

  
**Laridae**  
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Cover Art: *Cult*, 48” x 60” oil, glitter, and assorted jewels on canvas 2019, by student artist Arielle Tesoriero

“Cult” contains elements referencing Kate Chopin’s 1899 novel *The Awakening*. This is one of my favorite novels. “A green and yellow parrot, which hung in a cage outside the door, kept repeating over and over: ‘Allez vous-en! Allez vous-en! Sapristi! That’s all right!’ He could speak a little Spanish, and also a language which nobody understood, unless it was the mocking-bird that hung on the other side of the door, whistling his fluty notes out upon the breeze with maddening persistence.”

Edna Pontellier, the main character of *The Awakening*, is a wife and a mother. She is described as not being particularly attractive, a bad parental figure, and an unaccomplished painter. This resonates with me as I feel I have similarities with Edna, (although I am not a mother), so in “Cult” I represent not only myself, but Edna. The first lines of the novel open with a parrot and a mocking bird, which represent Edna’s entrapment in society. She is an outcast, as women were expected to follow the four rules of “the cult of domesticity” or “the cult of true womanhood,” which were piety, purity, domesticity and submission. Throughout the novel, Edna defies these rules by acknowledging her sexual desires and establishing her own identity apart from her husband, her children, or anyone else. The ideology of “the cult of true womanhood” was more prevalent in the late nineteenth century, but the twenty-first century has adapted its own expectations, or societal roles, for women.

I particularly refer to themes of desire, sexuality, sensuality, dependency, and confinement in “Cult.” Co-dependent relationships are a large theme of this piece as my “character” wonders to herself why someone hasn’t answered her yet. Is the person ignoring her? Are they too busy to answer? Why have they taken so long to answer? The dependency of social media has encouraged her codependent relationships. Edna awakens to a number of things as the novel progresses, which my “character” in “Cult” hopes to achieve. Edna awakens to the fact that she is not happy and that she finds her life unfulfilling; she awakens to grow a sense of her power and potential; she awakens to a growing sense of artistic skill and ambition; she awakens to understand that love and sex do not always go together; and she awakens to the idea that she can live her own life and have her own identity. My “character” wants to break free from “the cult of true womanhood” and understand herself as her own person without the codependent relationships she is used to through social media, but she isn’t sure she will ever be able to accomplish this.

For further information, visit [arielletesoriero.com](http://arielletesoriero.com).



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## Letter from the Founder

Greetings! Welcome to Salisbury University's very first undergraduate research journal: *Laridae*. This journal was brought to you by the Office of Undergraduate Research and Creative Activity (OURCA).

Since June 2018, we have worked hard to bring you the very first edition of this student-led journal. Supported by OURCA, our Faculty Advisory Board, professors, and staff members, we bring you a collection of student writers from a range of studies at Salisbury University. We invite you to read and view the areas of studies represented in this journal, take inspiration from them, and develop your own work, whether it be a research paper or a creative project that could someday be featured in a future edition of this journal.

"Laridae" is a Latin word that means a "gull family," and in that same spirit, this journal demonstrates the different works from Salisbury University students that reflect the academic diversity within our university. The mission of *Laridae* is to reflect the hard work that is done by our students and to provide an opportunity for students to showcase their work. As you turn the next pages, we hope that new ideas blossom in your mind, so that your work may be represented in a future edition of this journal. In the spirit of Salisbury University, I say to you: Learn, Live, Lead.

Abiodun Adeoye  
Student Founder



## Letter from the Editor

Salisbury University is an emerging presence in the arena of student-led research and creative activity. Much of the impetus behind this movement comes from the generous support of faculty and staff at Salisbury University; without their combined efforts, students would not have access to the tremendous resources offered by the Office of Undergraduate Research and Creative Activity (OURCA), the Writing Center, the Office of Graduate Studies and Research (GSR), the Nationally Competitive Fellowships Office, which enabled the creation of *Laridae*.

In this context, *Laridae* was assembled in an effort to complement and highlight the great works produced by Salisbury University's brilliant undergraduate student body. The process began when Abiodun (Abey) Adeoye conceived the idea to bring an undergraduate academic journal to Salisbury University. Early in the idea development phase, Abey partnered with OURCA and GSR. These partners came to form the bedrock on which this student-led journal has constructed a foundation.

With the help of a supportive staff, *Laridae* began to take shape in the spring of 2019. The *Laridae* team spoke to numerous classes and at several school-sponsored events to solicit submissions. By the end of the spring semester, we had received nearly 25 submissions. Throughout the long editing period, which lasted from May to September 2019, the *Laridae* team whittled the submissions down to 12 outstanding manuscripts you will read in this journal.

We are proud of our work thus far and delighted to share this diverse collection of academic works from a range of disciplines. Moreover, this first *Laridae* team is honored to serve as sculptors of history. We designed this journal to act as a vehicle for the dissemination of new knowledge and perspectives across Salisbury's campus. Now it is up to you to use it.

Under the principle of promoting diversity in thought, I dare the student body of Salisbury University to challenge conventions with probing questions and to share your findings with your peers.

Harrison Leon  
Student Editor-in-Chief  
*Sapere Aude*



# THE FANTASY POLICE FORCE: HOW *BROOKLYN NINE-NINE* TAKES THE STIGMA OUT OF SEXUAL ORIENTATION

Melissa Reese

## ABSTRACT

*Brooklyn Nine-Nine* is a situation comedy created by Dan Goor and Michael Schur that currently airs on NBC on Thursday nights. This program is a considerable departure from other sitcoms in the fact that not only does the series have LGBTQ characters in its main ensemble cast, but it also never uses one's sexual orientation as the source of the jokes, but instead mocks society's deeply ingrained homophobia and internalized heteronormativity. In the program, Captain Raymond Holt comes out as gay, and Detective Rosa Diaz comes out as bisexual, with the squad of the Nine-Nine universally accepting them for who they are. Captain Holt tells Rosa how brave she is for coming out and openly speaking her truth. Ultimately, this paper will argue how *Brooklyn Nine-Nine* naturalizes all sexual orientations and seeks to increase understanding with members of its audience who may not have been sympathetic to LGBTQ members in the past.

## INTRODUCTION

*Brooklyn Nine-Nine* is a television crime comedy series created by Michael Schur and Dan Goor. The series was canceled by Fox after its fifth season, but when the fans of the series and celebrities expressed their discontent with the cancelation, it was picked up for a sixth season by NBC and even extended beyond its scheduled 13-episode run to 18 episodes. *Brooklyn Nine-Nine* follows the fictional detectives of the 99th precinct of the NYPD as they hilariously solve cases. This fictionalized version of the NYPD has an ethnically and sexually diverse team of crime solvers. The program has been praised for having a black police captain who identifies as gay and a Latina detective who identifies as bisexual. The series operates as a fantasy police program in which the police force is self-aware, accepting of all people, is comprised entirely of feminists, and is ethnically and sexually diverse. *Brooklyn Nine-Nine* normalizes people of all sexual orientations and repudiates homophobia

and biphobia by making homophobia and biphobia the target of the jokes rather than homosexuality and bisexuality, which is a considerable departure from other sitcoms.

This program exemplifies the necessity of accepting minorities and people of all sexual orientations through its characters. The 99th precinct is led by Captain Raymond Holt, played by Andre Braugher. His character begins the series as straight-laced and unemotional, but as he begins to open up to his squad, his character becomes more complex. This complexity is revealed to Jake Peralta when Captain Holt tells him he is gay. Holt had to harden himself to all the discrimination that he had to face as an openly gay black detective in the 1970s, which is why he often appears unemotional. Captain Holt's husband, Kevin Cozner, is played by Marc Evan Jackson, who appears just as unemotional and intellectual as Holt. Kevin is an English professor who only has a guest role on the program, but Captain Holt often talks about their relationship when Cozner is not present.

Jake Peralta, played by Andy Samberg, is a jokester who loves solving puzzles but dislikes the more menial aspects of his occupation, such as the tedious paperwork. He wishes his job were more like the plot of *Die Hard*. He likes to imagine himself as an action hero who single-handedly saves the day. He thinks of his squad as his family and Captain Holt as his father because his biological father abandoned him and his mother. Jake is in love with Amy Santiago, but he has a hard time admitting his love for her in the first two seasons. Amy Santiago, played by Melissa Fumero, is a brilliant, talented Latina detective who is just as competitive as Jake. The two of them frequently make bets, and they begin the series with a competition to make the most arrests for the year.

Sergeant Terry Jeffords is played by Terry Crews. Terry is an effeminate and loving father figure, but he is still an effective member of the police force

and the most muscular and health-and-fitness-obsessed member of the team. Through the series' portrayal of a strong, yet sensitive black man, viewers get to see a positive portrayal of masculinity and ethnicity. Much of media actively bestializes and hyper-sexualizes black men, so it is refreshing to see Crews' character eschew these stereotypes.

Michael Hitchcock and Norm Scully, played by Dirk Blocker and Joel McKinnon Miller, respectively, serve as comic relief as the two laziest, most ineffectual members of the police force. The joke of the series is that they are good detectives, but they are too lazy to do their job in their old age, so they pretend to be incompetent to avoid doing any work. The two of them have built up a reputation for being the lovable buffoons of the squad.

Stephanie Beatriz plays the uber tough Rosa Diaz. Rosa is just as unemotional and deadpan as Captain Holt, but she has a more difficult time opening up to people about her personal life because she is such a private person. Once she begins dating women, she finally comes out to the squad and to her parents about her bisexuality and how she has known this about herself for a very long time. She realized this about herself in the seventh grade after recognizing that she had a crush on both Zack Morris and Lisa Turtle on *Saved by the Bell*. The Nine-Nine acts as her surrogate family when her parents, especially her mother, struggle to accept her sexuality. Her experience differs from Captain Holt's coming out experience because times have changed, and her co-workers are more accepting, but she still struggles with insensitive comments from her family.

*Brooklyn Nine-Nine* is an extremely popular series with a dedicated fanbase. After making the move to NBC, it debuted with 3.56 million viewers (Mitovich, 2019). This is significant because the series was still able to maintain a large viewership in its sixth season. This demonstrates that the program still felt fresh and interesting to its audience and did not recycle similar plotlines as many other

sitcoms do. The series has won and been nominated for numerous awards. In 2014, after the premiere of the first season, it won a Golden Globe for Best Television Series – Comedy or Musical, and actor Andy Samberg also won a Golden Globe for Best Performance by an Actor in a Television Series – Comedy or Musical (IMDb, 2019). Actor Andre Braugher was nominated for a Primetime Emmy Award for Outstanding Supporting Actor in 2014, 2015, and 2016 (IMDb, 2019). Braugher was the recipient of a Critics' Choice Award for Best Supporting Actor in a Comedy Series in 2014 and 2016 (IMDb, 2019). Due to its strong and positive portrayal of the LGBTQ community, the series has been nominated for the GLAAD Media Award for Outstanding Comedy Series every consecutive year, beginning in 2014, and the program finally won the award in 2018 (IMDb, 2019). It is important to note that the program won the award in 2018 after Rosa Diaz's character came out as bisexual. In fact, Emily Murray (2018) calls the program "the most important show of the past decade" (par. 7). Murray writes, "Being effortlessly diverse and able to address current and serious issues within a half-an-hour comedy, *Brooklyn Nine-Nine* is unlike any other sitcom" (Murray, 2018, par. 49). By simply stating who these characters are without it ever feeling like a big deal or the punchline of a joke, the audience understands that these characters are real, complex people, not just sitcom archetypes of LGBTQ characters. The mistake that many series make is trying to use a character's minority status to represent all people within that group rather than focusing solely on the individual character. Heterosexual white characters are never used to represent an entire group of people; they are written as individuals. Therefore, it should follow that characters of minority status should not be used to represent an entire group of people. The writers and creators of *Brooklyn Nine-Nine* recognize that viewers will identify and connect more with a character who is an individual, not just a member of a minority group.

Actress Stephanie Beatriz came out as bisexual herself in 2016 before it was revealed in the series that her character Rosa Diaz was bisexual (Jung, 2018). This gave the storyline more credibility and authenticity since Beatriz and Diaz's identities and coming out stories were similar. Beatriz also felt the type of alienation distinct to being both bisexual and a Latina woman. She stated, "It's difficult because so much of the Latin-American community connects so deeply with their religious roots ... And for many immigrants in this country, the church can be a cornerstone of feeling like you

belong here" (Jung, 2018, par. 10). Her parents are deeply religious and have had a difficult time coming to terms with her sexuality because of their spiritual values and the way the church has actively shunned the LGBTQ community. Her story is very similar to the journey of her character Rosa throughout the fifth season. It was important to her that the program's dialogue stressed and repeated the word "bisexual" because many series are afraid to label characters and say the word out loud for fear of retribution from the dominant ideology that it is unnatural and deviant to identify as anything other than heterosexual.

Beatriz said she found comfort in art museums when she was growing up because that was the only safe space for her to admire the beauty of the female body. Unfortunately, she also felt guilty for admiring the artwork in a sexual way because she had internalized the dominant ideology of heteronormativity (Jung, 2018). She said her bisexual awakening occurred in art museums because she did not see any bisexual characters portrayed on television, accurately or otherwise. *Brooklyn Nine-Nine* breaks away from social mores of heteronormativity and internalized homophobia and biphobia. These characters break away from their status as "The Other" and are accepted and loved for who they truly are by their squad members. By having a positive and honest representation of the LGBTQ community, members of the audience who may not have been sympathetic to LGBTQ members in the past can still identify with the characters and come to understand and sympathize with them because of the program's strong writing. Perhaps, the viewers' perception of members of the LGBTQ community will even change through the viewing of the program. As for people who do identify as members of the LGBTQ community, they will derive pleasure from seeing themselves represented positively and honestly. They will also derive pleasure from their understanding of who they are and the fact that they have a place in society. The fact that these characters are not defined by their sexualities is what gives the program the massive impact that it has on audiences since it is such a huge departure from the dominant ideology.

## METHODOLOGY

In order to complete this study, episodes were viewed from the DVD collections. These episodes had strong themes of positive representations of homosexuality and bisexuality and negative representations of homophobia and biphobia. Three episodes that depicted these themes were selected for critical analysis: the "Pilot" episode, the

16th episode of the first season titled "The Party," and the 10th episode of fifth season titled "Game Night" (Goor & Schur, 2013; Liedman & Ozeri, 2014; Hallam & Noble, 2017). A close reading was performed on each episode and detailed notes about the social coding of homosexuality and bisexuality present in these episodes were taken. The following discussion critically examines how *Brooklyn Nine-Nine* naturalizes homosexuality and bisexuality through honest representation and how it mocks homophobia and biphobia in both a playful and an educational way with description and analysis of the examples that were collected.

## RESULTS

The first episode to be discussed is the episode titled "Pilot" that started off the series. This episode follows Jake's contentious relationship with his new captain. Captain Holt is stricter and more by-the-book than Jake's previous captain, Captain McGintley. Jake got along well with his previous commanding officer because he had a similarly laid-back attitude and allowed him to goof off and play pranks at work. The previous captain was mostly oblivious to what was happening within the precinct, and he even looked the other way and ignored Jake and Rosa's fire-extinguisher roller chair derby. Jake's initial perception of Captain Holt is less than favorable. Jake perceives him as robotic and even performs robotic voice impressions of the new captain. Jake does not understand why Holt insists so strongly on him wearing a tie to work or why he receives desk duty in the filing office after making a mistake that led to a criminal fleeing the scene. Jake has the egotistical, carefree attitude of a total goofball, and Captain Holt is a tough leader who rarely conveys any emotion. His expression is often blank, and he speaks in a low, monotone register.

The audience is positioned to side with Jake in the beginning because, before Holt comes out to Jake, he just seems like a tough, unfriendly boss. In the final act of the episode, during their stakeout in the car, Jake asks Holt why it took him so long to have his own command unit when he was such a decorated detective and had solved high-profile cases. Holt tells him in his iconic deadpan voice that it is because he is gay. Jake is confused, and the audience is positioned to feel confused as well because Holt's character does not fit in with the stereotypical portrayal of a gay man on a television sitcom. Usually, gay men in sitcoms are effeminate, overtly emotional, obsessed with fashion, and have high-pitched, nasally voices. Holt's character eschews the dominant representation of how a gay man ought to behave. Holt is intensely focused on

his work, expresses little to no emotion, and has a strong, masculine, authoritative energy that commands respect and intimidates members of his squad. Holt is surprised when Jake tells him that he did not know that he was gay because even though he did not state it directly, Holt did not try to hide his sexuality either. Jake realizes that he is a bad detective for not noticing the signs that Holt is gay. Jake remembers how Holt made a comment about him doing too much “manscaping” when Jake showed him the tie that he had wrapped around his chest in defiance of the dress code, how Gina said she got a “gay vibe” from him, and how there was a framed article on the wall about the NYPD’s first openly gay captain. Jake feels stupid and ignorant for not noticing these details before. This scene highlights the ever powerful and potent consequences of heteronormativity in society. The dominant ideology of society dictates that people should be assumed to be straight unless directly stated otherwise. The scene challenges the viewer to recognize and confront their own blind-spots and ignorance and makes the viewer wonder why gay people have to come out in such a direct way while straight people do not. This episode demonstrates to the viewer how assuming someone is straight, unless they specifically state that they are not, is a form of internalized homophobia and heteronormativity. Rather than poking fun at Holt’s sexuality as many other sitcoms would have, the joke of the episode is what a poor detective Jake is (even though he thinks of himself as the best detective of the Nine-Nine). The theme of satirizing how stupid and ridiculous internalized homophobia and heteronormativity are runs throughout the course of the series.

At the end of the episode, while they are on their mission, Jake has an epiphany, and he realizes that the reason that Holt was so concerned with him wearing a tie was because it was part of a uniform. Wearing a uniform is extremely important to Holt because it has the symbolic connotation of them being part of a team. When Holt began his career in the 1970s, he was often excluded from that team, but now he is the captain of the team. When Jake realizes the symbolic meaning behind his character’s costume, it brings him and Holt closer together. This episode marks the beginning of Holt and Jake’s relationship as they come together to form a team. They are only able to form this team once Jake is aware of Holt’s identity because honesty is a core component of any true relationship. As the series develops, Holt becomes a father figure to Jake to replace his absentee biological father. As Jake’s relationship with Holt deepens, they gain a better understanding of one another through their honest

conversations about what Holt had to go through because of his sexual orientation.

In the season one episode titled “The Party,” the Nine-Nine is invited to Captain Holt’s birthday party (Liedman & Ozeri, 2014). Jake is under the impression that Captain Holt does not want the Nine-Nine there because they received the email invitation last-minute, and Holt said that his husband Kevin invited them to the party, not him. Jake thinks that Kevin is the one who wants them there, not Holt. Jake believes that Holt thinks he will embarrass himself in front of Kevin, and Jake makes it his mission to win Kevin’s approval and his friendship. Jake initially plans on using gruesome crime stories because he is used to using these types of stories to excite civilians. Jake is disappointed when Kevin informs him that his house has a no “cop-talk” policy. Jake struggles to connect with Kevin because he is much more of an intellectual scholar than he is. Kevin is a professor of classical literature at Columbia University, and Jake has trouble relating to him. Unlike in many other series or indeed in real life, Holt and Kevin are seen as the life of the party while Jake and the rest of the squad are seen as outsiders.

Jake has a difficult time coming to terms with being the unpopular person at the party. This is a massive shift from most series where Holt and Kevin would have been alienated and condemned for their sexuality. This is also an enormous shift from negative attitudes toward interracial couples since Holt is a black man who is married to a white man. In this episode, their sexualities and ethnicities are not an issue amongst their academic friends. Their friends are more interested in discussing subjects of academia than discussing their sexuality, because their friends have known them a long time and their sexuality is no longer a pertinent issue. However, this was not always the case. Jake sees an old picture of Holt and Kevin standing off to the side of the room while Holt’s colleagues were all grouped together. Jake comes to the realization that Kevin does not dislike him and the Nine-Nine because of their personalities. He dislikes police in general because of the way that they have actively ostracized and excluded his husband. Therefore, Jake is bothered by three things at the party: Kevin seemed to dislike the Nine-Nine before ever having met them, Hitchcock and Scully were mistaken for a gay couple who knew first-hand about the kind of discrimination Holt faced, and there was a picture of Holt and Kevin being shunned by Holt’s police colleagues.

The audience is positioned to sympathize with Kevin for wanting to protect himself and his husband and insulate his home and office from the same

kind of discrimination and ignorance that Holt faced at work. Kevin makes the effort to make both his home and his office at Columbia University a safe space where police procedures cannot be discussed in any capacity. Jake feels sorry that Kevin feels so vulnerable to discrimination and for being so obstinate in his goal of protecting both himself and his husband.

Continuing the exploration of identity in the season five episode titled “Game Night,” Rosa Diaz comes out to both her co-workers and her parents as bisexual. Rosa is an extremely private person, so she has difficulty talking about her personal life in any capacity to her co-workers. She simply states that she is bisexual at a briefing meeting and says that she will field exactly one minute of questions pertaining to the topic of her sexuality. Amy asks her when she knew, and Rosa replies that she knew when she was in seventh grade watching *Saved by the Bell* and felt attracted to both Zack Morris and Lisa Turtle. The episode does not miss a beat. Instead of making fun of Rosa for being attracted to both male and female characters, Jake half-jokingly is more concerned about which male and female characters are most attractive when he says, “The fact that the words Kelly and Kapowski didn’t just come out of your mouth is lunacy” (Hallam & Noble, 2017). Terry wonders aloud why Rosa is just telling the squad now, and Rosa informs him that she knew Charles would not be able to keep it a secret after he found out on the road trip. By having Rosa tell the squad rather than Charles, the writers of the series give Rosa agency and power in her own life. Rosa was able to tell the squad that she was bisexual on her own terms and in her own words. Charles respected her wishes, so he did not publicly out her even though he is bad at keeping secrets. Hitchcock raises his hand and tries to ask her a question, and Rosa simply shuts him down and says a hard “no” because she knows he will say something insensitive. Holt is impressed by how much better Rosa’s coming out went than his own coming out. He is also impressed by how easily the team accepts her sexuality and how much times have changed.

Later, in the evidence lockup room, Rosa worries that she got too personal and emotional with the squad even though she told them in such a matter-of-fact way. Jake assures her that even though she told them something personal about herself, they are all still scared of her. This is oddly comforting to Rosa and is consistent with her character. Rosa asks for Jake’s help coming out to her parents because she feels that she does not know the right words to say and because her father is very traditional. Jake agrees to tag along to a family dinner with Rosa and her parents.

Her parents assume that she is dating Jake, which is another example of the program illustrating heteronormativity and how damaging it is. Jake's phone rings, and Rosa's father sees a picture of him with his fiancée, Amy, wearing her engagement ring. Her parents are strangely accepting of the idea of Rosa being Jake's mistress. Rosa does not understand how they could possibly be accepting of that, and her father tells her that he was worried that she was going to tell him that she was gay because of how nervous she sounded on the phone earlier. Rosa is understandably horrified that they would rather she be someone's mistress than in a loving relationship with a woman. She tells them that their worst fears are true and that she is not straight; she is bisexual.

Rosa decides to give her family another chance at their family game night. Nevertheless, when she gets there, she realizes that her mother's homophobia runs even deeper than her father's. Her mother tells her that it does not matter what Rosa calls herself because she can still get married to a man and have children. Rosa replies that she can still do those things with a woman, but her mother simply dismisses her and tells her that it is going to be a man. They start playing Pictionary, and Rosa gets a card saying "Wedding." Rosa takes a swig of alcohol and decides to draw a picture of two women getting married. When her mother sees her drawing a picture of two women, she cannot possibly comprehend that they are a couple. Rosa furiously draws several hearts and a wedding ring, and her mother still does not get it. She guesses that they must be sisters or even co-owners of a chocolate shop. Rosa's mother's deeply engrained sense of homophobia makes her unable to even imagine that two women could possibly be in a relationship and getting married.

Rosa tells her mother that she might get married to a man like she clearly wants, but she might not. Rosa makes a point of declaring that she is bisexual, and her father angrily replies that there is no such thing as being bisexual. Rosa tells him that she knows that there is because that is who she is. Her father asks her what she wants them to say, and she replies simply that she wants them to say that they accept her for who she is. Her parents remain silent and are still shaking their heads, unable to comprehend what she is saying. This episode is brutally honest about how painful and damaging it can be for children when their parents do not accept their identity. The hopeful part of the episode comes in the final scene where Jake and the rest of the squad bring a load of board games for them to play together as a family. Jake tells her that they will have

a game night together every single week. This gives Rosa some comfort because at least she is accepted by one of her families.

The episode ends with the moral lesson that one's friends can become their chosen family. Rosa feels immensely comforted by Captain Holt's words of wisdom that "Every time someone steps up and says who they are, the world becomes a better, more interesting place. So, thank you" (Hallam & Noble, 2017). This episode focuses more on the journey of coming out and coming to terms with one's own sexuality than any other episode of *Brooklyn Nine-Nine*. LGBTQ issues are explored in a direct way in this episode. The episode's storyline differs from Captain Holt's journey, which is a more subdued storyline, because he came out several years ago. With Rosa, the journey is much more relevant and ongoing. By having a younger character, particularly a Latina character, come out, the series reaches an even broader audience. Even though Rosa is a tough, emotionally reserved character just like Holt, her journey is still more relatable than Holt's because her struggle with coming out is more fully developed by having such brutal, intense moments with her parents who do not accept her identity.

## CONCLUSION

*Brooklyn Nine-Nine* has a profound positive potential to impact its viewers and to possibly change the way in which people think of the social issue of homophobia. Viewers are encouraged to confront their own preconceived ideas of heteronormativity through the viewing of this program. The average viewer of this program can become emotionally attached to both Captain Holt and Rosa's journeys of coming to terms with their own sexualities and coming out to their friends, family, and co-workers. Viewers could be comforted by how accepting the squad of the Nine-Nine is and saddened by those who do not accept these characters' true identities, such as Captain Holt's former police colleagues and Rosa's traditional parents. The viewer is positioned to think of sexual orientations other than heterosexuality as completely natural.

*Brooklyn Nine-Nine* is representative of a trend of television and film characters' sexualities being perceived as natural since it first began airing in 2013, particularly bisexuality. In the CW television series *The 100*, which began airing in 2014, Clarke Griffin's character is revealed to be bisexual. Annalise Keating's character in *How to Get Away with Murder*, which began airing in 2014, is bisexual. Additionally, Magnus Bane's character in *Shadowhunters* and Eretria's character in *The Shannara Chronicles* are bisexual. In *Supergirl*, which

began airing in 2015, Alex Danvers comes out as a lesbian in the second season. In *Orphan Black*, which began airing in 2013, Cosima Niehaus and Delphine Cormier have a passionate and complex relationship that is not defined by gender. In fact, when Rachel Duncan says, "So, you're gay" after she sees the two of them kissing, Cosima replies, "My sexuality is not the most interesting thing about me" (Levine, 2014). In the 2017 Marvel film, *Thor: Ragnarok*, Tessa Thompson's character Valkyrie is bisexual. By normalizing the sexual orientation of these pop culture icons in mainstream media, societal perceptions of sexual orientation and gender may have shifted. Through the promotion of greater inclusivity in film and television as well as society at large, cultural attitudes are beginning to shift, and people are beginning to no longer see people of minority status as "the other." Though progress is slow, these programs are paving the way toward a more understanding future in media. Through the viewing of these programs, the audience is encouraged to perceive the characters as complex individuals whose sexual orientations are a part of their identities, not the grand summation of who they are as people.

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# TURNING THE PAGE ON A NEW LEARNING STYLE: THE EDUCATIONAL ASPECTS OF GRAPHIC NOVELS

*Anna Burns*

## **ABSTRACT**

According to NPD Bookscan Data, a company data provider for the book publishing marketplace, graphic novels have become one of the highest growth categories. In 2017, the graphic novels category experienced a sales growth of 15% (Comics and Graphic Novels, 2017). Commercially, graphic novels are becoming increasingly popular; however, there is still a lack of their presence in various schools ranging from K-12th grade (Clark, 2013). As graphic novels have differing benefits for differing ages, this paper focuses primarily on the studies of graphic novels for children in K-8th grade. There is a common stigma that graphic novels are inferior to traditional prose (Lopes, 2006). This negative judgment about graphic novels hinders the potential educational benefits that could be offered to students. This paper argues that graphic novels have the power to motivate students to read, enhance visual literacy, and improve overall reading comprehension strategies. Graphic novels have educational power and, if graphic novels are continuously labeled as “junk reading,” then that power cannot be used in schools to teach students valuable skills.

## **LITERATURE AND EDUCATION**

A graphic novel is a:

*“format of text written and illustrated in the style of a comic book. To be considered a graphic novel, rather than a picture book, a story is told using a combination of words and pictures in a sequence across the page. The specific format is what makes the story a graphic novel, and usually includes text, images, word balloons, sound effects, and panels” (A Guide to Using Graphic Novels with Children and Teens, 2019).*

Rather than a comic book, which is multiple short illustrated stories compiled into one book, a graphic novel is one larger illustrated story, making it a graphic novel. Graphic novels can be fiction or nonfiction, from multiple genres, and can also be intended for different age groups.

Although graphic novels have somewhat of a presence already in libraries and daily lesson plans, they need to be expanded to the Common Core

school curriculum so all students can benefit from their educational aspects. The difference between a lesson *plan* and a *curriculum* is a lesson plan is the temporary, individual teaching of a subject planned out by a teacher; the Common Core Curriculum, however, is planned by communities, the state, and educators, and lasts for a longer period.

Regarding the Common Core in the curriculum, the English Language Arts Framework standards highlight communication processes of writing, reading, speaking, listening, and viewing (Department of Curriculum and Instruction, 2010). All of these communication processes are taught in dynamic relation with one another.

Diamond Book Distributors published a list of Common Core-encouraged graphic novels for students of certain grades. The list extends from Pre-K to 10th grade and above (The Diamond Graphic Novel Common Core List, 2019). Graphic novels start at the beginner level for younger students with texts such as *Johnny Boo Zooms to the Moon* (Kochalka, 2014), *Super Dinosaur* (Kirkman, 2011), and *The Last Unicorn* (Beagle, 2010). As students master the introductory levels, graphic novels become more advanced in order to challenge their reading with texts like *March*, *Pride and Prejudice*, and *Persepolis* (diamondcomics.com). Graphic novels are similar to traditional novels because they have a beginning, middle, and end to the overall story. Unlike comics, the graphic novel’s text is both visual and written (National Council of Teachers of English, 2007). Although the usage of graphic novels indicates multiple similar learning effects compared to regular text novels, there is still a stigma associated with the illustrated format. Research indicates that graphic novels have the potential to address and achieve numerous skills for students and therefore qualify as an effective format of text to be implemented in the Common Core curriculum. This present stigma may be a major reason why the format is not being fully implemented in school curricula.

## **STIGMA**

The graphic novel format has faced challenges due to its stigma and has not yet been fully accepted by educators. Even in studies that demonstrated the positive aspects of graphic novels, teachers were still hesitant to use them for their teaching plans, primarily because of the stigma and the fear that their professional credibility was at stake. A study conducted by Spencer Clark (2013) had pre-service teachers evaluate various graphic novels for the purpose of seeing if the negative bias against graphic novels would affect the teacher’s responses. Clark (2013) discovered that a majority of the pre-service teachers gave positive reviews of the graphic novels they read, saying that graphic novels have the potential to engage students in historical agency, historical inquiry, multiple perspectives, and overall reader engagement. When asked if the teachers would consider using graphic novels in their future classrooms, the teachers said they wanted to, but they were worried about their professional acceptance being damaged in the process due to the bad reputation of graphic novels. (Clark, 2013). The teacher’s hesitations to implement graphic novels into their future classroom were likely due to the negative stigma of how graphic novels are commonly compared or mistaken for comic books. Comic books are often read for pleasure and are usually not commended for being literary or educational. Graphic novels are not comic books, however, and this study emphasizes how powerful the stigma is about graphic novels in the educational community. The stigma is unproductive to the potential strengths that graphic novels could have in schools if placed in the curriculum.

## **MOTIVATION**

A study conducted by Eileen Richardson (2017) focused on comparing graphic novels to traditional novels and which text students were better able to comprehend. In her research, Richardson discussed that graphic novels address many aspects of education, including tone, narrative structure, and character development. Difficult vocabulary is addressed within

graphic novels as illustrations help provide contextual clues to assist readers with more difficult words. The key aspect that Richardson focused on, however, is the motivation to read and learn. Motivation is crucial because if a student is not motivated to read then their reading skills cannot be improved. Overall enjoyment of reading guides students to explore more genres and multiple formats of texts (Richardson, 2017).

In Richardson's study, there were 20 students from 5th grade and 20 students from 6th grade. Half were given a copy of the traditional text version of *Coraline* and the other half were given the graphic novel version. After the groups read their assigned book, they filled out a 15-question review of *Coraline* that also included questions on if the students enjoyed their assigned book, graphic, or text (Richardson, 2017). The results showed that there was no difference in comprehension scores between those students who read the graphic novel and those students who read the traditional text. Richardson (2017) found that students who received the type of book they wanted, graphic or traditional text, scored better on the review questions than the students who did not receive their preferred novel format. These results place graphic novels and traditional texts on the same level and also emphasize the importance of choice and motivation to read.

## **VISUAL LITERACY**

We now live in a digital age in which technology and many forms of media surround us. From movies to the internet, students are highly exposed to digital literacy practices that isolate them from the text-heavy practices in school curricula. Werner-Burke et al. (2012) found that graphic novels could be a great solution, as they offer a valuable new medium for literacy that acknowledges the interest of visuals to students. Werner-Burke et al. (2012) elaborates that with graphic novels students have to make meaning from visuals, text, and specific format cues, thus enforcing rigorous cognitive demands on readers. Graphic novels boost the interest of reading for students and also provide a new literacy that is crucial in today's digital age.

Visual literacy is defined by Michael Pagliaro (2014) as "... all of the skills and knowledge needed to decode images and ... understand the contents of the image" (p.34). Visual literacy is required by the National Council of Teachers of English (Pagliaro, 2014). Visual literacy research has shown that graphic novels allow students to acquire many visual literacy skills. Visual literacy is strengthened for

readers because with graphic novels, readers make meaning from texts instead of classic texts imposing their meaning on readers. There is an effective combination of visual and textual information, causing the student to not only learn, but also to become confident and motivated to learn (Pagliaro, 2014). Pagliaro's research demonstrates that graphic novels possess many visual literacy skills that could greatly benefit readers by helping adjust to the digital age and by strengthening overall visual literacy.

## **RESISTANCE**

In reviewing preliminary research, there was a common counterclaim that if students rely solely on graphic novel illustrations then it will diminish their own visualizing skills when reading regular texts (Brenna, 2012; Dresang et al, 2006). Beverley Brenna (2012) addressed this stereotype of graphic novels by stating that if graphic novels were to limit visualization, then that would likely increase concerns from the public, specifically on the notion that children who regularly visualize when reading might be compelled to reject graphic novels. Brenna (2012) explains, however, that this notion is not true because, in her research on reading comprehension, "there did not appear to be a link between visualizing during reading and preferences for graphic novels" (p. 5). With graphic novels, visualization skills would likely be strengthened by a graphic novel because one has to make inferences from each illustration panel to the next. There are numerous art forms and comprehension strategies that go into a graphic novel and as students learn each one from reading, their visual literacy is improved, and these skills can be transferred to regular texts.

## **READING COMPREHENSION STRATEGIES**

To demonstrate if graphic novels had a positive effect on the development of reading comprehension strategies and reading for pleasure, researcher Beverley Brenna (2012) conducted a study over a five-week period with 10 one-hour sessions in a grade four classroom with 21 students. Various animal fantasy graphic novels were given to students depending on their reading level. For example, groups of students who had a high reading level received *The Tale of Despereaux* and students who had more of a moderate reading level received *Babymouse*. To explore the comprehension strategies taking place, there were classroom observations, small group activities, discussions, and questionnaires. The results of this study indicated that students felt connected with reading graphic novels and were

very engaged in continuing to read them. Several noted strategies came from student discussions when they would summarize plot and character details, pause to predict future events in the story, and make inferences based on given information from the text and illustrations. All of these listed skills suggested improvement in student reading strategies (2012). Other improvements increased were synthesizing skills, oral reading, and exploring depictions of time. Students also gained an understanding of key format examples in graphic novels like close up, panorama, distance, long shots, and speech bubbles. Another observation to note is when students rated which format of book they would rather read, the graphic novel came first but was followed by the traditional text and not by comics or cartoons (Brenna, 2012). This indicates that graphic novels and traditional texts should be considered on the same level. Graphic novels should not be perceived as a stepping stone to reach traditional text.

## **BABYMOUSE PRIMARY RESEARCH**

Primary research will discuss how the graphic novel *Babymouse* (Holm & Holm, 2008) demonstrates simplistic, yet effective, literary strengths for young readers. *Babymouse* is intended for children aged seven and up and is a very popular graphic novel that has won multiple Children's Choice Awards with over 1.7 million books sold (Babymouse Series, n.d.). *Babymouse* also promotes visual literacy and the teaching of graphic novel format. In more adult graphic novels, the format can be complex, especially if one does not have strong visual literacy, so *Babymouse* helps build that visual literacy along with other graphic novel components. On the page taken from *Babymouse: Queen of the World* (See Appendix A), one can see that the order of the panels is intended to guide the reader. In this case, it is left to right, much like regular prose. In graphic novels, the authors can alter font and speech bubbles for mood or tone. An example of this is when Babymouse's friend says "Attack of the Giant Squid," as it is in bold. The use of bold-face type is interpreted as emphasizing the phrase "Attack of the Giant Squid" and giving it more importance than other words in that panel. Another example is the word "Ring" placed in a speech bubble of exclamation with spikes on the outside, signifying that of a loud ringing bell. If it was in a normal bubble, it would signify the bell saying the word "ring." Additionally, when Babymouse is frightened, her speech bubble has curvy droopy ends, which implies shaking and suspense. Along with these examples are labels; there is a speech bubble with an

arrow at the end of it pointing to the fog that has appeared which can broaden vocabulary.

Also, the graphic novel includes both onomatopoeias, when the giant squid turns off the light there is a click and the cause and effect in panels that encourages children to make inferences. When the squid turns the light off, the next panel is pitch black. This gives a major clue to the reader that the squid turning off the switch caused the lights to turn off. Plus, the tentacle shown gives a hint to the reader that a squid is present in this scene with Babymouse, so that causes predictions to be made about the events to come (Holm & Holm, 2008, p. 22). This is just one page of a children's graphic novel and there are numerous reading comprehension strategies present that are commonly found in regular text that strengthen a child's reading. The only difference is that it is in graphic novel format.

### IMPLEMENTING GRAPHIC NOVELS INTO THE CURRICULUM

In the past, there have been several efforts to effectively implement graphic novels into the Common Core curriculum (The Diamond Graphic Novel Common Core List, 2019). In 2006, the Maryland State Department of Education teamed up with Diamond Comic Distributors and created a program called Maryland Comics in the classroom (Karp, 2013). Several sources of research discuss this program with praise (Karp, 2013), but upon close examination, it was not a fully successful program. This program primarily sought to find out whether comic books can serve a useful instructional function in the classroom and how they would be perceived by teachers and students. Results from the program showed that students were very motivated to read the comic books (Sonneschein et al., 2006.) Some implications with the program, however, were that the comic books chosen were made by Disney 40- to 50-years prior. In addition, the researchers did not conduct a true experiment or compare pre-program and post-program levels of motivation, which makes it difficult to compare results (Sonneschein et al., 2006.) Although this program had good intentions, it was not effective with beginning the process of implementing more graphic novels into the classroom.

The first step for effectively implementing graphic novels into the school curriculum would be debunking the negative stigma about graphic novels. This is difficult to do since much of society has grown up with the understanding that books without pictures are superior to books with pictures. Ending the stigma can happen by exposing ourselves to more graphic novels and reading more



adaptations of regular texts as graphic novels. There are resources available for both the educational community and eager readers for how to understand the format of the graphic novel. Just like traditional text novels, there are graphic novels that are not well written or are inappropriate for certain ages, but there are also rubrics that help one identify which graphic novel is best for an individual.

### CONCLUSIONS

Although there is not much educational research on graphic novels, graphic novels show true promise within the educational community. There are many more aspects that graphic novels can address beyond reading comprehension strategies. These aspects include educating students with autism, helping ESL students learn English (Pagliaro, 2014), teaching human rights and sensitive topics that are often difficult to teach in a classroom

setting (Carano & Clabough, 2016), and strengthening writing and creativity skills by having students make their own comic panels with various online programs (Werner-Burke et al., 2012). Graphic novels have so much potential to further improve students' education whether with reading comprehension strategies, visual literacy, a newly formed motivation, or love for reading. Graphic novels should not only be commercially popular, but also educationally encouraged. The classic picture of a student holding a textbook with a comic book hidden inside can soon become a student reading a graphic novel that is a mixture of the two – both educational and entertaining.

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# RIGHTING A HISTORICAL ABSENCE: THE BENEFITS OF LGBTQ+ INCLUSIVE HISTORY IN K-12 SCHOOLS FOR YOUTH

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## ABSTRACT

Education is a fundamental tool in shaping the reality of society. A lack of education leads to a loss of heritage and of a noticeable presence across history. A common rhetoric within 21st century American society is that homosexual, transgender, and non-binary identities are primarily contemporary concepts. There is innumerable evidence across history that shows this to be false. One of the results of this ignorance is that children and young adults within the lesbian, gay, bisexual, transgender, and queer (LGBTQ+) community often fall victim to homophobic discrimination and violence. Studies have shown that LGBTQ+ youth in K-12 schools are particularly susceptible to the traumatic effects of homophobia, which has led to an increase in critical mental health issues and suicide rates. However, further studies have shown that multicultural, LGBTQ+-inclusive curricula within K-12 schools increases tolerance and understanding among students which subsequently percolates into society and reduces the negative consequences of homophobia. This paper analyzes the current climate of K-12 schools (faced by heterosexual and LGBTQ+ youth) and highlights some of the rich, diverse history that could be included in an LGBTQ+-inclusive curriculum.

## INTRODUCTION

In 1996, the United States Court of Appeals for the Seventh Circuit heard the case of *Nabozny v. Podlesny*<sup>1</sup>. While attending school in Ashland, Wisconsin, Jamie Nabozny suffered relentless homophobic bullying from his classmates. Nabozny described incidents that included being urinated on, physically beaten to the point of hospitalization, and even a mock rape performed upon him while “20 other students looked on and laughed<sup>2</sup>.” School officials told Nabozny that “boys will be boys” and that he should expect the bullying because he was homosexual; faculty took no action to protect Nabozny from the abuse<sup>3</sup>. As

a result, Nabozny dropped out of school and successfully sued the school district for failing to provide a safe environment; the case settled in Nabozny’s favor for nearly one million dollars. His case became notorious for being the first legal challenge to anti-LGBTQ+ violence in schools and subsequently launched a flurry of LGBTQ+ youth advocacy across the nation<sup>4</sup>.

Unfortunately, in 2017, 28.9% of LGBTQ+ students reported being physically harassed for their sexual orientation; 12.4% reported being physically assaulted in schools<sup>5</sup>. Since 1999, the Gay, Lesbian, and Straight Education Network (GLSEN) has initiated a biennial School Climate Survey to comprehensively discern the environment faced by LGBTQ+ youth within K-12 schools across the United States. In the 2001 survey, approximately two-thirds of LGBTQ+ youth (68.6%) felt unsafe in their school due to their sexual orientation; a significant drop of nearly 10% (59.5%) occurred between 2001 and 2017<sup>6</sup>. However, there has been no improvement in derogatory language: Nearly all LGBTQ+ students (98.5%) have heard “gay” used in a negative way and have felt distressed by such remarks<sup>7</sup>. One study shows that LGBTQ+ youth might hear around 25 anti-LGBTQ+ remarks per day, which can even be heard in groups as young as elementary school<sup>8</sup>.

Typically, transgender students face more hostile environments than LGB youth. In the National Center for Transgender Equality’s 2015 U.S. Transgender Survey report, only 12% of nearly 28,000 transgender respondents from the United States and territories reported being out in any grade between kindergarten and 12th grade; 77% reported at least one incident or more of being verbally or physically harassed while in school. Nearly one in four transgender students were physically assaulted for being transgender, and transgender females were more likely to be attacked than transgender males. In addition, those of a multiethnic background, such

as Native American, black, and Hispanic LGBTQ+ youth, were more likely to face a negative environment<sup>9</sup>.

Harassment and violence against LGBTQ+ youth increasingly puts youth at risk for self-harm and suicidal ideation or action. Suicide is the third leading cause of death amongst youth in the United States, but is the second leading cause of death among LGBTQ+ youth<sup>10</sup>. Studies have estimated that each incident of harassment or violence against LGBTQ+ youth increases the likelihood of self-harming or suicidal ideation by nearly three times the estimate of heterosexual youth<sup>11</sup>. Ultimately, LGBTQ+ students are five times more likely to attempt suicide than heterosexual students; transgender students are more than four times more likely to attempt suicide than LGB cisgender youth<sup>12</sup>.

Unfortunately, homophobic bullying negatively affects heterosexual youth as well. In fact, students who bully are nearly just as likely as their victims to be poorly adjusted to school and may have similar rates of depression and anxiety to LGBTQ+ youth<sup>13</sup>. Repeated incidents of homophobic victimization, even indirectly, cause extreme stress in heterosexual male youth who are perceived to be, or may be perceived to be, non-masculine or non-heterosexual<sup>14</sup>. Heterosexual victims of homophobic harassment – particularly male victims – are often hyper-vigilant about conforming to societal gender expectations. The social hierarchy of school hallways often invokes a strict gender code or script that youth are expected to follow – a code that transgender students fall victim to more so than cisgender students.

## REVIEW OF THE LITERATURE

Despite the growing amount of corroborating research within the United States that proves the necessity of an LGBTQ+-inclusive education, only California, New Jersey, Illinois, and Maryland require schools to teach LGBTQ+-inclusive subjects as of September 2019. In 2005, researchers

examined more than 200,000 lines of text in high school textbooks used in California to discover that only an estimated 3% of material covered LGBTQ+ topics of any kind; roughly 80% of the textbooks only referenced negative LGBTQ+ topics, such as sexually transmitted diseases and prostitution<sup>15</sup>. In 2011, California passed the Fair, Accurate, Inclusive, and Respectful (FAIR) Education Act, which compels the inclusion of diverse LGBTQ+ representation within social studies curricula and school textbooks<sup>16</sup>. Since then, California has begun gradually updating the history and social science curricula frameworks statewide, requiring new multicultural, minority-inclusive textbooks and lesson plans. In 2019, Illinois, Maryland, and New Jersey began to make changes to the history curricula to reflect LGBTQ+-inclusivity, though New Jersey will only require the curriculum to be taught in middle and high schools<sup>17</sup>.

Despite the progress made in these four states, many other states have “no promo homo” laws – laws against promoting or teaching homosexuality in a positive way<sup>18</sup>. In fact, 20 states – where more than 25,000,000 children attend schools – currently have laws that contribute to anti-LGBTQ+ curricula; in some cases, teachers are required to teach anti-LGBTQ+ curricula, while other states allow teachers to choose between anti-LGBTQ+ curricula or no LGBTQ+-inclusive curricula at all<sup>19</sup>. In addition, some states also have “promo hetero” laws that require teachers to advocate the supposed benefits of heterosexual marriage or define marriage by a heteronormative standard that specifically excludes same-sex unions<sup>20</sup>. While no state in the United States has a specific anti-LGBTQ+ curricula law, Arizona law does prohibit the promotion of homosexuality as a “positive alternative life-style<sup>21</sup>.”

The precarious educational environment is often made worse by the unreliability of faculty intervention and the discomfort some teachers may have with discussing LGBTQ+ topics. Approximately 56.6% of LGBTQ+ students report hearing homophobic remarks from their teachers and 71% report hearing transphobic or negative remarks about gender expression from teachers and faculty<sup>22</sup>. In addition, heterosexual teachers often report that they feel uncomfortable intervening because of their lack of knowledge about LGBTQ+ issues or own negative opinions<sup>23</sup>. Some criticisms of LGBTQ+-inclusive curricula focus on the sexual aspect of homosexuality and its inappropriateness for children of young ages; it is seemingly irrelevant that most history curricula teach about

heterosexuality without talking about sex<sup>24</sup>. As an overwhelming result, few students report feeling as though they have a safe space or support system within their school to speak about their gender expression or sexual orientation.

LGBTQ+ youth of color can face unique challenges from racism, homophobia, transphobia, and sometimes all of the above. Therefore, the additional inclusion of culturally diverse LGBTQ+ knowledge is beneficial to racial relations and safety in schools<sup>25</sup>. Chicana and Chicano individuals often report feeling a stressful disengagement between their Latin and LGBTQ+ identities; inclusion of Latin LGBTQ+ diversity within lessons assists in bridging the gap between multiple identities<sup>26</sup>. Native American LGBTQ+ individuals often struggle with the different cultural values of their multiple identities. Though “coming out” and identity celebration is a large part of belonging to the LGBTQ+ community, Native American cultures often reject individualization and emphasize group solidarity<sup>27</sup>.

Ultimately, research has overwhelmingly proven that the presence of LGBTQ+-inclusive curricula results in nearly 73% of LGBTQ+ students feeling safer in schools due to a reduction in anti-LGBTQ+ harassment<sup>28</sup>. By learning about typically absent LGBTQ+ history and people, the feeling of otherness or abnormality of LGBTQ+ people is reduced. Often after learning more about LGBTQ+ history or people, students become more aware of their own behavior in relation to their fellow LGBTQ+ classmates; some teachers report students self-correcting or others feeling more comfortable challenging offensive behaviors<sup>29</sup>. Proponents of LGBTQ+-inclusive curricula emphasize that the goal is to change behavior not necessarily beliefs.

Though it might appear in different forms that are unfamiliar to the 21st-century, LGBTQ+ history goes back thousands of years. Western society often has a rigid view of LGBTQ+ rights as going from bad to good, but this might not necessarily be the case. Teaching students about the earliest known accounts of homosexuality – dating well before the beginning of Christianity – allows them to gain a new perspective of history. For example, by learning about Ancient Greek and Roman history, students might also learn age-appropriate information on how the ancient warriors once viewed sexuality similarly to, and perhaps more positively than, modern society<sup>30</sup>.

Unfortunately, historians and anthropologists often face roadblocks in the sense that it is difficult to prove

homosexuality or transgeneriness when the idea of being homosexual or transgender did not exist until the early to mid-20th century. While *homosexuality* was a term coined in the late 19th-century, homosexuals were believed to be a third sex until around 1915<sup>31</sup>. In addition, it is only when social conditions are favorable that blatant LGBTQ+ subcultures begin to form in society. If their environment is hostile, LGBTQ+ individuals often model extreme heterosexual lives to protect themselves or form more subtle subcultures that must be interpreted. Ergo, though historical evidence exists that heavily weighs in favor of these individuals belonging to the LGBTQ+ community by modern understandings, it is impossible to definitively state their sexuality or gender. However, it is important to present some historical figures and their lifestyles as potential evidence of homosexuality before the 21st century. By hiding these individuals away, educators are “straight-washing” the past to fit a heteronormative view. As a result, LGBTQ+ students might misunderstand that non-heterosexual identities are not a 21st-century idea.

As Christianity began to spread across the globe, many cultures who viewed gender and sexuality more fluidly were negatively affected by the rigid standards held by Christians. Native Americans in particular were subject to violence and discrimination from early European settlers who rejected tribal views of gender and sexuality. Numerous terms across Native American tribes developed to describe those who did not fit into a typical masculine or feminine role within the tribes. Most Native American tribal cultures maintained a distinction between men and women, not-men and not-women, and lesbians and gays<sup>32</sup>. In some tribal cultures, not-men and not-women were thought to be clairvoyant and were often honored as the shamans of the tribe<sup>33</sup>. As European settlers began conquering Native American land, they imposed the word *berdache* that was adopted from the French word *berdash* meaning “a young [male] slave used for sexual purposes” on these not-men and not-women<sup>34</sup>.

Though some scholars continue to use *berdache* to describe LGBTQ+ Native Americans, many tribe members and scholars have replaced the word with the term *two-spirit* to be more appropriate. However, *two-spirit* tribe members identified themselves with unique language based on their tribe. Teaching LGBTQ+ youth about the diversity of Native American gender practices is essential to deepening not only awareness of history but increases understanding of the complexities of modern interpretations

of gender and sexuality. For instance, within the Eastern Dakota Santee tribe that originally covered regions in what is now Minnesota and Iowa, the two-spirit people were identified as *winkte*. Despite the general acceptance most two-spirit tribe members faced in Native American cultures, Dakota Santee *winkte* were marginalized and never officially assimilated within regular tribal activities<sup>35</sup>. In contrast, one of the first North American nations, the Lakota, were far more inclusive of *winkte* tribe members<sup>36</sup>. Marriages for *winkte* were not uncommon and they often participated in hunts, war parties, and organized care for weaker members of the tribe<sup>37</sup>. In addition to the Dakota and Lakota tribes, the Yurok tribe located in the northwest area of California used the term *wergern*, the Yuki – also in western California – referred to two-spirit individuals as *iwopnaitip*, and two-spirits of the Juaneño nation in southern California were referred to as *kwiit*<sup>38</sup>.

Even in the 17th century, evidence exists of a gender non-conforming individual living in a Puritan settlement in Virginia. Thomas Hall, born male, often dressed as a woman and took on traditionally feminine roles and activities<sup>39</sup>. When asked which perceived gender identity was more accurate, Hall replied that both *man* and *woman* applied. Unfortunately for Hall, the villagers could not understand the ambiguity of gender nonconformity; a community-wide hunt to discover Hall's true gender took place. Ultimately, it was decided by local courts that Hall would have no choice but to wear both male and female attire to resolve any questions about whether Hall was a man or a woman – leaving Hall no ability to choose between the two<sup>40</sup>. Hall's experiences in the 17th century provide a cultural understanding of early colonial attitudes towards gender non-conforming individuals and would be able to create parallels for 21st-century genderfluid youth.

Another area that LGBTQ+-inclusive curricula could expand upon would be the California Gold Rush of the mid-19th century. As miners from the East-coast left their families to travel to mine gold in the West, large groups of men suddenly found themselves in close proximity free from the customary social constraints of their cities. During the 19th century, bed-sharing was a common practice among men and same-sex romantic friendships were frequently cultivated, particularly among Chinese bachelors<sup>41</sup>. In addition, gender became more fluid as miners took pride in their appearance and a freer culture of cross-dressing thrived outside of most societal boundaries<sup>42</sup>. Though little evidence exists that explicitly proves homosexual

relationships on the frontier, enough evidence exists that displays a potentiality for non-heterosexual incidents.

Further potential evidence of LGBTQ+ existence from the 19th century lies within letters exchanged by African American women Addie Brown and Rebecca Primus and white seamstresses Charity Bryant and Sylvia Drake<sup>43</sup>. Very little documented history of same-sex relationships between African Americans exists before the 20th century; this is often attributed to the unlikelihood of white slave masters to record slave romances and the inability of black LGBTQ+ individuals to record their own history at the time. In the case of Addie and Rebecca, only 120 of Addie's letters to Rebecca remain and none from Rebecca to Addie; historians must interpret the relationship between the two women based on Addie's emotional letters and letters that have been saved from Rebecca to her family. In one letter, Addie wrote to Rebecca: "You say absence strengthens friendship and our love will not grow cold. Mine will never. I will always love you and you only"<sup>44</sup>. Similarly, much of Charity and Sylvia's relationship is interpreted from the little correspondence and journals that survived through time, as well as some public records<sup>45</sup>.

Incorporating discussions about the sexuality of historical government figures could be readily incorporated in schools as most students cover these individuals in standard curricula. For example, President James Buchanan was reportedly in a close romantic friendship with Senator William R. King until King's death in 1853; Buchanan never married and referred to his relationship with King as a "communion of central importance"<sup>46</sup>. President Abraham Lincoln, who served after Buchanan, has for nearly a century been subject to speculation about his potential non-heterosexuality. Though Lincoln was married until his death and had four children, he did share a bed with a close male friend for many years<sup>47</sup>. Even without delving into the possibility of these two presidents belonging within the LGBTQ+ community, youth would be able to examine the close, romantic same-sex friendships these men shared without shame<sup>48</sup>. Finally, Former First Lady Eleanor Roosevelt had a large circle of lesbian influences in her life who are said to have contributed to her politics. In addition, Roosevelt had a close relationship with journalist Lorena Hickok for many years; letters exchanged between Roosevelt and Hickok suggest that more than a platonic friendship existed. However, like many other LGBTQ+ relationships in the past, it was never publicly defined by the involved parties

to be an intimate romantic relationship; therefore, historians can only speculate<sup>49</sup>. The inclusion of Roosevelt, Lincoln, and Buchanan's potential non-heterosexuality in history curricula adds depth and diversity to studies of American presidents.

It is important to offer multiple realities of the LGBTQ+ community, such as representations of men who have relationships with men but do not consider themselves gay. Such representations highlight how sexual politics and social relationships formulate communities and how sexuality is less black and white than modern society might think. Former FBI director J. Edgar Hoover historically was not a gay ally and his politics often conflicted with the rights of the LGBTQ+ community. However, despite not identifying as such, it seems very likely that Hoover was homosexual; most evidence specifically focuses on Hoover's close relationship with his assistant Clyde Tolson<sup>50</sup>. In addition, one of Hoover's close allies, Roy Cohn, was a well-known closeted gay lawyer who died of AIDS and worked to eradicate homosexuals from the government from the late 1940s to the early 1960s<sup>51</sup>.

Historical events are just as important to include in an LGBTQ+-inclusive curriculum; not only are the events often credited for furthering the goals of the LGBTQ+ community, but they also highlight some less well-known people throughout history. For example, during the 1963 March on Washington, Dr. Martin Luther King Jr. attracted a crowd of more than 250,000 people for his famous "I Have a Dream" speech. However, few students learn that the march was organized in seven weeks by African American activist Bayard Rustin who received little credit due to being a gay man<sup>52</sup>. Several decades before this, the Harlem Renaissance of the 1920s was contributed to by numerous LGBTQ+ individuals, including blues singers Gladys Bentley and Ma Rainey<sup>53</sup>. Also within the 1920s, the Prohibition era allowed gay culture to flourish; speakeasies where alcohol was illegally sold provided a convenient – if dangerous – place for the LGBTQ+ community to meet<sup>54</sup>. Around the same time, German sexologist Magnus Hirschfeld began studying people he called transvestites – a term that was used to describe transgender individuals that is now considered to be outdated – who inspired him to help develop the earliest methods of sexual reassignment surgery for transgender individuals<sup>55</sup>. Most history lessons in K-12 schools ignore Hirschfeld's contributions to society; Hirschfeld's research – including hundreds of interviews with LGBTQ+ people from around the world – was destroyed by Nazis

in 1933<sup>56</sup>.

The World War II era was one of the most controversial periods of modern LGBTQ+ history, but most K-12 curricula gloss over the problems the LGBTQ+ community faced. As World War II began, men and women from all across the country joined the military and gay subcultures expanded. Members of the LGBTQ+ community who might never have met another LGBTQ+ person were suddenly within close proximity to one another. As a result, the LGBTQ+ community nationalized, leading to major LGBTQ+ cultures within larger cities, such as San Francisco and New York City. However, concerns of “sexual perversity” negatively affecting the troops led the military to issue “blue discharges,” which were neither honorable nor dishonorable that were printed on blue paper, for soldiers suspected of being or proven to be homosexuals. Soldiers with these Section 8 discharges were often unable to find a job upon their return home<sup>57</sup>. At the end of World War II, the American government began firing all employees that they believed to be communists or a threat to national security, including homosexuals, leading to a period of time known as the Lavender Scare. In 1953, President Dwight Eisenhower enacted Executive Order 10450 that prohibited homosexuals from working in the government. The order continued until the 1970s and affected thousands of men and women; a State Department official once admitted to terminating at minimum 1,400 employees for being homosexual<sup>58</sup>.

In the years after World War II, society was becoming increasingly more hostile to the LGBTQ+ community, which had begun organizing on a national scale. While many LGBTQ+ youth might be at least vaguely familiar with the Stonewall Riots of 1969, they are less likely to be familiar with the Cooper’s Doughnuts riot of 1959 and the Compton Cafeteria riots of 1966, which are credited as strongly influencing the Stonewall Riots<sup>59</sup>. Students benefitting from an LGBTQ+-inclusive curricula would gain a more accurate and diverse understanding of the Stonewall Riots as a more complex series of incidents of harassment between police forces and LGBTQ+ community members that had built over time. In addition, the numerous LGBTQ+ people of color who led the riots, such as Marsha P. Johnson, are often left out of history. Johnson, a transgender woman of color, was a prominent figure in the Stonewall Riots and a founding member of the Gay Liberation Front<sup>60</sup>. LGBTQ+ youth of color, particularly African American youth, who already have limited references to diverse LGBTQ+ history would greatly benefit from examples of strong LGBTQ+ people of color within the 20th century.

Finally, LGBTQ+-inclusive curricula might also look to international cultures to gain material. For example, LGBTQ+ individuals in India use the term *hijra* to describe neither male nor female individuals who might be described in a Western context as intersex or transgender. *Hijra* typically dress in a manner similar to women and perform in ceremonies,

though they are outcasts in Indian culture. *Travestis* is a South American word for transgender – describing men who desire other men and transition to become a woman and – similar to the *hijra* in India and transgender individuals in the U.S. – the *travestis* are oft subject to violence and discrimination<sup>61</sup>. In China, transgender individuals might be referred to as *yin-yang persons*; the word *bianxing* specifically refers to a person who changes their sex through reassignment surgery<sup>62</sup>.

## CONCLUSIONS

History illustrates ever-shifting progressions and regressions in how all cultures and people are respected and remembered. Incorporating multi-faceted identities that have appeared throughout time into youth education is paramount to normalizing diversity and increasing positive relations between majority and minority groups in the United States. LGBTQ+ youth are some of the most vulnerable members of Western society and are often subject to victimization and abuse within school hallways. By increasing the amount of LGBTQ+ content in humanities and social sciences, LGBTQ+ and heterosexual youth form greater foundations for LGBTQ+ knowledge and understanding. Therefore, mandating and incorporating LGBTQ+-inclusive curricula within K-12 schools nationwide is crucial in reducing the mental health disparities and alarmingly high suicide rates among LGBTQ+ youth.

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## Endnotes

<sup>1</sup> *Nabozny v. Podlesny*, 1996 United States Court of Appeals, Seventh Circuit.

<sup>2</sup> Isabel Killoran and Karleen Pendleton Jiménez, “*Unleashing the Unpopular*”: *Talking About Sexual Orientation and Gender Diversity in Education* (Olney, MD: Association for Childhood Education International, 2007), 8.

<sup>3</sup> Killoran and Pendleton Jiménez, “*Unleashing the Unpopular*”, 8.

<sup>4</sup> Jason Cianciotto and Sean Cahill, *LGBT Youth in America’s Schools* (Ann Arbor, MI: University of Michigan Press, 2012) doi: 10.3998/mpub.4656286; *Nabozny v Podlesny*

<sup>5</sup> Joseph G. Kosciw et al., “GLSEN 2017 National School Climate Survey: The Experiences of Lesbian, Gay, Bisexual, Transgender, and Queer Youth in Our Nation’s Schools,” GLSEN, 2018, 18, accessed March 28, 2019, <https://www.glsen.org/article/2017-national-school-climate-survey>.

<sup>6</sup> Joseph G. Kosciw and MK Cullen, “The GLSEN 2001 National School Climate Survey: The School-Related Experiences of Our Nation’s Lesbian, Gay, Bisexual and Transgender Youth,” GLSEN, 2002, 12, accessed March 28, 2019, [https://www.glsen.org/sites/default/files/2001\\_National\\_School\\_Climate\\_Survey\\_Full\\_Report.pdf](https://www.glsen.org/sites/default/files/2001_National_School_Climate_Survey_Full_Report.pdf); Kosciw, “2017 School Climate Survey”

<sup>7</sup> Kosciw, “2017 School Climate Survey”

<sup>8</sup> Jason Cianciotto and Sean Cahill, *LGBT Youth*

<sup>9</sup> Sandy E. James et al., “The Report of the 2015 U.S. Transgender Survey,” National Center for Transgender Equality, 2016, accessed April 2, 2019, <https://transequality.org/sites/default/files/docs/usts/USTS-Full-Report-Dec17.pdf>.

<sup>10</sup> Sari L. Resiner et al., “Mental Health of Transgender Youth in Care at an Adolescent Urban Community Health Center: A Matched Retrospective Cohort Study,” *Journal of Adolescent Health* 56, no. 3 (2015): doi:10.1016/j.jadohealth.2014.10.264; “Facts About Suicide – The Trevor Project,” The Trevor Project, accessed May 8, 2019, <https://www.thetrevorproject.org/resources/preventing-suicide/facts-about-suicide/#sm.0001r4cx6ceulcpfwey2d84f996hh>

<sup>11</sup> The Trevor Project, “Facts About Suicide”

<sup>12</sup> The Trevor Project, “Facts About Suicide”; Resiner, et al., “Transgender Youth”

<sup>13</sup> Dorothy L. Espelage, “Chapter Six: Bullying and K-12 Students,” in *LGBTQ Issues in Education Advancing a Research Agenda*, by George L. Wimberly (Washington, DC: American Educational Research Association, 2015); V. Paul Poteat et al., “Short-Term Prospective Effects of Homophobic Victimization on the Mental Health of Heterosexual Adolescents,” *Journal of Youth and Adolescence* 43, no. 8 (2013): doi: 10.1007/s10964-013-0078-3.

<sup>14</sup> Kosciw, “2017 School Climate Survey”

- <sup>15</sup> Cianciotto and Cahill, *LGBT Youth*
- <sup>16</sup> “Making the Framework FAIR: California History-Social Science Framework Proposed LGBT Revisions Related to the Fair Education Act,” The Committee on Lesbian, Gay, Bisexual, and Transgender History, 2014, accessed April 8, 2019, <http://clgbthistory.org/projects/fair-framework>.
- <sup>17</sup> S.Res.1569, Sess. of 2018 (NJ 2018), [https://www.njleg.state.nj.us/2018/Bills/S2000/1569\\_R2.pdf](https://www.njleg.state.nj.us/2018/Bills/S2000/1569_R2.pdf); Samantha Schmidt. “Maryland schools aim to include LGBT and disability rights in history curriculum.” The Washington Post, 2019. Accessed September 11, 2019; Amanda Jackson. “LGBTQ history curriculum will now be taught in Illinois schools.” CNN, 2019. Accessed on September 11, 2019. <https://www.cnn.com/2019/08/11/us/illinois-lgbtq-history-curriculum-trnd/index.html>
- <sup>18</sup> Clifford Rosky. “Anti-Gay Curriculum Laws.” *Columbia Law Review* 117, no. 6 (2017): 1461-541. <http://www.jstor.org/stable/44392956>; “No promo homo” was coined by Nan Hunter in 1978 to describe the Briggs Initiative which allowed schools to terminate any public school teacher who was pro-LGBT; Cianciotto and Cahill, *LGBT Youth*
- <sup>19</sup> Rosky, “Anti-Gay Curriculum Laws”, 1475. Eleven states: Alabama, Texas, Mississippi, Oklahoma, Florida, Illinois, North Carolina, Florida, Louisiana, South Carolina, and Arizona
- <sup>20</sup> Rosky, 1475. Seventeen states: Alabama, Arkansas, Florida, Indiana, Louisiana, Michigan, Mississippi, Missouri, North Carolina, North Dakota, Ohio, South Carolina, Tennessee, Texas, Utah, Virginia, and Wisconsin
- <sup>21</sup> Rosky, “Anti-Gay Curriculum Laws”, 1470
- <sup>22</sup> Kosciw, “2017 School Climate Survey”.
- <sup>23</sup> *Nabozny v. Podlesny*, 1996 United States Court of Appeals, Seventh Circuit.
- <sup>24</sup> Daniel Hurewitz, *Understanding and Teaching U.S. Lesbian, Gay, Bisexual, and Transgender History*, ed. Leila J Rupp and Susan Kathleen Freeman (Madison, WI: University of Wisconsin Press, 2017).
- <sup>25</sup> Cianciotto and Cahill, *LGBT Youth*
- <sup>26</sup> Horacio N. Roque Ramirez, “Borderlands, Diasporas, and Transnational Crossings: Teaching LGBT Latina and Latino Histories,” *OAH Magazine of History* 20, no. 2 (2006): 39-42, doi:10.1093/maghis/20.2.39.
- <sup>27</sup> Lester B. Brown, *Two Spirit People American Indian Lesbian Women and Gay Men* (Binghamton, NY: Harrington Park Press, 1997).
- <sup>28</sup> Kosciw, “2017 School Climate Survey”
- <sup>29</sup> Hurewitz, “Understanding and Teaching”
- <sup>30</sup> John Boswell, *Christianity, Social Tolerance, and Homosexuality: Gay People in Western Europe from the Beginning of the Christian Era to the Fourteenth Century* (Chicago: University of Chicago Press, 2015), 260.
- <sup>31</sup> Vern L. Bullough. “Magnus Hirschfeld, an Often Overlooked Pioneer.” *Sexuality and Culture* 7, no. 1 (2003): 62-72. doi:10.1007/s12119-003-1008-4.
- <sup>32</sup> Brown, “*Two Spirit People*”, 6.
- <sup>33</sup> Brown, 6. Biological women (not-men) who performed traditionally masculine gender roles and biological men (not-women) who performed traditionally feminine gender roles
- <sup>34</sup> “Berdache (n).,” Home: Oxford English Dictionary, accessed April 25, 2019, <https://www.oed.com/view/Entry/17877?redirectedFrom=berdache#eid>; Brown, “*Two Spirit People*”, 16.
- <sup>35</sup> Brown, 23-25.
- <sup>36</sup> Brown, 25.
- <sup>37</sup> *Ibid.*
- <sup>38</sup> Lilian Faderman and Stuart Timmons, *Gay L.A.: A History of Sexual Outlaws, Power Politics, and Lipstick Lesbians* (Berkeley, CA: University of California Press, 2009).
- <sup>39</sup> Kathleen M. Brown, ““Changed...Into the Fashion of Man” The Politics of Sexual Difference in a Seventeenth-Century Anglo-American Settlement,” *Journal of the History of Sexuality* 6, no. 2 (1995): accessed March 1, 2019, <http://www.jstor.org/stable/3704121>.
- <sup>40</sup> Brown, “Politics of Sexual Difference”
- <sup>41</sup> Susan Lee Johnson, *Roaring Camp: The Social World of the California Gold Rush* (New York: W.W. Norton, 2001).
- <sup>42</sup> Johnson, *Roaring Camp*
- <sup>43</sup> Karen V. Hansen, “‘No Kisses Is Like Youres’: An Erotic Friendship between Two African-American Women during the Mid-Nineteenth Century,” *Gender & History* 7, no.2 (1995): doi: 10.1111/j.1468-0424.1995.tb00019.x.; Rachel Hope Cleves. *Charity and Sylvia: A Same-Sex Marriage in Early America*. Oxford: Oxford University Press, 2017.
- <sup>44</sup> Hansen, “An Erotic Friendship”, 160.
- <sup>45</sup> Cleves, *Charity and Sylvia*
- <sup>46</sup> David D. Doyle, Jr., “Nineteenth-Century Male Love Stories and Sex Stories,” in *Understanding and Teaching U.S. Lesbian, Gay, Bisexual, and Transgender History*, ed. Leila J. Rupp and Susan Kathleen Freeman (Madison, WI: University of Wisconsin Press, 2017).
- <sup>47</sup> Eaklor, *Queer America*. Bed-sharing was a common 19th century practice as earlier stated, but accounts from Lincoln’s family and friends suggest that he had more than platonic inclinations towards men
- <sup>48</sup> Poteat, “Homophobic Victimization”.
- <sup>49</sup> Lilian Faderman, *To Believe in Women: What Lesbians Have Done for America – a History* (Boston: Houghton Mifflin, 2000)
- <sup>50</sup> Claire Bond Potter, “Queer Hoover: Sex, Lies, and Political History,” *Journal of the History of Sexuality* 15, no. 3 (2006): doi:10.1353/sex.2007.0021.; Claire Bond Potter, “Public Figures, Private Lives: Eleanor Roosevelt, J. Edgar Hoover, and a Queer Political History,” in *Understanding and Teaching U.S. Lesbian, Gay, Bisexual, and Transgender History*, ed. Leila J. Rupp and Susan Kathleen Freeman (Madison, WI: University of Wisconsin Press, 2017)
- <sup>51</sup> Bond Potter, “Public Figures, Private Lives”
- <sup>52</sup> Ian Lekus, “Queers of Hope, Gays of Rage: Reexamining the Sixties in the Classroom,” in *Understanding and Teaching U.S. Lesbian, Gay, Bisexual, and Transgender History*, ed. Leila J. Rupp and Susan Kathleen Freeman (Madison, WI: University of Wisconsin Press, 2017).
- <sup>53</sup> James F. Wilson, “Chapter 5: “In My Well of Loneliness”: Gladys Bentley’s Bulldykin’ Blues,” in *Bulldaggers, Pansies, and Chocolate Babies: Performance, Race, and Sexuality in the Harlem Renaissance* (Ann Arbor, MI: University of Michigan Press, 2010), 154-191, accessed May 1, 2019, <http://www.jstor.org/stable/10.3998/mpub.1175684.1>. Gladys Bentley was well-known for cross-dressing and married her white lesbian partner in a public civil ceremony; Wilson, “*Harlem Renaissance*”, 170. Ma Rainey’s “Prove it on Me Blues” makes numerous references to her bisexuality.
- <sup>54</sup> Eaklor, *Queer America*

<sup>55</sup> Bullough, “Magnus Hirschfeld”

<sup>56</sup> Bullough, “Magnus Hirschfeld”

<sup>57</sup> Hegarty, “The Other War”, 183.

<sup>58</sup> Hegarty, 193

<sup>59</sup> Faderman and Timmons, *Gay L.A.*, Cooper’s Doughnuts was a café frequented by LGBT people of color; after one too many raids at the café, drag queens began throwing doughnuts and coffee at police; Susan Stryker, *Transgender History* (Seal Press, 2008). After enduring frequent harassment by the police, drag queens and transgender LGBT people of color began attacking police with coffee and eventually fists

<sup>60</sup> Stryker, Susan. *Transgender History*. New York, NY: Seal Press, 2008..

<sup>61</sup> Leila J. Rupp and Susan Kathleen Freeman, “The Ins and Outs of U.S. History: Introducing Students to a Queer Past,” in *Understanding and Teaching U.S. Lesbian, Gay, Bisexual, and Transgender History*, ed. Leila J. Rupp and Susan Kathleen Freeman (Madison, WI: University of Wisconsin Press, 2017), 22-23.

<sup>62</sup> Howard Chiang, *After Eunuchs: Science, Medicine, and the Transformation of Sex in Modern China* (New York: Columbia University Press, 2018)

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# LIFE AFTER TAKING THE MYERS-BRIGGS TYPE INDICATOR TOOL: A DISCOURSE ANALYSIS OF THE R/MBTI SUBREDDIT COMMUNITY

Tara Ward

## ABSTRACT

The Myers-Briggs Type Indicator (MBTI) personality inventory tool is popular amongst individuals and companies because its self-reporting questionnaire produces accurate personality results. However, the communities created by MBTI users and the new knowledge that members are making within these communities by using MBTI terminology have not yet thoroughly been researched. An apt platform to research this new knowledge first-hand is the website known as Reddit, using online ethnography to present these results. Despite its reputation as a site solely for play, Adrienne Massanari argues in *Participatory Culture* that Reddit is also a carnival, a performance, a play-space, a platform, and a community (201). Massanari was working to define Reddit as a whole; however, if she had focused on a single community, she would have gained more detailed results. This study analyzed a grouping of 59 posts from the Reddit group devoted to the MBTI tool called r/mbti, by discerning the purpose and what type of knowledge each post attracted. Purposes were grouped into themes to discover what r/mbti members valued, then Legitimation Code Theory (LCT) was implemented to reveal implicit rules within the community. Also utilized were James Gee's theories of discourse acquisition through apprenticeship and Ann Johns' theories on how communities define themselves and exclude others. Results revealed the r/mbti community was motivated by themes of Identity, Community, Truth, and Knowledge. Members were using language in a way that validated the feelings of others who had gathered in the community because they felt misunderstood elsewhere. Overall, this investigation found Reddit to be more than a site for play. MBTI provides the lexis for r/mbti members to utilize in the online community in order to fulfill the important psychological need for camaraderie and knowledge.

## INTRODUCTION

First published in 1943, the Myers Briggs Type Indicator instrument, (MBTI),

Table 1

*The Six Functions of the MBTI Tool (The Myers & Briggs Foundation)*

Function	Definition
Introversion (I)	Introverts direct their attention inward and take energy from their inner world.
Extraversion (E)	Extroverts direct their attention toward their surroundings and gain energy from the outside world.
Sensing (S)	People who prefer to use sensing focus on the details of the situations they are confronted with.
iNtuition (N)	People who prefer to use intuition see overall patterns and possibilities.
Thinking (T)	Thinkers base decisions off principles and logic.
Feeling (F)	Feelers base decisions off values and repercussions.
Judging (J)	Judgers prefer to immediately organize information to come to conclusions and enjoy structure.
Perceiving (P)	Perceivers prefer to fully evaluate, and adjust if necessary, their information before coming to a conclusion.
The 16 personality combinations	ESTJ, ISTJ, ENTJ, INTJ, ESTP, ISTP, ENTP, INTP, ESFJ, ISFJ, ENFJ, INFJ, ESFP, ISFP, ENFP, INFP

was created by a mother-daughter team. Katherine Cook Briggs and Isabel Briggs Myers, inspired by the theories of Carl G. Jung, sought to streamline Jung's work into a more usable and accessible format. The format allows users to understand themselves better through discerning their strengths and weaknesses in areas like communication, learning, and social interactions. The information gained from the MBTI is meant to be used to guide the user toward personal growth and job fields they are most suited for. The team also wanted its use to be ethical and as systematic as possible. Therefore, each question was thoroughly researched and only certified administrators are allowed to conduct the tool. Consequently, in order to take the MBTI, one must pay a

fee for these services. Since these facts are largely unknown to the general public, many websites claiming to have the MBTI for free are widely visited and held by the public to be the true MBTI. Other parties were able to simulate the real MBTI so easily because Jung's theories and descriptions of the terms (extrovert or introvert, sensing or intuition, thinkers or feelers, and judgers or perceivers) have been thoroughly published and are therefore easily copied. For example, introverts prefer to focus on their inner world whereas extroverts do not. Sensing focuses on basic information compared to intuition, which interprets information. Thinkers prefer logic more than feelers, and judgers like to make decisions more than perceivers. All of this is information

available to anyone (See Table 1). This history is relevant to understanding the background of the MBTI and, most importantly, the widespread use of the above terms if not the actual tool. The terms help users understand the results of the MBTI session and become part of the user's lexis to be used later in discussion with certified administrators, family, and peers. This paper addresses a gap in knowledge about how those who have taken the MBTI utilize its lexis to construct in-group community identity.

Research about the tool itself is vast. The MBTI has been researched largely as a management or career counseling tool. And, not long after its appearance, debates about the merits of the MBTI started (Logan). The MBTI has been proven useful on a management level by helping people understand themselves and how to work with others (Costello). On a career-counseling level, the tool has been proven retroactively accurate and therefore it is often used to guide those without jobs into a field of their liking and ability (Goodyear). However, for all of the scientific research and codes of ethical use, the MBTI is basically a way for people to define themselves and, of course, some people are going to have something to say about their types. The tool that provides insight into personality and human behavior has never been researched in conjunction with the community it has initiated.

The focus of this investigation was the overlooked community initiated by the MBTI. What follows is an overview of the r/mbti community, discerning the priorities of the community using thematic analysis, investigating the best way to become part of the community by deducing what type of knowledge is most valued, and discovering what motivates people to use the MBTI other than self-discovery and job guidance. The online forum known as Reddit was utilized in order to investigate the social practices of the MBTI community to find out how the community constructs its identity. A brief literature review illuminates the basis on which this research was built, followed by a breakdown of the theoretical framework that displays the lens and theories used to

inform this study. The Methods section clarifies the data collection and analysis procedures.

## LITERATURE REVIEW

This section briefly discusses existing research. However, this paper focuses on the intersection of MBTI and Reddit, since this intersection has never before been researched. Instead this study investigates the component parts of the research question: How do users of the MBTI utilize the lexis and how do Reddit users create a sense of community? Regarding the social practices of the r/mbti community, the closest research available is Adrienne Massanari's *Participatory Culture, Community, and Play Learning from Reddit*, which does much to shed light on Reddit in general. Reddit is a carnival, a performance, a play-space, a community, a platform (Massanari). Reddit is a space where people "meet" and share ideas. Massanari found Reddit to be a place of activism and mobilization as well as a place for people to be unforgettingly honest about their opinions.

Massanari's overview props Reddit up as a more or less accurate representation of humanity. Redditors can be honest or vindictive, pure or crude, and, more often than not, somewhere in between. Due to the general nature of her research, Massanari provides an excellent overview of the role of Reddit and its Redditors, the themes within Reddit, how Redditors feel about their chosen platform, what Reddit can teach us, and what an analysis of Reddit can tell us about humanity. However, since Massanari does not include an analysis of a specific community she cannot elaborate on certain questions like: What motivates Redditors or how do members classify themselves?

While Reddit has successfully entered the scholarly field through Massanari's book, the r/mbti community has not yet been researched on a scholarly level. In fact, an online search reveals the community initiated by the MBTI is not a source of popular research either. "7 Reasons Why The Online MBTI Community Is Dominated By iNtuitives" is one of the only articles found relating to this topic. In the article, Heidi Priebe

asserts that MBTI blogs, forums, and online communities in general are dominated by intuitives who prefer to use

their instincts and make up only 26.6% of the global population rather than sensors who focus on details and make up the majority (Priebe). Priebe points out that since sensors are the majority of the population, social systems are catered toward them. This leaves intuitives feeling left out, misunderstood, and undervalued, hence their increased involvement in online forums for like-minded people. Priebe makes a logical argument for why intuitives are more attracted to the online scene than sensors but she also does not research a specific community.

While Massanari and Priebe have made initial furrows into Reddit and the MBTI community, neither of them has the data necessary to explore how the interactions of the MBTI community can illuminate human behavior. Therefore, I have formed a query whose investigation will result in information that will supplement what is already known about Reddit and the MBTI community: What practices do r/mbti Redditors use to construct their own community and identity?

## THEORETICAL FRAMEWORK

With the introduction of the internet, the number of discourse communities has exploded. A discourse community, a term originally popularized by John Swales, has a set of common goals, mechanisms of intercommunication primarily to provide feedback, uses and possesses one or more genres, a threshold number of members, and a specific lexis (Swales). Research into these communities can provide unique insight into human nature if their social practices and not only their language use is studied (Gee).

Social practices form an important part of individual or group identity. While identity is what an individual, or a group, is, it is also what they are not. Rather than discourse communities being an open forum that anyone can attend, there are groups that prioritize certain traits over others, and this can lead to selectivity with regard to their members (Johns). However, the layers of traits and rules of a community are, at times, implicit and this makes it difficult for new people to become full-fledged members. Often, this situation can be remedied with a period of apprenticeship, but if experience without knowledge is gained then these apprenticeships can be unsuccessful. A Legitimation Code Theory (LCT) analysis can be useful in revealing the implicit rules of discourse communities by sorting members into specializations: knowledge, knower, elite, and relativist (Maton). Knowing what specialization dominates a

**Table 2**  
*The Four Specializations of Legitimation Code Theory (Maton)*

Specialization	Definition
Knowledge code	Users emphasize what they know in terms of textbook knowledge.
Knower code	Users emphasize who they are in terms of life experience.
Elite code	Users demonstrate both a textbook knowledge and knowledge gained from experience.
Relativist code	Users provide opinions without supporting evidence.

community is helpful in determining what skills a prospective member needs in order to be accepted into said community. LCT can be useful in revealing and therefore helping others learn the rules and values of a community (Maton).

This study draws on a number of theories for research into the identity construction practices of the r/mbti community. First, the discourse community theories developed in Literacy, Discourse, and Linguistics will help illuminate the intricacies of communication such as why a certain post or Redditor is more popular than others (Gee). This theory will also inform the LCT lens implemented in order to sort popular Redditors and posts into categories to reveal what type of knowledge the r/mbti community most values and/or uses (Maton). The study also draws from the theories developed in “Discourse Communities and Communities of Practice” for how r/mbti Redditors identify with their community and if/how they are excluded from their community (Johns).

## METHODS

The way in which r/mbti members utilize the MBTI lexis to make sense of life events, their meaning-making practices, is unique. In order to investigate these meaning-making practices, I chose to conduct an ethnography, defined as a systematic study and description of a culture by the Oxford English Dictionary (OED). At points in this paper, I have used online ethnography, considering I created a Reddit account in order to interact with, and therefore affect, the r/mbti community. I reflect on why I gave certain posts upvotes or downvotes and use my own motivations to shed light on why other Redditors did or did not do the same.

In order to produce comprehensive results, triangulation was used through the application of two approaches: thematic analysis and LCT (DePew; Maton). A thematic analysis revealed popular topics and therefore some of what motivates r/mbti Redditors. Applying LCT helped sort posts into knowledge, elite, relativist, and knower specializations to see which code dominated and thrived in the r/mbti community.

Data was collected through the r/mbti homepage on Reddit. The name of each post was recorded along with the number of votes and comments it had at the time of data collection (See Appendix). A total of 59 posts were collected to conduct a thematic analysis and apply the LCT lens. First, the rhetorical purpose of each post was discerned and then the posts were grouped according to similar purposes: trying to identify oneself, trying to identify others, characterizing type(s), characterizing function(s), forming a sub

Table 3

*Themes and Their Frequency Within the R/MBTI Community*

Themes	Rhetorical Purpose	Frequency (votes/comments)	Examples
Identity	Trying to identify oneself*	12 (71/136)	“Type me” or “Am I an ESTP or ENTP?”
Identity	Trying to identify others	4 (21/35)	“Type my friend”
Identity	Characterizing type(s)	15 (132/292)	“My analysis/typing of the <i>Star Trek</i> characters”
Identity	Characterizing function(s)	11 (25/91)	“Ti-Ne-Si?” or “Ne vs Se on video games”
Seeking community	Forming a sub community	1 (1/0)	“MBTI WhatsApp group”
Seeking truth	Discussing merit*	6 (18/37)	“Best website for MBTI resources”
Quest for Knowledge	Self-improvement	2 (9/17)	“What’s a self-help book that has changed the way you approach life?”
Quest for Knowledge	Promoting understanding through sharing experiences	6 (116/269)	“What’s the worst assumption one has made about your type?”
Quest for Knowledge	Asking for help	1 (1/4)	“How do I handle a desperate ISFJ”
Anomalies	Anomalies	1 (2/6)	“TV/series movie recommendations”
	<b>Total</b>	<b>59 (396/887)</b>	

Note. \* “Is this site reliable? What would my most likely type be based off of this?” is counted as two separate posts: once for discussing merits, once for trying to identify oneself. Examples are titles of one or two posts that can generally represent their respective groups.

community, discussing merit, seeking self-improvement, promoting understanding through sharing experiences, asking for help, and anomalies. Finally, purposes were grouped and sorted into themes (See Table 2).

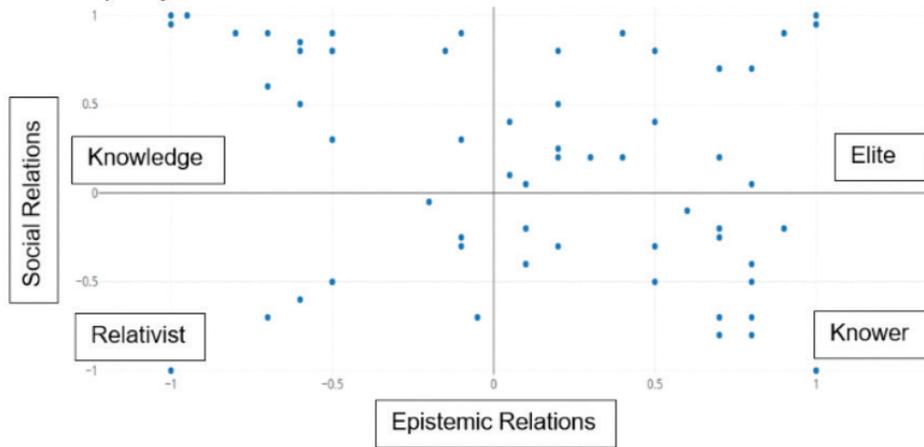
## RESULTS

The thematic analysis revealed that r/mbti Redditors most frequently post about, like, and comment on characterizing types (theme: identity). The post purposes that occur the least are: 1) asking for help, 2) forming a sub community, 3) self-improvement. Anomalies occur rarely, (1/59) 1% of the time. The post purposes that occur the most are: 1) characterizing types, 2) trying to identify oneself, 3) characterizing function. However, this dynamic changes when considering votes and comments. The top three topics that received the most votes and comments are: 1) characterizing type, 2) understanding through sharing experiences, 3) trying to identify oneself.

Note. Epistemic Relations are defined as how much the post attracted Redditors who valued literary knowledge. Social Relations are defined as how much the post attracted Redditors who valued knowledge gained through social interaction (“Theory”).

In order to apply an LCT analysis, the four knowledge specializations were defined. All members used terms such as the four-letter personality groupings, commonly (See Table 1). Therefore, members who used uncommon, but correct, MBTI terms (such as tertiary function<sup>1</sup>, Te<sup>2</sup>, Fi<sup>3</sup>, etc.) were placed on the knowledge code plane. Members whose posts consisted mostly of their personal experiences were placed on the knower plane. The elite plane was used for those who used both uncommon MBTI knowledge and personal experience. Finally, members who used just enough of the common terminology to qualify as members but lacked some sort of

**Table 4**  
*LCT Analysis of r/mbti Redditors*



reasoning behind their statements were placed within the relativist plane.

The LCT analysis revealed that 20 out of the 59 posts catered to those with an elite specialization in the r/mbti community. Also, 15 out of the 59 posts catered to those with a knowledge specialization and 16 catered to those with a knower specialization. Finally, eight out of the 59 posts catered to a relativist specialization (See Table 3).

## DISCUSSION

This section discusses the implications of the findings by sorting them into the thematic subheadings of Seeking Community, Seeking Truth, Quest for Knowledge, and Identity. Also the rhetorical purposes of each theme is explored using emic perspective to hypothesize about the motives of members. The final section will be dedicated to LCT and which codes a prospective member should learn in order to most likely be accepted into the r/mbti community.

### Seeking Community

By far the theme that occurs the least in the r/mbti community is that of seeking community, only one post out of 59. Only one such post occurred within the time frame and had received only one up vote. The fact that this post received so little attention means that r/mbti is fulfilling the needs of its members for a sense of community. Additionally, the link within this post was to a WhatsApp group chat. Group chats, while helpful for keeping everyone in the loop as to what time to meet up, are not known to be a place of extensive discussion. Group chats serve the purpose of informing many people at once and/or being a place of unfocused discussion among friends. On the contrary, Reddit's format supports long posts inside which only that topic is addressed.

This provides a focused discussion that members can join, comment, then leave to join another topic without turning the tide of the conversation completely like they would do in a group chat. Therefore, r/mbti members ignored this post because, in addition to members' sense of community being satisfied, it is also likely that members preferred the format of Reddit. This preference also speaks to the purpose of the r/mbti community to not only find solidarity with like minds but the need for space to discuss and theorize.

### Seeking Truth

Quite a few knowledge code Redditors are members of r/mbti with 15 out of the 59 posts attracting this type of specialization. They are the members most interested in "seeking truth." These Redditors often discuss the merits of the MBTI demonstrating advanced knowledge of its pros, cons, history, and components. A more in-depth look at these discussions revealed this field is made up of steadfast believers and questioners of the tool and they all cite extensive examples to support their position. It is reasonable to conclude that the Redditors that fall into this category want to spread the knowledge that comes along with MBTI or caution people against taking it too seriously. The length and breadth of these discussions are important to note here because it supports the theory that Reddit is not only a place to play. R/mbti members interested in seeking truth often write paragraphs-long posts and receive almost equally as long responses all with evidence supporting their claims. These well-researched posts expressed with informal, and at times "erroneous," grammar are examples of the pure use of language. R/mbti members are using language largely just to communicate without taking time to address grammar. Although there does seem to be a baseline skill level, it

mostly relates to spatial use. As long as members do not do a hard return after every sentence or insert extraneous spaces within their text, their ideas are addressed without grammar prejudice.

### Quest for Knowledge

The "quest for knowledge" category is a strange one. It is the second most popular (nine out of 59) but still far behind the most popular theme (Identity) and includes two of the most unpopular purposes: "asking for help" and "anomalies." As a theme, it is understandable that it is the second most popular theme being that the MBTI was designed to give users knowledge about themselves and others. However, it is by no means a close second. An analysis of the most popular purpose within the theme provides some insight into this conundrum. Only six Redditors made posts that elicited other members to share their life experiences, but an overwhelming 269 responded. Referring back to Gee's theories on community inclusion reveals that the few Redditors who want to know about the experiences of the other types provide the instrumental service of making other members feel included. Additionally, according to basic human vanity, people are more interested in talking about themselves even within a community that wants to learn about other people.

The unpopularity of the "asking for help" and "self-improvement" purposes was also strange considering the aforementioned values of this community. However, it is likely that these posts were simply framed incorrectly to garner attention. Worded instead as a call to people with an ISFJ personality to share what comforts them instead of "How do I handle a desperate isfj," the post most likely would have attention on the level that "promoting understanding through sharing experiences" received because it would have appealed to others' sense of vanity. The same incorrect framing goes for "self-improvement" in addition to a lack of MBTI diction. In all, if the Redditors who posted within these two purposes are to become full-fledged members they must learn to use a baseline of MBTI language and frame their posts within the more popular purposes.

### Identity

"Trying to identify oneself", "trying to identify others", "characterizing type(s)", and "characterizing function(s)" were all placed under the theme of Identity because these posts were concerned with defining things or people. The most popular rhetorical purpose by frequency, votes, and comments was that of "characterizing type(s)." A brief overview reveals that the purpose of the

comments were to contribute knowledge, ask questions, or pose counter points. Members attracted to these types of posts seemed to be a rigorous bunch unsatisfied until the most detailed description could be provided. This practice of relentless description is in keeping with people or groups still trying to construct their identity.

Similar to “characterizing type” is the purpose of “trying to identify others”; however, these categories are separated based on the fact that “characterizing type(s)” was more general and often about more than one type, while “trying to identify others” were posts with one specific person in mind other than the original poster. The slight difference in definition but vast difference in frequency (15 posts concerning “characterizing type” to four posts concerning “trying to identify others”) reveals the r/mbti community is more interested in defining the types rather than defining people using the types. This would seem to indicate that the r/mbti community is more interested in personality theory rather than using the types to understand the people around them. The majority interest in theory over practical application supports Priebes’s assertions that intuitives, who are more inclined to discuss theory, dominate r/mbti.

I expected “trying to identify oneself” to be a more popular purpose before analyzing the data, but upon further contemplation as long as the (true or fake) MBTI tests gave people accurate or likable results, then there was no need to further try and identify oneself in the forum. Throughout the course of this research, I was given the impression that users of fake MBTIs usually received slightly different results each time, such as ISTP and INTJ. However, these results focused the user’s search to the IxTx<sup>+</sup> grouping and, from the in-depth descriptions, they could pick the one most closely related to them. In accordance with the human trait of flattering oneself, it is safe to assume some bias in this picking and choosing method. I believe the theory that one can grow into a different type over time (ISTP at 15 years of age but ESTJ at 30 years of age) gained as much popularity as it did among r/mbti members because users did not feel one-hundred percent certain about their chosen type to begin with.

Lastly, “characterizing functions” was a surprising purpose for an informal online forum. However, when taken into account the number of members who possessed a knowledge code the resulting interest in the finer points of the MBTI tool was less surprising. Members avidly discussed the relationships between the functions. These relationships left a lot to be interpreted, such as how a person

acts when using their Judging or intuitive function and how they act when using both functions together. The functions can stand alone and a person can use one or another to base their actions off of or the functions can combine to result in completely different actions. Within these complex discussions, members seemed to reaffirm their commitment to the MBTI community because it is a community that accepts and celebrates the minute variations that make up individuals.

### LCT

The definitions used for the LCT analysis are as follows: Knowledge code members were well versed in the technical terms and components of the mbti (tertiary functions, Te vs Ti); knower code members relied on their experiences with people whom they knew the type of; those with an elite code talked in technical terms of their real life experiences; and relativists provided opinions without supporting evidence and/or simply commented “cool” or “agree.” Additionally, the hypothesis that most relativists vote rather than comment had no method to measure this theory. This analysis is only an approximation as the time restraints of this study did not allow for the delineation of individual Redditors. Rather, this study investigated which posts attracted the most of each code specialization.

The analysis revealed that elite code dominated the commenting section of 20 out of the 59 posts. It is reasonable to surmise that since humans are a predominantly social species, most members go into the r/mbti community with some understanding of other’s behavior. A basic understanding of human behavior combined with an investigative interest in the MBTI would result in an elitist code specialization somewhat easily. However, as in all societies, there are those that rely more on knowledge or knowing codes. In r/mbti 15 out of the 59 posts were dominated by the knowledge code members and 16 by the knower code members. I would hypothesize that more knowers were drawn to the r/mbti community because they are interested in learning about identity and others, rather than debate (a pastime preferred by knowledge code members). Nevertheless, more data is needed to prove or disprove this hypothesis.

Lastly, eight posts were dominated by relativists wanting to have a little bit of fun guessing the personality types of celebrities. However, the r/mbti community has 32,195 members overall. While it is safe to assume that many of these accounts are inactive, it is also safe to assume that not all members post frequently, or perhaps at all. Therefore, this group of members is classified as

relativist code specialists in the extreme being that they only read through and vote on posts.

### **CONCLUSION**

The Myers Briggs Type Indicator tool is extremely popular. The MBTI is used by various organizations and people for guidance. However, this study revealed other reasons why people take the MBTI. The numerous discussions relating to identity revealed that members longed to fit in and have their daily life practices and feelings recognized as legitimate. The MBTI finally gave users, who felt unrecognized by society, vocabulary to use that they felt accurately described themselves. The MBTI validated their seemingly contradictory feelings and actions; and they reveled in it. The r/mbti community was brought about so members could share their enthusiasm with others that knew the lexicon. This enthusiasm also manifests itself in the longer discussions seeking truth where the ideas were valued far above the use of proper grammar. Last but not least, are the discussions centered around gaining more knowledge? These discussions are essential to maintaining the community because it further validates every member by letting them share their knowledge and experiences with a group of people who will respect them.

In the research of MBTI communities, this investigation brings to light a novel role the MBTI plays; validating the Redditors’ feelings. In a society that criticizes quickly, freely, and as a matter of course, users of the MBTI find solace in its all-encompassing personality descriptions. In furthering research on Reddit, this investigation provides ample positive evidence that Reddit is not simply a place to play. Undoubtedly a place of negative aspects, Reddit is also home to communities like r/mbti that are filled with many intelligent Redditors having their human need to connect fulfilled. In addition, thoroughly researched discussions are taking place on a renowned “play” site for the entertainment of others, calling into question various societal views, such as: those without formal training and research are uninformed and lack the dedication or resources to become so, or, the public in general is uninterested or has no use for “higher” education. The r/mbti community is discussing highly theoretical ideas in their free time and many of them are probably not academics. With respect to discourse communities, research into the r/mbti community revealed that communities naturally form out of need, whether that need be to discuss, commiserate, celebrate, or just acknowledge. Also, due to the total number of members contrasted with the

number of members who post, those possessing a relativist code may be more important to maintaining a community than heretofore discussed.

Some limitations to such a specified and short study are the small sample sizes and time windows. In addition to collecting more data, further studies might benefit from an in-depth analysis of one post, tracking upvotes and comments over time, and analyzing top posts of all time. Additionally, a comparison of comments

to votes might help discern if relativists are more inclined to only vote and how much of an impact this has on the popularity of a post. Data such as this would further illuminate the meaning making practices of the r/mbti community.

Overall, prospective members of r/mbti should arrive equipped with a baseline knowledge of MBTI. Additionally, they should possess either significant personal experience or knowledge in order to become a full-

fledged member. After such requirements are met, the r/mbti community will be more than happy to discuss anything from celebrity personalities to the pros and cons of the Beebe function. Just as long as these new members keep to themes delineated within this paper, they will be in for many well-informed funny validating conversations.

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## Endnotes

<sup>1</sup> One's tertiary function is a skill the individual has access to but it is less developed than the functions of the individual's four-letter sequence.

The ability to use one's tertiary function increases later in life (The Myers & Briggs Foundation).

<sup>2</sup> One who looks for logic and stability outside the self (The Myers & Briggs Foundation).

<sup>3</sup> One who focuses on their own value system (The Myers & Briggs Foundation).

<sup>4</sup> A notation style used to indicate all personality types that include the letters I and T: ISTJ, INTJ, ISTP, INTP

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## Appendix

### Posts within 7 hours (11/5/2018 12:44)

1. "I'm having a hard time accepting my real type" – 24 votes/53 comments (trying to identify oneself)
2. "What is my type" – 5 votes/3 comments (trying to identify oneself)
3. "Normie and NPC meme is just bias against xSFJs in general" – 4 votes/ 3 comments (commentary, characterizing types)
4. "What would you say is your most characterizing function?" – 5 votes/12 comments (direct question, characterizing function)
5. "Ne vs Se on video games" – 1 vote/5 comments (Characterizing function)
6. "Competitive Ne hobbies" – 2 votes/ 6 comments (Characterizing function)
7. "Adjectives you associate with each type" – 3 votes/ 8 comments (Characterizing type)
8. "Type my friend" – 2 votes/ 11 comments (trying to identify others)
9. "MBTI WhatsApp group" – 1 vote/ 0 comments (forming a sub community)
10. "The hidden true of MBTI - cognitive functions are biases of the mind" – 0 comments/votes (commentary, merit)
11. "Stereotypes: INTJ vs INTP (Question)" – 2 votes/5 comments (direct question, Characterizing type)
12. "An amusing observation - relationships" – 1 vote/2 comments (commentary, discussion, characterizing types)
13. "How many INTPs does it take to change a lightbulb?" – 1 vote/ 2 comments (direct question, Characterizing type)
14. "The many uses of the Beebe Model" – 1 vote/ 2 comments (commentary turned discussion, merits)

### Posts within 1 day (11/12/2018 12:41pm)

1. "Leadership qualities of each type" – 1/0 (Characterizing functions)
2. "Type iconic protagonists" – 2/2 (Characterizing functions)
3. "Thinking vs. feeling (yes, yet another question about this)" – 2/2 (direct question, characterizing functions)
4. "Is depression more commonly found in some personality types than others" – 12 votes/13 comments (characterizing type)
5. "Ti-Ne-Si?" – 0/11 (Characterizing function)
6. "What's a self-help book that has changed the way you approach life?" – 3/7 (direct question, self-improvement)
7. "What's the one thing you wish the opposite types would understand?" – 4/18 (direct question, promoting understanding through sharing experiences)
8. "What champions do you guys main in league of legends?" – 1/11 (direct question, characterizing type)
9. "Tv/Series/Movie recommendations" – 2/6 (anomaly, unrelated)
10. "MBTI and parents/siblings" – 2/6 (promoting understanding, discussion)
11. "How do I handle a desperate isfj" – 1/4 (direct question, asking for help understanding)
12. "Say something nice about a type that's not yours!" – 50/119 (characterizing type)

13. "best way to figure out which type you are" – 3/1 (trying to identify oneself)
14. "INEJ "hate" thread" – 0/11 (characterizing type)
15. "Let's Play a Game!" – 2/3 (characterizing type)
16. "If you could trade types for one to seven days which type would you trade with and why?" – 4/22 (characterizing types – by saying what they think they would get out of being those types)
17. "Am I confused about my type, or just about my life?" – 1/2 (trying to identify oneself)
18. "Are Ji doms usually the most authentic?" – 3/8 (characterizing functions)
19. "What does every function look like in its inferior and PoLR form?" – 8/31 (characterizing function)
20. "Is r/shittyreactiongifs an example of Ni-Te?" – 0/4 (characterizing function)
21. "Liza Koshy" – 1/5 (trying to identify others)
22. "What's the worst assumption one has made about your type?" – 22/86 (promoting understanding)
23. "Type me" – 2/7 (Trying to identify oneself)
24. "Sociopath's results on the MBTI test" – 53/49 (promoting understanding)
25. "INFP testing as ESTJ" – 6/3 (trying to identify oneself)
26. "Getting reaction out of people, what is this?" – 11/22 (trying to identify oneself)
27. "J's, how do you organize your life and task lists?" – 6/ 10 (direct question, self-improvement)
28. "Do any critics reject MBTI because they believe certain MBTI types/combinations are not normal or possible?" – 11/26 (merits)
29. "Post your current phone wallpaper or desktop background" – 2/29 (promoting understanding)
30. "Does a very confident INTJ transform into an ENTJ" – 0/12 (characterizing types)
31. "Dominant Introverts" – 42/77 (characterizing type)
32. "Can you grow up as an ISFJ only to develop more functions as you grow up and be more INFP?" – 0/12 (Trying to identify oneself)
33. "Is this site reliable? What would my most likely type be based of this?" – 1/4 (trying to identify oneself/ merits of certain sites)
34. "Am I possibly just an unhealthy INFP? or something entirely different?" – 6/2 (trying to identify oneself)
35. "Why do Ji doms seem to value "closure" so much?" – 1/10 (direct question, characterizing functions)
36. "ExTP?" – 8/16 (trying to identify oneself)
37. "Meghan Markle?" – 6/7 (trying to identify others)
38. "Are the IDRlabs tests accurate?" – 5/7 (discussing merits)
39. "My analysis/typing of the Star Trek characters" – 8/3 (characterizing types)
40. "I've scoured the internet and have yet to find a MBTI typing thread for Everwood" – 2/1 (characterizing types)
41. "Do type rivalries exist?" - 33/81 (promoting understanding)
42. "I accurately typed someone in real life!!!!" – 12/12 (trying to identify others)
43. "Best website for mbti resources?" – 1/6 (discussing merits)
44. "Am I an estp or entp?" – 5/15 (trying to identify oneself)



*Unclean Yellow*, 36"x36" oil on canvas 2019, by artist Arielle Tesoriero

"Unclean Yellow" references the 1892 short story "The Yellow Wallpaper" written by Charlotte Perkins Gilman. The story encompasses an unnamed narrator who suffers from post-partum depression who is confined in a colonial mansion her husband rented for a summer. The narrator's husband, John, is a respected physician and diagnoses the narrator with "temporary nervous depression—a slight hysterical tendency." As part of her cure, the narrator is forbidden from pursuing any activity other than domestic work, which includes working and writing. They reside in a room at the top of the house, with barred windows and peeling yellow wallpaper. The narrator describes "the color [as] repellent, almost revolting: a smouldering, unclean yellow" as she "never saw a worse paper in [her] life." The narrator's condition worsens as she grows increasingly anxious and depressed. She spends most of her time studying the wallpaper, which she describes as helping her condition.

The narrator then starts to observe a woman hiding behind the wallpaper. The image of the figure stooping down and "creeping" around behind the wallpaper becomes clearer each day. The narrator can see very distinctly that the figure is a woman trapped behind bars. She also begins to notice that the wallpaper smells, and that the smell follows her at all times. At night, the woman in the wallpaper shakes the bars in the pattern violently as she tries to break through them, but she cannot break free. The swirling pattern has strangled the heads of the many women who have tried to break through the wallpaper. Soon, the narrator locks herself in her room and starts stripping the wallpaper. She hears shrieks within the wallpaper as she tears it off. She contemplates jumping out of a window, but she can't because the windows are barred. In the morning, her husband finds her creeping around her room with all the wallpaper ripped off. He faints, and the narrator continues to creep over him.

"Unclean Yellow" mirrors "The Yellow Wallpaper" as there is a mutual theme of repression, imprisonment, and escape from an unfulfilling life. While physical escape from contemporary society and from the constraints of her own life are impossible for the narrator, she is able to find escape in the imaginary woman in the wallpaper. Similarly, I use social media to escape my life and create a false sense of reality. The wallpaper in "Unclean Yellow" represents social media platforms such as Facebook or Instagram, where users are able to portray a false identity to project to others. The result of this projection is not the destruction of the wallpaper, but the decomposition of the figure itself—as my face is three dimensional, but my body has disappeared and all that is left is the stripes of my shirt. My hair deconstructs itself into abstract forms as I lose my body. I will eventually become the wallpaper, or simply the social media platform. "It was not intended to drive people crazy, but to save people from being crazy, and it worked." - Charlotte Perkins Gilman.

For further information, visit [arielletesoriero.com](http://arielletesoriero.com).

# INCREASING MIGRANT WOMEN'S REPORT OF PPD: ELIMINATING STIGMA THROUGH IMPROVED SCREENING PRACTICES

*N'tuma Kamara*

## **ABSTRACT**

The World Health Organization defines health as a state of complete physical, mental, and social wellbeing. However, all too often, mental health tends to be overlooked whether by patients themselves or by their physicians. Postpartum depression (PPD) is one commonly overlooked psychiatric condition – its late detection and treatment posing severe health risks for both mother and offspring. Existing medical literature recognizes immigrant women as having the highest risk for postpartum depression. However, this group of women is identified as least likely to seek help for PPD. For immigrant women, barriers at the individual and healthcare level hinder PPD diagnosis. Among these barriers is cultural stigma. This paper draws upon peer-reviewed studies across the social sciences and medical literature to argue that PPD screening practices alone are ineffective in decreasing this stigma. At the health care level, inadequate screening practices – notably low screenings by practitioners and culturally inappropriate types and use of risk assessment tools – act as further deterrents. Influential figures and organizations in the health care setting need to recognize the urgent need to screen for PPD among immigrant women.

## **INTRODUCTION**

In the year following childbirth, one in seven women in the United States may experience postpartum depression (Wisner et al., 2013). With approximately four million live births occurring annually in the U.S., this equates to roughly 600,000 diagnosed cases of postpartum depression (Carberg, 2018). When accounting for all clinically recognized pregnancies, including miscarriages and stillbirths, the number of reported postpartum depression cases increases to over 900,000 (Carberg, 2018). Postpartum depression (PPD) is a mood disorder that occurs in mothers during the first year after childbirth. As noted by Evagorou et al. (2016), the condition includes the typical symptoms of a depressive episode (i.e. hopelessness, fatigue, changes in appetite and sleep patterns, and suicidal thoughts),

coupled with irrational fears for the child's health and, in some cases, thoughts of harming one's child. Given the prevalence and health consequences of postpartum depression, it may seem obvious that PPD sufferers would seek out appropriate health services. However, Thurgood, Avery, & Williamson (2009) stated that as many as 50% of PPD cases go undiagnosed, primarily due to the reluctance of mothers to report their depression. This hesitancy in help-seeking is highest among immigrant women in the United States, who also face a higher incidence rate of postpartum depression (Schmied, Black, Naidoo, Dahlen, & Liamputtong, 2017; Playfair, Salami, & Hegadoren, 2017; Santiago & Figueiredo, 2015). For this specific group of women, barriers to seeking help exist at the individual and health care level. At the individual level, the cultural stigma surrounding mental health is a major obstacle to reporting PPD symptoms (Sampson, Torres, Duron, & Davidson, 2018). At the health care level, inadequate screening practices – notably low screenings by practitioners and culturally inappropriate types and use of risk assessment tools – act as further deterrents. Screenings for postpartum depression may be bypassed due to language barriers, a patient's reluctance to disclose emotional problems, and a lack of physician training in detecting PPD (Tobin, Napoli, & Wood-Gauthier, 2015). Moreover, the Western-centric nature of standard screening tools like the Edinburgh postnatal depression scale engenders complications of cultural relevance and semantics (Tobin et al., 2015). The United States is home to a growing number of ethnic groups in need of culturally sensitive health care. Current screening practices must be improved to eliminate cultural stigma and encourage immigrant women's help-seeking behaviors for postpartum depression.

## **POSTPARTUM DEPRESSION: AN OVERVIEW**

The postpartum period is the period in which mothers experience emotional, physical, and social changes related to a newborn's arrival. It is consequently a

critical time for a mother's health. While many women acclimatize themselves readily to the increased pressures resulting from pregnancy and childbirth, some may suffer emotional complications that, if not treated promptly, may lead to ill-health and possibly death. Although the exact causes of PPD are unknown, research shows that risk factors such as a previous history of depression and anxiety, stressful life events, and genetic predisposition can trigger the onset of PPD, the effects of which may manifest as mental distress in mothers, developmental issues in infants, and familial problems (Playfair et al., 2017; McGarry, Sheng, Egger, & Baksh, 2009). Mental distress in mothers includes depressed mood, loss of interest or pleasure in activities, restlessness, irritability, and low energy (Sit & Wisner, 2009). Such psychological symptoms can impede maternal-infant bonding, as the afflicted mother is less inclined to engage with her newborn. As cited by Evans et al. (2015) and Tel et al. (2018), PPD can also cause weak attachments of the infant to his or her mother, which could result in behavioral and emotional difficulties, delays in development, and poor socialization. Postpartum depression can also undermine family dynamics. Changes in the mother's demeanor can engender feelings of confusion, disappointment, and helplessness in the spouse and fuel marital discord. For immigrant women whose cultures may disapprove of negative emotions concerning motherhood, their expression of PPD could create a hostile environment. This hostility could worsen their mental state, as their husbands and broader family may not provide the support needed at this critical time.

Evans et al. (2015) and Mukherjee et al. (2017) reported that 10 to 20% of postpartum women in the U.S. experience depression. However, according to Tobin et al. (2015), this rate can be as high as 42% in the female immigrant population due to factors such as lack of social support, migration status issues, language and financial barriers, and/or little understanding of the healthcare system and how to access it (Evans, Phillippi, & Gee, 2015; Tobin

et al., 2015). These sociocultural factors hinder the establishment of a trusting relationship between immigrant women and their healthcare providers. In so doing, they contribute to immigrant women's unwillingness to open up about their experiences with PPD, and thwart opportunities for screening.

### **IMMIGRANT WOMEN: AN INSIGHT INTO THEIR HELP-SEEKING BEHAVIOR**

More than 20 million female immigrants reside in the United States. These women form a subset of the U.S. population characterized by diverse nationalities and health needs unique to the immigrant community and its individual members (American Immigration Council, 2014). With this diversity comes different challenges to receiving health care; documentation being the most obvious one. According to Fazel-Zarandi et al. (2018), over 11.3 million immigrants are undocumented. This immigration status discourages many from accessing medical services because of the fear that their personal information will be disclosed (Kuo, 2017). In the case of immigrant women suffering from PPD, undocumented citizenship is a reason to delay getting care before or during the early stages of the disorder. This long wait can result in visits to the emergency room that could have been avoided with the preventive care offered at a routine checkup. An undocumented status also brings about added stress due to worries about deportation. Howard (2018) imparted that the recent anti-immigration sentiment brought in by the Trump administration places immigrant women at even higher risks for depression during their pregnancy. As the number of deportations rises under President Trump, more immigrants, especially Mexican immigrants, fear the arrival of the U.S. Immigration and Customs Enforcement (ICE) on their doorsteps (Howard, 2018). Accordingly, many immigrants are increasingly determined to avoid the U.S. health care system because a visit from ICE entails separation from family members and the return to the violence and poverty in their home countries.

Along with citizenship issues, language and financial barriers are additional challenges to receiving care. As Schyve (2007) explained, when non-English speaking patients are treated by physicians who speak only English, their ability to obtain information regarding their health is greatly diminished. Likewise, for English-speaking immigrant women, cultural beliefs could foster miscommunication with care providers (Schyve, 2007). These beliefs can influence

their understanding of health concepts and affect their health-related decisions. For example, the Pew Research Center (2012) found that some Muslims believe in the existence of the demon *jinn*, stating that 77% of Malaysian Muslims believe in *jinn*, as well as 86% of Moroccan and 55% of Iraqi Muslims. *Jinn*-possession is thought to cause mental illness. Consequently, individuals from these cultures might be motivated to seek treatment from a spiritual healer instead of a medical doctor because of their uneasiness with the style of American health care. In terms of financial barriers, ethnic groups in the U.S. are more prone to being uninsured or underinsured. Dr. Jane Delgado, President and CEO of the National Health Alliance for Hispanics, identified Hispanics as least likely to have health insurance, with 30% of this group uninsured (Hickson, 2012). For the many Hispanics working minimum wage jobs, their employment status disqualifies them from public health programs while denying them the income needed to afford quality care (Machado, 2014). Hispanics are therefore liable to postpone visiting their doctors until they are very sick, lowering their quality of life.

Health professionals should encourage help-seeking by becoming sensitive to the diversity within the immigrant community and tailoring their interventions accordingly. Regarding *Jinn*, health providers can accommodate patients' spiritual beliefs by allowing them to hang amulets in the room or pray as part of the treatment plan. Small actions like these will appeal to immigrants, most of whom value a doctor-patient relationship that is welcoming and concerned for the individual as a whole. Overall, failing to respond to the health needs of diverse women greatly diminishes the ability to screen and treat this population for complications such as PPD. With that said, cultural stigma is a shared health challenge among all immigrants, and a deciding factor in whether immigrant women obtain screenings for PPD. Therefore, the elimination of cultural stigma is key to increasing immigrant women's help-seeking behaviors.

### **CULTURAL STIGMA AND HELP-SEEKING**

Matsumoto (1996) defined culture as "the set of attitudes, values, beliefs, and behaviors shared by a group of people" and communicated from one generation to the next (as cited in Spencer-Oatey, 2012). In the health care setting, culture is consequently a powerful driver of behavior. According to the Office of the Surgeon General (2001), culture influences how people communicate their

symptoms and which ones they report. It also decisively affects whether people seek help, the type of help they seek, and how much stigma they attach to mental illness (Office of the Surgeon General, 2001). As noted by Thurgood et al. (2009), culture also influences the meanings people give to their mental state. In keeping with these findings, a systematic review of literature revealed that certain ethnic groups in the U.S. experience heightened community and self-imposed stigma in admitting to PPD symptoms. Specifically, Schmied et al. (2017) found that most of the participants in their study came from countries with high expectations of motherhood. Similarly, in a survey of 19 Latinas in the U.S., Sampson et al. (2017) concluded that fear of being labeled as crazy or being judged as an incompetent mother was a common obstacle to the acknowledgment of postpartum depression. This stigma is prominent among collectivistic or non-Western cultures, namely in Africa, Asia, Latin America, and the Middle East. Collectivistic cultures are community-oriented. Leake and Black (2005) observed that these cultures place great importance on upholding the family's reputation and are inclined to dismiss mental health disorders, which are viewed as sources of shame for the entire family. Thus, collectivistic cultures do not recognize postpartum depression as a legitimate medical concern. Rather, PPD is regarded as made-up and frowned upon by relatives. Women suffering from PPD may internalize this stigma and deny their symptoms. Moreover, as mental illness is taboo in collectivistic cultures, they might see the condition as a spiritual problem rather than a medical one, and resort to their religion for a cure.

Abdullah and Brown (2011) highlighted the ethnocultural beliefs that shape mental illness stigma. The authors noted that in Asia, where many cultures value strict adherence to norms, emotional self-control, and family recognition through achievement, mental illnesses are often stigmatized and seen as shameful. The authors also found that some African cultures may disapprove of members with psychiatric disorders because of their decreased capacity to fulfill traditionally assigned roles. Such findings reveal the centrality of culture to obtaining treatment for mental health. The understanding of the impact cultural norms have is crucial to developing mental health services appropriate to the cultural and social context of racial and ethnic groups in the U.S. It will also enable doctors to incorporate their patients' values into care delivery as a way of bridging the divide between cultural beliefs and Western medical practices.

## IMPROVING HELP-SEEKING THROUGH BETTER SCREENING PRACTICES

Understandably, little can be done to change the attitude of an entire culture. A more natural and effective approach is to motivate immigrant women to accept PPD as a legitimate obstetric complication and to receive care. Health care providers, specifically pediatricians, obstetricians-gynecologists (OB-GYNs), and family practitioners, are key players in encouraging help-seeking behaviors as they are in constant contact with mothers during and after pregnancy. Well-baby visits occurring three to five days after birth are opportune times for pediatricians to gauge mothers' emotional wellness. Likewise, at six weeks post-birth, obstetricians and gynecologists evaluate postpartum women for a general examination. For this reason, Sit and Wisner (2009) identified OB-GYNs as well-positioned to detect PPD. Even more so, OB-GYNs can incorporate pre-birth depression screenings within the standard care delivered to stop the advancement of depression into the postpartum period. The same can be said for family practitioners, whose comprehensive role in their patients' care could make them sensitive and responsive to changes in patients indicating PPD.

As previously shown, the involved role of health providers in a mother's pregnancy means they are valuable to the detection of depression. Yet, some may forgo opportunities to screen for reasons ranging from time constraints to insufficient training (Evans, Phillippi, & Gee, 2015). Evans et al. (2015) revealed low screening rates for postpartum depression among a majority of physicians. Their literature review showed pediatricians as least likely to use screening tools, compared with OB/GYNs (4%) and family practitioners (10%). These low percentages and inconsistencies in PPD assessment exist because screening is not a routine part of clinicians' care. Although organizations such as the American College of Obstetricians and Gynecologists (ACOG) and the U.S. Preventative Services Task Force recommend routine screening for postpartum depression, the guidelines are not consistent across states or health institutions, as noted by Knights et al. (2016). Practitioner inconsistencies with screening means that immigrant women are not forthcoming about their experience of PPD. According to Schmied et al. (2017), a common misconception among immigrant mothers is that the symptoms of PPD are a normal part of pregnancy. Because these women do not recognize their symptoms as stemming from postpartum complications, they

are not apt to ask if symptoms they are experiencing are normal or signs of mental distress. The implementation of routine screening would provide a valuable opportunity to ask about and assess for PPD. Further, it will act as an incentive for practitioners to adopt culturally responsive practices so that patients agree to screening.

Additional findings by Tobin et al. (2015) also brought into question the validity and quality of the risk-assessment screening of foreign-born women. PPD risk assessment tools include the Edinburgh Postnatal Depression Scale (EPDS), the Beck Depression Index, and the General Health Questionnaire (GHQ), self-report inventories composed of multiple choice questions that gauge cognitive and physical symptoms of depression in patients. While certain organizations, including Postpartum Support International (PSI), recommend the use of these tools for universal screening (Postpartum Support International, 2018), the evidence supporting universal screenings outcomes is limited. Further research is needed on PPD screening outcomes before universal screenings can be employed. Also, while current risk assessment tools are mostly effective in detecting PPD in the general population (Playfair, et al., 2017), they have been found to be ineffective for diagnosing PPD in immigrant women (Tobin et al., 2015).

Interpretation is one of the challenges to screening immigrant women for PPD. Health care providers were found to rely on language interpreters when using tools to assess PPD in non-English speaking women (Playfair et al., 2017). It was discovered that this method of screening presented challenges because the concept of PPD may not exist in non-Western languages. Playfair et al. (2017) also mentioned that words such as "depressed" and "sadness" may not translate in certain languages, including some in Asia. Thus, interpreters may struggle to find a fitting description of PPD within their native tongue, which can result in flawed or meaningless results. Problems with translation could lead to an incorrect diagnosis or no diagnosis at all. Interpreters and health care practitioners also pose the risk of offending immigrant women. It was found by Playfair et al. (2017) that Vietnamese and Arabic mothers felt that questions on the EPDS and GHQ regarding self-harm, sex, and suicide were inappropriate. A direct translation of such questions might seem insensitive to patients from cultures where self-harm, sex, and suicide have different connotations and are considered taboo. All of these difficulties reinforce the communication barriers that

cause frustrations with seeking medical interventions. Notably, the overt approach to detecting PPD may magnify the stigma surrounding PPD.

Another concern with screening tools is their ability to detect depressive symptoms in certain ethnic groups. EPDS and other assessment tools of its kind are heavily influenced by Western ideas, including how emotions are experienced and displayed. Therefore, symptom expression and risk might not be reflected in results because, the manifestation of PPD differs between Western and non-Western women as (Evagorou et al., 2016). In Korea, PPD is mainly manifested with headaches, dizziness, sleep disturbances, and numbness, while in Nigeria, the condition is displayed through nausea, vomiting, and a burning sensation in the head. Most of the aforementioned symptoms fall under the three noted ways in which immigrant women manifest PPD: physical distress, illusionistic experiences (i.e., the phantom cry, the sensation of ants in the head, etc.), and metaphors symbolizing the unnamable ailment (Evagorou, Arvaniti, & Samakouri, 2016). While these findings do not represent all immigrant women, they show substantial differences in the appearance of PPD around the world. Current screening tools, therefore, risk invalidating immigrant women's experiences of PPD, preventing future disclosure of symptoms.

## SOLUTIONS FOR IMPROVED SCREENING PRACTICES

Further quantitative and qualitative research on immigrant women is needed to improve screening practices. As a first step, hospitals and primary care teams must conduct a health needs assessment on the immigrant community as it relates to postpartum depression. Wright, Williams and Wilkinson (1998) defined a health needs assessment as a systematic approach to understanding a population and its needs for more efficient healthcare delivery. A needs assessment would inform health providers about immigrant women's health profile, which includes their sociodemographic characteristics, health status, risk factors, and health behaviors. The knowledge derived from the health profile will enable health programs to establish immigrant-friendly health services and reinforce minimum health-care standards for all immigrant groups. An assessment of different ethnic and cultural groups must also be taken. These groups face different problems from the wider immigrant community and require services that are sensitive to their cultural and linguistic backgrounds. The understanding of their distinctive cultural practices, beliefs, PPD symptom expressions, and languages will aid health

providers in the development of screening practices.

To begin with, information on cultural practices and beliefs will guide health providers in their interactions with immigrant women. For instance, Su et al. (2014) confirmed that many cultural customs do not conform to Western views on autonomy. Cultures where other relatives make decisions related to a woman's health are pertinent examples. When caring for these women, health providers must involve the family in discussions as a show of respect. In the case of PPD, providers should educate the family or whoever is the head of decision-making about PPD, the importance of screening, and available treatment methods. Actions such as these build a sense of trust and familiarity, which plays at least a partial role in women consenting to be screened. Additional information about symptom expressions in immigrant women will also improve screening practices. Currently, the EPDS, GHQ, and other risk assessment tools are Western-centric. They are based mostly on Western women's experiences of PPD and use language that may not resonant with a vast majority of non-Western women. Prominent health organizations must undertake cross-cultural investigations into women's experiences of PPD. More specifically, they must conduct studies on the appearance of PPD around the world and among immigrants in the United States to create risk assessment tests that

thoroughly reflect PPD manifestation.

It is true that by attempting to develop screenings tailored to every cultural group, health organizations may fall into the trap of stereotypes. Every immigrant woman is different, each with her own behavioral, cognitive, and emotional expressions. However, as Playfair et al. (2017) noted, the adoption of more culturally tailored assessments is vital to ending the existing "one-size-fits-all" approach to screenings. By combining evidence-based research on less represented ethnic and racial groups with personal knowledge of patients' needs, health professionals will be better equipped in adapting PPD risk assessment to individual immigrant mothers.

Removing language barriers is another solution for improved screening practices. The diversity of languages within the immigrant community and the limited access to interpreters, contribute to the challenges of providing culturally sensitive care (Tobin et al., 2015; Playfair et al., 2017). Moreover, the translation of current screening tools might not be an appropriate method for detecting PPD in immigrant women (Playfair et al., 2017). One possible solution would be for health practices to hire interpreters who ethnically and linguistically represent the immigrant population in the communities they serve. However, even if these interpreters were made available, difficulties with conceptual equivalence might still result in faulty translation. This hurdle to screening highlights

the importance of incorporating into practice risk assessments questions that are culturally related to PPD symptom expressions. With the improvement of screening practices, the health field can go about enforcing universal screening, so that health providers are obligated to screen for PPD in immigrant women, as well as in the general population.

In short, although postpartum depression is a detectable and treatable condition, the low screening rates are worrisome given the consequences of untreated PPD on a mother and her child. Immigrant women face a number of sociocultural barriers to obtaining screening for PPD, the foremost of which is stigma. The stigmatization of PPD in certain non-Western cultures hinders immigrant women's ability to recognize their mental state and access appropriate health services. Current PPD screening practices do not help in eliminating this stigma; they might even be contributing factors. Thus, health professionals must incorporate cultural sensitivity into their interactions with immigrant women as well as in the risk assessment tools employed in screening to remove stigma and empower immigrant women to take control of their mental health.

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# ETHICS AND MORALS IN NICU CARE: ATTITUDES, STIGMAS, AND CARE AMONG MEDICAL STAFF

Maggie Giggey

## ABSTRACT

The rising incidence of Neonatal Abstinence Syndrome (NAS) due to opioid-addicted pregnancies has resulted in moral and ethical dilemmas among medical staff in the Neonatal Intensive Care Unit (NICU). Dilemmas result from interacting with two highly demanding populations: the substance-abusing mother and the NAS infant. In order to analyze attitudes and determine the relevance of morals and ethics in the NICU, this paper addresses three major dilemmas present in the literature: (1) role conflict, (2) the NICU as an unfit environment for NAS, and (3) stigmas about substance abuse in mothers. A universal medical oath and substance abuse education are suggested as potential solutions to change attitudes and stigmas of addiction in the NICU. By critically analyzing literature from reputable journals, results have indicated that negative attitudes promulgated by prejudice toward opioid addiction contributes to a decrease in care to both NAS infants and their mothers. This paper aims to increase education among the medical and general population and develop a better understanding of larger influences in medical care practices.

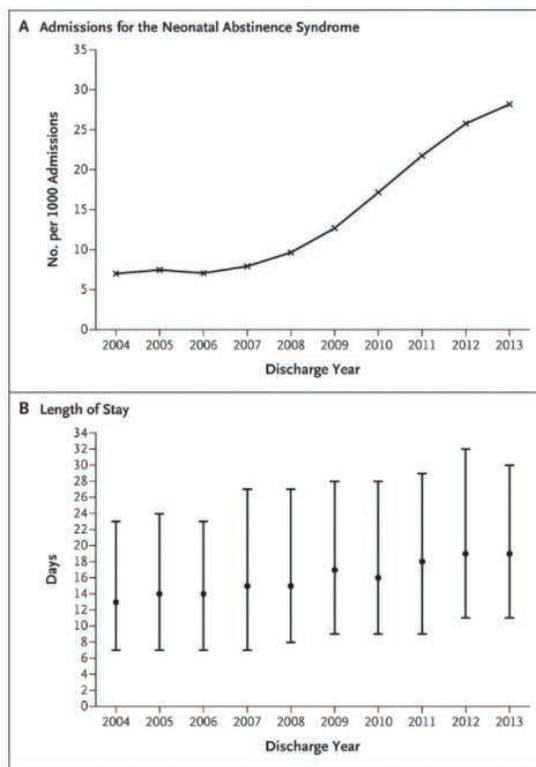
## INTRODUCTION

The Neonatal Intensive Care Unit (NICU) typically provides critical care to infants born before the full nine months gestation. These premature infants require technological and medical interventions to breathe, eat, and move because they are highly underdeveloped and are at risk of health complications from the moment they leave the womb. However, a second infant population is also cared for in the NICU: those with significant health issues. Neonatal Abstinence Syndrome (NAS), or drug addiction in babies, is one such case handled by the NICU. NAS results from drug exposure from the pregnant mother and includes symptoms such as projectile vomiting, poor feeding, excessive sucking, tremors, seizures, high-pitched crying, sleep disturbances, etc. (McQueen & Murphy-Oikonen, 2016; Tolia et al., 2015). In recent years, there has been an increase in opioid addiction in pregnant

mothers and a subsequent increase in the abstinence syndrome in infants admitted to the NICU (Figure 1). It is reported that “5% to 10% of pregnant women abuse drugs during pregnancy, not including alcohol” (Maguire, Webb, Passmore, & Cline, 2012, pp. 282), and from 2004 to 2013, there was a significant increase in NAS NICU admissions from seven cases per 1,000 to 27 cases per 1,000 (Tolia et al., 2015, pp. 2120). Additionally, opioid addiction in pregnant mothers is not only a U.S. problem but a global one (Fraser, Barnes, Biggs, & Kain, 2007; Reid, Greaves, & Poole, 2008).

The influx of NAS patients and their substance-abusing mothers contribute to significant moral and ethical dilemmas and cause NICU staff to struggle with the ancient and modern medical oath principles of beneficence, the obligation to do good, and nonmaleficence, avoiding harmful actions/words (Maguire et al., 2012, pp. 284). In other words, medical personnel must respect the patient, promote healing with as little discomfort as possible, and provide a supportive environment. The associated dilemmas include: conflict between the perception of the medical staff’s role in the field and providing mundane nursery-like care to NAS patients, concerns on whether NAS infants belong in the NICU or should be cared for in a better suited environment, and stigmas regarding substance abuse in mothers. An increase in the prevalence of NAS and a reported overall lack of knowledge on substance abuse in the literature, warrant solutions in medical and nursing school education.

A positive environment and solutions to alleviate punitive attitudes are needed due to the increasing incidence of NAS in the NICU. Negative attitudes and stigmas from medical staff toward NAS in the NICU contribute to a negative environment for NAS infants and drug-addicted mothers. The following paper



**Figure 1**  
*Increasing NAS Admissions and Length of Stay*  
Adapted from “Increasing incidence of the neonatal abstinence syndrome in U.S. neonatal ICUs” by Tolia et al., 2015, *The New England Journal of Medicine*. doi: 10.1056/NEJMSa1500439

discusses the relevance of morals and ethics in the NICU and the three major themes introduced above: role conflict, the NICU as an unfit environment for NAS, and stigmas about substance abuse in mothers. Solutions in the form of a universal medical oath, increased substance-abuse education in medical and nursing schools, and refresher courses during active practice of medicine will be introduced as possible improvements to the NICU and the medical field at large. This paper seeks to increase education among three populations: the medical staff, the general population, and addicted mothers.

## BACKGROUND: MORALS AND ETHICS IN THE MEDICAL FIELD

A doctor's role is of great importance in society because of the intimacy and direct care intrinsic to the physician-patient relationship. Medical professionals – nurses especially – are required to protect the patient by keeping their information confidential, treating the patient regardless of opinion, and being respectful to all parties involved in the healing and support of the patient. Due to this complex interaction, it is expected that medical professionals remain morally and ethically adept to provide the utmost provision of care. Morality is a set of traits or actions influenced by the values within society; whereas, ethics is an analysis and reflection between right and wrong behaviors (Simpson, 2016). A guide to moral and ethical conduct in the medical field is often found in the form of medical oaths. An analysis of moral principles found in ancient and modern medical oaths will be discussed and applied to a specific area in medicine: the NICU and NAS care. The quality of care toward patients and families could increase if there is a significant focus on moral principles and increased enforcement of them.

## MODERN MEDICAL OATHS AND THE HIPPOCRATIC OATH

It is common practice for medical institutions to require graduates to recite an oath in the closing ceremony at graduation. A medical oath is a pledge to adhere to moral and ethical practices in the professional field of medicine, maintain patient confidentiality, and follow the principles of beneficence and non-maleficence (Askitopoulou & Vgontzas, 2018a). By making the declaration of intent public, bystanders witness the commitment to the service of all humanity in sickness and in health.

Each oath varies depending on what practices the individual schools want to enhance. Older oaths used in the past are often modified to fit the schools' preferences. In an analysis of 84 different medical oaths, 31 oaths were derivatives of the Hippocratic Oath and encompassed similar moral and ethical principles, while others used different types of pledges (Greiner & Kaldjian, 2018). The Hippocratic Oath contains references to beneficence and nonmaleficence and was created in 400 BC, making it one of the oldest medical texts in existence. Modern medical oaths frequently reuse and reword the Hippocratic's ancient principles, indicating research should be performed to determine their relevancy to patient care in the medical field.

As medical professionals, nurses are also required to recite an oath upon

graduation, the Nightingale Pledge. Both oaths encompass the same moral principles of care: confidentiality, respect, beneficence, and non-maleficence. Specifically, both address protecting personal information, abstaining from delivery of harmful drugs, and remaining faithful to the profession (Miracle, 2009; Simpson, 2016, pp. 104). For this paper, references to universal oaths will be applied to both the physician and nurse population.

## DISCOURSE ON RELEVANCY.

Due to the variance and multitude of oaths, some argue that the Hippocratic Oath is no longer relevant in the medical field. The biggest criticism of the oath is that the "society ... has undergone major, social, political and moral changes" (Askitopoulou & Vgontzas, 2018a, pp. 1482). Not only are there arguments about the inconsistent expression of ethical values across medical oaths, there are debates on whether political and economic changes affect relevancy.

Simpson (2016) concluded that medical oaths are no longer relevant in healthcare because they have no impact on the ethical behavior of physicians due to the barriers from economic and political standpoints. He posits that significant cost reductions, insurance schemes, and universal healthcare aid diminishes the physician-patient relationship and creates administrations that are "subservient to the demands of the medical aid scheme" (p. 54).

Although this is an issue faced by hospital administrations, it is not a barrier to the oath itself. In fact, now more than ever, medical professionals must stay true to the real values of caring for patients and fight against a society becoming increasingly focused on economics. The values represented in the Hippocratic Oath are still very much relevant today because without a basic guideline, medical professionals retain "too much autonomy [which] leaves no binding on professionals and ... becomes a powered vehicle without a brake" (Kumar, 2010, pp. 172). As stated by Askitopoulou and Vgontzas (2018b):

*Even though the ethics of the Oath [were] inspired by the moral culture of its time, the Oath as a whole is still pertinent to medical professionals conveying the duties and commitments of a physician. The fundamental principles of beneficence, non-maleficence and confidentiality in the physician-patient relationship ... are principles still applicable to the ethical practice of modern medicine (p. 1498).*

Thus, morals and ethics are still an important aspect of healthcare and should be implemented in the creation of a universal oath.

The parts of the Oath being emphasized in this paper are beneficence and non-maleficence, two moral principles that create dilemma in the NICU. Moral dilemmas in these areas contribute to the ensuing discourse on conflict with mothers, families, and NAS infants. Before introducing potential solutions, an analysis of stigmas, attitudes, and dilemmas regarding these populations is necessary to understand challenges to moral principles.

## NEGATIVE ATTITUDES OF NURSES AND PHYSICIANS IN NAS CARE

NAS infants require a lot of extra attention and handling. A focus on nurse attitudes is predominant because of their frequent contact with the NAS babies and their encompassment of a significant portion of the NICU staff. Dr. Diana El-Metwally, a NICU doctor, described that many babies are often in such a tight, clenched position that they seem completely rigid and are sometimes unresponsive to stimuli such as a soothing touch or a warm bottle (as cited in Abbasi, 2017). Nurses must spend a significant amount of time attempting to calm these restless infants, which contributes to their feelings of inadequacy and blame toward the addicted parents. Out of frustration for attending to a difficult infant, one nurse responded vehemently on how mothers make their infants suffer: "I want to take a recorder and just record their crying, and have the mom ... sit at the bedside and whenever they fall asleep just put it on and say, Listen, we have to deal with this weaning process that you put them through" (Maguire et al., 2012, pp. 283). Other negative attitudes among medical staff include apprehension, frustration, blame, and cynicism, which contributes to the loss of beneficence and nonmaleficence in the medical field. The staff no longer avoid harmful acts and may fail to provide the best care to patients.

Dilemmas among the NICU staff stem from social and health-related interactions between two groups of people: substance-abusing mothers and their babies. As evidenced in the quote above, nurses feel great stress when attending to drug addiction and it affects their actions by contributing to an overall punitive environment in the NICU. In addition to verbal discontent and condescension, a study done in Australia found that avoidant body language reflecting disapproval is often exhibited by staff and affects how the mother will act around them (Fraser, Barnes, Biggs, & Kain, 2007). As a result of cynical beliefs and attitudes, there is a decrease in overall quality of care to both NAS patients and

families. The decrease in care is alarming considering the global increase in NAS diagnoses and opioid addiction in the child-bearing population.

As reported by Maguire et al. (2012), NICU nurses “are at a particularly high risk for compromised moral integrity. [They] ... must contend with personal ethical obligations to provide the best possible care to the infant while providing support and guidance to the parent” (p. 281). Medical professionals are required by oath to care for all people, yet the stigmas and prejudice held by NICU medical professionals against opioid addicts has impacted their care of NAS infants. Negative perceptions of drug abuse have been linked to the principles of benevolence and non-maleficence and reported to create dilemmas in three areas of thought: role conflict, the NICU as an unfit environment for NAS, and stigmas about substance abuse in mothers.

### **ROLE CONFLICT**

One of the most pervasive themes referenced in the literature was the conflicting role perceptions held by nurses. Murphy-Oikonen and colleagues (2010) reported “conflict between a perception of the nursing role in the NICU as technically skilled and the frequently mundane role of caring for infants with NAS” (p. 309). Unlike caring for high-risk neonates, NAS does not require a significant amount of knowledge – except when administering pharmaceuticals. Nurses feel like they aren’t performing the jobs they were trained to do: administer care to preemies who struggle to survive. Most of the roles that nurses must provide involve swaddling, rocking, and calming – actions typical of normal care from mothers. But with many of these mothers missing in action, the tasks fall to the nurse and other assistant staff, which aggravate the negative attitudes even more. The nurses report feelings of stress, inadequacy, and fatigue when caring for NAS, which also decreases staff satisfaction in the field (Sweigart, 2017).

An analysis of these frustrations introduces the concern on whether infants are getting the quality of care they need. Many nurses struggle to provide care for NAS infants in addition to high-risk preemies and feel NAS doesn’t belong in the same unit. If nurses and doctors have an overall negative attitude toward NAS care and feel the NICU is not the proper environment for this population, how can they provide adequate care for these babies if they constantly feel exasperated?

### **THE NICU AS AN UNFIT ENVIRONMENT FOR NAS**

Time constraints, staff shortages, and subtractive care from premature and high-

risk neonates are among the frequently expressed feelings toward removal of NAS populations from the NICU. A nurse from the Murphy-Okionen et al. (2010) study summed it up well when she said:

*It is unbelievable how much time and energy these babies require. The level of care they require compromises the amount of time ... that the nurse(s) have with other babies in the unit. How can you properly care for a sick child when all of your time is spent trying to console, feed, and care for unruly babies that will not sleep, [or] eat, and scream all the time. It is disruptive to the other babies and the entire unit... (p. 309).*

She mentioned role conflict, frustrations with the NAS presence in the hospital and time constraints imposed by NAS care – all the which are reasons frequently given in discourse regarding NAS care in the NICU. The nurse hints that the quality of care to NAS and healthy infants could be lacking due to the negative perceptions and attitudes associated with substance abuse. Participants in the Fraser et al. (2007) study shared similar views and even argued that the mother and baby need an environment that will facilitate bonding, which cannot be obtained within an intensive care unit.

However, the NICU may still be the best place for these individuals. Removal is simply avoiding the problem, ignoring substance abuse, and passing the burden to other staff. NAS patients still suffer from significant health conditions that inhibit their ability to function normally and require the administration of pharmaceuticals to recover. Additionally, NICU staff have the potential to influence mothers and their decisions to seek treatment, making it even more important to evaluate how attitudes may affect the environment. Facilitating an open dialogue between the staff and mother could also fulfill the promise of medical oaths to provide the best care possible and prevent discriminatory attitudes.

### **STIGMAS AND MARGINALIZATION OF ADDICTED MOTHERS**

The most concerning moral dilemma is the tendency of medical professionals to stigmatize the mother. Interview responses revealed a portrayal of mothers as unfit to care for their children, which explains hesitation to discharge and the belief that substance addiction doesn’t belong in the NICU (Reid, Greaves, & Poole, 2008). The stigma that is most often demonstrated by both society and the NICU is that, “The ‘substance-abusing’ mother scenario is cause for removing rights and entitlements. The mother is seen as unfit and incapable, and the child is constantly at risk” (p. 227). The circumstance of the mother

is frequently disregarded in favor of preventing potential risks to the safety of the child.

Multiple quotes from medical staff demonstrate the unfit-to-care stigma while initiating discharge. One such example involved a nurse that demanded the mother care for her infant when she said “promise me right now that when the baby ... [cries] you will put him in his crib, put the side rail up ... and walk out of the room. I don’t want to read in the newspaper that you dropped him, that you threw him, that you drowned him, that you hurt him” (Maguire et al., 2012, pp. 284). This type of threatening warning is a clear violation of the moral principle of beneficence and non-maleficence in the medical field. Nowhere in this warning does it encourage or help the mother with her addiction, instead it places blame and reflects the unfit-to-care stigma.

It is expected that nurses and doctors remain impartial, nonjudgmental, and avoid harmful comments when providing care to a diverse range of populations, and this does not occur when medical staff in all departments immediately see addiction as a nuisance (Bartlett, Brown, Shattel, Wright, & Lawellan, 2013). An important topic found in modern medical oaths is avoidance of discrimination (Greiner & Kaldjian, 2018) on the “basis of race, religion, or other human right grounds” (Askitopoulou & Vgontzas, 2018a, pp. 1485). As demonstrated by the feedback from nurses and doctors, some professionals view and speak to addicted mothers in a very brusque and harsh way, and it directly reflects the societal marginalization toward those who abuse drugs.

Additionally, when a significant amount of blame is placed on the shoulders of the mother, it can lead her to avoid the NICU and its practitioners (Bartlett et al., 2013). As outlined in this paper, issues among the staff are as follows: frustration with NAS infants, anger at having to deal with the results of the mother’s addiction, role conflict, and discriminatory treatment. The negative environment does not cater to the wellbeing of the populations involved. The NICU may lack education on substance abuse and a consideration of the mother’s circumstance and perspective. The current literature fails to include views from addicted NICU mothers which leads to a significant point of this paper: to introduce a new perspective and push for implementation of a positive environment.

### **NICU MOTHERS AND SUBSTANCE ABUSE**

A keystone study done by Bartlett and colleagues (2013) indicated that negative attitudes and stigmas affected caregivers’

willingness to assess patients, and patients' willingness to seek treatment. What is lacking among all medical professionals and the NICU staff is an understanding of the psychological causes of substance abuse. Addicted individuals are generally subject to some form of trauma originating before their first trial with drugs. Among psychological concerns such as depression and anxiety, incidences of abuse, sexual harassment, rape, and domestic violence also increase risks of abusing substances (Marcellus, 2014). The mothers may even feel guilt over the infant's hospitalization, but the power of addiction is so great and has such a profound effect on the brain, that they may feel no pleasure with their baby unless they are using (Marcellus, 2014, pp. 410). The chemical and psychological effects may help explain scarcity of NAS mothers in the NICU.

Addicted mothers are an important population. Those mothers who hope to raise their child must be actively involved in rehabilitation and building a support network. Yet there is no literature considering the point of view of the NICU substance-addicted mother. It is odd that a problem specially affecting the mother and contributing to the reported rise in NAS diagnoses and admissions is so overlooked and marginalized. Data analyzing the mother's feelings and attitudes is needed. Fighting against the unfit-to-care stigma, providing adequate compassion care, and creating an intervention for mothers is necessary to help prevent NAS in subsequent pregnancies.

### **FIGHTING THE STIGMA**

Reid et al. (2008) found that women using substances, whether that is drugs or alcohol, identified that they made irresponsible decisions and wanted to fight for custody of their child. The study does not reference NAS or the NICU, but it does mention Fetal Alcohol Syndrome (FAS) which is also treated in the NICU, and it provides perspectives from addicted mothers. Most in the group did everything in their power to keep their kids from social workers or child protective services and attended rehabilitation treatments. Seeking help conflicts with the belief that all addicted mothers cannot adequately care for their baby. If the mother is willing to fight her addiction, she should be encouraged and have the chance to change instead of immediately having her child taken away. Some of the mothers in the 2008 study also felt that "It's hard to quit drugs and they [social services] should be more empathetic to the mother and not just ... [Think,] is it safe for the child to go somewhere else?" (p. 220). This same attitude can be applied to the addicted NICU mother in relation to how staff

follow the unfit-to-care stigma.

The mothers reflected upon how hard it is to function in society while also being labeled as a drug user. As stated in the section on stigmas, the rights of the mother are disregarded in favor of the child's wellbeing (Reid et al., 2008). There should be a balance where both affected groups are getting the help and provision of care they need in a positive environment, absent of cynical and judgmental attitudes and body language.

### **PROVIDING A POSITIVE ENVIRONMENT**

Multiple sources referenced a positive environment as a potential solution that mandates further study on how such a solution can be accomplished (Fraser et al., 2007; Maguire, 2013; Marcellus, 2014). Addiction specialists agree that the treatment given by medical staff has the potential to influence behaviors and success in addiction recovery (Maguire, 2013, pp. 410), but staff continue to contribute to significant "barriers to successful substance abuse treatment" when they treat mothers punitively (Fraser et al., 2007, pp.6). The Reid et al. (2008) study interviewed mothers who had been or were currently abusing solvents, drugs, or alcohol in order to evaluate the challenges of negotiating stigmas and attitudes from society. A participant in the study illuminated the feeling of cravings and the subsequent claustrophobic judgment from others when she said:

*Even though you want to do certain things, you're fighting against them, you're retaliating, and the first thing you want to do is run. And we do it our whole lives, you know, our first instinct...when somebody points something out to us that's wrong, that we don't want to deal with, is to retaliate (p. 218).*

This feeling of retaliation is likely a result from the negative attitudes, stereotypes, and negative treatment from society. Contemptuous looks, avoidant body language, and judgement result in defensive manners. In reference to the NICU, many mothers probably share similar feelings, and nurses have commented on how hard it is to resist retaliating back and blaming the mother for hurting her baby (Maguire et al., 2012). Relieving pressure and marginalization in the medical field and using a trauma-based approach may be an effective way to cater to the wellbeing of both the NAS mother and NAS infant (Marcellus, 2014).

### **SOLUTIONS**

Because NAS is such an urgent and pressing issue, implementations are needed to improve the environment of the NICU for both infants and mothers.

NICU staff often overlook the common causes of substance abuse due to lack of education. Sources analyzing potential alleviants referenced education as the most effective way to facilitate change in the NICU. Even asking the question of "What is happening?" instead of "What is wrong?" is a better way of developing an understanding of the mothers' circumstances (Marcellus, 2014, pp. 312). In other words, there should be more of a focus on external causes such as physical abuse and psychological factors, and less on internal faults such as a call for attention. An increase in education has the potential to change the societal perception of substance abuse as a social deviance, to a more supportive view that sees addiction as a health problem.

As for the medical field, implementation of a universal moral and ethical code of conduct and substance abuse education courses could be a substantial step toward providing an accepting environment in the NICU and beyond.

### **A UNIVERSAL MEDICAL OATH: CORRECTING ATTITUDES**

NICU staff members struggle with the moral principles of beneficence and non-maleficence identified at the beginning of this paper. Morals and ethics still have practical applications in the medical field with the physician-patient relationship which indicates a universal medical oath may limit the ambiguity surrounding moral conduct.

According to Greiner and Kaldjian (2018) the most common elements in oaths included confidentiality, beneficence, discrimination, a promise to provide care, and an obligation to professional practice. Oaths hardly mention respecting marginalized societies and reducing disparities. Due to the societal problem of addiction, oaths should be reevaluated to include such aspects. As part of a universal oath, beneficence, non-maleficence, discrimination, a promise to provide care, a pledge to the profession, and staying true to the altruistic nature of helping and healing should be reinstated. With a universal oath enumerating the important moral principles for every medical professional, and a focus on greater enforcement in practice, there could be an opportunity to correct adverse, immoral attitudes. Data is needed to determine whether it could impact the NICU and other areas of care. Ideally the universal oath should help increase awareness of the importance of moral and ethical principles in the medical field and increase quality of care.

## **INCREASED EDUCATION: CATERING TO SUBSTANCE ABUSE**

Analysis of innovative treatment programs by Nathoo et al. (2013) found that a focus on outreach, harm reduction, cultural safety, and care to both mother and child are effective methods when addressing the problem of addiction. Additionally, a focus on trauma-based care that utilizes the four Rs – realizing trauma exists, recognizing its effects, responding to the problem, and resisting traumatization – has the potential to help staff treat patients with substance abuse (Marcellus, 2014). If these methods could be incorporated into a required medical class for universities, each department of medicine would have access to knowledge on how to interact with marginalized populations.

A series of protocols could be installed to guide the interactions between professionals and substance abuse patients. The protocols should enhance the importance of working as a team while achieving four main goals: provide a positive environment, avoid judgmental attitudes, encourage treatment, and facilitate open discussions with the addicted individual. In turn, anyone who abuses drugs would have the chance to feel comfortable and at ease while visiting healthcare facilities. In practice, when an

affected infant is admitted to the NICU, these protocols would be implemented after all medical staff are properly briefed on the conditions of the child.

Classes taken at universities teaching proper protocols and substance abuse refresher courses taken during active medical practice would provide training that could enhance the quality of care in the NICU and beyond. To determine success or failure, pilot programs are needed in select hospitals containing NICUs to assess how these protocols could work in large-scale applications. Ideally, hospitals with Level 3 and 4 NICUs in areas prone to opioid addiction should be utilized. These NICUs are equipped to handle extreme prematurity in addition to NAS complications and would have suitable populations to perform the study.

## **CONCLUSION**

Doctors and nurses have roles of great importance in society because of the intimacy and direct care intrinsic to the physician-patient relationship. They enact the power of healing and can produce a change in the lives of their patients. NICU nurses and physicians have the potential to influence the attitudes and behaviors of mothers and encourage treatment, but adequate care cannot be achieved if

nurses and physicians are dismissive and cynical towards substance abuse in the NICU. Stigmas and negative attitudes regarding NAS infant care and dealing with addicted mothers result in dilemmas in the practice of moral principles associated with beneficence and non-maleficence. Potential solutions suggested in this paper included a universal medical oath to provide guidelines of proper care and addiction education to influence a positive environment in all aspects of care. Further studies are needed to assess the impacts of implementing these types of solutions. One question remains: other than an increase in education, what can be done to reduce the marginalization of NAS patients and stigmatization of substance abuse? Attitudes are difficult to change, and medicine is only one aspect of society. For real impact, a multidisciplinary approach and a gradual shift in attitude is still needed to reduce stereotypes and stigmas surrounding substance abuse.

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# EVALUATION OF INTENSIVE CARE MECHANICAL VENTILATOR RESPONSE TIME DURING VARYING LEVELS OF INSPIRATORY EFFORT

*Sarah Donley*

## **ABSTRACT**

**Objective:** Mechanical ventilators must be responsive to a patient's variable inspiratory demand. Responsiveness is one attribute used to compare these expensive, but necessary lifesaving devices. Under varying levels of inspiratory effort, triggering performance was compared between the Maquet Servo-i and Respiration Esprit ventilators.

**Methods:** The Ingmar ASL 5000 Breathing Simulator was used to provide normal respiratory mechanics (compliance of 50 mL/cm H<sub>2</sub>O; resistance of 3 cm H<sub>2</sub>O/L/s; spontaneous rate of 15 breaths/min) and inspiratory muscle pressures of 10, 15, and 20 cm H<sub>2</sub>O for 5-minutes each. The simulator was connected to each ventilator with identical settings (pressure support (PS) of 10 cm H<sub>2</sub>O; positive end-expiratory pressure (PEEP) of 0; and, a trigger flow of 3 L/min). Trigger response time, time from spontaneous effort (SoE) to a minimum pressure (P<sub>min</sub>), and the maximum pressure drop during triggering were collected.

**Results:** The Esprit ventilator trigger response time and time from SoE to a P<sub>min</sub> decreased under conditions of rising inspiratory muscle pressure, whereas the Servo-i trigger response time and time from SoE to P<sub>min</sub> increased with rising inspiratory muscle pressure. Both ventilators demonstrated a greater maximum pressure drop during triggering with each increase in inspiratory muscle pressure. However, for an inspiratory muscle pressure of 15 and 20 cm H<sub>2</sub>O, the drop in pressure was much larger for the Servo-i.

**Conclusions:** Both ventilators are suitable for clinical use, however, the Respiration Esprit ventilator demonstrated a better response to a high ventilatory demand. A potential reason for this is the greater peak inspiratory flow rate (PIFR) capability of the Esprit ventilators. The Esprit's internal flow generator is a turbine and seems to be capable of a faster initial flow than the pneumatic flow design of the Servo-i.

## **INTRODUCTION**

The goal of mechanical ventilation is to provide adequate oxygenation and ventilation in order to reduce a patient's work of breathing. Different modes of ventilation can provide either partial or full breathing support for the patient. The timing of breath delivery during mechanical ventilation is dependent upon the breath type, mode, and internal triggering mechanisms of a specific ventilator.

Assist control is a traditional mode of ventilation that provides full ventilatory support by manipulating a volume delivery target or pressure delivery target. These methods are referred to as Assist Control-Volume Control (ACVC) and Assist Control-Pressure Control (ACPC) respectively. Patient inspiratory effort is not required under full ventilator support; however, when a respiratory effort is present, patients often require sedation to maintain synchrony with the ventilator.

The common use of sedatives in conjunction with mechanical ventilation could be minimized with proper ventilator settings to match a patient's ventilatory demand. ACVC has a set tidal volume that guarantees the patient receives a volume of gas with each delivered breath. This mode of ventilation is used when a minimum minute ventilation needs to be maintained through a guaranteed respiratory rate (breaths delivered/min) and tidal volume.

In ACPC, a prescribed pressure (cm H<sub>2</sub>O) above positive end-expiratory pressure (PEEP) is set in addition to a respiratory rate. Each breath results from the application of the prescribed pressure, which affects tidal volume delivery. Although the same pressure is applied during each breath, the volume of gas entering the lungs will vary depending on patient lung compliance, resistance, and inspiratory effort. As a result, minute ventilation will vary in this mode.

Respiratory mechanics are dictated by compliance and resistance. Lung compliance is a determination of how readily the lungs accept the volume of gas being delivered. Emphysema is an example of a pathology exhibiting abnormally

high compliance. In this disease process, the lungs will easily accept the volume of gas being delivered since they have lost elasticity. Lungs with low compliance resist the volume of gas being delivered since the lungs show characteristics often referred to as "stiff" (Hess, 2014). Acute respiratory distress syndrome (ARDS) is an example of a pathology that exhibits reduced compliance. Pressure-controlled breaths are often used for patients who have decreased lung compliance in order to manage pressures delivered to the lungs, thereby reducing the risk of iatrogenic barotrauma (Lumb, 2017). Iatrogenic barotrauma can occur when a healthcare provider sets ventilator settings that over-distend lung alveoli, resulting in a type of acute lung injury, known as a pneumothorax. Lung resistance to airflow increases when bronchospasm or copious secretions are present in the airways.

Pressure Support Ventilation (PSV) is an adjunct of ventilatory assistance that provides partial support since it requires the patient to breathe spontaneously. The patient may receive a PEEP, which improves oxygenation by creating an increased surface area for gas diffusion. When a patient spontaneously inhales, a triggering mechanism activates the pressure support, sending pressure and resulting flow to the lungs. When the inspiratory flow meets a preset minimal flow, the ventilator will stop delivering the inspiratory pressure and flow, thereby allowing passive exhalation. It is important to consider that an increased level of pressure support will help the patient inspire a larger tidal volume, which could be essential for maintaining proper minute ventilation or detrimental by causing barotrauma, an injury to the lung due to excessive air or pressure. Pressure supported breaths also serve the purpose of overcoming airway resistance of breathing through an endotracheal tube with a small internal diameter.

Patients in the intensive care unit (ICU) often have a variable inspiratory demand. There can be vast changes in the volume of gas being inhaled with each breath, or a patient can exhibit "air hunger" with abnormally high inspiratory

flow demands (McGee, Frechette, & Dailey, 2011). This introduces the component of a peak inspiratory flow rate (PIFR), which is the maximum flow delivered by the ventilator during a breath. An air-hungry patient will require a higher PIFR in order to be more comfortable on the ventilator. This is because a high PIFR will deliver a faster initial flow resulting in the majority of gas delivery during the beginning of each breath, thereby satisfying air hunger. PSV is dynamic due to the differences in design of mechanical ventilators made by various manufacturers. It is also influenced by patient demand. Appropriate PSV settings will provide a more normal respiratory pattern, which improves patient comfort if the pathophysiology for which they are intubated allows them to achieve adequate minute ventilation during partial breathing support (McGee, Frechette, & Dailey, 2011). Monitoring the average PIFR a patient generates should guide the clinician in determining proper ventilator settings should the patient need full ventilatory support (McGee, Frechette, & Dailey, 2011).

Variable inspiratory demand can be the result of pain, acid-base imbalance, abnormalities to the respiratory system, or from injury to the brain. This raises the question of how ventilators perform against a patient with variable inspiratory demand. A previous study by Olivieri, Costa, Conti and Navalesi (2012) indicated that inspiratory demand can affect ventilator breath delivery in terms of trigger response time, sensitivity, and pressurization. In order to determine the effect of variable ventilatory demand on ventilator responsiveness, triggering performance between two ICU ventilators, the Maquet Servo-I and Respirationics Esprit were evaluated under varying levels of inspiratory effort in pressure support ventilation.

**SIGNIFICANCE**

Patient-ventilator synchrony is important in maintaining the life support necessary for a ventilated patient. Synchrony is impacted by the ventilator’s ability to efficiently detect a spontaneous breath from a patient while providing proper pressure and flow in satisfaction of patient inspiratory demand. Ventilator asynchrony will occur when a patient’s inspiratory demand is not being met.

According to Thille, Rodriguez, Cabello, Lellouche and Brochard (2006), patient-ventilator asynchrony is “defined as a mismatch between the patient and ventilator inspiratory and expiratory times” (p. 1515). It is inevitable that there will be a time delay in recognizing patient effort, as technology has not progressed to the point where breath delivery will

**Table 1. Mean Values for an Inspiratory Muscle Pressure of 10 cm H<sub>2</sub>O**

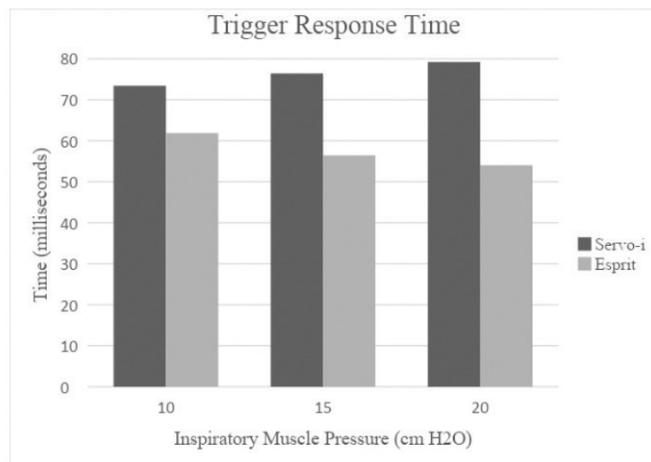
Ventilator	Trigger Response Time (ms)	Time from Soe to Pmin (ms)	Maximum Pressure Drop (cm H <sub>2</sub> O)
Servo-i	73	59	-0.33
Esprit	62	54	-0.30

**Table 2. Mean Values for an Inspiratory Muscle Pressure of 15 cm H<sub>2</sub>O**

Ventilator	Trigger Response Time (ms)	Time from Soe to Pmin (ms)	Maximum Pressure Drop (cm H <sub>2</sub> O)
Servo-i	76	61	-0.60
Esprit	56	51	-0.43

**Table 3. Mean Values for an Inspiratory Muscle Pressure of 20 cm H<sub>2</sub>O**

Ventilator	Trigger Response Time (ms)	Time from Soe to Pmin (ms)	Maximum Pressure Drop (cm H <sub>2</sub> O)
Servo-i	79	63	-0.86
Esprit	54	46	-0.55



**Figure 1. Mean Trigger Response Time.** This figure displays the average time for the pressure to fall and rise back to baseline during an inspiratory effort. The Esprit TRT is lower in all three measures of inspiratory muscle pressure. This suggests that the Esprit is more capable of detecting effort and applying initial flow over the Servo-i.

occur as soon as a patient begins to inhale. There are several patterns of asynchrony that a patient may develop while on a ventilator. Ineffective triggering can occur if a patient has a weak inspiratory effort or intrinsic PEEP due to lung hyperinflation. With this, breath delivery fails to activate, imposing a higher muscle workload on the patient as they attempt to trigger a breath. In cases of high ventilatory demand, a patient may double trigger the ventilator since inspiratory time and PIRF are inadequate. Another pattern of asynchrony is auto-triggering. This occurs when the ventilator falsely interprets leaks in the ventilator’s circuit or cardiogenic oscillations as an inspiratory effort and delivers a breath (Thille et al., 2006).

Patient-ventilator asynchrony causes obvious discomfort to the patient, leading to respiratory distress. Although changes in ventilator settings may reduce discomfort, this usually introduces the use of sedatives. However, sedation should be avoided if possible, as a study by Kress, Pohlman, O’Connor and Hall (2000) found that

daily spontaneous awakening trials, which is when sedation is turned off and a neurological examination is performed, decreased the duration of mechanical ventilation and the length of stay in the intensive care unit. Minimizing ICU length of stay and duration of mechanical ventilation is important in improving patient outcomes. This emphasizes the importance of effective triggering mechanisms in mechanical ventilators in order to maximize patient comfort.

**METHODS**

**Lung Model and Ventilators**

The Ingmar Active Servo Lung 5000 lung simulator is capable of mimicking many encountered types of pulmonary physiology through the manipulation of its respiratory mechanics. The ASL 5000 was set to normal respiratory mechanics (compliance of 50 mL/cm H<sub>2</sub>O; resistance of 3 cm H<sub>2</sub>O/L/s; spontaneous rate of 15 breaths/min; inspiratory rise time of 30%; and, an inspiratory release time of 10%). For both ventilators, data were collected

from a 5-minute evaluation period under each varying level of inspiratory muscle pressure of 10, 15, and 20 cm H<sub>2</sub>O.

Two intensive care mechanical ventilators were evaluated; the Maquet Servo-i and the Respironics Esprit. Both ventilators were connected to the lung simulator with a standard patient circuit under the same settings (pressure support of 10 cm H<sub>2</sub>O; PEEP of 0; a trigger flow of 3 L/min; and, an inspiratory cycle off of 30%).

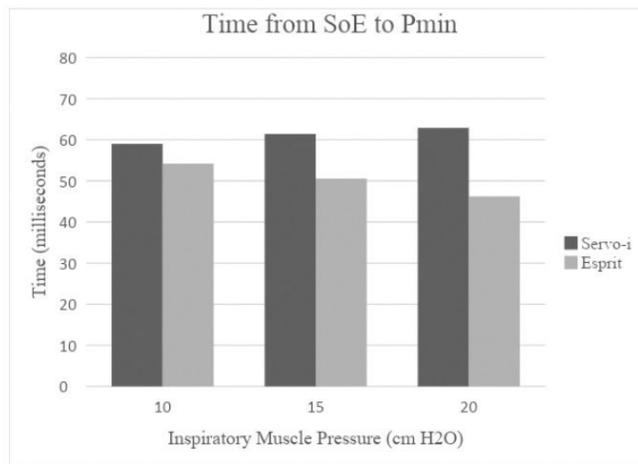
Ten breaths were then taken from the last minute of the evaluation period. This was to allow the lung model to stabilize in each test condition, which took approximately two-three minutes (Dexter, McNinch, Kaznoch, & Volsko, 2018). Trigger response time, time from spontaneous effort (SoE) to a minimum pressure (Pmin), and the maximum pressure drop during triggering were analyzed to assess ventilator responsiveness. Triggering performance was evaluated utilizing the ASL software algorithms and the data from the ten selected breaths from each testing condition were imported into Microsoft Excel and calculated for the mean values. No further statistical analysis was run.

### Measured Variables

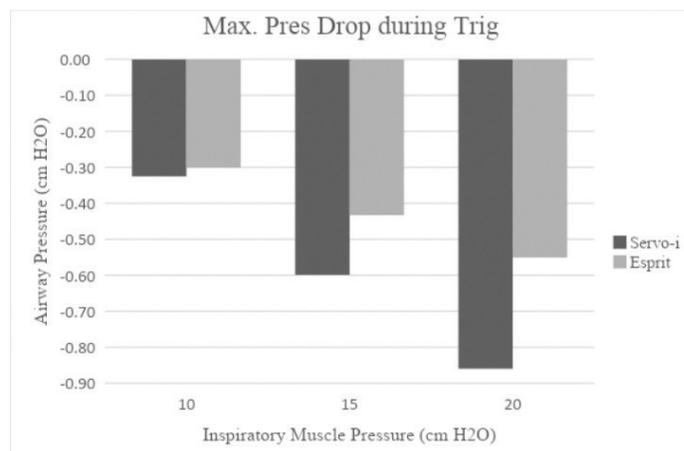
Trigger response time (TRT) is defined as the time in milliseconds for the pressure to fall and rise back to baseline during an inspiratory effort. This parameter is important because it is an indicator of the ventilator's ability to detect a patient's effort to breathe and apply sufficient inspiratory flow to meet their demand (Ferreira, Chipman, & Kacmarek, 2008). It also is a measure of the "inspiratory work required to trigger the ventilator; therefore, the lower its value, the smaller the work required of inspiratory muscles" (Battisti et al., 2005, pp. 1785). Time from SoE to Pmin is defined as the time in milliseconds from the start of SoE to the Pmin needed to trigger the ventilator. This is a measure of the ventilators ability "to sense inspiratory effort and open the inspiratory flow valve" (Ferreira et al., 2008, pp. 1673). The maximum pressure drop during triggering – measured in cm H<sub>2</sub>O – is another parameter measuring the inspiratory muscle workload required to trigger ventilator breath delivery. This is important to measure since the magnitude of pressure drop is proportional to inspiratory effort.

### RESULTS

Trigger response time for the Maquet Servo-i and the Respironics Esprit varied. The Esprit TRT decreased with each subsequent increase in inspiratory muscle pressure, whereas TRT for the Servo-I increased (Figure 1). Similarly, with time



**Figure 2. Mean Time from SoE to Pmin.** This figure displays the average time from the start of an inspiratory effort to the lowest airway pressure required to trigger ventilator breath delivery. The Respironics Esprit mechanical ventilator outperforms the Maquet Servo-i under each measure of inspiratory muscle pressure, suggesting that it is superior in spontaneous breath detection.



**Figure 3. Mean Maximum Pressure Drop during Triggering.** This figure displays the inspiratory muscle workload required to trigger ventilator breath delivery. The Maquet Servo-i measures were more negative, demonstrating increased workload for patients.

from SoE to a Pmin, the Respironics Esprit demonstrated a decrease in time with an increase in inspiratory muscle pressure, whereas the time in the Maquet Servo-i increased (Figure 2). Both ventilators demonstrated a greater maximum drop in pressure during triggering with each increase in inspiratory muscle pressure. For an inspiratory muscle pressure of 10 cm H<sub>2</sub>O, both ventilators had a similar average of -0.30 cm H<sub>2</sub>O in the Esprit and -0.33 cm H<sub>2</sub>O in the Servo-i. However, for inspiratory muscle pressures of 15 cm H<sub>2</sub>O and 20 cm H<sub>2</sub>O, the maximum drop in pressure was much larger for the Servo-I (Figure 3). Tables 1-3 provide the mean values for each measured variable under their respectable level of inspiratory muscle pressure.

### DISCUSSION

The decrease in trigger response time and time from SoE to Pmin, as well as lower drops in maximum pressure during

triggering under increased inspiratory effort, suggest that the Respironics Esprit ventilator is better equipped to satisfy a variable inspiratory demand than is the Maquet Servo-i. One explanation for the Esprit ventilator's optimal performance under increased inspiratory effort is that it demonstrated a higher PIFR than the Servo-I with each breath. In one analyzed breath under a Pmus of 10 cm H<sub>2</sub>O, the PIFR for the Esprit was 113 L/min versus 105 L/min in the Servo-i. This difference in PIFR is due to different flow generator systems in each ventilator. The internal flow generator in the Respironics Esprit is a turbine, which is capable of delivering a higher initial flow over the pneumatic gas system in the Maquet Servo-i.

Continued innovation in mechanical ventilator development is necessary to reduce the time delay between a spontaneous inspiratory effort and the application of ventilatory support. Engineers play an important role in

improving the technical performance of ventilators. Advancements specifically in developing reliable sensors to measure patient variables, such as pressure, flow, oxygenation, as well as actuators which are capable of providing desired pressure/flow to patients, are vital (Dellaca, Veneroni, & Farre, 2017). There is also a need to develop artificial intelligence, mathematical systems, and control systems to tailor mechanical ventilation to the individual patient. This requires a multidisciplinary approach since engineers may not know the intricacies of respiratory pathophysiology.

## CONCLUSIONS

All mechanical ventilators must undergo bench studies to determine if they meet the safe minimum human usage threshold as determined by the United States Food and Drug Administration (FDA). Many bench studies have indicated that a trigger response time <100 ms is deemed clinically satisfactory, as it is below the conscious threshold of inspiratory effort (Battisti et al., 2005). Although both the Maquet Servo-i and the Respironics Esprit mechanical ventilators are suitable for clinical use, this study suggests that

the Esprit is better equipped to support patients with high ventilatory demand in the context of the studied variables.

## APPENDIX A

### Acronyms and Abbreviations

ACPC	Assist Control-Pressure Control
ACVC	Assist Control-Volume Control
ARDS	Acute Respiratory Distress Syndrome
ASL	Active Servo Lung
CPAP	Continuous Positive Airway Pressure
FDA	Food and Drug Administration
ICU	Intensive Care Unit
PEEP	Positive End-Expiratory Pressure
PIFR	Peak Inspiratory Flow Rate
Pmin	Minimum Pressure
Pmus	Inspiratory Muscles Pressure
PS	Pressure Support
PSV	Pressure Support Ventilation
SoE	Spontaneous Effort
TRT	Trigger Response Time

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# THE MOLECULAR EFFECTS OF HYPERPHOSPHORYLATED TAU PROTEIN PROGRESSION ON THE PATHOLOGY OF ALZHEIMER'S DISEASE

*Mariah Passwaters-Stamper*

## **ABSTRACT**

Throughout the United States, nearly six million people display symptoms of a chronic, neurodegenerative disease known as Alzheimer's. Alzheimer's disease (AD) is characterized by the presence of neurofibrillary tangles (NFTs) within the axons of neurons as well as beta-amyloid plaques throughout the brain (The National Institute of Aging, 2018). The tau protein, a naturally occurring microtubule-stabilizing protein, transforms into pathological networks of insoluble, paired helical filaments once hyperphosphorylated. The appearance of insoluble networks within the neurons is linked to the disease progression of AD, thus contributing to rapid cognitive decline. Today, researchers aim to uncover the underlying molecular progression of AD and to reverse the progression of AD via the therapeutic intervention of a protein resistant to folding into insoluble paired filaments, such as the human fetal tau protein. This review of the tau protein, as a pathological substance that progresses AD, analyzes the molecular structure of tau, links the mechanism of hyperphosphorylation to increased AD progression, and promotes future research to use the human body's own proteins as a defense against AD.

Patients with Alzheimer's disease exhibit slow cognitive decline and consistently progress through the mild, moderate, and severe stages of Alzheimer's disease. Dementia is commonly associated with Alzheimer's disease and patients display symptoms such as memory loss, language deficits, and have difficulty performing activities of daily living. Abnormal clumping of tau protein and beta-amyloid plaques causes healthy neurons to die, thus shrinking the brain and resulting in a loss of rich and numerous neuronal connections (SantaCruz et. al., 2005).

AD does not currently have a cure as advertised medications superficially ameliorate the symptoms, but do not heed the rapid molecular progression of the disease process (The National Institute of Aging, 2018).

Common techniques to diagnose Alzheimer's disease (AD) involve cognitive memory tests, although the definitive means of diagnosis is via inspection of post-mortem brain samples. Two forms of Alzheimer's disease, early-onset and late-onset, exist and differ vastly on the basis of genetics. The early-onset form of AD is heritable, affects less than 10% of the population, and appears in the mid-30s, while the late-onset form of AD occurs sporadically, makes up 60-80% of dementia cases, and appears in the mid-60s (The National Institute of Aging, 2018). Past research has extensively studied the effects of the presence of beta-amyloid plaques in the brain; however, sparse to no information is available about the commonly observed counterpart and potential therapeutic target: the tau protein. Once hyperphosphorylated, tau undergoes a conformational change and forms an insoluble network of paired and straight helical filaments, thus disrupting homeostasis within the brain, inducing a sharp decline in cognitive function, and attributing to the rapid disease progression of Alzheimer's disease.

Tau proteins are expressed naturally within the brain as soluble, microtubule associated proteins (MAPs), thus aiding in the stabilization of microtubules, which serve as regulators of transport within the axon of a neuron. As a result of alternative splicing of the MAP gene on chromosome 17, wild-type tau exists as six isoforms within the brain and serves as a mode of microtubule stabilization (Medeiros et al., 2011). The standard function of tau proteins is to promote the assembly of tubulin

into microtubules and is governed by the amount of phosphorylation present (Iqbal et. al., 2010). In a healthy brain, tau is present in a native, unfolded state and possesses approximately 2-3 moles of phosphate/tau protein. Hyperphosphorylation of tau results in the occurrence of lowered biological activity and increased pathological activity (Iqbal et. al., 2010). The addition of phosphate groups to the native protein promotes the self-assembly of tau molecules into insoluble neurofibrillary tangles composed of paired and straight helical filaments (Harrington et. al., 1991). The native tau protein consists of random coil structures, while the core of the neurofibrillary tangles is composed of beta-structures (Barghorn et al., 2004). The modification of a phosphate group onto tau, disrupts microtubule assembly and erroneously sequesters normal tau. The toxic activity of pathological tau protein is directly linked to the variable of hyperphosphorylation. Recent in vitro studies have analyzed the effects of dephosphorylating toxic tau and have found that the dephosphorylated protein quickly resumes normal function (Medeiros et al., 2011). In AD patients, declining levels of phosphatase occur in an irreversible manner, thus perpetuating the hyperphosphorylation and accumulation of toxic tau (Liang et al., 2009).

Determining the sequestration and developmental timeline of the formation of tau neurofibrillary tangles within the brain in model organisms, such as mice, is crucial in order to understand the developmental pathway and route of disease progression Alzheimer's disease undertakes. At the University of Minnesota Medical School, researchers genetically engineered a transgenic mouse model containing mutant human tau strains to analyze the presence and effect of neurofibrillary tangles. Post-

mortem brain samples of 3.5-month old mice exhibiting memory loss revealed the absence of neurofibrillary tangles via Western blot analysis, thus revealing the presence of neurofibrillary tangles may not be the sole hallmark of tauopathies. Instead of viewing NFTs, researchers observed the presence of tau oligomers, which may serve as a precursor to NFTs in human Alzheimer's disease patients (Berger et al., 2007).

Alzheimer's disease progression is heavily dependent upon the variable of age. Immunohistochemistry reveals the localization of hyperphosphorylated tau changes as a function of time. As the age of the subject increases, positive tau localization switches from the axons to being predominantly measured in the cell bodies of the hippocampus and neocortex. Extensive accumulation of abnormal tau in the hippocampal and neocortex regions of the brain correlates common symptoms of AD progression, such as loss of memory, language, and spatial reasoning (Andorfer et al., 2003).

The spread and presence of tau in the brain serves as an indicator of life expectancy and prospective cognitive function. Thus, in order to determine the extent and rate at which toxic tau spreads, researchers developed a transgenic mouse model and injected diluted brain homogenates from tau expressing mice into the hippocampal region of control mice. Six months post-injection, the experimental mice displayed tau neurofibrillary tangle formation within the hippocampal region as well as in the fimbria, optic tract, and thalamus (Clavaguera et al., 2009). After seeding the insoluble tau into a nearby cell, internal clumps of tau displaced tubulin and induced further filament assembly of the surrounding full-length tau proteins (Frost et al., 2008). The positive transmission of tau and rapid trans-synaptic spread throughout the brain, exhibits the dangerous, progressive nature of the disease process (Alonso et al., 2004). In humans, tau is predominantly present in the 3 and 4 repeat isoforms. The misfolding of tau isoforms into various conformers is linked directly to the appearance of specific tauopathies, such as fronto-temporal dementia and Alzheimer's disease (Hyman, 2014). Due to the correlation between conformers of tau proteins and the likelihood of disease, future pharmacological research may design drugs to target specific tau conformations (Sanders et al., 2014).

The mechanism of toxic tau progression throughout the cell exhibits a rapid seeding pattern and often migrates along the neuron in a cortico-cortical top-down manner. Induction of healthy,

tau expressing cells with preformed tau fibrils (PFFs) *in vivo*, yields cells with mass amounts of insoluble tau assembled into filamentous structures resembling NFTs within three hours. The exogenous tau is adsorbed via spontaneous endocytosis, thus recruiting large amounts of soluble tau to self-assemble into filaments (Guo et al., 2010). After the formation of the insoluble tangles, the NFTs progress throughout the brain in a stepwise fashion (De Calignon et al., 2012). NFTs move from the entorhinal cortex in the direction of the limbic cortices as Alzheimer's disease progresses (Pooler et al., 2013). Additionally, researchers discovered the NFTs progression rate can be classified on a scale of severity from I-IV and the movement of NFTs proceeds along neurons via a cortico-cortical connection (Braak & Kelly Del Tredici, 2018). Classifying the degree of NFTs and tracking the location of NFT progression is vital to future clinical applications in order to correctly target specific regions of interest (Chambraud et al., 2010).

Trans-cellular transport of tau across membranes exhibits a rare method of secretion and successful tau propagation is heavily dependent upon the presence of synaptic connections. Tau is secreted in a trans-cellular manner across the plasma membrane into nearby cells where aggregates begin to form. The ability to be secreted across membranes increases with the degree of hyperphosphorylation present. Increased levels of phosphorylation promote microtubule destabilization, thus increasing free protein availability (Katsinelos et al., 2018). The creation of an *in vitro* neuronal model exhibits the significant effect of synaptic connections as the knockdown of synaptic activity significantly depresses the rate of neuron-to-neuron propagation (Calafate et al., 2015). Future Alzheimer's disease prevention methods may focus on synaptic therapies and carefully regulate the gene expression of synapses present within the brain (Ittner et al., 2010).

Resident immune cells within the brain, known as microglia, serve as regulatory cells that change in response to their surroundings. Microglia sense pathological changes via extracellular receptors and change conformation in order to perform various functions. Activated microglia often secrete pro- or anti-inflammatory molecules in response to their microenvironment and phagocytize detected foreign invaders (Perea et al., 2018). Aberrant activation or deletion of microglia is linked to AD progression in the form of increased tau propagation. Inhibition of the synthesizing exosome pathway and lowering of microglia levels allowed researchers

to observe decreased levels of tau propagation within an adeno-based virus model (Asai et al., 2015). The observed cessation of tau propagation provides the direction for future research to target the synthesis pathway of exosomes in order to slow down Alzheimer's disease progression.

In order to clinically express Alzheimer's disease, NFT sequestration in the neurons must produce a varying degree of measurable neurodegeneration (Iqbal et al., 2009). Mitochondrial elongation within neurons is directly linked to neurodegeneration and mitochondrial dysfunction (Wang & Fei Liu, 2008). To determine the effect of toxic tau on the formation of abnormal mitochondrial morphologies, researchers developed *in vivo* models of *Drosophila* and mice, which contained human tau isoforms. Although both models possessed either toxic tau or wild-type tau, only toxic tau models exhibited elongation of mitochondria and subsequent neurotoxicity as toxic tau serves as an inhibitor of the fission protein, DRP1 (DuBoff et al., 2012). The mechanism of inhibition is a consequence of actin stabilization in the presence of tau but is reversible if the proper mitochondrial fission conditions are restored (DuBoff et al., 2012).

The precursors to NFTs, tau oligomers, serve as toxic proteins, which inhibit mitochondrial function, kinesin-dependent transport, and accelerate AD disease progression (Holmes et al., 2014). Tau oligomers are sequestered in the mitochondrial porin, thus disrupting proper organelle distribution, hindering energy production, and potentially activating cellular apoptotic pathways (Shafiei, Scott et al., 2017). The presence of tau oligomers disrupts kinesin-dependent transport due to the destabilization of microtubules, which serve as tracks for intracellular transport (Ebner et al., 1998). Thus, tau oligomer cell types display altered distributions of organelles within the cell. In addition to Alzheimer's disease, increased levels of tau oligomers are exhibited in patients with a history of a traumatic brain injury (TBI) (LaPointe et al., 2009). Mice possessing a TBI were injected with human tau expressing isoforms and consequently displayed acceleratory rates of cognitive decline. Additionally, tau oligomers were observed in areas outside of the original injection site, such as the hippocampus (Gerson et al., 2016). The transmission of tau spreads rapidly once seeded in the cell; thus, the risk of developing Alzheimer's disease increases if a subject experiences a TBI.

After positively identifying the presence of tau oligomers and NFTs in

Alzheimer's disease, researchers aimed to develop passive immunization techniques to target and reduce disease progression. One method of passive immunization involves the intracerebroventricular injection of a tau oligomer-specific monoclonal antibody (TOMA) into mice in order to reduce tau oligomers. In addition to the appearance of lowered concentrations of tau oligomers, TOMA-treated mice also displayed signs of a recovering memory, thus exhibiting the protective and reversible role TOMA has on AD progression (Carranza-Castillo et al., 2014.) In addition to reducing tau oligomer concentrations, researchers aimed to lower measured levels of hyperphosphorylated tau. Tau antibodies were injected into the N-terminal projection domain of pathological tau once a week for one month. The resultant data displayed reduced levels of tau protein, hyperphosphorylated tau protein, and pathological beta-amyloid proteins (Dai et al., 2015). Clearance of hyperphosphorylated tau and reduction of tau oligomers via passive immunization potentially provides a pathway for future biologically derived vaccines.

The hyperphosphorylation of tau is dependent upon expression levels of protein kinases, such as the family of microtubule affinity regulating kinases (MARK). MARK protein kinases are responsible for hyperphosphorylation of tau, thus attributing to the instability and breakdown of microtubules (Drewes et al., 1997). After molecular cloning of MARK and purification of brain samples, researchers analyzed the expression levels of MARK protein kinases and discovered MARK to be overexpressed in brain tissue. MARK kinases exhibited the ability to phosphorylate MAP, thus decreasing microtubule stability and aiding in the breakdown of microtubule arrays (Drewes et al., 1997). As a potential inducer of pathological tau progression, optimized MARK inhibitors may serve as a therapeutic method to target AD pathology. Introduction of MARK inhibitors possess a high affinity to bind to KXGS microtubule binding domains in tauopathy disease models (Sloman, 2016). Reduction of tau phosphorylation and inhibition of the spread of pathological tau may allow researchers to slow or even reverse the rate of AD progression.

In order to restore biological activity within the brain, phosphatases, such as protein phosphatase 2B (PP2B), are present within the brain and function to remove additional phosphate groups. Extraction of post-mortem, human brain samples measured the release of phosphate in the presence of phosphatase 2B and found the extent of restored

microtubule assembly activity was directly correlated to the number of phosphate molecules released (Wang et al., 1996). PP2B was observed via immunoprecipitation at increased levels in an AD brain. Partial cleavage by caplain I activates PP2B in an AD brain, thus resulting in the appearance of increased PP2B levels (Qian et al., 2011). PP2B serves as a regulator of phosphorylation and may be introduced into *in vitro* AD models to analyze the effect of PP2B on hyperphosphorylation levels of tau proteins.

The analysis and quantitative measurement of cerebrospinal fluid (CSF) biomarkers can be utilized to determine the morphology of tau fragments as well as confidently diagnosis different mental diseases among patients. CSF samples were obtained from neurology patients via a lumbar puncture followed by ELISA testing and immunoblot analysis of the samples. The resultant samples yielded the presence of truncated tau protein fragments, which served as biomarkers of AD (Johnson et al., 1997). In an additional research study, CSF samples were collected and analyzed from late-onset AD patients, anxious-depressed patients, and patients exhibiting mild cognitive impairment (MCI). The measured concentrations yielded significant differences of CSF levels among the control, late-onset AD, and anxious-depressed patients (Ivanou & Christian, 2005). Thus, patient samples of CSF are able to serve as a means to diagnosis varying mental illnesses and as a means to characterize the likelihood a patient will develop AD. In the future, the implementation of routine CSF sampling may aide the field of mental health by providing a more effective method to diagnosis various mental illnesses. Quantitatively and precisely measuring biomarker levels is more efficient in diagnosing patients rather than a healthcare professional performing a potentially biased cognitive interview on patients.

Due to the recent findings of CSF as a medium to identify biomarkers of Alzheimer's disease, patients are now able to receive a clinical diagnosis before symptoms of late-term Alzheimer's disease manifest. Cerebrospinal fluid samples were taken from cognitively normal subjects over the age of 65 years old in a cohort study. Subjects whom exhibited increased levels of CSF markers were significantly at a higher risk of experiencing early mortality rates and exhibiting symptoms of cognitive decline associated with late term AD (Vos et al., 2013). Based on measured CSF levels, researchers were able to classify subjects into groups, such as cognitively normal, stage I AD, stage

II AD, or stage III AD. To measure and validate the classifications of the study, deceased participants in the original study were brought into autopsy and displayed intermediate to high levels of change correlated to neuropathologic AD. In addition to the presence of CSF biomarkers, the ability to form ion channels under acidic conditions also implies the presence of AD (Patel et al., 2015). Tau ion channels formed during AD appear similar to beta-amyloid channels and may aide in the increased progression of tau pathology.

The rate of tau synthesis and biological properties of human fetal tau protein differs greatly from human adult tau protein, thus fetal tau serves as a potential therapeutic intervention method for AD progression in adults (Villa-Ortiz et al., 2001). Human fetal tau is only present in the brain as a shortened isoform, 3R, and does not form paired helical filaments in the presence of hyperphosphorylation. The inability of fetal tau to form PHFs correlates to the absence of NFTS and cognitive decline. Engineering human adult tau to possess the properties of fetal tau or introducing embryonic kinases into the central nervous system of adults may hold the key to reducing AD progression. (Jovanov-Milošević et al., 2012).

In addition to the utilization of human fetal tau protein, lithium and the process of polymerization may serve as potential therapeutic measures to inhibit tau pathology throughout Alzheimer's disease. The addition of lithium to *in vivo* and *in vitro* pathological tau models causes the dephosphorylation of hyperphosphorylated tau protein molecules, thus restoring the microtubule stabilizing ability of tau and blocking the formation of insoluble, paired helical filaments (Muñoz-Montaño et al., 1997). Hyperphosphorylated tau is present within Alzheimer's disease in an unpolymerized form and sequesters normal tau protein into paired helical filaments. Pathological tau also inhibits the ability of tau to bind and stabilize microtubules. Inducing the polymerization of pathological tau results in the loss of inhibitory abilities as tau regains its microtubule stabilizing functions and disassociates from paired helical structures (Li et al., 2006). Dephosphorylation of pathological tau and the ability to regain microtubule-stabilizing capabilities are the underlying key mechanistic pathways that must occur in order to reduce the effects of memory loss associated with Alzheimer's disease.

Overall, the progression and pathology of Alzheimer's disease are correlated to the presence of pathological tau protein, which

aggregates into neurofibrillary tangles within the brain. Accumulation of neurofibrillary tangles within the axons of neurons attribute to the appearance of cognitive decline and often leads to a clinical diagnosis of Alzheimer's disease. In addition to therapeutically targeting hyperphosphorylated tau proteins, researchers may also target down-regulated gene regions with the

transcriptome of patients presenting with Alzheimer's disease (Annese et. al., 2017). Lastly, a common misconception within the research community of AD is the notion that beta-amyloid plaques accumulate prior to tau pathology. On the contrary, tau pathology precedes the accumulation of beta-amyloid plaques by ~ 27 years, thus tau-targeted clinical interventions must be implemented first.

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*Sleep*, 24”x48” oil on canvas 2019, by artist Arielle Tesoriero

“Mad Girl’s Love Song” – *Sylvia Plath*:

I shut my eyes and all the world drops dead;  
I lift my lids and all is born again.  
(I think I made you up inside my head.)

The stars go waltzing out in blue and red,  
And arbitrary blackness gallops in:  
I shut my eyes and all the world drops dead.

I dreamed that you bewitched me into bed  
And sung me moon-struck, kissed me quite insane.  
(I think I made you up inside my head.)

God topples from the sky, hell’s fires fade:  
Exit seraphim and Satan’s men:  
I shut my eyes and all the world drops dead.

I fancied you’d return the way you said,  
But I grow old and I forget your name.  
(I think I made you up inside my head.)

I should have loved a thunderbird instead;  
At least when spring comes they roar back again.  
I shut my eyes and all the world drops dead.  
(I think I made you up inside my head.)

The speaker of the poem in “Mad Girl’s Love Song” speaks directly to her former lover about their relationship. She wonders if the love really existed, or if it’s a figment of her imagination. The first stanza of the poem contains three lines that are repeated through-out the poem: “I think I made you up inside my head.” These lines imply the narrator’s struggles with disassociation. Her world exists only when she opens her eyes and it ends when she closes them. She often thinks of her lover, but can’t distinguish if these scenarios actually occurred or not. The poem reveals an obsessive view of love, which is also shown in “Sleep.” In “Sleep,” I am lying in bed with my phone under my pillow (unknown to the viewer), after I have sent the text message “I miss you” to someone I am thinking about. I wait anxiously to receive their message, as I think of all the possible things they could reply with. Because of my obsession with technology, I lack communication skills to admit my feelings in person. I perpetuate unrealistic standards of love and relationships as I scroll through Instagram, making up scenes of myself and this person together. What if they told me exactly what I wanted to hear? What if they told me they loved me? What if they told me we would be together forever?

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# THE EFFECTS OF FASTING ON IMMUNE FUNCTION AND AUTOIMMUNITY

*Julia Hamilos*

## **ABSTRACT**

Dietary interventions including intermittent fasting, prolonged fasting, and fasting-mimicking diets have been shown to be beneficial in decreasing the severity of multiple autoimmune diseases including Multiple Sclerosis, Rheumatoid Arthritis, Inflammatory Bowel Disease, Systemic Lupus Erythematosus, Type I Diabetes, and Asthma. Research in both mice and human models exhibit the specific effects that these interventions have on multiple components of the immune system and display ameliorative and restorative effects. This review will discuss research on the effects of fasting on both the healthy and diseased immune systems of humans and mouse models of autoimmune diseases. The studies discussed will stress the overall conclusion that more research should be done on the use of fasting as a new therapy for autoimmune diseases.

## **INTRODUCTION**

Autoimmune diseases represent a relatively new hurdle within the framework of modern medicine that is still largely misunderstood in terms of pathogenesis, prevention, and treatment. Autoimmunity occurs when the normal immune response becomes dysregulated. For example, an adaptive memory cell develops an affinity for self-antigen, which results in an immune-mediated attack against self. In the case of the immune response, “self” indicates the natural host biology as opposed to infectious pathogen or abnormal host cells (like cancer). The immune response is usually controlled by immune regulatory factors (including regulatory cells), but in the cases where it is not, autoimmune disease may follow the development of autoimmunity. Many factors may contribute to the pathogenesis of autoimmune disease including both genetic and environmental components. Additionally, the risk of autoimmune disease increases with age as the immune system accumulates damaged cells and loses its ability to metabolically regulate itself (Choi et al., 2017). It is also believed that unchecked proinflammatory cytokines may also contribute to the pathogenesis of autoimmune disease (Moudgil & Choubey, 2011). Due to these unchecked contributors to autoimmune disease, it becomes increasingly important to

understand the mechanisms by which the immune system is controlled and regulated. One control mechanism is metabolic regulation.

Numerous studies find many beneficial effects of dietary interventions such as caloric restriction, intermittent fasting, prolonged fasting, and fasting-mimicking diet (FMD). Calorie restriction involves the reduction of consumed calories to 500 kcal per day or less. Comparatively, intermittent fasting involves the regulation of feeding hours to certain hours of the day so that the body will experience a fasting period during non-feeding hours. Prolonged fasting (PF), arguably the most extreme form of dietary intervention, includes restriction of food intake over a period of 48-120 hours (Cheng et al., 2014). Since restriction of food intake may pose a health risk to vulnerable groups in the population, the fasting-mimicking diet, a plant-based diet providing micronutrients, is a good alternative in that it mimics the effects of fasting on internal biomarkers of oxidative stress without the complete abstinence from food (Brandhorst et al., 2015). These interventions are proving to protect against disease, to regenerate multiple bodily systems, to increase lifespan, and to rejuvenate the immune system (Brandhorst et al., 2015).

It is this effect on multiple systems of the body that makes fasting enticing to explore as possible therapy for autoimmune disease. This review will discuss research that describes the effects of fasting on both healthy and diseased immune systems, as well as some of the risks to human health associated with modern drug treatments. These studies will support the conclusion that more research should be conducted on the use of fasting as possible therapy for ameliorating autoimmune disease.

A study conducted by Faris et al. (2012) took advantage of Ramadan intermittent prolonged fasting to study its effects on the cells of the immune system in a group of healthy individuals. This type of fasting lasts for 8-24 hours during the hours between dusk and dawn. Researchers found that fasting resulted in decreased concentrations of circulating white blood cells (WBC) as well as decreased expression of

proinflammatory cytokine signals. This is of importance due to the known effects of how unchecked cytokine signaling can ramp up the immune response, which can increase inflammation (Faris et al., 2012). Furthermore, more research conducted by Cheng et al. (2014) shows that fasted mice undergo a decrease in WBC counts and proinflammatory cytokine expression during fasting. This decrease in cell and cytokine count is followed by a subsequent increase in cell number upon refeeding due to hematopoietic stem cell (HSC) regeneration, which is stimulated during this process. Additionally, not only do cells die and regenerate during this process, but WBCs return in a corrected myeloid/lymphoid ratio that typically becomes skewed with aging. Previous research has shown that as the immune system ages, the ratio of lymphoid-derived to myeloid-derived leukocytes becomes skewed toward more myeloid cell production. This results in an immune system with a smaller proportion of adaptive (those of lymphoid lineage) cells than innate cells (primarily those of myeloid lineage), which can reduce one's ability to combat certain pathogens, exhausting the innate immune system and leading to an unnecessary level of inflammation. The beauty of the fasting-induced HSC proliferation described here is that it corrects for this myeloid bias observed in aged rats. This “rejuvenation” of the immune system decreases inflammation and increases features such as stress resistance, longevity, memory, and motor coordination (Cheng et al., 2014).

There have been several studies conducted in recent years testing the effects of fasting on various autoimmune diseases, mainly in mouse models. There is some variation in the specific kind of dietary intervention used as well as the specific effect observed. However, what they all have in common is an observed reduction in the clinical severity of disease. This can be observed in mouse models of Multiple Sclerosis (MS), Type I diabetes, and Inflammatory Bowel Disease (IBD) in addition to human models of Asthma, Rheumatoid Arthritis, and Systemic Lupus Erythematosus (SLE) (Choi et al., 2016; Okada et al., 2017; Wei et al., 2018). In the following paragraphs, this review will describe some of the interventions and

clinical findings of these studies.

MS is an autoimmune disease marked by the demyelination of neuronal axons by myelin-specific T-helper cells, which can result in permanent damage to the nervous system and neurological disability (Choi et al., 2017). Such damage to the central nervous system results in significant impairment of bodily systems, causing tremendous pain and significantly reducing the quality of life. Common treatments for MS, as well as other autoimmune diseases, include immunosuppressant drugs to prevent further damage by suppressing the harmful activities of the dysregulated immune system, which attacks neuronal axons in this case. While this may slow down the progression of the disease and keep the aberrant immune system at bay, it does not provide any relief to the neurological damage that has already occurred (Choi et al., 2017). A study by Choi et al. (2016) found that an FMD in a mouse model of MS promotes regeneration and differentiation of glial cells and remyelination of axons (Fig. 1). In addition, other beneficial effects include reduced inflammation, leukocyte death and regeneration, and decreased proinflammatory T-cells. These effects are fascinating because not only is the immune system being controlled, but reversal of damages that were considered irreversible is occurring. In contrast to modern drug therapy, this option could offer much more to those suffering from the debilitating effects of this disease. Furthermore, a study conducted by Okada et al. (2017) finds similar disease ameliorative effects of fasting in a mouse model of colitis. Colitis is marked by inflammation of the colon resulting in damage to intestinal epithelial cells and intestinal crypts (Okada et al., 2017). Intestinal crypts are also referred to as intestinal glands and act as sites for intestinal cell proliferation (Okada et al., 2017). Mice in this study were induced to develop acute colitis which is similar to IBD in humans. Mice induced with colitis displayed severe loss of intestinal crypts as well as increased expression of inflammatory cytokines such as interleukin IL-1 $\beta$  and IL-17 (Okada et al., 2017). These effects were reversed in the mice which underwent intermittent fasting. The researchers report decreased disease severity after intermittent fasting via reduction in inflammation and restoration of crypts, which regenerated epithelial cells.

Moreover, in another study by Wei et al. (2018), researchers found similar effects using an FMD in a mouse model of Type I diabetes. This condition is marked by an immune attack of insulin-producing  $\beta$ -cells in the pancreas. During

the FMD, fecal samples, blood glucose levels, and insulin levels were all examined. After the cessation of the FMD, mice were euthanized and both pancreatic and hepatic tissues were extracted for examination. The researchers found that intermittent FMD significantly reduced blood glucose levels, increased beta cell proliferation and functioning, and decreased buildup of fat around the liver (Wei et al., 2018). Mice in this group also displayed improved hyperglycemia and glucose tolerance compared to control mice (Wei et al., 2018). This research shows that not only does this intervention help to manage the disease by reducing inflammation, but it promotes the body's natural repair mechanisms.

The previous studies described here have all shown improvements of human diseases in mouse models, but studies in human subjects also display similar results. A study by Han et al. (2018) observed the effects of an FMD on patients with asthma and found that the intervention displayed some immune-modulatory effects. In this study, peripheral blood samples were taken from participants after undergoing a 24 hour fast and again after a fixed-calorie meal. Peripheral blood immune cells were analyzed for protein levels of inflammatory cytokines as well as expression levels of inflammation-related genes such as the NLRP3 inflammasome, which is known to play a role in airway inflammation (Han et al., 2018). In addition, airway epithelial cells were analyzed for the expression of inflammatory genes, cytokine release, and T-helper cell activation. The results of this study found that the fasting process decreased the expression of the NLRP3 inflammasome, decreased cytokine release from airway epithelial cells, and decreased the activation of T-helper cells (Han et al., 2018). Additionally, the researchers did not find the NLRP3 inflammasome to be blunted in those fasted patients that were already being treated with inhaled corticosteroids and conclude that corticosteroids may have "indirect systemic effects" on the activities of this inflammasome (Han et al., 2018). Han et al. (2018) note that corticosteroid treatments have been found in previous studies to increase the risk of cardiometabolic and metabolic diseases via upregulation the NLRP3 inflammasome, making fasting interventions an even more desirable method of treatment.

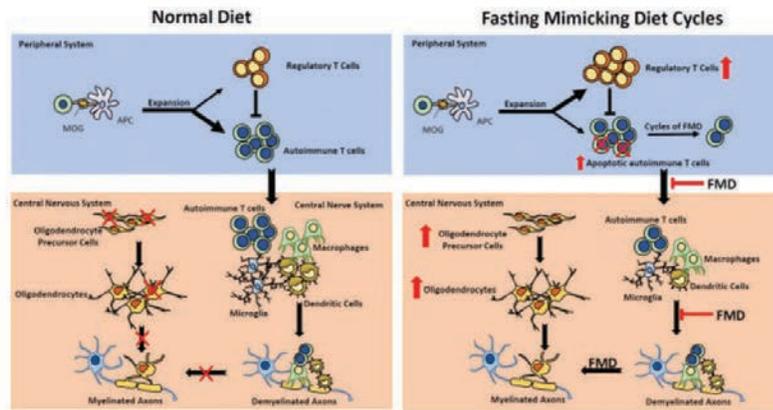
Moreover, a case study by Dr. Joel Fuhrman and his team of medical practitioners report the remission of various autoimmune diseases in five patients who were subjected to medically supervised fasting periods anywhere from one-three weeks (Fuhrman et al., 2002).

Before the treatment, all patients were taken off of antirheumatic medication, educated on how to follow a vegan diet, and began to follow that diet. Five different cases are reported in patients suffering from one of three autoimmune diseases: Rheumatoid Arthritis, Mixed Connective-Tissue Disease, and SLE. The individual lengths of fasting differed between patients but all lasted between 7 and 24 days. The patients were instructed to drink a quart of water each day and practitioners observed patients by obtaining a weekly blood chemistry panel. At the end of each individual fasting period, Dr. Fuhrman et al. (2002) reported a halt in the rheumatic symptoms of each patient. The fasting stages were broken with a slow transition back into a carefully curated all vegan diet. All five patients went into remission and were able to abstain from medication after this treatment.

Although there are beneficial outcomes associated with intermittent fasting and FMD, the question remains whether this is a better treatment option than what modern drug therapy can provide? We do have very effective drugs being used to treat these diseases, but they do not come without a hefty list of undesirable side effects. In addition, the precise risk associated with taking immunosuppressant drugs is the very feature that the drug is designed to do: suppress the immune system. This is obviously desired when it comes to alleviating the harsh symptoms associated with one's own immune system attacking your body. Although immunosuppression may not be such a desirable effect if it leads to opportunistic infections that the normal immune system is capable of managing. In a population-based epidemiological study on IBD patients taking immunosuppressant drugs, researchers found that the risks of developing opportunistic infections on immunosuppressants was significantly increased; the risk of developing opportunistic infections was increased by as much as 3.7% and the risk of developing serious infections was increased by as much as 14% (Kirchgesner et al., 2018). These were the highest increases and were observed in those patients in combination therapy in contrast to Thiopurines or anti-tumor necrosis factor (TNF) alone, although each type of treatment held its own increased risk of infection (Kirchgesner et al., 2018). In a similar study, it was found that 9.1% of patients included in the study developed opportunistic infections over the course of the year on immunosuppressants (Naganuma et al., 2013). The highest risk factor associated with the development

of opportunistic infections involved patients over the age of 50 years old, suggesting that older patients are especially vulnerable to the risk factors of these drugs. More specifically, Lefèvre et al. (2009) described a case in which a patient with SLE developed an infection with JC polyomavirus as a result of her suppressed immune system, which caused irreversible neurological damage. The patient was able to survive the infection after being taken off the immunosuppressants, although this is an infection that would result in the death of most SLE patients. Overall, immunosuppressive drugs come with their own individual risks that should be considered in deciding which treatment options are best in treating patients of autoimmune diseases.

Altogether, these studies support that further research should be the focus in investigating interventions such as intermittent fasting and FMD as potential therapies for autoimmune diseases. The sheer ability of fasting to regulate



**Figure 1. FMD promotes immune suppression and regeneration of myelinating cells in MS (from Choi et al., 2016).**

and restore the dysregulated immune system gives it an advantage over typical drug treatments, which merely serve to manage symptoms and hinder further progression of the disease. In addition, fasting serves as a far more natural method

of healing disease that does not hold the pharmacological risks associated with immunosuppressive drug therapies.

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# EFFECTS OF EXERCISE INTERVENTION ON FUTURE EXERCISE HABITS

Aaron Tate-Moore

## ABSTRACT

The aim of this study was to identify factors affecting the likelihood of college students to exercise and to identify what influence exercise intervention has on the exercise habits of college students. Data was collected from Salisbury University students (n=71). Surveys were used to identify factors related to exercised (n=40) and unexercised (n=21) students and assess the effect of exercise intervention on future exercise habits of an experimental group (n=10). Exercise habits of the experimental group increased 125.0% post intervention and increased all factors associated with increased exercise. Our findings show that exercise intervention decreases factors associated with reduced exercise and the act of exercising itself fosters a positive cycle of increased exercise behaviors.

## INTRODUCTION

In the United States alone, the 2018-2019 school year is projected to have nearly 20 million students enrolled in colleges or universities nationwide<sup>1</sup>. Higher education is a period of high stress and up to half of student populations may be experiencing psychological difficulties in the form of stress and anxiety<sup>2</sup>. Research has proven that exercise is an effective method of alleviating this stress and anxiety<sup>3,4</sup>. However, only 46.2% of college students meet the recommended guidelines for exercise<sup>5</sup>. In effect, college students are at an increased risk of compromising their mental health. In addition, as higher education requires long hours of sedentary behaviors such as attending lectures or studying course material, college students risk physical health complications such as cardiovascular disease, cancer, and type 2 diabetes<sup>6</sup> resulting from inadequate or nonexistent physical activity levels. Mental and physical health benefits

combined with evidence to suggest that exercise increases cognitive and executive function<sup>7,8</sup> prove the beneficial nature of exercising regularly and support the need to increase exercise habits among college

students.

The factors associated with exercise behaviors must first be identified and understood in order to effectively increase exercise habits. Ball, Bice, and

Survey Questions	
<b>Exercise Habits</b>	
Q4	Do you exercise at least 2 times per week?
<b>Categorical</b>	
Q5	Do you have a fitness or health major such as Exercise Science, Nursing, Respiratory Therapy, Medical Laboratory Science, Community Health, Applied Health Physiology, Athletic Training, Pre-Med, Pre-Physical Therapy, etc.?
Q6	Did you play at least 1 sport in high school either for your school or for a community team?
Q7	Do you play or did you play sports in college either for your school or for a community team?
<b>Intrapersonal Perceptions</b>	
Q8	Do you consider yourself health conscious?
Q9	Are you conscious of your exercise habits?
Q10	Do you think negatively of your body?
Q11	Do you think positively of your body?
Q12	Are you satisfied with the appearance of your body?
Q13	Are you unsatisfied with the appearance of your body?
Q14	Do you feel exercise can improve the appearance of your body?
Q15	Are you satisfied with your current health?
Q16	Are you unsatisfied with your current health?
Q17	Do you feel exercise can improve your health?
<b>Familiarity and Accessibility to On-Campus Fitness Resources</b>	
Q18	Are you aware of the resources on campus to help you improve your fitness?
Q19	Are you aware of on-campus facilities that you can use to exercise?
Q20	During the academic year, do you live near easily accessible facilities or equipment which you can use to exercise?
Q21	Do you feel comfortable going to on-campus facilities to exercise whether or not you have actually done so?
Q22	Do you feel comfortable reaching out to faculty members regarding fitness advice whether or not you have actually done so?
<b>Fitness Knowledge and Expertise</b>	
Q23	Do you feel you have the necessary skill set and knowledge to compose your own fitness/exercise plans?
Q24	When you exercise, do you know how to properly perform movements?
Q25	When you exercise do you know how to properly use equipment?
Q26	Do you know of several different types/forms of exercise?
Q27	Do you know for what purposes to utilize several different types/forms of exercise?
Q28	Do you understand the human body's physiological response to different types/forms of exercise?
Q29	Do you understand how the human body's physiological response to exercise affects your health?
<b>Attitudes towards Exercise</b>	
Q30	Do you feel exercise is simple to do?
Q31	Do you feel exercise is enjoyable to do?
Q32	Do you find that it is easy to make exercising a habit?
Q33	Once you have made exercise a habit, do you find it easy to restart after breaking the habit? (If you have never made exercising a habit, select "No")
Q34	Do you feel exercise is necessary if you are healthy?
Q35	Do you feel exercise can help to prevent you from becoming ill?
Q36	Do you feel exercise is necessary if you have a healthy diet?
Q37	Do you think a healthy diet is necessary if you exercise?
Q38	Do you feel exercise and a healthy diet are both equally necessary for your health?
Q39	Do you consider exercise an important determining factor of your health?
Q40	Do you consider exercise the number 1 determining factor of your health?
<b>Social Influences</b>	
Q41	Do you have friends who exercise frequently (at least two times per week)?
Q42	When you do exercise, do you exercise with friends?*
Q43	Do your friends occasionally invite you to exercise with them?*
Q44	Do you have friends you feel comfortable exercising with whether or not you have actually done so?
Q45	Does your family exercise frequently (at least 2 times per week)?
Q46	When you do exercise, do you exercise with family?*
Q47	Does your family occasionally invite you to exercise?*
Q48	Do you feel comfortable exercising with your family whether or not you have actually done so?

**Table 1:** Survey questions given to subjects with "Yes," "No," or "Maybe" as possible answer choices.

\*Answer choices were "Yes," "No," or "Sometimes."

	Unexercised Control Group (n=21)						Exercised Control Group (n=40)						Experimental Group (n=10)					
	Pre-Intervention			Post-Intervention			Pre-Intervention			Post-Intervention			Pre-Intervention			Post-Intervention		
	Yes	No	Maybe	Yes	No	Maybe	Yes	No	Maybe	Yes	No	Maybe	Yes	No	Maybe	Yes	No	Maybe
Q4	0	21	0	3	18	0	40	0	0	34	6	0	4	6	0	9	1	0
Q5	6	15	0	5	16	0	13	27	0	13	27	0	4	6	0	4	6	0
Q6	13	8	0	12	9	0	32	8	0	32	8	0	7	3	0	7	3	0
Q7	3	18	0	4	17	0	14	26	0	17	23	0	4	6	0	4	6	0
Q8	8	4	9	9	4	8	29	4	7	30	2	8	5	5	0	10	0	0
Q9	16	2	3	16	3	2	32	2	6	34	1	5	4	5	1	10	0	0
Q10	9	9	3	7	8	6	20	11	9	11	14	15	8	1	1	1	5	4
Q11	10	3	8	9	6	6	15	7	18	14	9	17	4	4	2	6	1	3
Q12	6	8	7	6	11	4	9	21	10	6	18	16	1	8	1	7	3	0
Q13	8	10	3	9	7	5	16	13	11	19	11	10	7	3	0	3	7	0
Q14	18	0	3	20	0	1	39	0	1	39	0	1	10	0	0	10	0	0
Q15	10	6	5	11	6	4	21	14	5	21	11	8	7	2	1	8	1	1
Q16	6	15	0	6	14	1	13	21	6	10	22	8	2	7	1	1	8	1
Q17	18	0	3	20	1	0	37	1	2	37	2	1	10	0	0	10	0	0
Q18	9	7	5	13	5	3	29	5	6	32	3	5	4	5	1	10	0	0
Q19	17	4	0	17	2	2	38	0	2	37	1	2	10	0	0	10	0	0
Q20	15	4	2	18	3	0	38	2	0	38	2	0	10	0	0	10	0	0
Q21	8	12	1	9	10	2	30	7	3	29	5	6	5	2	3	9	1	0
Q22	4	17	0	3	14	4	14	20	6	17	18	5	4	5	1	9	1	0
Q23	10	7	4	12	8	1	28	9	3	27	8	5	4	5	1	9	0	1
Q24	8	5	8	10	7	4	22	5	13	26	5	9	5	3	2	10	0	0
Q25	11	5	5	9	8	4	20	5	15	23	7	10	4	4	2	10	0	0
Q26	17	3	1	17	2	2	36	2	2	33	3	4	5	3	2	10	0	0
Q27	12	5	4	15	4	2	27	7	6	26	5	9	5	4	1	7	3	0
Q28	11	6	4	10	9	2	20	10	10	16	14	10	6	3	1	6	3	1
Q29	14	4	3	12	7	2	27	8	5	18	10	12	7	1	2	7	1	2
Q30	10	7	4	9	9	3	27	8	5	25	8	7	2	6	2	7	2	1
Q31	4	8	9	6	8	7	28	4	8	29	4	7	5	5	0	10	0	0
Q32	2	19	0	2	18	1	16	18	6	20	15	5	3	6	1	7	1	2
Q33	2	19	0	3	17	1	14	17	9	19	15	6	2	6	2	7	1	2
Q34	13	4	4	14	2	5	40	0	0	36	1	3	7	2	1	9	1	0
Q35	18	1	2	18	1	2	33	2	5	38	0	2	9	1	0	8	0	2
Q36	14	2	5	14	3	4	37	1	2	29	2	9	7	2	1	8	1	1
Q37	15	1	5	15	3	3	35	0	5	33	1	6	8	1	1	8	0	2
Q38	19	1	1	19	1	1	39	1	0	40	0	0	6	2	2	9	0	1
Q39	15	4	2	15	3	3	37	1	2	38	0	2	8	0	2	9	1	0
Q40	2	18	1	0	18	3	6	27	7	6	28	6	1	8	1	2	7	1
Q41	20	0	1	16	4	1	34	3	3	38	1	1	9	0	1	9	0	1
Q42	6	9	6	5	8	8	7	9	24	4	9	27	0	2	8	4	2	4
Q43	8	10	3	9	11	1	26	10	4	31	6	3	5	2	3	5	2	3
Q44	17	3	1	15	6	0	37	3	0	39	1	0	6	1	3	8	1	1
Q45	4	17	0	2	18	1	20	12	8	22	15	3	5	3	2	5	3	2
Q46	1	19	1	5	14	2	3	35	2	3	28	9	2	8	0	2	5	3
Q47	6	14	1	7	13	1	15	21	4	15	22	3	2	6	2	2	6	2
Q48	12	7	2	11	7	3	29	9	2	21	19	0	7	2	1	9	1	0

**Table 2:** Number of both pre-intervention and post-intervention responses for the unexercised control group, the exercised control group, and the experimental group.

Maljak found that previous exposure to exercise better equips people to address exercise barriers<sup>9</sup>. The same study also determined that increased exercise habits are associated with setting health-related goals. Another study focusing specifically on college students found that motivation is a key component of exercise frequency and that low motivation often results from individuals perceiving themselves to lack the necessary competence to exercise effectively<sup>10</sup>. The study also confirmed that college students who exercise for positive, intrinsic reasons such as enjoyment, pleasure, and satisfaction are more likely to maintain regular exercise behaviors long-term as opposed to those who exercise for negative reasons such as guilt and shame. According to Mazzola, Moore, and

Alexander, a heavy workload is a factor that prevents many from exercising<sup>11</sup>. They also found that social support helps increase physical activity and that exercise facilitators had the strongest effect on behaviors to the point where subjects exercised more with a facilitator present even when barriers were also present. The existing literature also mentions that the promotion of self-determined motivation serves to foster exercise behavior in college students<sup>12</sup> and that it may take 42-49 days to establish an exercise habit<sup>13</sup>.

The aim of this study was to identify factors affecting the likelihood of college students to exercise and to identify what influence exercise intervention has on the exercise habits of college students.

## METHODOLOGY

Subjects were given survey questions with “Yes,” “No,” or “Maybe” as possible answer choices (Table 1). Answers determined previous exposure to fitness, how familiar subjects are with on-campus fitness resources, their intrapersonal perceptions, their level of exercise expertise, their attitudes toward exercise, and their social-influences. Categorical questions placed subjects into an unexercised control group, an exercised control group, and one experimental group referred to as the intervention group.

The unexercised control group (n=21) consisted of subjects who reported exercising less than twice per week. The exercised control group (n=40) consisted

of subjects who reported exercising at least twice per week. The control groups had no participation in the exercise intervention. Subjects in the control groups completed a pre-intervention survey. At least one month after completing this survey, controlled subjects were asked to complete an identical post-intervention survey. The intervention group (n=10) consisted of a mix of both exercised and unexercised subjects who were involved in a separate resistance training study. Participation in the separate study acted as an exercise intervention. As a part of the intervention, subjects were instructed on proper weight training technique and weight room safety. These subjects completed a one-repetition maximum (1-RM) test on the bench press, squat, and seated row. The intervention group performed 11 weeks of resistance training and was instructed not to alter their diet and aerobic exercise levels throughout the study period. The training regimen consisted of the following machine-guided modalities: bench press, military press, arm curls, arm extensions, seated rows, squats, calf extensions, leg curls, and leg extensions. Training sessions occurred three to five times per week, pacing the progression of each subject based on variations in their weekly training outcomes. Subjects experiencing greater strength training improvements were assigned higher training intensities through increased repetitions and greater training loads. Experienced trainers accompanied subjects during all training sessions until subjects reported they were comfortable and confident in their ability to train alone. Training sessions occurred consistently at the same times on the same days. The intervention group was asked to complete a pre-intervention survey prior to beginning the resistance training study. At least one month after the conclusion of the training study, these subjects were asked to complete an identical post-intervention survey.

All subjects (n=71) were 18 years of age or older and part-time or full-time students attending Salisbury University. The data collected consisted of the number of responses for each question per group (Table 2). Data from the control groups was compared to each other to identify factors determining the likelihood of whether Salisbury University students exercise. Data from the experimental group was analyzed to identify if the intervention had any significant effect on the identified factors and the subjects' future exercise habits. All numerical values discussed throughout the paper were calculated to four significant figures. All experiments received IRB approval.

## RESULTS AND DISCUSSION

### Nature of Factors Related to Exercise Habits

The results show that prior exposure to fitness through athletic participation is associated with more frequent exercise behaviors (Table 3A), supporting previous findings<sup>9</sup>. Health- or fitness-related majors were also more associated with those who exercised regularly, but this may likely reflect individuals choosing an academic concentration based on already established interests in health and fitness. Health consciousness was also significantly associated with exercised subjects (Table 3B), which expands on the role of perceived wellness in one's exercise habits<sup>10</sup>. The findings of this study also indicated that negative body perceptions are more associated with those who do not exercise regularly.

Interestingly, negative body perceptions were initially more prevalent within the exercised control group perhaps due to a desire among physically active students to reduce these perceptions via exercise. Although negative body perceptions appeared to motivate some of these subjects to exercise, these subjects experienced a significant decline in negative body perceptions to the point of having less negative body perceptions than the unexercised control group after one month (Table 3C). These findings reflect that negative perceptions are a stronger barrier than facilitator to exercise and that exercise reduces these negative perceptions. In turn, this may initiate a positive cycle of increased exercise habits.

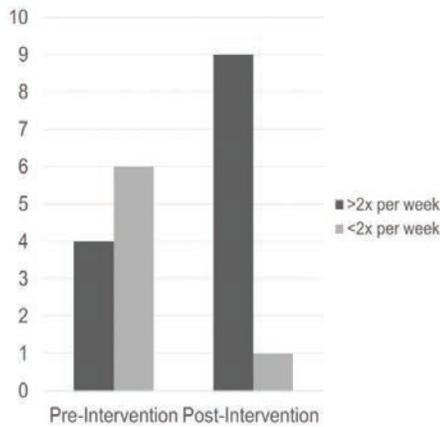
Being unfamiliar with on-campus resources and facilities greatly affected the likelihood of students to exercise, suggesting that simply increasing student awareness could also increase exercise frequency. In addition, students expressing discomfort in attending on-campus facilities or reaching out to faculty had a reduced likelihood of exercising regularly. Exercised control subjects showed an

increase in comfort with reaching out for fitness advice, which also may initiate a positive cycle of increased or maintained exercise habits. The practical knowledge to compose fitness plans, perform movements, and use equipment was associated with increased exercise habits. Although these measures decreased by a lesser percentage among the unexercised group, it must be noted that these measures were already lower to begin with. The findings suggest that increasing practical exercise-related knowledge may cause students to be more inclined to exercise. We found no relation between a technical understanding of exercise physiology and exercise habits, so when increasing students' knowledge of exercise and fitness to increase exercise habits, it may be more efficient to focus solely on practical skills rather than technical knowledge.

Viewing exercise as simple and enjoyable were both highly associated with exercised individuals. This shows the need to address students' attitudes toward exercise as an important step to increasing exercise habits. The largest factor associated with lack of exercise was the difficulty of forming a regular exercise habit (Table 3D). Any effort to increase exercise behaviors must be attentive to this issue. Our findings also show that students who valued the role of exercise to their health were much more likely to exercise regularly. The proportion of unexercised students who reported exercising with friends was significantly lower than that of exercised students (Table 3E), which highlights the importance of social support identified by previous studies<sup>11</sup>. Encouraging students to exercise in groups with peers is a promising method of increasing their exercise habits. However, having family that exercised regularly was much more related to increased exercise habits than having friends who exercise regularly (Table 3F). Similar with Arenaza et al.'s findings<sup>14</sup>, these results indicate that the exercise habits of individuals tend

	UCG: % Pre- Intervention	UCG: % Post- Intervention	UCG: % Increase/ Decrease	ECG: % Pre- Intervention	ECG: % Post- Intervention	ECG: % Increase/ Decrease
<b>A</b>	38.10%	38.10%	0.000%	57.50%	61.25%	+6.522%
<b>B</b>	38.10%	42.86%	+12.50%	72.50%	80.00%	+3.448%
<b>C</b>	42.86%	33.33%	-22.22%	50.00%	27.50%	-45.00%
<b>D</b>	90.48%	83.33%	-7.895%	43.75%	37.50%	-14.29%
<b>E</b>	57.14%	61.90%	+8.333%	77.50%	77.50%	0.000%
<b>F</b>	19.05%	9.524%	-50.00%	50.00%	55.00%	+10.00%

**Table 3:** Percentages and percentage changes between pre-intervention and post-intervention for the unexercised control group (UCG) and the exercised control group (ECG). Findings in **A)** prior athletic participation, **B)** health consciousness, **C)** negative body perceptions, **D)** difficulty with habit formation, **E)** exercising with friends, and **F)** having family that exercised regularly, are shown.



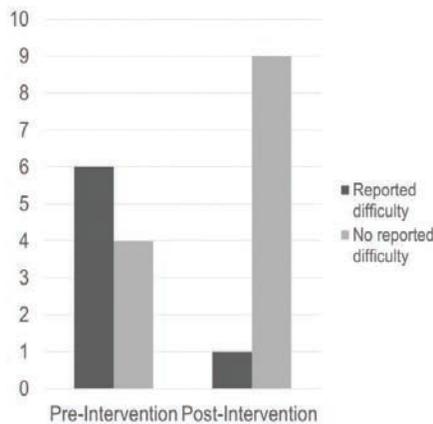
**Figure 1:** Self-report of experimental subjects' exercise habits pre-intervention and post-intervention.

to reflect and directly affect the exercise habits of their family members. Therefore, this research suggests that family-based intervention may also serve to benefit students with inadequate exercise habits.

### Observed Effects of Exercise Intervention

We designed the intervention to influence subjects to increase their future exercise habits. The use of trainers to accompany subjects during their training sessions worked to instruct the subjects on proper form and technique. This was to increase the subjects' competence and, in turn, increase motivation<sup>10</sup>. Additionally, after reporting enough self-perceived competence, subjects completed the intervention alone without the assistance of a trainer. This promoted self-determined motivation, an important component to increase exercise behaviors<sup>12</sup>. Furthermore, the intervention lasted 11 weeks, enough time to establish and act on an exercise habit<sup>13</sup>.

Exercise habits among the experimental group more than doubled, which showed that the intervention was ultimately successful in its applications of significant factors identified in previous studies (Fig. 1). The intervention caused an extraordinary increase in exercise and health consciousness, positive body perceptions and satisfaction, awareness of fitness resources and facilities, comfort using said facilities, reaching out to faculty for advice, perceived competence to compose personal fitness plans, ability to properly perform exercises and use equipment, and how to properly utilize exercises. There were also significant increases in the perceived simplicity and enjoyableness of exercise, and the ease of making and maintaining exercise habits (Fig. 2). Not only did students



**Figure 2:** Self-report of experimental subjects' difficulty with habit formation pre-intervention and post-intervention.

report exercising with friends and family more, but they also reported being more comfortable doing so. The intervention essentially increased all factors associated with increased exercise behaviors, which greatly increased future exercise habits. Significant findings are summarized in Table 4.

### Limitations

This study's most important limitation to note is the great variation in sample sizes between the exercised control (n=40), the unexercised control (n=21), and experimental group (n=10) and statistical analysis was not performed due to logistical and resource limitations. Groups of larger and equal sample sizes would be ideal for comparison in order to avoid limiting the data's representativeness and all conclusions based on our data must be made with this in mind. Also, having both an exercised and unexercised experimental group would have been ideal for analysis, but given the small sample size available for this study, a mixed experimental group was used.

### CONCLUSION

The aim of this study was to identify factors affecting the likelihood of college students to exercise and to identify the influence of exercise intervention on college students' exercise habits. The strongest factors identified to have a positive effect on students' exercise habits were prior athletic participation, high perceived health consciousness, low negative body perceptions, ability to form habits, exercising with friends, and having family members that exercise. The intervention influenced each of these factors in a manner favorable to increased exercise habits. Students who reported having family members that exercise

	EXPG: % Pre-Intervention	EXPG: % Post-Intervention	EXPG: % Increase/Decrease
A	40.00%	90.00%	+125.0%
B	80.00%	10.00%	-87.50%
C	50.00%	90.00%	+80.00%
D	40.00%	90.00%	+125.0%
E	40.00%	90.00%	+125.0%
F	60.00%	10.00%	-83.33%
G*	80.00%	80.00%	0.000%
H	20.00%	50.00%	+150.0%

**Table 4:** Percentages and percentage changes between pre-intervention and post-intervention for the experimental group (EXPG). Findings in A) exercising at least twice per week, B) negative body perceptions, C) comfort using facilities, D) comfort reaching out to faculty for advice, E) perceived fitness competence, F) difficulty with habit formation, G) exercising with friends, and H) exercising with family is shown.

Although the number of subjects reporting exercising with friends was unchanged post-intervention, subjects reported exercising with friends more frequently.

also increased, likely due to the trend of individual habits affecting family members identified in a previous study.

Past research has identified time constraints<sup>9</sup> and a heavy workload<sup>11</sup> as a major obstacle that keeps people from exercising regularly. The intervention was not designed to give students more time in their schedule or alleviate their academic workload. However, the intervention may have influenced students' perception of how much time they have to devote to exercise and the degree to which their workload acts as an exercise barrier. Future research would do well to explore this possibility. Future research would also do well to explore the effect of exercise intervention specifically on different genders and sexes as previous studies have shown gender-based and sex-based differences affecting college students' exercise behaviors<sup>12, 15, 16</sup>.

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# CHARACTERIZING CARBON QUANTUM DOT BYPRODUCTS IN THE SYNTHESIS OF COPPER-INDIUM-SULFIDE QUANTUM DOTS

*Austin Dabbs*

## ABSTRACT

Quantum dots are crystalline spheres of 2-15 nanometers across with photonic capabilities that are dependent on their physical size. This relatively new technology has potential in LEDs, solar panels, and biotechnology. However, because they are often made using toxic metals and organic solvents, there is interest in creating nontoxic alternatives. Copper-indium-sulfide quantum dots synthesized in water are of considerable interest because their synthesis is easy and safe. However, there has been only some success in controlling the color of their emission, which greatly limits their use. In addition, their synthesis can lead to the unintentional formation of carbon quantum dots, which glow blue and can skew data. This research describes the process through which carbon quantum dots can form and offers suggestions to mitigate their formation while synthesizing copper-indium-sulfide quantum dots.

## INTRODUCTION

Quantum dots are crystalline spheres of semiconducting material, 2-15 nanometers (nm) across, that function as artificial atoms (PlasmaChem, 2013). Semiconductors are materials that exhibit a bandgap energy, which means they can conduct electricity if the ground state electrons, occupying the valence band, absorb enough energy to transition to the empty conduction band (Figure 1). This transition may occur when the material absorbs or loses energy in the form of light. When these materials exist as crystalline structures of nanoscale dimensions, their electrons are confined and the bandgap energy is dependent on the size of the nanoparticle, which is synthetically tunable, as illustrated in Figure 1. The band gap and quantum dot size are inversely proportional – larger quantum dots will have a smaller band gap requiring a smaller energy photon to excite an electron across the band gap. Meanwhile, smaller quantum dots have larger band gaps, which require a greater energy photon to excite an electron. Once excited, the electron will lose some energy to heat and then fall back down to its original ground state. The energy

the electron previously absorbed is then re-emitted as a lower energy photon, resulting in the emission of light of a specific color (Chen, 2013). Since color is a property of photon energy, this creates a direct relationship between the size of the quantum dot and the wavelength of the outgoing light as shown in Figure 2. In other words, larger quantum dots will absorb and re-emit redder light and smaller quantum dots will absorb and re-emit bluer light. The ability to control the size, and therefore the color of the quantum dots, led to research into quantum dot use in solar panels. The most common solar panels today use silicon – a bulk semiconducting material – to convert light into electricity (Pan, 2018). This is because the band gap of crystalline silicon is rigid and can only absorb set wavelengths with high efficiency (Pan, 2018). However, quantum dot's variable band gaps offer an efficiency advantage against bulk silicon. We should be able to create solar panels with efficiency that approaches 100% by layering different quantum dots that absorb different wavelengths with high efficiency such that less energy is lost as heat, and more of the spectrum of sunlight is converted into electricity.

Currently, most quantum dots are synthesized in toxic and environmentally harmful organic solvents (Chen, 2013). For example, the best quantum dots today are made from lead and cadmium (Chen, 2013). Their improved performance is a result of large Bohr radii for the materials. Larger Bohr radii allow for a greater range of band gaps and more room for tuning the size of the quantum dot. A Bohr radius is a property of material composition, and therefore can be adjusted by changing composition. This means the color of the quantum dots can also be changed by changing composition (Pan, 2018). The goal of this research was to create high-quality quantum dots without toxic composition and without the use of toxic organic solvents. In order to be classified as high-quality, these quantum dots had to be comparable to their toxic counterparts in the following areas: color controllability, water solubility, and light-harvesting

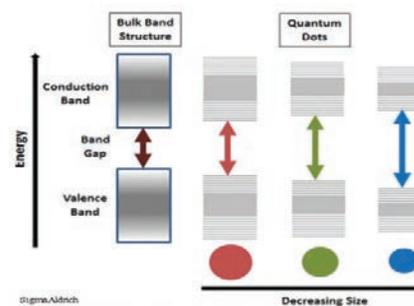


Figure 1: The relationship between quantum dot size and the color absorbed. Larger dots absorb redder light and smaller dots absorb bluer light. (Millipore Sigma, 2013).

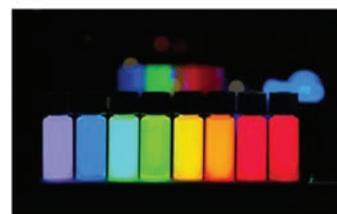


Figure 2: High-quality quantum dots of increasing size (left to right) made from cadmium, zinc, selenium, and sulfur made by PlasmaChem (PlasmaChem, 2013).

ability.

The quantum dots originally chosen as fitting these properties are copper-indium-sulfide ( $\text{CuInS}_2$ ). The synthesis outlined in this paper is based on the work of Chen et al., which used a “green and facile synthesis of water-soluble Cu-In-S/ZnS core/shell quantum dots” (2013). Researchers Chen et al. adjust the color of the quantum dots by adjusting the ratio of copper to indium in their synthesis. This is a compositional adjustment yielding changes in quantum dot color. Many attempts were made to replicate the results as described, but synthesis of quantum dots in the light yellow and green regions of the light spectrum remained fruitless.

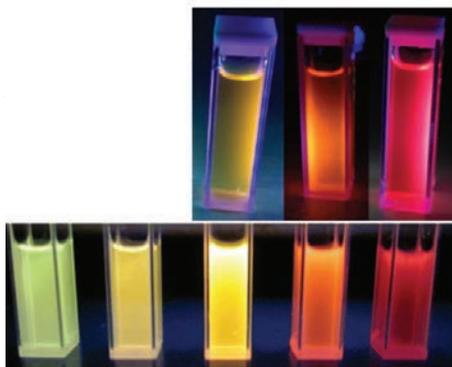


Figure 3: CuInS<sub>2</sub> quantum dots in our lab (top) against CuInS<sub>2</sub> quantum dots claimed from research by Chen et al. (bottom) (2013) shown glowing under ultraviolet light.

of CuInS<sub>2</sub> synthesis and proved to be destructive to the procurement of our intended product.

## METHODS

A typical synthesis involves mixing and stirring 250 $\mu$ L 0.1M aqueous CuCl<sub>2</sub>, 19 $\mu$ L 0.04018M InCl<sub>3</sub> dissolved in ethanol, 0.4M aqueous trisodium citrate, 1.5mg L-glutathione, and 23.8 $\mu$ L of aqueous 1.00M sodium sulfide (Na<sub>2</sub>S) in 5.5mL of water. The solution is then heated in a microwave reactor at 300W for 10 minutes at 95°C. After their synthesis, the quantum dots are capped with a layer of ZnS by adding a capping solution that contains zinc and sulfur ions and microwaved again for 10 minutes at 95°C. The process of capping improves their performance by filling out the spherical shape of the quantum dots. This synthesis provides water-soluble CuInS<sub>2</sub> quantum dots which can be precipitated out when the solution is added to 10mL of isopropanol. This leaves a precipitate that can be resuspended to create solutions which glow under ultraviolet light as shown in Figure 3.

To adjust the size of the CuInS<sub>2</sub> quantum dots, we attempted to replace the highly reactive sodium sulfide with L-glutathione, another sulfur source. This route has been shown to work with cadmium sulfide quantum dots (Liu, 2017). All reactants were kept in the same amounts, and heating was raised to 205°C in order to decompose the glutathione and free the sulfur atom. Our hypothesis was that the decreased reactivity of the sulfur source would result in slower formation of quantum dot crystals, giving us smaller quantum dots at the end of our synthesis.

## RESULTS AND DISCUSSION

The color of the quantum dots is determined by the location of their

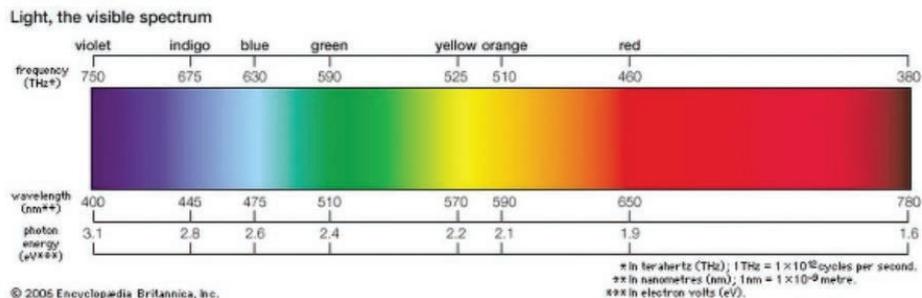


Figure 4: The visual spectrum of light.

emission using a fluorimeter. The fluorimeter fires a beam of light of a chosen wavelength at a solution containing fluorescent material such as quantum dots. The fluorescent material absorbs that light if it is energetic enough and reemits the light at its fluorescing color. The given wavelength is compared to its respective color using a visible light spectrum shown in Figure 4.

It is important to note that our synthesis takes place at high pressure, high temperature, and in an acidic environment and therefore is apt for the formation of common blue carbon quantum dots shown in Figure 5. These are not our intended product. In order to determine if the synthesis in which L-glutathione served as a sulfur source successfully produced our intended CuInS<sub>2</sub> product or if the emissions observed were a result of unintentional carbon quantum dots, we compared a control containing carbon dots, and an experimental run in which the ingredients for CuInS<sub>2</sub> were left largely unchanged, but formation of CuInS<sub>2</sub> was stifled. We compared the emission spectra of these two samples to determine if the ingredients of CuInS<sub>2</sub> would create carbon dots.

In our synthesis, the acidic environment is a result of the metallic ions suspended in solution because both Cu (II) and indium (III) act as Lewis acids. Indium (III) was able to sufficiently lower pH without the presence of Cu (II). To determine if indium's role as the acid was producing carbon quantum dots, we removed CuCl<sub>2</sub>. This prevents the formation of CuInS<sub>2</sub> quantum dots but still creates an acidic environment (pH 5.46) for carbon quantum dots to form. Against this sample, we created a vial in which we knew carbon quantum dots would form by adding sodium citrate and L-glutathione to a 5.5mL aqueous solution acidified to a pH of 5.29.

Transmission electron microscopy completed at the University of Maryland College Park Advanced Imagery and Microscopy Lab showed faint spherical particles of 2nm across in our experimental sample (Figure 6). We tested both the experimental and our

control for absorbance in a UV/Vis spectrophotometer. This tests the region at which the sample will absorb by firing a beam of increasingly energetic photons and measuring the wavelength at which the sample absorbs. Blue quantum dots should absorb a wavelength between 320-350nm. This is realized in the UV/Vis spectrum as a "bump" where the energy of incoming photons matches that of the band gap and serves as evidence of quantum dots. Table 1 shows that quantum dots form in an environment of only indium, and that quantum dots of a weaker absorption form in an acidic environment absent of indium. This shows that the presence of CuInS<sub>2</sub> forming materials is not necessary to achieve the glowing mixture that we have. Through this, we were able to rule out the possibility that the spherical particles shown in Figure 6 were our intended product. These experiments verified that we had not been successful in making CuInS<sub>2</sub> quantum dots using L-glutathione as a sulfur source. Instead the quantum dots creating the blue glow were carbon dots.

## CONCLUSION

We conclude that carbon quantum dots can form as a byproduct of high-temperature synthesis of CuInS<sub>2</sub> quantum dots, and, therefore, we must be wary of their formation in future syntheses. Accidental creation of carbon dots could skew data by vastly outshining other quantum dots in spectra due to their enormous fluorescence (Bhunia, 2013). Because the formation of carbon quantum dots is such a simple process, future work requires temperature considerations during synthesis of quantum dots made in solutions with sodium citrate or other carbon-based reactants. High temperatures at and above 205°C can form carbon quantum dots from sodium citrate ligand, while synthesis at 95°C have been shown to avoid their formation. This research did not test if carbon quantum dots form at basic, high pH environments. For that reason, it is of interest to see if high pH can prevent the formation of carbon quantum dots during the synthesis of an intended product, such as CuInS<sub>2</sub>

quantum dots.

Quantum dots remain a promising technology. Their reputation as harmful in synthesis and composition slows their potential adoption to solar cells and other technologies, and a clean development is necessary to their widespread adoption. CuInS<sub>2</sub> quantum dots are promising as safe alternatives, and more research into their aqueous synthesis is necessary to make them comparable in use to their lead and cadmium counterparts. This research seeks to highlight a significant speedbump that researchers seeking aqueous methods of their synthesis may encounter. Furthermore, this research highlights the formation of carbon quantum dots for all aqueous high-temperature, high-pressure, and acidic syntheses for which researchers should be vigilant to prevent.



Figure 5: Carbon quantum dots made from sodium citrate.



Figure 6: TEM shows small colloids. The faint appearance of the quantum dot (left) evidences a composition of a light atom such as carbon.

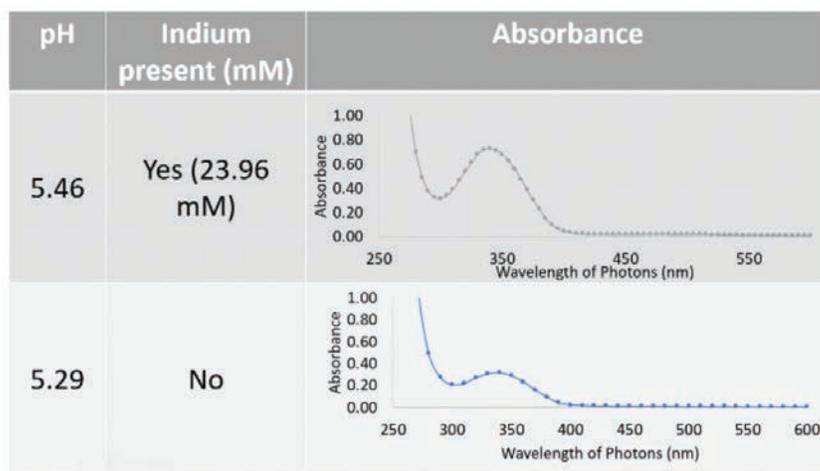


Table 1: A solution microwaved with indium and a solution microwaved and made with acid absorb at the same wavelength. Both solutions show a characteristic bump of absorbance indicating the presence of quantum dots.

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# SEVERE THUNDERSTORM CLIMATOLOGY OF THE DELMARVA PENINSULA (1987-2017)

*Roger Riggan*

## ABSTRACT

Convective weather events appear to be spatially limited in the southern-most portions of the Delmarva Peninsula. This hypothesis is put to the test after several years of similar observations. Severe thunderstorms are the products of intense atmospheric convection. Spatial analysis of convective weather can be performed using the point locations of any confirmed severe weather report released by the Storm Prediction Center (SPC) in Norman, OK. Severe thunderstorm parameters are defined by the National Weather Service (NWS) as any one of the following: wind gusts > 50kts (58mph), hail with diameter > 1” and/or produces a tornado. In this study, geographic information systems (GIS) technology was used to create a 30-year climatological map of severe weather reports across the Delmarva Peninsula. These maps were used to analyze the spatial distribution and frequency of severe weather events in the area of interest. Each severe thunderstorm parameter was statistically tested using Quadrat Analysis in order to verify if and where data clustering is occurring on the Delmarva Peninsula. The results for each parameter showed statistically significant clustering north of the Delaware state-line. These results support the initial hypothesis and the need for more research on this topic.

## INTRODUCTION

Severe thunderstorms are a common warm-season threat in the continental United States. The NWS estimates severe thunderstorms were associated with 36 fatalities and \$823.4 million dollars in losses on average from 1995-2017 (National Weather Service, 2018). The spatial region of severe weather impacts is often localized when compared to the size of the watch area. This results in a large population of individuals who have become desensitized to severe weather alerts such as watches or warnings (Mitchell, 2019). Understanding the spatial distribution of severe weather is a fundamental step in correcting this issue. This paper will look at the spatial distribution of events on the

Delmarva Peninsula from 1987-2017.

I have often attempted to intercept squall-lines and other convective storm cells as they move across the Chesapeake Bay toward the western coast of the Delmarva. I have noticed that convective storms tend to weaken or dissipate as they reach the southern periphery of the Peninsula. These observations are what warranted this investigation into the spatial distribution of convective weather events on the Delmarva Peninsula. Mark Murphy of the University of North Carolina Chapel Hill used geographic information systems (GIS) technology to analyze the spatial distribution of cloud-to-ground (CG) lightning strikes in the interior southeastern United States. Murphy defined a study area and used data from the National Lightning Detection Network (NLDN) to classify thunderstorms by the spatial and temporal patterns of CG lightning strikes (Murphy & Konrad, 2005). Similar methods can be used to construct a spatial climatology record of convective weather on Delmarva. Severe thunderstorms are driven by atmospheric convection (NOAA National Severe Storms Lab, 2019). This makes severe weather parameters ideal for analyzing convective weather distributions on the Delmarva Peninsula. A 30-year climatology record of severe weather impacting the Delmarva Peninsula was

constructed to analyze if there is a spatial distribution that matches the initial observation. Spatial analysis has been performed on this record in an attempt to verify if there is an uneven spatial distribution of severe thunderstorm events on the Delmarva Peninsula. Verifying the climatological distribution of severe thunderstorm events will create an opportunity for further research to determine the factors responsible for the distributions unveiled in this study.

## METHODS

A severe thunderstorm is defined by the NWS as “any storm that produces winds in excess of 50kts (58mph), hail at least 1” in diameter, and/or a tornado” (National Weather Service, NOAA, & US Department of Commerce, 2017). Using this definition, it is possible to review archived storm reports retrieved from the SPC to indicate point locations impacted by any one of the three severe thunderstorm parameters. Archived data sets for each parameter ranging from 1950-2017 were obtained from the SPC’s SVRGIS web page (<https://www.spc.noaa.gov/gis/svrgis/>). The data was available in comma separated values (.csv) or as a GIS database (Storm Prediction Center, 2018). GIS files are most appropriate for this study as the spatial distribution of events is the primary

Quadrat Analysis Hypotheses	Null	Alternate
<i>Tornado</i>	The spatial distribution of tornadoes on the Delmarva is completely random	The spatial distribution of tornadoes on the Delmarva shows a statistically significant degree of clustering
<i>Hail</i>	The spatial distribution of hail on the Delmarva is completely random.	The spatial distribution of hail on the Delmarva shows a statistically significant degree of clustering
<i>Wind</i>	The spatial distribution of wind on the Delmarva is completely random	The spatial distribution of wind on the Delmarva shows a statistically significant degree of clustering.

**Table 1:** States the Null and Alternate Hypotheses of the Quadrat Analysis performed on the data

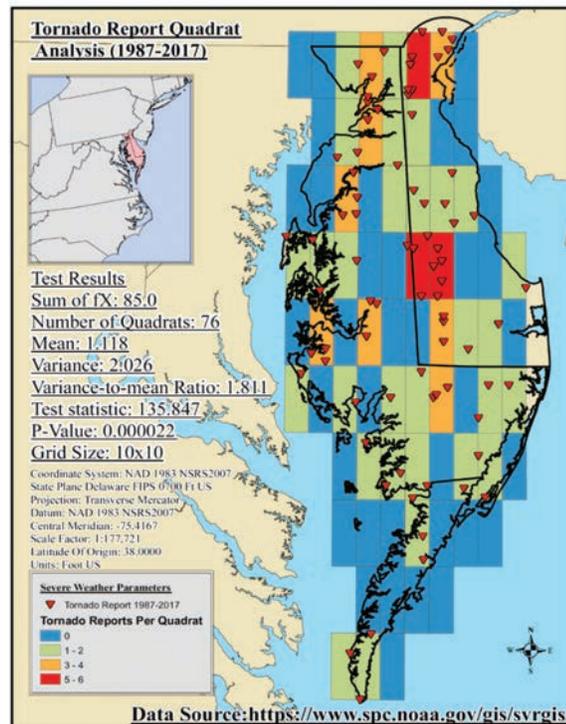
**Formula 1:**  $\chi^2 = VMR(m - 1)$  where m is the number of quadrat cells from analysis

interest of this research.

ArcMap was used as a tool to construct and perform data analysis in the study area. A base map centered on the Delmarva Peninsula was created as well as a reference map to highlight the Delmarva Peninsula in relation to the East Coast, which is positioned in the upper-left corner. The North American Datum, NAD 1983 State Plane Delaware Transverse Mercator projection was used to create the most accurate land area representation of the Delmarva due to the north-to-south land orientation (Kimerling, Buckley, Muehrcke, & Muehrcke, 2016). Next, each database file for the severe weather parameter was imported into ArcMap. These files included all reported locations for wind, hail, and tornado of any size and/or magnitude in the United States from 1950-2017.

To narrow down the data for the area of interest, each database had to be stratified several times. The first stratification allowed only data points that fell within the Delmarva Peninsula land boundary to be included. The second stratification allowed only data within the range of 1987 to 2017 to be presented in order to build the most recent 30-year climatology record. Wind and hail report data required one more stratification to meet the base criteria for this study. All wind data was provided in knots, with a minimum report of 50kts or unknown. The data was stratified again so that unknown wind values were removed from the data set. Arguably, unknown values could remain included since they were accepted by the SPC. However, this study worked with only data that had a verified wind speed to fit the criteria listed above. Stratification was done again with the hail report data so that only hail reports of 1" or greater was presented. Tornadoes did not require the additional stratification since tornadic storms are considered severe by definition. The Delaware state-line was used to separate the study area into two. Area north of the state-line is referred to as the "Upper Shore" and area south of the line is considered the "Lower Shore." This separation will be important during the discussion of the results of this study.

Each dataset of severe weather parameters was run through a GIS Quadrat Analysis (McGrew, Lembo, & Monroe, 2014). This statistical test uses the frequency of an event in question occurring over numerous quadrat grids that are overlaid on a study area to determine spatial distribution patterns. Table 1 displays the null and alternate hypotheses for each severe weather



**Figure 1** gives a visual description of the tornado quadrat analysis. Each confirmed report is shown at the location it occurred. Quadrat analysis results in a VMR = 1.811 &  $p = 0.000022$  indicating statistically significant clustering of tornado reports. The superimposed quadrats were color-coded based on the number of reports, which revealed that the bulk of the reports occurred north of the Delaware state-line.

parameter. For this study, a 10x10 quadrat grid was superimposed on the Delmarva Peninsula, with quadrats not including any part of the Delmarva landmass being removed from the grid. Each dataset of severe weather parameters was run individually through the quadrat analysis tool in ArcMap. The test provides a Quadrat, Frequency Table, and Original Point shape files that can be opened in ArcMap once the analysis was complete. The statistical results appeared as a web link in the C:/TEMP folder on the PC, which was then copied and pasted as a text box on the map to show the results visually as well as numerically in one figure per dataset.

Figures 1-3 display results for each severe weather parameter after performing Quadrat Analysis. The numerical results from the Quadrat Analysis provided this study with a Variance-to-Mean Ratio (VMR) for each variable. The VMR is the numerical value used to determine the type of spatial distribution occurring in the data set.  $VMR > 1$  shows clustering.  $VMR \approx 1$  shows randomness.  $VMR < 1$  shows dispersal. The VMR was used to calculate statistical significance by using Formula 1. This returns  $\chi^2$ -value that was used to determine a significance value (McGrew, Lembo, & Monroe, 2014).

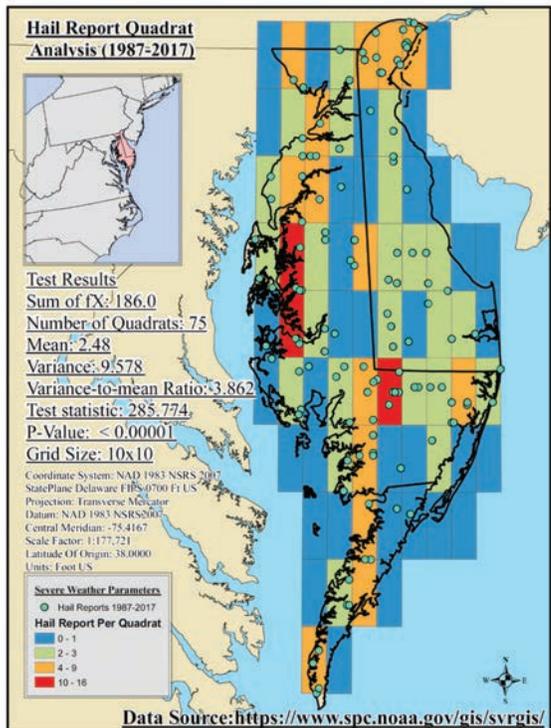
To address the research question of this study, the Quadrat frequency counts were sorted by natural breaks to highlight any anomalies during the analysis.

## RESULTS

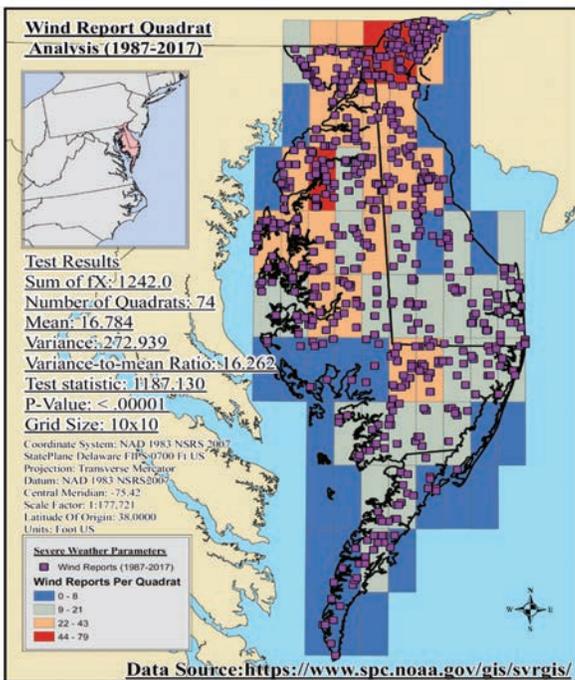
Analysis of the statistical results and what they mean to each individual parameter is discussed individually below in order to highlight the anomalies and descriptive details discovered from each analysis. The results from all three are then pulled together and shared in the final conclusion.

## TORNADO RESULTS

Figure 1 displays the result of the quadrat analysis of tornado report data ranging from 1987-2017. There were 85 tornado reports in the study area during the timeframe of interest. A total of 76 quadrats ( $m=76$ ) were generated and placed over the study area. The VMR equaled 1.811, which is indicative of clustering. Using Formula 1, the  $\chi^2$ -value was found to equal 135.847,  $p=0.00022$ . Therefore, the null hypothesis is rejected and it is statistically determined that there is a clustering of tornado reports on the Delmarva Peninsula between 1987-2017. Figure 1 shows three distinct hotspots for tornado activity with five to six



**Figure 2** gives a visual description of the hail quadrat analysis. Each confirmed report is shown at the location it occurred. Quadrat analysis results in a VMR = 3.862 ( $p < 0.00001$ ) indicating statistically significant clustering of hail reports. The superimposed quadrats were color-coded based on the number of reports, which revealed that the bulk of the reports occurred north of the Delaware state-line.



**Figure 3** gives a visual description of the wind report quadrat analysis. Each confirmed report is shown in the location it occurred. Quadrat analysis resulted in a VMR = 16.262 ( $p < 0.00001$ ) indicating statistically significant clustering of wind reports. The superimposed quadrats were color-coded based on the number of reports, which revealed that the vast majority of the reports occurred north of the Delaware state-line.

reports within the same quadrat over the study period – all three of these are in Delaware. Eight other quadrats with three to four tornado reports during the study period are located within the Delmarva Peninsula. Seven out of the eight quadrats are located in the Upper Shore. The number of quadrats with zero to three tornado reports were similar in both regions (34 north, 30 south). Using statistically significant clustering and a descriptive analysis of the quadrats, this study revealed clustering in the Upper Shore between 1987-2017. Almost 70%, 59 out of 85 of the reports, of all the tornadic activity throughout the study period occurred in the Upper Shore area. The combination of both quadrat hotspots and the majority of events occurring in the Upper Shore supports the overarching hypothesis that convective weather events appear spatially limited in the southern-most portions of the Delmarva Peninsula.

## HAIL RESULTS

Figure 2 displays the result of the quadrat analysis of hail report data ranging from 1987-2017. There was a total of 186 hail reports in the study area throughout the timeframe of interest. A total of 75 quadrats ( $m=75$ ) were generated to cover the study area. The VMR for hail report data equaled 3.862, which is indicative of clustering. The  $\chi^2$ -value was calculated using Formula 1 and equaled 285.774 ( $p < 0.00001$ ), which rejects the null hypothesis. Therefore, it was determined statistically that there is a clustering of hail reports on the Delmarva Peninsula between 1987-2017.

Figure 2 shows three distinct hotspots for hail activity with 10-16 reports within the same quadrat over the study period. The hotspots were located around these Maryland cities: Salisbury, Cambridge, and Easton. The Cambridge quadrat was the only one to register 16 events. It is important to note that the map layered several reports because they were assigned the same coordinates. There were 14 other quadrats that had four-nine hail reports within the study period, eight of these were located in the Upper Shore. The number of quadrats with zero-three hail reports varied slightly between regions (32 north, 25 south). Similar to the tornado results, there was more clustering in the Upper Shore than the Lower Shore. However, it is interesting to note that there was a shift in hotspots between hail and tornado reports. In particular, the two quadrats in Delaware that were hotspots for tornadoes were cold spots for hail. Furthermore, several quadrats that were cold spots for tornadoes showed moderate hail activity, including some quadrats from the Wicomico County border down toward Northampton County in Virginia.

Parameter	VMR	$\chi^2$ -value	P-Value
<b>Tornado</b>	1.811	135.847	0.000022
<b>Hail</b>	3.862	285.774	<0.00001
<b>Wind</b>	16.262	1187.13	<0.00001

**Table 2: Summary of results from each Quadrat Analysis**

**Formula 1:**  $\chi^2 = VMR(m - 1)$  where m is the number of quadrat cells from analysis

**WIND RESULTS**

Figure 3 displays the result of the quadrat analysis on wind report data ranging from 1987-2017. There was a total of 1242 wind reports in the study area throughout the timeframe of interest. A total of 74 quadrats ( $m=74$ ) were generated to cover the study area. This study found the VMR to equal 16.262, which is indicative of clustering. The  $\chi^2$ -value was calculated using Formula 1 and equaled 1285.593 ( $p < 0.00001$ ), meaning the null hypothesis was rejected. Therefore, it was determined statistically that there is a clustering of wind reports on the Delmarva Peninsula between 1987-2017.

Figure 3 shows that the majority of the wind report hotspots occurred in the Upper Shore. Cities of Chestertown, MD, and Wilmington, DE, were major hotspots with 44-79 reports. The map clearly showed a clustering of events in the Upper Shore. The map also showed in the Lower Shore that Salisbury, MD, consisting of two quadrats, was the only area moderately impacted by wind reports (22-43 reports). Meanwhile, in contrast, the map revealed a total of 17 moderately impacted quadrats in the Upper Shore. That means approximately 90% of the quadrats with 22-43 reports were located in the Upper Shore. It is important to note that the number of wind reports greatly outnumbered those for tornadoes and hail: 85 tornado reports, 186 hail reports, and 1,242 wind reports. Since tornado and hail reports were less common events on the Delmarva Peninsula, wind reports provided a better proxy for determining

spatial patterns in this analysis. The fact that the wind parameter analysis strongly supports the hypothesis is incredibly important because high winds are the most common hazard associated with severe thunderstorms (NOAA National Severe Storms Lab, 2019).

**CONCLUSION**

Results from Figures 1-3 are summarized in Table 2. Each parameter test concluded that statistically significant clustering did occur within the study area. Analysis of frequency counts show that the clustering mostly occurred in the Upper Shore. These results support the initial hypothesis that convective weather events are spatially limited in the southern-most portions of the Delmarva Peninsula. This analysis verifies a correlation between the locations and frequency of convective weather reports on the Delmarva Peninsula. It is recommended that this pattern be verified through alternative methods to ensure the findings listed above are correct. Other proposed data sources include archived radar scans, insurance claims from storm damage, and remotely sensed lightning strikes.

This study did not conclude that severe weather events did not occur at a given location just because there was no record of a report. It is likely that modern technology reports are more accurate than they were in the past several decades. Breaking down the time scale into decadal quadrat analysis would show if the pattern is evolving or static. A changing pattern would be expected, but a consistent

pattern would be indicative that there are common atmospheric features leading to intense convection in the hotspot areas that would warrant critical analysis. The results of this study call for research into the causation of the spatial distribution of severe weather events on the Delmarva Peninsula. If the pattern were to hold through multiple rounds of analysis, then it may be safe to say there are some variables responsible for the variation. One hypothesis is as follows: The Chesapeake Bay's water temperatures are often cool in the spring months (March, April, May), which results in a more stable marine layer. Any convective system moving through this marine layer would weaken or dissipate due to the disruption of Convective Available Potential Energy (CAPE) (American Meteorological Society, 2017). Conversely, this process reverses in the summer months (June, July, August) once the water temperature has increased. The Chesapeake Bay then provides more moisture, which increases CAPE allowing severe storms to maintain intensity as they approach the Delmarva Peninsula. Moreover, storms are then reinforced by the sea breeze front along the Atlantic Coast. Future research is needed to test this hypothesis and breakdown the seasonality of these storm reports. Discovering the seasonal distribution and confirming the pattern in a different temporal scale would warrant deeper investigation into the role the Chesapeake Bay plays in convection on the Delmarva Peninsula.

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