Journal Introduction

Editorial Mission

Paw Prints: The Michigan Tech University Journal of First-Year Writing is a student-run academic journal that provides an opportunity for first-year writing students to publish their work. The goal of *Paw Prints* is to publish and support student writers. *Paw Prints* focuses on creating a community where students can submit their work, collaborate with peers, and explore new ideas through scholarly writing. Submissions to the journal will go through an anonymized peer review process.

Editorial Board

Enterprise Members

Sponsoring Institution

Paw Prints is published under the auspices of Michigan Technological University's Department of Humanities First-Year Writing Program and the Ink & Ore Publications Enterprise.

Communications

Paw Prints editorial staff can be reached at pawprints@mtu.edu.

Cover Design by Cal Gilbertson. Printing by Michigan Tech Print Services.

Editors' Introduction

The Michigan Tech University Journal of First Year Writing, also known as *Paw Prints*, is a student-run academic journal that features work created for UN 1015: College Writing, Reading, and Research. The journal is run by the Ink & Ore Enterprise, with help from the students enrolled in the course HU 3606: Editing. The journal serves as both a publication opportunity and a learning experience in the editing and publishing process. Paw Prints was founded with the initiative of producing a platform to highlight and recognize student writing. The goal was to recognize quality writing that was produced from the first-year writing course, UN 1015: College Writing, Reading, and Research. The journal highlights research writing from diverse genres that demonstrate the creativity and engagement of their work. *Paw Prints* aims to build a stronger and more visible writing culture on campus by encouraging students to take pride in their work, to see themselves as active voices in academic conversations, and to connect with a wider community through peer review and collaboration.

This year, we've graduated from a one-off issue to a full-fledged Enterprise team that is working on solidifying our processes and building our team. Forming an Enterprise has allowed us to establish roles within the organization and separate into distinct but collaborative teams, working not only on *Paw Prints* but also the literary magazine *Kupari* and Michigan Tech's student newspaper, *The Lode*. Becoming an official organization within Michigan Tech has also afforded us the privilege of working with the UN 1015: College Writing, Reading, and Research professors to integrate their writing curriculum with ours and with the HU 3606: Editing students to provide them with real papers to develop their editing skills. It also helps us to make sure this is a long-term, well-oiled project at Michigan Tech that will continue after our team is gone. Doing so has simplified our process tremendously; instead of hoping just for submissions, we hope for better and better work from our first-year class. Instead of reaching out to previous reviewers and editing everything in a scramble, we have a built-in team of reviewers and editors we can rely on.

Our second issue covers a wide range of topics that we believe fellow students will find interesting, timely, and thoughtful. Our journal reflects the variety of majors and interests to be explored on campus. Foresters and environmental engineers will enjoy Seth Tartamella's deep dive into the history of Common Buckthorn in "Ecological Effects and Management of Common Buckthorn (*Rhamnus Cathartica*), a Michigan Invasive," while social science students will enjoy Coral Weidenbach's "Cost of Capital Punishment: The Enormous Evidence Against the Death Penalty." Readers who are interested in neuroscience or just an animal lover, Justin Lask's "Diving Deeper into the Ethics of the Containment of Orcas for Entertainment Purposes." Our fourth article, "Curious Obsession: an Inquiry of *Magic: The Gathering* and its Cultural Relevancy" takes its title and each of its headings from popular (and sometimes notorious) *Magic: The Gathering* cards (including "Closing Statement"!). We find this to be a fantastic touch on a well-researched paper that was clearly written with passion and forethought and executed effectively.

Ella Karbowski's "A Return to Balance: Why Ayurveda Matters Now More Than Ever" is for people who want to explore medicine outside of traditional western standards. Karbowski emphasizes how healthcare is not "one-size fits all," and it interested us to learn about different treatment types for both physical and mental health. Dylan Walsh's "The Dangers of Androgenic Anabolic Steroids" provides a crucial resource for gym rats & aspiring looksmaxxers alike to make their gains while staying healthy and safe. Both students of computing and those who simply share J.J. Reams' fascination with technology will need to see the article "Are APUs the Future of Computing?" to be fully prepared for the next big leap in processing. Lucas Centner's article, "Scouting and its Impact on Youth", came to us highly recommended from our reviewers;

"The introduction to the paper does a good job of grabbing the reader's attention, and the rest of the paper does well at keeping it," and after reading it, we had to agree.

We're incredibly proud of the articles we've selected to include. We initially feared that we might not receive enough submissions, or that we wouldn't be able to represent a breadth of content as wide as we know our student body is capable of, but the moment we began reviewing our submissions, these fears disappeared; in reality, our biggest hurdle in the selection process has been picking which articles not to publish, given our limited budget and timeframe. We're overjoyed to be able to bring some of the incredible writing of our first-year students to the attention of the reading community.

Please enjoy.

Paw Prints Editorial Team

Jamie Perlman
Rowan Kerns

Submission Guidelines

The guidelines that applicants were provided with when submitting their manuscripts are included here in full.

To prepare your article for submission, review the following guidelines. *Paw Prints: The Michigan Tech University Journal of First-Year Writing* is aimed at members of the campus community (including students, faculty, and staff) as well as readers from the Copper Country.

- You (the author) must be a first-year undergraduate student. In particular, articles prepared for first-year writing courses are prioritized, but all first-year writers are invited to submit.
- Your manuscript should be about any academic topic that you are interested in and/or passionate about.
- The recommended length of your manuscript is 3,000 words, or ten pages, including figures and tables if applicable.
- Include a minimum of 6 peer-reviewed sources in your reference list. Please contact the editorial board (pawprints@mtu.edu) if your subject is less-researched and are struggling to find enough sources of existing literature.
- Your manuscript should be well-written, readable, and understandable for a broad audience with no prior knowledge of your topic.
- Your manuscript should follow APA student paper guidelines.
- You will provide a short (≤ 200 words) writer's statement with an explanation of why you wrote the article, what department you belong to, and your contact information (MTU email and name) alongside your article.
- The use of generative AI is prohibited for drafting & revising. If you used AI for your research, you must cite any information, images, and text, according to APA guidelines for AI citations.

Additional details:
- Your manuscript should be in a Microsoft Word Document (.docx) format. Do not submit .pdf documents.
- Your manuscript must not include your name on the document. This is so that the review of your article can be unbiased.

Table of Contents

Editorial Mission ····· — 1 —

Editorial Board ····· — 1 —

Enterprise Members ····· — 1 —

Editors' Introduction ····· — 2 —

Submission Guidelines ····· — 4 —

Seth Tartamella, "Ecological Effects and Management of Common Buckthorn *(Rhamnus Cathartica)*, a Michigan Invasive" ····· — 6 —

Coral Weidenbach, "Cost of Capital Punishment: The Enormous Evidence Against the Death Penalty" ····· — 11 —

Justin Lask, "Diving Deeper into the Ethics of the Containment of Orcas for Entertainment Purposes" ····· — 18 —

Daniel Staats, "Curious Obsession: An Inquiry of *Magic: The Gathering* and its Cultural Relevancy" ····· — 25 —

Ella Karbowski, "A Return to Balance: Why Ayurveda Matters Now More than Ever" ···· — 31 —

Dylan Walsh, "The Dangers of Anabolic Androgenic Steroids" ····· — 38 —

J.J. Reams, "Are APUs the Future of Computing?"" ····· — 43 —

Lucas Centner, "Scouting and its Impact on Youth" ····· — 49 —

Enterprise Biographies ····· — 55 —

Faculty Advisors' Biographies ····· — 55 —

Authors' Biographies ····· — 56 —

Thank You to Our Reviewers & Copyeditors ····· — 57 —

Ecological Effects and Management of Common Buckthorn (*Rhamnus Cathartica*), a Michigan Invasive

Seth Tartamella

Writer's Statement

I am Seth Tartamella, and am a first year applied ecology major in the College of Forest Resources and Environmental Science.I wrote this article because common buckthorn is one of the first invasive species I learned about in my vegetation of North America class and composition offered a perfect excuse to learn more about an invasive I was unfamiliar with. My goal with this article was to research the basics of common buckthorn's invasion and share what I found with the community of Michigan Tech while gaining experience writing in a scientific manner.

Introduction

The goal of this research is to make clear the situation surrounding an invasive species: common buckthorn (*Rhamnus Cathartica*). In order to understand the complex effects of a species invasion, we must ask an important question: "What species are considered invasive to the Upper Peninsula of Michigan?" This is an important question because it establishes whether or not a species is actually problematic. Many species that are introduced for ornamental, agricultural, or other reasons never escape cultivation. For a species to truly be considered invasive, it needs to have traits that make it a dominating force outcompeting native species. Another important aspect of that question is the clarification that we are interested foremost in species causing problems in the local area, such as common buckthorn. Anyone spending time in the beautiful Keweenaw Peninsula will notice the thickets of common buckthorn dominating forest understories. The importance of the threat invasives like common buckthorn pose is much harder to overlook when one can take a short walk along the MTU campus disc golf course and witness their effects first hand. Common buckthorn is producing drastic effects to local ecosystems and must be addressed to protect the beauty of the unique environment found only here.

Ecological Effects of Common Buckthorn

Common buckthorn is a woody shrub native to Eurasia (Archibold et al., 1997, p. 617). It has 2–3 inch long simple elliptical to oval leaves with fine serration arranged alternately, but may appear opposite or nearly so (Seiler et al., 2025; Barnes & Wagner jr., 2004, p. 184). Common buckthorn produces copious amounts of small black drupes that contain 2–4 seeds (Archibold et al., 1997, p. 617). The terminal bud is replaced by a thorn and is flanked by two lateral buds, resembling a buck's hoof. Common buckthorn was initially introduced to North America during the colonial period for medicinal purposes. Not enough research into the history of common buckthorn's spread has been done to say for sure, but it likely arrived around here at some point after 1800. It has since escaped cultivation and is naturalized across much of the United States, including in the Upper Peninsula. Its large invasion range is attributed mostly to human causes due to its popularity as a hedge plant (Kurylo & Endress, 2012, pp. 602–605).

The presence of common buckthorn in the Upper Peninsula is significant because it causes drastic changes to native ecology. Common buckthorn's presence here in our natural areas is actively altering their ability to perform natural functions by suppressing native species, altering the way soil forms, and reducing native species diversity. This matters because the organisms that make this area their home are a unique expression of nature and provide a beauty unavailable anywhere else on Earth. In order to safeguard the things that contribute to

this beauty we need to understand how common buckthorn is able to dominate and what that does to native ecology.

One trait that allows common buckthorn to change native biotic communities is its allelopathic habit. Allelopathy is the term used to describe a plant's ability to alter the soil around it to suppress the growth of competing species. This helps the allelopathic species ensure its domination of sites where it becomes established. In a study to assess the allelopathic capabilities of common buckthorn it was found to reduce the abundance of many types of nearby native plants by preventing germination (Warren II, et al. 2017, pp. 1236–1237). The researchers hypothesized that common buckthorn's allelopathic chemicals are so effective because they are completely foreign to native plants; they have not adapted alongside common buckthorn and therefore have no resistance to these chemicals. Common buckthorn uses this advantage to invade forest understories and form dense monotypic patches, something it is incapable of in its native range (Knight, 2005, p. 31).

Allelopathy is not the only way common buckthorn affects soil. Its leaves contain high levels of nitrogen, so after dropping they decay much faster than the leaves of native plants. These leaves are also attractive to invasive earthworms and result in an increased earthworm population (Heneghan, 2003, pp 28–30). These traits combine to cause leaf litter in invaded woodlands to decay much faster than it otherwise would (Heneghan et al., 2002, p. 110), changing an element important to native environments. Soil arthropod communities rely on substantial leaf litter density, so less leaves on forest floors mean there is less habitat available to this community, reducing species richness and affecting forest ecosystem functions. There is also a higher ratio of unmineralized nitrogen in soil surrounding common buckthorn, suggesting the microbial community is affected as well (Heneghan, 2005, pp. 44–48). Changes in soil formation could have persisting impacts to the land even after successful eradication of common buckthorn.

Another invasive trait *R. cathartica* demonstrates is its method of seed dispersal. It produces a fleshy fruit which appears attractive to birds as a food source, but birds are unable to digest its seeds, so they unwittingly disperse them far and wide. This mode of dispersal is evident by the large clumps of *R. cathartica* that tend to form under perching trees and along fencerows; places that birds frequent (Archibold et al., 1997, p. 617). Bird dispersal allows common buckthorn to move over vast distances and expand its range of invasion quickly.

Unfortunately, seed dispersal is not the only interaction between common buckthorn and birds. The research done by Knight et al. (2007, p. 934) states: "Apfelbaum and Haney (1987) claim that bird species diversity declines as invasion of *R. cathartica* progresses." They go on to reference another source by Schmidt and Whelan (1999, pp. 1504–1505), to clarify that this is due to the increased predation birds face when nesting in non-native shrubs. Similarly to the soil arthropod community, these birds are not adapted to survive alongside common buckthorn.

Common buckthorn also increases deer herbivory of nearby native plant species. White-tailed deer avoid eating *R. cathartica*, instead preferring native plants they are familiar with. Research by Warren II et al. (2025, p. 4) stated: "Our results demonstrate a synergistic negative interaction between overabundant deer and *R. cathartica* [common buckthorn] invasion, whereby the combined presence of both stressors amplified herbivory damage to native woody plants more than either factor alone." Increased deer herbivory caused by common buckthorn presence suppresses nearby native plants while the near complete lack of predation allows common buckthorn to grow uncontested. This competitive advantage allows it to quickly dominate areas with high deer populations where it becomes a dense thicket of pure buckthorn.

Common Buckthorn Management

It is easy enough to see that if common buckthorn is left unchecked it will drastically alter the native landscape and affect the integrity of natural ecosystem functions. Fortunately it is widely recognized that this issue needs a solution, so many researchers are working to develop effective management solutions. These strategies fall under four main categories: mechanical, chemical, biological, and burning.

Mechanical management involves physically removing or cutting common buckthorn. Unfortunately, it is often not that simple because common buckthorn is a vigorous stump sprouter; Once the main stem is cut it will send up more shoots from the remaining stump, becoming a dense bush. Simply cutting the trunk is not sufficient because it leaves the root systems intact, allowing the plant to resprout vigorously. In addition to that, if the buckthorn had been around for long enough to produce fruit there will be seeds banked in the soil, which will pop up to resume the dominance of their parent bush. Using this strategy on its own is possible, but highly impractical (Moriarty, 2005, p. 53).

Mechanical removal is often paired with herbicides for just that reason. Once the buckthorn is cut or girdled, the stump is sprayed with herbicide to fully kill the plant and prevent vegetative reproduction (Moriarty, 2005, p. 53). Herbicide is an effective way to deal with large amounts of buckthorn, but application of herbicides requires permitting and training because it can affect native plant regeneration if used improperly.

An alternative to chemical controls is the use of biological controls, such as fungi. The master's thesis of Michigan Tech student Lindsey Dolinski (2021, p. 19) discussed her findings in applying a fungal culture to common buckthorn stems after cutting, which was effective in colonizing the buckthorn and preventing regeneration. This fungus is native and has little chance of affecting nearby trees because it needs an open wound to infect its host. Using this fungus is also much safer than herbicides and has a lower ecological impact, so it is a promising alternative.

The other technique usable after mechanical removal is prescribed burning. Common buckthorn is not adapted to survive in areas disturbed by wildfire, so the reintroduction of fire to currently suppressed areas could help hinder buckthorn's ability to regenerate and dull its competitive edge. Fire becomes even more effective when there are fine fuels to help it spread. Research by Schuster et al. (2024) found that seeding in grasses after mechanical buckthorn removal is advantageous because it provides fuel in areas that otherwise would have been bare ground. Fire can then spread into areas previously dominated by buckthorn, which will suppress its regeneration and allow native fire adapted species to resume dominance.

Conclusion

Buckthorn is a problematic invasive present in much of North America, including the Upper Peninsula. Previous studies on common buckthorn have made it clear that the species causes a plethora of problems for native ecosystems through its allelopathic capability, influence on soil formation, and effects on native species. These problems result in changes to ecosystem functions. Ecosystems are delicate things that may take time to recover, but the situation is far from hopeless. Management practices are being developed to restore areas affected by this invasive back to their natural state. With more interest and funding, this invasive could certainly be eradicated, allowing affected areas to begin the restoration process.

References

Apfelbaum, S. L., & Haney, A. (1987). Management of degraded oak savanna remnants in the Upper Midwest: preliminary results from three years of study. In J. Ebinger (Ed.) Proceedings of the Oak Woods management workshop [workshop] Peoria, IL, United States.

Archibold, O. W., Brooks D., & Delanoy L. (1997). *An investigation of the invasive shrub European Buckthorn, Rhamnus cathartica L., near Saskatoon, Saskatchewan. Canadian Field–Naturalist, 111*(4), 617–621. https://doi.org/10.5962/p.358266

Barnes, B. V., & Wagner jr., W. H. (2004). *Michigan trees: A guide to the trees of the great lakes region* (9th ed.). University of Michigan Press.

Dolinski, L. F. (2021). *Assessing the Utility of a Native Wood–Decomposing Fungus as a Biocontrol Alternative to Herbicides on Invasive Buckthorns in Forests of the Keweenaw Peninsula of Michigan* (Publication No. 1328) [Master thesis, Michigan Technological University]. MTU Digital Commons.

Heneghan, L. (2003). *And when they got together… impacts of Eurasian earthworm and invasive shrubs on Chicago woodland ecosystems. Chicago Wilderness Journal*, 1(1), 27–31.

Heneghan, L. (2005, September). *Impact of Rhamnus cathartica (European Buckthorn) on Midwestern Woodland Ecosystems and the Implications for Restoration Management. In L. C. Skinner (chair),* Biological Control. *[Symposium]. Proceedings: Symposium on the Biology, Ecology, and Management of Garlic Mustard (Alliaria petiolata) and European Buckthorn (Rhamnus cathartica)*. St. Paul, Minnesota, USA.

Heneghan, L., Clay, C., & Brundage, C. (2002, June). Rapid Decomposition of Buckthorn Litter May Change Soil Nutrient Levels. *Ecological Restoration, 20*(2), 108–111.

Knight, K. S. (2005, September). Buckthorn Biology and Invasion History. In L. C. Skinner (chair), *Biological Control.* [Symposium]. Proceedings: Symposium on the Biology, Ecology, and Management of Garlic Mustard (*Alliaria petiolata*) and European Buckthorn (*Rhamnus cathartica*). St. Paul, Minnesota, USA.

Knight, K. S., et. al. (2007). *Ecology and ecosystem impacts of common buckthorn (Rhamnus cathartica): a review. Biological Invasions*, 9(8), 925–937. https://doi.org/10.1007/s10530-007-9091-3

Kurylo, J., & Endress, A. G. (2012) *Rhamnus cathartica*: Notes on its Early History in North America. *Northeastern Naturalist, 19*(4), 601–610. https://doi.org/10.1656/045.019.0405

Moriarty, J. (2005, September). Conventional Management of Buckthorn Species. In L. C. Skinner (chair), *Biological Control.* [Symposium]. Proceedings: Symposium on the Biology, Ecology, and Management of Garlic Mustard (*Alliaria petiolata*) and European Buckthorn (*Rhamnus cathartica*). St. Paul, Minnesota, USA.

Schmidt, K. A., & Whelan, C. J. (1999). Effects of Exotic *Lonicera* and *Rhamnus* on Songbird Nest Predation. *Conservation Biology, 13*(6), 1502–1506. https://doi.org/10.1046/j.1523-1739.1999.99050.x

Schuster, M. J., et. al. (2024). Understory Revegetation Enhances Efficacy of Prescribed Burning after Common Buckthorn (*Rhamnus cathartica*) Management. *Natural Areas Journal, 44*(4), 206–214. https://doi.org/10.3375/2162-4399-44.4.206

Seiler, J., Jensen, E., Niemiera A., & Peterson, J. (2025). *Common buckthorn.* Virginia Tech Dendrology. https://dendro.cnre.vt.edu/dendrology/syllabus/factsheet.cfm?ID=559

Warren II, R. J., et. al. (2017). Allelopathic invasive tree (*Rhamnus cathartica*) alters native plant communities. *Plant Ecology, 218*(10), 1233–1241. https://doi.org/10.1007/s11258-017-0766-2

Warren II, R. J., et. al. (2025). Common buckthorn (*Rhamnus cathartica*) invasion exacerbates white–tailed deer (Odocoileus virginianus) browsing on native woody plants. *Invasive Plant Sci. Manag, 18*(23): 1–6. https://doi.org/10.1017/inp.2025.10023

Cost of Capital Punishment: The Enormous Evidence Against the Death Penalty

Coral Weidenbach

Writer's Statement

While thousands of years old, execution is still a very relevant topic today. It is something that I have been passionate about for years. I first wrote about the issues surrounding the death penalty when I was in 8th grade and have continued researching it ever since. I believe it to be a glaring problem within our justice system that often gets very little attention. When I was told that our final project in UN1015 would be to write a journal article, I knew that this would be my topic immediately. There are many facets to the capital punishment debate, and I have focused on what I believe are the five more important issues. Those are prejudice, costs, deterrence, innocence, and closure.

Introduction

Few issues divide Americans more deeply than capital punishment. Supporters claim that the death penalty delivers justice and prevents future crimes, while critics argue that it is unfair, costly, and ineffective. Even people who once supported the practice have begun to question its purpose. Justice Harry Blackmun, after years on the U.S. Supreme Court, concluded that the death penalty experiment has failed. His words reflect the growing realization that the system does not always serve justice but instead exposes its deep flaws. "I yield to no one in the depth of my distaste, antipathy, and, indeed, abhorrence, for the death penalty… That distaste is buttressed by a belief that capital punishment serves no useful purpose that can be demonstrated." (Blackmun, 1972). This quote from Justice Blackmun shows that even those who once supported the death penalty realized its immorality.

Capital punishment has a long history in the United States. Since the 1970s, there have been 1,647 executions throughout 34 states. As of April 2025, there were 2,067 prisoners on death row and capital punishment was legal in 27 states (DPIC, 2025). A 2010 poll by Lake Research Partners showed that 61% of voters would choose a punishment other than the death sentence for murder (DPIC, 2016). Capital punishment, also known as "judicial homicide", has been on the decline for the past few decades (DPIC, 2025). But what has caused the shift in opinion on the death penalty? Numerous studies have been done throughout the past few decades about the influences the death penalty system has on society, ranging from discrimination within the justice system to the economic burden of capital punishment.

Despite how the death penalty has been framed as the ultimate justice, its harm far outweighs its good. Capital punishment should be abolished in the United States because it fails to deliver justice or deterrence, imposes irreparable harm through wrongful convictions, disproportionately targets marginalized groups, delays closure for the families of victims, and undermines the moral and financial integrity of the justice system. To understand why the death penalty persists despite evidence of its failures, the systems that sustain it must first be examined.

The Judicial System is Discriminatory

One of the biggest problems with the death penalty is how unevenly it is applied. There is a large amount of discrimination involved in judicial homicide, with the most significant disparity in the races of the victims. The Death Penalty Information Center (2016), a non-profit that aims to provide analysis on issues surrounding capital punishment, found that more than 75% of victims

in cases resulting in a death sentence were White, even though nationally only 50% of murder victims are White. This domination of one demographic, specifically White victims, clearly shows the targeted discrimination evident throughout the justice system, and the way some lives are valued over others.

Many more researchers have investigated the effects of discrimination on capital sentencing around the country. A study done in the state of Washington showed that juries were three times more likely to sentence a Black defendant to death compared to a White defendant in a similarly situated case (Beckett & Evans, 2014). The same study also found that even though prosecutors were less likely to be influenced by race compared to juries, they were almost three times more likely to seek execution in cases that received extensive publicity (Beckett & Evans, 2014). This is a blatant misuse of the justice system, using human life as a tool to gain public favor. Sadly, there are many examples of where race has played a major role in a capital sentencing trial.

One of the most notable examples is the Supreme Court Trial, Buck v. Davis, which was decided in 2017. Duane Buck had been convicted of capital murder in Texas in 1995 for double homicide, and sentenced to death (Arriaga, 2017). During his trial, Buck's attorney called a psychologist to write a report and testify on whether Buck was likely to commit acts of violence in the future. Although the psychologist concluded that Buck was unlikely to be a future danger, he testified that Buck was statistically more likely to act violently because he is Black, stating that race is a factor "known to predict future dangerousness" (U.S. Supreme Court, 2017). This is an incredibly harmful stereotype that has existed within and outside of the justice system since its creation.

Buck argued that his attorney's introduction of the report and witness violated his Sixth Amendment right to the effective assistance of counsel. The Supreme Court agreed, and Buck's sentence was reduced to life in prison (Arriaga, 2017). Unfortunately, this was not an isolated event. During Buck's appeals process, the Texas Attorney General identified five other similar cases in which the psychologist had testified on race's effect on dangerousness (U.S. Supreme Court, 2017). This is a very obvious example of how race and discrimination can affect the outcome of a capital trial. There are many more cases out there, most of which with prejudice that is much more subtle and difficult to prove.

There is more to discrimination than just race though. One of the most common forms of inequity within judicial homicide is in the gender of the defendant. It probably does not come as a surprise that people are squeamish about the idea of executing women; as one judge stated: "I don't think there's any rational or objective thought about it, but there's a feeling that incarceration for a woman is far more degrading than for a man" (Shapiro, 2000). As of 2014, women had only made up 2% of the death row population (DPIC, 2016) even though about 11.7% of known murders in 2014 in the U.S. were committed by women (FBI, 2014). Even when women are sentenced to death, their sentences are often changed to life imprisonment. There is no way to get around this substantial disparity; people view women differently from men and that is unlikely to ever change.

It is no secret that the justice system is also financially discriminatory, particularly within capital cases. While it is law that defendants are entitled to an attorney, there is a big difference between the poorly paid court-appointed lawyer and the skilled prosecutors who receive the help of the police. Unsurprisingly, defendants represented by court-appointed attorneys are over twice as likely to receive a capital sentence compared to those represented by private attorneys or public defenders (Costanzo, 2002). The idea that the system that decides who lives and who dies is associated with monetary status for proper representation is abhorrent. As Shapiro (2000) says, "The people of the United States are unable to apply the death penalty

fairly. This is not a failing of the people, but rather of the process." If the law cannot be applied impartially, then surely its supposed purpose of deterrence holds true.

Capital Punishment Does Not Deter Murder

Another major factor when considering the death penalty is its deterrent effect on murder. Many of the people who favor the use of capital punishment over life imprisonment argue that executions can prevent future murders. Numerous studies have been conducted in an attempt to prove that the idea of a death penalty deters murder from happening, but it is virtually impossible to completely isolate the effects of capital punishment on criminals' mindset, and there are countless other variables that need to be considered. These variables can include the population, time period, per capita income, and unemployment rates, to name a few (Ehrlich, 1973). Dr. Lamperti (2010) writes "if there were a substantial net deterrent effect from capital punishment under modern U.S. conditions, the studies we have surveyed should clearly reveal it. They do not." Without proof, one cannot assume the effect that something has on society; the same way that people cannot claim that a new drug prevents a disease without rigorous testing. Experts have been studying the death penalty for decades, and no one can definitively say that executions prevent murders. All the while, continuing to assume so will only cause further harm.

Overall, a survey of experts from the country's top academic criminological societies showed that 88% reject the idea of capital punishment as a deterrent to murder (DPIC, 2016) and a 2009 poll of police chiefs ranked the death penalty last among ways to reduce violent crime (DPIC, 2025). The idea that executing people averts murder is misguided and outdated. If the death penalty cannot prevent crime, then what justification remains for its immense financial costs?

The Death Penalty is Too Expensive to Justify

An unexpected factor in the argument to abolish the death penalty is the high costs. Many people believe that a death sentence would be cheaper compared to life imprisonment, considering the state would no longer have to care for the prisoners. This might be true if the costs were measured at the time of execution, but the actual price of a death penalty case begins long before that.

The Supreme Court has consistently upheld the idea that death is different, meaning that every aspect of a capital trial is longer and more thorough compared to a non-capital trial. As a result, capital trials require more time for the defense and prosecution to gather evidence, more complex pretrial motions, and a separate sentencing phase. Also, with so much at stake, more retrials and appeals will likely occur after sentencing (Tabak & Lane, 1990). For example, "the death penalty cost California $90 million annually beyond ordinary expenses of the justice system, of which $78 million was incurred at the trial level" (Dieter, 2015). In New Jersey, the high costs were one component of the state's decision to abolish capital punishment. Over a 25-year period, the state spent $235 million despite not having any executions (Dieter, 2015). On average, a single death penalty inmate costs approximately $1.12 million more than a general population inmate (McFarland, 2016). Despite the high toll continually paid, the reality is that most capital cases do not result in a death sentence and that most death sentences do not result in an execution. The costliness of the death penalty might be defensible if it guaranteed accurate convictions, but there are cases that show otherwise.

The Risk of Wrongful Executions

Although it is uncommon, there have been occurrences when defendants have been found innocent after they have been sentenced to death or even executed. People can argue all day on whether murderers deserve to be executed, but there is no rectifying these mistakes which

cost innocent people their lives. It only further proves that capital punishment is unsuited to the modern judicial system.

One such case is of a man named Jimmy Dennis. In 1992, Dennis was found guilty of the murder of 17-year-old Chedell Williams and was given the death penalty. His sentence was overturned in 2017 after 25 years on death row due to three Brady violations, which is when the prosecution withholds evidence that benefits the defense. The first was that Chedell's friend, who was with her at the time, told the police that she recognized two of her classmates in the murder, but the prosecution never investigated this. The second was that a resident of the county correction facility reached out to the police after one of the offenders called to brag about committing the murder. Lastly, the state had a receipt that established Dennis's alibi. These were all purposely kept from the defense (Muse, 2021). Dennis had two little girls at home. He missed out on 25 years of their life.

Sometimes the evidence is revealed too late, such as in the case of Carlos DeLuna. DeLuna was 20 when he was arrested for the murder of Wanda Lopez. Eyewitnesses in the gas station had described "a Hispanic male wearing a gray sweatshirt." When DeLuna was brought in, he told the police that the perpetrator was Carlos Hernandez, a friend of his who looked so similar they were often mistaken as twins. They had been together earlier in the night, before Hernandez split off to go to The Shamrock, where Lopez had been working. During DeLuna's trial, the police denied Hernandez's existence, claiming he was "a figment of DeLuna's imagination." DeLuna was executed on December 7, 1989.

Six years after the execution, Professor Leibman of Columbia University began one of the most in-depth reviews ever performed of a death penalty case. Within a day he found Carlos Hernandez, who had been arrested over 35 times. Leibman also found crime scene photos that had not been revealed to the jury. They showed the scene covered in blood, including a bloody footprint belonging to the killer. Not a single speck of blood was found on DeLuna's clothes (Liebman et al., 2014).

Liebman then tracked down the eyewitness who saw the perpetrator leaving the store and asked how certain he was in his identification. "He said about 70 percent but then added that had the police not told him that they found DeLuna hiding under a truck two blocks away that he would have been only 50 percent certain" (MTIP, 2021). Edwin Grimsley (2012), a case analyst for the Innocence Project, writes, "In total, nearly 75% of the DNA exoneration cases involve an eyewitness misidentification – approximately 42% of which are cross-racial misidentifications." There is no shortage of careless mistakes that have cost people their lives. Since 1973, there have been 202 cases in the U.S. where individuals convicted and sentenced to death have been exonerated (DPIC, 2025). And even when the right person is convicted, the death penalty still fails to deliver closure or healing.

The Myth of Closure for Victims' Families

One of the main arguments in support of the death penalty is the closure it provides to families of the victims. While every case is different, there are many instances where an execution is more emotionally taxing than a sentence of life imprisonment without the possibility of parole. One reason is the long appeals process that usually takes place after a conviction. Appeals are formal requests to a higher court to change a lower court's decision. They generally focus on legal errors, not the facts of a case.

A paper published in the Marquette Law Review studied survivors' experiences in Texas, a death penalty state, and Minnesota, a life without the possibility of parole state. In the study, families were interviewed throughout the appeals process. One mother in Texas described her frustration with the system: "We haven't had a sense of justice. I feel like my life is on hold

because it just hasn't been carried out… When is it gonna be over?" (Armour & Umbriet, 2012). Another made comments about not knowing who to believe throughout the process. "Now it's just waiting. I get frustrated at that. In my mind there's a possibility he might be set free if they've lost the evidence. [Prosecutor] Joe Michales says, 'Oh no, they won't do the whole trial. They do pieces.' I don't trust him because they haven't told me the same story as the D.A.'s office" (Armour & Umbriet, 2012).

In the end, Armour and Umbriet (2012) repeatedly found that a sense of control throughout the appeals process was the best association to survivor well-being instead of some unrealistic ideal of closure. Control, which is oftentimes found times lacking in death penalty cases. In Minnesota, where life imprisonment is used, survivors had greater control. This was likely because the appeals process was predictable and completed within two years. In Texas, however, the process was drawn out, elusive, and unpredictable. It generated feelings of injustice, powerlessness, and in some instances, fear. Although the grief remained high for Minnesotans, no longer having to deal with the murderer, or the criminal justice system, allowed the survivors' control and energy to be put into the present for healing.

Conclusion

What can be done about crimes that have shattered one's view of the world? Revenge is no real help, but what sort of action is? None that is directed toward undoing the past; the death penalty cannot undo what has been done. Only purposeful action directed toward the future can ever help. If the death penalty offers neither fairness, deterrence, nor closure, its moral foundation collapses.

In the United States, the justice system is built on the essential idea of reformation and rehabilitation. The idea that people can grow from their mistakes and feel remorse for what they have done. Armour and Umbriet (2012) found that some participants thought they might feel differently about the murderer if they expressed remorse, or that said remorse might even aid in the participant's own healing. That option is eliminated when the death penalty is involved. A justice system that values life and fairness must find its strength not in execution but in empathy and reform.

Therefore, the most sensible decision is to abolish the death penalty and replace it with life imprisonment with or without the possibility for parole. It is already common for death penalty states to require that anyone not sentenced to death for first-degree murder must serve a sentence of life imprisonment. Several states have completely abolished capital punishment and replaced it with a life sentence in cases of first-degree murder (Appleton & Grover, 2007). It is the logical conclusion to encourage the rest of the country to transition to life imprisonment. This would enable a reduced financial burden, eliminate the risk of wrongfully executing defendants, executing defendants based on prejudice, and potentially provide a better chance of closure for victims.

References

Armour, M.P. & Umbreit, M.S. (2012). *Assessing the Impact of the Ultimate Penal Sanction on Homicide Survivors: A Two State Comparison.* Marquette Law Review. 96(1). https://scholarship.law.marquette.edu/cgi/viewcontent.cgi?article=5144&context=mulr

Arriaga, A. (October, 2017). *Texas death row inmate Duane Buck has sentence reduced to life after Supreme Court Orders retrial.* The Texas Tribune. https://www.texastribune.org/2017/10/03/high-profile-death-row-case-comes-end-guilty-plea/

Appleton, C. & Grover, B. (2007). The Pros and Cons of Life without Parole. *British Journal of Criminology*, 47(4), 597-615 https://heinonline.org/HOL/Page?handle=hein.journals/bjcrim47&id=605&collection=journals&index=

Beckett, K. & Evans, H. (2014, January). *The Role of Race in Washington State Capital Sentencing, 1981-2012*. https://dpic-cdn.org/production/legacy/WashRaceStudy2014OldVersion.pdf

Blackmun, H. (1972). Furman v. Georgia: Dissent Blackmun. *Wikisource*. https://en.wikisource.org/wiki/Furman_v._Georgia/Dissent_Blackmun

Costanzo, M. & Friends Committee on National Legislation (2002) The Death Penalty Is Discriminatory. In M. E. Williams (Ed.), *Opposing Viewpoints. The Death Penalty*. Greenhaven Press. https://link.gale.com/apps/doc/EJ3010124265/OVIC?u=lom_accessmich&sid=bookmark-OVIC&xid=821d6eeb

Death Penalty Information Center. (2016). Facts about the Death Penalty. https://www.supremecourt.gov/opinions/URLs_Cited/OT2016/16-5247/16-5247-2.pdf

Death Penalty Information Center. (2025). Facts about the Death Penalty. https://files.deathpenaltyinfo.org/documents/pdf/FactSheet.pdf

Dieter R. C. (2015). The Death Penalty Is Too Costly for Society. In N. Merino (Ed.), *Current Controversies. Death Penalty*. Greenhaven Press. (Reprinted from Testimony of Richard C. Dieter, Executive Director, Death Penalty Information Center, 2013) https://link.gale.com/apps/doc/EJ3010955216/OVIC?u=lom_accessmich&sid=bookmark-OVIC&xid=68596d92

Ehrlich, E. (November, 1973). The Deterrent Effect of Capital Punishment: A Question of Life and Death. *The American Economic Review*. 65(3). 397-417 https://www.jstor.org/stable/1804842?seq=6

Federal Bureau of Investigation. (2014). Expanded Homicide Data Table 3. FBI. https://ucr.fbi.gov/crime-in-the-u.s/2014/crime-in-the-u.s.-2014/tables/expanded-homicide-data/expanded_homicide_data_table_3_murder_offenders_by_age_sex_and_race_2014.xls

Grimsley, E. (September, 2012). What Wrongful Convictions Teach Us About Racial Inequality. *Innocence Project*. https://innocenceproject.org/news/what-wrongful-convictions-teach-us-about-racial-inequality/#:~:text=In%20total%2C%20nearly%2075%25%20of,characteristics%20of%20a%20dissimilar%20race.

Lamperti, J. (2010, March). Does Capital Punishment Deter Murder? A brief look at the evidence. Dartmouth College https://math.dartmouth.edu/~lamperti/my%20DP%20paper,%20current%20edit.htm

Liebman, J., Crowley, S., Markquart, A., Rosenberg, L., White, L.G., & Zharkovsky, D. (2014) *The Wrong Carlos: Anatomy of a Wrongful Execution*. Columbia University Press.

McFarland, T. (2016). The Death Penalty vs. Life Incarceration: A Financial Analysis. *Susquehanna University Political Review*, 7(4) https://www.researchgate.net/profile/Torin-Mcfarland/publication/324804378_The_Death_Penalty_vs_Life_Incarceration_A_Financial_Analysis/links/5ae34579458515c60f68b6ad/The-Death-Penalty-vs-Life-Incarceration-A-Financial-Analysis.pdf

Montana Innocence Project. (February, 2021). 5 Innocent People Who Executed or Exonerated on Death Row. *Montana Innocence Project*. https://mtinnocenceproject.org/5-innocent-people-who-were-executed-or-exonerated-on-death-row/

Muse, Q. (February, 2021). For 25 Years, Jimmy Dennis Was a Death-Row Convict. Then One Day He Wasn't. *Philadelphia Magazine*. https://www.phillymag.com/news/2021/02/06/jimmy-dennis-musician-death-row/

Shapiro, A. (2000). Unequal Before the Law: Men, Women, and the Death Penalty. *American University Journal of Gender, Social Policy, & the Law*, 8(2), 427-470 https://heinonline.org/HOL/Page?handle=hein.journals/ajgsp8&id=435&collection=journals&index=

Supreme Court of the United States. (February, 2017). Buck v. Davis, Director, Texas Department of Criminal Justice, Correctional Institutions Division. https://www.supremecourt.gov/opinions/16pdf/15-8049_f2ah.pdf

Tabak, R.J. & Lane, J.M. (1990). The Execution of Injustice: A Cost and Lack-of-Benefit Analysis of the Death Penalty. *Loyola of Los Angeles Law Review*, 23(1), 59-146 https://heinonline.org/HOL/Page?handle=hein.journals/lla23&id=79&collection=journals&index=

Diving Deeper into the Ethics of the Containment of Orcas for Entertainment Purposes

Justin Lask

Writer's Statement

My goal for this article is to bring to light the intelligence of orcas. I wanted to focus on the physical attributes of orcas, as well as highlight the effects that captivity has on orcas, to advocate for their freedom. My passion for orca freedom was sparked by the movie *Free Willy*, which I watched as a kid, and I wrote this article in hopes of raising awareness about orca containment.

Introduction

Did you know that there have been no documented cases of wild orcas killing humans, but there have been four cases of captive orcas killing humans? Orcas, or killer whales, are toothed whales that are part of the oceanic dolphin or *Delphinidae* family. Their unique color scheme, large size, and creative intelligence have made orcas popular attractions in aquariums. Debates on whether the confinement of orcas is ethical began when orcas started being captured and put on display in the 1960s. While California passed the California Orca Protection Act in 2016 to prohibit the captivity of orcas for purposes such as entertainment, there are no federal laws in America that prohibit the confinement of orcas (Seaside, 2023). Although there was a bill introduced in Congress in 2017 that prohibited the capturing and breeding of orcas for the purpose of entertainment, it was never passed (H.R., 2018). Orcas should not be kept in enclosures for entertainment purposes because they have highly developed cognitive abilities and are capable of complex emotional interactions.

Neuroanatomy

The social complexity of orcas can be attributed to their impressive brain structure. Lori Marino, author of "Cetaceans Have Complex Brains for Complex Cognition," noted that cetaceans have large insular and cingulate cortices, which are consistent with high-level cognitive functions such as attention, judgment, intuition, and social awareness in primates (2007). Orcas have a brain composition that contains structures that are similar to primate brains. This suggests that orcas have similar cognitive abilities to humans in areas such as attention, judgment, intuition, and social awareness.

The ratio of brain-to-body size of animals is recorded in the form of the encephalization quotient (EQ), which is used to compare the cognitive function of different species. "The EQ for orcas is 2.57, which means that even when their large body size is taken into account, their brains are still two and a half times larger than expected. Orcas, therefore, have more brain tissue available to serve complex cognitive functions, such as self-awareness (a sense of personal identity), social cognition, culture, and language" ("A Summary,"" n.d.). Humans have an EQ of 7.4 and bottlenose dolphins have an EQ of 5.3; this puts orcas in third place in terms of EQ (Anderson, 2016). While EQ isn't a direct measurement of emotional intelligence, it strongly suggests that orcas are capable of higher-order thinking, as well as emotional intelligence.

Along with having a high EQ, orcas have large parts of the brain that correlate with communication. MRI scans analyzed in the article "Neuroanatomy of the Killer Whale (*Orcinus Orca*) From Magnetic Resonance Images" revealed that orcas have a very large and developed insular cortex and temporal operculum (Marino, 2004). In humans, the operculum is associated

with speech, so it is not a stretch to suggest that the same area in orcas is associated with communication (Marino, 2004). If that is the case, orcas would have a highly complex form of communication. Orcas produce a wide range of clicks and whistles for communication and echolocation, which supports the idea that orcas can have complex relationships with one another.

Along with an impressively large brain, orcas also have a high level of gyrification, which is how wrinkly the brain is. According to Michelle Bender, who serves on the Advisory Board for the Global Alliance for the Rights of Nature and is a member of the IUCN's World Commission on Environmental Law, the gyrencephalic index of orcas is 5.7 compared to human beings' 2.2 (2024). The gyrification of the brain relates to the processing speed and capacity of the brain. Because orcas exhibit a higher level of gyrification than humans, it is reasonable to infer that they can process information more rapidly. The impressive makeup of an orca's brain gives it the ability to process information and feel complex emotions.

The brains of orcas are indeed complex. Their brains are built to succeed in an aquatic environment and within an expansive social network. The authors of "The harmful effects of captivity and chronic stress on the well-being of orcas (*Orcinus Orca*)" wrote that, "As a group, modern cetaceans, and therefore orcas, possess the neurobiological foundations of complex psychology, emotion, and behavior: 1) large relative brain size, 2) an expanded neocortex, 3) well-differentiated cortical cytoarchitecture, and 4) an elaborated limbic system" (Marino, 2020). These characteristics not only support intelligence and emotions but also suggest that orcas are conscious of their existence on this planet.

Other areas of the brain also contribute to the social complexity of orcas: "The anterior cingulate and insular cortices, the temporal operculum, and paralimbic regions (all situated deep within the forebrain) are well developed in orcas and other cetaceans" (Marino, 2020). These areas of the brain are associated with "…social functions such as attention, prediction, social awareness, and empathy" (Marino, 2020). These functions allow for the formation of complex social connections within a pod, which orcas in captivity don't have access to.

Demonstrate Theory of Mind

Orcas' ability to demonstrate Theory of Mind (ToM) shows that the confinement of orcas is unethical. Theory of Mind is the ability to understand what others are feeling, and it is the ability to predict the behaviors of others in response to certain stimuli. In the study, "Orca Behavior and Subsequent Aggression Associated with Oceanarium Confinement," the behaviors of orcas Canuck, Katina, Kasatka, and Kotar were observed. These orcas were all caught from Icelandic waters, so they were all part of a wild pod for at least a year.

The orcas in this study demonstrated ToM on multiple occasions. "Hockins describes an incident in which Kotar seemed to perform a test of human frailty on him. At first, Kotar bit down hard enough on Hockins to induce pain, and Hockins signaled Kotar to stop. Kotar eased the bite pressure but did not release Hockins. Then Kotar slowly reapplied the bite pressure. When it reached the limit of comfort, Hockins repeated the stop signal. Kotar let Hockins go, but (as interpreted by Hockins) registered surprise at the difference between the two bite pressures… Hockins notes that thereafter, none of the other orcas in the pool ever bit down harder than this level that Kotar established, although none of the other orcas performed this sort of test on Hockins" (Anderson, 2016). Cognitive empathy was shown in this test because the orcas recognized Hockins's pain/comfort tolerance and didn't surpass that level again.

The authors also found that the orcas went out of their way to form connections with certain humans. "Typically, the orcas would stay with most visitors just long enough to accept fish, and then move along to the next visitor. However, the orcas seemed to spend longer periods of time

interacting with people who did not feed them. The authors interpret this as an effort on the orcas' behalf to interact with certain humans at a level of friendship… This could be a reflection of affective ToM (comprehending feelings in another—in this case feelings of affection directed at the orcas by humans)" (Anderson, 2016). Although many animals maintain strong bonds with humans, the orcas in this study went out of their way to build and maintain relationships with certain humans, not just the ones that feed them. This shows that orcas depend heavily on social bonds, and confining them to an aquarium prevents them from forming the extensive social network that orcas have in the wild.

John Hargrove, a former orca trainer, describes a time when Takara, an orca, demonstrated empathetic behavior. "Immediately after the accident, Takara proceeded to use echolocation throughout his body in a way he had not experienced before. Then, Takara very gently pushed him to the edge of the pool in a way she had never been trained to do. Hargrove was later discovered to have broken ribs and soft tissue damage. This could be interpreted as reflecting cognitive ToM, affective ToM, and possibly affective empathy" (Anderson, 2016). This is yet another situation where a captive orca has demonstrated its ability to understand the feelings of humans.

Reconciliation as Proof of Higher Thinking

The capability of orcas to reconcile after agonistic behaviors demonstrates their complex social relationships. The authors of the research article, "Social interaction analysis in captive orcas (*Orcinus orca*)," found that "first-affiliative behaviors occurred earlier after aggressions (on average within the first 3 min) than in control periods" (Sánchez–Hernández, 2019). This means that orcas demonstrated friendly behavior just three minutes after conflicts. The author also noted that reconciliation in primates is thought to be linked to cognitive abilities like memory and individual recognition (Sánchez–Hernández, 2019). This shows that orcas demonstrate cognitive abilities similar to primates. The ability of orcas to reconcile after fighting shows that they understand empathy and have the capacity to reflect upon their actions.

Ability of Orcas to Mourn

The ability of orcas to mourn demonstrates their empathic ability and processing of emotions. Observations of orcas in the wild have shown the ability of orcas to feel deep emotions and form strong social bonds. "These observations include reports of long-range contact calling when separated from others, grieving behaviors, and helping (epimeletic) behaviors.

In addition to assisting individuals in distress, "epimeletic behavior often involves adult individuals attending to a dead individual by keeping them afloat, lifting or pushing the individual, performing attempts that look like 'resuscitation,' and carrying them around by the mouth or on the body" (Marino, 2020). Observation of orcas mourning in the wild proves the ability of orcas to form complex social relationships that go beyond survival. The most serious account of this was observed in 2018 when "A 20-year-old orca known as J35 or Tahlequah gave birth to a female calf who died within 30 minutes. The calf was carried on J35′s back, rostrum, and in her mouth for 17 days. When the body slipped off, she retrieved it" (Marino, 2020). Although not beneficial for the survival of the pod, the mother orca carried around her dead calf for an extended period of time, showing that orcas are able to feel deep emotions.

Effects of Captivity on Orcas

The captivity of orcas has drastic effects on their physical and mental health. Orcas in captivity can become victims of malnutrition, poor oral health, and the signature collapsed dorsal fin. As with the case of many captive animals, "There have been numerous reports of

oral stereotypies in captive orcas, including biting and chewing on hard tank surfaces, hard toys, and the steel gates used to separate the whales. These behaviors lead to extensive and chronic dental pathologies" (Marino, 2020). These behaviors are caused by the stresses that are brought about by confinement. Also, due to the nature of the tanks and the role of the orcas in entertainment, "100% of captive adult male orcas have collapsed dorsal fins" (End Captivity, n.d.). Under the water, the dorsal fin is supported by the surrounding water pressure, but in captivity, orcas spend a lot of time at the surface, which causes their dorsal fin to collapse to the side. Although the collapsed dorsal fin doesn't seem to cause pain, it is a sad characteristic of captive orcas.

Orcas in captivity are more prone to diseases. "Between 1971 and 2017, there have been 35 documented orca deaths at SeaWorld facilities alone. When causes of death were available, the most commonly implicated conditions were viral, bacterial and fungal infections, gastrointestinal disease, and trauma" (Marino, 2020). The reason why captive orcas are so prone to diseases isn't clear, but it could be due to having a weakened immune system, exposure to harsh chemicals in the pools, trauma, improper use of antimicrobials, or an imbalance of microbiota in the tank environment (Marino, 2020). Regardless, orcas in captivity seem more prone to suffering from lethal diseases.

Captivity also invokes aggressive tendencies in orcas. Though orca-to-orca aggression has been observed in the wild, the occurrence of orca-to-orca aggression is higher amongst captive orcas (Marino, 2020). This could be due to the tight confinement of the tank in which orcas are kept. In the wild, orcas are able to distance themselves from one another to de-escalate a situation, whereas captive orcas do not have any way to separate themselves from one another. Along with orca-to-orca aggression, orca-to-human aggression is higher in captive orcas. There are no accounts of a wild orca killing a human, but there are four accounts of captive orcas killing humans, and there are many other instances of injuries (Marino, 2020). Perhaps the most famous of these accounts is the death of Dawn Brancheau by the orca, Tilikum. Tilikum had taken three lives during his time in captivity. Though the reasons for his aggressive behavior are unknown, they could've been due to abusive treatment, frustration, or a decline in mental health. Along with aggressive behavior directed at others, captive orcas have also been observed to harm themselves. Captive orcas have been observed to bang their heads against the walls and gates of their tanks, breach themselves on the edges of the pool, and refuse to eat (Marino, 2020).

The captivity of orcas deprives them of an extensive social network, which decreases the survival rate of captive-born calves. Female orcas depend upon the support of their pod to raise a calf. In captivity, female orcas have been observed to neglect their young after birth, causing a high infant mortality rate (Marino, 2020). This leads to human intervention being required to raise a calf, which involves separating the mother from her calf. Not only does this prevent the mother from teaching her calf, but it also implants a strong human-orca bond on the calf, making the chances of a successful release into the wild slim if it were to happen.

The tanks that orcas are kept in deprive them of certain sensory inputs. An important sense of orcas is their auditory sense. Orcas are capable of interpreting a large variety of natural sounds and using echolocation, something that a concrete tank deprives them of. It was found that "…exposure to excessive or unnatural levels or types of acoustic input can cause a number of impacts to cetaceans, including but not limited to decline in reproductive success (due to physiological and behavioral changes), accelerated aging, suppression of the immune response, as well as premature hearing loss" (Marino, 2020). The amount of noise from crowds of people, water pumps, construction, and other miscellaneous sources can overstimulate orcas, leading to developmental stress.

The tanks also lead to boredom in orcas. Wild orcas are used to being able to move around and travel, viewing a variety of scenery and interacting with different things in the environment. Being in a tank confines an orca to an unchanging, boring environment. This promotes a "logging" behavior, which is when the cetacean just floats on the surface of the water, interacting with no one and nothing (Marino, 2020). Although there are attempts at enrichment to stimulate orcas, they do not compare to the stimulation that freedom provides.

Potential for Orca Rehabilitation and Release

There have been 15 successful orca releases from sea pens, which are netted enclosures that are submerged in ocean water to simulate a semi-natural environment. One of the most famous orcas that has been released from captivity is Keiko, who played the role of Willy in *Free Willy*. Though the success of Keiko's release is up for debate, it is indisputable that Keiko was able to survive in the open ocean after being in captivity. The main issue with the release of Keiko was that he was in captivity for so long that he sought out human connection more than connections with other orcas. Though attempts were made, Keiko was never successfully integrated into a wild orca pod.

This introduces a problem with releasing orcas that have been in captivity for long periods of time or that were bred in captivity. Orcas have strong social bonds and culture within their pod. "Pods typically consist of a few to 20 or more animals, and larger groups sometimes form for temporary social interactions, mating, or seasonal concentrations of prey" (Killer Whale, 2025). These pods are led by a matriarch. "Within each pod, there are several family units that each descend from a single female ancestor. These units, called matrilines, are typically composed of an adult female, the 'matriarch', and her female and male offspring" (Southern Resident, 2025). The integration of captive orcas, especially those bred in captivity, into wild pods is difficult because a wild orca pod consists of a family. This means that the integration of a captive orca into a pod would likely only be the consequence of breeding, and there is insufficient research on the breeding success of released captive orcas with wild orcas. There is one orca, Springer, that has successfully given birth to a calf since her release, though she was only in captivity for 31 days (Orca in Seapens, n.d.).

Another reason why the integration of captive orcas into wild pods may be difficult is that each pod of orcas has a unique set of calls that they use to communicate with each other. Orcas use calls to find food, coordinate hunts, and socialize. Among the complexity of the calls themselves, there are a large number of pod-specific calls that an orca must learn in order to communicate effectively within the pod. These calls are important for the formation and maintenance of relationships within a pod. "Although many discrete calls may have little context-specific meaning, the call repertoire as a whole may be important in determining and maintaining the social organization of the pod and its community" (Ford, 1989). For a wild-born orca, learning a pod's language is relatively simple, but for a captive orca, it would be more difficult. It would likely be similar to the difficulty of a human trying to learn a second language.

So, should captive orcas be released? It really depends on the view of the public. While it is possible to capture and release orcas back into the wild, long-term captivity creates a reliance of orcas on humans, as shown in the case of Keiko. Keiko was able to be free, but was unable to integrate into any pod. This could be because of the cultural differences and language barrier between Keiko and the wild orcas, or it could be because Keiko simply preferred human companionship over orca companionship after being in captivity for so long. Orca releases also take a lot of time and money. In the case of captive-born orcas, they would have to be slowly integrated into the ocean environment and taught how to hunt and survive. There would also be backlash from aquatic animal entertainment businesses like SeaWorld that generate a large income from orca attractions.

On the bright side, these businesses have started to phase out the use of orcas for entertainment, with SeaWorld ending its orca breeding program in 2016 due to public backlash, especially after the release of the movie *Blackfish*, a documentary released in 2013 that highlighted the dark side of orca captivity following the death of orca trainer Dawn Brancheau during a routine with the orca Tilikum at SeaWorld. While the release of orcas from captivity is unlikely, the ending of orca breeding programs is attainable, and with the right publicity, the captivity of orcas could be completely ended in the near future.

Conclusion

Orcas are remarkable creatures that demonstrate complex social and emotional needs that captivity does not provide. Captivity has a large range of physical and psychological effects on orcas that decrease their lifespan and have led to serious cases of aggression, some resulting in death. Overall, the intelligence and social complexity of orcas give them the right to be treated with respect and appreciated in their natural environment, as should be the case with all intelligent animals.

References

A Summary of the Effects of Captivity on Orcas. PETA. (n.d.). https://www.peta.org/wp-content/uploads/2021/06/SeaWorldCruelty.pdf

Anderson, R., Waayers, R., & Knight, A. (2016). *Orca Behavior and Subsequent Aggression* Associated with Oceanarium Confinement. Animals (Basel), 6(8), 49-. https://doi.org/10.3390/ani6080049

Bender, M., & Lee, D. (2024, August 27). *Rights for the Southern Resident Killer Whales. Earth Law Center*. https://www.earthlawcenter.org/blog-entries/2018/8/rights-for-the-southern-resident-orca#_edn5

End Captivity. Whale Dolphin Conservation USA. (n.d.). https://us.whales.org/our-goals/end-captivity/#:~:text=Dorsal%20fin%20collapse%20%E2%80%93%20orcas%20kept,orcas%20have%20collapsed%20dorsal%20fins.

Ford, J. K. B. (1989). *Acoustic behaviour of resident killer whales (*Orcinus orca*) off Vancouver* Island, British Columbia. Canadian Journal of Zoology, 67(3), 727–745. https://doi.org/10.1139/z89-105

H.R.1584 - 115th Congress (2017-2018): *Orca Responsibility and Care Advancement Act of 2017* | congress.gov | Library of Congress. Congress.gov. (n.d.). https://www.congress.gov/bill/115th-congress/house-bill/1584

Killer Whale. NOAA. (2025, January 14). https://www.fisheries.noaa.gov/species/killer-whale#:~:text=Pods%20typically%20consist%20of%20a,feed%2C%20communicate%2C%20and%20navigate.

Marino, L., Connor, R. C., Fordyce, R. E., Herman, L. M., Hof, P. R., Lefebvre, L., Lusseau, D., McCowan, B., Nimchinsky, E. A., Pack, A. A., Rendell, L., Reidenberg, J. S., Reiss, D., Uhen, M. D., Van der Gucht, E., & Whitehead, H. (2007). *Cetaceans have complex brains for complex cognition. PLoS Biology*, 5(5). https://doi.org/10.1371/journal.pbio.0050139

Marino, L., Rose, N. A., Visser, I. N., Rally, H., Ferdowsian, H., & Slootsky, V. (2020). *The harmful effects of captivity and chronic stress on the well-being of orcas (Orcinus orca). Journal of Veterinary Behavior*, 35, 69–82. https://doi.org/10.1016/j.jveb.2019.05.005

Marino, L., Sherwood, C. C., Delman, B. N., Tang, C. Y., Naidich, T. P., & Hof, P. R. (2004). *Neuroanatomy of the Killer Whale (Orcinus orca) from Magnetic Resonance Images. The Anatomical Record Part A: Discoveries in Molecular, Cellular, and Evolutionary Biology*, 281A(2), 1256–1263. https://doi.org/10.1002/ar.a.20075

Orca in Seapens. Free Morgan Foundation. (n.d.). https://www.freemorgan.org/orca-in-seapens/

Sánchez–Hernández, P., Krasheninnikova, A., Almunia, J., & Molina–Borja, M. (2019). *Social interaction analysis in captive orcas (Orcinus orca). Zoo Biology*, 38(4), 323–333. https://doi.org/10.1002/zoo.21502

Seaside. (2023, March 21). *Freeing Killer Whales Through Legislation.* Seaside. https://www.seasidesustainability.org/post/freeing-killer-whales-through-legislation#:~:text=The%20U.S.%20currently%20does%20not,facilities%20should%20house%20killer%20whales.

Southern Resident Killer Whale. Marine Mammal Commission. (2025, January 15). https://www.mmc.gov/priority-topics/species-of-concern/southern-resident-killer-whale/#:~:text=Within%20each%20pod%2C%20there%20are,family%20unit%20has%20remained%20together.

Curious Obsession: An Inquiry of *Magic: The Gathering* and Its Cultural Relevancy

Daniel Staats

Writer's Statement

Magic: The Gathering is a game that sits very dear to my heart and has been for a very long time. I started playing with my older brothers when I was around 7 years old, and, ever since then, *Magic: The Gathering* has been a way for me to bond with my family, make friends, and to spend time with the people I love. As I've grown older, I've come to understand more and more about the game, and how it has changed and aged with me. *Magic: The Gathering* is deep, varied, and complex due to its nature and age, which has captivated me to no end throughout my time playing the game and especially through my research. Moreover, *Magic: The Gathering* has meant so much to me over such a long time. This article is a conduit through which I can express my appreciation for the game and those with whom I play it; I hope my readers will share this appreciation.

Fresh Start: Introduction

Magic: The Gathering (MTG) is a trading card game first published by Wizards of the Coast (WOTC) in 1993. First envisioned by Richard Garfield, *Magic: The Gathering* brought forth a completely unique style of card game: one where collecting the game pieces and building your deck was just as, or even more important, than the gameplay itself. Since MTG first hit the market, it has developed a devoted fanbase, enchanting players with stories of far-off worlds, powerful magic, adventure, and heroism. This paper seeks to prove that, over its lifetime, the innovations that MTG brought to gaming solidified it as an intergenerational cultural phenomenon through creative storytelling and dynamic gameplay.

Ideas Unbound: Inception of MTG

Ever since its inception, *Magic* was intended to be a highly social game. Richard Garfield (2013) explores this in one of his design blogs while discussing the transition between the first and second versions of the game:

> Moving from Alpha to the Beta version was like releasing a wild animal. The enjoyable game that was Alpha now burst the confines of the duel to invade the lives of the participants. Players were free to trade cards between games and hunt down weaker players to challenge them to duels, while gamely facing or cravenly avoiding those who were more powerful. Reputations were forged—reputations built on anything from consistently strong play to a few lucky wins to good bluffing.

Magic: The Gathering was always intended to be played amongst a group of people, social dynamics and all. Trading, selling, buying, and winning cards were all intended mechanics, as well as all of the interactions players would have and the reputations they would build. This social and highly personal nature defines the game, how players interact with it and each other, and plays a crucial role in enticing new players to learn how to play.

Playing games on kitchen floors, lunchroom tables, and in empty classrooms is a collective memory shared by the majority of *Magic: The Gathering* players, especially by those who played in its early years. Garfield illustrates this in another one of his design blogs (Garfield, 2013), reminiscing over a time when he was first designing the game; he recalls when he was playing with one of his colleagues at 10:00 at night, and ended up playing the game until the

sun rose the next day. Many players share memories similar to this when they were young, spending hours playing with their friends, trying to squeeze in games whenever they could: between classes, during lunch, after school, and late at night. These memories and this fondness are key factors in explaining why *Magic* attracts the attention of so many players.

Initially, the concept was for MTG to be owned by one person in a household, like any other board game. The pool of cards was to be split between the players, and, through playing the game, the card pool would slowly change and players could change their decks between rounds (Garfield, 2013). However, the philosophy behind what the game was intended to be changed quickly. As Mark Rosewater, *Magic's* current lead designer states,

> When looking at *Magic's* origins, it's important to understand that Richard Garfield wasn't designing the game for what it became. No one could have. You don't design a game expecting it to be a phenomenon that changes the landscape of gaming. He was making a game, like any other game, that you'd buy at your local game store. You'd spend what you normally spent on a game (about $20 to $30 back in 1993) and play at home with your friends. If you had fun, on occasion, you might buy a booster pack to supplement what you already had (2024, para. 3).

As shown in this quote, *Magic: The Gathering* had a very significant impact on the landscape of gaming and quickly became a cultural phenomenon. This was not necessarily by intention; it was not Garfield's purpose to change the landscape of gaming when releasing *Magic: The Gathering*, he was only intending to design a game to be enjoyed by like-minded people. He quickly realized that what he had created was something dynamic, engaging, and, most importantly, incredibly popular that redefined the boundaries of what a board game could be.

Rampant Growth: How MTG has Changed Over Time

Instantly, *Magic: The Gathering* was a smash hit, selling out its first Alpha printing of 2.6 million cards, printing another 7.3 million, and selling out of those as well. This initial printing contained 302 unique cards (Wizards of the Coast, 2008). Since the first printing in 1994, there have been 111 additional printed expansion sets, including over 30,000 unique cards, according to Scryfall's database (Scryfall, 2026). Each expansion set (excluding Universes Beyond) takes place on a "plane", which can be thought of as an alternate dimension that certain characters can travel to and from. Each plane has its own identity, theme, and story, which allows the game to explore many different genres of fantasy. These genres range from from the Norse-mythology-inspired Kaldheim to the Japanese-folklore-inspired Kamigawa to the dark, gloomy set of vampires, werewolves, and zombies of Innistrad (Wizards of the Coast, 2008). As Rosewater states,

> The key to success in game design is making sure that your game has something for every player to be passionate about (and not necessarily the same thing). Success comes from making sure every player loves something about your game, not from focusing on making sure no player hates anything about it (2019, para. 6).

This illustrates the importance of having a wide variety of genres, characters, and themes within *Magic: The Gathering*. It's no coincidence that so many MTG sets are based around already existing cultural phenomena. Allowing players to identify with a theme they already love encourages them to become even further engrossed in the game. Moreover, this diversity also allows players to experience a wider variety of themes that they may not have already been exposed to.

It's no secret that the design philosophy of *Magic* has changed over time either. Being that the game is over 30 years old, it is by no means the same game that it was during its debut. Rosewater discusses this in one of his design blogs:

> There are a lot of things we took as a given that we're starting to reevaluate. How casual is *Magic* supposed to be? How does competitive play connect to the larger ecosystem? What level of complexity is correct? How many mechanics is a set supposed to have? How many sets are we supposed to make a year? How much innovation does Magic need? What role should nostalgia be playing? How backwards compatible do new themes and mechanics have to be? (2024, The Seventh Stage section, para. 6).

This quote plainly shows how MTG is in a state of revision, and the questions that the game designers ask themselves when adding new content to the game. As the game ages, the playerbase ages with it; younger players pick up the game, and older players leave it on the proverbial shelf. Over time, this shifting playerbase and change in design philosophy causes the game to change. A new player taking a very short look at the list of cards printed in Alpha would be able to tell you that there's something different, not just that the art style and rules text formatting have changed, but that the design philosophy itself has changed. Countless changes have been made to the rules of the game, many mechanics have been added, and plenty have been shelved, intended to never be printed again. There's even a scale the game designers use to indicate how likely a mechanic is to be printed in future sets, called the Storm Scale, named after the Storm mechanic (Rosewater, 2022). All this is to say that the incredible diversity and complexity of the game, combined with its age, means that it is a mutable entity with a history and culture, much like the stories, themes, and cultures it draws from.

Indomitable Creativity: Why MTG Means so Much to so Many

In his paper *The Sense of Wonder*, Medlock discusses how the growth of understanding and lived experiences contribute to the development of nostalgia and a lost sense of wonder. He states,

> Remnants of obsolete play patterns and once-competitive strategies permeate collective memories, enticing players to both revisit and reflect. Player desires to reengage with previous content releases have resulted in the formation of a collectors' market for discontinued products, as well as community managed formats that exclusively allow early cards like "Premodern." (Medlock, 2024, p. 4)

This illustrates how impactful the sense of nostalgia is to the current game of *Magic: The Gathering*. With the continual release of cards, there is a bias to include newer, more powerful cards in more recently built decks, using newer play patterns and strategies. Due to this, there is a pervading sense of loss felt when players leave behind sets of cards and strategies that they feel sentimentally attached to. This is further exacerbated by the attachment players have to the characters, events, and stories represented in the cards, not just the cards themselves. Seth Glickman discusses the nature of the stories represented in these cards and how they relate to the player experience (Glickman, 2024, pp. 12–16). Glickman describes an example of this with the illustrations on a set of three cards: Sun Titan, Animate Dead, and Terminate. The first, Sun Titan, depicts a towering giant donned in holy armor, evoking a sense of holy justice and power. The card's flavor text, a section of text at the bottom of a card used for embellishment, states: "A blazing sun that never sets." The next card printed later that year, Animate Dead, depicts the shambling corpse of the previously mentioned Sun Titan being resurrected by some unholy force. It bears only pieces of its previously spotless armor, now tarnished and dirty. The final card in this saga, Terminate, printed in 2017, evokes powerful imagery of Sun Titan being burned to pieces, screaming in agony as it is helplessly reduced to dust. The card bears the flavor text "All suns must set." While this Sun Titan character is never

named or mentioned anywhere else in MTG lore, players can stitch together a narrative in which this great archon of holy justice was killed by some powerful, unholy force, then later, its corpse reanimated to serve the bidding of some greater dark power. There are so many parts of this story left unanswered, but these unanswered questions allow players to construct their own narrative of what happened to this unnamed character, and even embed themselves in the story as the holy force commanding the Sun Titan, or reanimating its shambling corpse. This allows players to construct a deeper sentimental attachment to their cards and the characters represented, amplifying the aforementioned sense of nostalgia.

The social nature of the game is another extremely important part of how the culture of the game has developed and changed over time. Limbert discusses the importance of the social aspects of *Magic: The Gathering*. He posits that, as simple as it is stated in the name of the game, gathering with other players is a key piece of what defines the game (Limbert, 2012, p. 39). The culture of the game is heavily influenced by the shared understanding of the complex mythos of the game. As stated by Crutcher, "*Magic* requires players to manage a deep and complex mythos, layered worlds (e.g., Theros and Innistrad), large-scale conflicts and their evolutions, a sophisticated ludic language, and an intertextual and adaptive narrative." (Crutcher, 2017, Conclusion) When players develop this deep connection to their cards and the story told within them, it allows players to bond deeply with each other as well. Through the deep connections that *Magic: The Gathering* players share, its complex and intricate culture is formed.

Expressive Iteration: The Importance of Self-Expression Through Deckbuilding

Magic: The Gathering is a creative conduit through which players can express themselves. Self-expression is an incredibly important part of leisure and creativity, and MTG seeks to scratch that itch amongst its playerbase, and does so well. Rosewater states in his blog *Why Diversity Matters in Game Design* the importance of giving players a connection with the game by allowing them to influence it. He states that allowing players to express themselves encourages them to connect more quickly and more strongly than they would otherwise, so allowing players to decide on their own playstyle is important (Rosewater, 2019). Following this logic, *Magic: The Gathering* was designed to be inherently self-expressive. When a player constructs a deck of cards to play with, they make thousands of decisions about what kinds of cards they want to include and exclude, what the strategy of the deck should be, how powerful they want the deck to be, how they want to win games, how they want to interact with their opponents, and what kinds of decks they want their deck to be able to play against. There are 30,000 unique cards and over 90,000 unique printings on Scryfall's database. There are a myriad of combinations of cards and strategies that players can employ. Therefore, each deck is carefully and personally crafted, a reflection of the personality of the builder.

Rosewater discusses three categories that *Magic: The Gathering* players fall into, named Timmy, Johnny, and Spike. In summation, Timmy players enjoy the social aspect of the game, playing large, flashy cards to revel in the spectacle of it all, and to share this excitement and experience with their friends. Johnny players enjoy building decks with unique, new strategies using rules and play patterns that many players haven't considered. They think of the game equally as a puzzle to be solved and as a game to be played, and love generating interesting and creative solutions to the problems their decks face. Spike players love to play competitively. Not to say that Spike players only play the game to win, rather they thrive when squeezing every little bit of performance out of their deck and testing their skills against others. These categories are inherently generalizations, and almost all players exhibit some combination of all three of these characteristics, but these personas exemplify the core motivations the vast majority of players hold (Rosewater, 2013).

The key connection that all of these characteristics share is that they're a reflection of the player's personality on their deck and play pattern. Almost every player who is sufficiently experienced in the game identifies closely with one of these tropes, and recognizes that their decks are a reflection of how they see themselves, how they see the game, and how they see the world. Therefore, it could even be argued that building a *Magic: The Gathering* deck is as much of an art form in and of itself as it is a means to play the game. This plays another extremely important role in why MTG is held so close by the players who enjoy it, being that the inherent self-expression in deckbuilding enhances the players' attachment and enjoyment significantly.

Closing Statement

Magic: The Gathering is a game that has a lot of importance to many people, and for good reason. In its infancy, MTG offered dynamic gameplay that was different from any other board game at the time. It introduced something unique and engaging that players loved. Additionally, MTG further entices players by allowing them to engage with cultural themes they already know and love, and share those experiences with others. The literary nature of the game is also incredibly important. When players are able to engage with the stories presented in the cards, it develops a deep attachment that players are able to share with one another. Clearly, *Magic: The Gathering* is an incredibly important and influential piece of media, so it's no wonder that the game has only grown over the past 30 years and has redefined the nature of what a game can exist as and the deep meaning it can hold for its players.

References

Crutcher, P. A. (2017). Magic: The Gathering, A Literary Text. *Americana, 16*(1), 1-10. https://www.americanpopularculture.com/journal/articles/spring_2017/crutcher.htm

Garfield, R. (2013, March 12). *The Creation of Magic: The Gathering.* Magic: The Gathering Article Archive. https://magic.wizards.com/en/news/making-magic/creation-magic-gathering-2013-03-12

Glickman, S. (2024). A Battlefield of Textual Elements: Bookishness in Magic: The Gathering. *The New Americanist, 3*(1), 1-24. https://www.euppublishing.com/doi/full/10.3366/tna.2024.0024

Limbert, T. J. (2012). *The Magic of Community: Gathering of Card Players and Subcultural Expression.* Master's thesis, Bowling Green State University, 39. https://etd.ohiolink.edu/acprod/odb_etd/etd/r/1501/10?clear=10&p10_accession_num=bgsu1342464535

Medlock, K. (2024). "The Sense of Wonder": Gaming Capital and Nostalgia for Inexperience in Magic: The Gathering. *Games and Culture, 20*(8). https://journals.sagepub.com/doi/full/10.1177/15554120241234399

Rosewater, M. (2013, December 3). *Timmy, Johnny, and Spike.* Magic: The Gathering Article Archive. https://magic.wizards.com/en/news/making-magic/timmy-johnny-and-spike-2013-12-03

Rosewater, M. (2019, August 19). *Why Diversity Matters in Game Design.* Wizards of the Coast. https://magic.wizards.com/en/news/making-magic/why-diversity-matters-game-design-2019-08-19

Rosewater, M. (2022). *Storm Scale: Throne of Eldraine through Strixhaven, Part 1.* Magic: The Gathering Article Archive. magic.wizards.com/en/news/making-magic/storm-scale-throne-of-eldraine-through-strixhaven-part-1. Accessed 3 Mar. 2026.

Rosewater, M. (2024, August 12). *Stages of Design.* Magic: The Gathering Article Archive. https://magic.wizards.com/en/news/making-magic/stages-of-design

Scryfall Magic: The Gathering Search. (2019). https://scryfall.com/

Wizards of the Coast. (2008, March 19). *The Known Multiverse.* Magic: The Gathering Article Archive. https://magic.wizards.com/en/news/feature/known-mutliverse-2008-03-19

Wizards of the Coast. (2008, September 4). *Alpha, Beta, and Unlimited Editions.* https://web.archive.org/web/20080904131914/http://www.wizards.com/magic/tcg/productarticle.aspx?x=mtg_tcg_abu_productinfo

A Return to Balance: Why Ayurveda Matters Now More than Ever

Ella Karbowski

Writer's Statement

Coming into composition as a first-year student, I knew almost immediately that I wanted to write a medical anthropology paper. I love combining the interdisciplines of biology and the physical sciences with topics in the social sciences. Ayurveda has always been part of my family's daily life, as we believe natural medicines are just as important as synthetic ones. I was inspired to learn more about the traditional practices of Ayurveda and the history behind the medical practices. I started at Michigan Tech as a biomedical engineering student; however, I soon realized that the aspect I loved most about the major was the medical anthropology aspect. This paper, among other reasons, inspired my switch to anthropology. I am excited to continue to explore medical anthropology as well as the various other social sciences that Michigan Tech has to offer.

I've lost track of how many times I've visited the doctor with a seasonal cold only to receive another short-term prescription. The routine doctor's visit is efficient, but it also reveals something missing in my healthcare experience: little attention is given to preventing these recurring illnesses in the first place. This pattern raises a larger question about how our medical system approaches everyday health: How might traditional systems complement modern medicine by emphasizing balance and long-term health? Ayurveda, a traditional Indian medical system, focuses on just that–creating balance within an individual to prevent disease and combat illness through a wide variety of natural cures. In India and Nepal, Ayurveda is a recognized medical system with state-approved education and training. Incorporating it into Western medicine could help to generate new research that bridges the gap between natural principles and already emerging technologies. Recognizing the relationship between the two practices would help to create more individualized treatments. These ideas will help to inspire a holistic and natural perspective on wellness and medicine. Integrating Ayurvedic medicine into Western healthcare would expand treatment options, advance medical research, and promote a more holistic understanding of wellness through its unique, natural principles.

For over 5,000 years, Ayurveda has been recognized as an Indigenous traditional medical system within India; it's practiced like how standard medicine is used in the U.S. Balance is one of the key principles of Ayurvedic medicine, focusing on the interconnectedness of the mind, body, and spirit. It is based on the idea that the body has three life forces: the Doshas, which include Vata, which governs movement, the nervous system, and elimination; Pitta, which regulates metabolism, digestion, absorption, and body temperature; and Kapha, which provides structure, stability, and moisture to the body and mind (Jaiswal & Williams, 2016). The goal of Ayurvedic practice is to maintain or restore the natural balance of an individual's Doshas through personalized dietary adjustments, lifestyle modifications, herbal remedies, yoga, and meditation.

Ayurveda, through its natural preventative measures, promotes a more holistic understanding of everyday wellness. By prioritizing the well-being of the whole individual, it works as a tool to maintain balance that can be integrated easily into one's life. Through its focus on preventative techniques, Ayurveda can be split into a balance between daily practices, dinacharya, and seasonal routines, ritucharya (Rao et al., 2019). These practices enable a

more holistic understanding of wellness by providing ways to align the body, mind, and spirit with the natural rhythms of the world. When understanding these daily regimens, it can become easier to focus on preventing ailments through the use of natural remedies. Ayurveda also promotes a more holistic understanding of wellness by recognizing that not everyone needs to be treated in the same way.

Western medicine tends to step in after a problem shows up, which leaves a lot of Americans dealing with sudden, expensive healthcare bills; the integration of Ayurveda would help to alleviate some of the costs associated with proper healthcare. According to the Center for Medicaid and Medicare Services (CMS), prescription drug spending was nearly $334 billion in 2019 and is projected to grow, with the country paying the highest prices among developed nations. These numbers are staggering, and many Americans lack access to proper healthcare. With a high focus on preventative care and the use of natural remedies, Ayurveda poses as a cheaper alternative to pharmaceuticals and modern healthcare; it would also potentially lower outpatient visit costs in public facilities. Many of the practices are inexpensive or do not require any additional funds. Using natural care within modern medicine would help to reduce costs due to the resources available; this idea is supported by Mishra et al. (2024), who note that, "Governments and health systems could consider integrating Ayurveda into the broader healthcare system, offering more affordable access to the masses through initiatives such as Central Sector Scheme for Promotion of Ayush Intervention in Public Health Initiatives (PHI) which aims to promote the integration of Ayurveda with public health initiatives such as National Rural Health Mission (NRHM) and National Urban Health Mission (NUHM)." These public health initiatives are integral for the incorporation of Ayurvedic medicine, and in return will lower medical costs for many Americans.

Reluctantly, many Americans are pushed into a dependency on pharmaceuticals, as the cycle between getting sick, going to the doctor's, and being prescribed medicine continues. Healthcare has unfortunately turned into a large-scale business rather than a practice that focuses on equitable care for all. As discussed by Rang (2013), big pharmaceutical companies tend to mislead doctors, leading to the harm of patients. Pharmaceutical companies spend about twice as much on marketing than the research and development of new drugs, which leads to a significant ethical concern regarding patient safety. The limited treatment approaches within Western medicine are a cause for concern. The integration of Ayurvedic medicine would alleviate some of this concern by introducing new ways of treatment–not only would patients gain access to more holistic and preventive care, but healthcare systems would also benefit from a more comprehensive, collaborative approach to treatment.

Ayurveda is not just a policy-level solution; its strength comes from how naturally it fits into everyday routines. It offers practices that empower people to care for their well-being long before illness develops, grounding health in balance rather than reaction. Yoga, rooted in the same Vedic tradition, is the most intuitive place to begin. With a strong historical significance, yoga is often considered a "sister science" to Ayurveda. Both practices stemmed from the Vedas, ancient religious texts that have guided Hinduism for centuries. Much like Ayurveda, yoga focuses on creating balance and promotes well-being by improving mental and physical health. Yoga poses are a practice that guides the nervous system into stillness, and they help to lay the foundation for meaningful meditation. Depending on your focus, your practice can help to balance the three Doshas. To balance Pitta, one might focus on gentle movements that soothe the body. For strong Vata, one might focus on slow components of the practice while emphasizing breathwork. And last, to balance Kapha, create a practice with more vigor and energy (A. Vaidya & R. Vaidya, 2023). Yoga is a practice that you can tailor to fit your life and needs. You may find yourself spending ten minutes out of your day trying a guided YouTube video, or maybe you want to check out your local yoga studio–there is no wrong way to practice yoga.

The practices of Ayurveda are often simple and easy to incorporate into an average person's daily life. Choosing a simple practice to enhance your health will allow you to find a grounding balance every day. An example of this from my daily life is incorporating the practice of yoga. I have found that it also helps to reduce stress and anxiety in my daily life. Yoga calms the nervous system, lowers stress, and is shown to increase mood-boosting chemicals like GABA, dopamine, and serotonin (R et al., 2023). Choosing to incorporate yoga into my daily routine was something that I found to be easy to commit to because Michigan Technological University offers a physical education course focused on the practice. Yoga is considered an integral and essential part of Ayurveda because the two work harmoniously. Finding something suited to your life is important when practicing the incorporation of Ayurveda into your routine. This could include taking a daily supplement, practicing intentional movement, or simply getting adequate sleep every night, which will allow you to begin to find balance over time.

Much like yoga and meditation–simple daily practices–Ayurveda focuses on balance within one's life overall. As opposed to the demanding Western pharmaceutical industry that mass-produces singular drugs as a way of treatment, Ayurveda takes a different, more balanced approach. For example, instead of prescribing various anxiety medications as a generalized way of curing anxiety, it identifies where the imbalance comes from, whether it be Vata (nervous energy), Pitta (inflammation), or Kapha (lethargy)–the three Doshas. This point is supported by researchers, who argue that the three Doshas work in synchronicity and an imbalance in one can limit one's wellbeing (Travis et al., 2015). If one has an imbalance with Pitta, Ayurveda may suggest avoiding spicy or acidic foods and focusing on taking cooling foods like cucumbers and sweet fruits, whereas Western medicine would focus on taking anti-inflammatory medications. Additionally, there are ways to find balance through movement and breath, as supported by the practices of yoga and meditation–something that pharmaceuticals cannot replicate alone. Through this focus on natural remedies for a subject-based approach, Ayurveda supports a more holistic approach to health and well-being.

Due to the focus on approaching health through natural solutions, Ayurveda can expand treatment options beyond those of Western medicine. Instead of taking medications, going to extensive therapies, or receiving surgeries, Ayurveda focuses on preventing issues before they arise through its use of herbs, plants, oils, and movement. If a patient is experiencing chronic pain, in Western society, they may be sent to physical therapy, given pain medications, and might have to undergo surgery. Using Ayurveda, the patient will receive Abhyanga (therapeutic oil massage) along with meditations and pranayama (breathing exercises) to relieve both tension and anxiety surrounding their pain. The idea of using Abhyanga to treat chronic pain is supported by a study conducted by Basler (2011), which concluded that therapeutic oil massages help reduce stress within an individual's life. In return, these anti-stress effects can also have an impact on the whole body and will reduce pain within the body. Another way natural treatments are incorporated into Ayurveda is through dietary supplements. One such supplement is turmeric, which has been shown to have many beneficial healing effects on the body.

Through the use of dietary supplements, Ayurveda emphasizes the ability to expand treatment options rather than relying on nonsteroidal anti-inflammatory drugs, which are often used in Western medicine. Additionally, another alternative to pharmaceutical symptom management is Panchakarma, which includes oil treatments, herbal steam, and digestive resets, and is used for conditions like autoimmune disease, skin disorders, and chronic fatigue. According to Conboy et al., (2009), they expand upon the idea of Panchakarma to demonstrate how this treatment method can improve one's quality of life. Within their research, they write, "Panchakarma may be effective in assisting one's expected and reported adherence to new and healthier behavior patterns." This alludes to the idea that Ayurvedic ways of treatment can benefit one's overall health and life. Overall, Ayurveda offers new ways of treatment in opposition to Western pharmaceuticals.

Due to the multitude of treatment options that Ayurveda offers through its natural principles, it can also be used to advance medical research. Various dietary supplements and methodologies found in Ayurveda demonstrate medical breakthroughs. To begin, Curcumin–the active ingredient in turmeric–is now widely studied for its anti-inflammatory, antioxidant, and anticancer properties. Clinical trials continue to explore its potential in treating arthritis, Alzheimer's, and even depression. Kunnumakkara et al. (2023) expand on the idea of the natural compound found in turmeric and other dietary supplements: "Natural compounds exhibit diverse biological activities and drug-like properties… They have a remarkable role in human health and disease prevention and act as a powerful means of promoting optimal health, longevity, and quality of life." Another dietary supplement that contains natural compounds linked to health benefits is Aswagandha. Ashwagandha (Withania somnifera) is being researched for its adaptogenic effects–helping the body manage stress, improve energy, and balance hormones–influencing studies on stress biology and neuroendocrine function. Within their research, Mikulska et al. (2023) discuss the emergence of research surrounding Ashwagandha and its reported sleep benefits: "Current research covers many aspects of human health, including neuroprotective, sedative, and adaptogenic effects and effects on sleep." In contrast to Western medical research, Ayurveda utilizes its natural principles to expand the medical field through a different perspective.

With its growth potential and the emergence of public health initiatives, integrating Ayurvedic medicine with Western medicine will be beneficial for both practices. The Ayurveda market is predicted to grow significantly, with a forecast of increasing by $11.3 billion between 2024 and 2029, driven by a growing interest in natural products and low-side-effect medicines (Team, T. M., 2025). The holistic healthcare approach of Ayurveda resonates with consumers seeking natural remedies for various health concerns, which makes the market a rising industry. The integration of Ayurvedic practices into modern healthcare systems is paving the way for a more comprehensive and inclusive approach to healthcare. Ayurvedic treatment plans and therapies, encompassing weight management and various health concerns, are being researched and developed, emphasizing safety and efficacy. Continuing to use Ayurvedic medicine, especially within Western societies, will continue to progress the market as well as the potential for treatment options.

Training for proper use of Ayurveda is already sprouting in the United States and surrounding countries. Located in Nevada City, California, the California College of Ayurveda offers comprehensive education surrounding Ayurveda. From introductory programs to advanced clinical training, the school offers paths that lead to certification as a Clinical Ayurvedic Specialist (CAS). This training, already offered in the United States, will help to emphasize the connection between traditional and modern medicine. Strengthening both practices, this type of training will allow for the spread of knowledge and, therefore, will lead to more regulation of Ayurveda–something that is necessary to ensure safe medical practices. Due to its emergence in the United States and in many South American countries, the Pan American Health Organization (PAHO) and the World Health Organization (WHO) have taken an interest in adopting policies that incorporate traditional and complementary medicines, providing a supportive framework for Ayurveda's growth. With backing from the PAHO and the WHO, it may be possible to develop regulations and safe practices surrounding Ayurveda, which would offer ease of integration as medicine develops (Hoenders, R. et al. 2024).

It is important to consider the need for regulation, research-backed safety standards, and practitioner training, which would strengthen both Ayurvedic and Western medical systems. While India has government-recognized Ayurvedic universities and national licensing, the United States lacks standardized oversight for Ayurvedic supplements, practices, and education. This gap has sometimes led to concerns about product purity, mislabeled herbal blends, or unregulated treatments. However, these issues highlight why integration—not separation—is necessary. By incorporating Ayurveda into Western healthcare systems, the U.S.

could implement FDA-approved quality control measures, develop accredited training programs, and encourage collaborative care among physicians, researchers, and Ayurvedic practitioners (Kumar & Arya, 2024). Creating shared clinical guidelines would help legitimize Ayurvedic treatments while ensuring their safety and reliability. With regulation and scientific validation, Ayurveda's natural methods could be practiced more safely and effectively, expanding trustworthy healthcare options for millions of Americans.

Some may believe that Ayurveda is solely a lifestyle choice and cannot treat major diseases or illnesses. Due to the idea that Ayurveda is a preventative method of medicine, its treatment methods often go unnoticed or underappreciated. Many natural dietary supplements have been linked to medicinal properties. Ayurvedic herbs like Ashwagandha (Withanolides), Turmeric (Curcumin), and Tulsi (Holy Basil) have shown anti-cancer and immune-boosting properties in modern studies. Curcumin, in particular, has been found to slow the growth of cancer cells and reduce inflammation associated with tumor development. For type 2 diabetes, Ayurvedic herbs such as Gurmar (Gymnema sylvestre) and Bitter Melon (Momordica charantia) are used to naturally regulate blood sugar and improve insulin sensitivity, offering a more sustainable complement to medication (Zoi et al., 2021). Rather than being solely a lifestyle choice, Ayurvedic techniques can be integrated into Western medical practices to treat and cure diseases using natural measures.

Although Ayurveda may offer many natural healing properties, some argue that Western medicine is superior to Ayurvedic medicine because of the wide variety of pharmaceuticals that are available. Western medicine focuses on expanding the options for pharmaceuticals, as they are often quick to obtain and effective at curing illness. Western medicine has built a dependency on pharmaceuticals and has turned health into a large-scale business as medicinal profit margins skyrocket. According to Ledley et al (2020), "from 2000 to 2018, 35 large pharmaceutical companies reported cumulative revenue of $11.5 trillion and gross profit of $8.6 trillion," making the pharmaceutical industry one of the leading national markets. In comparison, Ayurveda doesn't focus on turning a profit foremost and considers preventative medicine to be superior to fast-acting pharmaceutical drugs. Pharmaceuticals often treat diseases after they appear, but Ayurveda emphasizes preventing disease by maintaining balance in diet, lifestyle, and mental health. Additionally, Ayurvedic medicine focuses on the treatment of the whole individual rather than treating issues in isolation, like pharmaceuticals tend to do. While Western medicine and ideals can be beneficial in many instances, incorporating Ayurveda to prevent diseases and illnesses before they arise can be of benefit. If you prevent diseases, then you will not have to rely on costly medicine and cures that fuel the pharmaceutical industry.

Overall, blending Ayurvedic practices with Western healthcare would create a more complete view of health, introduce new natural forms of treatment, and drive medical innovation by drawing on Ayurveda's distinctive, nature-based approach to healing. Since I began to practice natural forms of medicine, I have noticed that I have been so much more invested in my self-care on a day-to-day basis and have loved having a cleaner and holistic way of health within my life. In the U.S., it can be easy to build a reliance on pharmaceuticals; however, Ayurvedic medicine can help to stray away from dependency on pharmaceuticals and focus on preventative techniques. On the other hand, if it is not incorporated into Western medicine, individuals might struggle to afford the cost of their medications and continue to use pharmaceuticals in a way that solely treats illness and doesn't work to prevent ailments. In short, it is important to incorporate a balance of natural Ayurvedic health practices with those of Western healthcare to create a more holistic idea of health.

References

Basler A. J. (2011). Pilot study investigating the effects of Ayurvedic Abhyanga massage on subjective stress experience. *Journal of alternative and complementary medicine (New York, N.Y.), 17*(5), 435–440. https://doi.org/10.1089/acm.2010.0281

Chopra, A., & Doiphode, V. V. (2002). Ayurvedic medicine: core concept, therapeutic principles, and current relevance. *Medical Clinics of North America, 86*(1), 75–89. https://doi.org/10.1016/S0025-7125(03)00073-7

Conboy, L., Edshteyn, I., & Garivaltis, H. (2009). Ayurveda and Panchakarma: measuring the effects of a holistic health intervention. *TheScientificWorldJournal, 9*, 272–280. https://doi.org/10.1100/tsw.2009.35

Fauzi, F. M., Koutsoukas, A., Lowe, R., Joshi, K., Fan, T. P., Glen, R. C., & Bender, A. (2013). Linking Ayurveda and Western medicine by integrative analysis. Journal of Ayurveda and *Integrative Medicine, 4*(2), 117–119. https://doi.org/10.4103/0975-9476.113882

Hoenders, R., Ghelman, R., Portella, C., Simmons, S., Locke, A., Cramer, H., Gallego-Perez, D., & Jong, M. (2024). A review of the WHO strategy on traditional, complementary, and integrative medicine from the perspective of academic consortia for integrative medicine and health. *Frontiers in medicine, 11*. https://doi.org/10.3389/fmed.2024.1395698

Jaiswal, Y. S., & Williams, L. L. (2016). A glimpse of Ayurveda - The forgotten history and principles of Indian traditional medicine. *Journal of traditional and complementary medicine, 7*(1), 50–53. https://doi.org/10.1016/j.jtcme.2016.02.002

Kumar, A., & Arya, V. (2024). Achieving holistic health through ayurveda along with advanced technologies: A conference report. *Journal of Ayurveda and integrative medicine, 15*(3). https://doi.org/10.1016/j.jaim.2024.100967

Kumaravel, G. (2015, September). *Engineering aspects of Ayurveda: The mechanics and thermodynamics of human physiology.* ResearchGate. https://www.researchgate.net/publication/281741413_Engineering_aspects_of_Ayurveda_The_Mechanics_and_Thermodynamics_of_Human_Physiology

Kunnumakkara, A. B., Hegde, M., Parama, D., Girisa, S., Kumar, A., Daimary, U. D., Garodia, P., Yenisetti, S. C., Oommen, O. V., & Aggarwal, B. B. (2023). Role of Turmeric and Curcumin in Prevention and Treatment of Chronic Diseases: Lessons Learned from Clinical Trials. *ACS pharmacology & translational science, 6*(4), 447–518. https://doi.org/10.1021/acsptsci.2c00012

Ledley, F. D., McCoy, S. S., Vaughan, G., & Cleary, E. G. (2020). Profitability of Large Pharmaceutical Companies Compared With Other Large Public Companies. *JAMA, 323*(9), 834–843. https://doi.org/10.1001/jama.2020.0442

Mallick, S. (2024). *Mainstreaming Ayurveda: Alternative medicine and public health care system in Delhi.* Routledge. https://doi.org/10.4324/9781003421863

Mikulska, P., Malinowska, M., Ignacyk, M., Szustowski, P., Nowak, J., Pesta, K., Szeląg, M., Szklanny, D., Judasz, E., Kaczmarek, G., Ejiohuo, O. P., Paczkowska-Walendowska, M., Gościniak, A., & Cielecka-Piontek, J. (2023). Ashwagandha (Withania somnifera)-Current Research on the Health-Promoting Activities: A Narrative Review. *Pharmaceutics, 15*(4), 1057. https://doi.org/10.3390/pharmaceutics15041057

Mishra, R., Singh, J. P., & Antiwal, M. (2024). Cost perspective of Ayurveda: The question of affordability. *Annals Ayurvedic med, 2024; 13*(4) 342-345, DOI.10.5455/AAM. 199182.

Morandi, A., Tosto, C., Sartori, G., & Roberti di Sarsina, P. (2011). Advent of a link between Ayurveda and modern health science: The proceedings of the first international congress on Ayurveda, "Ayurveda: The Meaning of Life-Awareness, Environment, and Health," March 21-22, 2009, Milan, Italy. *Evidence-based complementary and alternative medicine: 2011*. https://doi.org/10.1155/2011/929083

Mukherjee, P. K., Harwansh, R. K., Bahadur, S., Banerjee, S., Kar, A., Chanda, J., Biswas, S., Ahmmed, Sk. M., & Katiyar, C. K. (2017). Development of Ayurveda – Tradition to trend. *Journal of Ethnopharmacology, 197*, 10–24. https://doi.org/10.1016/j.jep.2016.09.024

Parasuraman, S., Thing, G., & Dhanaraj, S. (2014). Polyherbal formulation: *Concept of Ayurveda. Pharmacognosy Reviews, 8*(16), 73–80. https://doi.org/10.4103/0973-7847.134229

Rang, H. (2013). Bad Pharma: how drug companies mislead doctors and harm patients. *British Journal of Clinical Pharmacology, 75*(5), 1377–1379. https://doi.org/10.1111/bcp.12047

Rao, M. V., Harti, S., Ghildiyal, S., & Rai, S. (2019). AYUSHCHARYA 2018 - 'A National Conference on Dinacharya and Ritucharya for public health promotion'. *Journal of Ayurveda and integrative medicine, 10*(3), 230–231. https://doi.org/10.1016/j.jaim.2019.07.001

R, P., Kumar, A. P., Dhamodhini, K. S., Venugopal, V., Silambanan, S., K, M., & Shah, P. (2023). Role of yoga in stress management and implications in major depression disorder. *Journal of Ayurveda and integrative medicine, 14*(5), 100767. https://doi.org/10.1016/j.jaim.2023.100767

Stefanicka-Wojtas, D., & Kurpas, D. (2023). Personalised Medicine—Implementation to the Healthcare System in Europe (Focus Group Discussions). *Journal of personalized medicine, 13*(3), 380. https://doi.org/10.3390/jpm13030380

Team, T. M. (2025, March 21). *Ayurveda Market Growth and Trends (2025-2029).* Technavio.org; Technavio Newsroom. https://newsroom.technavio.org/ayurveda-market-industry-analysis

Tillu, G., Bhalerao, S., & Godatwar, P. (2024). The World Ayurveda Congress - A movement for the advancement of Ayurveda. *Journal of Ayurveda and integrative medicine, 15*(6), 101123. https://doi.org/10.1016/j.jaim.2024.101123

Vaidya, A. D. B., & Vaidya, R. (2023). A century of 'The science of yoga' (1921-2021): Revival, renewal and renaissance. *Journal of Ayurveda and integrative medicine, 14*(1), 100613. https://doi.org/10.1016/j.jaim.2022.100613

Zoi, V., Galani, V., Lianos, G. D., Voulgaris, S., Kyritsis, A. P., & Alexiou, G. A. (2021). The role of curcumin in cancer treatment. *Biomedicines, 9*(9), 1086. https://doi.org/10.3390/biomedicines9091086

U.S. Department of Health & Human Services (2020, December 16). *CMS Office of the actuary releases 2019 National Health Expenditures.* CMS.gov. https://www.cms.gov/newsroom/press-releases/cms-office-actuary-releases-2019-national-health-expenditures

The Dangers of Anabolic Androgenic Steroids

Dylan Walsh

Writer's Statement

I discovered my passion for the gym during my senior year of high school. Resistance training has brought me to the best physical health in my life and strengthened my mental resolve. I was severely underweight for the majority of my life, but due to my efforts in the gym, I've gained significant lean muscle mass and I am now at a healthy body weight. My perception of self has also improved, my confidence has increased, and I am more capable of accomplishing difficult tasks, in and out of the gym.

Gym culture has a massive presence online. As a new lifter, I saw hundreds of Instagram Reels and Youtube videos, inundating me with vast quantities of information. This included different training styles, nutrition plans, as well as videos of users posting their physiques. Many of these physiques were utterly astonishing, being those of professional bodybuilders. These individuals possess incredibly muscular, unbelievably lean physiques. However, those physiques are rarely achieved without the use of steroids. Steroids, specifically androgenic anabolic steroids, amplify skeletal muscle growth and allow people to obtain "more ideal" physiques with less effort. These drugs are effective, but pose significant health risks.

As I consumed more gym related internet content, I noticed a concerning trend. Whether it was for bodybuilding or for "looksmaxxing" benefits, I witnessed many people my age openly admitting to the use of steroids on their social media platforms. This seriously concerned me, and motivated me to write this paper.

My objective with this paper is to spread scientifically backed information regarding these harmful substances to my readers. I want to show that despite the undeniable effectiveness of steroids, they carry an even greater health risk. Hopefully, the information I present can deter potential users, and prevent them from subjecting themselves to bodily harm.

Introduction

The use of androgenic anabolic steroids (AAS) is an under-discussed substance abuse issue, especially among college-aged men. AAS are a derivative group of the testosterone hormone, which stimulate muscle growth and fat loss and masculinize the user: increasing body hair and deepening the voice (Kanayama & Pope, 2018). As Kanayama and Pope note, testosterone and its effects were discovered in 1935, and methods to synthesize other AAS were developed throughout the 40′s and 50′s. Bodybuilders in these decades began to adopt androgens as a method to enhance their physiques, and saw great success in competition. During the 60′s, AAS began to spill over into other branches of athletics, especially sports requiring a high degree of muscular strength. Due to the effectiveness of steroids, the use of these compounds was banned by the Olympics in 1967. In the 1980′s, the use of AAS began to permeate into circles of casual gym-goers, as access to information about steroids and the substances themselves became much easier to obtain. Starting in the early 2000′s, the average user of steroids shifted from elite athletes and bodybuilders to the typical gym-goer (Kanayama & Pope, 2018). This shift is particularly problematic, as AAS come with a whole host of side effects, resulting in them being an unsustainable and unsafe way to build muscle for the average person.

Physical Side Effects

The side effects from supraphysiological doses of AAS pose significant health risks to the user. Scientific literature indicates six systems of the body are impacted the most by steroid use: the neurological system, cardiovascular system, liver, urinary tract, musculoskeletal system, and reproductive system (Albano et al. 2021). The effect of AAS on each of these systems can be incredibly detrimental to the user's health and quality of life. Additionally, there is evidence that many of these adverse effects are irreversible, leading to lifelong impairments (Kanayama et al. 2008). Ultimately, the lasting effects of these substances will stay with users for their entire lives, all to provide a shortcut to more muscle mass and strength.

Of the plethora of side effects caused by AAS use, the impacts on the cardiovascular system have the greatest propensity for lasting effects and mortality. In a literature review by Kanayama and colleagues, a longitudinal study that compares the mortality rates of powerlifters to a control group of males was highlighted as evidence for cardiovascular side effects. The study followed 62 powerlifters who at one point had placed in the top five of the Finnish championships, and 1,094 control males. The mortality rate of powerlifters during the study was significantly higher than that of the control, with a mortality rate of 12.9% (eight individuals), where only 3.1% of the control group (34 individuals) died. Specifically, three of the eight deaths were caused by a myocardial infarction (Kanayama et al. 2008). These deaths were more than likely due to the compromised cardiovascular systems of these athletes that had been damaged by steroid abuse. Moreover, a literature review conducted by Albano and colleagues supports this by identifying specific mechanisms linked to steroid use that increase the likelihood of cardiac failure. Specifically, prolonged use of AAS can cause cardiac hypertrophy, which reduces blood flow to the heart, and causes arrhythmias. Users of AAS also have a greater volume of atherosclerotic plaque, as compared to non-users, which restricts blood flow to the heart. The risk of a heart attack is significantly increased in steroid users due to these side effects (Albano et al. 2021). Therefore, using AAS puts the cardiovascular system at a significant risk of damage, to the point where it can endanger the life of the user.

Even though the cardiovascular damage is most life-threatening, AAS do not solely affect the cardiovascular system. Many other body systems are impacted by these substances, one of which being the reproductive system. In a 2008 literature review, researchers at Harvard Medical School concluded that the disruption to the body's natural testosterone production caused by AAS can lead males to become hypogonadal once they discontinue steroid use (Kanayama et al. 2008). This is a likely contributor to the psychological side effects of these substances. Steroid abuse is a primary cause of hypogonadism. As highlighted by a separate literature review, 20% of patients treated for hypogonadism were previous users of AAS (Albano et al. 2021). This statistic is likely lower than the actual number, due to AAS being illegal in the U.S. and patients not wanting to admit to a crime. Considering the magnitude of that number, it is evident that steroids are incredibly disruptive to natural hormone production, potentially the most disruptive of any external stimuli.

Hormonal disruption can also cause unintended physical changes in the bodies of users. As seen in the 2021 literature review by Albano and colleagues, AAS can physically alter reproductive systems of users of both sexes. As a result of hypogonadism, males can experience gynecomastia, a condition where they develop breasts, as well as testicular atrophy. Due to the supraphysiological testosterone in their bodies, females can experience breast and uterine atrophy, as well as menstrual irregularities (Albano et al. 2021). These effects can be incredibly dysphoric for users, as their physique can become mis-aligned with their gender identity, potentially resulting in physiological damage. Albano's findings are also supported by research regarding hypogonadism. In a literature review focused on long term impacts of AAS, researchers found that "dysphoric feelings associated with hypogonadism may prompt some AAS users to resume taking AAS again and again…" (Kanayama et al. 2008, Neuroendocrine

effects, p. 2). Essentially, dysphoria can lead users to prolong their cycles or develop a dependence on AAS, which magnifies the life-threatening side effects impacting other bodily systems. These studies indicate how dysphoria related to side effects of AAS can damage the psyche of users, exacerbating physical impact these substances have.

Psychological Impacts

Not only are the physiological side effects of steroids dangerous, but the psychological impacts can be equally disruptive to the user's quality of life. A literature review conducted by researchers at Harvard Medical School found high doses of AAS are linked to mood and behavioral changes, as well as depressive symptoms (Kanayama et al. 2008). Behavioral changes include hypomanic or manic episodes, irritability, aggression, and violent behavior. These side effects can put the user and the people around them at risk. The depressive symptoms are primarily reported after the user discontinues use of steroids. Post-cycle depression is one of the most dangerous psychological side effects, as several studies in this review have documented suicides, showing the psychological side effects can be just as deadly as the physical side effects. Furthermore, a literature review conducted by Albano and colleagues (2021) demonstrated that supraphysiological doses of AAS obstruct neurotransmitter activity, specifically those controlling stress response and inhibition (Albano et al. 2021). This research helps to explain the phenomenon of "roid rage," as AAS are incredibly disruptive to the neurological system. It can be concluded that the physiological disruptions from steroids are the driving force behind the psychological symptoms experienced by athletes.

The psychological side effects of AAS are dangerous enough on their own, but they can become magnified if the user develops a dependence on these substances. Illustrated by information found in a 2008 literature review by Kanayama and colleagues, users of AAS are likely to conflate their muscularity and self-esteem. This body image disturbance can lead to athletes developing a dependence on steroids in order to maintain their self-esteem (Kanayama et al. 2008). Once a person is dependent on steroids, this can have drastic consequences to their physical health. They will continue to use AAS for longer periods of time and at higher doses, magnifying the physical side effects and putting their life at risk. Moreover, users might progress to high forms of substance abuse to cope with the psychological side effects. A literature review conducted by researchers at the University of Catania in Italy shows that during periods where users discontinue steroids, they frequently self-medicate with drugs or alcohol to dull the depressive symptoms (Albano et al. 2021). This progression to other substances can be even more antagonistic, as unlike steroids, there are no redeeming physical effects of drugs or alcohol. By showing how dangerous a dependency on AAS is, these sources solidify the magnitude of psychological damage that steroids can inflict.

Motivations for Use

Despite the clear links between AAS and negative physical and psychological effects, some people still argue they are worth using. Users feel that the benefits provided by steroids in the short term are worth risking their health for. The motivations of steroid use fall into two categories: improvements to strength and improvement to physical appearance. This is highlighted by a survey conducted by researchers at the University of Connecticut. The survey aimed to understand the motivations behind using AAS and had 2,385 respondents. Of the respondents, 82.2% indicated that aesthetic improvements were a motivational factor in using steroids, and 50.0% said that increasing their physical strength was the reason (Bonnecaze et al. 2020). Users are so desperate for appearance and strength improvements that they willingly inject harmful substances into their body. This is further supported by another study conducted in the Netherlands, which sought to draw connections between body-image-centric social media use and the use of steroids. Researchers found that there was both a negative correlation between body image and aesthetic social media content consumption, and a positive

correlation between steroid use and aesthetic social media content consumption. They define aesthetic social media content as any fitness content with a focus on the subject's physique (Hilkens et al. 2021). Given these correlations, it can be concluded that negative body image increases likelihood of AAS use in individuals. This aligns with the findings of the 2020 study and reinforces the understanding that body image is a key driver in AAS users. Overall, it is evident that a negative body image may cause a person to use AAS in spite of the side effects.

The sheer effectiveness of steroids leads many users to believe the benefits justify the risks. In fact, AAS are the singular most effective method for muscle hypertrophy. To prove this, researchers tracked the fat free mass (FFM), a metric proportional to muscle mass, of men in four different groups: no exercise, testosterone with no exercise, placebo plus exercise, and testosterone plus exercise. The testosterone groups had the greatest increase, with an average percent increase to FFM of 9.1% in the exercise group and 6.1% in the no exercise group. The placebo groups grew significantly less, with a 2.1% increase in the exercise group and a decrease of 0.3% in the no exercise group (Bhasin et al. 1996). These numbers help contextualize the reason users believe steroids are worth the risk.

Steroid users, without stepping foot in a gym, will grow more muscle than someone on a rigorous resistance training program. This data indicates that if your primary goal is to build muscle and you don't care about the life-threatening side effects, you should take AAS. This is consistent with the beliefs held by users of AAS, where increasing muscle mass holds more value than their physical health. The study by Bonnecaze and colleagues (2020) demonstrated that 82.2% of AAS users indicated muscle hypertrophy as a primary reason for using AAS. Since users value muscle growth so greatly, it follows that they would risk their health for the hypertrophic effects of AAS.

AAS Awareness

There are undoubtedly people that choose to use AAS who are completely aware of the side effects, but shockingly, there are some users unaware of the harm AAS can cause. According to a literature review conducted by Kanayama and colleagues, some people believe low doses, cycling, or additional drugs like liver protectants can reduce risk. This claim is not supported by the pharmacological literature. Kanayama also indicates that the culture around AAS minimizes the side effects, resulting in users who are not making fully informed decisions (Kanayama et al. 2008). Because of misinformation regarding steroids, users are less likely to understand the breadth of risks, and may have a false sense of safety regarding these substances. Limited access to accurate information regarding AAS leads to a higher risk of abuse. The inverse is true as well; the more informed a person is about AAS, the less likely they are to abuse them.

The Adolescent Training and Learning to Avoid Steroids (ATLAS) program is an excellent example of this. ATLAS sought to measurably reduce the use of AAS among teenage athletes. Seven weekly sessions were delivered to over 1,500 high school football players, addressing AAS effects and dangers. The 9–12 month follow-up survey showed only 1.4% of participants of ATLAS used AAS, and 3.4% of the control group used AAS (Goldberg et al. 1996). What this demonstrates is people who thoroughly understand the harmful effects of AAS are significantly less likely to use these compounds. This finding corresponds to the conclusion that ill-informed people are more likely to abuse AAS. Ultimately, the scientifically proven side effects of AAS pose too much risk when thoroughly considered.

Conclusion

In summary, usage of AAS carries far too much risk to the users' health to justify the benefits. With potential to cause irreversible effects to multiple bodily systems, the use of steroids can lead to life-threatening consequences. Damage to the cardiovascular system caused by AAS is among the most life threatening, as atherosclerosis and cardiomyopathy present in long term users of AAS greatly increase the likelihood of cardiac death. Hormone imbalances caused by the surplus of exogenous testosterone have wide-reaching effects, impacting both the physical body and mental health of users. The psychological side effects are equally dangerous to the health of the user. Severe mood and personality disorders caused by the disruption to brain chemistry can cause users to transition to abusing other substances or in the worst cases, taking their own life. These side effects make it evident that AAS are far too hazardous to the user's health to justify the hypertrophy they stimulate. Spreading awareness of this fact will reduce the amount of deaths related to androgens.

References

Albano, G. D., et. al. (2021). Adverse Effects of Anabolic-Androgenic Steroids: A Literature Review. *Healthcare, 9*(1), 97. https://doi.org/10.3390/healthcare9010097

Bhasin, S., et. al. (1996). The Effects of Supraphysiologic Doses of Testosterone on Muscle Size and Strength in Normal Men. *New England Journal of Medicine, 335*(1), 1–7. https://doi.org/10.1056/nejm199607043350101

Bonnecaze, A. K., O'Connor, T., & Aloi, J. A. (2020). Characteristics and Attitudes of Men Using Anabolic Androgenic Steroids (AAS): A Survey of 2385 Men. *American Journal of Men's Health, 14*(6), 155798832096653.

Goldberg, L., et. al. (1996). Effects of a Multidimensional Anabolic Steroid Prevention Intervention: The Adolescents Training and Learning to Avoid Steroids (ATLAS) Program. *JAMA: The Journal of the American Medical Association, 276*. https://www.ohsu.edu/sites/default/files/2019-06/JAMA-ATLAS.pdf

Hilkens, L., et. al. (2021). Social Media, Body Image and Resistance Training: Creating the Perfect "Me" with Dietary Supplements, Anabolic Steroids and SARM's. *Sports Medicine - Open, 7*(1). https://doi.org/10.1186/s40798-021-00371-1

Kanayama, G., Hudson, J. I., & Pope, H. G. (2008). Long-term psychiatric and medical consequences of anabolic–androgenic steroid abuse: A looming public health concern? *Drug and Alcohol Dependence, 98*(1-2), 1–12. https://doi.org/10.1016/j.drugalcdep.2008.05.004

Kanayama, G., & Pope, H. G. (2018). History and Epidemiology of Anabolic Androgens in Athletes and non-athletes. *Molecular and Cellular Endocrinology, 464*, 4–13. https://doi.org/10.1016/j.mce.2017.02.039.

Mubarak, G., et. al. (2025). Abnormalities in Blood Parameters in Athletes Taking Anabolic Androgenic Steroidal Agents; an Observational Clinical Study. *Substance Abuse and Rehabilitation, 16*, 1–12. https://doi.org/10.2147/sar.s495789

Webb, C. M., & Collins, P. (2017). Role of Testosterone in the Treatment of Cardiovascular Disease. *European Cardiology Review 2017, 12*(2). https://doi.org/10.15420/ecr.2017:21:1

Are APUs the Future of Computing?

J.J. Reams

Writer's Statement

My name is J.J. Reams. I am currently a first-year Electrical Engineering student in the ECE department at Michigan Technological University. I have always had a deep interest in technology, from smart watches to supercomputers, they fascinate me. This being so, when I needed to choose a topic for research in my composition class, I knew it had to be something tech related. After some brief digging, I decided to choose APUs. I have known what they are for a long time, but there is a lot to them that I had never considered before, so I thought they'd be a fun choice. While it ended up being much more work than I had anticipated, I'm glad I chose APUs as my topic, and I hope you find them as interesting as I do.

Introduction

From smartphones to supercomputers, they are everywhere, and come in countless different shapes and sizes. New ideas and inventions constantly emerge; some are much less impactful, and many only affect a small sector of computing, leaving the rest as it was, while others significantly change how computers function and how people use them. One such invention is the accelerated processing unit, or APU. Many different terms are used to describe APUs. In this article, the term APU, coined by Advanced Micro Devices (AMD), one of the world's largest semiconductor manufacturers, will be used. An APU is a combination of a graphics processing unit (GPU) and a central processing unit (CPU) (AMD Fusion APU Era Begins, 2011). Both the CPU and GPU play critical roles in most computers, and the combination of the two into a single unit could have major impacts on computing as a whole. Although APUs are not yet perfect, they are likely to play a major role in the future of many computing sectors.

Background

APUs are not a new concept. AMD's Fusion project launched its first generation of APUs in 2011 (AMD Fusion APU Era Begins, 2011). While these processors pale in comparison to most modern-day processors, and even many from that era in terms of raw processing power, their launch marked a turning point in processor technology. Many AMD APUs are designed for consumers, especially in laptops and compact systems. However, they are also used in professional computing, and some variants of these combined chips are designed almost exclusively for that sector. The origins of these other variants are scattered widely, with some being fifty years old, and others being far newer than even Fusion. The "professional sector" is not a small category. It describes essentially anything not for the "average at-home user." It classifies a vast array of situations and processes, some with little or no relation to each other, and others very closely related. A key part of the professional sector is something called parallel computing. Parallel computing is "a process where large compute problems are broken down into smaller problems that can be solved simultaneously" (Flinders & Smalley, 2025). While this is a technique taken advantage of in nearly every modern computer, it plays a uniquely important role in professional sector processes, such as machine learning. Without parallel computing, machine learning algorithms and many other things would take such an extreme length of time to execute that it would be impossible to run them.

Hardware Architecture and Performance

There are many different aspects to APUs that give them an advantage over traditional computer hardware, but there are also aspects that reduce their potential effectiveness in real-world applications. Traditional discrete graphics, utilizing a separate GPU, can enable a more computationally powerful graphics processor, but discrete graphics also come with specific downsides that APUs aim to address. One such downside is the requirement of the Peripheral Component Interconnect Express (PCIe) bus to transfer data to and from the GPU. PCIe is a bus that is used to transfer data quickly between a computer and external devices. One of the most common devices is a discrete GPU, but many other devices can also be used with PCIe. While PCIe is fast, it is not fast enough to keep up with the demands of the CPU's RAM, the GPU's RAM, and the CPU and GPUs themselves. RAM stands for Random Access Memory, and it is the location where data that is actively being used, was recently used, or that is expected to be used soon is stored. RAM is absolutely critical to a computer's performance. As mentioned earlier, an APU has both a CPU and a GPU on one chip, so there is no need for PCIe to carry data back and forth. Thanks to the removal of this bottleneck, parallel overheads, "required execution time that is unique to parallel tasks, as opposed to that for doing useful work" (Introduction, n.d.), are cut significantly for data-intensive processes. Workloads with large transfers also receive faster end-to-end execution (the completion of the process from start to finish) because of this (Daga et al., 2011; Dashti & Fedorova, 2017). However, these gains are not always realized. For small transfers or activities that are heavy in translation, gains can be negated by address-translation costs—the performance cost to redefine the memory location of data to its actual location in memory (Arpaci-Dusseau, A., & Arpaci-Dusseau, R.H. n.d., p. 2)—and other such factors (Daga et al., 2011; Dashti & Fedorova, 2017).

If a discrete GPU has its own RAM, where does the GPU in an APU store data? APUs utilize something called unified memory. Unified memory is RAM that is shared between the CPU and GPU. Normally, if both the CPU and GPU need the same data, it must be written twice. One copy is stored in system memory for the CPU, while another is stored in the GPU's RAM, known as Video Random Access Memory (VRAM). This extra writing of data takes time and can slow down performance. With unified memory, this is much less of an issue since both the CPU and GPU draw from the same memory pool. The physical distance between the CPU and GPU also makes a difference, so having them closer to each other makes for faster data transfer. However, unified memory is not perfect. Unified memory can get overwhelmed by having a CPU and GPU talking to it at the same time, as it only has so much bandwidth (Dashti, M. & Fedorova, A., 2017, pp. 59–60).

Energy efficiency is something that has begun to matter quite a bit, and APUs tend to be rather energy efficient. With both the CPU and GPU on a single chip, less power is wasted moving data around. Having both processors on the same chip also means that they share power limits. This inherently reduces power consumption, but it can also reduce performance in tasks that require extremely high graphics power compared to a discrete GPU (Intel Corporation, n.d.). Power is also saved in cooling. In a computer with a discrete GPU, the GPU generally needs its own dedicated cooling solution, which consumes some extra power, but with an APU, there isn't a discrete GPU, so cooling it is irrelevant.

APUs provide an appealing balance of speed, cost, and efficiency for many uses. They show how hardware design is moving toward combining multiple specialized components into one unit, which can lead to smarter, more efficient computers overall. As chip manufacturers continue to refine APU technology, the performance gap between integrated and separate processors continues to narrow, and the unique advantages of APUs continue to shine through in new, exciting ways (Dev, K., Reda, S., 2016, pp. 78–79).

Software and Scheduling Challenges

While the hardware innovations behind APUs offer significant potential, their success in real-world applications depends heavily on the software and scheduling systems that manage heterogeneous computing tasks. Since an APU integrates a CPU and a GPU on the same die, it shares power, memory, and bandwidth resources, as discussed earlier. This design introduces new challenges for operating systems and runtime schedulers, which must decide how to allocate workloads between the CPU and GPU efficiently. Traditional task scheduling developed for systems where CPUs and GPUs are separate components often fails to account for shared resource contention and interdependent performance effects (Dev et al., 2018). Thus, in systems with APUs, the scheduler must evaluate the type of workload, whether it is highly parallel or sequential, and assign it to the most appropriate processing unit (Dev, K., Reda, S., 2016, p. 78). For instance, a large matrix multiplication task used in neural network training may be better suited for the GPU's parallel processing units, while control-heavy logic, where the computer focuses on directing the flow of execution rather than performing complex calculations, or branching workloads may perform better on the CPU (Zhu, Q. et al., 2017, pp. 967–970).

A core challenge in this hybrid scheduling process is heterogeneous workload balancing. Since both the CPU and GPU share unified memory and data buses, they often compete for the same resources. Without intelligent scheduling, one component can easily starve the other of memory bandwidth or cache access, leading to decreased performance (Dashti, M., Fedorova, A., 2017, pp. 59–63). Cache is RAM-like storage on the chip itself that is much smaller than RAM, but also much faster. Studies have shown that APUs experience significant slowdowns under basic scheduling approaches but can achieve throughput improvements of 9–46% when schedulers dynamically balance workloads and manage interference (Zhu, Q. et al., 2017, pp. 971–975). To address this, researchers have proposed co-aware schedulers that monitor real-time utilization and adjust workload distribution accordingly (Dev & Reda, 2016, pp. 78–81). These schedulers not only improve computational efficiency but also ensure consistent performance in professional contexts such as scientific computing and data analytics.

Another critical software concern is memory coherence and consistency in unified memory systems. Traditional architectures keep CPU and GPU memory separate, requiring data to be explicitly transferred between the two. While APUs eliminate this need through shared physical memory, they also introduce complexity in maintaining data consistency between processing units. The operating system and runtime environment must ensure that both the CPU and GPU always have synchronized views of shared data (Dashti, M., Fedorova, A., 2017, pp. 60–63). Failure to do so can result in race conditions (where the outcome is essentially reduced to random chance) or data corruption, which are unacceptable in professional computing environments where precision and reproducibility are of the utmost importance. Furthermore, maintaining this introduces computational overhead that can displace some of the performance gains provided by other areas of APUs.

Power and thermals were briefly touched on earlier as part of APUs' potential energy efficiency gains, but they also add another layer of complexity to APU scheduling. Since both the CPU and GPU occupy the same chip, their temperatures directly affect one another. When one unit runs at maximum, it can limit the thermal headroom available to the other, forcing frequency throttling (reduction in speeds) and reducing overall system performance (Dev et al., 2018). Intelligent thermal-aware schedulers must therefore predict and manage power distribution between the CPU and GPU dynamically, balancing performance with thermal stability.

Software challenges definitely represent one of the greatest barriers to unlocking the full potential of APUs in professional and high-performance computing. As new research reveals

ways to streamline scheduling and other software processes related to APUs, APUs are expected to continue becoming an increasingly viable option for professional computing processes.

Discussion: Strengths and Limitations of APUs in the Professional Sector

After examining both the hardware and software aspects of APUs, it becomes clear that these processors represent a significant step forward in the evolution of computing. By integrating a CPU and GPU onto a single chip, APUs offer a blend of efficiency, compactness, and speed that has meaningful implications for both consumer and professional computing. However, these advantages are balanced by a range of limitations related to scalability, software support, and performance under demanding workloads. A comparative look at the strengths and weaknesses of APUs helps illustrate why they have become so influential, and why they are not the universal solution for high-performance computing.

The most prominent strength of APUs lies in their efficiency. Because data does not need to travel across the PCIe bus to a separate graphics card, latency is reduced, as is power consumption (Daga, M. et al., 2011, p. 141). Unified memory, which allows both the CPU and GPU to access the same data pool, minimizes the duplication of data and improves end-to-end throughput for many workloads (Dashti, M., Fedorova, A., 2017, pp. 60–63). This efficiency advantage makes APUs especially appealing in applications where compactness, energy savings, and low heat output are priorities, such as embedded systems and professional edge devices (Intel Corporation, n.d.). Hewlett Packard Enterprise describes edge devices as "computing devices near the network's edge, usually near data sources or consumers… Their local data processing prowess significantly reduces latency and response time, surpassing the capabilities of traditional data centers or clouds" (Hewlett Packard Enterprise, n.d.). Moreover, having both processors on the same die allows for improved coordination between serial and parallel workloads. The CPU can manage complex branching logic and scheduling, while the GPU can perform massively parallel computations simultaneously, resulting in smoother execution across mixed workloads (Dev, K., Reda, S., 2016, pp. 78–80).

Another major advantage of APUs is accessibility. Traditional high-performance systems equipped with discrete GPUs are expensive and consume significant power. This creates a barrier for smaller research groups, educators, and professionals who need computing capability without building a dedicated workstation or cluster. APUs reduce both hardware and operational costs by combining multiple compute functions within a single unit (AMD, 2011). This opening of high-power parallel computing to a larger audience enables broader participation in computationally intensive fields such as data science, engineering, etc. As chip technology continues to advance, APUs are expected to further narrow the performance gap between integrated and discrete processors.

Energy efficiency also plays a growing role in the appeal of APUs. Modern computing faces increasing demands for sustainability, with data centers and personal devices alike pressured to lower their environmental impact. Because APUs consolidate two major processors and often share cooling systems, they waste less energy and produce less heat. These gains, while small on a single-system level, scale significantly when applied across thousands of units in enterprise or institutional environments (Intel Corporation, n.d.). The trend toward hybrid chips continues to reinforce the idea that integration can deliver not just speed, but also sustainability.

Despite their many advantages, APUs face critical limitations that have prevented them from fully replacing discrete computing systems. One of the most prominent challenges is scalability. While integration improves efficiency for moderate workloads, it also limits performance headroom for extremely intensive tasks such as large-scale machine learning training or advanced scientific simulations. In these cases, dedicated GPUs with higher memory

bandwidth and specialized VRAM still outperform integrated solutions by a wide margin (Zhu, Q. et al., 2017, pp. 967, 972–973, 975). Because APUs share power and thermal limits between CPU and GPU cores, pushing one component to its maximum can throttle the other, leading to less than ideal returns under sustained heavy loads (Dev et al., 2018).

Memory bandwidth is another limiting factor. Unified memory simplifies data management but can also become a bottleneck when both the CPU and GPU attempt to access the same data simultaneously. Dashti and Fedorova (2017) found that address translation and coherence maintenance introduce enough overhead that they can begin to erode the benefits of unified memory in highly parallel workloads. This limitation becomes particularly evident in high-performance professional applications such as real-time rendering or scientific modeling, where data throughput is critical.

Software complexity compounds these hardware challenges. As Kaur et al. explain, the complexity of modern hardware architectures makes efficient software scheduling increasingly critical. Traditional schedulers, originally built for homogeneous or single-device systems, struggle to manage the distinct processing characteristics of CPUs and GPUs within heterogeneous environments. Consequently, researchers continue to develop advanced, adaptive scheduling algorithms that can dynamically balance workloads between CPU and GPU resources to optimize performance and energy efficiency (Kaur et. al., 2025, pp. 1–3, 9–12). Developers must contend with new issues and complexities that complicate the optimization process. Thanks to this, realizing the theoretical performance potential of APUs often requires custom-tuned software, a barrier that can limit their broader adoption in professional environments.

The dual nature of APUs, highly efficient yet inherently constrained, reflects the trade-offs that often define technological innovation. For many applications, particularly those emphasizing cost efficiency, moderate parallel workloads, or other such needs, APUs are a great solution that merges the strengths of CPUs and GPUs into a unified, energy-efficient package. However, for situations that prioritize raw throughput, high scalability, or specialized acceleration (such as deep learning or high-end 3D rendering), discrete hardware remains the superior choice.

The future of APUs likely depends on continued improvements in memory bandwidth, power management, and programming support. As software ecosystems mature and chip manufacturers adopt hybrid architectures with high-bandwidth memory and AI-specific cores, many of the current limitations could be mitigated. In this sense, APUs likely will not completely replace traditional discrete systems, but they do represent a crucial step toward the broader vision of unified, efficient, and accessible computing. Their balance of practicality and performance ensures that they will remain an influential part of computing's evolution for years to come.

Conclusion

Accelerated processing units embody the growing convergence of performance and efficiency in modern computing. By integrating CPU and GPU functionality into a single chip, APUs nearly eliminate data transfer bottlenecks in many scenarios, often reduce power consumption, and can improve accessibility. Although challenges still constrain their use in high-end workloads, ongoing advances in programming for these chips, unified memory, and chip design continue to narrow these gaps.

The future of APUs likely lies in continued convergence: not merely between CPUs and GPUs, but among entire ecosystems of specialized accelerators designed for artificial intelligence, simulation, and data analysis. As research into adaptive scheduling, unified

memory architectures, and chiplet-based designs advances, APUs may evolve into a new class of “universal processors” capable of balancing flexibility with raw power. While discrete hardware will always have its place, APUs capture the central spirit of modern computing: efficiency through integration. In this way, they are not just a glimpse of the future; they are already shaping it.

References

AMD Fusion APU era begins. (2011, January 4). Advanced Micro Devices, Inc. https://ir.amd.com/news-events/press-releases/detail/168/amd-fusion-apu-era-begins

Arpaci-Dusseau, A., & Arpaci-Dusseau, R. H. (n.d.). Mechanism: Address Translation. In Operating Systems: Vol. VERSION 1.10 (pp. 3–4). https://pages.cs.wisc.edu/~remzi/OSTEP/vm-mechanism.pdf

Daga, M., Aji, A. M., & Feng, W. (2011, July 1). On the Efficacy of a Fused CPU+GPU Processor (or APU) for Parallel Computing. *Symposium on Application Accelerators in High-Performance Computing (SAAHPC)* https://doi.org/10.1109/SAAHPC19302.2011

Dashti, M., & Fedorova, A. (2017). Analyzing memory management methods on integrated CPU-GPU systems. *ACM SIGPLAN Notices, 52*(9), 59–69. https://doi.org/10.1145/3156685.3092256

Dev, K., et. al. (2018, August 29). *Implications of Integrated CPU-GPU Processors on Thermal and Power Management Techniques.* Ar5iv. https://ar5iv.labs.arxiv.org/html/1808.09651

Dev, K., & Reda, S. (2016). Scheduling Challenges and Opportunities in Integrated CPU+GPU Processors. *ESTIMedia’16: Proceedings of the 14th ACM/IEEE Symposium on Embedded Systems for Real-Time Multimedia*, 78–83. https://doi.org/10.1145/2993452.2994307

Fang, J., et. al. (2023). A perceptual and predictive batch-processing memory scheduling strategy for a CPU-GPU heterogeneous system. *Frontiers of Information Technology & Electronic Engineering, 24*(7), 994–1006. https://doi.org/10.1631/FITEE.2200449

Flinders, M., & Smalley, I. (2025, July 22). What is parallel computing? IBM. Retrieved October 2, 2025, from https://www.ibm.com/think/topics/parallel-computing

Intel Corporation. (2024). *What Is the Difference Between Integrated Graphics and Discrete…* Intel. https://www.intel.com/content/www/us/en/support/articles/000057824/graphics.html

Introduction to Parallel Computing Tutorial | HPC @ LLNL. (n.d.). https://hpc.llnl.gov/documentation/tutorials/introduction-parallel-computing-tutorial

Kaur, R., Asad, A., Wahid, S. A. A., & Mohammadi, F. (2025). A survey of advancements in scheduling techniques for efficient deep learning computations on GPUs. *Electronics, 14*(5), 1048. https://doi.org/10.3390/electronics14051048

Hewlett Packard Enterprise Development LP. (n.d.) *What is an Edge Device | Glossary*. https://www.hpe.com/us/en/what-is/edge-device.html

Zhu, Q., Wu, B., Shen, X., Shen, L., & Wang, Z. (2017). Co-Run Scheduling with Power Cap on Integrated CPU-GPU Systems. *2022 IEEE International Parallel and Distributed Processing Symposium (IPDPS)*, 967–977. https://doi.org/10.1109/ipdps.2017.124

Scouting and its Impact on Youth

Lucas Centner

Writer's Statement

During my youth, I wasn't sure of much. But one thing that I was sure about was scouting. I feel as though Scouting has helped make me become the person I am today. I have learned countless lessons, made many memories, and it has provided me with many opportunities that I am grateful to have had. I cherish the times I had in Scouting, and when my composition teacher explained this paper to our class, it seemed like a no-brainer to choose this topic. My main research question is "What are the potential benefits, if any, of youth participation in scouting?" Across all of my research, there was one prevailing opinion amongst all of the sources that I had gone through. This consensus was that involvement in Scouting programs is beneficial for youth, and sets them up for success currently and later in life. Even in the public opinion sources that I had gone through, I had little against participation in scouting programs.

An Introduction to Scouting

The Scouting Movement is well known around the globe and has existed for over a century. The Scouting movement was led by Robert Baden-Powell of Great Britain. Baden-Powell, born February 22, 1857, in London, England, was an officer in the British Army and became a national hero for his defense of Maheking, a city now called Mahiking in present-day South Africa, during the Second Boer War. During the war, Baden-Powell wrote a military textbook in 1899 titled *Aids to Scouting*, promoting his unorthodox methods of leading troops through small teams called patrols. Despite being intended for the army, many youths were reading his book and copying his methods. After learning this, Baden-Powell reworked his book for a younger audience and published *Scouting for Boys* in 1908. *Scouting for Boys* was intended to be a guidebook for youth organizations that existed in 1908, but quickly became the handbook of the growing Scouting movement at the time. In 1907, while Baden-Powell was writing *Scouting for Boys*, Baden-Powell hosted a camp for boys on Brownsea Island, an island off the coast of England, where he took 20 boys from different socioeconomic backgrounds camping and put his methods to the test. This camp of 20 boys run by Baden-Powell is widely recognized as the start of the scouting movement (*Britannica*).

At this camp, Baden-Powell split the boys into groups of six or seven, which he called "Patrols" and had the boys in each patrol elect a leader called the "Patrol Leader." This patrol system is very similar to the patrols found within Baden-Powell's *Aids to Scouting*. The patrol leader would lead and direct the boys within his patrol to learn outdoor skills such as tracking, reconnaissance, mapping, signalling, knot-tying, first aid, and several other skills. Baden-Powell (1908) also placed strong emphasis on certain values within *Scouting for Boys* with the "Scout Law," which states:

> 1. A Scout's Honour is to be Trusted. 2. A Scout is Loyal 3. A Scout's Duty is to be Useful and to Help Others. 4. A Scout is a Friend to All, and a Brother to Every Other Scout, no matter to what Social Class the Other belongs. 5. A Scout is Courteous: 6. A Scout is a Friend to Animals 7. A Scout Obeys Orders of his patrol leader or Scout master without question. 8. A Scout Smiles and Whistles 9. A Scout is Thrifty (pp. 49–51).

The Scout Law is meant to be a set of guidelines that a Scout would follow through their daily activities. Baden-Powell (1908) also put the Scout Oath into *Scouting for Boys*, which states:

> You all take the Scout's Oath, that is you promise, *on your honour*, three things, namely: 1. To be loyal to God and the King. 2. To help other people at all times. 3. To obey the Scout Law (p. 20).

The Scout Oath is similar to the Scout Law in the way that it is a set of guidelines; however, they differ in that the Scout Oath is seen as a promise that one takes, while the Scout Law is a list of characteristics that a Scout would aim to have. The Scout Oath is also related more to overall society with the first point, "To be loyal to God and the King" and the second point, "To help other people at times." The first point is encouraging Scouts to be loyal to a higher belief and their country, and the second point is encouraging Scouts to help other people at all times, with no expectation of reward or compensation. With the success of the camp and the release of *Scouting for Boys*, providing a clear framework of values and clear instructions of leadership practices for others to utilize, the Scouting movement quickly took off and spread all over the globe with 176 different national Scouting organizations. While the Scouting movement has evolved over the years, it has still held onto its core values found in the Scout Law and Scout Oath from within *Scouting for Boys* with little to no variation.

The Current Youth Crisis

Worldwide, today's youth are faced with many challenges and stressors not seen before. These challenges have caused a troubling increase in mental health conditions in younger age groups compared to their older counterparts. The Agency for Healthcare Research and Quality (HRSA, 2022), a government agency dedicated to health research and data collection in the United States, reported that mental health disorders are increasing sharply among younger populations. Nearly 15% of people ages 10–19 experience a mental health disorder, contributing to 13% of the disease burden — a measure of the overall impact that health conditions have on a population — in this age group.

Further findings from HRSA (2022) paint an increasingly concerning picture of youth mental health in the United States. Among children ages 2–8, 17.4% had a diagnosed mental, behavioral, or developmental disorder. For youth ages 12–17, 20.9% experienced major depressive disorder at least once, 36.7% reported persistent feelings of sadness or hopelessness over a one-year period, and 18.8% had seriously considered attempting suicide. Additionally, the rate of youth receiving specialty mental health care rose from 11.8% in 2002 to 16.7%, and depression diagnoses among children ages 3–17 increased by 27%. Together, these statistics paint a troubling picture of the mental health challenges facing today's youth.

Despite these concerning statistics about the condition of today's youth mental health, several courses of action can be taken to improve their mental health. According to the United Kingdom's National Health Service (2022), several actions can be taken to improve mental health. These include connecting with other people, being physically active, learning new skills, giving to others, and being mindful of the moment. Scouting allows youth to do all five of these activities that are beneficial to mental health. To elaborate, Scouting brings together youth of different backgrounds and helps foster camaraderie and friendship between them. Scouting also leads to routine social activities for youth to look forward to, such as meetings, campouts, and various other activities. Next, Scouting also promotes youth to be physically active on campouts and other activities. Another way Scouting also promotes youth to be physically active is within the requirements of ranks within Scouting, there are several physical fitness requirements that promote education and participation in physical activity.

Continuing on, Scouting provides youth opportunities to learn new skills. As previously mentioned in this paper, Baden-Powell led the group of scouts during the time at his camp and taught them several outdoor skills. Scouting also provides youth opportunities to give to others

through volunteering; a big component of scouting is volunteering. Lastly, scouting provides youth with an opportunity to practice mindfulness through other outdoor activities.

Scouting Sets Youth Up For Success

Scouting has been shown to provide other benefits to youth to help them both short term and long term. Scouting does this by providing an opportunity to exercise leadership and cooperate with others, leading to increased self-confidence, improved social skills, and increased academic achievement. This was found in a study conducted by several researchers from the University of Almeria in Spain. The researchers conducted a study on 430 youth aged 13–17 years old, with half of the youth being a participant in Scouting and the other half not participating in Scouting. The youth consisted of 49.8% boys and 50.2% girls, with an average age of 14.82 years. With this group of students, researchers used several questionnaires, such as the Rosenberg Self-Esteem Scale, the Social Skills Scale, and an academic questionnaire, to collect data on the relationship between the youth, participation in Scouting, and self-esteem, academic achievement, conflict resolution, social skills, and various other qualities. With the data that the researchers collected, they came to several conclusions about Scouting participation. Asensio-Ramon et al. (2020) found that teens that participated in Scouting activities had better academic performance and conflict resolution skills versus teens who don't participate in Scouting activities. The researchers also acknowledged that their findings are consistent with other studies on informal education settings, including Scouting, further indicating that these environments positively influence the personal and interpersonal skills of younger children and teens. The researchers attributed this positive relationship between Scouting and academic performance to the development of discipline, confidence, and increased willingness to confront challenging experiences found within the Scouting program. This study concluded that youth participation in Scouting is very likely shown to have various positive effects on youth, with youth that participated in Scouting outscored their non-Scouting peers on all the questionnaires that the researchers had collected. Overall, this study found that it is beneficial for youth to participate in Scouting, and it is not the only study to find this result.

The following study, conducted by the University of Tartu, also found these results by collecting surveys of Scouting participants. However, in addition to the surveys, researchers also conducted focus group interviews, with a total of 38 participants in these more personal interviews. Within the many findings of the focus group interviews, these following conclusions are notable. Kasearu et al. (2020) found that Scouting was associated with long term positive emotions, which in turn increased youth's energy and motivation in other aspects of their lives. The researchers also noted that many respondents had said something along the lines of how Scouting allows them to put themselves to the test, do things independently, and take responsibility for their actions in a low stakes environment. The respondents also explained how this had given them more self-confidence and made them courageous in their daily lives. A particularly noteworthy conclusion from this study was the aforementioned ability to do things independently.

In today's society, it seems that youth have diminishing autonomy compared to their parents and their parents have less autonomy than their parents' parents. Scouting creates an unique environment where youth have a higher degree of independence than they normally would. This more independent environment, which is laid out in Baden-Powell's *Scouting for Boys*, allows for personal growth which many other activities that youth do simply can't emulate due to their lack of independence. Another critical part of this paper is the inclusion of quotes from the respondents:

> I am more open to challenges and also bolder, it's the same thing again – that I dared to come here, that I take on more challenges in the future. I'd like to become a veterinarian but it isn't completely certain, maybe Scouting will give me the courage to go and try out

> whether it's the right field for me. And if it isn't, so what, I will seize some other challenge. Plus, Scouting gives you motivation somehow … You're in your routine, you go to some event, help organize something and afterwards you feel like it was an energy boost for doing other things (Kasearu et al., 2020).

This study is particularly noteworthy because of these recorded statements from the participants during the focus group interviews. These statements provide a glimpse into the Scouting participants' perspective of the benefits of Scouting. According to these statements and from the researchers' conclusions, Scouting provides an environment for youth to put themselves outside their comfort zone in a low stakes, high reward environment, leading to increased self-confidence and better responsibility. Self-confidence and self-esteem are seen to have a positive impact on school performance as seen in this study facilitated by the university of Bern, Switzerland, in which the authors discuss various studies about self-esteem:

> The success orientation of high self-esteem students makes them more engaged and persistent in achievement contexts, and more likely to exhibit adaptive cognitive and emotional reactions to challenge, which then increases the likelihood that they will do well in school (Covington, 1989). Moreover, self-esteem is associated with higher levels of self-efficacy, which increases the use of adaptive self-regulatory strategies (Pintrich & de Groot, 1990) and promotes motivation and task engagement (Green et al., 2012). Finally, high self-esteem is a coping resource that contributes to persistence after academic failure (Baumeister et al., 2003; Orth & Robins, 2022).

This study states that there are a plethora of benefits of high self-esteem and self-confidence, including being well adapted to challenge, having higher self-efficacy, and being tenacious after failure. Tying these statements back to the previous studies in this section of the paper, which show that Scouting increases self-esteem and self-confidence, among other traits, can also be seen to have the benefits of increasing adaptability to challenge, increased self-efficacy, and improving tenacity. Overall, Scouting can help set youth up for success in the present and in their future by improving various traits and aspects of their lives and preparing them to face adversity head on.

Scouting and Citizenship

When one hears "citizenship," their first impression of the word may be the right to participate in elections and enjoy certain privileges. However, there is another meaning of the word. The Oxford dictionary also defines citizenship as "the quality of an individual's response to membership in a community" (Oxford, 2026). According to this definition, a good citizen is one who responds positively to their membership in their community. This can be related to the Scout Oath with the first point, loyalty to God and one's country, in which loyalty to one's country can be seen as having good citizenship. One way one can respond to their community is by voting. The study found earlier in this paper, conducted by the University of Tartu, also found that Scouts have higher participation in elections.

> A total of 64.5% of the respondents in the Scout study, aged 16–26, turned out to vote in the 2017 local elections, and 74% plan to vote in the next elections. As these respondents included those who were 16–26 years of age in 2017, we see that the turnout was 79% in the elections. Polls conducted across the country showed that 59% of the 24,000 youths aged 16–17 cast a vote, and by age, the turnout was even lower in the following youth age groups. In comparison, overall turnout at the 2017 local elections was 53.3% of all Estonian citizens eligible to vote. Thus, youths involved in Scouting are politically more active than their peers and the society as a whole (Kasearu et al., 2020).

The evidence found in the study shows that Scouts voted more as a percentage of their age group versus their non-Scouting peers. This means that participation in Scouting could be shown to increase the likelihood of one being involved in local politics and elections, therefore being more involved in one's community and fulfilling their duty as a citizen. Another way Scouting helps one be a better citizen can also be found in the Scout Oath, with the second point, help others at all times. Any act of helping another, no matter how big or small the impact it has, can be seen as a net positive for the community. Overall, Scouting can be seen as a way to help youth become better citizens by improving participation in politics and voting, and by encouraging them to help other members of their community.

Conclusion

The Scouting movement can have a wealth of benefits for youth who participate in it. Scouting participation can improve mental health and help prevent certain mental health disorders, such as anxiety and depression, by providing youth with routine social interactions, promoting physical fitness, facilitating the learning of new skills, providing opportunities to get outside and reconnect with nature, and to practice mindfulness. Scouting participation also sets youth up for success in the present and the future by improving their leadership skills, self-esteem and confidence, social skills, better academic performance, improved self-efficacy, and the ability to persevere under pressure. Finally, Scouting benefits society by making youth better citizens of their community through increased political participation and the promotion of selfless acts to others. While seen as a traditional old school activity, Scouting still presents itself as a viable activity with solutions to the problems of youth and has many benefits in store.

References

Agency for Healthcare Research and Quality. (2022). Child and adolescent mental health. In *2022 national healthcare quality and disparities report* (pp.73–82). https://www.ncbi.nlm.nih.gov/books/NBK587174/

Asensio-Ramon, J., Álvarez-Hernández, J. F., Aguilar-Parra, J. M., Trigueros, R., Manzano-León, A., Fernandez-Campoy, J. M., & Fernández-Jiménez, C. (2020). *The influence of the Scout movement as a free time option on improving academic performance, self-esteem and social skills in adolescents. International Journal of Environmental Research and Public Health*, 17(14), 5215. https://doi.org/10.3390/ijerph17145215

Baden-Powell, R. (1908). *Scouting for Boys*. Dover Publications https://www.gutenberg.org/files/65993/65993-h/65993-h.htm

Britannica Editors. (2026, February 18). Robert Baden-Powell, 1st Baron Baden-Powell. *Encyclopaedia Britannica*. https://www.britannica.com/biography/Robert-Stephenson-Smyth-Baden-Powell-1st-Baron-Baden-Powell

Kasearu, K., Otstavel, S., & Truusa, T.-T. (2020). *Perceived influence of Scouting on personal development, skills and future prospects*. University of Tartu. https://skaut.ee/images/Dokumendid/TU_skautluse_mojuuuringu_raport_EN.pdf

National Health Service (NHS). (2022, December 16). *5 steps to mental wellbeing*. https://www.nhs.uk/mental-health/self-help/guides-tools-and-activities/five-steps-to-mental-wellbeing/

Orth, U., & Robins, R. W. (2022). *Is high self-esteem beneficial? Revisiting a classic question. American Psychologist, 77(1), 5–17.* https://doi.org/10.1037/amp0000922

Oxford English Dictionary. (2023). *Oed.com*. https://doi.org/10.1093//OED//3970756571

Szałachowski, R. R., Weronika Własak, & Wioletta Tuszyńska-Bogucka. (2024). *Scouting as a Scouting as a strategy in support of mental health development through the formation of sense of self-efficacy. Brain Sciences*, 14(12), 1268. https://doi.org/10.3390/brainsci 14121268

Meet the Editors

Here, we present some brief background on the members of our hard-working editorial teams. This student-operated journal wouldn't be possible without the help of every person listed here. From the bottom of our hearts, we thank you for reading this issue of our journal!

Enterprise Biographies

Jamie Perlman is the president of Ink & Ore Enterprise at Michigan Tech, Paw Prints team lead, and a part of the original Paw Prints team. She is a fourth-year Scientific and Technical Communication major at Michigan Tech from Ann Arbor, Michigan. She loves history, F1, automotive design and engineering, music, *Magic: The Gathering*, the Pleiades star cluster, and working on everything you have read and will read in this journal.

Devin Palczewski is the vice president of Ink & Ore Enterprise and is a member of the Kupari team. He is a third-year English Major from Macomb, Michigan and enjoys playing games, reading, and being outside in his free time.

Charles Driscoll is a first-year Scientific and Technical Communication major at Michigan Tech. They are involved with the Huskies Pep Band, WMTU, and are a new member of Ink and Ore Enterprise. He's from Chicago, Illinois and loves to read, write, and consume music however he can.

Rowan Kerns is a fourth-year Scientific and Technical Communication major at Michigan Tech. They were a part of the initial editorial leadership team for Paw Prints, and now work with Paw Prints for the Ink and Ore Enterprise. They are from Ann Arbor, Michigan and love drawing, playing guitar, and spending lots of time outside.

Max Meyer is a fourth-year Scientific and Technical Communication major from River Forest, Illinois. His areas of interest include video game development and creative writing.

Brendan Philo is a fifth-year Scientific and Technical Communication major with minors in Psychology and Philosophy. He is from Lowell, Michigan, and he loves bonfires with friends and night drives.

Bella Wicker isa third-year Cybersecurity major from St.Johns, Michigan. She currently works as the editorial assistant for *The Lode* and likes sewing and Minecraft.

Faculty Advisors' Biographies

Holly Hassel has been a professor in the Department of Humanities and director of the first-year writing program at Michigan Tech since 2023. She has previously taught at North Dakota State University and the University of Wisconsin-Marathon County. Her areas of expertise are

writing studies, writing program administration, and writing assessment. As Director of First-Year Writing, she teaches writing students and mentors writing instructors as they integrate *Paw Prints* into the curriculum.

Prof. M. Bartley Seigel is the author of *In the Bone-Cracking Cold* (Wayne State University Press, 2025) and *This Is What They Say* (Typecast Publishing, 2013). A former Poet Laureate of Michigan's Upper Peninsula and Academy of American Poets Laureate Fellow, his poems have appeared in literary journals such as Poetry Magazine, Michigan Quarterly Review, About Place, and Split Rock Review, among many others. He is Writing Center Director and Associate Professor of Creative Writing at Michigan Technological University.

Authors' Biographies

Lucas Centner is a first-year Electrical Engineering major. He is from Fraser, Michigan, and enjoys swimming, fishing, tennis, and everything outdoors.

Ella Karbowski is a first-year Anthropology student with a minor in Art. Ella is from Midland, Michigan, and grew up with a love for all things outdoors. She is an avid skier, disc golfer, and hiking enthusiast. She joined the Delta Phi Epsilon sorority during her first semester at Michigan Tech. Ella loves to travel and wants to experience as many things as possible. She works at Mount Bohemia in the winters but also loves spending summers in Houghton.

Justin Lask is a second-year student studying Mechanical Engineering.

Daniel Staats is a first-year Computer Engineering major who is from Issaquah, WA, but now lives in Scotts, MI. He enjoys hiking, cooking, and Magic: The Gathering.

Seth Tartamella is a first-year Applied Ecology major. He is from Rochester Hills, Michigan and enjoys reading, baking, and backpacking. He prefers toast with butter and jam.

J.J. Reams is a first-year Electrical Engineering major at Michigan Tech. He is from Pinckney, Michigan, and enjoys a variety of activities, including water sports such as fishing and jet skiing, playing video and board games alone or with friends, and messing with his PC and other tech.

Dylan Walsh is a first-year Mechanical Engineering student. He is from St. Joseph, Michigan, and enjoys working out, playing video games, *Magic: the Gathering*, and snowboarding.

Coral Weidenbach is a first-year Environmental Science & Sustainability major with a minor in International Spanish. They are from Waterford, Michigan, and enjoy hiking, line dancing, reading, making crafts, and watching hockey.

Thank You to Our Reviewers & Copyeditors

Without the insightful and constructive feedback of our reviewers and copyeditors, the operations of our journal would be impossible. We are grateful to everyone who reviewed submissions for us this past semester:

Nick Abraham
(R & C)

Madison Baldwin
(R & C)

Sean Bennink
(R & C)

Chase Benson
(Reviewer)

Molly Bentley
(R & C)

Cody Carrico
(R & C)

Logan Cole
(R & C)

Emily Costigan
(R & C)

Jenna DeVries
(R & C)

Charles Driscoll
(R & C)

Helen Erickson
(R & C)

Kaylee Fowler
(R & C)

Lorelei George
(R & C)

Cal Gilbertson
(Reviewer)

Anna Hartz
(R & C)

Eliana Juntilla
(R & C)

Rachel Kinnamon
(R & C)

Scout Lex
(R & C)

Alex Light
(R & C)

Max Meyer
(Copyeditor)

Frank Nguyen
(R & C)

Devin Palcewzki
(Copyeditor)

Brendan Philo
(Reviewer)

Yalmer Primeau
(R & C)

Rachael Roszman
(Reviewer)

Ryan Rothe
(R & C)

Baden Webster
(R & C)

Ryan White
(R & C)