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EDITOR'S INTRODUCTION

The Wagner Forum for Undergraduate Research is an interdisciplinary journal which provides an arena where students can publish their research. Papers are reviewed with respect to their intellectual merit and scope of contribution to a given field. To enhance readability the journal is subdivided into three sections entitled *The Natural Sciences and Quantitative Analysis*, *The Social Sciences* and *Critical Essays*. The first two of these sections are limited to papers and abstracts dealing with scientific investigations (experimental, theoretical and empirical) and complex mathematical/statistical modeling. The third section is reserved for speculative papers based on the scholarly review and critical examination of previous works. This issue sports an updated cover which has the refreshed version of the President's seal in place of the older one.

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Section I: The Natural Sciences & Quantitative Analysis

Accessing Diynes Containing Thiocyanate End-Groups En Route towards Polydiacetylenes

Oskar Erik Sundberg (Chemistry)*

This research explores the synthesis of diynes with sulfur-containing end groups en route towards accessing novel polydiacetylenes (PDAs), a class of conjugated polymers with conductive properties.¹ Diynes containing thiophene and thiocyanate end-groups have been targeted, with the latter being the focus of this project. Thiocyanate (SCN) end-groups are expected to impact the electronic properties of the polymerized system because of the resonance-stabilization and electronic effects of these groups. Efforts to synthesize 1,4-dithiocyanatobuta-1,3-diyne have yielded promising results, with ¹³C NMR spectra containing peaks that correspond to predicted spectra. Additional characterization is needed to confirm isolation of this novel diyne before polymerization conditions can be fully explored. Removal of trace solvents such as triethylamine has proven troublesome, thus complicating initial polymerization efforts. However, recent spectroscopic data indicates successful isolation of the diyne from residual solvents that would facilitate future polymerization attempts.

I. Introduction

Polydiacetylenes

Polydiacetylenes (PDAs) are an extensive family of conducting polymers (*Figure 1*). This class of polymers has been of interest to organic chemists since the 1960s.¹ In 1976, Wegner and colleagues demonstrated the ability to topochemically polymerize diacetylenes or diynes into a conjugated system of tethered double and triple bonds.² Diacetylene monomers can be polymerized through various techniques to form a useful polymerized system that gives rise to many unique properties. It was relatively early established that PDAs absorb light in the visible spectral region and that the particular wavelength that is absorbed can change due to a planar non-planar backbone conformation transition.³ This chromatic property of PDAs was further explored during the 1980s and resulted in research indications that PDAs possess the ability to exhibit two distinctly different colorimetric phases, one blue phase and one red phase. Furthermore,

* Research conducted under the supervision of Dr. Racquel DeCicco in partial fulfillment of the Senior Program requirements.

the research also indicated intriguing fluorescent properties of the red-phase.⁴ In most cases PDAs exhibit a blue color but exposure to certain external stimuli causes this drastic colorimetric change, which is visible to the naked eye (*Figure 2*).¹

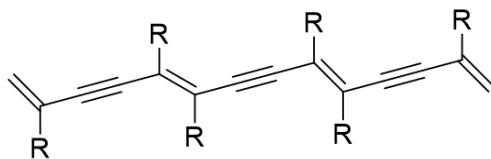


Figure 1. General structure of polydiacetylenes

Diacetylene monomers have also been shown to organize and form configurations in a variety of ways, while still conserving their chromatic properties, thus further expanding the possible application of PDAs as an integral component of sensory detection assemblies. Among the diverse physical conformations that PDAs can organize in are vesicles, Langmuir monolayers, self-assembled films and single crystals.^{1, 5, 6} Furthermore, PDAs have demonstrated the ability to integrate as a component of other host matrices such as inorganic materials, other polymers, and living cells.¹ Because of these intriguing properties, PDAs have the potential to be useful in various sensory assemblies. Incorporating various PDAs within a sensory platform allows for the recognition of a diverse set of molecules. Since the PDA side-groups are intrinsically negatively charged there is an innate ability to detect positively charged amphiphilic molecules, however, modifications of side-groups has allowed for the detection of negatively charged molecules as well.^{1, 7, 8} Further studies have shown observable colorimetric transformations occur within PDAs through the exposure to viral particles such as the H5N1 strain of influenza.⁹ This versatility in detection possibilities has attracted the interest of various industries that have an incentive to detect certain particles or molecules.¹

The unique ability of PDAs to undergo a colorimetric transformation visible to the naked eye through external stimuli such as temperature changes, pH changes, and the presence of certain biological molecules has drawn interest from industries that can benefit from such sensory abilities.¹⁰ The food industry, for example, suffers large economic losses estimated to be between \$2.9-6.7 billion annually.¹⁰ These economic losses are primarily due to medical costs and decreased productivity caused by food pathogen related diseases. Recalls of compromised products also contributes to this economic loss.¹⁰ Furthermore, there is also a large interest in better pathogen detection

technology because many foodborne illnesses occur each year.¹⁰ Current detection technology only allows for pathogens to be discovered after the problem has arisen. Since PDAs can be integrated into solid supports such as plastic, their use would enable real time monitoring during all the major steps from production to meal preparation.¹⁰ The possibility for biosensor technology to be utilized for this purpose was demonstrated by Sezginürk and Dinçkaya who detected thiourea, a carcinogenic compound, in fruit juice.¹¹

Of all the interesting properties pertaining to PDAs, the colorimetric transformation has attracted the most attention. The transformation that occurs causes PDAs to absorb a wavelength of 500 nm (red-phase) rather than of 640 nm (blue-phase).¹ The mechanism responsible for the transformation has yet to be elucidated entirely but is generally attributed to a disruption of the conjugated network resulting in shorter electron delocalization lengths (*Figure 2*).¹² Studies strongly suggest a correlation between induced structural reformation and the colorimetric change.^{12, 13} Moreover, interactions between the attached side-groups have shown to play a prominent role in the transformation through crystallographic and theoretical studies.¹² The interactions between specific functional groups on the PDAs have a great impact on the planarity of the PDA backbone and consequently on the overlap between adjacent π -orbitals.¹³ The significant impact of attached side-chains has caused a surge in research efforts to modify the diynes that comprises the polymerized system, as is the goal of this research.

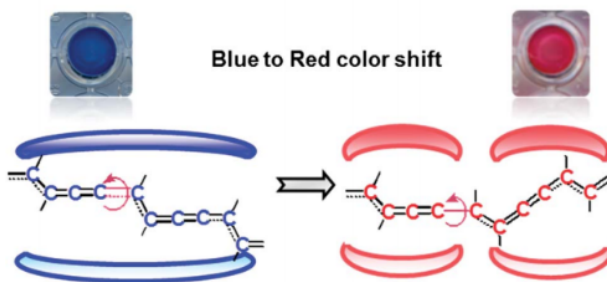


Figure 2. Colorimetric change of PDAs¹

Polydiacetylene Formation

For PDAs to obtain their useful properties successful polymerization of the diacetylene monomer must occur. The so called 1,4-polymerization of diacetylenes and triacetylenes was for a long time only attainable when allowing the monomers to self-assemble and polymerize through UV-irradiation exposure.¹⁴ The method was working in

these cases because certain monomers take on a solid-state structure that is pre-organized at the distances and orientations that the final polymer also contains. (Figure 3).¹⁴ In efforts to expand the scope of which conjugated diynes and triynes are able to undergo 1,4-polymerization, guest-host strategies were pioneered by Fowler and Lauher.¹⁴ This general strategy utilizes a host molecule to generate the specific parameters that the guest monomer requires to be responsive to 1,4-polymerization. As various monomers require various distances and orientations, host molecules must be developed to satisfy the particular parameters that the guest molecule requires.¹⁴

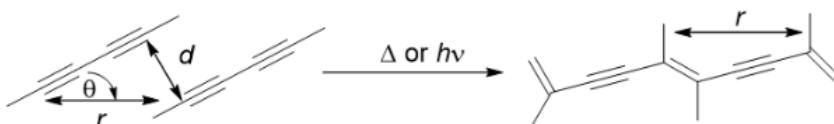


Figure 3. Parameters for 1,4-polymerization of diynes, $r = \sim 4.9 \text{ \AA}$, $\theta = 45^\circ$, $d = 3.5 \text{ \AA}$ ¹⁵

Certain diyne monomers, such as those which contain carboxylic acids, have been shown to be able to arrange themselves to satisfy these parameters, and through subsequent UV-irradiation undergo polymerization.¹⁶ It was, however, in this study also concluded that shorter diacetylenes proved unable to polymerize under these conditions, suggesting that smaller diacetylenes require a cocrystallization agent.^{16, 17} The cocrystallization agent, also known as the host, allows a bond formation to occur between the C1 and C4 atoms of the diacetylene molecules. The bond formation between these carbons is possible due to hydrogen or halogen interactions between the functional groups of the host molecule and the end groups of the diacetylenes.¹⁴ This reaction is typically initiated by irradiation or heating and results in a polymer backbone oriented along a well-defined lattice direction with a repeat distance of $\sim 4.9 \text{ \AA}$ (Figure 3).¹⁸

II. Materials and Methods

Materials

N-bromosuccinimide, trimethylsilyl-acetylene, acetone, triethylamine, silver nitrate, copper (I) chloride, diethyl ether, sodium sulfate, copper (II) sulfate, hexanes, and deuterated chloroform were purchased from Sigma-Aldrich. Ammonium thiocyanate was purchased from Acros Organics. Reagents were not purified prior to use, with the exception of copper (I) chloride, which was purified according to standard methods to remove any oxidized copper species.¹⁹ NMR spectra were obtained using a Varian 400 MHz instrument and deuterated chloroform as the solvent.

In the synthesis of 1,4-dithiocyanatobuta-1,3-diyne only the overall yield was calculated in order to minimize loss of product and to avoid hazardous intermediates. NMR spectra were obtained for the diyne and the peaks will be reported in Section II.4.

Synthesis of 3-bromo-1-(trimethylsilyl)-1-propyne (Compound 2)

To 9 mL of acetone, 0.56 g (3.15 mmol) of *N*-bromosuccinimide and 0.6675 g (1.053 mmol) of trimethylsilyl-acetylene **1** were added with 0.127 g (0.05 mmol, 5 mol %) silver nitrate catalyst. The reaction was stirred at room temperature for 60 minutes to yield 3-bromo-1-(trimethylsilyl)-1-propyne **2**. Solvent was removed *in vacuo* and the residue was extracted with two 15 mL portions of hexanes and washed with 15 mL deionized water. The organic extracts were washed with a saturated sodium thiosulfate mixture in order to remove excess bromine. The combined ether extracts were dried over sodium sulfate and filtered. Removal of solvent *in vacuo* afforded compound **2** as a brown oil.

Synthesis of 3-thiocyano-1-(trimethylsilyl)-1-propyne (Compound 3)

Ammonium thiocyanate 0.4941 g (6.3 mmol) was added via syringe to the a round bottom flask containing compound **2** and 9 mL of acetone. The reaction mixture was stirred for 60 minutes at room temperature. Solvent was removed *in vacuo* and the residue was extracted with two 10 mL portions of ether and washed with 15 mL deionized water. The combined ether extracts were dried over sodium sulfate and filtered. Solvent was removed *in vacuo* to afford 3-thiocyano-1-(trimethylsilyl)-1-propyne **3**.

Synthesis of 1,4-dithiocyanatobuta-1,3-diyne (Compound 4)

Alkyne **3** was subjected to Glaser coupling conditions using 0.0244 g (0.15 mmol) of copper(I) chloride and 12 mL triethylamine as the solvent. The coupling reaction was left to run for 24 hours, which yielded diyne **4**. Triethylamine solvent was removed *in vacuo* and the diacetylene product was extracted with one portion of 15 mL of ether, and the organic extract was washed with three 20 mL portions of aqueous copper(II) sulfate, which afforded 0.08824 g (91.9 % crude) of brownish oil. ¹³C NMR was used to characterize the product of this reaction. ¹³C NMR (400 MHz, CDCl₃): δ 11.61, 46.25, 104.152, 107.021, 113.509. Many NMR spectra featured peaks at δ 11.61 and 46.25, which indicate presence of triethylamine traces.

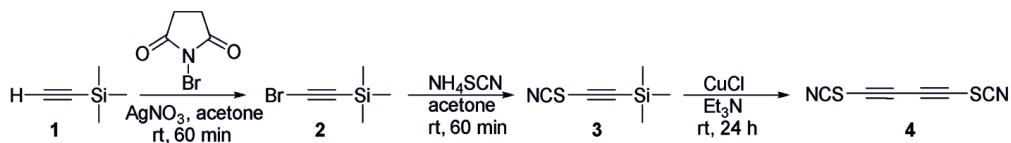


Figure 4. Synthesis of 1,4-dithiocyanatobuta-1,3-diyne

Polymerization attempts

Host-guest method:

Polymerization of diyne **4** was attempted using 5,5'-(oxalyldiimino)dipentanoic acid (Compound **5**, Figure 5) as the host molecule. 0.216 g (0.75255 mmol) of host compound **5** and 0.0824 g (0.5017 mmol) of guest **4** were dissolved in 10 mL ethanol and transferred to a crystallization dish. The dish was covered with perforated foil and solvent was allowed to slowly evaporate over several days.

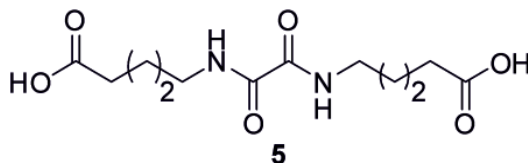


Figure 5: 5,5'-(oxalyldiimino)dipentanoic acid host (**5**)

Slow evaporation method:

Polymerization of diyne **4** was attempted using a solvent mixture of hexanes and deuterated chloroform. The dissolved diyne was placed in a crystallization dish that was covered in perforated foil. The solvent mixture was allowed to slowly evaporate over several days.

III. Results and Discussion

Spectra

Throughout the course of this project, many variations of the general synthesis procedures have been attempted and only the most successful efforts were described in the previous section. Nuclear Magnetic Resonance (NMR) Spectroscopy was the primary characterization method used to determine the identity of the product(s) obtained in each reaction trial. The general procedure reported here has yielded diyne **4**, which produced a ^{13}C NMR spectrum that was compared with predicted spectrum obtained through ChemDraw** (Figure 6 and Figure 7). The ^{13}C NMR spectrum featured in Figure 6 is not

reflective of the percent yield reported in the previous section Synthesis of 1,4-dithiocyanatobuta-1,3-diyne. In order to obtain this spectrum multiple extractions and washes had to be employed, which caused a significant loss of product. Therefore, the percent yield would not be an accurate representation of the success of the synthesis and was not reported. While there was significant variation in the chemical shifts for the peaks in the alkynyl region, the peak corresponding to the nitrile functional group had similar chemical shifts (~113 ppm) in both the experimental and predicted spectra. The discrepancy between the chemical shifts for the sp-hybridized carbons serves as motivation to pursue more advanced computational methods for generating NMR spectra for compound **4** in the future. Over the time of this research many modifications such as change of solvents, reaction times and work-up procedures have been made to the procedure. These modifications will be discussed further in the next section.

Although ^{13}C NMR alone cannot serve as sufficient evidence to guarantee successful synthesis of 1,4-dithiocyanatobuta-1,3-diyne, further validation efforts will be made in the next steps of this research. One possible route to further validate the synthesis of the target product as mentioned previously is through the use of computational chemistry. Through computational methods employing Gaussian^{***}, NMR spectra can be simulated and compared to those obtained in the synthetic route towards 1,4-dithiocyanatobuta-1,3-diyne. This computational approach will be explored in the immediate future.

Experimental Modifications

Many modifications have been made to the general procedure in order to obtain the target molecule. Initially acetonitrile was the solvent used throughout the synthesis. However, overlapping peaks between the nitrile groups in the product and solvent rendered this a less than optimal solvent. Since all reagents displayed a similar solubility in acetone, this solvent was selected as the primary solvent for later trials as it was very volatile and produced unique peaks in the NMR spectra that did not overlap with any of the expected product peaks. Additional solvent issues were encountered during the Glaser coupling reaction when NMR spectra revealed peaks corresponding to residual triethylamine. The most efficient way in removing trace triethylamine proved to be incorporation of a copper(II) sulfate wash during the extraction.

** ChemDraw is a molecule editor software owned by PerkinElmer that offers a ^1H and ^{13}C NMR spectrum simulation feature

*** Gaussian is a general purpose computational chemistry package owned by Gaussian, Inc.

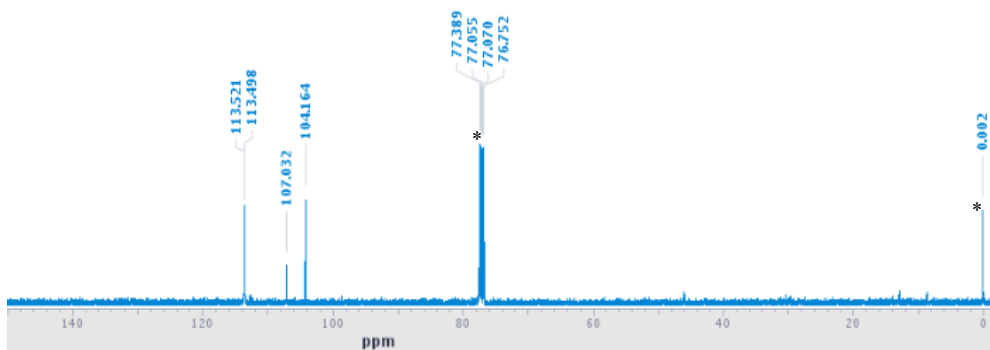


Figure 6. Obtained ^{13}C NMR spectra. * Indicate CDCl_3 and TMS solvent reference peaks.

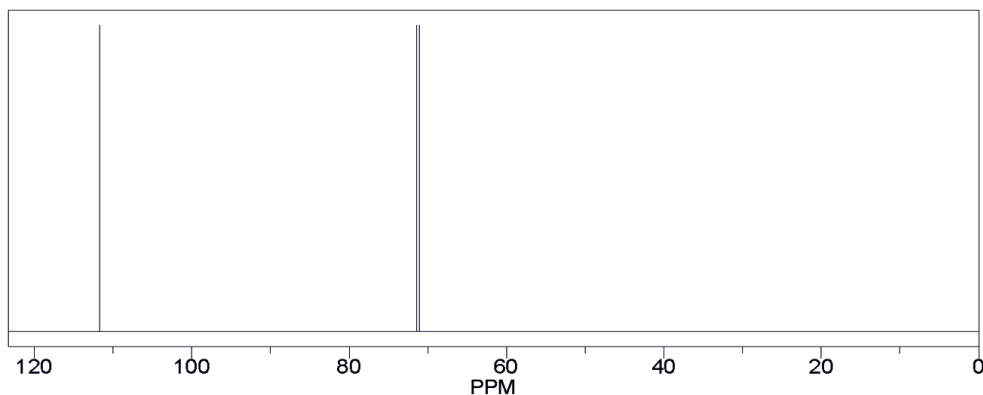


Figure 7. Predicted ^{13}C NMR spectra for 1,4-dithiocyanatobuta-1,3-diyne

A crucial improvement to the general procedure was the change in order of addition of reactants. Initial efforts were aimed toward replacing the bromine on *N*-bromosuccinimide with a thiocyanate group that could then be transferred to the trimethylsilyl-acetylene, based on previous literature precedents.²⁰ Many trials exploring various reaction times, reaction temperatures, solvents and work-up procedures were unable to produce the desired alkyne **3**. Later trials attempted an addition of bromine to trimethylsilyl-acetylene via *N*-bromosuccinimide, that could in a second step be replaced with a thiocyanate group (Figure 4). This important modification in the general procedure has allowed for a rather simple synthetic pathway to 1,4-dithiocyanatobuta-1,3-diyne.

Future Work

Percent yields for pure products and intermediates have yet to be determined due to several factors. Initial trials typically yielded crude products that contained excess starting material, solvents, and unwanted side-products as indicated by NMR spectra. Since successful reaction conditions have finally been determined, all synthesis steps will be repeated to obtain yields for each intermediate in the pathway towards diyne **4**. This will also allow for additional optimization of reaction conditions to be determined.

The presence of solvent together with the final product **4** also complicates polymerization and characterization efforts because of the inability to crystallize in solvent. However, promising NMR spectra do suggest more successful isolation of diyne **4**, which would facilitate future efforts to both determine properties of this compound and create polymers. Although the NMR spectra indicate efficient removal of trace solvents, the high reported yield of 91.9 % corresponds to crude material that contained trace amounts of solvents. This yield is rather high for a multi-step synthesis, thus further efforts in solvent removal must be employed. Attempts towards forming polydiacetylenes with thiophene side chains were inconclusive thus far, as there was no visible color change and NMR spectra did not suggest any structural changes. The melting point and solubility of the co-crystals will also be explored in future experiments.

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Effects of the Psychoactive Drug Caffeine on the Behavior of Zebrafish (*Danio rerio*)¹

Kevin Lipton (Biology)²

Caffeine, a psychoactive, plant-based alkaloid is found in a variety of food, which include coffee and tea leaves. Caffeine acts as a stimulant that has the potential to cause dependency if a large amount is ingested and is anxiogenic (anxiety causing). Zebrafish (*Danio rerio*) is an ideal model organism for pharmacological studies and neurobehavioral studies, due to the homology of their nervous system with that of the human nervous system. This experiment was performed to gain a better understanding of the behavior of zebrafish when exposed to caffeine. This study tested the behavior of adult zebrafish with a concentration of 0.00625% caffeine. The behavior was quantified by counting the number of lines each zebrafish crossed on a grid in 30 seconds, using recorded videos. Out of all the fish that were tested, there was only one fish that was not mobile and did not cross a single line, and this fish was in the experimental group. The range of the number of lines crossed for both the control fish and the experimental fish were similar, and the mean number of lines crossed between the two groups did not significantly differ (control: 38.6; experimental: 36.0). The experimental fish mainly swam at the edges of the bowl while the control fish were seen mostly swimming in the center of the bowl, which may indicate increased anxiety in the fish exposed to caffeine.

I. Introduction

Caffeine (C₈H₁₀N₄O₂), also called 1,3,7-trimethylxanthine, is a plant-based alkaloid found in a wide variety of food, including coffee and tea leaves (Turnbull et al., 2017). Caffeine has been reported to be the most frequently consumed behavior-altering drug in the world, with 85% of the U.S. population consuming at least a single caffeinated drink each day (Turnbull et al., 2017). Ingested at low to moderate levels (approximately 50 mg to 400 mg), caffeine has some positive effects such as increasing mental awareness and decreasing the risk of developing Alzheimer's disease. However,

¹ This work was presented at the 2017 meeting of the Metropolitan Association of College and University Biologists and the 2018 meeting of the Eastern Colleges Science Conference.

² Written under the direction of Dr. Brian Palestis in partial fulfillment of the Senior Program requirements.

too much caffeine exhibits detrimental effects, mainly on the cardiovascular system. Some of these ailments include an increased heart rate and irregular pulse (Rodriguez et al., 2014). Additionally, caffeine is a stimulant that can cause dependency if a large quantity is consumed (Rodriguez et al., 2014). To get the most out of caffeine's therapeutic effects without experiencing any adverse side effects, it is suggested that humans consume 300 mg each day, although it can be difficult to measure the exact amount of caffeine ingested from food and beverages (Gracia-Lor et al., 2017).

Energy metabolism in the brain is elevated with the presence of caffeine, but simultaneously the amount of blood flow to the brain is lowered, leading to hypoperfusion (circulatory failure of the peripheral tissue) in the brain. These effects are universal characteristics of caffeine, and are seen in many vertebrates (Nehlig et al., 1992). The neurons that control noradrenaline are stimulated by caffeine, affecting the release of the neurotransmitter dopamine (Nehlig et al., 1992). Caffeine also has potential therapeutic effects on the central nervous system due to its ability to cross over the blood brain barrier, and includes modulation of apoptosis and regulation of cell metabolism (Khor et al., 2013). A vast majority of the noticeable caffeine effects come from the role of methylxanthine on the neurons that control the neurotransmitter serotonin. The behavioral processes of learning and memory are associated with the effect of methylxanthine on arousal and fatigue (Nehlig et al., 1992).

Caffeine has also been reported to have anticancer benefits, and reduces the likelihood of developing certain types of cancer, such as the highly lethal gastric cancer. Gastric cancer accounts for approximately 60% of all cancer cases among the Asian population, and caffeine decreases this form of cancer by nearly one-half (Liu et al., 2017). Caffeine acts as an anticancer drug by its ability to suppress cell proliferation and induce apoptosis in various organs, including the stomach, liver, and brain (Liu et al., 2017).

This experiment was performed to investigate the following hypothesis: Zebrafish exhibit increased movement when exposed to a specified concentration of caffeine.

Zebrafish as a Model Organism

Zebrafish (*Danio rerio*) is a small, tropical freshwater fish most active during the day (Figure 1), and inhabits an area from the Western Ghats of India to the Western Himalayas (Arunachalam et al., 2013). In these regions, zebrafish are found in sandy, slow-moving rivers and streams (Arunachalam et al., 2013), where they can be seen feeding on zooplankton and insects (Spence et al., 2007). These fish exhibit shoaling

behavior (swimming in groups), as observed in the wild (Hutter et al., 2010). Zebrafish is a preferred species in pharmacological studies, because of its brief generation time, quick reproduction rate, possibility of genetic sequencing, intricate social behavior, and greater similarities with the genetic structure and function of the human nervous system compared to *Drosophila* (Ladu et al., 2015).



Figure 1: Zebrafish swimming in test bowl.

Furthermore, zebrafish were determined to be favorable in neurobehavioral studies (Wong et al., 2009). Due to the neuronal similarities between zebrafish and humans, zebrafish have been used to study certain conditions that affect the human central nervous system (Khor et al., 2013). Zebrafish share with humans the adenosine receptors A_1 and A_{2A} that are directly involved in the inhibition by caffeine (Ladu et al., 2015). Adenosine receptors function as homeostatic regulators in the central nervous system, governing neuron firing, and when disrupted, can cause behavioral and physiological changes (Bortolotto et al., 2015). A_1 , when inhibited, decreases the overall speed of zebrafish, whereas the inhibition of A_{2A} causes an increase in speed (Ladu et al., 2015). These G-protein coupled receptors also function in cell signaling mechanisms. Adenosine receptors are regulated mainly by ectonucleotidases, which is a group of enzymes that produces adenosine from the breakdown of ATP (Bortolotto et al., 2015). Caffeine is a nonselective antagonist of adenosine receptors that can generate seizures at great doses in a wide variety of animals, including zebrafish (Wong et al., 2010).

Previous Studies of Effects of Caffeine on Zebrafish

Among distinct psychoactive compounds, acute caffeine treatment has been used to induce anxiogenic (anxiety-causing) behavioral reactions in the novel tank diving test and the light/dark box (scototaxis) test (Ladu et al., 2015). Trials that were

completed showed that exposure to caffeine evoked certain anxiogenic behaviors such as diving behavior and erratic movement in adult zebrafish (Ladu et al., 2015). In the scototaxis test, adult zebrafish are placed in a black and white tank to determine preference for lightness or darkness. The administration of caffeine decreases the time spent in the white compartment of the tank, therefore increasing the time spent in darkness, which is a sign of anxiety (Maximino et al., 2011). Due to this increased stress caused by caffeine, elevated levels of the stress hormone cortisol were found (Ladu et al., 2015).

In a study by Wong and colleagues (2010), adult zebrafish that were exposed to caffeine experienced a decline in the number of shifts to the top of a novel tank and exhibited a rise in their freezing behavior, but caffeine did not influence the time that was spent at the top of the tank or their erratic locomotion. Additionally, caffeine decreased the distance traveled and their speed but had no impact on their meandering and turn angle. Contrary to the controls, zebrafish that were treated with caffeine experienced intense seizure-like behavior, such as hyperactivity outbreaks, spasms, and circular swimming. The observed behavior occurred after a caffeine administration of 250 mg/L, equivalent to a 0.025% solution (Wong et al., 2010). Computerized software that traces the zebrafish movement was also used to display the contrasting features between the erratic swimming of the caffeine-treated groups and the control group. This experiment was conducted by utilizing manual and video tracking modes of fish behavior (Wong et al., 2010).

Emotional stress is portrayed in organisms that are affected by anxiogenic disorders. Pharmacological analyses on adult zebrafish may help us to understand these disorders (Ladu et al., 2015). Ladu et al. (2015) used the unification of robotics and information theory to examine the impact of caffeine on the social behavior of adult zebrafish. Varying caffeine doses were used on 40 wild-type zebrafish for 20 minutes. Surprisingly, the average velocity of the focal subjects declined as caffeine administration increased (Ladu et al., 2015). Comparisons show that fish treated with 25 mg/L and 50 mg/L swam at a reduced velocity compared to control individuals. Comparisons among treatments also demonstrated that zebrafish that were administered the greatest concentration of caffeine transitioned less often between the two halves of the tank (a measure of locomotion) than individuals that were administered low and intermediate doses (Ladu et al., 2015).

In a similar study, DeTomaso (2016) showed that caffeine-exposed adult zebrafish swam at a decreased speed and exhibited more erratic movements when compared to the control, which swam with almost no freezing time. Overall, zebrafish

that were in the caffeine treatment group showed a decrease in the number of times they crossed lines on grid, which also demonstrates the decreased locomotion of zebrafish that were exposed to caffeine (DeTomaso, 2016).

Behavioral Responses to Caffeine Withdrawal

Behavioral reactions caused by abruptly stopping the consumption of caffeine, like in humans, have also been observed in zebrafish. The possibility of adult zebrafish becoming addicted to caffeine and the closeness of the genomes make it a particularly good organism to study the effects of caffeine withdrawal in humans (Cachat et al., 2010). The forebrain of zebrafish, which contain dopamine receptors, is very similar to the mesolimbic system in mammals, which is involved in the addiction to drugs, such as caffeine. Additionally, some regions of the zebrafish brain, such as the medial pallium, correspond to the hippocampus in mammals (Karoglu et al., 2017). Some of the most prevalent conditions that can occur in zebrafish due to the effects of caffeine withdrawal include anxiety behavior and seizures (Cachat et al., 2010).

Significance of Research

These research projects are significant, because the data representing the effects of caffeine on adult zebrafish could be used to predict and conclude how caffeine and other drugs could also affect humans (Gupta et al., 2014). Furthermore, if future studies are conducted, this research could potentially help develop treatments and therapies for people that abuse substances, such as caffeine and other drugs, and also establish strategies for dealing with withdrawal symptoms (Collier et al., 2014). Zebrafish offer many practical advantages as a model organism in determining biological interactions (Gupta et al., 2014). Current studies have shown the rise of adult zebrafish as a model for neurobehavioral research since zebrafish exhibit learning, sleep, drug addiction, locomotor behavior, and other neurobehavioral traits that are similar to those observed in humans (Gupta et al., 2014). Also, the homology between zebrafish genes and human genes make zebrafish a good organism to use to study these neurobehavioral traits (Tran et al., 2015). Additionally, the organization of the zebrafish brain as a whole is comparable to other vertebrates (Gupta et al., 2014).

Objectives

This experiment was performed to gain a better understanding of the behavior and anxiety of zebrafish. The hypothesis that zebrafish exhibit increased movement when exposed to caffeine was tested. Since the physiology of zebrafish and humans are

similar, the effects of caffeine on zebrafish can increase knowledge and understanding of human behavioral effects. The exposure of caffeine to zebrafish was expected to decrease movement and increase erratic locomotion compared to the control. This experiment is similar to the one conducted by DeTomaso (2016) in that most variables were kept the same and only the concentration of caffeine and the amount of recording time differed. DeTomaso (2016) exposed the zebrafish to 0.12% caffeine, equivalent to 1200 mg/L, while this experiment used a much lower concentration at 0.00625%, equivalent to 62.5 mg/L. Since there were extreme deleterious effects found in other research using high concentrations, this low concentration was chosen as a cautionary measure. Since caffeine is a psychoactive drug, experiments like this one can also demonstrate the effects of addiction and withdrawal symptoms of caffeine to zebrafish. Additionally, these symptoms can be applied when studying human biology, due to the nervous system similarities between zebrafish and humans. These trials utilize adult zebrafish, which have not been experimented on as often as the embryos of zebrafish. Furthermore, the results of this experiment can be used to compare the effects of caffeine on adult zebrafish and zebrafish embryos. The results of this experiment can also be compared to zebrafish exposure to other anxiety-causing substances. These experiments and similar studies also provide a greater understanding of the effects of caffeine to the social behavior of zebrafish, such as shoaling.

II. Materials and Methods

The zebrafish used in this study were purchased by the Wagner College Department of Biological Sciences at Arcadia Pet Store in Staten Island, New York. These fish were kept in three 10-gallon tanks of de-chlorinated water until they were used in the experiment. The zebrafish were provided with daily feedings throughout the duration of the experiment and kept in a temperature-controlled environment. The experiments were conducted at the same time each day of the study.

This experiment was performed over a 10-week period. A large, circular bowl with a diameter of 20 cm was obtained for use in this experiment. Dried anhydrous caffeine powder from Sigma-Aldrich (model number: 27602-250G) was obtained each week. Water from the fish tanks was used each day of the experiment. A Logitech video camera attached to a desktop computer was used in this experiment to record the zebrafish movement, as shown in Figure 2. Windows Video Maker was used to store and edit the videos. A paper with 3cm x 3cm squares drawn as a grid was used.

Procedure

Water was obtained from the fish tank, and a volume of 800 ml was measured. The water was poured into a large, circular bowl. Dried anhydrous caffeine powder was weighed, and 50 mg was dissolved in the water to reach the desired concentration of



Figure 2: The video camera that was used in this experiment. The camera was attached to a wooden plank over a grid.

.00625% caffeine (same ratio used throughout experiment). One zebrafish was transferred from the fish tank into the bowl with the solution, by using a net, and then the bowl was placed on the grid. The zebrafish was left undisturbed in the bowl for three minutes to limit any initial stresses that may have occurred due to the fish being placed in a new environment. The fish was then recorded with a camera attached to a desktop computer for 30 s. This process was repeated 63 additional times for a total of 64 fish trials (experimental group). After all of these trials were completed, each line on the grid that the zebrafish crossed were counted on the videos. When the caffeine treatment was complete, the bowl was washed thoroughly and the 64 zebrafish without caffeine were placed individually in the bowl and each was recorded for 30 s (control trial). Each line that these control zebrafish crossed was also counted. The process for the experimental and control zebrafish were repeated in the same manner each week until a total of 128 trials were completed (64 experimentals, 64 controls).

Statistical Analysis

The mean, standard deviation and range were calculated using SPSS statistical software on the computer. An independent samples t-test was used to test for a significant difference in the number of lines crossed between the two groups at significance level of $\alpha=0.05$. A parametric test was used, because the distribution approached a normal distribution.

III. Results

The 64 experimental fish and 64 control fish were all observed for the same length of time. During this time, each fish was video recorded as well as observed to see if any noticeable behavioral changes were seen. The number of lines crossed of each experimental fish as well as the frequency of the lines crossed is represented as a histogram and shown in Figure 3. The mean (\pm SD) of the experimental fish was 35.98 (\pm 12.90) lines crossed. Out of all the fish that were tested, there was only one fish that was not mobile and did not cross a single line (the immobile fish was in the experimental group).

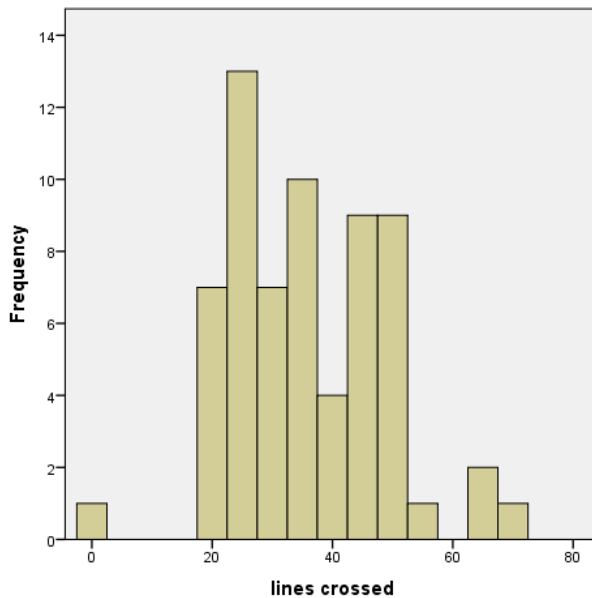


Figure 3: Experimental group

The number of lines crossed of each control fish and the frequency of lines crossed is represented as a histogram and shown in Figure 4. The mean (\pm SD) of the control fish was 38.63 (\pm 13.51) lines crossed. The range of the number of lines crossed for both the control fish and the experimental fish were similar (Figure 3, 4).

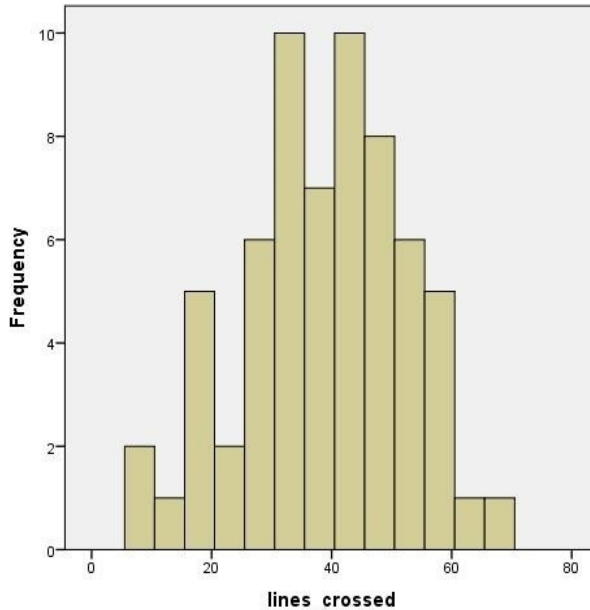


Figure 4: Control Group

The groups were compared and an independent samples t-test was used to see if the groups differed significantly. The number of lines crossed between the two groups did not significantly differ ($t = 1.13$, $df = 126$, $p = 0.26$).

Each fish that was used in the experiment was also observed for behavioral patterns that may have occurred. In the experimental fish trials, the overall pattern of swimming was more erratic and less smooth compared with the control. The one fish that did not swim that was in the experimental group was shaking vigorously throughout the video recording, possibly exhibiting seizure-like behavior. Also observed was the experimental fish mainly swimming at the edges of the bowl while the control fish were seen mostly swimming in the center of the bowl.

IV. Discussion

Similar studies that have been conducted are essential to the understanding of the behavioral and physiological effects of caffeine on zebrafish and other animals,

including humans. The hypothesis that zebrafish exhibit increased movement when exposed to an acute concentration of caffeine was explored. The experimental group was predicted to have increased locomotion compared to the control. This prediction was investigated due to the known hyperactivity effects caffeine has on humans (Merola et al., 2017). The results were different from what was expected; the control group and experimental group each crossed a similar number of lines, indicating similar locomotion between the experimental and control (Figures 3, 4).

Methodological Aspects

This study, as well as others, usually have certain techniques that produce errors that cannot be avoided. During the procedure, when counting the number of lines each zebrafish crossed, there are some potential errors that can occur. Some zebrafish swim fast and not in straight lines, and since the lines counted are done by the unaided eye and not by an automatic device, there can be some issues that arise. There are many close lines on the grid, and some fish change direction quickly, or stop half way between two lines, which can present a problem when counting the lines on the recorded videos. Other issues that can arise from using this method of data collection include the varying interpretations of lines crossed by the zebrafish. Some people that use this method of video recording count every line that the head of the zebrafish reaches, while others count the lines once the whole zebrafish moves passed a line, including the tail. Since zebrafish are social animals and prefer to be part of a shoal, studying the effects of caffeine on individual zebrafish can alter their behavior, which may not be a direct effect of caffeine (Maaswinkel et al., 2013).

Comparison with Results of Similar Studies

In a study conducted by Maximino et al. (2011), there were two caffeine concentrations administered to zebrafish, 0 mg (control) and 100 mg. Similar to this study, Maximino et al. (2011) handled the zebrafish during transportation from their housing location to the study location and were given 3 min of acclimation time. The trial was conducted for 900 s and the researchers found that the zebrafish exhibited anxiogenic behavior but not a locomotor difference (Maximino et al., 2011). The effect of no difference in locomotion can be due to the concentration of caffeine being too high, which can cause detrimental effects, as noted earlier (Rodriguez et al., 2014).

There are other studies that have been conducted on the response of zebrafish to habituation, a decreasing response to a constantly repeated stimulus, with 100 mg of caffeine administered to them (Wong et al., 2010). The habituation trials lasted 6 min

each and the researchers measured the number of transitions to the top of the tank, the time spent at the top of the tank, the frequency of erratic movements, single-minute habituation phenotype, and cumulative habituation (Wong et al., 2010). Consistent through most studies involving caffeine, Wong et al. (2010) found a significant increase in anxiety-like behavior, which was contrary to this study, and decreased movement between the two halves of the tank. The study also found an increase in erratic movements, consistent with this experiment, and decreased habituation behavior in the caffeine group (Wong et al., 2010). Contrary to this study, Wong et al. (2010) used a 24-hr light cycle, where the zebrafish tanks were under fluorescent light for 12 hours and in the dark for 12 hrs. Light cycles can potentially influence the results of studies that include them compared to other studies that do not use regulated light/dark cycles. Being on a regular routine, like that seen with the light cycles and the consistent feeding times, can possibly influence the behavior of zebrafish compared to not being on a regular routine. Conducting experiments that involve inconsistent times, such as the times when the animals are fed and the times when the study is being conducted, can potentially impact the results of such studies.

In most studies involving zebrafish and caffeine, the caffeine concentration of 100 mg/L (0.01%) have been used. In a study by Egan et al. (2009), the researchers pre-exposed the zebrafish in a beaker filled with 100 mg/L of caffeine for 15 min. The zebrafish was then transferred to a tank with the same caffeine concentration as the pre-treated beaker, where the study was being conducted. A behavioral phenotype test that measures anxiety in zebrafish, called the novel tank diving test, was performed. This test by Egan et al. (2009), similar to the one by Wong et al. (2010), measured the latency to the upper half of the tank, the total transitions to the upper half, the total time spent in the upper half, and the erratic movements. Egan et al. (2009) found increased anxiety-related behavior in the zebrafish, but did not find a significant change in their locomotion, a possible effect of the pre-treatment with caffeine prior to the start of the study. Egan et al. (2009) also examined the effects of caffeine on different strains of zebrafish. Wild type (control), albino, leopard, and longfin strains were compared using the same concentration of caffeine (100 mg/L). Latency to the upper half of the tank, total time spent in the upper half, total distance traveled, and average velocity were examined (Egan et al., 2009). The wild type strain was found to prefer the upper half of the tank, with fewer transitions than the other strains. Preference for the upper half and transitions between the two halves were the only statistically significant behavioral observations seen, with the greatest difference between the wild type and leopard strains (Egan et al., 2009). Among all four strains, the distance traveled and swimming velocity were similar,

revealing no readily apparent motor or neurological differences between these strains when exposed to caffeine. However, the baseline anxiety level is lower in wildtype zebrafish than any other strain, which has to be considered when comparing the anxiety-related behavior among the four strains (Egan et al., 2009).

Outlook of Future Studies

Caffeine is a popular drug that can be used in scientific studies to demonstrate its effects on a wide variety of animals, including humans. This study can unlock many key questions regarding the potential impacts caffeine has on zebrafish models, humans, and other animals. Since this study failed to take into account the social behavior of zebrafish, such as shoaling, other studies can be done to study the effects of caffeine on shoaling behavior, with multiple zebrafish in the test tank, instead of observing one zebrafish at a time. This study mainly observed the movement and locomotion of zebrafish, mainly a neurological effect, but additional studies can examine cardiac and developmental responses to caffeine. The majority of publications involving zebrafish and caffeine have been done on embryos, not adults, which mainly study the growth and teratogenicity of early exposure to caffeine (Rana et al., 2010). Further studies could be conducted to compare differing caffeine concentrations and its effects on a single organism and organisms of different species. Also, the effects of caffeine can be studied over a range of exposure times or different concentrations, to determine if there are any time-related effects or dosage effects on zebrafish behavior. These caffeine dosages for zebrafish can be compared to a typical human's caffeine intake to gain more of an understanding about the quantity that zebrafish are exposed to. In a study conducted by Silverman et al. (1992), humans consume an average of 227 mg of caffeine each day, which is equivalent to approximately two and a half (8 oz) cups of coffee. Withdrawal symptoms in humans are also well known and can be compared to zebrafish to see if any consistencies occur (Silverman et al., 1992). In humans, symptoms have been observed to occur in as little as a consumption of 100 mg each day for a month, and then abruptly stopping, which is equivalent to one 8 oz cup of coffee. These symptoms are similar to the symptoms exhibited by zebrafish, and include being over anxious, fatigued, mood changes, lethargy, and, if an extremely high dose was given (greater than 600 mg) for a month, seizures (Silverman et al., 1992). Since this study saw a decrease in movement among the experimental zebrafish, it is essential for other studies to be conducted to test the effects of caffeine using a full, comprehensive approach, to fully understand the role of caffeine on the behavior of zebrafish.

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Section II: The Social Sciences

Pink and Blue: How Stores are an Integral Part of Gender Socialization

Victor Ruan¹

The project involved the analysis of merchandise sold in retail stores and how these stores are catalysts to gender socialization and defining both masculinity and femininity. Visits to three different stores (H&M, Bath & Body Works, and JCPenney) clearly show the gendering of merchandise and the targeted audience. Gender socialization is an integral part of society, which has created expectations on how children should act in a certain manner to be considered a boy or a girl (and leaving little room for those who do not identify on this binary). Just like parents are guilty of, stores also cue consumers on how to properly “do gender” (West & Zimmerman, 1987). You could argue that stores are striving towards more gender-neutral products and many may advocate towards such, but these stores still participate in the social construction. There is validity that stores (Target) have established a more gender-neutral product line, but at the same time, the majority of retail stores conform to the social constructions of hegemonic as well as normative masculinity and normative femininity that we as a society have created. Perhaps more importantly, the majority of manufacturers or CEOs do not realize they are even gender socializing since we have grown up with these ideals since birth, which makes these restrictive ideas normative. This then emphasizes the ideal image for boys and girls how to be a man/woman when growing up. The fact that the connection between gender and sexual orientation is emphasized so much in males and females, suggests how closely gender conformity and heterosexuality (heteronormativity) are linked within hegemonic constructions of masculinity/femininity (Kane, 2006).

Data and Methods

In order to analyze how stores gender their merchandise, I decided to visit H&M, Bath & Body Works, and JCPenney. I chose these stores for the differences in their merchandise and their intended consumers. With H&M being a clothing store, Bath & Body Works a health and beauty store, and JCPenney being focused on children toys, it provides a diverse data sample. Thus, the different sources of data strengthen the analysis. The stores were examined in a span of two days. Starting at 10/17/18, I went to

¹ Written under the direction of Dr. Bernadette Ludwig for SO320: *Sociology of Gender*.

H&M from 1:30-2:00 pm and recorded my observations. Immediately after, I went to Bath & Body Works from 2:15-3:00 pm. On 10/19/18, I collected data at JCPenny between 7:00 and 7:30 pm. In ordered fashion, data were recorded in specific categories of landscape/environment, merchandise products, imagery/color association, quantity and price of products, and any presence of neutrality, if any. Also, during the collection of data, I took pictures of specific products that either showcased gendered merchandise for children and consumers.

Findings

Data collected from these three retail stores show that merchandise is gendered. H&M was the most apparent as the first floor was entirely for women and the second floor was split in half where the left side was for men and the right for women. This was clearly stated throughout the store as imagery and color association implied the idea that “x” is for females and “y” is for males. This seems to relate to the XY sex-determination system, which defines a sex of an individual is determined by a pair of chromosomes. Males typically have a pair of (XY) chromosomes, while females have (XX); and of course there are intersex people. It seems like these retail stores are placing restrictions that define what people should or should not wear just based on their sex chromosomes and traditional masculinity/femininity. The prevalent division of “men” and “women” products also highlighted the lack of gender-neutral merchandise. While observing the products, there are definitely trends as to what society expects men and women to wear, which is projected by H&M in their clothing merchandise. For men, the types of merchandise consist of button-down shirts, jeans/khakis, plain t-shirts, hats (caps/beanies), and sneakers. Also most of these clothes were not very “expressive.” In order to discuss this, the types of products for women should be detailed. The merchandise were mainly skinny jeans, t-shirts with images, boots/heels, revealing clothing, and things like leggings or scarfs. Now, when considering the differences between the “male” and “female” products, it is important to note the imagery and color association for each respectively. At H&M, the male products did not focus so much on imagery, but actually on the usage of colors and the division of gendered merchandise to define the male section of the store. The majority of the clothes were very dark, neutral types of colors like black, white, gray, blue, and sometimes red or green. As expected, the color options were fairly limited. In comparison, the female clothes were very expressive as many were of on the spectrum of pinks, purples, light blues, and also neutral colors such as white, gray, and black. It is interesting to see that the store reflects the idea that men should not be emotionally expressive as the main colors being sold of their clothing

are very neutral, monotone colors. In addition, t-shirts and almost all of the other clothing advertised to men were plain, while a good portion of the female t-shirts had some sort of image or quote linked to some sort of emotion. Yes, obviously there are some males/female clothes that bleed into the other, but they were not significant in number. When considering the ratio of “female” and “male” products it is clear that there are significantly more options available to women

I found Bath & Body Works, a health and beauty store, to be the most gendered of the three stores I visited. Almost all of the store products are geared towards women and the only section for men was a small display with colognes and hand sanitizers. “Female” products had a wide range of products of skin care; lotions, hand/body soap, hand sanitizers, perfumes, and other things that I did not even know existed, prior to conducting this study. Essentially, this store very much caters to women and it seemed very apparent. That even translated to the imagery and descriptions of the products. For example, consider the perfumes where some of the names include “Love and Sunshine,” “Sweet Pea,” and “Rose Fine Fragrance,” while the male colognes were only one-word names like “Leakwood,” “Noir,” or “Bourbon.” This was also the same with the hand sanitizer collection that included names and fragrances such as “Vanilla Berry Sorbet” and “Paris Amour” for women, while those marketed to men had exactly the same name as the colognes in the men’s collection. Clearly, there is gendering in this store, as it does not expect men to shop in this retail store for themselves, since our society reserves “beauty” and “pampering” for women. Surprisingly, despite the gendering of the products, the prices for “male” and “female” products were generally the same.

In the third store, JCPenney, I focused on the children’s toys section. Just like the other two stores, there was gendering of how the merchandise was marketed. The “boy” products are mainly about strength and heroism. Marvel characters like Ant Man or Black Panther were displayed in this section. These superheroes were only prevalent among the “boy” products reflecting traditional ideals that men are supposed to be physically strong in order to prove their masculinity status. The “girl” products were heavily focused on princesses (Ariel, Moana, Rapunzel). There was also a toy called “Baby Alive.” As the name suggests, it is a doll that aims to inspire young girls to take care of it like a baby, feed, change, and put it to sleep. This clearly is related to traditional perspectives that women are expected to be mothers be the primary caretakers.

Most toys included pictures that showed a little boy or girl playing with the product. With the superhero toys, it was a boy and vice versa with the girl products. These toys demonstrate how gender socialization starts at an early age and contributes

that those who do not fit into the idealistic characteristics of normative masculinity and normative femininity often feel less of a man or woman.

Analysis

The gendering of children and adult merchandise clearly reflects how much society is concerned with gender appropriate behavior, clothing, etc. Merchandise reinforces ideas around hegemonic masculinity as well as femininity. In addition, these products leave almost no room for intersex or non-binary children and adults. Not only are the children influenced on how they “should” act, but parents are also enforcing normative gender expectation based on merchandise they buy. Clearly, there are significant implications of gendering merchandise, most importantly sending a message that individuals who do not conform to the traditional ideas of what is considered a “man” (physically strong, void of emotions) or a “woman” (nurturing, frilly clothing), will be considered less masculine or feminine (hooks, 2014 [1989]).

In order to address the implications of gendered merchandise, consider the example of H&M. The clearly defined division throughout the store creates borders and restrictions that make people believe they cannot cross and make them normalize these gendered ideals. For example, the colors associated with “male” are neutral and monotone (black, gray, white, blue) whereas “female” products tend to be more vibrant (pink, purple, red, yellow) implying that men are less emotionally not very expressive. The much more vibrant and bright colors of the female clothing seems to support the idea that women are more inclined to express their feelings and emotions. This is also synonymous with the idea that there seems to be parallels between the social interactions between men and the challenges of creating male friendships. Consider a man cited by Brody (2016) who exclaims that maintaining friendships “doesn’t come so easily to men” (para. 1) as he contrasts this to his wife’s extensive friendships with other women. This shows that many men believe that talking about emotions and opening up is not manly, which often makes it harder to sustain intimate, long-lasting relationships (Brody, 2016). Rather, they feel that being a man means emphasizing (physical) strength and being reserved.

The idea of physical strength and mental toughness as essential elements of masculinity are conveyed starting at an early age. The toy selection at JCPenney makes this evident. Toys marketed for boys include, but are not limited to, different merchandise around superheroes and nerf guns. These products are sending messages that physical strength is a necessity to be considered masculine. These superheroes were created that have extreme powers like being able to survive supernovas or cast godly thunder, once

again emphasizing physical strength. Not surprisingly then, men use fights to bolster their masculinity and if they fall short, have to find other ways of asserting their dominance (Melzer, 2013).

And while boys are told to not show emotions, most toys advertised for girls emphasize emotions around caring. For example, the “Baby Alive” toy is a simulation of taking care of a child. That is a prime example of traditional femininity that tells girls that they are expected to have children and being childless makes one less of a woman (Blackstone, 2014). Similarly, princess and Barbie highlight that being “girly” means wearing vibrant dresses, jewelry, and elegant accessories. Subsequently, girls and women who do not fit this archetype may end up feeling insecure and less of a person and even be labeled as a lesbian or manly (Ezzel, 2009).

Parents often sanction gender nonconformity, especially for boys. Kane’s (2006) research revealed that the majority of parents (74%) expressed negative feelings when their sons played with “girly” toys, liked wearing frilly clothing, painted their nails, and liked ballet and Barbie dolls. Some of the parents, especially fathers, resented boys’ gender nonconformity because they fear that their sons will be viewed as gay (Kane, 2006). The fact that the connection between gender and sexual orientation is emphasized so much as it relates, shows how closely gender conformity, heteronormativity, homophobia and hegemonic constructions of masculinity are linked (Kane, 2006). In contrast, parents often supported that their daughters embraced more “masculine traits” since they argued that this made them more assertive and confident which would help in their future careers (Friedman, 2013). But recall, if girls and women are perceived as too masculine this can also backfire, as they may be labeled “aggressive” and/or “lesbian” (Friedman, 2013; Ezzel 2009).

Conclusion

Gendered merchandise has created messages towards children that have led to implications on gender conformity. Whether it be the divisive color palette of clothes sold at H&M or Bath & Body Works’ marketing primarily to women with products that are aligned with normative femininity (e.g. delicate, sweet), stores’ part in gender socialization is indisputable. This reinforces messages and expectations on what a boy/man or a girl/woman should wear or play with it. Not only are these ideas unrealistic but they also limit how people are allowed to express themselves. I experienced this first hand when I wore a dress for a few hours to see how people would react to others who breach gender norms. Not surprisingly, given that most stores advertise dresses exclusively to women, my peers were less than supportive exclaiming that “You can’t be

wearing a dress to school my man” and “bro, I can’t look at you the same again,” all accompanied by laughs and expressions of shock. Despite being a confident young adult these comments made me feel extremely uncomfortable, so I cannot even imagine how a young boy would feel. Society’s continuing pressure to conform is a major problem. Hopefully stores eventually start to include more gender-neutral products and support the idea that a toy, a dress, a fragrance should not determine one’s gender identity.

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Section III: Critical Essays

The Theme of the “Sleeper” in the Works of Paul Gauguin

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Paul Gauguin believed in an art form that was free of limitation and restriction. Art is the expression of what one truly feels, sees, and believes. He did not believe in painting only what was there, but what was not there. The “Sleepers” in his works are those who seem to be restricted in that they do not have motility or comprehension in sleep. However, as Gauguin portrays it, the true liberation is in slumber as it allows one to access their own personal dream worlds. The closed eyes of the subjects in sleep suggest a world beyond closed doors open to all possibilities and opportunities. The theme of the “Sleeper” in Gauguin’s creations illustrates two distinct worlds: one of fantasy and one of reality.

In his early works, Gauguin used his family and those closest to him as inspiration. In *The Little One is Dreaming*, 1881, the child sleeping is his daughter, Aline. The major themes in this work are life, death, and dreaming. The palette is muted and subtle with the exception of the clothing on Aline and the jester doll. This is representative of light and vibrancy that is found in the innocent life of a child. However, the jester evokes feelings of ambiguity and presents a sense of eeriness to the work as a whole. The wallpaper of the background consists of birds flying to and from a nest. This adds a feeling of movement and energy to the work. These birds are representative of the child’s fleeting dreams and an artist’s racing thoughts. The jester, in addition, gives insight into the dreams of a young child (Maleuvre 198). This work clearly represents Gauguin’s central theme of finding liberation in fantasy by exiting reality through dreams.

Similarly, this sharp divide between fantasy and reality can be seen in *The Sleeping Child*, 1884. The subject of this work is Gauguin’s son, Clovis. The fresh, crisp colors of the palette are used to express the view of dreamscape through color. Behind the closed eyes of Clovis, a vivid dream world ignites. This dream world consists of flying, whimsical beings in a sea of bright blue. Other interpretations of this work state that amongst the otherworldly creatures there are flowers that hold significance in the Tahitian culture (Cotter 45). These flowers are known as *tupapa’u* flowers. They are a sign that a ghost is thinking of you as they gleam in night of Tahiti (47). The physical

¹ Written under the direction of Dr. Laura Morowitz for AH 321: *The Madman and the Savage*.

resemblance to this plant and the flowers illustrated by Gauguin in this work prove that he always had a sincere appreciation for primitive, ethnic cultures. Further, the scaling of the objects in the work also illustrate a world free of worldly ties as the ceramic container on the tabletop next to Clovis is significantly larger than the child himself. Again, these figures provide a sense of energy and movement that portray fantasy as a constantly changing landscape where there is an absence of concrete reality.



The Sleeping Child, 1884

Moreover, the *Vision after the Sermon (Jacob Wrestling with the Angel)*, 1888 is one of Gauguin's most celebrated works. The world of fantasy and religion are brought to life in this work by artistic expression. The religious aspect is representative of a passage from the Bible in which Jacob wrestled with God and was blessed with the new title of "Israel" for having overcome the challenge (Buser 384). This work is vividly colored with red being of the most distinct. Gauguin uses color in a completely abstract way. Red is used as a symbolic color. It is used to illustrate violence, anger, danger and death (Buser 385). Red defines the image as dreamlike and unreal. Color is stripped of its original function of only being used in the natural world to one in which it is used expressively to separate reality from fantasy. Gauguin gives a new meaning to color by removing its restriction of only replicating reality.

In a letter to Van Gogh, Gauguin describes *Vision after the Sermon (Jacob Wrestling with the Angel)*, as "For me the landscape and the fight only exist in the

imagination of the people praying after the sermon” (Herman III 415). The Breton women in the work have their eyes closed in prayer portraying the dream world in which the Biblical passage comes to life in the light of their imaginations. Japanese prints served as a major influence to Gauguin in making of this work. The flatness of the landscape is an aspect of Japanese art that he had come to attribute to his own paintings. The lack of shadows provides the sense of illusion and fantasy. In addition, the branch that separates the work horizontally, influenced by prints, serves as the physical separation between reality and spiritual realm. However, this painting is not religious. It provides more of a “spectator religious” experience in which the viewer is watching others be religious; this was an extremely modern concept in the time this work was created (420). *Vision after the Sermon (Jacob Wrestling with the Angel)* gives rightful appreciation to the stylistic characteristics and abstract subjects that encapsulate Gauguin as a legendary artist.

Gauguin’s world of abstract vision is illustrated in *The Yellow Christ*, 1889. In this work, he expresses dreams and visions in vibrant color, form and composition. The central figure of this work is based on a seventh-century wooden crucifix that hung in a chapel in Brittany (Jarnes 30). The Christ figure is made in the image and likeness of Gauguin with similar facial features. This can be interpreted as portraying a connection to him and faith or as a means to display a higher level of spirituality that can be reached through prayer as displayed by the women. The color yellow is prominent in this work as Gauguin used it to convey primitivism and religion in the life of the Breton women. He chose to create a strong yellow presence against a background of autumn harvest. In Brittany, the harvest had deep religious meaning. The grain harvest was compared to the Christian cycle of life: birth, life, death, and rebirth (33). The use of yellow and the bleeding Christ figure can also be attributed to the time Gauguin spent with Vincent van Gogh in Arles. Van Gogh is known as the “great painter of yellow”. During their time together, the two artists left lasting influences on each other as seen in many of their later works. The incident involving Van Gogh cutting off his ear may have influenced Gauguin in the creation of the Christ figure to symbolize the way he left Van Gogh bleeding in Arles (Collins 88). *The Yellow Christ* portrays a complete dismissal of reality as the Breton women did not actually gather around a crucified Christ. This work is yet another by Gauguin that portrays the expanse of the imagination that lies beyond closed eyes. However, the true expanse of Gauguin’s idealistic dreamworld stemmed from his experiences in Tahiti.

At his arrival in Tahiti in 1891, Paul Gauguin formed an image that was rooted in visions of tropical bounty and primitive ethnic peoples. He imagined the country as

microcosm of the start of civilization that has not yet been touched by societies of Westernization. Gauguin saw Tahiti as an escape from all that is conventional (Danielsson 230). He wished to live a pleasure-filled life, living off the land and indulging with the people in paradise where he could want for nothing. Depicted in this way, Tahiti was Gauguin's dream and fantasy world. This world of lush bounty and beautiful, savage people encompassed his thoughts and impacted all aspects of his life until he reached the land of his imagination. Although Gauguin was disappointed to find that Tahiti was not the lush, primitive heaven of his dreams, he created works while he was there that depicted his longing for fantasy land absent of reality.

In *The Spirit of the Dead Watching*, 1892, Gauguin portrays a dreamscape that comprises several motifs that illustrate his view of the primary fantasy world of Tahiti. The subject of this work is Gauguin's native wife, fourteen-year old, Teha'amana. Teha'amana is lying on a bed, completely nude. The bed is covered in a wraparound skirt that is traditionally worn by the Tahitian people. The inclusion of this detail in the work demonstrates Gauguin's appreciation for the vibrant colors and prints of the Polynesian culture. Behind the bed, in profile, an older woman, a ghost figure watches over her. Gauguin gave life to a haunting, eerie, and supernatural setting through the use of color (Cotter 42). The color palette of this work evoke strong emotions in each aspect of the painting. For example, the browns, golds, and reds used to illustrate the color of Teha'amana's skin present with a sexual, erotic overtone. The vibrant contrast of the print on the bed portrays the vibrancy of the tropical landscape of Tahiti. More, Gauguin states his main use for the yellow bed sheets was to present the feeling of suspense to the viewer (43). The background of the work, behind the ghost figure, is expressive with a bright color palette depicting the limitless dreamscape. Additionally, the purples in the background emote the darkness of a nightmare, a "background of terror" (44). The *tupapa'u* flowers present in the dreamscape serve as a sign that the ghost figure is watching over Teha'amana (47). This painting is a prime example of how Gauguin used color to express feelings and emotions.

Further, Teha'amana's face is depicted in a way that evokes a strong sense of fear. In a letter to his wife Mette, Gauguin states, "I painted a nude of a young girl. In this position she is on the verge of being indecent. But I want it that way: the lines and movement are interesting to me. And so, I give her, in depicting the head, a bit of a fright" (Fraenkel 688). Initially, Gauguin, in another letter to Mette, stated that the source of the girl's fear was the old woman, ghost figure behind the bed. However, in his memoir, *Noa Noa*, he made himself the subject of her fear (689). All of Teha'amana's fear is not attributed to her fear of the dark or belief in spirits. Her fears can also be

attributed to Gauguin's sexual aggressiveness which deems the look in her eyes as a fearful, submissive one. His willingness to illustrate her facial features and eyes in such a way demonstrate that he saw her submissiveness as a reward (Rose 262).

The theme of the "Sleeper" in *The Spirit of the Dead Watching* presents two types of fantasies conveyed by Gauguin. First, although the physical imagery of sleep is not presented in this work, an obvious dreamscape is created in the background. The bed serves as the physical divide between reality and dreams. The fantasy world consists of the ghostly figure and the *tupapa'u* flowers which breathe a certain movement and energy into the work. Second, the presentation of the subject and ideas in this piece evoke sadism and racism (Gilbert 263). His overt use of sleep can be seen as a way to depict vulnerability in women (Beall 38). Teha'amana's look and position can be viewed as submissive without the ability to resist the domineering and aggressive sexual predator, the white, middle-aged colonist. Gauguin's portfolio is full of naked, young Tahitian women in a variety of differing positions in a multitude of settings. These works are categorized under "eroticism", however, this term could be masking Gauguin's true nature as a pedophile (Mathews 55). Gauguin's portrayal of women in all of his works is often challenged as differing interpretations suggest disrespect and belittlement to various cultures. Specifically, his works of naked Tahitian women considers a sexual and racial fantasy that emerges from Gauguin's position as a male colonist (56). The fantasy world of Gauguin is not strictly limited to the vivid dreams of children or expansive religious visions. Gauguin's depiction of women in his works evoked a racially "erotic" fantasy world in which his legacy is questioned.



The Spirit of the Dead Watching, 1892

Furthermore, *The Day of the God*, 1984, tells the story of the Tahiti Gauguin dreamed of, not the Tahiti he had come to know. The work is set in a Tahitian landscape by the water and is divided into three parts. The top portion consists of island women conducting a ritual near a Buddhist-type sculpture. Buddhist figures are a common theme found in the works Gauguin created in Tahiti. It is hypothesized that he connected to the Buddhist religion because of the tradition of meditation (Leithauser 68). Meditation grants vision without the use of sight. It involves searching inward to find truths and different perspectives about oneself. Gauguin believed dreaming provided the same revelation as behind closed eyes the expanse of honesty and imagination takes flight. In the middle of the work, there are two sleeping women and one woman posed to formally resembled the Buddhist sculpture behind her. This woman is similar to other Tahitian women Gauguin depicts as she is representative of an Eve in the Garden of Eden (Teilhet 110). The lower portion of the work is comprised of vibrant, brilliant contrasting colors reflected in water. The varying shapes of the reflections can be seen as a dismissal of reality into a land of imagination similar to the light of paradise. Gauguin dreamed of a lush paradise of endless indulgence in Tahiti. As the work depicts, he expected lush, tropical landscapes, beautiful ethnic women, spirituality in culture, and limitless opportunities in a world where he could never want again. The woman sleeping with her eyes closed is representative of this immense fantasy and dream world he created. Moreover, the overt themes of birth, life, and death are expressed in this work. Birth is seen by the women holding a child in the top portion of the work. The color white is used for their clothing to represent new life. Life is seen throughout the vibrancy of the palette used. The bright coloring of the landscape and figures emote a sense of aliveness and joy (Lennon 61). Death is represented by the figure with her back turned to the sea of color in the middle of work. The face of this figure is not shown as to represent the end of dreaming as darkness is now what is seen beyond closed eyes. The expanse of the fantasy world is non-existent without the ability to dream and imagine. This Tahitian landscape tells of the depths of Gauguin's own imagination and the stretch of his colored world behind closed eyes.

Additionally, *The Nativity*, 1896 portrays a religious fantasy created in the dreamworld of a sleeping Tahitian woman. A young Tahitian woman is in a deep sleep on bright yellow sheets. She is mostly clothed in a deep blue Tahitian print cloth. It is speculated that she is clothed because she is part of a religious scene. This distinction is made as it is Gauguin's commonplace to depict Tahitian women in the nude. In the background, there are two women, one of whom is holding a child. The print on the cloth is a yellow star representative of the North Star described in the biblical story of the birth

of Jesus. Both women are subtle in a pose of reverence and humility (Gayford 92). Moreover, the background illustrates a barn scene with a herd of resting farm animals. This scene is Gauguin's representation of the Tahitian Nativity (93).

The sleeping woman's head is encompassed in a yellow halo. The child's head is also surrounded by darker green shades resembling a halo. The woman in the far back of the work has wings colored in a mix of bright yellow and darker greens, resembling the angel Gabriel. The halo around the sleeping woman portrays her role as the Virgin Mary. She serves as Gauguin's Tahitian Madonna. The child is the Christ figure born on the Holy Night in a manger. The edge of the bright yellow cloth on the bed separates the real world from that of fantasy.

Gauguin's Tahitian Madonna demonstrates his unorthodox religious views and how prominent spirituality was in his everyday life. The world's religions, mythologies, and spiritual constructs were all united according to Gauguin (Price 22). He had strong beliefs in the mystic themes of religion and combined them with the subjects of his life to create the masterpieces that comprise his artistic career. Religion served as a major theme in the fantasy worlds curated by Gauguin.

Paul Gauguin was one of the greatest unconventional artists known to modern history. His bohemian, anti-Western approach to life created art that was unique and otherworldly. Gauguin's need for primitivism combined with limitless fantasy gave his works the ability to encompass universal topics that held timeless messages about religion, dreams, sexuality, life, and death. Gauguin's inability to accept reality as a concrete principle allowed him to share his influence with a myriad of religions and cultures. His passion for the Tahitian culture, during the 19th century, demonstrates how he was an open-minded and futuristic dreamer. His urge to assimilate with the culture and create a united society in religion and culture depicts his roots into a world of imagination. Gauguin spent his life exploring the world with his eyes closed using his dreams and fantastical thoughts to dismiss the rigidity of reality. The works he created serve as a living legacy of Paul Gauguin and his profound belief in the endless opportunities and inspiration found in the world of fantasy.

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A Physician's Right to Conscience

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The purpose of this paper is to explore the ways that legal abortion affects the obligations of providing doctors towards expectant mothers. Doctors that identify as religious tend to present themselves as pro-life. A pro-life doctor, even if in the field of reproductive health, may refuse to perform the abortion because they feel it is morally wrong. Pro-choice advocates tend to believe that a pro-life doctor that wants to work in the field of women's health should not, because abortion is a procedure that may be involved in the care of a patient. This is a topic of controversy because many doctors step into this field with the idea of saving lives, not terminating lives. This paper will examine the ways that president, Donald Trump, has addressed this concern, the effects on doctors, and the patient, regarding maintaining a healthy conscience for doctors. If legal abortion causes religious or moral controversy for providing physicians, then their right to refuse limits access to an expectant mother wishing for an abortion. This paper adds a new dimension about abortion in regards to the provider by exploring ways to protect the conscience of a doctor while avoiding the possible limitation of access to healthcare or reproductive services for the expectant mother.

I. Introduction

Abortion has been hotly debated in American politics in recent years. Most often debated are the issues related to a woman's reproductive rights, while the concerns regarding a physician's conscience rights are considered less often. But their protection is equally as important. The settlement of *Roe v. Wade* supreme court case in 1973, sparked the ongoing Pro-Life and Pro-Choice debate in America. In 1996, President George W. Bush issued conscience protections for Pro-Life doctors that did not want to participate in abortions. After President Barack Obama's decision to revoke these protections, our current President, Donald Trump, has further implemented these protections back through the U.S. Department of Health and Human Services. These rights are included in The Church Amendment and the Public Health Service Act section 245. This paper will examine the ways legal abortion affects the obligations of doctors towards expectant mothers.

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II. Literature Review

According to the U.S. Department of Health and Human Services, a health care provider's conscience rights are protected by federal statutes. Federal statutory health care provider conscience protections include, but are not limited to, The Church Amendments and The Public Health Service Act, section 245. The Church Amendments which were enacted in the 1970s, were of purpose to "protect the conscience rights of individuals and entities that object to performing or assisting in the performance of abortion or sterilization procedures if doing so would be contrary to the provider's religious beliefs or moral convictions" (Office for Civil Rights, 2018). The Public Health Service Act, section 245, was put into play in 1996. The act included the following guidelines:

it prohibits the federal government and any state or local government receiving federal financial assistance from discriminating against any health care entity on the basis that the entity: 1) refuses to undergo training in the performance of induced abortions, to require or provide such training, to perform such abortions, or to provide referrals for such training or such abortions; 2) refuses to make arrangements for such activities; or 3) attends (or attended) a post-graduate physician training program, or any other program of training in the health professions, that does not (or did not) perform induced abortions or require, provide, or refer for training in the performance of induced abortions, or make arrangements for the provision of such training. (Office for Civil Rights et al., 2018)

Roger Severino, the Trump administration appointee who now leads the U.S. Department of Health and Human Services civil rights office, has repeatedly stressed that strengthening conscience protections for health care workers is a top priority for his office. Because of this, there is also a new Conscience and Religious Freedom Office in hospitals for Pro-Life healthcare providers so they don't feel pressure about abortions. This research shows that there is an effort to protect the conscience of doctors and nurses that consider themselves to be Pro-Life, which is important in maintaining a healthcare system of passionate individuals; who work and provide under the circumstances in which they are comfortable.

An editorial from The New York Times, titled, "Abortion: Where are the Doctors?", reports on the shortage of doctors willing to perform abortions. It reported two different cases in which physicians were murdered by anti-abortion activists, one "on March 10, 1993," in which, "a physician named David Gunn was killed in Pensacola, Fla., by an anti-abortion activist." This editor wrote that, "Dr. Gunn had divided his time

among six abortion clinics in Georgia, Florida and Alabama.” The second murder reported in this editorial was, “on July 29, 1994”, in which, “Dr. John B. Britton was also killed by an anti-abortion activist. Dr. Britton regularly flew from his home elsewhere in Florida to work at Pensacola's only other abortion clinic.” (Abortion: Where are, 1994). These murders show that even the doctors who will perform an abortion are at risk of judgement from others. The editorial goes on to explain that women are struggling to find providers that will provide the service, and “in 83 percent of counties in the United States, not a single physician is willing to provide abortion services,” (Abortion: Where are et al., 1994). It continues to say that “even if there were no violence, many women would still face a long search for an abortion provider. Recent graduates of medical schools know little about the procedure. Only 12 percent of residency programs in obstetrics and gynecology offer training in first-trimester abortions; even fewer offer second-trimester training,” and the proposed solution to this problem is to, “return pregnancy termination to the curriculum”, of medical schools and residency programs. This data does not include the issues regarding the protection of a doctor’s conscience. Although, women are facing an issue that they cannot find a doctor to perform an abortion, the doctor’s protection of conscience is significant too. This source portrays the problems at hand.

Doctors do not want to be referred to as abortionists, according to the journal article titled, “The Abortion Problem as Doctors See It”, reviewed by Barbara Katz Rothman. Rothman teaches in the sociology department at Baruch College City University of New York, and quotes a doctor that was interviewed, “I don’t want to be known as an abortionist. I want to be known as a mother who loves mommies and their babies.” It is true that a doctor’s moral conscience or religious affiliations may affect the availability of services to a patient. Rothman’s solution is an “alternative to physician control”, and to “move abortion outside the private practice of medicine, and into the clinic,” but “abortion is a problem for physicians,” and “the clinic [is] an incomplete solution”. This is not a complete solution because there will still be only a small number of doctors *at* the clinic, and the access for an expectant mother is still scarce, being that the goal is to protect physician’s conscience as well.

“The US Surgeon General on the Health Effects of Abortion”, by C. Everett Koop, is a journal article regarding the US Surgeon General’s concerns addressed to Ronald Reagan in a letter during the time of his presidency. This is a source to demonstrate the progress of the abortion issue through different times. “The type of study the Surgeon General would consider satisfactory would be very costly,” and, “apparently such a study would focus on an initial sample of nonpregnant women and follow their

reproductive histories over time, such as during a period of five years” (Koop,1989). This review suggests that one of the worries of, “pro-lifers” during this time was regarding the negative health effects that abortion may cause on a mother. If enough evidence was found, pro-life supporters were in hopes that it would overwhelm the population of women and, “force the reversal of *Roe v. Wade*”. (Koop et al., 1989) This brings new insight regarding some of the guilt that may have been felt by physicians. They would not only feel guilty for terminating a pregnancy. Yet, they could possibly feel guilty to bring upon a negative health effect to a patient, such as a psychological burden. This could be another reason that doctors do not want to provide this service.

The 1973 U.S. Supreme Court decision of *Roe v. Wade* was intended to declare a woman’s legal right to an abortion. It also caused some unintentional effects on the lives of physicians. As reported by, “Unintended Consequences: Abortion Training in The Years After *Roe v. Wade*”, this decision caused, “a shift in abortion provision from hospital centers to nonhospital clinics,” which in turn, “produced a shift in the focus of anti-abortion activists toward individual physicians and their clinics.” (Aksel & Fein & Ketterer & Young & Backus, 2013). These authors stated that “anti-abortion activists strove to intimidate and make pariahs of these health care professionals on a very personal level.” In 1993, an anti-abortion group in Texas mailed a vulgar and menacing pamphlet of jokes to thousands of medical students. One of the jokes was as follows, “Q: What would you do if you found yourself in a room with Hitler, Mussolini, and an abortionist, and you had a gun with only two bullets? A: Shoot the abortionist twice.” (Aksel et al., 2013) Then later on that month, “David Gunn, an abortion provider in Pensacola, Florida, was shot and killed in front of the clinic at which he worked.” (Aksel et al., 2013) Due to this violence, many more medical students are becoming resistant to performing, or to learning how to perform abortions. Since there are less providers willing to follow through with the operation, there is a risk that women will look for, or access, an unsafe method of abortion. That is not our goal.

Autonomy, meaning “self-rule”, raises ethical question concerning the relationships between patients and their physicians. As stated in, “Patient and Physician Autonomy: Conflicting Rights and Obligations in the Physician-Patient Relationship”, moral conflicts emerge from maintaining a physician's claim to autonomy. Physician autonomy is endangered in the realm of physician’s religious beliefs or moral values. Although there is protection for nurses and doctors’ conscience, this only goes so far. Edmund Pellegrino wrote, “applicants to medical schools are now frequently asked about their views on abortion” and this, “question is asked so often that it seems unlikely to be of only passing interest to interviewers”. (Pellegrino, 1994) This data does not show or

confirm whether or not applicants are being denied due to their views on abortion. Pellegrino then goes on to question, “does the autonomy of the institution or health policy override the autonomy of either, or both, the patient and physician?” So, “which takes precedence when conflict is unavoidable?” (Pellegrino et al., 1994). This source does not answer this question but it can be further explored by questioning whether a physician should risk his or her autonomy by aborting a fetus that was causing a situation that was threatening the life of a mother. In other words, should a physician let the mother die, because they will not abort the child in a dangerous situation? This data does not answer these questions, although, these are deeper aspects of this ethical controversy regarding physician’s rights.

For a long time, the provision of a referral fulfilled one’s professional obligation. Due to this ongoing abortion debate, nurses, “have begun demanding not only the same right of refusal [as doctors], but also - because even a referral, in their view, makes one complicit in the objectionable act” (Charo, 2005). According to, “The Celestial Fire of Conscience - Refusing to Deliver Medical Care,” the lines in which a physician feels their conscience is morally protected is becoming blurrier. From this journal review, it can be assumed that by this information, some doctors feel as though making a referral to another doctor still goes against their moral conscience. This provides more insight regarding how deep the issue is here. Some mothers cannot even find a referral for an abortion, a direct effect of the doctor trying to protect his or her moral conscience. With this comes the question regarding whether or not a professional is obligated to give a referral, and what does it mean to be a professional in the United States? Does professionalism include the rather old-fashioned notion of putting others before oneself? Should professionals avoid exploiting their positions to pursue an agenda separate from that of their profession? And perhaps, most crucial, to what extent do professionals have a collective duty to ensure that their profession provides nondiscriminatory access to all professional services? (Charo et al., 2005). With that in mind, Charo answers these questions by saying that professional health care providers will make this distinction between what is a medical service or nonmedical care. Binding the wounds of a criminal before sending him back to the streets, is different than birth control, abortion, etc. These professionals believe those are lifestyle choices, and not a treatment for disease or illness. (Charo et al., 2005)

“Religion, Conscience, and Controversial Clinical Practices”, posted in The New England Journal of Medicine, adds a new dimension about how physicians feel about their ethical rights and obligations when such conflicts emerge in a clinical practice. A cross-sectional study was performed and reviewed and “the primary criterion

variables were physicians' judgements about their ethical rights and obligations when patients request a legal medical procedure to which the physician objects for religious or moral reason." (Curlin & Lawrence & Chin & Lantos, 2007). Sixty-three percent responded to the survey. It was estimated that "most physicians believe that it is ethically permissible for doctors to explain their moral objections to patients (63%). Most also believe that physicians are obligated to present all options (86%) and to refer the patient to another clinician who does not object to the requested procedure (71%)". (Curlin et al., 2007) This data suggests that many physicians feel that they are not personally obligated to provide for "legal but morally controversial medical procedures". (Curlin et al., 2007) A patient that is looking to have such procedure done, will likely have to search proactively for an accommodating physician.

Instead of a patient having to rely on a surgical abortion procedure, potentially hard to receive care due to the fact that many doctors do not want to perform the abortion, Paul Lombardo says in "How to Escape the Doctor's Dilemma? De-Medicalize Reproductive Technologies" that the solution is in pharmaceutical developments. These developments continue to make the potential for de-medicalizing reproductive decisions possible. In the early 1990s, mifepristone was determined to be safe and effective at terminating a first trimester pregnancy. It showed to interrupt 50 to 85% of pregnancies of less than 49 days. When combined with a follow-up prescription of prostaglandin, it is almost 100% effective in terminating pregnancies. (Lombardo, 2015) The problem is that these medications are tied to a professional licensure of a physician to prescribe the drug. This could also harp at the moral conscience of a doctor, with the potential guilt that they prescribed the means to a way of an abortion. With that being said, this data shows that in order for a physician to be totally out of this dilemma, there must be a possible institution of full and complete reproductive freedom, in which "women can access contraceptives, abortion, and artificial reproductive technologies without the absolute need for a medical gatekeeper" (Lombardo et al., 2015). This data does not address the details in which would allow for this system to be possible in the United States, but it seems to portray a possible solution.

This paper highlights the moral dilemma for physicians and nurses as they try to honor the rights of their clients while honoring their own moral code. Identifying possible solutions to this issue is important while respecting a woman's right to choose and maintaining a physician's ability to adhere to their own moral code. Providing an option for women to manage their own body and reproductive rights leaves the doctor out of the process.

III. Discussion

We discovered that prior to President Donald Trump and after President George W. Bush, many doctors and nurses were at risk of feeling pressured to perform such abortions. However, the doctors and nurses' personal religious or moral values may have been opposed to the medical procedure known as an abortion, which they were forced to execute regardless of their beliefs. The U.S. Department of Health and Human Services has made it clear that Donald Trump and his administration are pushing for the protection of doctors' moral conscience.

Two professionals at a major Catholic hospital stated, "a Catholic institution that does not perform abortions", first hand insight was provided on this topic. (M. Purchacki, Personal Communication, 2018) Melissa Purchacki, a registered nurse and clinical educator at Good Samaritan Hospital Medical Center, was asked the question, "Do you feel as though if a doctor or nurse does not want to perform an operation, such as an abortion, because they do not feel it is morally right, they have chosen the wrong occupation? Why?" she responded with, "No, I do not believe they have chosen the wrong occupation. I believe clinicians have a right to not offer services for procedures that go against their moral compass." This demonstrates that she believes it is not one's obligation to provide in a way that will affect them, for they will perform best under the circumstances in which they are most comfortable. When asked, "What do you suggest is the best solution to protect the conscience of doctors, nurses, and the reproductive rights of women?" Beth Intonato, another registered nurse at the same facility, responded with,

I think doctors and nurses always have to keep up to date with trends and needs of patients. I think each patient should have the right to what happens to their body however I think the patients have to be educated better out in the community. Sexual education has always been a very touchy topic. Whether it is a young pregnant teen or older woman, you never know what is going on in their lives and the best tool we have is education!(B. Intonato, Personal Communication, 2018).

Melissa Purchacki was asked that same question and had a different response, she suggested that, "if you do not believe in abortions do not work for a facility that performs them. As a healthcare provider you do not have to agree with a woman's choice but you should respect their right to choose what is best for them." (M. Purchacki, Personal Communication, 2018).

With that being said, it is important to note that with the suggestion made by Paul Lombardo, author of, "How to Escape the Doctor's Dilemma? De-Medicalize Reproductive Technologies", a nurse or physician would not have to choose where they

work based on whether or not they perform abortions at the facility. Although Melissa Purchacki believes this could be the solution, if abortion were to be taken care of with a drug, a person with a job in healthcare would not have to feel that they had limited options in where they could work comfortably. This is important in the same way in which an expectant mother should not have to feel that there are limited facilities available for abortion procedures. The drug would protect the availability for both the patient and the doctor. These pharmaceutical developments continue to make the potential for de-medicalizing reproductive decisions possible.

In sum, we discovered that just because a doctor or nurse has chosen a path in healthcare, does not mean they are required to perform all operations. If they feel uncomfortable to do so based on their religious or moral affiliation, they are protected in a way which allows them to decide not to do so.

IV. Conclusion

This paper concludes that it is beneficial for abortions to become a procedure that is totally out of the doctors' responsibility and only that of the patient. This means, that the issue of abortion would benefit from becoming a procedure that is only involved in pharmaceuticals. A drug that can effectively abort a fetus, would be only from the use of the mother, not a procedure that the doctor would have to perform. The doctor would not have to make the choice against his or her own moral code. Because of all of the ethical controversy, making abortions become a primarily pharmaceutical issue, the patient would not have to feel worried at the lack of providers, yet they would be able to feel comfort from the readily available supply of pharmaceuticals. Although the patient would be risking his or her conscience, that is her choice. In theory, we can protect the conscience rights of doctors and reproductive rights of women, all at once.

V. References

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