radius vs. equilibrium temperature and average density vs. radius, are interesting because they seem to be showing general relationships between the combined parameters of the planets.

Figure 9 shows that an increase in radius generally coincides with an increase in planetary equilibrium temperature. There are a couple of outliers; WASP-33b and HAT-P-23b, neither of which show absorption, have small radii and high temperatures. Other than those two, 22 planets seem to share the same relationship of increasing radii with temperature. There is no clear reason for this general trend; in relation to our research, this trend is not indicative of a trend relating the presence of sodium and/or potassium to a unique combination of radius and temperature. Quite the opposite; the 9 planets which show absorption follow the general spread of the planets very well, and it is clear from figure 9 that there are no trends relating absorption to radius and temperature.

The general relationship which can be seen in figure 10 appears to have more of a clear justification; planets with larger radii tend to have smaller densities. This makes physical

sense. The 24 planets in our search have similar values for mass and radius, thus it makes sense that planets with large radii generally have smaller average densities. Though once more, this relationship between physical parameters is not an indication of a relationship between physical parameters and absorption. As with figure 9, the 9 planets which show absorption follow the general shape of the plot along with the 15 planets which do not show absorption. We have concluded that there are no trends relating sodium/potassium absorption to a combination of radius and average density.

Finally, in the plot of average density vs. equilibrium temperature shown in figure 11, we again find no trends. There is no greater probability of a planet showing absorption in one part of this plot than the next.

#### 4. Discussion

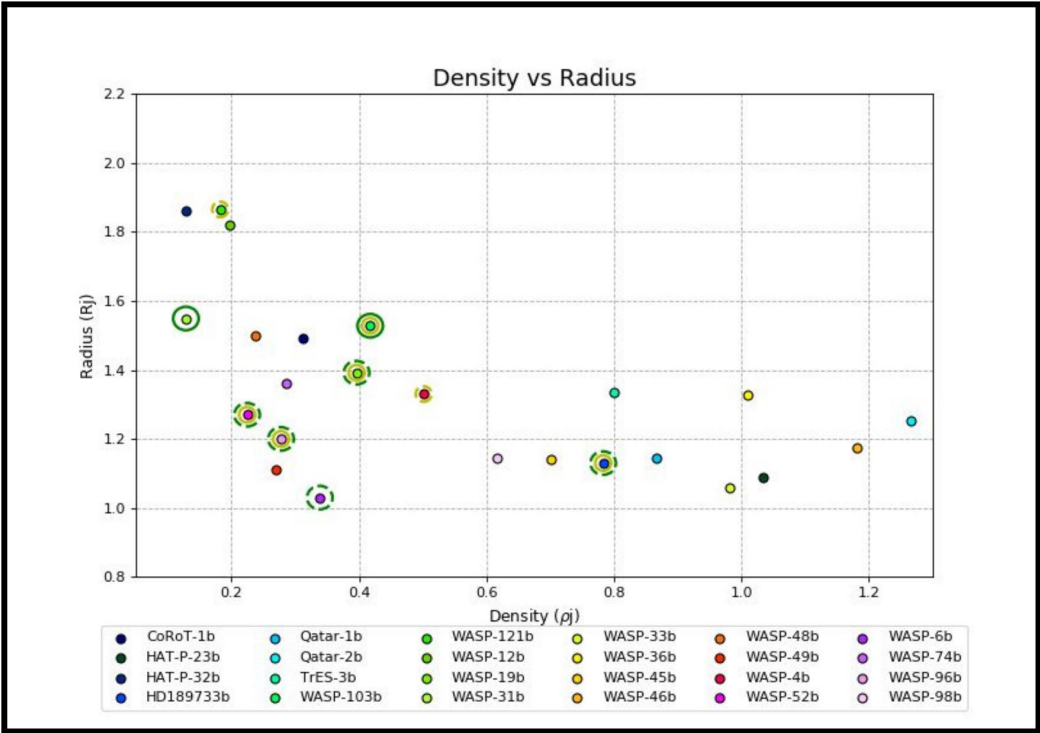
Having explored the relationship between the individual physical parameters of the exoplanets in our search and atmospheric absorption, and the relationship between combinations of physical parameters and atmospheric absorption, we have found no trends. With only 9 of the 24 planets in our search showing potential and/or definite absorption, we may still be limited in our ability to recognize trends by small sample size.

Two previous studies which have been conducted searching for trends include a comparative study by Sing et al., which compared water absorptions in the spectra of 10 hot Jupiters, and the analysis conducted by Wellbanks et al., which compared the relative abundances of water, potassium, and sodium in 19 hot Jupiters (2016; 2019).

Sing et al. compared the spectra of 10 hot Jupiters, and found that water is not depleted in hot Jupiters: when the spectral strength of absorption by water is weak, it is due to clouds and hazes in the exoplanet's atmosphere (2016). The exoplanets in their study have similar radii



Figure 10. Plot of average density vs. radius of the 24 planets.



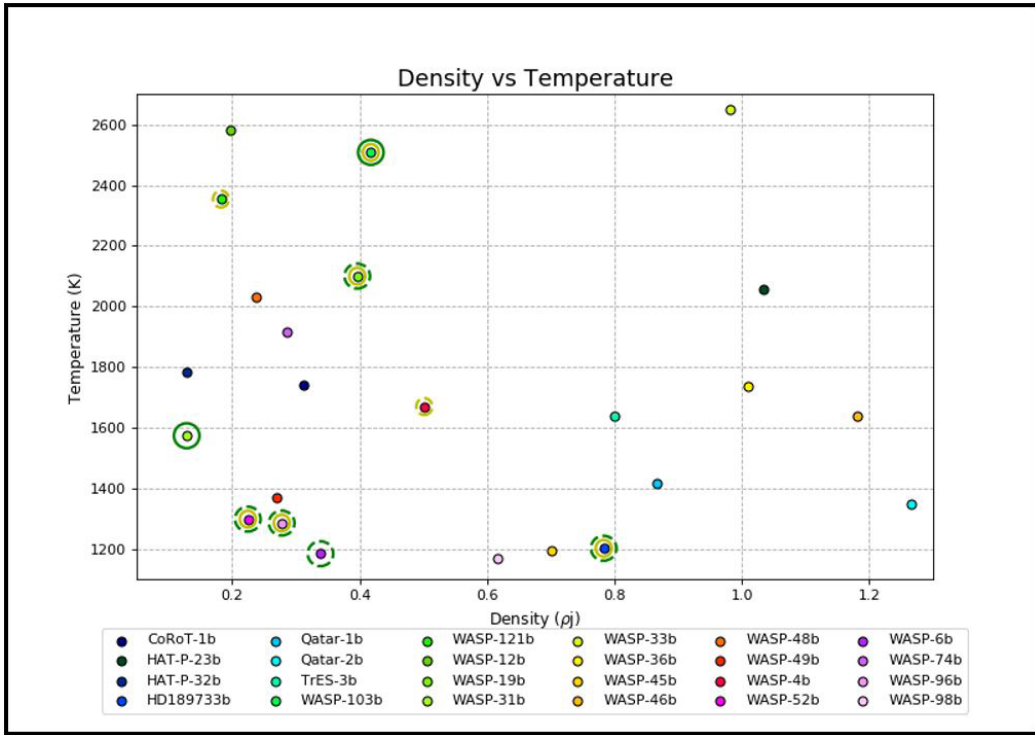
to ours ( $0.96 - 1.89 R_j$ ), masses ( $0.21 - 1.40 M_j$ ), and orbital periods ( $0.79 - 4.46$  days); indeed, there is an overlap of 5 planets between our study and the study conducted by Sing et al. (2016). In their study, out of 5 cases with absorption due to water, 4 also showed sodium absorption, and the  $R_p/R_*$  values for both absorption features seemed to be correlated with each other (see Figure 1 in Sing et al., 2016).

However, Wellbanks et al., analyzed the absorption features of water, sodium, and potassium in their study of 19 hot Jupiters, including the 10 studied in (Sing et al., 2016; 2019). Where they included the study of the metallicity of the host star, they found that there was a one-to-one correlation between the relative abundances of sodium and potassium, but this was not the case for water/potassium relative abundances (Wellbanks et al., 2019). With our future work set to include absorption due to water, we hope to find results which clarify the relations between water and other metals in the atmospheres of hot Jupiter exoplanets.

As is the case with our research, both Sing et al. and Wellbanks et al. suggest that they have small numbers, and larger studies need to be carried out to reach any conclusions. (2016; 2019). In particular, Sing et al. stated that future studies will benefit from atmospheric surveys which are able to differentiate planets with cloudy atmospheres from those with clear atmospheres; then, planets with clear atmospheres could be targeted for further study, which would allow us to determine valuable constraints on hot Jupiter formation models (2016).

### 5. Conclusions & Future Work

We have explored hot Jupiters with periods of up to 3.5 Earth days and with radii between one and two times the radius of Jupiter. We have searched for trends relating individual physical properties with absorption, and relating combinations of physical properties with absorption. In both cases, our results are the same; we have found no clear trends relating the physical properties of the planets in our search to the presence of sodium and/or

**Figure 11.** Plot of average density vs. temperature of the 24 planets.

potassium in their atmospheres. The number of planets with transmission spectral data is still small; of the original 191 in our search, only 24 had published spectral data. Of those, only 9 showed potential or definite potassium and/or sodium absorption. We have increased our numbers from the previous search, but still may be limited in our ability to recognize trends by our numbers.

Future work includes working directly with Prof. Stephen Kane and the Habitable Zone Gallery. The Habitable Zone Gallery will host the results of our research, and we will be working on introducing improvements with the goal of making the HZG a better resource for exoplanetary scientists. As previously mentioned, we will also be expanding our wavelength range of interest to include wavelengths from 3000 - 17000 Å; in this wavelength range, atmospheric features from potassium, sodium, and water can be seen.

## 6. Acknowledgements

I would like to acknowledge the scholarship support provided by the Mary Gates Endowment for this research.

## 7. References

- Alam, M. K., et al. "The HST PanCET Program: Hints of Na I and Evidence of a Cloudy Atmosphere for the Inflated Hot Jupiter WASP-52b." *The Astronomical Journal* 156.6 (Dec. 2018): 298.
- Bixel, A., et al. "ACCESS: Ground-based Optical Transmission Spectroscopy of the Hot Jupiter WASP-4b". *The Astronomical Journal* 157.2 (Jan. 2019): 68.
- Charbonneau, D., et al. "Detection of an extrasolar planet atmosphere". *The Astrophysical Journal* 568 (Mar. 2002): 377-384.
- Chen, G., et al. "The GTC Exoplanet Transit Spectroscopy Survey: Detection of sodium in WASP-52b's cloudy atmosphere." *Astronomy & Astrophysics* 600 (Apr. 2017): L11.

- Delrez, L., et al. “High-precision multi wavelength eclipse photometry of the ultra-hot gas giant exoplanet WASP-103 b”. *Monthly Notices of the Royal Astronomical Society* 474.2 (Feb. 2018): 2334 - 2351.
- Evans, T. M., et al. “An Optical Transmission Spectrum for the Ultra-hot Jupiter WASP-121b Measured with the Hubble Space Telescope”. *The Astronomical Journal* 156.6 (Nov. 2018): 283.
- “Exoplanet and Candidate Statistics.” NASA Exoplanet Archive, CALTECH, [exoplanetarchive.ipac.caltech.edu/docs/counts\\_detail.html](http://exoplanetarchive.ipac.caltech.edu/docs/counts_detail.html).
- “Exoplanets”. Edited by S. Seager. The University of Arizona Press. Book. (2010): p. 12.
- Gibson, N. P., et al. “Revisiting the potassium feature of WASP-31b at high resolution”. *Monthly Notices of the Royal Astronomical Society* 482.1 (Oct.2018): 606–615.
- Huitson, C. M., et al. “An HST optical-to-near-IR transmission spectrum of the hot Jupiter WASP-19b: detection of atmospheric water and likely absence of TiO”. *Monthly Notices of the Royal Astronomical Society* 434.4 (July 2013): 3252–3274.
- Huitson, C. M., et al. “Gemini/GMOS Transmission Spectral Survey: Complete Optical Transmission Spectrum of the Hot Jupiter WASP-4b”. *The Astronomical Journal* 154.3 (Aug. 2017): 95.
- Huitson, C. M., et al. “Temperature–pressure profile of the hot Jupiter HD189733b from HST sodium observations: detection of upper atmospheric heating”. *Monthly Notices of the Royal Astronomical Society* 422.3 (May 2012): 2477–2488.
- Jordán, A. et al. “A GROUND-BASED OPTICAL TRANSMISSION SPECTRUM OF WASP-6b.” *The Astrophysical Journal* 778.2 (Nov. 2013): 184.
- Kane, S. R. and Gelino, D. M. “The Habitable Zone Gallery”. *Publications of the Astronomical Society of the Pacific* 124.914 (Apr. 2012): 323–328.
- Lendl, M., et al. “Signs of strong Na and K absorption in the transmission spectrum of WASP-103b”. *Astronomy Astrophysics* 606 (Sept. 2017): A18.
- Louden, T., et al. “A precise optical transmission spectrum of the inflated exoplanet WASP-52b”. *Monthly Notices of the Royal Astronomical Society* 470.1 (Apr. 2017): 742–754.
- Mancini, L., et al. “Physical properties, transmission and emission spectra of the WASP-19 planetary system from multi-colour photometry”. 436.1 (Nov. 2013): 2–18.
- May, E. M., et al. “MOPSS. I. Flat Optical Spectra for the Hot Jupiters WASP-4b and WASP-52b”. *The Astronomical Journal* 156.3 (Aug. 2018): 122.
- Nikolov, N., et al. “An absolute sodium abundance for a cloud-free ‘hot Saturn’ exoplanet”. 557.7706 (May 2018): 526–529.
- Nikolov, N., et al. “HST hot-Jupiter transmission spectral survey: haze in the atmosphere of WASP-6b”. *Monthly Notices of the Royal Astronomical Society* 447.1 (Dec. 2014): 463–478.
- Pino, L., et al. “Combining Low- to High-Resolution Transit Spectroscopy of HD 189733b.” *Astronomy & Astrophysics* 612 (Apr. 2018): A53.
- Pont, F., et al. “The prevalence of dust on the exoplanet HD 189733b from Hubble and Spitzer observations”. 432.4 (July 2013): 2917–2944.
- Redfield, S., et al. “Sodium Absorption from the Exoplanetary Atmosphere Of HD 189733b Detected in the Optical Transmission Spectrum”. *The Astrophysical Journal* 673.1 (Jan. 2008): L87–L90.
- Seager, S. and D. D. Sasselov. “Theoretical Transmission Spectra during Extrasolar Giant Planet Transits”. *The Astrophysical Journal* 537.2 (July 2000): 916–921.
- Sedaghati, Elyar, et al. “Detection of titanium oxide in the atmosphere of a hot Jupiter”. 549.7671 (Sept. 2017): 238–241.
- Sedaghati, E., et al. “Regaining the FORS: Optical Ground-Based Transmission Spectroscopy of the Exoplanet WASP-19b with VLT+FOR2.” *Astronomy & Astrophysics* 576 (Apr. 2015): L11.
- Sing, D. K., et al. “A continuum from clear to cloudy hot-Jupiter exoplanets without primordial water depletion”. *Nature* 529 (Jan. 2016): 59.
- Sing, D. K., et al. “HST hot-Jupiter transmission spectral survey: detection of potassium in WASP-31b along with a cloud deck and Rayleigh scattering”. 446.3 (Jan. 2015): 2428–2443.
- Sing, D. K., et al. “HST hot-Jupiter transmission spectral survey: evidence for aerosols and lack of TiO in the atmosphere of WASP-12b”. 436.4 (Dec. 2013): 2956–2973.

- Sing, D. K., et al. “Hubble Space Telescope transmission spectroscopy of the exoplanet HD 189733b: high-altitude atmospheric haze in the optical and near-ultraviolet with STIS”. 416.2 (Sept. 2011): 1443–1455.
- Southworth, J., and Evans, D. F. “Contamination from a nearby star can-not explain the anomalous transmission spectrum of the ultrashort period giant planet WASP-103 b”. *Monthly Notices of the Royal Astronomical Society* 463.1 (Aug. 2016): 37–44.
- Tsiaras, A., et al. “A Population Study of Gaseous Exoplanets”. *The Astronomical Journal* 155.4 (Apr. 2018): 155.
- Weber, K., et al. (2019) “Searching for Trends in Atmospheric Compositions of Extrasolar Planets,” IdeaFest: *Interdisciplinary Journal of Creative Works and Research from Humboldt State University*: Vol. 3.
- Wellbanks, L., et al. “Mass-Metallicity Trends in Transiting Exoplanets from Atmospheric Abundances of H<sub>2</sub>O, Na, and K”. *The Astrophysical Journal* 887 (Dec. 2019): L20.

## ABOUT THE STUDENT AUTHORS

**Grace Boulanger** graduated in 2019 with a BA in Culture, Literature, and the Arts and a minor in Classical Studies. As a UWB alum, Grace is enjoying some time off before applying for graduate school and pursuing a doctoral degree. Grace's primary research interests are in oral narratives and death studies, how the two intertwine, and ultimately affect our understanding of dying and storytelling. When not reading about cadavers and forms of necromancy, Grace enjoys painting, walking around Greenlake, and using copies of 'The Stranger' to create grayscale collages.

**Wynter Broussard** will graduate in June 2020 with a BS in Physics and a minor in Mathematics. After graduating, Wynter plans to continue researching exoplanets; first in a PhD program, and ultimately for their career. They are the student leader of the exoplanet atmospheres research group, the student manager of the Space Public Outreach Team, and a member of the gravitational wave astronomy research group. Wynter is an advocate of scientific outreach, physics, and HD 189733b, which is their favorite exoplanet. In their free time, Wynter can usually be found playing video games, taking walks, and helping their youngest brother with math homework.

**Aaron Davis** is UW Bothell senior who will graduate in 2021 with a Bachelor in Health Studies, and double minor in Global Health and Health Education and Promotion. They have a passion for public health research and education, and they aspire to work as a researcher with health disparities. Aaron believes strongly in the power of community, and is a student representative on many UWB committees, in addition to being a student research assistant. Outside of school they enjoy serving marginalized communities as a shelter program manager and advocate, as well as participating in the arts.

**Katie Sue Eichner** is a senior graduating with a major in Society, Ethics, and Human Behavior and a minor in Gender, Women, and Sexuality Studies. Without a specific career in mind, she looks forward to using the skills she's learned from her time working the ARC and participating on the S&A Committee, the SAF Committee, and SFAC. She appreciates all the professors throughout the years who have indulged and graded her assignments based on Avatar: The Last Airbender as well as all those who have served as mentors over the past four years.

**Hielen Enyew** is currently an undergraduate student at the University of Washington with the intended majors of Astronomy and Physics. She is currently a part of "Characterizing Trends of Atmosphere of Exoplanets" research here at UWB with Dr. Paola Rodriguez Hidalgo. She is also a mentor and a tutor to incoming and current High school students at the Alene Moris Women's Center with their Making Connections program. In addition to being a mentor and a tutor with Making Connections, she also puts in time volunteering at Church, Seattle Public Libraries and with the outreach programs affiliated with League of Astronomy on UW Seattle campus. She is passionate about space and space science, in her free time she likes hiking, telescope gazing, reading books, watching movies and spending time with her family.

**Gabrielle Fox** is a University of Washington Bothell class of 2019 graduate. She received her bachelor's degree as a double major in gender, women, sexuality studies and society, ethics, and human behavior with a minor in diversity studies. Fox is presently working as a freelance writer while continuing to promote an agenda of feminist activism and social justice work.



**Jessica Heitzman** is a professional Registered Nurse in Seattle, Washington currently pursuing her Bachelor in Science of Nursing at University of Washington-Bothell. Initially finding passion for critical care nursing, the curriculum at UWB has inspired a transition into public health, which she will pursue after graduating in June 2020. Through her work she hopes to make a positive impact to her patients and lasting improvements to the health of her community. She plans to return to school in 2021 to pursue a Doctorate in Nursing Practice in Population Health at University of Washington, where she can broaden her knowledge and create a foundation for leadership in her profession.

**Jakob Johnson (Jamie Sanford)** will graduate in 2021 with a Bachelor of Science in Biology and a minor in chemistry. He is currently working towards a career in molecular biology, which combines his passions for chemistry, biology, and research. He is excited to be submitting to the CROW again after his 2019 publication on Bēowulf, Infallibility through Duality.

**Phoebe Angelina Keryte** is in the Health Studies program at the UW Bothell. After graduation, she will continue her academic journey and will attend the Accelerated Nursing Program at the University of Washington. Her interests have always been to give back within her tribal community as being a nurse in the maternal health care field. She received her A.A. at Northwest Indian College and been able to intern for Indigenous tribes such as the Swinomish, Lummi, and Maori. Overall her passion comes from her tribal community and she enjoys working with the elder and infants.

**Allen Lewis** is an undergraduate senior majoring in Biology and Health Studies. He enjoys writing and singing music and enjoys learning about science and technology. He has conducted undergraduate research on the topics of HIV and microbiomes on the UW Bothell campus. After graduating from UW Bothell, he wants to become a biomedical scientist, to study diseases and conduct research on treatments and cures for diseases.

**Lindsey McCormick** will be graduating in Spring 2020 with a Bachelors in Mathematical Thinking and Visualization, working towards a career in data analytics. She is planning on working towards a graduate certificate in Software Design after graduation. In her free time, she enjoys drawing, going to concerts, fitness, and spending time with her dog and friends.

**April Oertle** is a third-year transfer student at U.W. Bothell majoring in Chemistry. She started her academic career at U.C. Davis and obtained her Wilderness E.M.T. from the National Outdoor Leadership School. She is a member of the Wilderness Medical Society. After graduation, she plans to attend medical school to further her education in emergency medicine in order to serve rural communities. In her free time, she enjoys hiking with her corgi in Washington's great outdoors and volunteering at Little Bit Therapeutic Riding Center.

**Emily Person** is a senior who will be graduating in June of 2020. She plans to pursue a career in environmental studies which ideally would lead to a job in environmental consulting or environmental education. In her free time Emily enjoys hiking, rafting with her family, and visiting as many national parks as she can. She looks forward to graduating and is excited to see where the future takes her.

**Kimberly Rice** is a senior who is graduating in June 2020 with a double major in Nursing and Health Studies. She is a currently practicing Registered Nurse who appreciates being able to incorporate a public health perspective into her every day practice through her Health Studies courses. Throughout her coursework at UWB, she has had the opportunities to work with and support local communities who have been affected by various life obstacles such as financial hardships, chronic health insecurity, domestic violence, and food and housing insecurity. This work alone has produced an interest and motivation to create health policy change for vulnerable populations. She hopes to further pursue this interest as a graduate student in the near future through a Nurse Practitioner program.

**Shushmitha Radjaram** is a sophomore intending to major in Computer Engineering and minor in Mathematics. She is fascinated with the power of technology and its applications to science, math, and data. She has been focusing on improving the data collection and representation processes of the exoplanet atmospheres research she is a part of. This summer she will be interning at T-Mobile on a data architecture team, and is looking forward to the opportunity to learn more about data and computer science. Shushmitha is also a dancer on Natya UW- The University of Washington's competitive Indian classical dance team.

**Elisabeth Schnebele** is a third year undergraduate pursuing a degree in Gender, Women and Sexuality Studies. Elisabeth is passionate about social justice issues and channels much of her activism through writing. Currently, she works at the UWB Writing and Communication Center as a peer consultant. She intends to continue expanding her writing skills to use in her future career as an author and journalist. Elisabeth is hopeful that this will be her first publication of many.

**Karina Syrova** is a second-year student majoring in Health Studies. She plans to continue her education by applying to osteopathic medical school, to pursue a focus in radiology or surgery. Being Pacific-Northwest raised, she loves to be in nature. As well, she enjoys drawing, music, and reading in her free time. Her interest in Ayurveda began at an early age from the teachings of Dr. Vasant Lad, and continues learning about it to this day.

**Dacia Wagnon** recently transferred to UW Bothell and will graduate Winter 2021 with a Bachelor of Arts Degree in Health Studies. She has been deeply shaped by her unconventional upbringing in Texas, where she was homeschooled alongside her four siblings. She approaches her public health studies with the philosophy that health is an individual's ability, through resource access, to prevent disease, treat/combat challenges, and maintain positive emotional, social, physical, mental, and/or spiritual wellbeing. After graduating, she will pursue a career as a public health professional in a role where she can advocate for female reproductive health and knowledge access.

**Cliff Watson** will graduate in June 2021 with a Master of Fine Arts in creative writing and poetics from UW Bothell. He has a Bachelor of Science from Brown University and a Master of Science from UW Seattle in applied mathematics. He writes prose, poetry, and lyrics, and enjoys experimenting with multi-media and live performance settings. In 2017, his piece, Dialogue about croquet in a library, was set to music by Lili Kung, and performed by acrobats in a handstand circus act. In 2019, Cliff explored a diversity of forms, including song, screenplay, cartoon, and haibun, in his chapbook, Transformation. Cliff has been a program manager, software engineer, opera soloist, professional chorister, musical theatre actor, olde-tyme commercial reenactor, and circus set builder. He is an Assistant Career Advisor in UW Bothell's Career Services department. Cliff grew up in Eastern Washington and Hong Kong, and lives in Bellevue, Washington with his family.

**Tyler Youn** is a senior majoring in Health Studies. He is applying to dental school this year to become a dentist. Throughout his academic journey, he worked as a lab assistant in UW Physiology and Organic Chemistry department. To explore his interest in dentistry, he participated as a dental scholar in the UW Summer Health Professions Education Program in 2016 and the UW Healthcare Alternative Spring Break in 2018. He also started working and volunteering as a state registered dental assistant since 2016 at a local private practice and non-profit organization for underserved populations. He is grateful for the opportunity to publish his research paper in the 2020 edition of the CROW.

## ABOUT THE EDITORS

**Mickena Butler** is a junior at UWB with a major in Health Studies, and a minor in Global Health. Mickena enjoys listening to and looking for good music, reading, and watching movies or documentaries in her free time. She works as a CNA caring for fragile disabled children. She loves learning about public health issues and policies from around the world. Mickena hopes to be a public health advocate whether it be as a physician, social worker, a nurse, or helping to amend or create health policies. This is her first quarter being a part of *The CROW* editorial board, and she looks forward to being a part of it in quarters to come.

**Haley Damore** graduated in March of 2020 with a Bachelor of Arts degree in Health Studies. She has accepted an internship position at Fred Hutch Cancer Research Center helping to analyze data sets from their most recent Population Health Needs Assessment supplement. In doing this she will help to assess the greatest cancer needs for minorities in the greater Seattle area. She is involved in undergraduate research on virtual reality treatments for phantom limb pain in amputees. Upon graduation, she hopes to get involved in epidemiological research and plans to attend graduate school in the future. Although busy with research and full-time school, her most important role is that of a mother to her one-year old son. She is looking forward to expanding her experience in research writing as a board member for *The CROW*.

**Mohamad Ismail** is a senior who will be graduating in the spring of 2020 with a Bachelor of Arts degree in Health Studies. After graduation, he aspires to earn a master's degree in Physician Assistant Studies at the University of Washington. Outside of academia, Mohamad enjoys his time working as an emergency department medical scribe. Aside from school and work, Mohamad enjoys activities based in the natural world such as hiking, fishing, and ranching.

**Jenna Lau** is a fourth year undergraduate student who will be graduating in June 2020 with her BA in Health Studies. She plans to attend medical school in the future in order to become a Psychiatrist. Throughout her experiences at Cascadia College and UWB, she has been exposed to scholarly research of a variety of disciplines (such as organic chemistry, philosophy, and more!) Although Jenna has not always liked writing, she has come to appreciate and rather enjoy the process through being able to conduct her own research in previous classes. By being a part of *The CROW*, she hopes to show others that they too can develop their own passion and niche in composition. She looks forward to helping others transform their own interests and ideas into words too!

**Anna Mishkova** is a third year undergraduate pursuing a Bachelor of Science in Mathematics. Anna is an officer of the Mathematics Society on campus. She is a logophile, who enjoys writing and reading, and she is excited to be a part of the editorial board for the *CROW*. Currently, she works as a peer consultant at the Writing and Communication Center.

**Wessam Nakour** will be graduating in June 2020 with a Bachelor of Arts in Health Studies and a minor in Leadership. He is motivated as a father of two daughters to pursue higher education at the University of Washington Bothell. He currently works as the head manager of Seattle CruisePark and will be seeking career opportunities in the field of Public Health come Winter to further explore his interests. His passion for research writing was reflected in his class work and was introduced to the Campus Research and Observational Writings Editorial Board where he will continue to learn and apply his skills to *The CROW's* fifth volume.

**Rose O'Connor** is a first-year graduate student pursuing an MFA in Creative Writing and Poetics. She received a B.A. in English from Skidmore College in 2018 where she also minored in Management & Business. She plans on applying to PhD programs for Fall 2021 and hopes to one day teach at the college level. She currently works at UW Bothell's Writing and Communication Center and spends her free time knitting, watching documentaries, and drinking coffee.

**Audrey Tinnin** is a senior majoring in Culture, Literature, and the Arts. She currently works in the UW Bothell Writing and Communication Center as a peer consultant. In the future, she will pursue a career in education. On campus, Audrey participates in rotaract club and outdoor wellness activities. Audrey's interest in research led her to joining *The CROW* editorial board. She is grateful for the opportunity to be a part of the board, and she is looking forward to learning and gaining insight from others. Outside of class Audrey enjoys camping with friends.