Introduction

Dear Readers,

We are happy to present to you the first reworked and renewed Sabiduría Academic Journal. The Sabiduría Team worked very hard to enhance the publication. Under Associate Professor Robin Fiedler’s guidance, we have put together an anthology of student work truly worth the Dr. Floyd F. Koch Honors College.

Many students submitted their works in the hope of being part of the 2019 journal. Although only a few were selected, the decisions were difficult. The works compiled in this issue have all gone through a rigorous screening process to ensure that the best that Palm Beach State College has to offer is included. The screening process could not have been done without the help of the many volunteer Honors College Student Editorial Readers who took time out of their busy schedules to read and select these works.

On behalf of the entire Sabiduría Spring 2019 Team, we would like to sincerely thank Associate Professor Robin Fiedler and Honors College Manager Marcella Montesinos for their tireless work and efforts. Without their help, none of this would be possible. As well as a special thank you to Dr. David Pena for his help in mentoring the publication process of this academic journal.

Sincerely,

Christopher Sala and Shanice Guthrie
Sabiduría Editors

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Cover Art by Stephanie Val, PBSC Dr. Floyd F. Koch Honors College Student
A Perfect Brew by Jen Beebe

In February of 1692, a perfect brew of contention was simmering. In the months to come, it would boil over, and the result would be nearly two hundred convictions and the deaths of twenty-four innocent people – the victims of mass hysteria: those accused in the Salem Witchcraft Trials (Baker 10).

Witch hunts were prevalent in much of Europe for centuries. The French were wildly burning witches, and the English were busy at the gallows (Laden). Thousands of people died, and that does not include the millions of “heretics” often named witches, who were killed by the Inquisition (Laden). The Salem Town and Salem Village Witch trials could be called insignificant by comparison. Why then, are we still, three hundred years later consumed by these events?

Well, Americans like a good story, and this is our story. Woven deep into the fabric of our history, it is our shared cloak of shame from prerevolutionary times. We like to take it out of the closet every few decades to dust off and try back on. Maybe it is the darkness we enjoy or perhaps it is the mystery, an enigma that scholars have long rehashed using theories wildly differentiating. We want to know. We want to understand.

To do this, we have to set the stage: seventeenth-century New England was quite a setting, lots of vexing stuff to contend with. To start with, a biting cold had gripped the landscape. Some scholars have named the years leading and following this period a mini ice-age (Wolchover). Harsh winters made life rough. Economically people suffered, and emotionally it was tolling.
However, what may have been more tolling emotionally, to freezing and half-starved colonists - was the shrieking, murdering, marauding “Indians” coming with hatchets in the night. (Retrospectively speaking, let us not blame the Native Americans too harshly – we did take their lands, infect them with decimating diseases, removed them from any governing power over their country, pushed them relentlessly to the western edge of their world, and then that mass genocide bit.)

Yes, the Frontier Wars were scary for settlers. At this time in history, King William’s War was still fresh in their nightmares (Brinkley 74). The Wabanaki tribes to the northeast were prolonging the terror, desperately holding on to the hotly contested borders they were losing to the English settlers (Baker 66). Nearly everyone alive knew of a family member or friend who had been abducted, dismembered, or killed by Native Americans. Ten percent of the male population in New England was obliterated (Schiff “Inside the Trials). The fear was palpable: heavy and heady, a choking byproduct of the day. Adding to this, the Bay colony was still recovering from a recent epidemic of smallpox (Roach).

A lot of distressful circumstances were afoot. These were “fun” times. And if you know your history, you may know who loved “fun” the most in seventeenth-century New England? You guessed it, those “fun-loving” Puritans!
Puritans: the word that described just about everyone in Salem Town and Salem Village (Schiff “Inside the Trials). New England was founded on religious refugees escaping the persecution of an England that had embraced Enlightenment themes (Baker 284).

The Enlightenment philosophy threatened and undermined their strict adherence to religion, and in their eyes diminished ecclesial authority. (Yes, the Puritans were super-fun at parties.)

The Puritans of 1692 were especially stressed out. Their charter from England had been revoked, and they were operating for nearly a decade under no legal protection (Baker 207). The people were freezing. The economy was hurting. The Government was unstable. Their religion and worldview were threatened. Smallpox was scary. Indians were even scarier: The Frontier had literally smashed up against their boundary lines - no one was safe.

Yes, the Puritans were under significant strain.

These are largely external factors, however, wait for it - there is more: internal politics. Encroaching neighbors, family feuds (now it gets juicy). This was a county divided. Essentially, we have the merchants verse the farmers (Wallenfeldt).
Salem Town to the east was merchant heavy with a richer economy, fueled by its proximity to the harbor (Brooks). A wealthier, more urban-set resided there, with the Porters starring as the most affluent and successful family.

Enter the Putnams. Team Salem Village holds down the western farmlands, a smaller populated, agrarian section, under the leadership of the largest landowner: Thomas Putnam (Brooks). He is, in turn, backed by the newest minister Samuel Parris (Wallenfeldt).

The Porters and Putnams did not play nice together for all the obvious and cliché’ reasons of history. Jealousy, greed, power, land boundaries – the works. A change to a more urbanized culture in the east led to the emergent capitalist and individualistic thinking (Brooks). It turns out, that is a big “no-no” in Puritanical society, a threat to the Puritans’ very way of life (Wallenfeldt).

So, how are the kids doing in this manically religious, fear-driven land of war, cold, and insecurity, you may ask? (Or maybe you would not ask but work with me here readers). It turns out the kids are not alright.

Elizabeth Parris, Abigail Williams, Elizabeth Hubbard, and Ann Putnam Jr. were young girls; their ages ranged from nine to seventeen (Roshini O). In 1692, the first of them started to exhibit very strange behavior — fits of agony, screams of terror, unholy trances.

Map of Salem Town and Salem Village (Credit: merkspages.com)

Key
A= Accuser
D= Defender
= Accused Witch
They thrash and contort, bark like dogs, and hide under furniture. (It’s like getting my kids ready for school in the morning.) The doctors of the times carried bags brimming full of remedies taken straight out of the Dark Ages. The diagnoses come back, and it is (gasp) “bewitchment.”

These girls were the primary accusers, “the afflicted” who first “cried witch.” They had things in common outside of village affiliation: nearly all the accusers were of lower-status and many of them orphaned by the recent wars and disease outbreaks (Roshini). All of them were related in various ways to the Putnam side of the fence (light-bulb moment!). Moreover, it may not surprise you to learn that those that would be accused, condemned, and executed were largely from the Porter faction (Roshini).

Were these young “afflicted” girls traumatized by loss, paralyzed by fear, products of hysteria, desperate for attention? Or were they suffering from a more physical and tangible calamity?

Convulsive ergotism is one theory put forth in modern times to explain their behavior. Ergot is the same fungus that LSD is derived from. It is found in rye and other grains (“Salem Witch Trials” Editors, History). The damp conditions of the western farmland and the storage methods of their grain could have resulted in a contaminated supply (Wallenfeldt). Hallucinations, the sensation of skin crawling, seizures, spasms, and mania can all be associated with such an infection (Wallenfeldt). However, other historians dispute this claim: they cite the finer details (Schiff, Five Myths). One such conflicting detail was the convenient timing of the girls’ “fits.” They tended to be most afflicted during the trial, precisely when needed. Moreover, critics of the ergot theory point out that the entire colony was fed from the same centralized crop and others would have been infected (Schiff, Five Myths).

Hysteria or fungus – attention seekers or the sick and oppressed –whatever the cause of these initial fits, it was all downhill from here. Once the girls learned they were clinically “bewitched,” the stories started rolling. The first to be accused were marginal members of society. Outliers, non-church-goers, the independent and unmarried. Mainly women who exhibited small degrees of independence from men, and economic freedom in a strictly patriarchal society (Brinkley 73). They were a threat to the social order, a slave, a beggar, the elderly, the scorned and irascible (Wallenfeldt). This sat well with a community suffocating from religious doctrinarian and gripped by a misanthropic, male leadership. These were expendable members of society (Roshini).
Tituba, a slave woman of the Parris household, was the first to be accused. She carries heavy blame throughout history for her role in escalating the hysteria (Schiff, Tituba). At first, Tituba denied the charges leveled at her. However, she was a clever woman and learned quickly that the way to save her neck was to give the people what they wanted (Schiff, Tituba). Tituba was born on the wrong side of history: her Oscar-worthy performance and confessions would have earned her endless accolades in our modern world. Her tale was exhaustive in its horrors; spectacular in its details. It was gloriously persuasive with stories of sinister hogs and evil black dogs (Roshini). She raved of yellow canaries and monstrous, hairy creatures, who worked together with the “Devil in Black” to force her to serve him, and to “sign his book” (Schiff, Tituba). As the relentless questioning continued, Tituba named more “witches,” and together with the girls’ testimony, others were arrested. She was the catalysis for a diabolical conspiracy. The Witch Hunt was on.

Tituba, the first woman to be accused of witchcraft in Salem, Massachusetts. Illustrated by Alfred Fredericks for W.C. Bryant’s “A Popular History of the United States.” (Credit: History.org)

Before you knew it, upstanding, Bible-wielding, prominent members of the community like Rebecca Nurse and Martha Corey are accused (Worthen). No one was safe. The accusations go viral; it is a runaway effect: toddlers, men, and even dogs are condemned to die (Schiff “Five Myths”).

Now, we cannot write a paper about the Salem Witch trials without introducing Cotton Mather, a Harvard-schooled minister, and one of the most accomplished men of his day. He was a prime character in the witch-drama (Ray). Mather set the tone, preaching rhetoric teeming with tales of devils and sorcery. “Thou shall not suffer a witch to live,” Exodus and Mather demand from the pulpit (Schiff, Inside the Trials). His extensive
writings and belief in the supernatural, along with his well-known experience with recent Witchcraft “outbreaks,” fed the flames of hysteria.

Towards the end of the trial, when nearly two hundred people were charged, even our good and pious Mather, so committed to saving the souls of man from eternal damnation - appears to have an “easy-there killers” moment (Schiff “Inside the Trials). It was getting out of hand. Mather would write to the judicial magistrates of Salem warning of the perils of persecuting on purely spectral evidence (Ray).

Yes, you read it here: condemning and executing people based on “spectral evidence.” In case you did not know, this means stories about invisible spirits - ghosts that happened to look exactly like the accused person, attacking the “victims” (“sorry you cannot see them only I can”). Biting, pinching, choking. The afflicted girls had taken a page from Tituba’s book, and they were going all-in. Real crowd-pleasers, these gals. The invisible specters of the accused would viciously and unabashedly attack the kids during the hearings (Roshini). The poor children would be thrown around in lavish and extraordinary fashion and often fell into silent “trances” when questioned extensively. This spectral evidence was the primary evidence used to hang nineteen people, press a man to death with stones, and allow four others to die a dungeon’s death, waiting for the noose (Worthen).

But do not be brave, skeptical neighbors! Chances were if you scoffed at the trials’ if you voiced arguments over the sanity of the whole thing - you ended up named “Witch” and sentenced to die. Of course, if you confessed and named some of your Haven Friends
(wink, wink), well, then you went free (Roshini). Having rights to an attorney, the notion of “innocent until proven guilty,” and a little thing called due-process, are byproducts of these trials: this shameful stain on the fabric of our country’s infancy (Wallenfeldt).

This epidemic of witch trials in Salem went on for nearly a year until the Governor’s own wife was accused (Wallenfeldt). By then, the fervor had abated and the special court of “Oyer and Terminer,” created to accommodate a trial of this magnitude, was closed down for good (Baker 25).

We modern Americans are fascinated by our ancestors’ ability to seemingly eat up such fantastical stories started from children. Witches and wizards! Devils and demons! It is near silly to us. We must understand the full scope of the Puritan society of the times. God and Satan were rock stars. They were everywhere and undoubtable. Religion and superstition were so ingrained in their daily culture that to deny the Devil was to deny God himself. Fire and brimstone were all the rage.

Maybe the rye was bad, or maybe the kids were bad. Maybe it was a bad combination of both. Whatever the catalyst - things snowballed. Traumatic weather, disease, and the terror of the Frontier Wars underlined an environment that was ripe with political and economic unrest. It was a community gripped by superstition, led by feuding families and a rampant, unchecked government. Perhaps most relevantly, Salem was morally besieged by an oppressive religion that was being outpaced by a growing, urban world.

It was a perfect brew of contention and any chance we can - we, the descendants of colonial folly, enjoy stirring its contents and tasting it anew.
Works Cited


The Influential Brightness of the Dark Ages
by Erica Herrera*

The Dark Ages. Whenever the Medieval Ages is mentioned, the “Dark Ages” springs into people’s thoughts. In their minds, the Dark Ages was merely a time in history when knights fought gallantly to save their love, and where humans wandered in their intellect, mostly illiterate and unable to write ideas that would affect the world. For this “Dark Ages” impresses upon people that the world was philosophically and artistically dark, with no light of knowledge shining through the times—but the appellation is far from the truth. The Medieval Age was blindingly bright in the way of knowledge. The considerable amount of work alive from this time is considered the main witness to the intellectual and artistic achievements of the Medieval Age1. The brilliant works of the pen that we admire in modern culture derive from the medieval period, works such as Beowulf and The Song of Roland. The Medieval Age’s philosophy spawned arguments that are still debated. Medieval artwork is still sold and copied, famous for the ideas the artwork portrays. Even our form of education originated in the medieval age—the university was established, and our ideas of tests were cultivated in the 1400s to 1500s. The “Dark Ages” does not adequately convey the true life of the medieval period; that time in our history was antithetical to darkness—the light of intellect burst through the medieval period through the time’s writing, art, and philosophy, which still shine into our lives in the 21st century, spreading their light continually to the generations of time that followed after them.

In a world where technology is ubiquitous, it is difficult to imagine a world without technology. Instead of a family night of television, families in the medieval age would create stories. While sitting and telling stories may seem slow or boring for a fast-paced culture such as ours, oral storytellers were the masterminds behind classical works of literature that are still treasured. Because no readily available means to author a book existed—especially for those who were illiterate—oral storytelling became the way of passing tales down to the younger generations. Beowulf, a classic epic from the medieval age, is viewed by scholars as being an oral performance originally, then passed down in a written format2 (Szarmach). Many of the medieval “oral” tales we study now are preserved in writing3 (Birge Vitz and Lawrence). Most scholars believed it was nearly impossible for the writers of the “Dark Ages” to perform such magnificent, time-lasting pieces of literature. The modern academic scholars believe that since we have the medieval epics

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1 Erica Herrera is a dual-enrolled homeschool student in the Dr. Floyd F. Koch Honors College who loves to read old literature and write creative fiction.
2 See Barber’s Introduction for more on the witnesses of the Dark Age’s intellect.
3 See Szarmach for the history of oral performances.
3 See Birge Vitz and Lawrence for more on the preservation of oral stories.
written down, they are meant to be silently read (Birge Vitz and Lawrence). According to Birge Vitz and Lawrence, though, “centuries old storytelling traditions hold an intimate and powerful place in the heart of communities around the world.” Modernized researchers generally deem oral storytelling as a fading tradition, but the ancient method of entertainment is reviving in academics, growing in popularity, and returning with new strength4 (McCarthy). In our contemporary society, oral storytelling is indeed rare, but in the medieval age, it sparked the ideas for brilliant epics such as Beowulf, and it created mind-blowing legends to be passed down to future generations for their entertainment and education.

The study of philosophy has been present for many a century, and the medieval time’s philosophical studies were enlightening, powerful, and still applicable to present times. The study of philosophy was more professionalized during the Middle Ages than at any other time before the present. Much of the medieval time’s best philosophical work was contained in their theological works5 (Kenny). Two of the notable philosophers known for their theological works are St. Thomas Aquinas and St. Anselm of Canterbury. Both philosophers are studied presently, and they argued about similar topics. St. Anselm, the author of Monologian and Proslogian, contributed to modern philosophical theology and general philosophy with his famous ‘ontological argument,’ and even beyond his well-known argument6 (Williams). His ‘ontological argument’ was a catalyst for the attempt to prove God existed through philosophical arguments, and it is still favored by modern philosophers. St. Thomas Aquinas’ teachings are widespread and are among the most fascinating subjects in philosophy. They continue to attract modern theologians7 (Reeves). Even those who would not agree with his theology tend to admire his philosophical ideas. Both philosophers were brilliant in their time, but they also enlighten modern society with their thoughts and arguments—even contemporary knowledgeable scholars study them fiercely for their ways of arguing.

Medieval literature, in all its hidden splendor, surrounds modern culture but is rarely attributed to its time. During the 1400s to 1500s, a lengthy stretch of time, great literary works were formed, some by well-known authors (Geoffrey Chaucer, for example), but many by anonymous writers. These classics were crafted by “wordsmiths” centuries before scholars even though vernacular literature existed8 (Walker). When a medieval author is pictured, he is generally imagined as being a monk sitting at a wooden desk copying books solemnly and silently. While this image is somewhat true, it is far from encapsulating the plethora of ways books were generated in the medieval ages9 (Walker). Not all authors

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4 See McCarthy for examples of the return of oral storytelling.
5 See Kenny for more on religion in medieval philosophy.
6 See Williams for information on St. Anselm.
7 See Reeves for the impact and influence of St. Thomas Aquinas.
8 See Walker for more on medieval literature.
9 See Walker for more on the creation of medieval literature.
were monks, for one, and early models of the printing press were used by a very few authors. The turn of the century is a watershed for the literary world—before 1400 A.D, there were very few copies written, and have currently disappeared. By the 1500s, though, this changed, and books were constantly being produced\(^\text{10}\) (Walker). *Beowulf, The Song of Roland, The History of the Kings of Britain,* and more are still in print in the 21st century. Popular, modern books published now—such as Tolkien’s *Lord of the Rings* and Rowling’s *Harry Potter* series—are heavily influenced by the medieval epic *Beowulf.* Tolkien created an entire nation entitled “Rohan” from *Beowulf’s* Geats and even writes about a “hall” similar to the one in the setting of *Beowulf.* In one of Rowling’s *Harry Potter* books, a character rips off an enemy’s arm, alluding to the climax of the epic when Beowulf, the protagonist, rips off the monster Grendel’s arm in a fight. Certain school curriculums also use historical accounts such as *The History of the Kings of Britain,* by Geoffrey of Monmouth, and *The Song of Roland.* Though the influences of the works are rarely attributed to their time, a significant amount of our contemporary literature is still influenced by the medieval age.

Religion in the middle ages was a vital part of the medieval culture’s life, centered on every law created, every king who ruled, every layman who lived. According to Jeremy Catto, the main catalyst of religious thought was, by and large, to logically establish a theological language, which would then create a singular religious education. Nearly all theologians, however, were independent thinkers and philosophers, only united by their common use of theological sayings and thoughts\(^\text{11}\) (42). The majority of the medieval people, especially those dwelling in Anglo-Saxon lands such as England, Scotland, or even France, heard weekly sermons preached in Latin. Most laymen could not even understand Latin, so the sermons proved to be unhelpful for the public. Nevertheless, the Church grew in stature and wealth. Theologians began to rise to governmental powers, but the education of the theologians declined\(^\text{12}\) (43). As the Church continued to develop, theology decayed in its clarity and vibrancy, and the people were deceived about their theology. The growth and deception truly created a dark time for the medieval people, but then a light broke through the darkness: the Reformation. When Luther nailed his infamous 95 Theses on the door of Castle Church in 1517, he could not fathom the effects his doctrine would have on religious history and cultural history, starting wars in Europe and climaxing in the formation of the nation-state system in place now\(^\text{13}\) (Roen). The Reformation sparked the idea of *sola scriptura,* “by the Word of God alone.” The saying changed life in the medieval era—and thus our life as well—by drastically turning the Catholic Church’s teachings. When the people learned faith was “by the Word of God alone” and not by their Pope, they could read the Scriptures themselves. The Church’s false teachings were rooted out,

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\(^\text{10}\) See Walker for an explanation of the impact of the printing press.
\(^\text{11}\) See Catto, pg. 42, for philosophy in the medieval church.
\(^\text{12}\) See Catto, pg. 43, for more on the decline of the medieval religious leaders.
\(^\text{13}\) See Roen for the impact of the Reformation on the modern world.
and priests eventually turned from their governmental positions to focus on the Church. Because of the change in leadership, we have a separation between church and state\textsuperscript{14} (Roen). From this upheaval sprouted “Protestantism,” which streamed through history to the Pilgrims. Their Protestant beliefs pushed them to leave England and colonize a new country—America. Without the religious Reformation of the medieval era, Europeans seeking religious freedom would not have founded America the way we did—and the country’s entire history would be vastly different if it were not for the Reformation.

Education was formalized and popularized in the medieval age, creating what we know as the “university.” Universities are an essential part of modern culture. The medieval universities promoted a framework education, which means that they organized the materials and educated the students in an orderly manner. Teaching in a constructed format allowed the students to fully soak in the knowledge they learned, and we still teach using this pattern in current educational systems. Structured tests and degrees were also introduced in the medieval age\textsuperscript{15} (Jocic). Before public universities, only the wealthiest children and adults were educated; most of the medieval people were, therefore, illiterate or “uneducated”\textsuperscript{16} (British Literature). Like modern schools, students were instructed in math, science, humanities, etc. The original college in England was the University of Oxford, founded in 1096 A.D.\textsuperscript{17} (The Medieval University). The University of Oxford still thrives to this day, known for its publications and studies. Without the invention of the university, we would not have the educational systems that are in place in the present age—it is likely that most of the masses would remain uneducated like the medieval era before universities. In the United States alone, there are currently about 5,300 universities\textsuperscript{18} (Selingo). The numbers demonstrate how much of an impact universities have in our culture, and because of its popularity in the medieval era, we receive our modern education.

Intellect’s bright light bursts through the so-called “Dark Ages”; the title does not sufficiently describe the medieval life because of the massive amount of light that shines in the Medieval Era’s writing, storytelling, philosophy, religion, and education—and these areas still hold an immense impact in our current world. Although oral storytelling is not as attractive anymore, it was a vital part of medieval life, and it sparked the ideas for brilliant epics such as \textit{Beowulf} and \textit{The Song of Roland}. Philosophy is at a height in our culture, and the debates and thoughts philosophers meditate on currently were debated and philosophized on in the medieval era. Because of theologians like St. Anselm of Canterbury and St. Thomas Aquinas, famous debated about the existence of God were introduced, as was the “ontological argument” about God’s existence and eternity. Literature in the medieval world affects us like none other—we read books originally

\textsuperscript{14} See Roen for the change the Reformation made in modern government.
\textsuperscript{15} See Jocic for more on medieval universities.
\textsuperscript{16} See “The Medieval University” for information on illiteracy in the medieval age.
\textsuperscript{17} See “The Medieval University” for more on the first college in England.
\textsuperscript{18} See Selingo for more statistics on the number of universities in America.
written in the medieval time, and many more modern tales are heavily influenced by books such as *Beowulf*. The Reformation of the Middle Ages had a rippling effect throughout the history of the United States of America. Without the reform of the Church, the spiritual lives of many would be deceived, and the history of our country would be drastically different. Even our universities and forms of education are derived from medieval times, with universities founded and the idea of tests created. Our entire world reflects the light of the medieval age in one area or another. As Holmes stated it, “Western civilization was created in medieval Europe”¹⁹ (v). The medieval age was not dark intellectually speaking, as many imagine it to be—rather, it was a glaringly bright time in our history, a time we still feel the effects of in our modern culture. ²⁰

¹⁹See Holmes’ Forward for a broad commentary on the medieval world as a whole.
Works Cited


The Clinical Study of Orthorexia by Rachael Hobbs*

Abstract

With the rise of awareness involving healthy eating and exercising habits, the psychological community is also becoming aware of a rise in extreme behaviors relating to healthy eating. For those within the health community who display these behaviors, the psychological community has been able to identify distinct patterns of an eating disorder, referred to as orthorexia. Clinically, orthorexia is “a pathological obsession with proper nutrition that is characterized by a restrictive diet, ritualized patterns of eating, and rigid avoidance of foods believed to be unhealthy or impure” (Koven, 2015, para.1). The word Orthorexia comes from the two Greek words “Ortho” meaning right or straight, and “rexia” meaning without appetite. An individual with this eating disorder is intolerable to any foods that may not be one hundred percent organic and/or raw. One eating disorder related to Orthorexia is called Anorexia. Anorexia is an eating disorder derived from the idea of an individual’s desire to achieve a certain weight or body shape. Orthorexia occurs when an individual’s choice to eat healthy changes into an obsession that controls his or her life. When an individual does not eat a proper balanced diet, they can either become sick or, in extreme cases, can die. Certain foods contain nutritious organic chemicals which the human body cannot live or function properly without. This paper will cover what orthorexia is clinically, the organic chemicals individuals are missing in their meals or are ingesting too much of, and how this eating disorder can be treated.

Symptoms or Orthorexia

The initial use of the term orthorexia was first coined and used by Dr. Steven Bratman. He used this term to diagnose his patients who exhibited signs of overly excessive healthy eating habits (Bratman, 2017, para. 2). Signs such as overly scrutinizing foods, being sure to not eat foods that may have been exposed to pesticides, not eating a food item if there was any nutritional value lost in the production process of the food or, if it was a dairy product, being certain the dairy didn’t come from a hormonal-supplemented cow. Within the life of a person who struggles with orthorexia, a large quantity of time is spent analyzing foods to ensure the quality and health benefits the foods have to offer. Aside from meal time, another large portion of time is dedicated to the research of healthy foods, weighing the correct amount of food for each individual meal, and coordinating ingredients and dishes for future meals.

* Rachael E. Hobbs is the Co-Founder and President of the Medical Professions Association, Honors College Student Ambassador, was recently awarded the title Honors College Student of the Year 2018-2019, received the Leadership Excellence Award for Phi Theta Kappa 2017-2018, and is the Vice President of Service for the Five-Star Chapter of Phi Theta Kappa Alpha Gamma Sigma.
Healthy Eating Versus Eating Disorder

After some time observing patients with eating disorders, Dr. Bratman found that individuals who had an allergy, such as lactose intolerance, were more at risk of developing orthorexia than those who did not have a food allergy. Dr. Angela Guarda, the director of the Johns Hopkins Eating Disorders Program, has also observed the same pattern with her patients. “[M]any of the patients I saw with anorexia were vegetarians. Now, they also talk about eating exclusively organic food or say that they are lactose intolerant and allergic to gluten, when their blood tests show that they are not”. Dr. Guarda continues “[t]hese explanations are convenient ways to hide their fear of eating high calorie foods or foods prepared by others which provokes anxiety” (Oksman, 2015, para. 16). Although Dr. Guarda is referring to patients who have anorexia, patients who have orthorexia exhibit the same patterns in their reasoning behind eating or not eating certain foods. Because there is a fine line between eating healthy and developing an eating disorder, the line can be crossed even when the individual has the best of intentions. Some cases which have been observed by Dr. Thomas Dunn, a professor of psychology at the University of Northern Colorado, have shown a pattern in which individuals try to eat healthy, but then eventually cross the line from healthy eating to developing an eating disorder. Dr. Dunn recalls that patients typically escalate from “vegetarian. Then vegan. Then raw. Then they run out of things to eat” (Oksman, 2015, para. 21). Healthy eating is good, as it is with almost anything, in moderation but over obsession with a certain thing can take over that individual’s life.

Social and Physical Effects of Orthorexia

Due to the obsession of eating only healthy foods, many individuals who have orthorexia also suffer from social anxiety, depression, and separation from the world around them. One woman named Kaila Prins has her own personal experience regarding how a simple food allergy diagnosis can, over time, turn into an obsession that not only took over her life, but also caused more health problems than she initially had. When Prins was just thirteen years old, she started breaking out in hives due to an allergy to soy. This caused her attention to be drawn to food labels for the first time. Before this diagnosis, she would enjoy the occasional junk food snack just like any other teenager. But since the discovery of her soy allergy, she became an avid label reader and avoided unhealthy foods. Along with cutting soy out of her diet, Prins decided to cut out other food categories. In the span of one summer her diet went from that of a normal teenager, to a diet of “only eating whole wheat bread, peanut butter, fruit and salad” (Oksman, 2013, para. 2). Prins was 5ft 4in and her weight dropped to 97lbs. Because she wasn’t eating any food with a good source of protein, fats, or vitamins she was starving her body of the proper nutrition it needed as a growing thirteen-year-old.

Prins was a prestigious student throughout college, but after adding biking at least six miles a day to her rigorous eating routine she began to neglect her studies. By the time she graduated college with her bachelor’s degree, Prins also had started working with a personal trainer and followed other health fanatic’s meal guides. Prins continued her
education, but by the end of her first semester at Columbia University she went from a successful student to a student who was about to fail out of the college. Prins was depressed and even suicidal. She tried therapy, only to drop out of that as well. She was withholding healthy fats and proteins from her diet which her body needed. Prins eventually discovered the name for her eating disorder; orthorexia. She came across Dr Bratman’s book *Health Food Junkies* (Bratman & Knight, 2017) which talks about the eating disorder and Prins finally started to see the possibility of recovery.

**Orthorexia Compared to Other Eating Disorders**

In the current Diagnostic and Statistical Manual of Mental Disorders (DSM-5) there are eight classified Feeding and Eating Disorders; however, orthorexia is not a separately categorized condition, like anorexia nervosa or bulimia nervosa. Anorexia and bulimia are eating disorders derived from the idea of an individual wanting to achieve a certain weight or body shape/image. Orthorexia has no religious connection and is not derived from ethical beliefs nor the desire to be skinny or visually appealing. Orthorexia is derived from the idea of an individual wanting to be healthy and only eat foods that are completely organic and/or raw. If an individual who has orthorexia were at a friend’s party, for example, the orthorexic individual will have a difficult or impossible time eating food at said party. This is due to the fear of eating something which they did not prepare themselves because they are unaware of the ingredients and their origin.

Many symptoms of orthorexia overlap with those of anorexia and Obsessive-Compulsive Disorder (OCD), leading some professionals to list orthorexia as a subset of either disorder, rather than as a separate disorder (Koven, 2015, para. 3). While anorexia, OCD, and orthorexia patients display symptoms of a need to exert control, perfectionism, and intrusive thoughts (usually relating to food), orthorexia differs significantly from the other disorders in that “the content of obsessions in orthorexia is perceived as ego-syntonic” (Koven, 2015, para. 4). Ego-syntonic refers to behaviors that are consistent with one’s self image, contrasting the classically ego-dystonic anorexia and OCD.

Since orthorexia has only relatively recently been identified as a disorder, further scientific analysis on the correlation between the disorder and other psychoses has yet to establish a quantifiable link; there has been evidence relating to anorexia serving as a prodrome for future psychoses. Many of the symptoms that are applicable to both anorexia and orthorexia can herald the appearance of a future psychotic episode, leading one to infer that orthorexia too may be a prodrome for psychoses. While, functionally, anorexia and orthorexia may appear to be presentations of the same eating disorder or psychosis, the fundamental differences in cognition causing the disorders has led many professionals to classify orthorexia as a separate disorder from that of anorexia, OCD, or other psychotic disorders.
Diagnostic Boundaries of Orthorexia

In order to diagnose orthorexia, Bratman who is the original doctor to coin the term orthorexia and to diagnose a patient with the eating disorder, & Knight, an author who helped Bratman (2017) write Health Food Junkies, proposed a ten-question assessment which was later modified into the ORTO-15. ORTO-15 is a fifteen-question assessment about the patient’s perception of foods and the foods’ effects on him or her. The efficacy of the ORTO-15 has been called into question numerous times, prompting researchers like Donini et al. to validate the assessment. Further testing of the ORTO-15 showed that the assessment needed to be revised in order to better serve as a reliable diagnostic assessment of orthorexia (Domini, 2017, pp. 29-32).

When considering the diagnoses of orthorexia, it is important to consider the differences in diet and health habits according to region and culture. In cases where the ORTO-15 has been tailored for specific countries, often by removing certain questions from the ORTO-15 to create the ORTO-11, there has been an increase in internal consistency in these country-tailored assessments.

The assessments concerning the diagnosis of orthorexia still have much refinement to undergo, leaving many questions about the population affected unanswered. Some results of the modified ORTO-15 (like the ORTO-11 and the ORTO-11-HU) show conflicting results about which gender and age group are most at risk of developing orthorexia. These inconsistencies further prove that refinement of the orthorexia diagnosis assessment is required. The following is the list of questions which ORTO-15 asks individuals in order to diagnose the prevalence of orthorexia:

1) When eating, do you pay attention to the calories of the food?
2) When you go in a food shop do you feel confused?
3) In the last 3 months, did the thought of food worry you?
4) Are your eating choices conditioned by your worry about your health status?
5) Is the taste of food more important than the quality when you evaluate food?
6) Are you willing to spend more money to have healthier food?
7) Does the thought about food worry you for more than three hours a day?
8) Do you allow yourself any eating transgressions?
9) Do you think your mood affects your eating behavior?
10) Do you think that the conviction to eat only healthy food increases self-esteem?
11) Do you think that eating healthy food changes your life-style (frequency of eating out, friends, etc.)?
12) Do you think that consuming healthy food may improve your appearance?
13) Do you feel guilty when transgressing?
14) Do you think that on the market there is also unhealthy food?
15) At present, are you alone when having meals? (Donini, 2017, p. 30).
The responses to these questions are based on a four-point scale. One is equivalent to always, two is equivalent to often, three is equivalent to sometimes, and four is equivalent to never. If the test results come out to a number over 40, then the tested individual reportedly has normal healthy eating behavior. On the contrary, if the test results come out to a number under 40, then the tested individual is indicatively reported as having orthorexia. Furthermore, ORTO-15 is not the official test for orthorexia and the questions may differ depending on the country of origin of the individual being tested.

**Vitamin Toxicity**

One of the dangers orthorexic individuals are faced with is vitamin toxicity. Vitamin toxicity is “a condition in which a person develops symptoms as side effects from taking massive doses of vitamins” (Kaczkowski, 2013, para. 1). Because of the rigorous diet orthorexic individuals abide by, they are especially at risk of suffering from hypervitaminosis or vitamin toxicity. In 1974, for example, there was a man by the name of Basil Brown who believed that by drinking one gallon of carrot juice a day he would be healthy due to the high levels of vitamin A he was ingesting. Furthermore, Brown was taking vitamin A tablets to increase his intake of the vitamin even more. Basil Brown, “had taken 70 million units of Vitamin A in 10 days” not including the gallon of carrot juice he was drinking everyday (Special, 1974, para 4). This caused Brown’s skin to turn bright yellow, eventually leading to his death at the young age of 48. When Dr. David Haler, the pathologist who performed the autopsy, examined the man’s body he documented “the effect of the enormous intake of Vitamin A from carrots and tablets was indistinguishable from alcoholic poisoning” (Special, 1974, para 4). The reason an overdose of vitamin A has the same damaging effects as alcohol poisoning is because the liver cannot break down vitamin A fast enough to keep up with the amount of intake that Brown was ingesting. Furthermore, vitamin A is fat soluble meaning it dissolves in lipids and requires more effort for the liver to break it down. Resulting in scaring and eventually liver failure or cirrhosis of the liver.

Vitamin C, for example, is largely found in raw asparagus and, in large quantities, can cause kidney stones or gallbladder stones. Foods that are commonly found in orthorexic patient’s diets include cocoa, rhubarb, spinach, and chocolate, all of which consist of high concentrations of calcium oxalate. Calcium oxalate or CaC₂O₄ is a “salt of oxalic acid, which in excess in the urine may lead to formation of oxalate urinary calculi” (Calcium, 2017. Para. 15). Calcium oxalate forms crystals which are not water soluble and build up in the bladder or kidney causing bladder or kidney stones to form. For some patients, the reason they are more at risk of contracting urinary calculi could be because they “have enteric hyperoxaluria, meaning that their intake of the plant foods that are rich in oxalate is too high for their GI tract to handle” (University, 2010, para. 5). Therefore, these individuals should be ingesting less amounts of foods such as cocoa, rhubarb, spinach, and chocolate to avoid the risk of suffering from a bladder or kidney stone.

In the case of an individual experiencing severe hypercalcemia, extreme concentration of calcium in the blood stream, the affected individual is treated with the infusion of “a
solution of 0.9% sodium chloride into the patient's bloodstream. The infusion consists of 2.1 to 3.1 qts (2 to 3 L) of salt water given over a period of one to two days” (Kaczkowski, 2013, para. 13). This is the treatment used only in emergency cases of vitamin toxicity caused by vitamin D. The recovery for patients who experienced vitamin toxicity typically starts immediately after the patient refrains from taking the vitamin. Although, this is not the case with vitamin toxicity caused by vitamins D, A, and B6. Vitamin toxicity with any of these vitamins can result in long term effects to the body. Hypervitaminosis of vitamin D causes calcification of the soft tissue which is irreversible. Vitamin toxicity of vitamin A in pregnant woman can cause the baby to have birth defects which are irreversible. Although hypervitaminosis caused by vitamin B6 can result in damage of the nervous system, these symptoms have the potential of being reversed with recovery time expected to be longer than a year.

### Treatment of Orthorexia

In regard to the treatment of orthorexia nervosa, there are typically a few treatments or changes which the patient will go through in order to recover. Because orthorexia is a mental disorder as well as an eating disorder, the patient will undergo “cognitive-behavioral therapy, dietary and nutritional counseling, and medical management of any physical sequelae that result from extreme dietary restriction and malnutrition” (Peat, 2016, para. 16). The patient, with the aid of a doctor, will change their diet depending on what the patient’s body needs and the patient will also attend therapy to change their cognitive thinking about food. Unfortunately, because orthorexia nervosa is not yet recognized as an official eating disorder, the process of diagnosing an individual with orthorexia is still being determined. Therefore, many researchers and doctors are working hard towards DSM-5 officially recognizing orthorexia nervosa as an eating disorder.
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Distorted Morality: The Extents to which Procreative Beneficence May Influence Societal Advancement by Shanice Guthrie

Abstract

In the pursuit of continuous medicinal advancement, scientists have engendered the evolutionary Pre-implantation Genetic Diagnosis (PGD) as an answer to growing gestational concerns. Its use in combatting genetic diseases and disorders have been widely praised and accepted by the general populous. Deviating from its initial course, Pre-implantation Genetic Diagnosis have now become a mechanism to enable parents with the option to customize their off-springs. Pre-implantation Genetic Diagnosis offers a solution to mold a new generation based on current societal complaints, thus, fostering a preferable generation. The inherent impulse to create the perfect phenotypic child continues to blossom and translates itself into modern-day technology. A phrase now coined ‘Procreative Beneficence,’ by Julian Savulescu (2001), dramatically describes the ethical implications of restricting parents from enacting their right to select the best embryo. As history has dictated, society will continue to willfully ignore its contradictions in morality, to be able to justify its adherence to social constraints. The question that only time can answer is: to what end do we continue to pursue this superficial fight for perfection?

Geoffrey Fisher once said, “When you aim for perfection, you discover it’s a moving target.” Envision a century from now. You live in a society that is too technologically adept. You are expecting a child and had decided to exercise your right to modify its genetic make-up. You are guaranteed assurance that your child will possess the specific phenotypic traits you handpicked prior to its implantation. On the delivery day, you are presented with a "beautiful" child. As the child begins to age, an unforeseen complication occurs. The child is almost entirely phenotypically similar to every other "beautifully-made" child. At this point, it can be argued that the child would then be considered ‘average’ against a phenotypically diverse child, who embodies enviably different traits. It could then be assumed that we are intentionally subjecting ourselves to the same continuous cycle in pursuit of an unattainable ideal.

“Empirically, we appear to be driven to take control of our own evolution”(Comfort, 2013). The issue with our growing fascination in genetic selection is that it is no longer a source of hope for high-risk parents but instead a way to exercise our ideology innately unto our children. It is unlikely that the utilization of genetic technology will ever truly cease; therefore, the question is now purely ethical. We must seek to understand the moral implications and the extent to which Procreative Beneficence influences societal advancement. This paper will attempt to answer three pivotal questions:

1. To What Extents Do We Practice Pre-Implantation Genetic Diagnosis?
2. How is it Actually Being Employed by Society?
3. What are the Ethical Implications of Procreative Beneficence?
As technology continues to flourish at an astonishing rate, we must indulge ourselves entirely to comprehend and not misuse the mechanisms being introduced to us. Unbeknownst to us, the implication of our actions if left without scrutiny may consequently lead to extensive societal decline.

**To What Extents Do We Practice Pre-Implantation Genetic Diagnosis?**

Benjamin Franklin once said, “An ounce of prevention is worth a pound of cure.” Imagine if, at a 28-week check-up, you’re informed that your conceived child is expected to die within 24-hours of its birth. Diagnosed with Anencephaly, a fatal cephalic disorder in which there is an absence of substantial portions of the brain, skull, and scalp; a possible miracle is non-existent. The age of viability is 22 to 24 weeks, thus, eliminating the possibility of late-stage termination in 24 states. Devoid of all options, the fetus must be carried to term since it does not pose any imminent health risks towards the mother. The tragic and gut-wrenching journey one must go through to watch one’s child die only a few moments after its delivery must be inconceivable. In 1989, Pre-implantation Genetic Diagnosis (PGD) became the source of hope for couples desperately trying to conceive a healthy offspring.

Pre-implantation Genetic Diagnosis has become the preventative screening which ensures that only optimal embryos are being transferred to the uterus for implantation. Molina Dayal (2015), Physician at St Louis Fertility Clinic professed that PGD provides an alternative to current post-conception diagnostic procedures such as Amniocentesis or Chorionic Villus Sampling, which is sadly frequently destined to be followed by the discussion of termination. It can be argued that PGD became the answer to the most pressing parental concerns when it encompassed their unborn child.

In a study conducted by EUROCAT (European Surveillance of Congenital Anomalies) encompassing the years 2003-2007, it was recorded that there was a prevalence of significant congenital anomalies of 23.9 per every 1,000 births. The study, however, indicated that 17.6% of all cases were terminations of pregnancy following initial prenatal diagnosis. Baruch (2009), JD for the Genetics and Public Policy Center at John Hopkins University, expressed that due to the utilization of PGD cycles, over 15,000 healthy children were delivered in 2006. Evidently, PGD became an attractive means of preventing heritable genetic disease, eliminating the dilemma of pregnancy termination following unfavorable prenatal diagnosis (Dayal, 2015).

As technology progresses, we tend to utilize the prior knowledge that was available to us and manifests it into something more significant. Initially, PGD was employed to determine gender as an indirect means of avoiding any X-linked disorder (Dayal 2015). Baruch (2009) study concluded that 37% of patients who underwent PGD cycles were trying to prevent X-linked disorders. One prevalent example is Hemophilia. Melissa Conrad Stöppler, a medical doctor, explained that "Hemophilia A and B are inherited in an X-linked recessive genetic pattern, so males are commonly affected while females are usually carriers of the disease.” People who undergo PGD are more likely to select a female embryo who would only be a carrier.
Another primary use for PGD was to allow Jewish families to conceive a child that did not have Tay-Sachs disease. This disease is a rare, inherited disorder that destroys nerve cells in the brain and spinal cord. The Jewish Genetic Disease Consortium indicates that every 1 in 27 Ashkenazi Jews are carriers of the disease while every 1 in 125 Sephardic-Mizrahi Jews Carry this disorder. By utilizing Pre-implantation genetic diagnosis, Jewish couples who would otherwise be restricted to conceive due to ethical implications are now awarded an actual chance.

It is interesting to note that based on Dr. Baruch 2009 study, it indicated that 65% of PGD patients are for Aneuploidy. The primary reason is to prevent Down Syndrome (DS). The Center of Advanced Reproductive Services indicates that, while most embryos with abnormal chromosomes are not likely to survive, fetuses carrying an additional chromosome 13, 18 and 21 which is usually the case in Down Syndrome children, are more likely to survive to term. Parents who have prior given birth to a Down Syndrome child would undergo Pre-implantation Genetic Diagnosis to eliminate the occurrence of a second DS child. It is almost universally accepted to select an embryo that is healthy and not knowingly brought into the world to suffer (Baruch, 2009).

Deviating from its primary use, PGD is now being utilized for non-medically related sex selection. In 2005 it was recorded by Dr. Baruch at the Institute of Genetics and Public Policy Center, that 57% of IVF Clinics offer non-medical sex selection as an option for their patients. The appeal of being in total control of the development of one's off-springs has now begun to transcend into modern-day technology. It is especially reasonable to comprehend, that if physicians possess the capability to ensure that a specifically desired characteristic is present in your offspring, then the option should be given. In 2001, Julian Savulescu introduced the term ‘Procreative Beneficence,’ which is the principle of selecting the best child out of the possible children one can conceive. Individuals seemingly have a moral obligation to interfere with the forthcoming of a child whose life is projected to be filled with suffering and antagonizing pain. However, if the children are not expected to possess any chromosomal anomalies, then why undergo Pre-implantation Genetic Diagnosis? It may very well be due to our overwhelming sense of entitlement.

How is it Actually Being Employed by Society?

There is an increase in fascination for the non-medical uses of Pre-implantation genetic diagnosis each year. Savulescu (2007) exclaimed that genetic testing might very well be the determining factor for the overall value of a person's life. The increasing power and accessibility of genetic technology may one day give parents the option of entirely modifying the genetic make-up of their unborn children. This will not only spare them from diseases but will especially enhance them by allowing them to be: tall, well-muscled, intelligent or otherwise well-endowed with desirable traits (Wynne Perry 2013). Marcy Darnovsky, associate executive director of the Center for Genetics and Society, explained that if parents had a dozen possible embryos to implant, and the traits are embryos that are green-eyed, or the blond-haired ones, that's an extension of choices that should be perfectly acceptable. Darnovsky continued by saying that restricting them from this choice is a violation of their procreative autonomy. In 2009, a Los Angeles fertility clinic offered to let parents choose their embryo’s hair and eye color. After only one month the program...
was completely shut down due to extreme public disapproval (Keim 2009). It can then be reasoned that society is trying to repress the progression of genetic selection; however, that attempt has been futile.

Pre-implantation Genetic Diagnosis paves the path towards ensuring the desired life for one's child. Such morality, however, has influences very questionable principles. In the same 2005 study conducted by Dr. Baruch at the Institute of Genetics and Public Policy Center, it indicated that 4% of the 190 IVF clinics researched, had patients who requested the use of PGD to ensure that their child was born with a disability. Dr. Sanghavi (2005) addressed this finding by stating that, "Some mothers and fathers don't view certain genetic conditions as disabilities, but as a way to enter into a rich, shared culture." Such a desire for specific genetic defects by parents isn't a new proposition. In 2002 The Washington Post profiled Candace McCullough and Sharon Duchesneau, a deaf couple who had requested to have a deaf child by intentionally soliciting a deaf sperm donor. After five years, they conceived and delivered a partially deaf child (Sanghavi 2005). This request is not causing actual harm to the child, and therefore the procedure can legally be done. It is reasonable to conclude that PGD has not only strayed from its initial intent but has become a way to fulfill self-serving parental wishes. If society continues to move down this same path, the extents to which Pre-implantation Genetic Diagnosis will be used is not limited to the child's well-being, but instead is extended to the ideology of the parents.

To many, a simple concept such as gender may be a lot more detrimental than we perceive. We refuse to acknowledge the rather obvious implications of manually selecting the gender of our off-springs. This issue may have to do with our ignorance towards gender biases in expecting parents. In an independent survey, it was discovered that 66% of recipients indicated a preference for their first-born child to be male if given the option (Shanice Guthrie 2018). When these results were isolated and examined by the gender of the recipients, an astonishing 80% of males and 65% of females still indicated a strong preference towards a male offspring. These findings are presented in Figure 1 and 2 in the Appendix.

Such an innocent decision of sex selection may carry a lot more depth if viewed on a broader scale. Therese Hesketh, a professor of Global Health at the University College London, steered independent research alongside Li Lu and Zhu Wei Xing, on Asian societal sex preference. Hesketh noted that parental preference for sons is a ubiquitous factor in countries in East Asia through South Asia, to the Middle East and North Africa. The sex ratio at birth (SRB) can be defined as the number of boys born to every 100 girls, which is astonishingly consistent in human populations at around 105 male births to every 100 female births. Hesketh expressed that South Korea was the first country to report a very high SRB, due to the widespread uptake of sex-selective genetic technology. The study indicated that the SRB was reported to be as high as 125 in some areas. China was next to follow in this trend. Hesketh stated that due to the circumstances created by the one-child policy, it could easily be classified as the major contributing factor of the steady incline in the reported SRB from 106 in 1979, to 111 in 1990, 117 in 2001 and 121 in 2005. These findings are, however, not surprising. As previously addressed in the paper, Dr. Baruch had indicated that 57% of IVF Clinics offer non-medical sex selection as an
option for their patients in the United States. Such a sizable percentage suggests that there's apparently an appeal for it. Brendan Foht, an assistant editor of The New Atlantic, bioethical issues expressed that, couples that generally practice this are ones who already has around three boys and desperately want to try for a girl, a concept known as "family balancing." Primarily, it seems that genetic sex selection is genuinely sought after as a means to achieve one’s ideal family.

With the previous statistics in mind, the independent survey conducted by Guthrie (2018) indicated that 50% of individuals would not act on their preference to select the gender of their embryo. The other 50% was split somewhat closely, with only 27% exercising their gender preference and the remaining 23% indicating uncertainty. Does it put into question, why such a significant amount is so reluctant to utilize a mechanism that is available to transform our impulses into reality entirely? It may be attributed to our varying degree of ethics.

What are the Ethical Implications of Procreative Beneficence?

The argument of what is ethical will always continue to face scrutiny. With such a diverse society, it's hard to pinpoint a single belief which could be accepted as ethical under every circumstance. Referring to the case of the McCullough and Duchesneau, the family who tried to conceive a deaf child, many would consider the act as unethical. However, the disabled community may indicate otherwise. Paula Garfield, a mother of a completely deaf daughter, expressed that, "Deafness is about the language we use and the community we live in. It's about being part of a linguistic minority." It is almost inconceivable to expect a born-deaf individual to understand the perks of being able to hear. The apparent variance in morality is what has led many to scrutinize the belief that parents should be given the right to choose their embryos. The principle of Procreative Beneficence does not take into consideration the varying degree of beliefs among individuals. If the choice is entirely granted to parents, then no one will be able to regulate the genetic variation of the forthcoming generation truly.

One of the more problematic ethical concerns is that by allowing parents the right to exercise Procreative Beneficence, we are granting every citizen the power to dictate the flow of human civilization. Procreative Beneficence neglects to recognize that parents are not concerned with the factors indirectly affected by their choice. A prime example is China. Hesketh (2013) explained that due to China’s apparent bias towards males, their sex ratios at birth translates into vast numbers of excess males. Hesketh noted that "In 2005 it was estimated that 1.1 million excess males were born across the country and that the number of males under the age of 20 years exceeded the number of females by around 32 million." This was following the introduction of genetic sex-selective technology. China is now one of the five nations who has enacted laws restricting the non-medical use of genetic technology (WHO 2014). The major flaw observed was that no one took into consideration the uncertainty of society. Even with a preconceived notion of China’s gender bias we still proceeded to enable them with the choice of selecting their embryo, in hopes that conceiving a male offspring earlier on, would make them more inclined to produce females after (Hesketh 2013). Socrates was quoted as saying “People’s good behavior actually only exists for self-interest.” We seemingly would be more ethically inclined to
put the joy of our immediate family over the dire gender disproportion we would be enabling. A decision like this interestingly would be seen as ethically inconsiderate by the international community but morally correct based on Chinese expectations.

Societal expectations will always continue to dictate the manner in which we live our lives. "If someone was presented with a choice, conceive a child with short stature or modify their genes to make them tall or 'normal,' the answer may as well be unanimous" (Fairbanks 2018). SIRC (The Social Issue Research Centre) indicated in a 2005 study that, the 'Bias for Beauty' phenomenon operates in almost all social situations. They expressed that the majority of experiments conducted universally showed biased reactions towards more physically attractive individuals. Applying the principle of Procreative Beneficence, parents would then be most likely to customize children that possess physical traits universally accepted by the general populous. The concept of beauty, however, is much flawed. Danielle Barnes (2016), a researcher at Taylor University, exclaimed that "The media exhibits a glowing representation of the ideal image of what everyone should look like." This overwhelming flaunted expectation of beauty is constantly being forced upon society. Laura Brandt, an AP Psychology teacher, expressed that, "We are inundated with images from the media hundreds of times per day—and these are constant reminders of how beauty is defined." We epitomize ideal traits because of media perception, but we are unaware of our own innate preferences. The astonishing truth is, to create a universally appealing child is actually impossible. Siegfried (2013), a researcher at The National Institutes of Health in Bethesda, expressed that, "There is seemingly an overwhelming preference for bodies that are average and do not significantly stray away from the norm." Siegfried theorized that it might have something to do with a default recognition for the processes of genetics, in that "average" is an indicator a diversity of genes, thus decreasing the possibility of maladaptive ones. If that is the case, is it unethical to force our misconceptions unto our off-springs, diminishing their chances of genetic randomization? This sadly demonstrates another grey area of ethics. If someone attempts to adhere to societal norms, oblivious to the unknown implications of their decisions, then it is unlikely that their actions will ever be deemed unethical.

Without government regulation, society is left to be held accountable for its own actions. Our ethical principles become a sense of guidance, which curves our behavior. What we have yet to recognize is, ethics strongly contradicts a very noticeable pattern in modern society, subjectivism (Houdmann 2013). BBC experts explain that Subjectivism indicates that truth is subjective and that it is entirely dependent on the subject's ideology and experience. Determining right and evil must, therefore, happen on a case-by-case basis. One absolute standard, according to the philosophy of subjectivism, does not fit all. This philosophy is clearly established in the principle of Procreative Beneficence, as they're many who believe that it is more ethical to try to enhance your child's life to prevent unnecessary suffrage. In contrast to that are parents who believe that dictating the life of one's child by customizing them is entirely over-stepping the boundaries of good parenting. There will never be an exact stance on this issue as it is too big of a diverse pool of opinions. In today's society, it has become clear that any action done without indicating malicious intent may well be attributed to our personally differing views of righteousness. This, therefore, can only ever be viewed as ethically inappropriate depending on the viewer.
Conclusion

“It may not be “good” or "evil" to choose the genetic constitution of a child, but in doing so, we are making many more choices than we are aware of (Comfort 2013).” We may never be able to truly know the extents to which Procreative Beneficence will impact us as we are actively stunting its manifestation because of our own preconceived ethical convictions. Although we can propose theoretical implications of utilizing this mechanism, it is only just theories lacking data to reinforce its cause for concern. I can only conclude that more research is warranted to understand the real implications this practice may cause thoroughly. Based on current research the only notion can be held is that it would be deemed ill-suited to classify Procreative Beneficence as anything else but an attempt at steer heading civilization into a theoretically better future.
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Appendix

*Figure 1.* This pie chart summarizes survey data collected by Shanice Guthrie 2018. This visual display the cumulative findings derived from the question “If you were given the opportunity to pick the gender of your first born, what would that gender be?” It is presented as a percentage of 100 recipients.
Figure 2. This bar graph summarizes survey data collected by Shanice Guthrie 2018. This visual display the cumulative findings derived from the question "If you were given the opportunity to pick the gender of your first born, what would that gender be?" The results were then further isolated by the gender of the recipient.

Expert Opinion

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While many people may not realize it, one of the biggest factors in deciding how someone’s day will go, is the weather and the people who study it. According to the Merriam-Webster Dictionary, meteorology is, “A science that deals with the atmosphere and its phenomena and especially with weather and weather forecasting” (Meteorology). Under this umbrella definition are multiple branches that take this field of science to different topics. These topics include weather forecasting, climate change, oceanography, hurricanes, winter storms, and many more. Among these multiple topics is one that is not very common, and it is the topic of cloud seeding. According to the Encyclopedia Britannica, cloud seeding is, “deliberate introduction into clouds of various substances that act as condensation nuclei or ice nuclei in an attempt to induce precipitation” (Britannica). This definition essentially says that cloud seeding is taking minerals and elements and putting them into clouds to create more precipitation such as rain or snow. Scientists use different methods to control and manipulate the weather to what they want it to be. Cloud seeding has an interesting past and an uncertain future that has questions that need to be answered regarding the efficiency of it and the morality of it. Cloud seeding is an up and coming technique that will either have amazing benefits or disastrous effects on the world.

Cloud seeding first began in 1946 by an American Chemist and Meteorologist, Vincent J. Schaefer. He breathed into a box of dry ice to see that moisture had accumulated and theorized that this could lead to creating precipitation. His colleges made more advancements and discovered another kind of early cloud seeding by using silver iodide. Silver iodide and other minerals are used to simulate the air born particles that moisture collects around before a rainstorm. Silver iodide is a preferred material to use since it is similar in structure to that of an ice crystal, and therefore has more results. There are three different ways that cloud seeding is introduced into the atmosphere. They are static cloud seeding, dynamic cloud seeding, and hygroscopic cloud seeding. Static cloud seeding is done by introducing chemicals into the clouds to stimulate moisture growth. Dynamic cloud seeding is more complex than static cloud seeding since it requires 100 times more ice crystals. This process creates dynamic winds by increasing the rate and speed of winds into the clouds in order to have more water vapor pass through the clouds. Once they enter the clouds, they are more likely to form into moisture and stimulate precipitation. Hygroscopic cloud seeding has the most potential as it involves instilling salts and chemicals into the clouds by the use of flares and explosives in lower level clouds. One method is by attaching flares to the back of the wings of an airplane and having the airplane pass through or above the clouds. (Silverman). These are the main three types of cloud seeding, but they have multiple methods of how they are implanted. For example, one method involves taking a cannon or rocket, loading it with chemicals, and launching it into the clouds to stimulate moisture growth.
There are many debates as to how effective cloud seeding is. The problem with cloud seeding is that you can only create more moisture where the clouds already exist. When talking about a Chinese snowstorm that the government took credit for creating to help their drought, cloud seeding expert Arlen Huggins says, “If they are in a drought, they wouldn't be able to draw enough from cloud seeding, just for the lack of clouds” (Moseman). Many people hope that cloud seeding can be used to help get areas out of droughts, but it will not do much. The main way to combat droughts with cloud seeding is by filling up reservoirs with rain water in preparation for future droughts. Another problem with trying to determine the effectiveness of cloud seeding, is the unpredictability of specific clouds and storms. According to Arlen Huggins, “Attributing one storm to seeding is very difficult unless the cloud system is incredibly simple, like fog that has no chance of precipitation. If you see snowfall then, that's pretty demonstrative evidence that you succeeded” (Moseman). It is hard to predict if a storm was going to drop precipitation before the cloud seeding process, therefore it is nearly impossible to determine if the process created the resulting precipitation. Most people dismiss cloud seeding; however, the process always comes back up as many countries use it to create more water that they are in dire need of.

The use of cloud seeding has been used in multiple places since its conception. A famous example is when the United States tried to implement cloud seeding with Project STORMFURY. Project STORMFURY was done between 1962 and 1983 and was used on four different hurricanes in order to weaken them. Cloud seeding was introduced into the clouds of the outer eye wall of the hurricane with the hopes that once the new eye wall was formed with the outer eye wall, the hurricane would become weaker as it became bigger and more spread out. Once the hurricane is more spread out, the winds would die down creating less power and destructive force. During the experiment, which took place in eight days, for four of these days, “the winds decreased by between 10 and 30%. The lack of response on the other days was interpreted to be the result of faulty execution of the seeding or of poorly selected subjects” (Project STORMFURY). Regretfully, later on during the 1980s, these results were deemed inconclusive as there was a failure to take into account the effects of nature and non-human intervention in creating a weakening hurricane. Another reason that it was deemed inconclusive, was that the data suggests that introducing the new minerals into the cloud walls had no effects since there was already an abundance of natural ice and not enough super cooled water. As a result, Project STORMFURY was deemed a failure, however with new technologies being developed, it could be redone one day and be deemed a success.

Another instance of cloud seeding being used in real life applications is being used in China. During the 2008 Olympics in Beijing, they launched cloud seeding operations in order to lessen the chances of rain so that the Olympics could keep going without any weather-related interruption. In February of 2009, the Chinese government took credit for a massive snowstorm following a big four-month drought in Beijing. China is also looking to the future, as it suffers from dry agricultural regions in the northern part of its country. In order to help stop this and increase their food production, they are implementing a bunch of cloud seeding programs. According to an article by the *Daily Mail*, “China aims to use weather modification technologies to create more than 60
billion cubic meters [over 66 billion tons] of additional rain a year by 2020” (Prigg). According to that same article, China has also, “allocated 99 million yuan ($29.76 million) to spend on its weather modification program” (Prigg). China will end up becoming a leading titan in the cloud seeding and weather changing world as they increase their technological capacities and resources.

Cloud seeding has also been used for “Meteorological Warfare”. Meteorological warfare is using the weather to wage war against opposing enemies and is a relatively new thing in history. This type of warfare was first used in the 1960s and the 1970s against the North Vietnamese by the United States during the Vietnam War. According to an article by The New York Times, “The weather manipulation in Indochina, which was first tried in South Vietnam in 1963, is the first confirmed use of meteorological warfare” (Hersh). The United States engaged in meteorological warfare by introducing cloud seeding technologies during the monsoon season in order to create more rainfall to cause harm and interfere with North Vietnamese military operations. There have been different reports from the government on whether or not the operations were successful. Some officials would say yes and that it helped in ruining roads, supply chains, and interfering with radar involving surface-to-air missiles. Others say it had little to no effect on the war. One of the programs involved in this war was called, “Operation Pop-Eye” and was conducted over Laos. This program was documented and published in the Pentagon Papers afterwards and was a secret operation during the war. Most of the contents were top secret and many well-informed officials of the Nixon administration were not made aware of the details. During the war there were a few officials in the State Department that were weary over using cloud seeding as it could, “violate what we consider the general rule of thumb for an illegal weapon of war – something that would cause unusual suffering or disproportionate damage” (Hersh). There was also talk of the ecological effects cloud seeding would have on the ecosystem, and the negative or positive effects it will have in the long term. Afterwards the Soviet Union brought up the topic of weather warfare up to the United Nations after the controversy of these missions became public. The United Nations then put into effect on October 5, 1978, the “Convention on the Prohibition of Military or Any Other Hostile Use of Environmental Modification Techniques” (Convention on the Prohibition). This UN treaty essentially made it illegal to use meteorological warfare. The changing of weather patterns is to be used for non-hostile benefit only.

Late last December of 2018, Iran announced that they would be using drones for cloud seeding as well as some of their air force planes for a new program. According to the Iran News, “Initially, the operations will be performed by planes in the provinces of Fars, Chaharmahal and Bakhtiari, Isfahan, Kohgiluyeh and Boyer-Ahmad, Kerman and Yazd” (Iran to carry out cloud seeding). Iran has been using different cloud seeding methods for the past twenty years, but none have been done by the air force. Most of the methods were done on the ground through rockets, but these are not the most efficient forms of Hygroscopic seeding. The planes and drones will be much more effective. Iran also wanted to do this last year, but due to budget costs they were not able to perform it. In order to afford this, they are planning to import equipment from other countries such as Russia and China. Iran is predicting to have an increase in rain by 15 to 20 percent. Iran
is just one of many countries around the world planning and implementing cloud seeding technology into their way of life.

This United Nations law on Meteorological Warfare is the first of many outlines for the use of cloud seeding that will be coming in the future. As cloud seeding becomes more efficient and used around the world, laws will need to be created and research will need to be conducted to determine the ecological effects it will have on the Earth. Already the market for the cloud seeding equipment has been rising and is expected to continue to rise over the next decade. According to the Business Wire, “Global cloud seeding equipment market reached USD 97.7 Million in 2016 and is expected to register a CAGR [Compound Annual Growth Rate] of 7.1% across the globe during 2017-2024” (Global Cloud Seeding). According to the same report, Asia Pacific will have 38.9 percent of the global share by 2024 with 69.5 million U.S. dollars. Europe will increase by 5.5 percent, with the primary countries causing this being Russia and Germany. North America also has a lot of growth in the cloud seeding market and equipment with 6.9 percent. The reason these increases are happening are due to the effects of global warming and pollution, leading to a result of less rain. Russia and Germany are starting to face water scarcities as well and are looking to prepare for the future by investing in these technologies. (Global Cloud Seeding). The demand for cloud seeding is only gaining more traction and research, and as a result, will be something to look into during the next decade.

The United States is already looking at adding more laws to the ones that have already been passed. Many laws that are already in place are controlled by the state and local governments. Most of these laws are on when people try to make a lawsuit that someone was negligent in cloud seeding and damaged their land. Most of these cases never get anywhere since it is generally very hard to prove that the cloud seeding method actually worked in creating the weather that caused the damage. Some states, like Colorado have implanted a cloud seeder permit. According to an academic journal called, Rain, Rain, Don’t Go Away, “These regulations include instructions on how a cloud seeder can obtain a cloud seeding permit, the experience he or she must have to rightfully obtain a permit, and the terms by which a permit may be revoked” (Currier). According to the same academic journal, there has only been one big federal act passed and it was the Weather Modification Policy Act of 1976, and all it does is require cloud seeders to submit their reports to the Secretary of Commerce to be delivered to the President and then the public. Since the creation of this act, there has been a lot of extra research done to improve the cloud seeding process, and this act should be revisited. (Currier). There will soon be a need to reform and introduce more laws into the American government as cloud seeding becomes more necessary for the country.

The final topic of cloud seeding is something that has yet to be talked about, and that is the question of, “Should humans engage in cloud seeding activities? Is it a good thing to change the course of nature? Will it have any long term impacts on the environment? Will it be necessary to save the human race’s current way of life?” All of these questions have different solutions and theories. The future is full of hypotheticals, theories, and ideas, but not a lot of accuracy. It is very hard to predict the future, and it is even harder
to predict the future correctly. Some say that cloud seeding is fine, since it involves “natural” chemicals being instilled in the air. Others say that it should not be done since humans have engaged in changing the planet enough. To the same token, humans have already done so much, why not keep going? Finding the correct answer out of all of these questions is hard, and in the words of Dr. Gisela Diaz, “There are as many solutions as there are theories” (Diaz). The only thing that is currently certain, is that more countries are investing in cloud seeding technology, more research and experiments are being conducted, and laws are being written. Whether it is the right thing to do or not, countries are going forward and are heading for the clouds.
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Physics Engines: Their Functions and Their Applications by Ian M. Schiess

Abstract
With the logistics behind real-world testing and entertainment fading fast, physics engines are quickly becoming the most viable alternative for both scientific and recreational purposes. Physics engines are a collective of programs and complex algorithms designed for one purpose: to emulate realistic physical interactions. Physics engines, although widely used for video gaming since their creation, now serve far more complex purposes which not only include entertainment, but also solving complex problems in the fields of science, engineering, astrology, and so forth. The purpose of the research is to provide insight into physics engines, their history, their algorithms and inner workings, their applications, as well as a comparison between different engines. In the foreseeable future, simulations are likely to take part in nearly all facets of experimentation as well as daily living. Considering that physics engines are the main driving force behind these types of simulations, the study and development of physics engines is imperative for the progression of a technologically advanced society.

Keywords: Physics engines, video games, physics, computer programming, engineering, astrology, simulation

Introduction
According to the Merriam Webster dictionary, the definition of “Simulation” (n.d.) is “the imitative representation of the functioning of one system or process by means of the functioning of another.” Simulation is a tool created by humanity to assist with the performance of tasks. Before encountering a situation in real life, creating a mental simulation is typical human behavior. Doing so provides a sense of preparedness for the incoming situation and is overall beneficial. In the same way, simulating within a computer makes the outcome known before the real-life result takes place. However, humans need help with predicting realistic interactions; enter the physics engine. Physics engines are powerful computer programs that collect imputed data and send them through sophisticated algorithms to approximate realistic results. The history, algorithms and inner workings, applications, and comparisons of physics engines are exceedingly influential to the functioning and progression of society and were the focus of the research provided.

The History of Physics Engines
Since the late 1950’s, the applications, capabilities, and processes of physics engines have changed drastically. When comparing Pong and similar simple calculation games to the powerful algorithms of modern titles that run on engines such as Bullet and Havok, the differences are numerous and evident (Jones, 2011). Physics engines featured simple beginnings when Physicist William Higinbotham created what is known as the first video game in October 1958. Higinbotham’s creation was dubbed “Tennis for Two” and was a
simple tennis style game similar to Atari’s “Pong” which consisted of analog controls, an oscilloscope displays only five inches in diameter, circuitry consisting of resistors, transistors, capacitors and relays, and a simple physics engine (Chodos, 2008). As popular as Tennis for Two was, the high demand for a personal console video game was not surprising. Atari’s Pong was created in 1972 to fill that demand and was a tennis style Player versus Player (PVP) game featuring a still rudimentary physics engine that only had to calculate simple vectors. The humble beginning of physics engines was abruptly ended in the 1990s with the releases of Nintendo’s Super Mario Bros., which utilized some of the first real-world momentum calculations in video games (Melegari, 2014). With Super Mario Bros., we see the introduction of 3-dimensional environments and less linear level progression. The freedom 3-D gave to players spurred the creation of more modern titles. At this point, physics engines were completing complex calculations, utilizing soft and hard body physics, and were emulating realistic interactions. The first company dedicated to the creation of physics engines is Havok, founded in 1996 by a graphics research group at Trinity College in Dublin, Ireland. The first video game released with havoc technology was London Racer, which utilized physics calculations for collision debris. Havok is still relevant today with popular titles such as Rocket League using their engine (Reynolds & Collins, 1998). Seeing the implications of physics engines, other companies began to create their own, including NovodeX’s PhysX engine, which was eventually acquired by Nvidia in 2008. PhysX is the engine of many popular titles, including Call of Duty, Borderlands, and The Witcher (Reynolds & Collins, 1998). The physics engines of today are widespread and numerous. Large companies such as Intel and Nvidia continue to improve their technologies and develop big titles. Meanwhile, open source (public use) engines such as Bullet are popular with game designers on a budget (Jones, 2011).

**Algorithms and Inner Workings**

Physics engines handle the “physical” interactions in a simulation or game and are only one component of the larger game engine. While the other parts of the game engine are busy determining output such as audio and video, the physics and logic engines are responsible for determining what happens in the game. A game's logic engine will determine specific interactions. Meanwhile the physics engine will solve the “forward dynamics problem”, which will determine the motion of the system given the forces acting on it (Boeing and Braunl, 2007). For example, the logic engine may allow players to fly provided they have a specific item equipped, while the physics engine may determine the trajectory of the player's flight due to gravity, wind, and other factors. A physics engine's overall performance will affect how smoothly a game runs, how accurate the interactions are, and how stable the game is. Stated by Boeing and Braunl (2007) in “Evaluation of real-time physics simulation systems,” “There are six essential factors that determine the overall performance of the physics engine:” the integrator, object representation, collision detection and contact determination, material properties, and constraint implementation (P. 281). Other notable components of physics engines include numerical integration and the use of hard and soft body dynamics.
The Simulator Paradigm.

The simulator paradigm determines which aspects can be accurately simulated (Boeing & Braunl, 2007). A physics engine lacking a simulator paradigm would have trouble with accurately solving constraints. There exist five types of simulation paradigms: Impulse based constraint-based, penalty-based, collision synchronization, and hybrids (Erleben, 2005).

Determines which can be accurately simulated. This affects the accuracy in resolving constraints. An overview of simulator paradigms is presented in [Erleben, 2004]. Mirtich provides a comparison of constraint-based methods and impulse based methods in [Mirtich, 1996], and a comparison of penalty-based methods with constraint-based methods is presented by Baraff [1992].

The Integrator

The integrator is responsible for producing numerical accuracy within the simulation (Boeing & Braunl, 2007). By applying real-life physics equations to interactions within a simulation, the integrator can produce accurate numerical values.

Object Representation

Within a physics engine, the various objects involved in an interaction must be accurately represented. Object Representation allows for interactions within a simulation to be precise and efficient (Boeing & Braunl, 2007).

Collision Detection and Contact Determination

Without collision detection and contact determination, a physics simulation could not exist. Collision detection and contact determination determine when and where two objects collide, which is useful for determining exact numerical values for use in vectors, timelines, and other algorithms (Hadap & Eberle, 2004).

Material Properties

Material properties determine whether the system can approximate an object or not. Coulomb friction (A simple model for dry friction that is empirically accurate) is an example of one of these properties (Boeing & Braunl, 2007; Braff, 1992).
**Constraint Implementation**

According to Boeing and Braunl (2007), “Constraint implementation, determines which constraints are supported and how accurately they can be simulated.” (P. 282). (further supported by Erleben, 2005).

**Numerical Integration**

Beyond these factors, there is numerical integration. Numerical integration utilizes a wide range of algorithms and differential equations to calculate a definite integral. Among them is Euler’s method (also referred to as Euler’s formula), which is useful for solving ordinary differential equations given a starting interval (Baraff, 1992). Overall, numerical integration determines the accuracy of the resulting calculation from each of the five factors shown above.

**Rigid and Soft Body Dynamics**

**Rigid body dynamics.** In a simulation, hard body dynamics govern the interactions between rigid solids and other rigid solids, or soft solids. Rigid solids are defined by their constant shape and low contact interval time. Rigid body dynamics often utilize the Coulomb friction model (Baraff, 1992) and are generally more difficult to approximate then soft body dynamics, despite being computationally cheaper.

**Soft body dynamics.** In a simulation, soft bodies are defined by their ability to flex and bend while maintaining their general shape and mass. Unlike rigid bodies, soft bodies feature a lengthy contact interval, which increases their computational load (Baraff, 1992). Soft bodies also change shape readily, which makes rendering them a nightmare for graphics processors.

**Applications of Physics Engines**

As physics engine technology progresses and develops, the applications for it do as well. Utilizing a physics engine is often the most efficient or even the only option for large-scale computation. Various fields, including robotics, video games, and astrology make use of physics engines for their calculations and modeling.

**Robotics**

In the field of robotics, the use of physics engines is useful for determining the merit of a robot before its assembly. Servos, computers, and the high-grade materials used for robotics are often expensive, so the ability to test functionality pre-assembly saves a significant amount of time and money. Imagine assembling an entire system to find out that a single miscalculation or lapse in judgment renders it useless. Simulating real-life interactions accurately is of utmost importance in these engines. Therefore, a physics engine intended for use in robotics simulations should forego some efficiency for extreme accuracy and precision (Chung & Pollard, 2016). MuJoCo is an excellent engine for use
in robotics simulations due to its high stability, predictability, and precision. Other engines such as ODE and DART can produce similar results (Chung & Pollard, 2016).

**Video games**

With their various and often complicated inputs, as well as the intense rendering, logic, and audio engines, video games heavily tax the system they run on. Because of this, video games tend to optimize efficiency, speed, and stability over accuracy and precision. As such, the physics engines utilized in video games tend to be less accurate, and much faster/stable (Chung & Pollard, 2016). This is the reason why engines such as PhysX and Havok, which are highly optimized, are the two most popular physics engines used in games.

**Astronomy**

Astrophysicists are mostly observational and theoretical scientists. However, they also spend much of their time sitting at a computer. They use programs to run simulations, perform calculations, and write the code for astronomic scenarios. Simulation software with built-in physics computation such as Gadget-2 and interactive software such as Microsoft’s Worldwide Telescope are at the forefront of these technologies (Czekala & Newton, 2018). Orbital simulation software such as STK (Systems Tool Kit) are often used by astronomers and engineers to model extra-terrestrial bodies. Finding the right coding language for astronomical software can prove to be a difficult task, as each promising coding language has its benefits and drawbacks. For instance, Python is a powerful new coding language that utilizes different programs/packages, such as Scipy, Numpy, iPython, and Matplotlib which make it a versatile computational tool suitable for use on facilities such as ALMA (Atacama Large Millimeter/submillimeter Array). However, Python’s versatility becomes a drawback in the face of complex problem sets, where a language, such as Mathematica with its simplistic “notebook” style excels. Other coding languages find use in astronomy simulations as well, such as IDL, C/C++, Matlab, and Perl (Czekala & Newton, 2018).

**Comparisons Between Physics Engines**

Several studies, experiments, and surveys have been utilized to further define the differences and similarities between various physics engines and their purposes. In one such study by Chung and Pollard (2016), four engines (Bullet Physics, DART, MuJoCo, and ODE) were pitted against each other in a series of performance tests. The tests included simulations of a cube rolling both downhill and on flat ground in various directions. Each engine's parameters were tuned separately to match the analytical solution as close as possible. In the downhill tests, Chung and Pollard found that Bullet MB had the least variation in the number of rolls while MuJoCo achieved the least axis rotation. Bullet and ODE were found to be unpredictable in the downhill tests. In the flat ground tests, however, Bullet and ODE showed more predictable patterns than the rest. Another comparison, conducted by Boeing and Braunl (2007) shows the differences between seven engines (Ageia PhysX, Bullet Physics Library, JigLib, Newton Physics.
SDK, ODE, True Axis Physics SDK, and Tokamak.). A series of five tests were performed: integrator, material, constraint, collision, and stacking. According to Boeing and Braunl, PhysX performed the best in the integrator test, True Axis was the strongest in modeling restitution, and for large integrator step sizes, Newton provided the best estimation for static friction, and Tokamak was the most efficient for computing stacked objects and solved large chain restraints effectively. ODE provided exceptional results for constraint accuracy, while JigLib and Bullet performed well in the collision penetration test. In Boeing and Braunl's results, no one physics engine outperformed the others in every task. Nearly every engine performed the best in at least one task, meaning that a developer must be considerate in choosing an engine for a specific task.

**Conclusion**

Before the use of physics engines, engineers relied on calculations and judgment alone to predict the efficacies of a test, astrophysicists created theories and predictions without the use of accurate simulations, and robotics was mostly trial and error, with material costs collecting for every failed prototype. The solution was simulation. In various cases, the ability to simulate real-life interactions is the key to success, and something only physics engines are capable of. The value that the use of a physics engine adds to the experimentation and development process is non-replicable by other means, and with further development, the potential application of physics engines is limitless. Imagine a surgeon in training honing their skill within a realistic simulation before they enter the hospital. Imagine a simulation that allows a person with paraplegia to run, jump, and explore their newfound freedom. Imagine a physics engine predicting the long-term effects of climate change or an imminent natural disaster, the number of prevented casualties would be astronomical. The use of physics engines in their current applications is effective. However, given the potential of such technology, the significance of physics engines is severely underrated. “
References


The Free Will vs Determinism Debate by
Stephen Sims

Abstract
The freedom that makes us human, does it really exist or is it simply an illusion? Has every action we will make already been determined prior to our birth? These questions are answered as I defend the Compatibilism between free will and causal determinism from the view of Hard Determinism. The implications for society are extensively explored.

I. Introduction
The debate between Free Will and Determinism has captivated philosophers since antiquity and the debate still rages today. Free Will is defined as the ability of a rational actor to make a decision among various alternatives, implying the ability to choose otherwise. Human beings are inherently disposed to believe that their choices are the sole result of their own volition. This concept is intuitive and considered to be intrinsically part of the human condition. In fact, moral responsibility and the functioning of our system of justice is based on the idea that every rational actor has the ability to choose otherwise. Determinism is defined as every event being determined by antecedent events and the laws of nature, which is encapsulated in Consequence Argument. The rise of Determinism in philosophical thinking coincides with the rise of the Scientific Method. Physical beings are bound by the laws of physics. Every event can be explained by causation (i.e., cause and effect), which forms a chain that cannot be broken. One effect cannot have more than one cause. The debate between Free Will and Determinism, is related to the Mind-Body problem, the fundamental unsolved problem in the philosophy of the mind. One answer to the Mind-Body problem is called Materialism, which states that human beings and the world are comprised of only one substance, the material. Materialism and Determinism are two components of the same theory. The purpose of this paper is to show that causal determinism is in fact compatible with Free Will. Despite advances in neuroscience that have swayed many towards Hard Determinism, I seek to vindicate Compatibilism. This leads to the question, “Why should I care?” The implications of this debate are stark and fundamental to the functioning of our society. If every action of human beings is preordained through Hard Determinism, then how can we hold people who violate societal norms responsible for their actions? The implications are that we cannot.

II. Determinism
Causal determinism was first promulgated by the Stoics in Ancient Greece. The belief had a reemergence in 19th century Europe after the development of Newton’s laws of gravitation. These laws of nature seemed to show that the universe was deterministic, and all cause and effect had a predetermined conclusion. The first published articulation of determinism was by French mathematician Pierre-Simon Laplace in 1814. “We may regard the present state of the universe as the effect of its past and the cause of its future.
An intellect which at a certain moment would know all forces that set nature in motion, and all positions of all items of which nature is composed, if this intellect were also vast enough to submit these data to analysis, it would embrace in a single formula the movements of the greatest bodies of the universe and those of the tiniest atom; for such an intellect nothing would be uncertain and the future just like the past would be present before its eyes.¹ This articulation this became known as Laplace’s Demon. This view became common among scientists until the 20th century with the rise of quantum mechanics, chaos theory, and the irreversibility of thermodynamics.

The modern definition of causal determinism is set forth in the Consequence Argument, originally proposed by Peter van Inwagen in 1983.²

I. There is nothing we can now do the change the past.
II. There is nothing we can now do to change the laws of nature.

Adding premise I and II we arrive at:

III. There is nothing we can now do to change the past and the laws of nature.

If determinism is true then,

IV. Our present actions are the necessary consequences of the past and the laws of nature.

If determinism is true then, it seems that,

V. There is nothing we can now do to change the fact that our present actions are the necessary consequences of the past and the laws of nature.

VI. There is nothing we can now do to change the fact that our present actions occur.

You have no control over the laws of nature, the state of the universe and the planet earth, the country or region you are born in, your race, who your parents are, your DNA, and of anything that happened before you were born. It is a fact that there are certain properties of the world and of ourselves that we have simply no control over and could not change, even if we wanted to. The laws of nature and prior events are two such examples. It is true that causal determinism does exist. However, that alone does not alone explain the actions of human kind. A full explanation of the human condition is that causal determinism is compatible with free will and this in turn demands that we are held accountable for our actions. Premise I to III of the Consequence Argument is undeniable.

Premise IV begins with the assumption that determinism is true. The argument makes this leap to show the consequences of determinism, i.e. that free will does not exist, based off the premises of I, II, and III. According to Kane³, van Inwagen is able to derive premise V from premise IV by Rule Alpha: “There is nothing anyone can do to change what must be the case (or what is necessarily so).” Necessary meaning it could not be otherwise. If

¹ Laplace, Pierre-Simon (1814) A Philosophical Essay on Probabilities
the laws of nature and prior events could not have been otherwise, then it is necessary that our present actions are the consequences of these two facts, according to premise V. To conclude the argument, van Inwagen moves us from premise V to VI using Rule Beta: “If there is nothing anyone can do to change X, and nothing anyone can do to change the fact that Y is a necessary consequence of X, then there is nothing anyone can do to change Y either.”

Now we have reached the problem that arises from the Consequences Argument, which occurs in premises IV, V, and VI, which in effect is an argument for incompatibilism between determinism and free will. Although it is true that no one can change the law of nature or the past, the idea that all our “present actions are a necessary result of” these hitherto facts are unsubstantiated. This premise leads to the conclusion that every single action I made today was a result of a prior event that leads all the way back to before I was born, and to the start of the Big Bang. This in effect, means that the Consequence Argument has true premises but a false conclusion.

### III. Compatibilism

The Classical Compatibilism of Thomas Hobbes, David Hume, and John Stuart Mills viewed free will as simply an absence of constraints preventing us from free choice. The focus was on “external constraints to freedom, such as physical restraint (being in jail or tied up), coercion or threats (holding a gun to someone’s head), and physical disabilities (such as paralysis).” The modern view of Compatibilism takes into account internal constraints to our will, such as addiction, phobia, obsession, neuroses, and compulsive behavior that limit or nullify our freedom. Our freedom is thus limited by external restraints and internal constraints.

Harry Frankfurt’s Principle of Alternative Possibilities (PAP): “Persons are morally responsible for what they have done only if they could have done otherwise.” The principle of PAP directly leads to AP, which states that: “Free will requires that power to do otherwise, or alternative possibilities.” The modern definition of Compatibilism was revised in part by Harry Frankfurt, who proposed the Principle of Alternative Possibilities, AP, and the idea of first order and second order desires. Higher order desires and volitions are one of the main differences between human beings and animals. We are capable of thinking about what kinds of desires and purposes we should have. Thus, the “rational animals” are capable of “reflective self-evaluation,” meaning that we are not bound by instinct and instead can scrutinize the desires we were born with and in retrospect evaluate our decisions to elucidate our motivations, thus making possible a future ability to choose otherwise.

The most prominent examples of Frankfurt’s first order and second order volition is that of the unwilling drug addict. His first order desire to use drugs, due to an addiction. This addiction imposes an internal constraint on his will, reducing his freedom. According to Frankfurt, his second-order desire is for his first-order to desire to not come to fruition.
because of regret. For the addict, the second-order desire to not use drugs is often not effective. The reflective self-evaluation is that we can contemplate the results of our actions and strive to change future behavior. Our second-order volition is a desire or motive about another desire or motive. Free will is thus directly connected to second-order volition, reflective self-evaluation, and the ability to choose otherwise.

We can use our daily behavior as a window into understanding freedom of the will. If I was born in another century I could not drink energy drinks. The fact that these products exist does it meant that I have been predetermined to use them? Does the Consequence Argument, the laws of nature and prior events determine me to make the decision to drink energy drinks on a daily basis? Was there some prior event I am over-looking that first caused me to start drinking them and this first cause lead to the causal chain whereby my behavior has been determined? There certainly could have been a prior event that first caused by behavior, but since free will exists and is compatible with determinism, this first prior event and the laws of nature (such as my biology, my genetics) does not preordain my decisions. I still retain the ability to choose otherwise. My will can allow me to stop this causal chain of events and start a new chain of events by suddenly changing my decisions process. This is related to why I, or most people have never used cocaine, crack, flakka, PCP, etc. The reason is in my deliberation I weighed the pros and cons (cost/benefit analysis) of using these substances, realized the negative effects would derail my plans and I would feel regret for making such a decision. Thus, the evidence for freedom of the will manifests itself in deliberation before action, arriving at a decision using reason, making plans for the future, and the feeling of regret and shame. On the contrary, Hard Determinism implies that the decisions we make do not use any of these processes. Our decisions and actions were already determined in totality by the Consequence Argument, therefore they are tantamount to impulsive, spur of the moment action. In addition, this is why there is a difference in sentencing and thus moral responsibility between premeditated first-degree murder, impulsive unplanned second-degree murder, and manslaughter, the death not being the result of malice or intention.

IV. Antithesis

Professor Patrick Haggard, of the University College London (UCL), gives us a “End of History” conclusion to the Free Will problem: "As a neuroscientist, you've got to be a determinist. There are physical laws, which the electrical and chemical events in the brain obey. Under identical circumstances, you couldn't have done otherwise; there's no 'I' which can say 'I want to do otherwise'.” As a response to this unintuitive view Professor Haggard replied that "No one wants to be told they're just a machine.” Professor Haggard, who can be seen in the documentary by Closer to the Truth, entitled “Big Questions in Free Will” is one of the strongest proponents of a complete Hard Determinist worldview. In his view, every action and decision we make has been

determined by the laws of nature, our genetics, and prior events, the cause and effect going all the way back to the Big Bang.

The first scientific experiment to purportedly prove incompatibilism is known as the Libet experiments that took place in the 1980s. The recorded cerebral activity that preceded a voluntary action was compared to the reportable time of the subjective experience of intending to act. The onset of cerebral activity preceded the conscious intention to act by several hundred milliseconds. The Libet experiments show that the unconscious processes in the brain are the true cause of physical action before the consciousness is able to contemplate action, therefore the role of consciousness in volition is proven false. This can been see as not only evidence of a solely material mind but as a refutation of Free Will. According to Derk Pereboom, “any state that is conscious comes too late in the causal sequence to be efficacious in producing action. Instead, unconscious neural states cause action.”

The Libet experiments were used by proponents of Hard Determinism to show that free will is an illusion and to also give evidence toward epiphenomenalism. The Mind Body problem is the second unsolved problem of philosophy that has captivated thinking things since antiquity. The problems of Cartesian Dualism would lead to Materialism (Physicalism), Epiphenomenalism, and Idealism. Epiphenomenalism is the theory that mental processes play no causal role in physical action. Mental events are caused by physical events in the material brain but these events have no determination in how our body responds. We are all thus “foam on the front of the wave.” We see ourselves as in control, but we really have no role other to hang on for the ride. Sudden fear, a mental event, seems to make our heart rate and blood pressure increase exponentially, but it is our nervous system, a purely physical system, that created this result.

The main argument against Epiphenomenalism relies in its inherent contradiction. If the mind has no role in the physical reaction of the body, as in fight or flight, or of our knowledge of our own consciousness, then how can we have knowledge of epiphenomenalism? If our minds are a “ghost in the shell” then we could not have any knowledge of our own mind. A believer in epiphenomenal qualia using his physical being to advocate the rightness of epiphenomenal qualia is a contradiction because he is engaging in an activity that goes against his own theory. For this reason, Professor Frank Jackson, the creator of the infamous Knowledge Argument (of Epiphenomenal Qualia), would later refute his own theory because of the contradiction.

Flaws of the Libet experiments can be split into two main objections. The subject’s decision-making process is being tested on the scale of microseconds and the decision at hand is of an inconsequential nature. Serious life-changing decisions are not made on the scale of tiny fractions of a second and are of monumental importance, not of when I decide to raise my arm, etc. The experiment is about pushing a button or flexing a finger. This does not involve life-changing decisions because there is no planning, and thus does

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not show universal determinism or causation of our decision-making process. Furthermore, an EEG on top of a person’s head is not powerful enough to give conclusive evidence.

Bernard Baars has elaborated on the time scale necessary for significant decision making:

“Sensory events occurring within a tenth of a second merge into a single conscious sensory experience, suggesting a 100-millisecond scale. But working memory, the domain in which we talk to ourselves or use our visual imagination, stretches out over roughly 10-second steps. The tenth-of-a-second level is automatic, while the 10-second level is shaped by conscious plans and goals.”

A sequel to the Libet experiments was undertaken by Uri Maoz. In this experiment an EEG reader was implanted in the patient’s skull, directly on the brain, during surgery to ameliorate epilepsy. Afterward, the patient took a test to determine when she decided consciously to push a button. The experiment by Maoz rendered the same results as the Libet experiment. Maoz was able to predict what button the patient was going to push, before the patient is aware of her own inner decision to do it. The results are used as evidence by determinists that our conscious decision to act does not cause us to act.

This purported dichotomy between science and philosophy is evidenced by neuroscientist Sam Harris, the most influential Hard Determinist of the current epoch and member of the New Atheists. Sam Harris, in his book Free Will, describes free will as “an illusion.” “Our wills are simply not of our own making. Thoughts and intentions emerge from background causes of which we are unaware and over which we exert no conscious control.” Harris further elaborates that if our wills are not determined by prior causes then they are simply a product of chance and randomness, which is not freedom. Harris claims that free will has “given us both the religious conception of ‘sin’ and our commitment to retributive justice.” And contends that people on Death Row are inherently unlucky and less blameworthy due to “some combination of bad genes, bad parents, bad environment, and bad ideas.” And asks: “Which of these quantities, exactly, were they responsible for?” Of course, these unlucky attributes might not seem a very good excuse to the family of the victim.

The most influential philosopher to promulgate determinism is Derk Pereboom. In advocating skepticism of free will Pereboom relies on the Manipulation Argument. The argument begins that “the intuition that if an agent is causally determined to act by, for example, scientists who manipulate her brain, then she is not morally responsible for that action, even if she satisfies the prominent compatibilist conditions on moral

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11 Ibid., 48
12 Ibid., p. 54
To a compatibilist, theorizing on our moral responsibility while a fictional scientist controls our brain to make a specified decision, or to stop us from making our own decision, is not real evidence. In the realm of moral responsibility and criminal justice, Pereboom admits that according to free will skepticism that “agents do not deserve blame just because they have knowingly done wrong, neither do they deserve punishment just because they have knowingly done wrong.”

Science and philosophy being mutually exclusive and antagonistic toward each other is a misnomer. The atomic theory of quantum mechanics that was proven in the 20th century was originally formulated by a philosopher in Ancient Greece 2,500 years ago named Democritus. Newtonian Mechanic’s modus operandi of cause and effect seemingly proved the world to be deterministic in nature. The laws of classical mechanics are certainly causal based. In the 20th century gave rise to Quantum Mechanics and chaos theory, which has shattered our view of a perfectly ordered universe. The study of subatomic particles has led to the discovery that the universe at its smallest scale is based on probabilities. This has also led to the use of statistical mechanics. To those on the Compatibilist and Libertarian side of the free will debate this given the possibility that the indeterminism of nature at the subatomic level could give evidence towards free will. On the other hand, detractors claim that these indeterministic probabilities of QM have no bearing on the macro-level of human beings in their consciousness and decision making. Moreover, if quantum probabilities did play a role, it would amount to randomness and that is not freedom.

V. Reaffirm

When pondering the state of our society here in the United States, there are two historical acts of domestic terrorism that have left their imprint on my conscience from when I was growing up. In 1995, Timothy McVeigh and Terry Nichols detonated a 5,000-pound bomb of ammonium nitrate fertilizer and nitromethane race fuel inside a rental truck in front of the Alfred P. Murrah Federal Building in Oklahoma City. The cover of Newsweek Magazine showed a fire fighter holding the body of a small child covered in blood. Out of a total death toll of 168 lives, 15 children died and more than 680 were injured. The blast left a crater 30-feet wide and 8 feet deep in the ground.

In 1999, a high school in Colorado known as Columbine would be the scene of the worst school massacre in seventy years. Two students, Eris Harris and Dylan Klebold would murder 12 students before taking their own lives. This was supposedly the school shooting that changed America. In reality, nothing changed. Unfortunately, the Columbine massacre is not the worst school shooting in our history. In February 2018, 17 students were murdered in Marjory Stoneman Douglas in Parkland, Florida. In 2007, 32 students were murdered in the Virginia Tech Massacre. In 2012, the lives of 20 children between the ages of six and seven years old were lost at Sandy Hook Elementary School in Newton, Connecticut. In 1927, a maniac perpetrated the Bath School massacre that

14 Ibid., p. 278
killed 38 elementary school children, in Bath Township, Michigan. Russia would be the scene of the worst terror attack against children the world has ever seen. In 2004, Islamic terrorists from Chechnya held over 1,100 hostages at a school in Beslan, Russia. Hundreds of children were packed into the gymnasium that was packed with explosives. When the fires were finally put out, the bodies of 334 people, including 186 children, were laid to rest.

Hard Determinists believe that since determinism is true, that all human action is a direct result of the Consequence Argument that there is no ability to do otherwise and free will does not exist. The consequence of no ability by humans to make their own decisions means that moral responsibility is non-existent. No human action is determined by the agent and thus only by nature and prior events.

Humans cannot live in a society without moral responsibility. Believing that we can is nothing more than ideology. Human beings routinely commit unspeakable acts of evil towards their fellow kind. Viewing the news daily and studying world history illuminates how stark this fact truly is. Hard Determinism concludes that every murder, by way of the Consequence Argument, had to occur. Every murderer had to commit the act and every murder victim had to die. The perpetrator could not have chosen otherwise, and the victim could not have done anything to change this event, which is the result of proprieties out of their control. The same is true of rapists, and rape victims; of slave owners, and victims of slavery; of perpetrators of genocide, and victims of genocide.

VI. Pragmatism

What if science ultimately proves Hard Determinism true beyond any doubt? If Hard Determinism is true we still must base our morality and system of justice on the idea of free will to properly reign in human behavior, as to avoid major disruptions to society. Saul Smilansky, who rejects libertarian free will and compatibilism, argues in Free Will: From Nature to Illusion (2001) that the majority should believe in free will, even though it is an “illusion” because without this widespread belief relegating human action it would be detrimental to society. Without the belief that we control our own actions and our own destiny, it can lead to nihilism and a reduced sense of self-worth. Smilanksy calls this theory Illusionism, whereby the theory of Hard Determinism stays inside the Ivory Tower, believed only by some philosophers and most neuroscientists, but the “illusion” of Free Will is still near and dear to the hearts of the majority, who use this feeling to live productive and moral lives. This is akin to the theory of the “Protestant work ethic.”

In addition, Robert Kane, in discussing P.F. Strawson’s reactive attitudes, went further and exclaimed that “it would be irrational to give up feeling and expressing such attitudes toward one another because of what scientists might discover about physical particles or
biological phenomena in a laboratory” because reactive attitudes “fulfill fundamental human needs.”

Furthermore, in a study by Kathleen D. Vohs and Johnathan W. Schooler, entitled The Value of Believing in Free Will shows that belief in free will or determinism does, in fact, change our behavior. Participants would first read an article that expounded a belief in determinism (that behavior is a product of environmental or genetic factors) or a text that is neutral, followed by the performing of a particular task. The study showed that those who read the article promoting determinism would subsequently cheat during the task in much greater numbers than those who read the neutral text.

In addition, the first comprehensive survey of professional philosophers was conducted in 2014 by David Chalmers and David Bourget, to distinguish the majority view on thirty philosophical issues. On the question of free will, 59.1% of philosophers believe in Compatibilism, 13.7% Libertarianism, and 12.2% no free will.

The debate between Free Will and Determinism will likely never be conclusively solved, as mathematical certainty is not possible. This point was illustrated by David Hume: “Mathematical sciences have this advantage above the moral sciences: the ideas of the former are clear and determinate even to the smallest distinction” and “Geometric terms are clearly defined; moral ones are not, and introduce ambiguity into our reasoning.” This fact should not distract us from the implications of the debate that began in Ancient Greece and has reached a crescendo in this century.

VII. Conclusion

The most fundamental debate in all of philosophy, the debate between Free Will and Determinism has serious implications for human society and yet will likely never be solved to any conclusive degree, such as to mathematical certainty. The two main contenders for the title, Hard Determinism and Compatibilism both have their passionate defenders. The feeling of freedom we as human beings feel is not an illusion. The ability to choose otherwise, to break the causal chain of events precipitated by causal determinism is possible. We exercise our will by using reason and logic, using deliberation (cost/benefit analysis), the act of planning our future, using our second-order volition to counter our first-order volition, and when we feel regret and shame after making a wrong decision. These attributes of our will are what makes us human.

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The historical arc of psychology has progressed from the study of individual consciousness to the systematic investigation of a host of concerns that significantly intersect with the human condition. The post-modern world encompasses problems that are unique to the era. Our time is also one in which advances in many fields present humanity with many opportunities, including the prospect of traveling to Mars. To remain relevant, the field of psychology arguably has to make contributions to issues in new horizons, including space travel and the prospect of off-planet settlements. This paper recounts where the field of psychology has been and offers a prospective view of how psychology may make inroads into the realm of aiding settling humans on Mars.

**Psychology’s Scope**

**The Nature of Psychology**

Like other discreet disciplines, psychology has its own way of framing problems and issues—in this case, psychological phenomena. The word psychology itself is derived from the Greek word, psyche, which means mind or soul, and the root word, ology, which means, the study of. Therefore, psychology literally translates to the study of the mind and soul. According to the academic textbook, *Psychology*, “Psychology refers to the scientific study of the mind. Since science also studies observable phenomena and the mind is not directly observable, we expand this definition to include the scientific study of mind and behavior” (Spielman, 2014, p.6). Missing from the quoted definition is a notable domain. Since psychology, for much of its history has recognized a connection between biology and psychological nature, it is perhaps necessary to add the biological domain to the definition. Since psychology uses the scientific method, it uses empirical data to assemble theories, arrive at hypotheses, and validate assumptions.

As a scientific field, psychology subscribes to the goals of describing, explaining, predicting, and finding a solution or control to a certain problem. Once a certain problem has been identified, rather than leaping to a solution, psychology follows the rather slow process of gathering data and proposing possible explanations for the observations. The gathered evidence then allows for reliable predictions which then permit for best possible solutions. Rather than making cold recommendations to anticipated relationship conflicts among Martian settlers, psychologists would, in essence, define a problem, gather data,

* written by the students in Honors Psychology, Spring 2019.
relate the data to existing or new theoretical explanations, and then propose plausible solutions.

It is also important to recognize that psychology often relies on existing theoretical frameworks to define and solve problems. Each major theory in psychology arrives at its own research questions. As in other fields, answers in psychology, therefore, have an inherent bias in that they are based on a particular perspective. As the field ventures into new sub-disciplines, and as creative individuals disrupt traditional explanations, new paradigms will formulate new hypotheses and theories. Space psychologists will probably use established psychological evidence to make contributions but may well also have to arrive at new ways of regarding humans.

Finally, psychology is multifaceted, which means it has many sub-fields specializing in specific areas of study. As such, psychology has the potential to be used in diverse ways for the advancement of humanity on and off-planet. Many questions remain regarding our mental, behavioral, and bio-psychological processes. Answers to these questions can inform adaptations to current and future challenges, including finding increasingly effective treatments for psychological disorders.

**Methodological Approaches**

Psychology employs descriptive and inferential methods to gather and validate evidence. Since science strives to predict, it has a preference for inferential approaches that attempt to study relationships between variables. Inferential methods, such as experiments and correlational studies, thus often use data derived from descriptive data that is often gathered from survey or observational studies.

Much data is accumulated through the process of observation, which involves watching and recording the events that take place during a study. Another form of research is done through surveys, which is when researchers directly ask the questions related to variables in a study and gather information through responses. Whereas survey data is mostly quantitative, qualitative approaches use interviews to uncover processes that are not available from numerical data.

Experiments are the golden standard for arriving at causal relationships as they manipulate variables to detect effects on specific outcomes. Since it is not always possible to manipulate variables, it is necessary to resort to a variety of correlational methods which determine the strength of the relationship between variables.

Studies can be done in a natural setting or a laboratory. In a natural setting, data is collected without any external intervention. Laboratory studies bring participants to artificial or pseudo-artificial settings in which data is collected.

**Psychology’s Time Perspective**

According to *The Oxford Handbook of Positive Psychology*, “Time perspective is a preferential direction of an individual’s thoughts toward the past, present, or future, which exerts a dynamic influence on their experience, motivation, thinking, and several aspects of behavior” (Boniwell, 2009). The way individuals perceive their past, present, or future
can affect their thoughts and decisions. Like individual persons, fields can also hold particular time orientations.

For most of the history of Psychology, the main time perspective was the past. There was rarely any thought about the future; however, that changed when Professor of Sociology, Wendell Bell, started teaching that the social sciences need to change their time perspective to the future. According to the 1974 book, Social Science: The Future as a Missing Variable, Bell argues that, “There remains a need to shift the time perspective more towards the future, to develop an epistemology to take account of the openness, uncertainty, and problematics of the future” (Bell, 1974, p.96). While Bell states that the social sciences, including psychology, need to focus more on the future, he also argued, “Most of the core concerns of Psychology… deal with processual thinking, a time perspective that includes past, present, and future” (Bell, 1974, p.96). It is important to realize that psychology can deal with all of the three types of time perspectives; however, it is imperative that psychology starts looking towards the future, rather than the past, as the future holds more problems and uncertainties than the past.

Looking Toward the Future. Psychology has many areas of study that may appear in the future. Some of these areas of study will be connected to the possibility of space travel and the advancements of technology. Some of these fields will involve the field of biology, such as dealing with the stress that the brain would feel due to biological enhancements or the implantation of artificial intelligence (AI). Psychology will also need to deal with looking at character traits to determine what kind of person is best suited to work with another type of person to lead successful tasks, not to mention the complications of leadership, romantic relationships, language barriers, and power. Being able to understand how humans will behave in different settings, environments, and situations will determine the future of psychology as well as the ethics of human society.

In general, humans have a distinct problem with future thinking. Most humans do not have the imaginative power to think what the future can really hold, as their vision of the future is built on the basis of the present. In fact, when referring to the imagination and future thinking, Stumbling on Happiness states, “Most of us have a tough time imagining a tomorrow that is terribly different from today, and we find it particularly difficult to imagine that we will ever think, want, or feel differently than we do now” (Gilbert, 2006). When humans imagine the future, they imagine a future that has a small amount of change from the life they are currently living. It is hard to imagine that humans may one day become immortal through android technology, it is hard to imagine that the Earth will achieve world peace, and it is hard to imagine that the moment of Singularity could happen in the next thirty years. While it is incredibly difficult to predict the future, it is even more difficult to imagine a future that is not based on a person’s current view of reality.

Space Psychology

While not highly advertised, it appears that a field of space psychology is slowly being carved out of the general field. According to Who is a Space Psychologist, a definition of space psychology would be that it is, “about human mental processes in space-related
activities, and understand how living in space, as an example, influences’ astronauts’ mood and wellbeing and their capacity to perform” (Who is a Space Psychologist). Essentially, the purpose of space psychology is to study and create programs and technology that will help astronauts when they are in situations where a psychologist cannot be there to administer psychological help. Given its traditional way of approaching problems, the goals of the incipient field will probably be to describe, explain, predict, and solve biopsychosocial phenomena that facilitate and hinder space exploration.

**Exploration Models**

Existing exploration models may help shape space psychology as it readies to make pertinent contributions. Previous exploratory treks including Christopher Columbus’s trip to find a new trade route to India, the exploration of the American West by Lewis and Clarke, or even the launching of the Apollo Missions to the moon, holds lessons for fields that will make possible human settlements on Mars. Humanity can learn from its past explorations to predict what will be needed for future space colonization.

Planned exploratory journeys with lofty goals of venturing into the unknown certainly hold special lessons. The challenges faced by Lewis and Clark as they set into unexplored parts of the American continent included a lack of understanding of the rough terrain and life that lived there, lack of easy access to resources, and hostile life and animals. Two of the innumerable lessons from this endeavor were how to choose the right people, and the ways to rule and govern a group of people. For the first lesson, Clark had personally chosen and trained who came on the expedition. According to *Lewis and Clark*, “The expedition party included 45 souls including Lewis, Clark, 27 unmarried soldiers, a French-Indian interpreter, a contracted boat crew and a slave owned by Clark named York” (History.com Editors, 2009). Each of these members were chosen because they had a specific task to do and could do it well. This teaches us that every crew member needs a specific job that they are there for. The people chosen to go on a mission need to have a certain skill set that will benefit the team and lead to a successful mission. The second lesson is how to rule a group of people. According to the same article, “Lewis and Clark ruled the Corps with an iron hand and doled out harsh punishments” (History.com Editors, 2009). The group needs a strong leader who will lead them through the mission. If there is no set line of command, then chaos will ensue as members of the group continue to disobey and work against each other, which will lead to a failed mission.

The HI-SEAS project is also especially suited for deriving lessons for areas of study in space psychology. The HI-SEAS acronym stands for, Hawai’i Space Exploration Analog and Simulation.” According to the HI-SEAS Homepage, this experiment took place, “on an isolated Mars-like site on the Mauna Loa side of the saddle area on the Big Island of Hawaii at approximately 8200 feet above sea level” (HI-SEAS, n.d.). The experiment used multiple methodologies and generated data on psychological aspects of solving problems in tight quarters. Carmel Johnston was a member of the Mission IV group that stayed in the habitat for a full year and gave a TED Talk on her experience there. She stated that they “collected over 3,000 surveys on the group, as well as multiple hours of
One of the problems they had to address was running out of water for a few weeks because Mission Control forgot to tell them that the water truck broke down. This was a great test to see how the group interacted with each other and how they reacted in a crisis. Another instance of dealing with a high-stress problem was through the conservation of shower water. Most of the time, showers were taken as quickly and efficiently as possible, but one day, a group member took a twenty-minute shower, which made, “five weeks’ worth of water unusable” (TED Talks, 2017). Seeing how the group reacted to this news and treated the group member who put them in this situation is a good way of learning how humans react in these types of situations. Data produced by simulations such as the HI-SEAS project afford promising ways for psychology to identify problems and develop new methodologies for the study of space settlements.

Possible Areas of Study

Space psychology is inherently future-oriented as this field is being created in anticipation of space travel and exploration. The whole point of space psychology at the current moment is to gather information needed to have successful space-related missions in the near to late future. Whereas available data and methods may suffice to study near-future problems, psychology and other fields may have to summon imaginative scenes to tackle the far future. The latter entails an ability and disposition to abandon the tendency toward presentism and use the creative mind to imagine what today seems impossible. Space psychology should be poised to adopt almost every angle, option, and possibility.

Psychology has an important future in front of itself as there are many possible areas that it may study. For example, according to Mission to Mars, a problem that psychology may encounter is, “how astronauts might react to the experience of being so far from Earth” (Weir, 2018). The story went on to say that a lot of time in space stations is spent looking at the Earth and taking pictures of it. According to them, it helps relieve stress and anxiety, but that could be a problem since Mars is so far away from Earth. At that distance, it would be hard to see the Earth. Other problems that researchers are looking at are different types of coping mechanisms and biological indicators. According to that same article, when referring to psychologist, David Dinges, “he envisions such biomarkers being used in research to identify and test medications or behavioral strategies that could boost resilience” (Weir, 2018). NASA already has technology to screen the perfect astronaut, but Dinges wants to create a medication that can be used to help ordinary people on Earth in ordinary situations, as well as help ordinary people becomes astronauts. These are two of many new areas that are being looked at for the advancement of space psychology.

As foreseen, the areas outlined by APA are reminiscent of areas studied in the present. Removing ourselves from specific questions, it is possible to arrive at a set of global questions that space psychology may wish to address in its quest to formulate the new field. One set of questions certainly has to relate to performance, as performance is essential to off-world survival. A second pertinent general area of study will probably deal with well-being, as mere survival is not sufficient for human adaptation to new.
conditions. A third area in space psychology can also involve *methodological innovations*, as these will probably necessary to develop the new field

**Performance questions.** Just like Lewis and Clark had to tap into their problem-solving skills to solve all sorts of dilemmas that presented on their way to the Pacific Ocean, space explorers will have to use all varieties of mental abilities to contend with the exigencies of adapting to the new demands of space. There will be many “what if” contingencies in space exploration. How indeed does one solve the problem of an emergency loss of oxygen or water? The study of mental abilities suitable for space travel will also have to delve in the area of AI since we are at a juncture in which this field is being highly developed. To what extent can AI incorporated into learning machines supplement human natural mental capabilities?

Since human settlements of space are not foreseen to pose Robinson Crusoe conditions, space psychology will also have to study and provide recommendations for social situations that enhance or impede problem-solving and decision-making in space. What social skills are necessary to ensure a successful mission? What leader-follower combinations may or may not be necessary to operate a successful settlement? What would be effective conflict-resolution programs that decrease the probability of breakdowns in social cooperation?

Individuals in space will also have to regulate their emotions, personalities, and behaviors to perform at their best and prevent problems that are difficult to solve at a distance? How do we minimize psychological disorders that might surface in Mars? Should systematic stress inoculation be left up to individuals or should it be mandated for optimal performance? What program strategies can be used or devised to prevent psycho-emotional breakdowns?

Given current and future advancements in biology, the interplay between our biochemical make-up and the essence of our humanity will also probably feature prominently in the field of behavioral space exploration. The questions related to biopsychosocial adaptations will lend themselves for imaginative future thinking since it will probably delve into enhancements. Futurists such as Ray Kurzweil have predicted that a melding of machines with human brains will be probable around Year 2045 (Grossman, 2011). Will biological enhancements be necessary for human settlement of Mars? What specific performance and well-being problems will these enhancements solve? If human beings cannot produce offspring in distant space, how are settlements to be grown and sustained? How will the field of psychology need to change to incorporate such transformations in the human condition?

**Well-being questions.** Space psychology can make substantial contributions to the settlement of Mars if it can identify the physical and social environments that can enhance biopsychosocial well-being in that new world. Throughout time, different psychological perspectives have offered limited versions of well-being prescriptions for earthlings—although disputably, these have largely gone unheeded. Since the sample of humans with specialized abilities will be smaller and the since environments will be relatively narrow in scope, it will probably be easier than on earth to plan well-being environments on Mars. How will these environments avoid boredom? What types of
personal and social spaces will contribute to personal contentment? Will humans be able to disassociate completely from their Earth counterparts?

**Space Psychology Methodologies.** Research is in psychology’s DNA and will probably continue to be so. Just as in the past, psychologists will have to adopt and create methodologies that are especially matched to the study of space exploration. At first, the field will probably have to employ single-subject designs to obtain repeated measures in small samples of soon-to-be Mars settlers. Simulation and scenario-building methodology will probably have to be enhanced in order to make predictions of likely outcomes. In these endeavors, the new field of predictive analytics will probably have much to offer. Predictive technologies and algorithms will help psychologists to forecast which mental abilities, emotional constitutions, and personality combinations will enhance the success of space missions. Predictive analytics also hold promise in identifying the crucial psychological conditions that will be anathema to a space program. Developing new methodologies will also be the stuff of space psychology.

**Conclusions**

The general and specific questions posed above will probably help to prepare the initial framework for the new field of space psychology. As suggested, the general field of psychology will miss out if it becomes complacent and refuses to address issues that humans will confront in the near future. Space exploration poses possibilities for psychology that are both exciting and daunting. Based on its research orientation, psychology can become one of the sciences that help humans accomplish the goal of establishing off-Earth settlements. Like the *Star Trek* missions, space psychology must “boldly go” to areas it has not gone before.
References


A Prayer by Stephanie Val

An English Sonnet

Tell me why my eyes pour shimmering pink
While your eyes twinkle a spectrum of gold
There are no such words to describe this link
But I will be the one to warm this cold

While you stand upon a shrine ten feet tall
I'll look upon you with fidelity
To you, a stoic goddess, I am small
Still, my love rivals in sincerity

Your crisp lips I pray to plant a kiss on
Even if my insolence sickens you
My devotion grows warring as a swan
Still, as your smooth surface drips morning dew

I will wipe the thin frost that chills your feet
I'll stay praying to you bitter yet sweet
Christopher Sala is a West Palm Beach native who spent half of his life in Florida and the other half in Harrisburg, Pennsylvania. In Harrisburg, he was part of Troop 36 of the Boy Scouts of America where he became the most decorated scout and achieved the highest rank of Eagle Scout. He returned to Florida to attend Palm Beach State College, where he maintained a perfect 4.0 GPA, became Vice President of Scholarship for the Gardens Chapter of Phi Theta Kappa, Alpha Gamma Sigma, and became a co-editor for the Sabiduría academic journal. Sala plans to continue his college success at Florida State University in the fall 2019 school year.

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