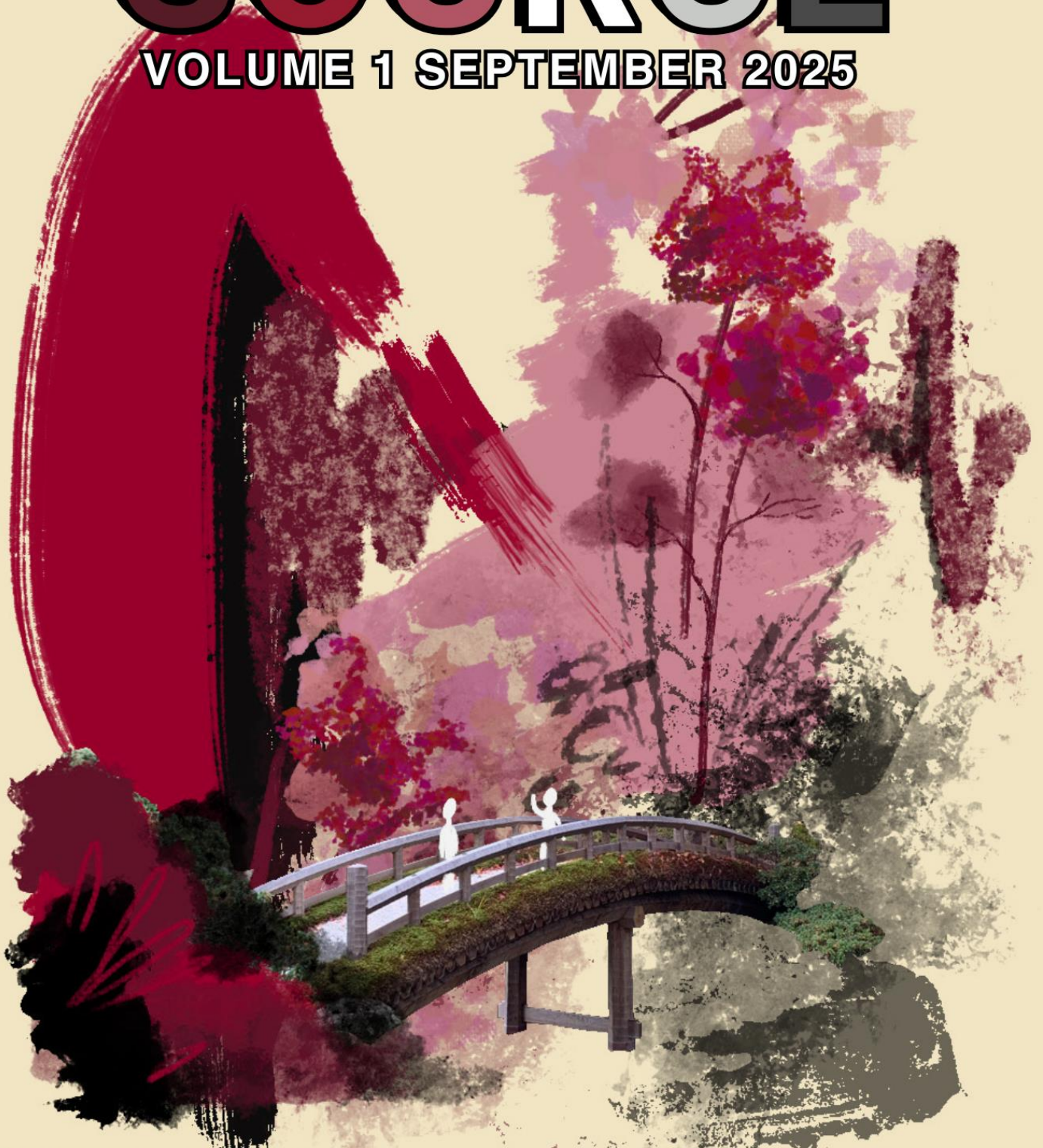


**Journal of the
Symposium Of University Research & Creative Expression**

SOURCE

VOLUME 1 SEPTEMBER 2025



**ISSN 2997-0059 (online)
www.cwu.edu/source**

CWU

**Symposium of
University Research
and Creative Expression**

Journal of the Symposium of University Research and Creative Expression (SOURCE)

Journal of the Symposium of University Research and Creative Expression (SOURCE) is the official journal of the annual Symposium of University Research and Creative Expression (SOURCE) at Central Washington University (CWU). SOURCE is open to all CWU students and participating Ellensburg High School students to present research or creative works. The Journal of SOURCE (ISSN 2997-0059 [online]) is published annually in the fall by Central Washington University, Ellensburg, WA. It is composed of projects registered at the most recent SOURCE and supported jointly by the Office of University Student Research, Office of Undergraduate Studies, and the CWU Libraries.

Each year, SOURCE adheres to a set theme for special sessions and engagement activities at the event. The 2025 symposium, being the 30th anniversary of SOURCE, follows the theme of Empowerment. Empowerment is the process of becoming stronger and more confident or gaining power to do something. SOURCE encourages and promotes self-empowerment through scholastic achievement.

EDITORS-IN-CHIEF

Hideki Takei, *Director (2023-25), Office of University Student Research; Professor & Department Chair, Information Technology Management*

Gary Meyers, *Assistant Professor, Sociology*

Gabrielle McNeillie, *Assistant Professor, Sport and Movement Studies*

MANAGING EDITORS

Ash Perron, *Program Coordinator, Undergraduate Studies*

Katie Seymour, *Office Assistant, Undergraduate Studies*

MENTOR REVIEWERS

David Gee, *Health Sciences*

Melissa Jordine, *History*

Charles Li, *English*

Kevin Lomax, *Information Technology Management*

Pamela McMullin-Messier, *Sociology, William O. Douglas Honors College*

Rodrigo Murataya, *Law & Justice*

Amanda Obery, *William O. Douglas Honors College*

Erika Pazian, *Art & Design*

Cynthia Pengilly, *English*

Holly Pinkart, *Biological Sciences*

Mary Poulson, *Biological Sciences*

Mary Radeke, *Psychology*

Susan Rivera, *Information Technology Management*

Christopher Schedler, *English*

Sarah Sillin, *English*

Jeffrey Snedeker, *Music*

Nicole Stendell-Hollis, *History*

Hideki Takei, *Information Technology Management*

Katharine Whitcomb, *English*

Mehran M. Zaini, *Physics*

PRODUCTION MANAGER

Katie Seymour, *Office Assistant, Undergraduate Studies*

EDITORIAL POLICY AND DISCLAIMER: *Journal of the Symposium of University Research and Creative Expression (SOURCE)* accepts manuscripts from presenters that participated in the SOURCE at Central Washington University. Manuscripts submitted must correspond with the student's presentation project and title. Students will submit the final manuscript via the online submission form along with a form signed by their CWU affiliated mentor signifying their approval of the paper "as-is" and thus fulfilling their editorial responsibilities. The student must be listed as the first author. Authors are asked to follow the submission guidelines and instructions found at <https://digitalcommons.cwu.edu/jsource/>.

The *Journal of the Symposium of University Research and Creative Expression (SOURCE)* only accepts works that have not been previously published, nor are forthcoming in an archival journal or book (print or electronic). Submissions must be original work by the submitting author(s) and must not infringe on any existing copyright. Please see the journal's [Publication Ethics online](#) for more information.

The Journal of SOURCE publishes manuscripts in the reliance upon the responsibility of their CWU affiliated mentor(s) to review and ensure papers comply with the appropriate style and format of the paper's discipline. Any opinions, statements or recommendations expressed in this journal are those of the respective author(s) and do not necessarily reflect the views of Central Washington University or SOURCE and the editorial team.

OPEN ACCESS PUBLICATION: The Journal of SOURCE is an open-access publication via the [CC BY-NC-ND 4.0](#) license, meaning that its material may be copied and distributed in any medium or format in unadapted form only, for noncommercial purposes only, and only so long as attribution is given to the creator. This journal is also covered under the [ScholarWorks Policy](#) which states that: "Except as provided above, or for any other use that is allowed by fair use (Title 17, §107 U.S.C.), you may not reproduce, republish, post, transmit or distribute any material from this web site in any physical or digital form without the permission of the copyright owner of the material. The copyright holders may grant third parties the right to use, reproduce, and share the article according to the Creative Commons license agreement.

CONTACT DETAILS: All correspondence regarding submissions or otherwise, should be made via the SOURCE team, by e-mail to source@cwu.edu. SOURCE website: www.cwu.edu/source.

COVER IMAGE: 橋 by Anika Saphiloff. An abstract multimedia piece representing the connections that creative projects and research can forge between people.

Table of Contents

<i>Journal of the Symposium of University Research and Creative Expression (SOURCE)</i>	2
<i>Table of Contents</i>	4
<i>College of Arts and Humanities</i>	6
Art and Design	7
FRIDA Kahlo: More Than the Unibrow, a Cultural Feminist Analysis.....	7
English	24
Poetry and Empowerment in Islam	24
From Old English Genitives to Modern English Possessives: Tracing Grammar Evolution through Biogrammar and Grammatical Biology	30
From Canterbury to the Conference: Chaucer’s First 18 Lines Reborn	47
Nathaniel Hawthorne’s Scarlet Redemption	68
Literary Networks Everywhere: An Analysis of Literary Connections Across Time and Culture	79
Dependency in Romantic Relationships: Bloom’s Other in <i>Ulysses</i>	89
History	108
The Battle of Moscow 1941	108
Music	122
CWU Horn Club 2025 Northwest Horn Symposium Performance and Presentation	122
<i>College of Education and Professional Studies</i>	126
Health Sciences	127
Prevalence of Diabetes Related to Acculturation, Dietary Quality, and Sedentary Lifestyle in Mexican Americans: National Health and Nutrition Examination Survey 2011 to 2018	127
Focus Group Interview: Perspectives of Virtual Dietary Counseling Methods Post COVID-19 Pandemic	159
Characteristics Contributing to the Risk of Diabulimia in Adults Living in the United States	185
Information Technology Management	209
Innovation Within Sustainable Technologies: The Future of Energy Conserving Hardware in Data Centers ..	209
Global Trends in AI-Driven Product Development: A Cross-Country Analysis	218
Optimizing Cybersecurity Through AI Predictive Analytics and Human Expertise.....	242
CWU's Electronic Waste Management: A Success Story in Sustainable Practice	263
Building Career Pathways: Investigating the Potential for a Cooperative Education Program for Graduate ITM Students at Central Washington University	269
<i>College of the Sciences</i>	300
Biological Sciences	301
Effect of Coniferous Trees and Water Availability on Soil Acidification	301
Antibiotic Resistance Trends in Coliform Bacteria of Kittitas County Waters	311
Law & Justice	326
Examine Supreme Court Decisions That Have Influenced the Gender Salary Gap	326

Physics.....	336
Construction, Optimization, and Characterization of an Undergraduate Cold Cathode Table-Top Electron Accelerator for Radiation Physics Education.....	336
Psychology	342
Emotion Recognition Accuracy With Fully Occluded Faces: Do Eye Gaze Patterns and Fixation Durations Shift When We're Wrong?	342
Sociology	349
Appropriate Blackness: Feminism, CRT, Marxism & Boxing.....	349
<i>William O. Douglas Honors College.....</i>	383
Tassel Turning Versus Tossing in the Towel: An Analysis of Undergraduate Student Persistence and Challenges.....	384
COVID's Impact on our Youngest Learners.....	415

College of Arts and Humanities

The College of Arts and Humanities had presentations from the departments of **Art & Design, Communication, English, History, Music, Philosophy & Comparative Religion**, and **Theatre Arts** at the 2025 Symposium of University Research and Creative Expression (SOURCE).

This volume of the *Journal of the Symposium of University Research and Creative Expression (SOURCE)* features full length submissions from the following departments and programs:

- Art and Design
- English
- History
- Music

Art and Design

FRIDA Kahlo: More Than the Unibrow, a Cultural Feminist Analysis

Karen Valencia

Project Mentor(s): Erika Pazian

Department of Art and Design, Central Washington University

Abstract: Frida Kahlo has been a common name in the art historical canon – one that reinvented Surrealism, despite not identifying with the style, and challenged conventional norms in artistic practices. Many of her works are discussed in Mexican art historical settings, however, the research of this paper will point the bulk of its focus directly onto *The Two Fridas*, offering additional discussion on how it connects to feminist theory. Kahlo was a deeply complicated woman, reduced to her bus incident, or tumultuous relationship with muralist Diego Rivera. The materials used as sources in this paper will give a bigger insight into various outside perspectives and an intimate vision of Kahlo's mentality and personal identity, which proved to be conflicting. The research will thoroughly examine Kahlo's womanhood and personhood as an artist in 20th-century Mexico. Each segment will deconstruct *The Two Fridas* and Frida Kahlo herself. Ultimately, the question answered will be: what was Kahlo attempting to communicate, and why has it been simplified via popular media? Why has Kahlo, herself, been a victim of simplification? Feminist theory suggests how she performed gender norms intersected with her race and sexuality, ultimately becoming defined by these characteristics, in a simplified manner. Who Kahlo was and how her most celebrated piece communicates her ideals, values, and sense of self is what this academic paper will dissect; to not only better understand the artist and her work, but also the application of feminist theory to *The Two Fridas*.

Keywords: Art History, Surrealism, Surreal, Feminist Theory, Mexican, Identity, Analysis

Introduction

To consider the art canon across time is to consider ‘peak’ male artistic achievement solely and to look at a narrative that has been written in favor of men – the gendered assumption that men have been born with a natural skill and talent for the visual mediums, referred to as a ‘genius’ by older academics, erasing a particular group: women.¹ The canon has disregarded and neglected female art, misinterpreting and simplifying those who *are* in the canon, and defining them by the men in their lives, or assigned gender at birth, rather than the richness in their identity, and core values that breathe life into their craft. Frida Kahlo is a name known by many, either because of her unique voice that challenged Surrealist norms, her unconventional way of practicing gender, or her distinctive appearance, including her iconic unibrow. Kahlo encompasses her experiences: she suffered a bus accident in her youth, which left her bedridden, was of mixed heritage, and had a fraught relationship with Diego Rivera – a canonical Mexican muralist, regularly overshadowing Kahlo. Many have overlooked her biography, the same traits that inspired her creative works, and how she practiced artistry. Kahlo rose to fame in the current contemporary era in both popular media and the art world, previously being pushed into an unknown corner in favor of her male counterparts. This research discusses the widely known *The Two Fridas*, delving into the heart that beats within the canvas. Through biographical insight and image analysis, a greater understanding is reached as to how Kahlo’s *The Two Fridas* represents a complex narrative often misinterpreted through needless simplification of women’s stories. Commonly remembered, but forgotten. Remembered but doomed to be simplified, like most women in the canon of her time – defined by gender and the men in their lives.

¹ Linda Nochlin and Catherine Grant, *Why have there been no great women artists?* (Thames & Hudson, 2021): 1-5, JSTOR.

It is known that most Academic literature regularly interprets Kahlo as a troubled woman with difficulties in her personal life, which bleeds into her sense of self, influencing her later creations. Eli Barta and John Mraz explain Kahlo's identity through an analysis of a 2002 film of the same name – they critique the over-reliant use of Rivera in film, as well as compare social representations of Kahlo herself, all while her rocky relationship with Diego Rivera follows each interpretation.² Shely Calderon Benpalti notes the differences in the Surrealist movement from male to female artists – bringing light to Kahlo and her interpretation of Surrealism despite not agreeing with the movement's ideals.³ Surrealism, a literary and artistic movement, encapsulated the inner self and the deep unconscious, revealing truths about humanity or one's personhood.⁴ Anna Haynes argues that the label of Surrealist was unfit for Kahlo, and the artist herself did not identify with the movement; instead, Haynes discusses Kahlo's hybrid identity through the lens of her artwork, and how it was easily represented with the visuals she created.⁵ Irma Dosamantes-Beaudry, in like manner, studies Kahlo introspectively, utilizing psychology and surveying the manifestation of her childhood and trauma in her works.⁶ Corrine Andersen speaks specifically about Frida Kahlo's pain and how her artwork served as a way to communicate those

² Eli Barta and John Mraz, "Las Dos Fridas: History and Transcultural Identities," *Rethinking History* Vol. 9 (4), December 2005: 449-457, OneSearch.

³ Shely Calderon Benpalti, "UNTAMED: The terrifying beauty behind the works of woman Surrealists," *MA Projects*, August 2023. Google Scholar.

⁴ Josh R. Rose, "Surrealism, an introduction," *Smarthistory*, Beth Harris and Steven Zucker, September 8, 2016, <https://smarthistory.org/surrealism-intro/>.

⁵ Anna Haynes. "Frida Kahlo: An Artist'In Between'," *Identity and Marginality eSharp* 6, no.2, 2006, 1-18, Google Scholar.

⁶ Irma Dosamantes-Beaudry, "Frida Kahlo: self-other representation and self-healing through art☆," *The Art in Psychology* 28, no. 1, 2001, 5-17, Google Scholar.

experiences, through symbolism, mentioning the piece of analysis, among others.⁷ *The Two Fridas* features a distinct stylistic approach that furthers the question of selfhood with each element, and researchers are eager to deconstruct the components that make up its symbolism. Molly Bryson, and *Revista Medica Clinica Las Condes* both discuss the clothing Kahlo wore, the colors, the heart and blood, and the link that is shown connecting both bodies.⁸ Nonetheless, most scholarship oversimplifies Kahlo's work in an attempt to fit her into the Surrealist box.

However, to understand her impact in the art canon, both then and now, one must take a step back and acknowledge her fame, past a level of art, and into mainstream culture. Today, her likeness is represented in movies, clothing, and poster material; rather than selling a copy of *The Two Fridas* on cheap canvas, she is photographed wearing a floral headdress positioned above her unibrow – many would rather own her likeness rather than a piece by her. What was it about Kahlo that converted her into a cultural icon of sorts, propelling her into stardom decades after her death? Oriana Baddeley eloquently writes about the fascination with Kahlo as a contemporary icon by investigating the 'Kahlo Cult' and deconstructing the fixation on the artist.⁹ In a similar light, Irma Dosamantes-Beaudry and Margaret A. Lindauer look into Kahlo as both an artist and a celebrity, examining her status as a cultural icon and inhabiting this aspect

⁷ Corrine Andersen, "Remembrance of an Open Wound: Frida Kahlo and Post-Revolutionary Mexican Identity," *South Atlantic Review* 74, no. 4 (2009): 119–30, JSTOR.

⁸ Molly Bryson, "The Two Fridas," Encyclopaedia Britannica, Jacqui Safra, <https://www.britannica.com/topic/The-Two-Fridas>. Doris Maria-Reina Bravo, "Frida Kahlo, the Two Fridas (Las Dos Fridas)," Smarthistory, Beth Harris and Steven Zucker, <https://smarthistory.org/kahlo-the-two-fridas-las-dos-fridas/>. "Las Dos Fridas," *Revista Médica Clinica Las Condes* 33, no. 3, 2022: 327, OneSearch.

⁹ Oriana Baddeley, "Her Dress Hangs Here: De-Frocking the Kahlo Cult," *Oxford Art Journal* 14, no. 1, 1991: 10–17, JSTOR.

of celebrityhood, framing her journey against the theory of feminism.¹⁰ Kahlo has been hailed as an icon for both feminist movements and Mexican womanhood, as Adriana Zavala writes in *Becoming Modern, Becoming Tradition: Women, gender, and Representation in Mexican Art*.¹¹ Frida Kahlo was a Mexican woman in 20th-century Mexico, a time when her male contemporaries were gaining fame and honor for their additions to the Mexican canon. It would not be until the modern day that she would be recognized as an icon of the Surrealist movement with works like *The Two Fridas*, but also as an idol of feminism, challenging the patriarchal gender roles in her time.¹² This scholarship informs the discussion that follows, this paper will delve further into Kahlo's selfhood and personhood by defying the oversimplification of her narratives in common media and expanding on her identity as a Mexican woman through the analysis of *The Two Fridas*.

Artistic Impact Felt Across Surrealism

The Two Fridas and other works by Kahlo may have reached canonical status due to the artist's ability to present her lived experience in a way that appealed to Surrealist ideals while challenging the expectations of the movement itself. The actuality of it, however, was the fact that her work was surrealist without being *Surrealist*, inhabiting characteristics that were out of the norm without confirming the movement's ideals. Andre Breton was the father of Surrealism,

¹⁰ Irma Dosamantes-Beaudry, "Frida Kahlo: The Creation of a Cultural Icon," *The Arts in psychotherapy* 29, no. 1, 2002: 3-12. Margaret A. Lindauer, *Devouring Frida: The art history and popular celebrity of Frida Kahlo* (Middletown: Wesleyan University Press, 2011).

¹¹ Adriana Zavala. *Becoming modern, becoming tradition: Women, gender, and representation in Mexican Art* (University Park, Pa: Pennsylvania State University Press, 2010).

¹² Sandra McGee Deutsch, "Gender and sociopolitical change in twentieth-century Latin America," *Hispanic American Historical Review* 71, no. 2, 1991: 259-306. JSTOR.

pushing the movement onto Kahlo and labeling her as a Surrealist despite her disagreement.¹³ In 20th-century Mexico, Surrealism was introduced by Andre Breton, baptizing the nation with the introduction of the movement – it illuminated the irrational and unconscious mind; they saw themselves as leading social change, the merging of shared realities across society.¹⁴ Kahlo did not consider herself or her work to be Surrealist; instead, as Anna Haynes writes, Kahlo insisted she painted her reality, not her dreams.¹⁵ Her work consisted of unique forms that challenged conventionality and gave dialogue to the reality she inhabited as a Mexican woman. Despite her limitations, she was categorized as part of a movement that she would eventually define through her creative practice, challenging it because of her rejection: surreal without being a Surrealist. Diego Rivera once wrote, “Frida is the only example in the history of the art of an artist who tore open her chest and heart to reveal the biological truth of her feelings.”¹⁶ As her significant other, he held bias in the manner he regarded her, but there was truth to the words he spoke – she was an exceptionally vulnerable person who bled into the cotton of her canvas in hopes of sharing with the world the physical existence of her very core. It was not as simple as exposing the unconscious mind to a genre of art but rather exposing her lived reality, pain, and joy. The impact that followed was built on her bare identity and honesty, which seeped directly into the work she created, most specifically her self-portraits.

The Two Fridas is a very celebrated work of Kahlo – one that introduces or rather continues the conversation on her split sense of self, her hybridity in a cultural sense. Doris

¹³ Calderon, “The Works of Women Surrealists,” 21.

¹⁴ Rose, “Surrealism, an Introduction.”

¹⁵ Haynes, “Frida Kahlo: Artist in Between,” 1-2.

¹⁶ Rivera, “Frida Kahlo Mexican Art.”

Maria-Reino Bravo of *Smarthistory* chronicles the most defining features of the portrait – painted in 1939, its composition focuses on two seated figures holding hands while sharing a bench, the background reflecting stormy darkness.¹⁷ The similarities in these characters are uncanny, but yet a glaring difference confronts the viewer; their clothing mirrors an internal brawl that Kahlo had been facing during this time, that being her heritage. An article that discusses Kahlo’s symbolic pain states the following regarding her dresses, “Upon closer examination, however, Kahlo destabilizes a neat duality in *The Two Fridas*. While one Frida wears a Tehuana costume, the other wears a Victorian blouse. Nonetheless, the Frida in the Victorian blouse also wears a Tehuana skirt...”¹⁸ Analyzing the chosen fashion is a highlight of the experiences Kahlo wanted to convey, the split nature of her personhood. It is with this in mind that the vulnerability she presents in her work is framed – it redefined Surrealism because the unconscious mind was a limited manner of pursuing the genre, Kahlo instead presented her lived reality, adding a freshness to this pre-existing canon that had not been considered in such a lens before, providing additional surrealist ideals. *The Two Fridas* is a non-traditional approach to intimate thought and feeling – rich in symbolism and meaning, it is a cross between strength and alienation, pressured under societal expectations. Having said that, her importance to the Surrealism genre is often overlooked in favor of other elements. Kahlo, in the contemporary world, has surpassed ordinary artistic fame and climbed the ladder of human culture, leaving behind Surrealism, and being integrated due to her so-called exotic nature, thus becoming simplified in the removal of individuality. Regardless of her affiliation with the genre, her

¹⁷ Bravo, “Frida Kahlo, Two Fridas.”

¹⁸ Andersen. “Remembrance of an Open Wound,” 1-3.

surrealist method of painting, as well as her nontraditional existence is what, ultimately, pushed Kahlo into such transcendence.

Frida Kahlo and Culture

With such an impact felt in the art canon, that influence transcends the art historical context and elevates itself into mainstream culture – Kahlo’s personhood and livelihood have cemented themselves into stardom. A select few have achieved such transcendence – with Kahlo’s celebrityhood, unlike her canonical peers, she has been propelled to great heights because of her gender and gender practice. This interpretation defines Kahlo solely through her identity, simplifying the richness found in someone of her depth and experience. In a film review by Eli Barta and John Mraz, they discuss the 2002 motion picture *Frida* through a cultural lens, claiming the movie should be seen as cinematic history because of its excellence – however, the analysis looks to the portrayal of Kahlo and Diego Rivera’s relationship, scrutinizing the sexuality of Kahlo and her relationships.¹⁹ In Hollywood, Kahlo’s intimacy with Rivera has been enhanced, emphasizing these elements over any of her artistic endeavors. Like Kahlo, many of her works are analyzed in the context of her tumultuous relations, shoving her into a suffocating box of sorts. Culturally, people viewed her as exotic because of her passions and method of presentation, wrapping herself in a shawl of love – seeing her as being from a third-world country, confirming the stereotype they had about exoticism. This obsession with her image slowly transformed into something else, *through* something else. An article by Dosamantes-Beaudry presents how, “Frida Kahlo’s immense popularity in the United States came on the heels of the emergence of two civil rights movements, the Women’s Liberation Movement and the Chicano Civil Rights Movement,” which explains how Kahlo fell into the movement as a

¹⁹ Barta and Mraz, “History and Transcultural Identities.”

representational icon.²⁰ When exhibiting her work, they would change the narrative to fit the larger context of the movement – Kahlo was not necessarily a believer in any feminist practice, but due to her womanhood and unique sense of self, she was dictated by culture to be a feminist icon of sorts. The movement ultimately reduced who Kahlo was.

Now, the question of Hollywood-level cultural importance rests on the concept of the feminist theory – has the mainstream’s interpretation of Kahlo solely as a feminist icon been to her detriment? In some respects, she is reduced to the relationships in her life. How she presents herself through unplucked eyebrows and the unshaven hair on her upper lip – some call it an untraditional way of performing femininity. The feminist movement took these interpretations of Kahlo and hailed her as an icon of feminism – is this cultural transcendence viable, or does it continue to stunt Kahlo’s individuality? It can be argued that the feminist lens helps understand Kahlo’s work, yet how deep can the rabbit hole go regarding Kahlo’s involvement in the movement itself? An excellent point is fostered by Lindauer that reminds readers, “feminist art historians and filmmakers reapproached the injustice of art historical oversight, they celebrated the artist’s forbearance in the face of relentless physical and emotional traumas. The artist’s fortitude resonated with feminist art history’s resolution to challenge chronologies and narratives that privileged men and disregarded women.”²¹ Kahlo was hailed as a feminist icon for her experiences, which she overcame during her lifetime – it was the burdens and shouldering of them that proved to feminists her role in the movement as a potential face of it. Her misinterpretation and fetishization in the mass media was something that the feminist movement acknowledged and wished to leave behind in favor of her becoming a cultural icon in the eyes of

²⁰Dosamantes-Beaudry, “The Creation of a Cultural Icon.”

²¹ Lindauer, *Popular Celebrity of Frida Kahlo*.

women. Historians have decided to name this phenomenon with Kahlo, labeling it the ‘Kahlo Cult’ which emphasizes the obsession and romanticization of the icon. Regarding the obsession that lays as the primary foundation of her fame, Baddeley writes, “In the case of Kahlo, the popular image is of the artist herself, the characteristic brows, the elaborate hair, the Mexican costume. It is primarily her appearance, not the formal language of her art, that has graced the pages of *Elle* and *Vogue* magazines.”²² While contemporary culture celebrates her gender and fortitude in the face of the many obstacles she faced, elevating her to feminism, there is no doubt the basis of her stardom is encapsulated because of her ‘exotic’ and ‘nontraditional’ nature and ways of practicing gender – it is her very appearance and relations with men that brought her into the limelight. Kahlo is defined by what is between her legs and the hair between her brows, leaving little to no room to breathe, rather than being known for the colors she painted in and the forms she created with her palette. It is this oversimplification that will inspire the following analysis – *The Two Fridas*, one of Kahlo’s most celebrated works, has had a variety of interpretations, but once put under a feminist analysis, its typical framing changes, suddenly there is a weight that has not been discussed. Suddenly, Frida Kahlo is humanized, not fetishized because of her exotic nature – her individuality is returned.

A Feminist Look into *The Two Fridas*

An art historical analysis, while thorough and informative, can leave out elements that often go neglected in traditional surveys – however, with an understanding of feminist theory, the analysis of *The Two Fridas* changes, now placed under the view of feminism, much is gained, and how can the simplification of her narrative be overridden through feminist theory? Feminist art history differs from the movement – defined as the focus on women in varying

²² Baddeley, “Her Dress Hangs Here,” 10-17.

artistic roles, with a scrutiny on the female gender, and the experiences of womanhood.²³ Many art historians in the feminist practice flocked to Kahlo, utilizing her as a way to reinsert women into the canon, causing her to rise in popularity during the contemporary era.²⁴ Understanding her role in the theory, it should be known that many have interpretations of Kahlo's piece, which go deeper into the contextual clues and piece together a fragile narrative of uncertainty in identity, but once the layers are peeled back, the reality is that she was a woman who had lived through constant trauma, which impacted her already strained perception of herself. Kahlo was complex, and feminist theory is an interdisciplinary study that incorporates a multitude of fields, which is needed when centering such discussions, giving a better method of interpreting her works. In a short journal by *Revista Médica Clínica Las Condes*, they describe the precision that Kahlo paints the heart and the implication of the conflict Kahlo inhabited with herself – a crisis rooted in potentially both her background and her struggles with maternity.²⁵ Kahlo portrays herself through two alternate versions as a way of conveying an internal struggle, attempting to communicate her sentiments and the world in which she was born. *The Two Fridas* is tumultuous, framed against a dark sky, with clouds as heavy as her central troubles. A feminist analysis can be accompanied by psychoanalysis theory, investigating the unconscious desire to communicate personal ideals and stresses.

The Two Fridas is an excellent subject of conversation to aid oneself in understanding Kahlo as both an artist and person, as well as a fantastic method of helping overcome the simplification of her narrative in the mainstream media. Kahlo was often defined by the

²³ Cothren and D'Alleva, *Methods & Theories of Art History*, 87.

²⁴ Zavala, *Becoming Modern, Becoming Tradition*, 204.

²⁵ *Revista Médica Clínica Las Condes*, "Las Dos Fridas."

emotions in her life – her split identity crisis or the affairs that were haunting her, all of which would later be reflected in her art. Kahlo was extremely limited in her mobility because of the bus accident in her youth, leaving her with feelings of isolation, welcomed by blank canvases and a palette of colors. Molly Bryson describes the following, “According to an insight Kahlo shared with a friend about *The Two Fridas*, the Frida in Tehuana costume, whose heart is intact, represents the Frida that Rivera loved, while the Frida in white, whose heart looks as if it has been ripped open, represents the Frida that Rivera rejected. The composition of *The Two Fridas* recalls *Frieda and Diego Rivera*, a wedding portrait painted by Kahlo in 1931.”²⁶ A stereotypical interpretation to be characterized by the man in her life, there is a semblance of truth to the exchange – painted in 1939, the year of their divorce, Kahlo had been emotionally challenged. A weight on her shoulders, the manner of expression was the depiction of split selfhood – perhaps the split of the Frida character was to mirror the split of divorce between herself and Rivera. The darkness behind her is evident in the darkness in her mind, the desperate fingers clutching at the locket held by the Frida on the right, and the expressions – defiant, staring straight at the viewer, as if to challenge them. Not necessarily defined by her spouse but defined by her experiences in life as a woman of many complications; passionate and devoted, she encompassed a heart that bled for the people around her and herself.

Historians and biographers alike have come to the agreement that Kahlo had endured neglect from her mother, failing to receive a proper connection that would have proved essential for her growth and personal development.²⁷ An upbringing that lacked the warmth needed to grow would determine her selfhood later in life, her split nature, and her thunderous troubles

²⁶Bryson, “The Two Fridas.”

²⁷Dosamantes-Beaudry, Self-Other Representation.”

with the people she met. *The Two Fridas* can then be interpreted as such: a visual narrative that encapsulates the heavy nature of Kahlo's mentality post-divorce from Rivera. The split identity reflected by the variations of Kahlo is tethered together because, ultimately, this is one person – the same person Rivera loved, torn apart by a pair of scissors, typically symbolic of a separation. Composed against a storm, the Kahlo on the left bleeds, but because of the link between the two, both are bleeding, not one. A locket of Rivera's profile is clutched by the Kahlo on the right, representing the difficulty in the separation, the unwillingness to let go and accept reality. The struggle with identity, perhaps, can be further emphasized through the active divorce – known as Rivera's wife, defined by this role, Kahlo suffered a taxing crisis as they separated; who was she, and what could define her now? In 20th-century Mexico, society was predominantly patriarchal in its gender roles, plunging Kahlo into the limited role of a wife.²⁸ However, the touching hands capture the eye of the viewer as the central subject in the piece, a realization of sorts striking Kahlo – despite these emotions and challenges, she is still Frida, not simply the wife of muralist Diego Rivera, but a person of her own making. *The Two Fridas* captures the turbulent years of Kahlo's kinship with Rivera, ultimately describing the divorce through a figural representation of a split-conscious – however, the purposeful link between them grounds Kahlo, reminding her that she is more than a relationship, that she need not be defined by the male presence in her life. Frida Kahlo was a woman of many feelings, as well as an impactful artist *The Two Fridas*, manages to capture – a complex thought process summarized in two figures.

Conclusion

Frida Kahlo has constantly been subjected to oversimplification in mainstream media as a victim of the patriarchy, only to be reclaimed by the feminist movement and feminist art

²⁸ Deutsch, "Gender and Sociopolitical Change in Latin America."

historians. Redefining the art canon, a space otherwise known to purely inhabit male artists, Kahlo stood on her own as a figure of impact for the Surrealist genre, challenging what could be considered as Surrealism. While Kahlo did not consider herself to be a Surrealist, her work had propelled her into stardom – however, upon closer inspection, it was not her work that had created fame, but rather who she was as a Mexican woman. The Cult of Kahlo was the term coined for the fanatics who followed Frida Kahlo in obsession with her, not as an artist, but as an exotic, unconventional figure. This popularity in culture would fascinate feminists of the movement, thus claiming her as a character to the cause, which many hailed her for her strengths and unique grasp of gender practice.

Feminist theory opens a gateway of variety in interpretations regarding Kahlo's artwork; utilizing it, *The Two Fridas* is analyzed as a visual metaphor for the separation she experienced from Rivera. The mentality and emotional drainage had materialized as two versions of Kahlo, but the link between them is a reminder – not just to the viewer, but to herself – that she is not defined by her relationships but by herself. Frida Kahlo created narratives that communicated for her but, ultimately, fell victim to a patriarchal society – simplifying her as exotic, reducing her to a floral headdress and unibrow against a brown complexion, a testament to the erasure of all components that individualized Kahlo. It is crucial to remember the icon for having surpassed these limitations, becoming something greater than a reduced narrative of an 'exotic' woman who felt too much – she is much greater, as has been proven, an artist of great reinvention.

Appendix



Frida Kahlo, *The Two Fridas* (*Las Dos Fridas*), 1939, oil on canvas, 67-11/16 x 67-11/16”
(Museo de Arte Moderno, Mexico City).

Bibliography

- Andersen, Corrine. "Remembrance of an Open Wound: Frida Kahlo and Post-Revolutionary Mexican Identity." *South Atlantic Review* 74, no. 4 (2009): 119–30.
<http://www.jstor.org/stable/41337719>.
- Baddeley, Oriana. "'Her Dress Hangs Here': De-Frocking the Kahlo Cult." *Oxford Art Journal* 14, no. 1 (1991): 10–17. <http://www.jstor.org/stable/1360274>.
- Bartra, Eli, and John Mraz. "Las Dos Fridas: History and Transcultural Identities." *Rethinking History* 9, no. 4 (2005): 449–57. doi:10.1080/13642520500307917.
- Bravo, Reina-Maria, Doris. "Frida Kahlo, the Two Fridas (Las Dos Fridas)." Smarthistory Frida Kahlo The Two Fridas Las dos Fridas Comments. Accessed January 14, 2025.
<https://smarthistory.org/kahlo-the-two-fridas-las-dos-fridas/>.
- Bryson, Molly. "The Two Fridas." Encyclopædia Britannica. Accessed January 14, 2025.
<https://www.britannica.com/topic/The-Two-Fridas>.
- Calderon Benpalti, Shely. "UNTAMED: The terrifying beauty behind the works of woman Surrealists." (2023).
- Cothren, W. Michael, and D'Alleva, Anne. *Methods and theories of art history*. Laurence King Publishing, 2005.
- Deutsch, Sandra McGee. "Gender and sociopolitical change in twentieth-century Latin America." *Hispanic American Historical Review* 71, no. 2 (1991): 259-306.
- Dosamantes-Beaudry, Irma. "Frida Kahlo: self-other representation and self-healing through art☆." *The Arts in Psychotherapy* 28, no. 1 (2001): 5-17.
- Dosamantes-Beaudry, Irma. "Frida Kahlo: The creation of a cultural icon." *The Arts in Psychotherapy* 29, no. 1 (2002): 3-12.

Haynes, Anna. "Frida Kahlo: An Artist 'In Between'." *Identity and Marginality, eSharp* 6, no. 2 (2006): 1-18.

“Las Dos Fridas.” *Revista Médica Clínica Las Condes* 33, no. 3 (2022): 327-
doi:10.1016/j.rmcl.2022.05.009.

Lindauer, Margaret A. *Devouring Frida: The art history and popular celebrity of Frida Kahlo*.
Middletown: Wesleyan University Press, 2011.

Nochlin, Linda, and Catherine Grant. *Why have there been no great women artists?* Thames &
Hudson, 2021.

Rivera, Diego, “Frida Kahlo and Mexican Art” (1943).

Rose, R., Josh, “Surrealism, an introduction,” in Smarthistory. September 8, 2016, accessed
March 5, 2025, <https://smarthistory.org/surrealism-intro/>.

Zavala, Adriana. *Becoming modern, becoming tradition: Women, gender, and representation in Mexican Art*. University Park, Pa: Pennsylvania State University Press, 2010.

English

Poetry and Empowerment in Islam

Stephanie Kerr

Project Mentor(s): Katharine Whitcomb

Department of English, Central Washington University

Abstract: In this collection I hope to express the abundance of empowerment my religion, Islam, has given me. Before my conversion I, like many, believed some misconceptions about women in Islam but now I have gained confidence and discovered I am capable of more than I ever thought. In this community I have also met many Muslim women who feel the same sense of empowerment. *Presentation recording available in the SOURCE 2025 playlist*

<https://www.youtube.com/@cwusource5518>

Keywords: Poetry, Muslim Identity, Correcting Misconceptions, Feminism, Creative Performance

Bright

She never knew she had a little light.
A shining beacon of hope or joy.
Always thought she would never be right.

She searched the sky above, left and right
For any sign of a god, some man to save her.
Always thought she would never be right.

She was always so odd, scrutinized, not all right.
Sinking into the dark, no light only shadow.
He found her in the dark, *the surest handhold*.

She took His hand, pulled herself into the light.
She was going to be all right
Resting in strength, no shadows to cause fright.

Veil

2 meters long.
Solid black, soft like sheets.
We can call it a garment
draped like curtains over frost crusted windows
like the curtains, soft and subtle.
We can call it empowerment while they call it terror
but I know
This isn't so subtle.
It's a glittering gold crown
upon my head.

Breath fast, fists clenched.
Deep breath out through the mouth.
It's just a piece of cloth
draped over my skull
but it's so much more.
We can call it submission while they call it oppression.
A truer love I've never known – I remind myself.
Walk out the door and remember
I fear only God.

I suppose it's no surprise

Convention never fit for me.
Expectation was always such a burden.
Feminism flexed and flowed
in a moving definition.

Was always a little more modest.
Feared I was a prude. Wanted to be
freed from the restraints of my mother's religion.

I'm an ordinary American woman
in the age group of maybe 12-42.
I worry too about cultural appropriation,
about the rights of women across the globe.

I'll tell you though, Adam ate that apple too.
It was never punishment that brought us here.
Look closely at all those bloody things
They're power and mercy.

They ask sometimes, why do you do this?
Subject yourself to backward old fashioned values?

Say, 'Are those who know equal to those who do not know?' (39:9)

**“Tears are prayers too, they travel to God when you can’t find the words”-
Jalaluddin Muhammad Rumi**

Wanted to hide behind the closed door,
behind the rush of water in the pipes.
Thought maybe I would start a downpour.

Instead, I went inside and prayed Salat.
Let my soul feel whole again,
opened my heart to Allah.

It’s not arms I found wrapped around me
but something more – something warmer.
I found God, his comfort free.

I fold myself down:
toes, knees, palms on the ground,
stained face stuck in a frown.

Feels as though I’m an empty vessel.
A weary soul, searching
For a home where I might nestle.

Like I’m brand new.
I might beg, plead – please
let me rest in His comfort.

Let the dam break. I want to float away
into the clouds – a weary soul searching the heavens.
My pain is so small when I look

at the world, still He holds it all.
When I fall onto my face, I give it to God.
From my tired eyes, my pain is so small.

I’m so tired God, I fall into submission.
I unburden my weary soul.

Woman, Actually

Hey,

I know you.

I think I do.

You're that girl

who was always so deficient

at making the right choices.

Always finding yourself

in groups where you didn't

quite fit.

You're that girl who

Always dressed like a s***,

who went and had a couple kids

got a little fat.

I thought I knew you.

Weird girl.

Goth girl.

Easy girl.

Why are you wearing hijab?

I thought I knew you.

You used to be so delighted

by your sins. Now what,

You think we'll all forget

who you really are?

Where did this piety come from?

I know you,

that white girl.

English hisses from your lips.

Natively, I think.

Excuse my stare, but I knew you

And now you look like someone else.

I had you all figured out,

had melted you down and shoved

you into a box.

Hey,

I know you.

Never met you.

Might not remember your name.

I don't think you're so pious after all.

From Old English Genitives to Modern English Possessives: Tracing Grammar Evolution through Biogrammar and Grammatical Biology

Charles X. Li

Project Mentor(s): Charles X. Li, PhD

Department of English, Central Washington University

Abstract: This paper presents a biologically grounded and historically informed framework, Biogrammar, as a means to explain grammatical evolution and cognitive processing. It compares Biogrammar with two foundational theories in the study of language: the Nature-Nurture Hypothesis and Chomsky's Universal Grammar. As a case study, the paper examines the historical evolution of English plural and genitive constructions, focusing on morphological developments such as the -as/-es mergers, his-genitives, group genitives, and the rise of the of + noun phrase pattern. These diachronic changes are interpreted as evidence of grammar functioning as a biologically adaptive system shaped by cognitive constraints and cultural usage. The study further explores how neural mechanisms, especially Broca's area and the FOXP2 gene, support grammatical processing, as demonstrated by impairments in individuals with Broca's aphasia. By linking morphological change with neurogenetic evidence, the paper argues that Biogrammar and its companion model, Grammatical Biology, provide a robust, bidirectional account of grammar's evolution, rooted in the interaction between neural architecture and communicative ecology.

Keywords: genitive, plural, the Nature-Nurture Hypothesis, Universal Grammar, Biogrammar

PROJECT OVERVIEW

The central aim of this project is to introduce and advocate for a new theoretical framework—Biogrammar—for studying how grammar evolves both diachronically and synchronically. This framework is developed in comparison with two firmly established

influential theories: the long-standing Nature-Nurture Hypothesis and Chomsky's Universal Grammar.

The Nature-Nurture Hypothesis. This theoretical approach refers to a conceptual framework used to explain human traits, behaviors, or cognitive abilities as the result of interactions between genetic inheritance ("nature") and environmental influences ("nurture"). It does not view nature and nurture as opposing forces but rather as interdependent contributors to human development. In other words, this hypothesis posits that the characteristics of an individual, whether psychological, biological, linguistic, or behavioral, emerge from the dynamic interplay between innate biological factors and environmental experiences. It focuses on three components: nature (biological determinism) that includes genetic makeup, heredity, neurological structures, hormonal activity, and evolutionary predispositions; nurture (environmental determinism) that encompasses upbringing, culture, education, social interactions, nutrition, life experiences, and language exposure; and interactionism (modern interpretation) that recognizes that neither genes nor environment act alone but influence each other in shaping traits. For example, genetic potential may require certain environmental triggers to be realized (gene-environment correlation or epigenetic modification). Though it has a wide range of applications, including in psychology about development of intelligence, personality, and mental illness, in medicine about risks of diseases like diabetes or depression as a function of both genes and lifestyle, and in education about learning styles and outcomes influenced by both cognitive capacity and classroom environment, this paper focuses on its application in linguistics about language acquisition and variation (e.g., Chomsky's Universal Grammar vs. usage-based theories). In short, this

hypothesis encourages a holistic view of human development that bridges biology and culture, genetics and experience, structure and practice (van der Hulst 7-8, 23-4, 487-88).

University Grammar. Chomsky's Universal Grammar (UG), especially in its early formulations, is a strongly synchronic theory grounded in the Innateness Hypothesis, which contends that humans are born with a biologically endowed language faculty. UG seeks to explain how children acquire complex grammatical systems rapidly, effortlessly, and uniformly across cultures. Central to this model is the poverty of the stimulus argument, which asserts that the linguistic input available to children is too limited to account for their rich grammatical competence without an internal, genetically specified mechanism, namely, Universal Grammar (Chomsky, 1972, 10, 79, 102, 113; Radford, 2004, 10-13).

Despite its synchronic focus, UG has addressed diachronic questions about its evolution. In more recent decades, Chomsky, especially with colleagues like Hauser and Fitch has engaged in biolinguistic inquiry: How UG might have evolved biologically. Its key idea is that the Merge operation (recursive structure-building) evolved in *Homo sapiens* around 70,000–100,000 years ago, enabling the rise of human language (2002, 1571-72). They claim that “[t]here is no longest sentence (any candidate sentence can be trumped by, for example, embedding it in ‘Mary thinks that ...’), and there is no non-arbitrary upper bound to sentence length” (1571). This succinctly demonstrates that speakers can start with a simple assertion and then embed it in another clause: “The cat slept” > “Mary thinks that the cat slept” > John believes that Mary thinks that the cat slept” > Because each new clause can embed the previous one, the language system can generate an infinite array of increasingly complex statements, and that demonstrates a defining

feature of human recursion. However, this account remains minimalist and speculative, avoiding detailed historical linguistics.

Chomsky makes a clear distinction between Internal vs. External Language (I-Language vs. E-Language). UG pertains to I-language (internal, mental representation), which is relatively stable, while E-language (external, social expression) undergoes diachronic change. According to Chomsky, “The shift of focus from the dubious concept of E-language to the significant notion of I-language was a crucial step in early generative grammar” (1991a 10). To him, E-language has been the subject of most traditional linguistic work, but it is a derivative notion and of less theoretical interest. This stance limits his engagement with historical change as a systemic process. Given this stance, he remains critical of traditional historical linguistics and sociolinguistics, which lack explanatory adequacy. To him and his associates, the term “language” refers to “an internal component of the mind/brain (sometimes called ‘internal language’ or ‘I-language’),” and it is the I-language that is “the primary object of interest for the study of the evolution and function of the language faculty” (Hauser, Chomsky, and Fitch, 2002, 1570). This reflects Chomsky’s long-held skepticism toward traditional historical linguistics and sociolinguistics in terms of their theoretical rigor, particularly when compared to the generative approach focused on I-language and Universal Grammar. Briefly, UG is mainly a synchronic theory concerned with the innate architecture of language acquisition. Chomsky considers diachronic evolution at the species level (emergence of UG), but not in the traditional historical-linguistic sense of phonological, morphological, or syntactic change across time. The Minimalist Program has opened some space for diachronic inquiry (e.g., how minimal operations evolved) but remains abstract and biologically framed (Chomsky 2014).

Biogrammar. The central argument of this study is the introduction of Biogrammar, a theoretical framework that conceptualizes grammar as a biologically grounded yet culturally responsive system, evolving through the dynamic interaction between the brain's cognitive architecture and patterns of language use. This paper does not attempt to cover every facet of this emerging framework, nor does it aim to exhaust its potential implications. Rather, its primary objective is to introduce Biogrammar as a generative line of inquiry and to open a new thread of research within the broader study of language evolution and grammar.

Unlike traditional models that prioritize either innate universality (as in Chomsky's Universal Grammar) or environmental conditioning (as in the Nature-Nurture Hypothesis), Biogrammar emphasizes the role of neurocognitive preferences, such as pattern-seeking, economy, and salience, in shaping grammatical forms over time. This framework accounts for both the synchronic operation of grammar in real-time processing and its diachronic adaptation through sociolinguistic, ecological, and evolutionary pressures. Closely related to the framework of Biogrammar is the concept of Grammatical Biology.

Grammatical Biology. Grammatical Biology is a complementary framework to Biogrammar that views grammatical structures as products of biological evolution, developing in tandem with the human brain and adapting across generations to communicative, cognitive, and ecological pressures. While Biogrammar emphasizes the dynamic interface between brain-based preferences and real-time language use, Grammatical Biology focuses on how grammatical forms and systems emerge, diversify, and stabilize over long-term evolutionary and historical timescales. It treats grammar as a biologically plausible system, shaped by evolutionary constraints and subject to variation and selection, much like traits in biological organisms.

EVOLUTION OF PLURAL AND GENITIVE CONSTRUCTIONS OF ENGLISH

Given the lens of Biogrammar, nearly all diachronic, synchronic, and cross-linguistic grammatical forms serve as potential evidence for understanding grammar as a biologically and culturally co-evolving system. This study focuses on the historical evolution of English plural and genitive/possessive constructions from Old English (449–1100) through Middle English (1100–1500), Early Modern English (1500–1800), and Modern English (1800–present) to argue for the legitimacy and explanatory value of the Biogrammar framework.

The origins of the Modern English plural *-s* and possessive *-’s* markers can be traced to Old English. Table 1 below outlines their historical roots in Old English inflectional patterns.

Table 1		
Old English (OE) Declensions of Masculine <i>a</i> -stem Nouns ^a		
	OE Noun “hund”	Meaning in Modern English “dog”
SINGULAR		
Nominative	<i>hund</i>	“(the) dog” as sentential subject
Accusative	<i>hund</i>	“(the) dog” as object of verb
Genitive	<i>hundes</i>	“(the) dog’s” as possessive
Dative	<i>hunde</i>	Object of preposition: at/for/to the dog
PLURAL		
Nominative	<i>hundas</i>	“dogs” as sentential subject
Accusative	<i>hundas</i>	“dogs” as object of verb
Genitive	<i>hunda</i>	“of the dogs” as possessive
Dative	<i>hundum</i>	Object of preposition: to/with the dogs

The first two columns are adapted from John Algeo and Carmen Acevedo Butcher. *The Origins and Development of the English Language*. 7th ed., Cengage Learning, 2014, p. 101.

- a. Old English nouns are categorized into classes (like *a*-stems, *ō*-stems, *n*-stems, *r*-stems, root-consonant stems) based on the vowel or consonant ending of their stems in Proto-Germanic, which governs how they inflect. Since masculine *a*-stem nouns account for up to 50% of all Old English nouns, my focus here is limited to this class.

Over the course of more than 600 years during the Old English period, word stress gradually shifted to the initial syllable of nearly all words. This regularized stress shift had a profound impact on the development of Old English noun declensions. As stress moved frontward, unstressed vowels in final syllables weakened, often becoming reduced or dropped altogether. This phonological process, technically known as phonological leveling, significantly altered the pronunciation, spelling, and even the syntactic structure of English (Algeo and Butcher 137-38). One key consequence was that by Middle English, many formerly distinct endings merged into *-es* [əs], which came to mark plural (nominative/accusative), genitive singular, and genitive plural. Then, the plural *-es* became dominant, replacing older plural endings from other declension classes (e.g., OE *-as*, *-an*, *-ru*, etc.). By the 14th century, it became the default plural marker for most nouns. Along with the time, this schwa [ə] in *-es* [əs] elided (dropped out) entirely in speech, leading to the modern plural pronunciation [-s] or [-z], for example, *hundes* ['hundəs] > ['hunds] 'dogs' and *kinges* ['kɪŋəs] > ['kɪŋz] 'kings.' This phonological process, known as "apocope," began in late Middle English (14th-15th century) and became widespread by the 16th century, especially in the dialects influencing London English. The resulting *-s* ending took on three allophonic forms in Modern English: [-s] after voiceless

sounds (e.g., *cats*), [-z] after voiced sounds (e.g., *dogs*), and [ɪz] or [əz] after sibilants (e.g., *horses*).

Although the schwa sound disappeared in speech, spelling retained the *-es* form in some contexts well into the Early Modern period. Over time, people reanalyzed the *-s* as the primary plural/possessive marker, not a reduction of *-es*. The apostrophe was introduced in the 16th-17th centuries to indicate this loss (e.g., *king's* for *kinges*).

His-Genitive. As the final *-e* in *-es* was dropped in speech, speakers reinterpreted the genitive *-s* as a contraction of “his”: *The king's crown* was heard as *the king his crown* (with an unstressed pronunciation of “his”). This reinterpretation, called morphological reanalysis, was a logical attempt to clarify possession after case-markings weakened. This foreshadowed the later development of the group genitive (Algeo and Butcher 175-76).

Group Genitive. The term group here refers to a noun phrase, rather than a single noun. In the group genitive construction, the possessive *-’s* is attached not to the head noun but to the entire noun phrase. For example, *the duke of York’s army* is correct—not *the duke’s of York army* (Algeo and Butcher 176-77). This construction arose as English shifted toward more analytic structures, providing a clearer means of marking possession in complex noun phrases. Because spelling and grammatical conventions were not yet standardized in the 16th century, grammar books of the time often mirrored spoken usage. As a result, some writers even wrote out the his-genitive, interpreting the possessive *-s* as a contraction of *his* (e.g., *the king his crown*). Although the his-genitive was common in the 15th and 16th centuries, it never fully supplanted older genitive forms. It began to disappear by the 18th century, as the apostrophe *-’s* became

standardized in writing, grammar became more analytic and prescriptive, and the his-genitive came to be recognized as ungrammatical, especially in cases involving feminine or plural possessors (e.g., *the queen his*, *the men his*).

The of + Noun Phrase Construction. This construction (e.g., *the roof of the house*) began to emerge in Middle English, particularly from the 12th century onward, as inflectional case endings began to erode, especially in constructions involving inanimate or abstract nouns. This shift reflects a broader transition from synthetic to analytic grammatical structures, influenced by multiple factors: French genitive models (e.g., *le toit de la maison*), contact with Norse-speaking populations, and the movement toward Subject–Verb–Object word order and prepositional phrase constructions in English syntax. By late Middle English, the *of* + noun phrase construction had become increasingly common and eventually dominant for expressing possession with inanimate nouns. Readers familiar with Chaucerian English can observe various possessive strategies coexisting during this transitional stage. For instance, *The Riverside Chaucer* (Benson, pp. 105, 116) offers examples of:

The genitive case: *the Wyves Tale of Bathe*,

The his-genitive: *the Wyf of Bathe hir Prologe*,

The group genitive: *The Wife of Bath's Tale*,

The of-construction: *the Tale of the Wyf of Bathe*.

These examples illustrate the dynamic variation in possessive expression during the Middle English period, reflecting the language's gradual restructuring away from inflectional morphology and toward prepositional and periphrastic constructions.

THE ROLE OF THE BRAIN IN LANGUAGE PROCESSING

Biogrammar emphasizes the neurological and cognitive basis of grammar, particularly in the brain's ability to process syntactic structures. It supports Chomsky's view that "language is rooted in an innate, genetically determined system" (van der Hulst 141). Research into the role of Broca's area (also "Broca area" sometimes) in speech production and syntax processing shows that language is indeed deeply rooted in the biological structures of the brain. Broca's area, located in the lower rear area of the left frontal lobe in the left hemisphere, as shown in figure 1 below that also includes other language-processing areas in the brain, plays a central role in producing grammatically correct speech and understanding complex syntactic relationships (O'Grady et al. 2017, 461-62; Javed et al. 2025).

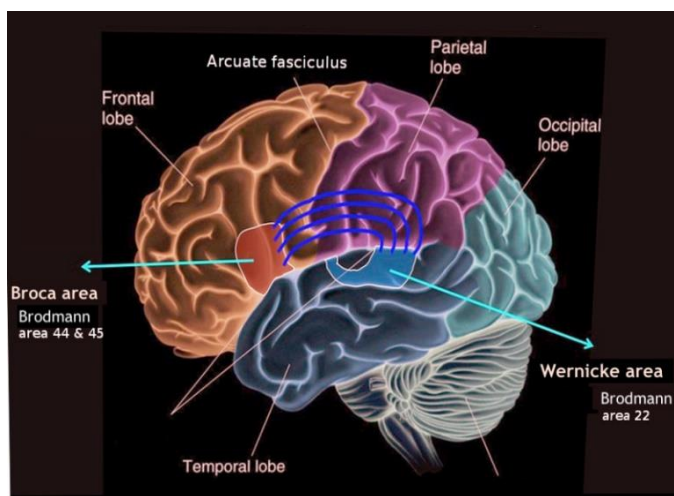


Fig. 1. The Broca and Wernicke Areas of the Brain, contributed by O Chaigasame, MD, in Kinaan Javed, et al. "Neuroanatomy, Wernicke Area," 2025.

When Broca's area is damaged, as in Broca's aphasia, individuals often exhibit impaired syntax; they struggle with grammatically complex sentences but still maintain semantic understanding. A patient with Broca's aphasia might say "two dog" instead of "two dogs." The plural -s is omitted or incorrectly used, reflecting a disruption in the brain's ability to process

grammatical structures. The failure to add the -s to indicate plurality could be linked to the motor control deficits that affect speech articulation, as well as the breakdown in syntactic processing in Broca's area. In the case of possessive markers, a Broca's aphasic patient might say "John book" instead of "John's book." The possessive -'s is often omitted. This shows a difficulty in processing grammatical features that indicate ownership or association, which are processed by the same regions of the brain responsible for syntax and morphology. These examples reinforce the idea that grammar is not just a cultural construct but is deeply biologically embedded in the brain's neural circuits. The plural -s and possessive -'s are critical grammatical markers, and their breakdown in Broca's aphasia illustrates how brain functions directly affect grammatical production. These pieces of neurological evidence support the idea that grammar is biologically determined and rooted in brain functions.

Neurological researchers have also discovered that FOXP2, a gene, plays a critical role in the development of language, including syntax processing and speech articulation. This gene is linked to motor control for speech, and its mutation leads to speech disorders and difficulties in producing grammatically correct sentences. In cases like Broca's aphasia, the damage to Broca's area is complemented by FOXP2 mutations, which can exacerbate difficulties in both morphological production (e.g., plural -s, possessive -'s) and syntactic structuring, as Benitez-Burraco summarizes from multiple researchers (385):

A point mutation or a deletion of FOXP2 give rise to different deficits, which are simultaneously of motor and linguistic nature: (i) a decreased level of lexical knowledge; (ii) a reduced capacity for morphological and morphosyntactic comprehension; (iii) diverse problems concerning morphology during production; (iv) a deficit in the capacity of the verbal component of the working memory for properly storing phonologically

relevant information, or even for sequentially articulating elements with phonological value; (v) a decreased capacity (in qualitative and quantitative terms) for retrieving elements from the lexicon; and (vi) a developmental orofacial dyspraxia, or even a spastic dysarthria, which would be accompanied by residual errors during development” (Gopnik 1990b; Vargha-Khadem et al. 1995; Watkins et al. 2002; Vargha-Khadem et al. 2005; Shriberg et al. 2006).

GRAMMATICAL BIOLOGY: GRAMMAR AS A BIOLOGICAL SYSTEM

In contrast to Biogrammar, Grammatical Biology takes a broader view of grammar’s evolution, examining it through the lens of biological systems that absorb the results of experience. This perspective views grammar as a biologically evolved system, shaped by the same processes that govern genetic inheritance and biological development. Just as genetic traits evolve over time, so too do the linguistic features of a language.

The development of plural *-s* and possessive *-’s* can be viewed through this lens: These markers evolved to meet communicative needs, and their changes reflect biological adaptation. The genetic parallels to grammatical systems are particularly evident in the way language forms, such as possessive *-’s*, develop in a manner similar to inheritance in biological systems, passed down and adapted to new linguistic contexts.

CONNECTING BIOGRAMMAR AND GRAMMATICAL BIOLOGY: A BIDIRECTIONAL FRAMEWORK

By combining Biogrammar and Grammatical Biology, we can see how neurological mechanisms and biological evolution interact in the shaping of grammar. Biogrammar provides the neurocognitive explanation for how humans are capable of processing and producing

grammatical structures, while Grammatical Biology explains how these structures evolved over time due to biological constraints and genetic changes.

The evolution of plural *-s* and possessive *-'s* and related possessive constructions from Old English to Modern English shows how morphological markers evolve to reflect biological and cognitive factors. This bidirectional framework allows us to understand grammar as a biologically embedded system, shaped both by the brain's neural circuits and the evolution of language within human cognition.

All considered, how does Biogrammar differ from the Nature-Nurture Hypothesis and Chomsky's Universal Grammar? The following section addresses this comparative question directly.

FRAMING THE COMPARISON: THE NATURE-NURTURE HYPOTHESIS, UNIVERSAL GRAMMAR, AND BIOGRAMMAR

At this point, it is necessary to compare the Nature-Nurture Hypothesis and Chomsky's Universal Grammar with the emerging framework of Biogrammar. A structured comparison that integrates all three frameworks can provide a clear and accessible way to highlight their conceptual similarities and critical differences. To that end, table 2 below contrasts Biogrammar with the two more established frameworks. It highlights how each framework handles synchrony and diachrony, the roles of biology and environment, and the view of language development and change.

Table 2 Comparative Analysis of Nature-Nurture Hypothesis, Universal Grammar, and Biogrammar			
<i>Dimension</i>	<i>Nature-Nurture Hypothesis</i>	<i>Chomsky's Universal Grammar</i>	<i>Biogrammar (This Framework)</i>
Core Focus	Interaction between genetics and environment in shaping human traits	Innate language faculty shared by all humans	Co-evolution of brain-based grammar and communicative practice over time
Synchrony	Explains present traits (e.g., cognition, language competence; examines real-time learning and adaptation	Focuses on I-language: current internal grammar and language acquisition mechanisms	Sees real-time interaction between brain output and language input; emphasizes how grammar operates <i>now</i> based on bio-cognitive factors
Diachrony	Explains development across life stages and generations; considers gene-environment evolution	Addresses species-level evolution of UG (e.g., Merge); largely avoids historical change of individual languages	Tracks how biologically-influenced grammar evolves historically; sees language variation and change as part of biological feedback loops
View of Language Change	Interaction of societal forces, learning patterns, and cognitive readiness	Minimally addressed; language change seen as peripheral (external)	Language change is <i>central</i> and biologically embedded; grammar adapts over time through interaction between brain, environment, and usage
Biological Grounding	Acknowledges genetic and epigenetic influence on traits and development	Strongly nativist; assumes pre-specified grammatical architecture in the brain	Emphasizes brain-based generativity, with adaptive plasticity via usage and environmental feedback
Environmental Role	Equally important as biology; includes culture, learning, social interaction	Secondary; environment “triggers” UG but does not shape it structurally	Vital to shaping how UG-like capacities mutate, stabilize, or diversify in populations
View of Universality	Traits are <i>universally possible</i> but expressed differently due to environment	UG is universal and largely invariant among humans	Universals are <i>probabilistic</i> , subject to evolution and divergence through communicative need

Compatible Theories	Epigenetics, Vygotsky, sociocultural theory	Generative Grammar, Minimalism, Bilingualism	Complex systems theory, emergence, historical linguistics, cognitive-functional grammar
Example Question	Why do some children read earlier than others?	How do children acquire complex syntax with limited input?	How did English evolve to favor SVO order and periphrastic constructions over time biologically and communicatively?

This comparative lens illustrates how Biogrammar, as a framework, complements but also challenges existing paradigms by insisting on a biologically active role in linguistic variation, historical change, and grammatical adaptation, a position that situates grammar as both a cognitive outcome and a cultural evolution.

CONCLUSION

This paper has introduced two foundational frameworks of language and language acquisition, the Nature-Nurture Hypothesis and Chomsky's Universal Grammar, and proposed a new, theoretically robust alternative: Biogrammar. In support of this framework, I examined the historical evolution of two key English grammatical markers: the plural *-s* and the possessive *'s*. I also explored how FOXP2, a gene implicated in speech and language development, contributes to grammatical processing through its influence on neural structures such as Broca's area. Further, I discussed how damage to this region, as seen in cases of Broca's aphasia, disrupts the production of grammatical markers, offering biological evidence for the grounding of grammar in neurocognitive architecture.

Finally, a structured comparison of the Nature-Nurture Hypothesis, Chomsky's Universal Grammar, and Biogrammar revealed three distinct paradigms: The Nature-Nurture Hypothesis as

a meta-framework bridging biology and environment; Universal Grammar as a minimalist, synchronically focused model rooted in genetic endowment; and Biogrammar as an adaptive, biologically informed grammar system that views diachronic change as central, not peripheral. This bidirectional framework that links neurocognitive mechanisms with evolutionary and cultural pressures offers a compelling explanation of how language originates, develops, adapts, and persists across time and populations, and opens the door to further interdisciplinary inquiry into the biological evolution of grammar.

Works Cited

- Algeo, John, and Carmen A. Butcher. *The Origins and Development of the English Language*. 7th ed., Cengage Learning, 2014.
- Benitez-Burraco, Antonio. “Genetics of Language: Roots of Specific Language Deficits.” *The Cambridge Handbook of Bilingualism*, edited by Cedric Boeckx and Kleanthes K. Grohmann, Routledge, 2013, pp. 375-412.
- Benson, Larry D. *The Riverside Chaucer*. 3rd ed., Houghton Mifflin, 1987.
- Chomsky, Noam. *Language and Mind*. Harcourt Brace Jovanovich, 1972.
- _____. “Linguistics and Adjacent Fields: A Personal View.” *The Chomskyan Turn*, edited by A. Kasher, Blackwell, 1991a, 5-23.
- _____. *The Minimalist Program*. MIT Press, 2014.
- Hauser, M. D., Chomsky, N., & Fitch, W. T. “The Faculty of Language: What Is It, Who Has It, and How Did It Evolve?” *Science*, vol. 298, no. 5598, 2002, pp. 1569–79.
- Javed, Kinaan, et al. “Neuroanatomy, Wernicke Area.” StatPearls Publishing, 2023. *StatPearls*, National Library of Medicine, 2025, <https://www.ncbi.nlm.nih.gov/books/NBK533001/>
- O’Grady, Williams, et al. *Contemporary Linguistics: An Introduction*. Bedford/St. Martin’s, 2017.
- Radford, Andrew. *Minimalist Syntax: Exploring the Structure of English*. Cambridge University Press, 2004.
- van der Hulst, Harry. *A Mind for Language: An Introduction to the Innateness Debate*. Cambridge University, 2024.
- Vygotsky, Lev S. *The Collective Works of L. S. Vygotsky*, edited by R. W. Rieber. Plenum Press, 1987.

From Canterbury to the Conference: Chaucer's First 18 Lines Reborn

Charles X. Li, Tony Liang, Anika Saphiloff

Project Mentor(s): Charles X. Li, Ph.D.

Department of English, Central Washington University

Abstract: This presentation examines the phonological shift from Chaucerian Middle English to Modern English, focusing on the Great English Vowel Shift. Using the first eighteen lines of Chaucer's "General Prologue" to *The Canterbury Tales* as a case study, we demonstrate how vowel sounds in Middle English transitioned to those in Early Modern and Modern English. By analyzing specific words from these opening lines, we illustrate the vowel changes that marked the shift and their impact on pronunciation. Our presentation will conclude with a recitation of Chaucer's first eighteenth lines, intertwined couplet by couplet by their Modern English counterparts, offering a direct comparison between the sounds of Middle English and Modern English. This provides a clear, audible demonstration of how the Great English Vowel Shift shaped the English pronunciation over time. *Recitation recording available in the SOURCE 2025 playlist:* <https://www.youtube.com/@cwusource5518>

Keywords: Chaucer, Middle English, Great English Vowel Shift, Early Modern English, Pronunciation

INTRODUCTION

This study examines the evolution of Chaucerian Middle English sounds into their Early Modern and Modern English counterparts, with particular emphasis on the transformative effects of the Great English Vowel Shift. We begin by outlining the scholarly division of the English language into four major historical periods, then present the vowel inventory of Middle English—focusing on both monophthongs and diphthongs—and proceed to detail how long vowels, short vowels, and diphthongs of late Middle English developed into new vowel systems

in later stages of the language. Using the first eighteen lines of Chaucer's "General Prologue" to *The Canterbury Tales* as a central case study, we trace how individual vowels changed in both quality and metrical function over time. Through the analysis of selected lexical items from these lines, we highlight the shift's impact on pronunciation and poetic rhythm. The presentation concludes with a recitation of the eighteen lines in both Middle and Modern English, offering a direct auditory comparison that illustrates how the Great Vowel Shift reshaped the sound of English.

BACKGROUND

Familiarity with the major developmental periods of the English language as identified by historical linguists, along with an understanding of the Middle English vowel inventory, enables us to trace the historical shifts in vowel sounds, technically known as vowel phonemes.

Major Developmental Periods of the English Language. The English language has a long history of over 1,500 years, starting from the Old English period (449 – 1100), through the Middle English period (1100 – 1500), then to the Early Modern English Period (1500-1800), and up to the Modern English period (1800-present). Though numerous phonological, lexical, and syntactic changes took place over this long stretch of time, our talk today focuses on the Great English Vowel Shift from the Middle English Period, represented by the Chaucerian pronunciation, to the Early Modern and Modern English Period.

The Inventory of Middle English Vowels. Middle English had thirteen monophthongs, namely simple vowels that did not involve gliding. Each monophthong is classified by its position in the

mouth cavity—front, central, or back—and by its height—high, mid, or low based on tongue placement. Of the thirteen monophthongs, six were short vowels and seven were long vowels; long vowels are indicated by double dots. These features are illustrated in the following Middle English monophthong quadrant (see figure 1), which we built based on the textual information by Algeo and Butcher (133-35).

		FRONT	CENTRAL	BACK
HIGH	Long	i:		u:
	Short	ɪ		ʊ
MID	Long	e:		o:
	Long	ɛ:		ɔ:
	Short	ɛ		ɔ
	Reduced		ə	
LONG	Long		a:	
	Short		a	

Fig. 1. Middle English Monophthong Quadrant in the Mouth Cavity

Theoretically, each vowel shown in the quadrant represents an underlying phoneme—an abstract sound unit that may vary in pronunciation depending on its phonological environment. For instance, any of these vowels may become nasalized when they occur immediately before a nasal consonant such as /m/, /n/, or /ŋ/. Phonemes are typically enclosed in forward slashes (e.g., /a/), while phonetic transcriptions of words are placed in square brackets (e.g., [bæn]), since actual word pronunciations reflect interactions among adjacent sounds. For visual clarity, however, figure 1 does not use forward slashes.

Readers already familiar with the International Phonetic Alphabet (IPA) notation system may have no difficulty reading each monophthong in figure 1 above. For those unfamiliar with the IPA, the following table illustrates the values of these monophthongs enclosed in two forward slashes. The first column lists the Middle English monophthongs; the second column provides

Modern English words containing equivalent vowel sounds; and the third column presents Middle English words that contains the matching Middle English vowels followed with their Modern English developments as glosses in parentheses.

As readers examine the table, they will quickly notice that long vowels in Middle English and Modern English do not occur in the same words with the same vowel values because of the effects of the Great English Vowel Shift, which we will discuss in detail in the next section.

Table 1		
Values of Middle English Monophthongs Illustrated with Modern English Equivalents and Middle English Example Words		
Monophthong	Modern English Equivalent	Middle English Example Words
1. /i:/	<u>f</u> ee <u>t</u>	kn <u>i</u> ght ‘knight’
2. /ɪ/	f <u>i</u> sh	f <u>i</u> sh ‘fish’
3. /e:/	f <u>a</u> ce	f <u>e</u> et ‘feet’
4. /ɛ:/	br <u>e</u> ad	gr <u>e</u> et ‘great’
5. /ɛ/	n <u>e</u> st	n <u>e</u> st ‘nest’
6. /ə/	th <u>e</u>	y <u>e</u> ‘eye’
7. /a:/	park (British)	t <u>a</u> le ‘tale’
8. /a/	f <u>a</u> ther	fl <u>a</u> t ‘flat’
9. /u:/	l <u>oo</u> se	cl <u>oo</u> d ‘cloud’
10. /ʊ/	g <u>oo</u> d	god <u>(e)</u> ‘good’
11. /o:/	s <u>o</u>	b <u>oo</u> t ‘boot’
12. /ɔ:/	p <u>a</u> w	b <u>oo</u> t ‘boat’
13. /ɔ/	p <u>o</u> t	br <u>o</u> th ‘brought’

In the case of [a:], American English does not retain this long vowel sound; the closest approximation can be found in words such as *car* [kar] or *park* [park], where the [a] is not only shorter but also colored by the following [r]. In contrast, British Received Pronunciation (often referred to as the Queen’s English) realizes these words as [ka:] and [pa:k], exhibiting non-rhotic, [r]-less pronunciation. As for /ɔ/, many American English speakers shift to the back vowel /ɑ/ when it occurs before a dental stop such as /t/ or /d/, so *pot* may be pronounced [pat].

In addition to the thirteen monophthongs, Middle English also had seven diphthongs or gliding vowels, each consisting of a primary vowel followed by a glide, as illustrated in figure 2 below, which we constructed based on the account by Algeo and Butcher (135–36). These diphthongs are likewise classified according to their position in the mouth cavity and the height of tongue placement.

	FRONT	CENTRAL	BACK
HIGH	ɪʊ		ʊɪ
MID	ɛʊ		ɔɪ ɔʊ
LOW	æɪ	aʊ	

Fig 2. Middle English Diphthongs

By the early Modern English period, these Middle English diphthongs had either merged with other sounds or been monophthongized, thereby reducing their number considerably. As a result, most lack direct Modern English counterparts. For this reason, table 2 below does not provide Modern English equivalents but instead offers Middle English example words, followed by their Modern English glosses in parentheses.

Table 2

Values of Middle English diphthongs Illustrated with Middle English Example Words and their Modern English Glosses

Diphthong	Middle English Example Words
1. /ɪʊ/	<u>newe</u> ‘new’
2. /ɛʊ/	<u>lewed</u> ‘lewd’
3. /æɪ/	<u>wey</u> ‘way’
4. /aʊ/	<u>lawe</u> ‘law’
5. /ʊɪ/	<u>poysen</u> ‘poison’
6. /ɔɪ/	<u>joy</u> ‘joy’
7. /ɔʊ/	<u>snow</u> ‘snow’

THE GREAT VOWEL SHIFT

The Great Vowel Shift (GVS) occurred between the 14th and 17th centuries. It represents the most prominent phonological development in the history of English and serves as a key marker distinguishing Middle English from both Early Modern and Modern English.

Accompanying the Great Vowel Shift (GVS) was a shift in emphasis from vowel quantity (i.e., vowel length) to vowel quality (i.e., vowel value). In other words, vowel quality gradually became more important than vowel length, to the extent that length ceased to be phonemic—that is, it no longer served to distinguish meaning. For example, the Middle English verb *bite*, pronounced [bi:t] or [bi:tə], meant “to bite,” which became [baɪt] in Modern English, referring to gripping or cutting with the teeth. In contrast, the Middle English noun *bit* [bɪt], with a short /ɪ/, referred to a small portion or piece, much like its Modern English descendant. In present-day

English, however, vowel length no longer distinguishes word meaning. For instance, pronouncing the Modern English verb *read* as [ri::d], [ri:d], or [rid] results in no change in lexical meaning. Because of this shift, linguists no longer use the colon symbol (:) to indicate phonemic vowel length in transcriptions after the Middle English period. Instead, phonologists describe vowels in terms of *tense* (more muscle tension) and *lax* (less muscle tension) quality to capture the contrast that remains phonemically relevant in Modern English. For example, /i/ is a tense vowel and /ɪ/ a lax vowel, and this contrast in quality forms a minimal pair: *seat* [sit] vs. *sit* [sɪt], where the difference in vowel quality alone results in a difference in meaning. Similar tense–lax vowel pairs function in the same way to distinguish meaning in other word sets.

Late Middle English Long Vowels. Historically, the Great Vowel Shift (GVS) primarily affected the seven long vowels of late Middle English, each of which was raised in the mouth cavity—typically from a lower to a higher position—impacting both front and back vowels. This systematic raising is the defining feature of the shift in these vowels. Although historical linguists have not determined the exact causes of the GVS, the seven long vowels moved as a set over a period of approximately 300 years. As they transitioned into their Modern English forms, the vowels passed through intermediate stages, most of which we set aside here to focus on their initial and final qualities. Figure 3 below illustrates the seven long vowels of late Middle English in comparison with their corresponding tense vowels in Early Modern and Modern English. In the figure, the late Middle English vowels are presented without example words, while the Early Modern and Modern English vowels are accompanied by sample words for illustration.

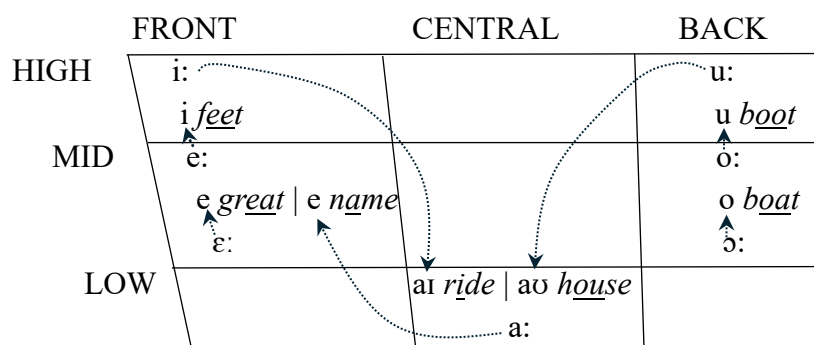


Fig. 3. The Great Vowel Shift (Adapted from Algeo and Butcher 135).

These shifts are summarized in table 3.

Table 3

Shifts of Long Vowels in late Middle English to Early Modern and Modern English, with Major Intermediate Developments Added^a

Late Middle English	Early Modern English	Modern English
/a:/ name ----->	/æ:/ > /ɛ:/ ----->	/e/ name
/e:/ feet ----->	/i/ ----->	/i/ feet
/ɛ:/ greet ----->	/e/ ----->	/e/ great
/i:/ ride ----->	/aɪ/ ----->	/aɪ/ ride
/o:/ boote ----->	/u/ ----->	/u/ boot
/ɔ:/ boot ----->	/o/ ----->	/o/ boat
/u:/ hous(e) ----->	/əʊ/ ----->	/aʊ/ house

Adapted from John Algeo and Carmen Acevedo Butcher. *The Origins and Development of the English Language*. 7th ed., Cengage Learning, 2014, p. 157.

a. We have replaced the original square brackets with forward slashes to indicate that these vowel sounds are phonemes.

To demonstrate the effects of the Great Vowel Shift on Chaucerian English below, we have purposefully selected example words from the first eighteen lines of Chaucer's "General Prologue" to *The Canterbury Tales*.

1. Middle English long /i:/ was diphthongized to /aɪ/ in Early Modern and Modern English:

knight [kni:t]	--->	knight [naɪt]
inspired [ɪnspi:rəd]	--->	inspired [ɪnspaird]

2. Middle English long /e:/ was raised up to /i/ in Early Modern and Modern English:

swete [swe:tə]	--->	sweet [swi:t]
seke [se:kə]	--->	seek [si:k]

3. Middle English long /u:/ was diphthongized to /aʊ/ in Early Modern and Modern English:

drouht [dru:xt]	--->	drought [draʊt]
flour [flu:r]	--->	flower [flaʊr]

4. Middle English long /ɛ:/ was raised up to /e/ in a handful of Early Modern and Modern English words:

grete/greet [grɛ:t(ə)]	--->	great [gret]
breke [brɛ:kə]	--->	break [brek]

5. Middle English long /o:/ was raised up to /u/, /ʊ/, or /ə/ in Early Modern and Modern English:

roote [ro:tə]	--->	root [rut]
wode/woode [wo:də]	--->	wood [wʊd]
blod/blood [blo:d]	--->	blood [bləd]

6. Middle English long /ɔ:/ was raised up to /o/ in Early Modern and Modern English:

goon [gɔ:n]	--->	go [go]

hooly [ho:li] ---> holy [holi]

7. Middle English long [a:] was raised up to [e] in Early Modern and Modern English:

Aprille [a:pril] ---> April [eprəl]

bathed [ba:ðəd] ---> bethed [beðəd]

Stressed Late Middle English Short Vowels. Compared to the long vowels of Middle English, the short vowels—/ɪ, ε, a, ɔ, ʊ/ in stressed syllables—have remained relatively stable throughout the history of the English language. For example, /ɪ/ and /ε/ have proven especially resistant to change, while /a/, /ɔ/, and /ʊ/ have undergone only minor shifts, as noted by Algeo and Butcher (160), which we illustrate below.

1. The short /a/ in Middle English later shifted to /æ/ in Early Modern and Modern English, or to /ε/ in a few instances (Benson 1297, 1305; Burrow and Turville-Petre 371):

that [θat] ---> thæt [ðæt]

whan [hwan] ---> whεn [wɛn]

2. The short /ɔ/ in Middle English later shifted to the back /ɑ/ before bilabial and alveolar stops /b, p, t, d/ in later English (for most speakers):

hoppen [hɔppən] ---> hop [hɑp]

lot [lɔt] ---> lot [lat]

3. The short /ʊ/ in Middle English later shifted to the central /ə/ when followed by /d/ or /l/ (for most speakers):

bud [ʊ] ---> bed [bəd]

mull [ʊ] ---> mell [məl]

Late Middle English Diphthongs. As previously mentioned, the number of diphthongs in Middle English was significantly reduced in later stages of English. This reduction was driven by four primary phonological processes: *monophthongization*, *merger*, *borrowing*, and *spelling pronunciation*.

Monophthongization. This refers to a sound change in which a diphthong becomes a monophthong or a single vowel sound. The following three Middle English diphthongs underwent this type of change:

1. /aʊ/ in Middle English ---> /ɔ/ in Early Modern and Modern English:

<u>l</u> awe [laʊə]	---	<u>l</u> aw [lɔ]
cl <u>a</u> we [klaʊə]	---	cl <u>a</u> w [klɔ]

2. /ɔʊ/ ---> /o/ in Middle English ---> /o/ in Early Modern and Modern English:

s <u>n</u> ow [snɔʊ]	---	s <u>n</u> ow [sno]
d <u>o</u> ugh [dɔʊx]	---	d <u>o</u> ugh [do]

3. /æɪ/ in Middle English ---> /a:/ in Late Middle English ---> /æ:/ in Early Modern English ---> [e] in Modern English:

<u>h</u> ail [hæɪl]	---	<u>h</u> ail [heɪ]
s <u>e</u> il [sæɪl]	---	s <u>a</u> il [seɪ]

Merger. It refers to the process whereby two different sounds become an identical sound.

4. The Middle English diphthongs /ɛʊ/ and /ɪʊ/ went through this process and ultimately became /yu/ or /u/ when after /t, d, n/ (for some speakers):

<u>f</u> ewe [fɛʊə]	---	<u>f</u> ew [fyu]

T <u>ues</u> dai [t <u>ʊ</u> zdaɪ]	--->	T <u>ues</u> day [t <u>y</u> uzde] or [t <u>u</u> zde]
n <u>ew</u> e [n <u>ʊ</u> ə]	--->	n <u>ew</u> [n <u>y</u> u] or [n <u>u</u>]

Borrowing. The diphthong /ɔɪ/ in Middle English was borrowed from the Old French development of Latin /au/ and remained unchanged from Middle English through Modern English (Algeo and Butcher, *Workbook* 133):

5. Lat. gaudia ---> OF joie ---> joy [dʒɔɪ]
 Lat. claustra ---> OF cloister ---> cloister [klɔɪstər]

Spelling Pronunciation. The diphthong /ɔɪ/, of French origin, was etymologically expected to be spelled *ui* (from Latin), but because the letter *u* was visually similar to the adjacent stroke letter *i*, the sequence was easily confused in manuscript writing. As a result, *ui* was respelled as *oi*, although the pronunciation remained /ɔɪ/. Ultimately, /ɔɪ/ shifted to [əɪ]. This diphthong then merged with the development of Middle English /i:/, which also shifted to /əɪ/, and both later evolved into the Modern English diphthong /aɪ/. The etymology of the verb *boil* in Modern English exemplifies this sequence of borrowing, spelling adaptation, and phonological merger, while the verb *join* provides a clear example of spelling pronunciation.

6. Lat. bullire > OF boullir > Middle English boull [bɔɪl] > Later English boul [baɪl]
 (nonstandard) (Algeo and Butcher, *The Origins and Development of the English Language*, 7th ed., 161)
 Lat. jungere > OF jouindre > Middle English jouinen [dʒɔɪnən] > Later English jouin [dʒɔɪn] (Algeo and Butcher, *Workbook*, 7th ed., 133).

In sum, of the seven Middle English diphthongs, /aʊ/, /ɔʊ/, and /æɪ/ were monophthongized to /ɔ/, /o/, and /e/ respectively. The diphthongs /ɛʊ/ and /ɪʊ/ merged into /yu/, while /ʊɪ/ ultimately merged with /i:/, evolved into /aɪ/, and later gave rise to /ɔɪ/ through spelling pronunciation. The other diphthong, /ɔɪ/, borrowed from Old French, remained unchanged. These developments are summarized in table 4 below.

Table 4

Shifts of Diphthongs in Middle English to Early Modern and Modern English, with major intermediate developments added.

Late Middle English	Early Modern English	Modern English
[aʊ] <u>lawe</u>	-----> [ɔ]	-----> [ɔ]
[ɔʊ] <u>snow</u>	-----> [o]	-----> [o]
[æɪ] <u>nail</u>	-----> [a:] -----> [æ:] -----> [ɛ:]	-----> [e]
[ɛʊ], [ɪʊ] <u>fewe</u>	-----> [yu]	-----> [yu]
[ɔɪ] <u>joy</u>	-----> [ɔɪ]	-----> [ɔɪ]
[ʊɪ] <u>join</u>	-----> [əɪ] -----> [aɪ]	-----> [ɔɪ]

In addition to the diphthongs /aɪ/, derived from Middle English /i:/, and /aʊ/, from Middle English /u:/, both of which were outcomes of the Great Vowel Shift, there were four diphthongs in Early Modern English: /aɪ/, /aʊ/, /yu/, and /ɔɪ/. However, modern phonologists no longer regard /yu/ as a true diphthong, but rather as a combination of the glide /y/ and the simple vowel /u/. As a result, only three diphthongs are recognized in present-day English.

To be able to read Chaucer's lines of verse, we must also understand the poetic meter he created, namely, iambic pentameter.

RHYTHM AND RHYME OF IAMBIC PENTAMETER

Chaucer is credited with the creation of iambic pentameter and heroic couplets in the history of English poetry (Benson xliii; Li 199-200). Iambic pentameter represents a prototypical abstract pattern of alternation between weak and strong metrical positions, arranged in five pairs or feet (Youmans, 346-49; Li 158-63; Youmans and Li 154). The poet's task is to both observe and construct a system of correspondence rules that assign weak and strong syllables to their appropriate metrical positions (Halle and Keyser 169). To illustrate iambic pentameter, using generative metrical theory, we adopt the following notational conventions:

- W indicates a weak metrical position filled by a weak (unstressed) syllable.
- (W) marks an initial missing syllable, typically at the beginning of a line.
- $\emptyset$ (null symbol) also denotes a missing syllable creating a headless line.
- S represents a strong metrical position filled by a strong (stressed) syllable.
- | (virgule) marks a foot boundary.
- (x) indicates an optional extrametrical unstressed syllable at the end of a line.

Although headless lines account for only about 1.1% of Chaucer's iambic pentameter verse (Li 237–39), we have chosen the opening heroic couplet of his "General Prologue," which includes the first line, a headless line, and the second line, to illustrate his prototypical abstract iambic pentameter as realized in two concrete, metrically instantiated lines.

(W)	S		W	S		W	S		W	S		W	S		(x)
$\emptyset$	Whan		that	Ap		rille	with		hise	shour		es	soot		(e)
The	droghte		of	March		hath	perc		ed	to		the	root		(e)

This heroic couplet consists of a pair of rhymed lines written in iambic pentameter. Heroic couplets were commonly employed in epic and narrative poetry, contributing an elevated

and formal tone to the verse. Although Chaucer's *Canterbury Tales* are composed in this form, they differ significantly from the epic tradition by incorporating humor, social commentary, and a wide range of vividly drawn characters. Nevertheless, Chaucer's use of heroic couplets lends the work a sense of poetic structure and grandeur.

Another phonological feature that enhances the rhythm of Chaucer's verse is the syllabic pronunciation of certain verb endings in the past tense or past participle, as well as plural noun forms. For example, in line 2, the word *perced* is pronounced [pɪərst] in Modern English, which is a monosyllable occupying a single metrical position. In Middle English, however, it was pronounced [pɛ:rsəd], a disyllable that fills two metrical positions. Similarly, in line 7, *The tendre croppes, and the yonge sonne*, the plural noun *croppes* is pronounced as a monosyllable [krɒps] in Modern English, but in Chaucerian English, it was [krɒpəs], a disyllable that conforms to the metrical pattern.

SETTING THE STAGE: THE FIRST EIGHTEEN LINES OF CHAUCER'S "GENERAL PROLOGUE"

Before we begin our recitation of the first eighteen lines of the "General Prologue" to Geoffrey Chaucer's *The Canterbury Tales*, it is helpful to provide some context for those who may not be familiar with the work.

Written in the late 14th century, *The Canterbury Tales* is a collection of stories told by a group of pilgrims traveling to the shrine of Saint Thomas Becket in Canterbury. Chaucer, often referred to as "The Father of English Poetry," presents the tales through the voices of a diverse group of characters, each representing different aspects of medieval society.

The “General Prologue” serves as an introduction to these characters. It sets the scene for the pilgrimage and introduces us to the pilgrims themselves, each of whom will tell a tale during the journey. In the first eighteen lines, Chaucer introduces the arrival of spring, a time of renewal and pilgrimage. The lines describe how people feel compelled to embark on pilgrimages during this season to seek spiritual solace, and they establish a vibrant, lively atmosphere to set the stage for the journey. The accompanying image vividly depicts these characters in the brisk, awakening season of spring.



Fig. 4. William Blake. *The Canterbury Pilgrims*. The Art Institute of Chicago, 1810.

As you listen to our recitation, pay attention to how Chaucer employs iambic pentameter and heroic couplets, along with the distinctive pronunciation of Chaucerian Middle English. This rhythm and structure lend the lines a musical quality that helps capture the spirit of the pilgrimage and the voices of the characters who will soon speak.

RECITING THE FIRST EIGHTEEN LINES

Now that we've set the stage, we are ready to recite these eighteen lines. Since they are written in heroic couplets, we will present each couplet alongside its Modern English counterpart, allowing you to fully appreciate both our recitation and Chaucer's captivating lines, which set the tone for the great tales to follow. We also provide a phonetic transcription of each line, reflecting the rendition of Chaucerian Middle English pronunciation.

GENERAL PROLOGUE: Lines 1 – 18

ø Whan that Aprille with hise shoures soote

[ø hwan θat á:prɪl wɪθ hɪs šú:rəs só:tə]

The droghte of March hath perced to the roote

[θə drú:xt ɔf mɑrʃ hɑθ pé:rsəd to: θə ró:tə]

When April's fruitful rains descend

And bring the droughts of March to end,

And bathed every veyne in swich licour

[and bá:ðəd év(ə)rɪ væm ɪn swiʃ lɪ'ku:r]

Of which vertu engendred is the flour;

[ɔf hwiʃ vértɪu enjéndrəd ɪs θə flú:r]

Bathing each vine in such sweet showers,

That young buds burst and unfurl flowers,

Whan Zephirus eek with his swete breeth

[hwan zéfɪrəs e:k wɪθ hɪs swé:tə bré:θ]

Inspired hath in every holt and heeth

[ɪnspí:rəd hɑθ ɪn év(ə)rɪ hólt and hé:θ]

When West Wind too, with his mild airs,

Inspires in fields and hidden lairs

The tendre croppes, and the yonge sonne

[θə tэндrə króppəs and θə yóŋgə sónnə]

Hath in the Ram his half[e] cours yronne,

[haθ in θə rámm his hálvə kú:rs irónnə]

Fresh-minted leaves, and when the sun

Halfway toward the Bull has run;

And smale foweles maken melodye,

[and smálə fú:ləs má:kən mēlodí:ə]

That slepen al the nyght with open eye—

[θat slé:pən ál θə níxt wíθ ó:pən í:ə]

When small birds sing for all they're worth,

Wide-eyed all night with reckless mirth,

So priketh hem nature in hir corages—

[sɔ: príkəθ hēm natíur in hır kɔrǎ:ʒəs]

Thanne longen folk to goon on pilgrimage[s],

[θan lóŋgən fólk to: gó:n ɔn pílgrɪmǎ:ʒəs]

Mad for love in trees and hedges,

Why, then folks go on pilgrimages

And Palmeres for to seken straunge strondes,

[and pálm(ə)rəs fɔr to: sé:kən stráʊŋjə stróndəs]

To ferne halwes kowthe in sondry londes

[to: fɛrnə hálwəs kú:θ in sóndrɪ lóndəs]

And pilgrims yearn for foreign strands

And distant shrines in sundry lands.

And specially from every shires ende

[and spésyallɪ frəm év(ə)rɪ ší:rəs éndə]

Of Engelond to Caunturbury they wende

[ɔf éngəlonð to: káuntərbri: θæɪ wéndə]

In England, from every plot or skerry,

They make their way to Canterbury,

The hooly blisful martir for to seke

[θə hó:lɪ blísful mártɪr fɔr to: sé:kə]

That hem hath holpen whan þat they were seeke.

[θat hɛm haθ hólpən hwan θat θæɪ wɛ:r sé:kə]

(Algeo and Butcher, *Workbook*, 135-136)

Seeking the shrine of great Saint Thomas,

To pay for sins or keep a promise.

(Glaser 21)

CONCLUSION

We conclude our presentation by echoing Chaucer's heroic couplets and marveling at the amazing historical development of the English language:

To end, we leave you with a thought in verse,
Rendered in heroic couplets, to immerse:
Languages evolve, they change through time and space,
Imagine, five hundred years from now, this place.
The speakers of that age may look and say,
"The English of the past seemed strange," I say!
So with this thought, we end our humble show,
We hope you've loved it, and that it will grow.

Works Cited

- Algeo, John, and Carmen Acevedo Butcher. *The Origins and Development of the English Language*. 7th ed., Wadsworth Cengage Learning, 2014.
- _____. *Workbook: The Origins and Development of the English Language*. 7th ed., Wadsworth Cengage Learning, 2014.
- Benson, Larry D. *The Riverside Chaucer*. 3rd ed., Houghton Mifflin, 1987.
- Black, William. *The Canterbury Pilgrims*. The Art Institute of Chicago, 1810.
- Burrow, J. A., and Thorlac Turville-Petre. *A Book of Middle English*. 2nd ed., Blackwell, 1992. Rpt. 1996.
- Glaser, Joseph. *The Canterbury Tales in Modern Verse*. Jackett Publishing, 2005.
- Halle, Morris, and Samuel J. Keyser. *English Stress: Its Form, its Growth, and its Role in Verse*. Harper and Row, 1971.
- Li, Charles X. (née Xingzhong Li). *Chaucer's Meters*. 1995. University of Missouri-Columbia, PhD dissertation.
- Youmans, Gilbert. "Milton's Meter." *Phonetics and Phonology I: Rhythm and Meter*, edited by Paul Kiparsky and Gilbert Youmans, Academic Press, 1989, pp. 341-79.
- Youmans, Gilbert, and Charles X. Li (née Xingzhong Li). "Chaucer: Folk Poet or Littérateur?" *Studies in the History of the English Language: A Millennial Perspective*, edited by Donka Minkova and Robert Stockwell, Mouton de Gruyter, 2002, pp. 153-75.

Nathaniel Hawthorne's *Scarlet Redemption*

Zoe Elizabeth Prince

Project Mentor(s): Sarah Sillin

Department of English, Central Washington University

Abstract: An oft misunderstood classic of literature, Nathaniel Hawthorne's *Scarlet Letter* tells the story of Hester Prynne, her minister and lover Arthur Dimmesdale, and their ruthless enemy, Roger Chillingworth. In the Puritan colony of Boston Massachusetts, 1642, Hester's child born out of wedlock earns her a scarlet letter, marking her forever as a flagrant sinner. In the midst of betrayal, shame, and superstition, Hester shines as an incredible testimony to fortitude. Though lauded as a beautiful romance, within the *Scarlet Letter* many readers miss the bitter musings of the author's narration, which constantly reproves the religious community while uplifting the object of their scorn, Hester. To Hawthorne, this is no mere historical fiction: it is a work of penance for a family fallen from grace. Hawthorne's *Scarlet Letter* is a compelling case for the art of close-reading as crucial for understanding, and should inspire readers to pull back the historical curtain, uncovering a dark and tragic history of men abusing their power. Drawing on his own culture's understanding of it, Hawthorne betrays a deep knowledge of and respect for the Bible, a book whose influence knew no bounds in the 1600s and 1800s alike. This context of biblical literacy lends a crucial lens through which to view Hawthorne's narrative: as a deeply symbolic magnum opus. *The Scarlet Letter* serves as the author's redemption for the sins of his brutally rigid Puritan forefathers through Hester Prynne, who redeems Hawthorne's name by exemplifying all the biblical attributes his ancestors had not.

Keywords: American History, Religion, Literature, Close Reading

Then Jesus said to the crowds and to his disciples, “The scribes and the Pharisees sit on Moses’ seat, so do and observe whatever they tell you, but not the works they do.

For they preach, but do not practice.

They tie up heavy burdens, hard to bear, and lay them on people’s shoulders, but they themselves are not willing to move them with their finger.

They do all their deeds to be seen by others.” – Matthew 23.1–5, The Holy Bible

Of what use is all religion: all law, all power, all tradition, all authority, if you have not love (*The Holy Bible*, 1 Cor. 13.1–3)? Early America received a mass exodus of religious refugees from Catholic persecutors in Europe. Figures of the time, like early pilgrim governors John Winthrop and William Bradford, wrote of their desire to become like a “city on a hill” in the new country. This was an idea inspired by Jesus’s sermon on the mount, an admonition for His followers to exemplify His love to the nations: “*For we must consider that we shall be as a city upon a hill. The eyes of all people are upon us. So that if we shall deal falsely with our God in this work we have undertaken, and so cause Him to withdraw His present help from us, we shall be made a story and a by-word through the world*” (Winthrop). The intentions of the persecuted immigrants to New England served as a hopeful testament to the fortitude of community and the principles of charity and freedom which founded settlements like Massachusetts Bay and Plymouth. However, these communities were constantly marked by death, conflict, starvation, and wretched sickness, and the generations that followed strayed from the foundations of their forefathers, developing a coarse, rigid, and oppressive relationship, both with the cultures around them and other branches of Protestantism, that soon bled into their very

own communities as well, forever tainting the name of the Puritans. The persecuted became the persecutors.

One of the most well-known works of fiction that analyzes the Puritan community is Nathaniel Hawthorne's *The Scarlet Letter*. Forever a classic, the book was published in America's antebellum era, 1850, but was set hundreds of years before in the early 1640s (Hawthorne 43). This setting is no mere happenstance, though not contemporary to the author's time; the Puritan era was one very personal to Hawthorne, whose ancestors were some of the first Europeans to set foot on American soil (Barnes & Noble, Inc.). Sometimes seen as incredibly critical towards Puritan society, *The Scarlet Letter* follows a young woman estranged from her husband who is outcast by her community for falling into adultery. Her resulting journey through a culture of shame is one marked by resilience in the face of adversity and a beautiful gentleness which her community isn't owed. While *The Scarlet Letter* tears down the Puritans' conduct in many ways, it also uses the protagonist, Hester Prynne, to exemplify a course correction for the Puritans into the grace that they had forgotten. Nathaniel Hawthorne's deeply symbolic and personally significant magnum opus, *The Scarlet Letter*, serves as the author's redemption for the sins of his Puritan forefathers: brutality against women, punishment disproportionate to the crime, and adherence to a culture of shame and rigid religion despite the Bible's clear condemnation of this same behavior. The character of Hester Prynne redeems Hawthorne's family name by exemplifying all the attributes his ancestors had not: Christ's love for his enemies, unflinching resolve in the face of Puritanical tyranny, and reforming the hearts of her community through her example of turning the other cheek.

The story begins in the midst of Hester Prynne's punishment at the hands of her Puritan community: she stands upon a raised platform in the town's public square holding her child,

Pearl, born out of wedlock, with a crimson letter A stitched onto her bosom. This mark Hester is to wear forevermore, a permanent divide between herself and the rest of the townsfolk, who are apparently without sin. This scene is one of the first biblical parallels we see Hawthorne use, hearkening to the story of John 8, where the Pharisees drag a woman caught in adultery before Jesus. Hawthorne's familiarity with the Bible should be obvious even for casual readers of *The Scarlet Letter*; however, scholars confirm both his personal faith and the broader context of his culture's biblical literacy: "the New England mind was saturated with the Old Testament . . . All children were raised on the Bible from the cradle, and writers could assume, as we can no longer do, that the stories of Moses in the bulrushes, or Lot's wife, or Ruth amid the alien corn, or Abraham's sacrifice, were known to them as our children know the complex lore of missiles and moon-conquest" (Walsh 1). Furthermore, Hawthorne's personal Christian faith does not seem to be in question. Indeed, author Conor Walsh says, "Hawthorne 'considered his Christian faith unshakable'" and "Although he is exceedingly discrete about quoting and alluding to particular sources, Hawthorne allows the Bible to become a quite noticeable, though critically overlooked, aspect of his fiction" (17). If then, we assume Hawthorne's familiarity and fondness for Christianity, why attack one of the quintessential American religious groups from history?

For the remainder of the story, Hawthorne highlights Hester's struggle to bear the permanent reminder of her mistake, saying, "Continually, and in a thousand other ways, did she feel the innumerable throbs of anguish that had been so cunningly contrived for her by the undying, the ever-active sentence of the Puritan tribunal" (Hawthorne 78). However heavy the burden may have felt, this punishment was a light one considering typical Puritan punishments in the 1600s. Hawthorne's narrator hints to this, saying that the severity with which the people treated even the merest of grievances "befitted a people amongst whom religion and law were

almost identical” and that no mercy was to be found in their hearts of stone; “Meagre indeed, and cold, was the sympathy that a transgressor might look for, from such bystanders” as the Puritans (Hawthorne 45, 46). While public ridicule may seem severe to us today, and certainly felt so to Hester, the Puritans were known for their cruelties, chief among them Hawthorne’s very own ancestors.

According to Nancy Stade, Hawthorne’s great-great-great grandfather, Puritan magistrate William Hathorne, “sentenced a burglar to having his ear lopped off and the letter B branded onto his forehead” (Stade xviii). More relevant perhaps, Hawthorne’s ancestor was infamously severe towards a Quaker woman, Anne Coleman, whom Hathorne had toured around three towns “half-naked” to flog in the public squares of each (Stade xix; Hawthorne 249). This severity towards women seems to have been a hallmark of William’s career, as court documents from Salem in 1668 indicate an additional, and quite namely, recipient of said severity: “Hester Craford, for fornication . . . was ordered to be severely whipped and that security be given to save the town from the charge of keeping the child. . . . The judgment of her being whipped . . . was left to the Worshipful Major William Hathorne” (xix). Not only was Hawthorne’s inclusion of a sinful woman as protagonist purposeful, but even her very name begins to clue us into the remorse and fear of hereditary sin at the core of the author’s motives for the book. Hawthorne will do what he can to repent for his forefathers by turning the very prey of Puritan society into their redemption, and, by extension, redeem himself as well: “Whoever exalts himself will be humbled, and whoever humbles himself will be exalted” (Matt. 23.12). The Puritans indeed were due to be humbled.

This is done in the very beginning of the book where Hawthorne addresses his own faults before he introduces Hester’s. *The Scarlet Letter* begins with a chapter titled “The Custom

House,” which at first glance seems to have little to do with the story. Before beginning his examination of Hester’s life, Hawthorne expositis his own in this mysterious chapter. He begins by exposing the lineage of his family as having had no small part in tainting the name of Salem, Massachusetts: “He [William Hathorne] . . . was a ruler in the church; he had all the Puritanic traits, both good and evil” (Hawthorne 7). We here get our first glimpse into Hawthorne’s perspective of the Puritans: much nuanced. He then goes onto mention the notoriously ruthless prosecutor of the Salem witch trials, William Hathorne’s son, John Hathorne (“Reverend Deodat Lawson, Statement on the Salem Witches and Witches’ Testimony”). John Hathorne was responsible for the “martyrdom” of nineteen people, most of them women, whose blood Hawthorne is assured “left a stain upon him [John]. So deep a stain, indeed, that his old dry bones . . . must still retain it” (7). Curiously, Hawthorne does not distance himself from his ancestors, he does not let these histories lie buried despite being several generations removed. Instead, he drags them into the light as they become the motivation for the very story he is about to tell: Hester’s.

But why feel so personally responsible for someone else’s actions? Hawthorne answers directly by saying, “I know not whether these ancestors of mine bethought themselves to repent, and ask pardon of Heaven for their cruelties; or whether they are now groaning under the weight of them in another state of being [Hell]” (7). Hawthorne makes a striking statement here: he recognizes that despite all the decorum of the Puritans, it does not secure salvation. He laments his uncertainty of his ancestors’ repentance for their cruelties; indeed, history records that while all of the other examiners of the accused witches later expressed remorse for their action, John Hathorne, Nathaniel Hawthorne’s great-great grandfather, never did (Stade xix). The very knowledge of their lack of remorse is what prompted Hawthorne to take on this subject matter.

Repentance for sin secures salvation, repentance the Puritans never displayed, but Hester does. *The Scarlet Letter* flips the Puritan power structure on its head and uplifts the remorseful, sinful woman above her self-righteous adjudicators.

In order to make the crimes of the past right, Hawthorne quickly takes his ancestor's mistakes upon himself: "I, the present writer, as their representative, hereby take shame upon myself for their sakes, and pray that any curse incurred by them . . . may be now and henceforth removed" (Hawthorne 7). The character Hawthorne creates to atone, Hester Prynne, also voluntarily takes on another's guilt: when she is pressured by the Puritans to reveal the father of her child, the other half of the sinful encounter, she stands strong and remains loyal to the man. Defiantly, she says, "'Never! . . . It is too deeply branded [her lover's name]. Ye cannot take it off. *And would that I endure his agony, as well as mine*'" (Hawthorne 63). We can see Hester's strength, despite her meek acceptance of her own punishment as her just reward, in her decision to remain defiant in protecting her co-conspirator. Her love of Dimmesdale is stronger than her sense of "justice" and her refusal to oust him displays her value, like Jesus commands, of love above all, another way she fulfills a value the Puritans did not. Would that Hawthorne's ancestors had exemplified a similar love for others at the cost of their own reputations.

It seems, then, that the legacy of Puritanical shame places a burden and fear on Hawthorne not easily shaken, especially considering his family's fall from affluence in the generations following these two men:

But woe to you, scribes and Pharisees, hypocrites! For you shut the kingdom of heaven in people's faces. For you neither enter yourselves nor allow those who would enter to go in. Woe to you, scribes and Pharisees, hypocrites! For you travel across sea and land to make

a single proselyte [convert], and when he becomes a proselyte, you make him twice as much a child of hell as yourselves. (Matt. 23. 13–15)

How could the son of Puritans, with their emphasis on hereditary sins, not attribute this misfortune to the cruelties ignored within his family? Something *must* be done, lest Hawthorne also become a child of hell.

This idea of hereditary sin is embedded in much of his work, as in this moral from Hawthorne's novel *The House of Seven Gables*: "The weaknesses and defects, the bad passions, the mean tendencies, and the moral diseases which lead to crime are handed down from one generation to another" (Mills 96). In *The Scarlet Letter* also, Hawthorne uses Hester's experience to expose her community's own sins, hidden from obvious view: "Hester . . . fancied, then, that the scarlet letter had endowed her with a new sense. She . . . could not help believing, that it gave her a sympathetic knowledge of the hidden sin in other hearts" (Hawthorne 80). What could Hawthorne be getting at here, but a retrospective jab at ancestors and the culture they represented, who acted as though they were completely righteous; with no thought for the vulnerable, the weak or those who had made mistakes? Hester reveals the truth: "the outward guise of purity was but a lie, ...if truth were everywhere to be shown, a scarlet letter would blaze forth on many a bosom besides Hester Prynne's" (Hawthorne 80). The author's feelings towards Puritans and motives for the book are clear: loveless rule-followers should not be God's representation on earth, much as Jesus revealed in his animosity towards the Pharisees. Woe to them!

Her namesake being a woman who'd been abused at the hands of Hawthorne's ancestor, Hester notably does not seek retribution or revenge for her treatment. Instead, she patiently bears the shame of her scarlet letter and is never once unkind to her abusers. Hester is Hawthorne's

representation of “turning the other cheek”, which is displayed positively; she owns her mistake and is willing to be accountable to God for her actions, saying “Let him [God] do with me, as, in his justice and wisdom, he shall see good” (Hawthorne 127). Hester’s steadfast kindness is the only thing that melts the Puritans’ hearts of stone, showing them yet again the love and grace that they had not been representing.

Years pass after Hester’s initial discovery and punishment, and though she lives in isolation outside the village with her daughter, she does not depart completely and braves their scorn day after day working as a seamstress and nurse. Her years of service thaw the Puritan’s view of her: “The letter was the symbol of her calling. Such helpfulness was found in her – so much power to do, and power to sympathize, that many people refused to interpret the scarlet A by its original signification. They said it was meant Able; so strong was Hester Prynne, with a woman’s strength” (Hawthorne 150). Hester is Hawthorne’s ultimate rebuke of the Puritans: she does not despair under the weight of her mistake, despite the pressure to do just that. Instead, she knows her righteousness is not found in the eyes of man, but in her Creator, who offers grace freely. Indeed, she offers hope to Dimmesdale, who crumbles under the weight of his own sin, kept secret rather than dealt with in the light, a familiar plight to Hawthorne. Hester pleads with him, “Heaven would show mercy, hadst thou but the strength to take advantage of it . . . The future is yet full of trial and success. There is happiness to be enjoyed! There is good to be done” (Hawthorne 185)! This hopefulness can only be attributed to Hester’s fall: the scarlet letter had forged within her the strength to recognize the truth behind all of the Puritans’ posturing, “they had made her strong, but taught her much amiss” (Hawthorne 188). Though Hester endures far more than any other character, she reflects the merciful, steadfast love of Christ and practices what the Puritans preach. Hester’s hopeful example seeks to redeem Dimmesdale in the

immediate, but Hawthorne is using her to paint the rigid Puritans in a more realistic light, and calling all men who think themselves righteous to repent:

What is unavoidable in the larger realm of Hawthorne's writings is that each person is sinful either by his or her own actions or by the inheritance of ancestors . . . The struggles of the recognition that humankind consistently harbors sin within the heart leads to two courses of action: allowing the heart to harden, or to search it out for its iniquities. (Walsh 292)

Hester's happy ending and restorative relationship with her community mirrors Hawthorne's own hopes for his book: a more nuanced view of the Puritans who fail in key ways but are not beyond redemption, and he hopes, neither is he. Hester is the true Puritan, and the recompense Hawthorne pays for the ways his forefathers had fallen. From the inspiration of their unrepentant hearts, he fashioned a redeemer who recognized her own faults, rather than fixating on others'. From their rejection of the Bible's command to love others as yourself, he wrote a story of a heroine who adhered to her values of kindness and loyalty. From their cruelty, he created a character who patiently bore all things and never broke, remaining a steadfast example of Christ in her love for all. Hester bears on her back the burden of the Hawthorne family's violent past, purposefully exemplifying her own Redeemer, who bore on His back the sins of us all, that we may be free forevermore.

Works Cited

- Barnes & Noble, Inc. Note on Nathaniel Hawthorne, *The World of Nathaniel Hawthorne and The Scarlet Letter*; Inspired by *The Scarlet Letter*, and Comments & Questions. *The Scarlet Letter*; by Nathaniel Hawthorne, Barnes & Noble Books, 2003, pp. ix-xii.
- Hawthorne, Nathaniel. *The Scarlet Letter*. Barnes & Noble Books, 2003.
- The Holy Bible*. English Standard Version, Crossway, 2015.
- Mills, Barriss. "Hawthorne and Puritanism." *The New England Quarterly*, vol. 21, no. 1, 1948, pp. 78–102. JSTOR, <https://doi.org/10.2307/361158>
- "Reverend Deodat Lawson, Statement on the Salem Witches and Witches' Testimony." *American History Told by Contemporaries*, edited by Albert Bushnell Hart, New York: Macmillan, 1917, pp. 38-51.
- Stade, Nancy. Introduction. *The Scarlet Letter*, by Nathaniel Hawthorne, Barnes & Noble Books, 2003, pp. xiii-xxxv.
- Walsh, Conor Michael, "Nathaniel Hawthorne and his biblical contexts" (2009). UNLV Theses, Dissertations, Professional Papers, and Capstones. 1115.
<http://dx.doi.org/10.34917/2493798>
- Winthrop, John. "A Model of Christian Charity," in *A Library of American Literature: Early Colonial Literature, 1607-1675*, Edmund Clarence Stedman and Ellen Mackay Hutchinson, eds. (New York: 1892). <https://www.americanyawp.com/reader/colliding-cultures/john-winthrop-dreams-of-a-city-on-a-hill-1630/> Accessed 3 Nov 2024.

Literary Networks Everywhere: An Analysis of Literary Connections Across Time and Culture

Rachel Riffel

Project Mentor(s): Katharine Whitcomb

Department of English, Central Washington University

Abstract: This paper explores the concept of literary discourse as a networked form, using Caroline Levine’s theory of “networks” as expansive systems of meaning. Through the poetry of several postmodern poets and their texts such as Terrance Hayes’ *American Sonnets for My Past and Future Assassin*, Anne Carson’s *The Beauty of the Husband*, and Maggie Nelson’s *Bluets*, this essay analyzes how contemporary poets use intertextuality, historical references, and classical forms not as rigid structures but as connective nodes in a broader literary web. These texts illustrate how poetry continues to participate in an evolving cultural and literary conversation that transcends time, geography, and genre to communicate common human experiences. Through this networked discourse, poets challenge hierarchical traditions and assert marginalized voices, while also engaging in an ongoing dialogue with the past. Literary networks provide a lens for understanding the interconnectivity of texts that perpetuate the enduring human desire to find meaning through shared cultural memory. This specialized discourse is foundational and expandable to the growing inclusivity of the literary canon and community.

Presentation recording available in the SOURCE 2025 playlist:

<https://www.youtube.com/@cwusource5518>

Keywords: Networks, Form, Postmodern, Poetry, Connection, Discourse

There is an age-old saying that history repeats itself. This maxim is never truer than in the study of the humanities. We seem to repeat cycles of revolution, renaissance, and advancement that are always closely patterned by recession, resistance, and decline. Author Michael Chabon says in his essay on fan fictions that “there is a degree to which, just as all criticism is in essence

Sherlockian, all literature, highbrow or low, from the Aeneid onward, is fan fiction.” One of the most infectious networks in literature is literature itself. Writers and creators reference each other’s work to give credence to what inspired their own, and to maintain a literary colloquium within the community. This network of literary references expands to other networks that are historical, regional, cultural etc. In today’s post-modern literature, the use of venerable styles and conventions perpetuate and expand the networks of classic literature and influence of literary history. This essay will examine literary networks within Terrance Hayes’ *American Sonnets for My Past and Future Assassin*, Maggie Nelson’s *Bluets*, and Anne Carson’s *Beauty of the Husband* within Caroline Levine’s theory of networks as form.

In an interview regarding her book *Forms: Whole, Rhythm, Hierarchy, Network*, Princeton professor, Carline Levine comments that while we think that humanity is exciting or exceptional, we are just repeating ourselves, history, and forms. In her book, Levine discusses how the definition of form can be broadened to encompass any repeated pattern, which is not exclusive to mere poetic structures. Patterns of time, schedules, historical references, people, places, or ideas can all be organizational tools to enhance meaning and scansion. Levine divides these patterns into four main groupings: whole, rhythm, hierarchy, and network. When defining networks, Levine argues that “...there is no such thing as self-enclosed culture--certainly never one that can appear as such” (116). Culture cannot be contained—it must have a point of origin and reference to maintain relevance and thus survive. Who better than the very creators themselves to keep the ancient art of writing and storytelling alive?

Levine considers networks one of the most powerful means of form since they have unlimited influence and connection across cultures, time, and space. “Theoretically, networks are capable of unending expansion: Once there is a link between two nodes, there is a network, and

it can grow simply by linking to new nodes., there is a network and a certain infinite extensiveness” (117). Like points on a spider’s web, these nodes are what connect topics to each other, which form sometimes multiple wholes. “Some critics consider wholeness to be a myth that networks helpfully shatter. Others adopt wholeness as a troubling reality that can and should be violated by networked extension” (117). This disruption of reality is what makes the form so fascinating and malleable to the writer. Writers can create and use nodes to connect readers to the past, foreign cultures, characters, social standards, etc. Some especially like to connect old forms of poetry and prose to present-day issues.

Terrance Hayes’ book of poems *American Sonnets for My Past and Future Assassin* connects the traditional form of the sonnet with the modern-day experiences of the black community in America. In these sonnets, Hayes demonstrates that forms do not have to be restrictive, but can be merely another node, or connection point, between the author and their discovery. For centuries, the sonnet form has been viewed as rigid in its structure, requiring 14 lines, iambic pentameter, ABABCDCDEFEFGG rhyme scheme, and if you’re Shakespearean, an octave, sestet, and couplet within. While these rules have been established as a form of high art, and consequently the hierarchical form, poets such as Hayes have utilized the sonnet convention to deconstruct its hierarchy, making it merely a node within the network of classical literature. They also create new nodes between the marginalized black poet between the dominant white male such as William Shakespeare and Christopher Marlowe, making them equal nodes in the network of classic literature. Hayes elevates himself to be part of the sonnet discussion in which he would be in the same discourse with Shakespeare and Marlowe.

In Hayes’ sonnet “[We suppose Ms. Dickinson is like the abandoned...]”, there is an obvious effort to include literary references to one another. The speaker alludes to the poet Emily

Dickinson, the Greek mythology character Orpheus, Saint Francis, and American poet Galway Kinnell. He mixes in nodes that connect to nature and animals such as black birds, bears, fish, paws, sow. All of these nodes also connect to the topic of masturbation: “We suppose Ms. Dickinson is like the abandoned / Lover of Orpheus & too, that she loved to masturbate / Whispering lonely dark blue lullabies to Death” (Hayes 1-3). The speaker goes on to postulate what might happen if like Saint Francis, everyone could make spur orgasm with a brush of the ear or a single touch (Hayes 9,12). Hayes combination of topics creates an unforeseen network of literary references with sexual pleasure and animals. While I’m not suggesting his intent is bestial, this is an unconventional combination, but one that intends to connect sexuality with that of the natural and possibly supernatural world. He implies religious devotion and a sexual attraction to Death, just as Emily Dickinson, who famously questioned religion, wrote a poem about her courting Death. Hayes expands not only the sonnet form stylistically, but also its thematic ability to connect with unconventional nodes that end of making sense.

In his book on the writing process, *My Trade Is Mystery*, poet Carl Phillips encapsulates how writing functions within a network and is essential to research: “Meanwhile, given that everything we write comes to us via the many lenses of the experiences we’ve accumulated across a life—we speaking of trees, for example, according to what we know of trees by actual experience and through what we’ve experienced of trees in books, movies, nursery rhymes, and more—then everything we do is at some level research for the next poem” (Phillips 37). While earlier in the chapter, he clarifies that one does not need to just focus on literary networks to write, his explanation of the writing subject’s process is valid. Phillips, like Hayes, writes in conventional forms while deconstructing the hierarchy of these forms into mere nodes. He, like Hayes, is a black man, who also identifies as homosexual. Throughout his writing carrier,

Phillips has written about his relationships with men both sexually and romantically. His use of traditional forms, which typically depicted heterosexual relationships brings his experience to an equal playing field with the established hierarchy.

Anne Carson's fictional essay titled *Beauty of the Husband* structures much of her language and references within the network of classic literature. Within the poems, she uses several connections points to British and Western literature including Charlotte Bronte's novel *Jane Eyre*, the works of John Keats' *Otho the Great* and John Milton's *Paradise Lost*. Throughout the tangos, she creates a network of locations and key historical figures from Britain and Western Europe. She also refers to classic European cities such as Venice and Paris. While in Paris, commonly associated with love and romance, the speaker discovers her husband's mistress is a French woman. In the second tango, the speaker recalls how her husband stays up all night with his friends smoking cigarettes and playing strategic war-based board games (29-32). This example establishes a male dominance within their household, which is enhanced by the "classic" male obsession with war and strategy. This node connects to the previous lines in which she refers to the battle of Troy (7-13). It seems that we take a journey and each point on the map is a node connecting to the next. Carson alludes to classic writers and historical figures such as Duchamp, Napoleon Bonaparte, and Verdi. Napoleon especially reinforces the male hierarchy within these tangos, making the speaker sound even more powerless to her husband's sexual desires.

Throughout the excerpts, the speaker describes a sordid relationship between herself and her husband. She uses an instance in which her ex-husband was especially unimaginative while not only taking from the ancient Greek poet Homer but also taking this reference from her own writings:

[He] Used my starts to various ends, for example in a pocket I found a
letter he'd begun
(to his mistress at that time)
containing a phrase I had copied from Homer: is how
Homer says
Andromache went
after she parted from Hektor—"often turning to look back." (7-13)

This allusion enhances the sorrow the speaker feels when finding out that her husband takes advantage of her mentally as he steals her ideas, and physically as we later discover his infidelity. The speaker also implies an "age-old" experience of women being taken advantage of by the patriarchy within Western culture. Though she does not say this reference directly, one might recall a connection point to Penelope's longing for Odysseus' return to Ithaca. However, while she waits, Odysseus is unfaithful to her, similar to the relationship between the speaker, her husband and his mistress. Whether this is Carson's intended connection point, it does not really matter, because the reader is able to create their own connections based on prior knowledge or lack thereof. She still communicates once again "age old" sorrow that women across time have experienced.

At the beginning of each tango, Carson inserts a quote from the Romantic poet John Keats. Several are some a lesser-known Keats play called *Otho the Great: A Tragedy in Five Acts* and *The Jealousies: A Faery Tale*, and one is from his annotations John Milton's *Paradise Lost*. Carson plants this node to act as an equalizer between the speaker and Keats. It is almost as if they are having a conversation through their own characters about love and loss. She begins with a quote from *The Jealousies* in which Keats remarks: "more / Bad reasons for her sorrow, as

appears / In the framed memoirs of a thousand years” (3). Through this reference, Carson connects the crafted sorrow from Keats’ story to the sorrow of the speaker. Using *The Jealousies* is also thematically appropriate. Later in tango III, the speaker says, “jealousy can eat to a heart’s core, this formula having occurred to his / as he says in the must and amber / of a Paris balcony / watching his opera beauty arrive on the arm of a strange cavalier?” (37-40). This node of jealousy between men and women also connects to the story of Odysseus and Penelope, Helen and Paris, Napoleon and Josephine. Through these nodes of historical and literary references, Carson is able to connect the speaker’s experience with infidelity and loss to that of major figures throughout history, deepening the sorrow that she feels.

In Maggie Nelson’s *Bluets*, we observe many of the same themes with similar literary and cultural nodes. Similar to Carson, Nelson formats *Bluets* as a series of numbered “propositions” or prose to create a whole. Each “bluet,” meaning a “smaller blue,” can be perceived as its own node as Nelson alludes to many artists, writers, philosophers, and historical figures who contributed to the speaker’s consciousness and perception of events that occur. Her “principal suppliers” include Goethe and Wittgenstein, especially in her mimicry of Goethe’s own *Theory of Colours*.

Nelson’s inclusion and creation of many nodes expands the network and breadth of connections that can be associated with the color blue, loneliness and loss. For example, on page 30, at the end of proposition 76, the speaker recalls a time when she saw a “guy on Craigslist two blocks away who says he has an hour to kill and a dick longer than a donkey’s. He has posted a photograph to prove it.” Despite the brashness of the speaker’s revelation concerning the size of her neighbor’s penis, Nelson juxtaposes this commentary with a quote from Transcendentalist Henry David Thoreau: “77. ‘Why should I feel lonely? Is not our planet in the Milky Way?’”

(Thoreau). While many might blush at this juxtaposition, Nelson is quite genius in establishing and expanding connections between the past and present, technology and nature, high art and low art.

Later, on the same page, in proposition 78, Nelson combines many nodes to create a network that might even be labeled as “too much,” as the speaker labels the painting at the Tate in London:

78. Once I traveled to the Tate in London to see the blue paintings of Yves Klein., who invented and patented his own shade of ultramarine, International Klein Blue (IKB), then painted canvases and objects with it throughout a period of his life he dubbed “l’epoque bleue.” Standing in front of these blue paintings, or propositions, at the Tate, feeling their blue radiate out so hotly that it seemed to be touching, perhaps even hurting, my eyeballs, I wrote but one phrase in my notebook: too much. I had come all this way and I could barely look. Perhaps I had inadvertently brushed up against the Buddhist axiom, that enlightenment is the ultimate disappointment. “From the mountain you see the mountain,” wrote Emerson. (Nelson 30)

Nelson’s inclusion of iconographic, historical, and cultural markers become the nodes for the same reoccurring obsessions throughout history. She combines the location of a high-art establishment, the Tate, which is in London, a central hub for Western art, development and culture with Buddhist and Transcendental philosophy. Emerson being her choice of voice at the end of the proposition, exemplifies the connection between nature and the urbanization of London. She also uses French, another example of high art, and the extreme power Klein’s patented blue. She connects the art world with the literary world, transcendentalism with industrialization.

Throughout Western Literature, we observe the intertextual exchanges of references and new connections being made to create a broader network. This broader network encompasses a more wholistic view of what life is like for humanity. Whether the nodes connect to minorities, marginalized sexual orientations, or even hierarchies themselves, over time, they depict the same human experiences. We consistently see cultural, historical, and thematic markers used as nodes within a network of the whole. These nodes can also be subjective points of reference that can vary from reader to reader. So, in essence, the network never really has a stopping point, leaving room for unlimited expansion. While some might view literary references as cyclical or merely inside jokes, they are markers for future generations and points of contact for forgotten, yet beautiful works of art and literature. The project of poetry is to communicate shared human experience which include sexuality, gender, love and heartbreak, and through the form of network, we can map those endless connections to the human spirit.

Works Cited

Carson, Anne. *The Beauty of the Husband: A Fictional Essay in 29 Tangos*. Alfred A. Knopf, 2001.

Chabon, Michael. *Maps and Legends: Reading and Writing Along the Borderlands*. United Kingdom, Open Road Media, 2011.

Hayes, Terrance. *American Sonnets for My Past and Future Assassin*. Penguin Books, 2018.

Levine, Caroline. *Forms: Whole, Rhythm, Hierarchy, Network*. Princeton University Press, 2015.

Phillips, Carl. *My Trade is Mystery: Seven Meditations from a Life in Writing*. Yale University Press, 2022.

Dependency in Romantic Relationships: Bloom's Other in *Ulysses*

Lydia Smaciarz

Project Mentor(s): Christopher Schedler

Department of English, Central Washington University

Abstract: James Joyce's *Ulysses* explores themes of love, grief, religion, culture, and identity while following the journey of Leopold Bloom, a husband and father who has a problematic sense of Self. Bloom's difficulty to find himself is prominently shown through his relationship with his wife, Molly, with whom he no longer has a healthy romantic relationship. Bloom reminisces on several memories with Molly which expose the reason for his lack of Self – his dependence on Molly. This presentation applies Jacques Lacan's concept of "The Mirror Stage" to Bloom's nostalgic memories of Molly in *Ulysses*. "The Mirror Stage" addresses the Self, the Other, and the Self's dependence on the Other to establish one's own being. In this case, Molly is Bloom's Other, and therefore, he relies on her for a whole sense of Self. The nostalgic episodes that Bloom has throughout the novel are not an escape to a more pleasurable time in his life, but rather a longing for a time where he had a firm sense of Self due to the conscious gaze of the Other, Molly. By the end of the novel Bloom has begun to detach himself from Molly and consequently regain a whole sense of Self without her consistent gaze. Exploring Molly as Bloom's mirror emphasizes that self-identity becomes problematic when there is excessive dependency in a romantic relationship.

Keywords: Psychoanalysis, Literary Criticism, Identity, Relationships

Introduction

Ralph Harper suggests "nostalgia is an inescapable part of the human condition; it is a desire to come into presence or being" (Smith 514). This definition can be used to describe nostalgic episodes of protagonist Leopold Bloom who lacks a sense of Self throughout James Joyce's *Ulysses*. Since the tragic death of his son, Rudy, Bloom has experienced a rough patch in

his relationship with his wife, Molly. He knows that his wife will have an affair with a man named Boylan soon and reacts by nostalgically reminiscing on times when their relationship was healthy, and therefore, he was “Happy” (Joyce 128). Bloom appears to long not only for the romantic relationship he once had with Molly, but also for the sense of Self he now lacks. After his nostalgic episodes, Bloom has a melancholic realization of his broken identity when he states, “Me. And me now” (Joyce 144). This recognition instills motivation in Bloom, allowing him to begin the process of re-establishing a firm sense of Self that avoids dependence on the Other. Until this realization, Bloom was dependent on Molly to establish his identity, yet his sense of wholeness only in the gaze of Molly was a misrecognition. Using Jacques Lacan’s concept of the mirror stage, I will argue that Bloom’s nostalgic episodes in “Lestrygonians” are not merely a visitation to a more pleasurable time in his life, but a longing for a time where he had a firm sense of Self due to the conscious gaze of the Other, Molly; only by separating his identity from Molly does Bloom begin to feel whole again.

Lacan’s Mirror Stage

Lacan’s psychological concept of “The Mirror Stage” involves the Self, the Other, and the dependence on the Other to establish one’s own being. This concept addresses that, “our image, which is equal to ourselves, is mediated by the gaze of the other... We are at once dependent on the other as the guarantor of our own existence” (Mambrol). According to Lacan, the mirror stage occurs at the age of 6-18 months when a child sees itself in a reflection. This recognition allows the child to separate its autonomy from its mother. The reflection can be seen as Lacan’s description of the “Ideal-I,” specifically defined by Mambrol as, “the stable and autonomous version which the child does not experience in itself and hence yearns to be the other.” The child realizes that before this recognition, its own body was only “bits and pieces”

and therefore, the child does not want to return to the past. The reflection it identifies with is the Other, and there is a reliance on the Other to have a sense of being, sense of Self, and sense of identity.

From this point forward, the Self has a reliance on the Other to form its identity. Upon recognition of the reflection, the ego (the part of the psyche between the id and the superego) takes form and “is based on an illusory image of wholeness and mastery” (Mambrol). The id, ego, and superego are the three structural parts of the psyche in accordance with Sigmund Freud’s psychoanalytic personality theory. The id is an unconscious part of the psyche that “responds directly and immediately to basic urges, needs, and desires” (McLeod). The psyche is entirely id in a newborn, which is why the ego must be formed with the development of the Self. In contrast to the id’s impulsiveness, the ego is entirely rational. The ego is the mediator of “the instinctual desires of the id and the moral constraints of the superego, operating primarily at the conscious level” (McLeod). Ideally, the ego is socially acceptable and works to present the desires of the id and the constraints of the superego in an appropriate way. Finally, the superego is the unconscious moral part of the psyche. There are two parts of the superego: the conscious and the ego-ideal (or ideal self). The conscious “can punish the ego by causing feelings of guilt” while the ideal self “is an imaginary picture of how you ought to be” (McLeod). Understanding the function of the ego in relation to the other parts of the psyche enhances Lacan’s idea that the ego’s function is “one of *mis-recognition*; of refusing to accept the truth of fragmentation and alienation” (Mambrol). The ego is formed out of an imaginary identity, which produces conflict with one’s sense of Self.

Lacan emphasizes the alienation that accompanies this sense of Self due to the Self having a realization that its own being is reliant on an Other. Alienation in Lacanian terms is a

lack of self or identity in one's own being. Eventually, the Self understands that it will never be complete because it will never embody the Other; until then, the Self is seeking truth through a misrecognition or illusion. Further, Lacan implies "our image, which is equal to ourselves, is mediated by the gaze of the other. The other, then, becomes the guarantor of ourselves" (Mambrol). Lacan's ideas about alienation and reliance on "the gaze of the other" which surround the mirror stage will be key components to identifying Molly as Bloom's Other, and therefore, the illusory foundation for his sense of Self.

Molly as Bloom's Mirror

In *Ulysses*, Molly can be seen as a representation of this mirror image because of Bloom's dependence on her to complete his identity. Bloom is continuously returning to the past when he was in Molly's gaze; specifically, at the peak of their relationship when Bloom received full attention from Molly. After experiencing Molly's gaze, he does not want to return to "bits and pieces," as he was before Molly; the Bloom who did not know of the gaze of the Other. Once he was in her gaze, Bloom felt a sense of Self. As he begins to fall out of her gaze, he again feels himself becoming "bits and pieces." Therefore, when he feels that he might be returning to the Self he was before Molly, a time when he was not in her gaze, he uses nostalgia to regain a sense of Self – the Self he was when they were at their relationship's peak. For example, in "Lestrygonians" Bloom begins to obsess over a moment where he, Boylan, and Molly were walking by the Tolka: "She was humming...He other side of her. Elbow, arm. He. Glowworm's la-amp is gleaming, love. Touch. Fingers. Asking. Answer. Yes. Stop. Stop. If it was it was. Must. Mr Bloom, quickbreathing, slower walking passed Adam court" (Joyce 137). Remembering this moment is affecting him negatively, which is why he must tell himself to stop and essentially attempts to hush the thought. Bloom's fuller sentences become fractions of a sentence until he

loses control over the narrative completely thus signifying his lack of composure and wholeness of self. The narrative switch from first to third person in this moment emphasizes his lack of control over who he is in the present. Once he composes himself and regains control over the narrative, Bloom recalls, “I was happier then” referring to when he and Molly were young (Joyce 137). This moment emphasizes how Bloom escapes present moments, when he is less sure of himself, by returning to the past, when he and Molly were at a more pleasant time of their relationship. Devlin states, “Bloom’s unconscious fantasies reveal this elided gaze, his repressed and even denied enthrallment to an imaginary but ever-present other” (884). In my argument, Molly is not imaginary, but perhaps the image that Bloom creates of her is. When he feels alienated, or confused, he returns to a time where he felt more secure in his identity due to the attention he received from Molly even though he is being reliant on only an illusion of his Self.

Nostalgia and Longing for a Lost Sense of Self

Nostalgia is a key component to Bloom’s current state of Self because he relies on nostalgic episodes to regain his understanding of what he believes to be a truer self. Nostalgia has numerous definitions; therefore, when I refer to nostalgia, I will be referring to a longing for the sense of Self and identity one has in a previous time in life. We can put this definition into context with Bloom and his complications with identity to uncover the truth about his relationship with Molly. Wilson says nostalgia occurs, “perhaps, to rediscover a former self (a self that seemed more like the ‘true self,’ for instance)” (299). Bloom discovers certain truths about his Self, or “former self,” through nostalgic and post-nostalgic reflections. Although Bloom does use nostalgia to reminisce on a happy period of his life, his main goal is to rediscover his past Self which appeared more secure and in control due to its relation to the Other. Wilson also addresses a definition of nostalgia from Dacis explaining, “nostalgia is one of

the means...we employ in the never ending work of constructing, maintaining, and reconstructing our identities” (301). Bloom is attempting to maintain a previous identity and consequently reconstruct the identity that has been deconstructing for the past 11 years (since the death of Rudy).

Bloom begins the “Lestrygonians” chapter of *Ulysses* reminiscing about a time when he went to the kitchen to retrieve raisins for Molly. Bloom recalls, “Night I went down to the pantry in the kitchen...What was it she wanted? The Malaga raisins. Thinking of Spain. Before Rudy was born” (Joyce 124). Bloom states that this memory was before Rudy. After Bloom and Molly lost Rudy, their relationship began to weaken. Therefore, all of Bloom’s happy memories will be before Rudy because that was when he and Molly still had a happy and healthy relationship. Wilson explains, “While one’s nostalgic memories may connote a pleasant or good time in the past, the fact that the individual is removed from that ideal situation can trigger sadness and a sense of loss” (297). The ideal situation to Bloom includes his servitude for Molly by retrieving what “she wanted.” Being a servant to Molly provokes her attention towards Bloom, and possibly even her appraisal, which would put him in her gaze. In upcoming nostalgic episodes, Bloom will enter a melancholic state due to this ‘sense of loss’ regarding Molly’s attention.

Bloom’s next nostalgic episode in the chapter is when his daughter, Milly, was young, and Molly appears to be pregnant with Rudy. Bloom states, “Never put a dress on her back like it. Fitted her like a glove...Just beginning to plump it out well...Happy. Happier then” (Joyce 127-128). In this episode, Bloom is using nostalgia to return to a happier time which implies his lack of happiness in the present. Smith explains, “I can’t be nostalgic for something I still have, a time I still inhabit, or a place easily accessible to me” (508). This would mean that Bloom is nostalgic for happiness and a healthy relationship because it is something he now lacks.

However, perhaps Bloom's use of "Happy" signifies how he feels in the present moment as he indulges himself in past pleasures. He is realizing he is happy now, as he reminisces on a past Self and begins to recognize his flaw: relying on Molly. Although he can be happy now, he was still "happier then" (when he was in the dark and simply reliant on a misrecognition of himself in the image of the Other). Bloom repeats that he was happy again: "Sitting there after till near two taking out her hairpins. Milly tucked up in beddyhouse. Happy. Happy" (Joyce 128). These post-nostalgic reflections put an emphasis on his happiness and desire to return to their relationship before Rudy. While having a happy and healthy marriage is important, Bloom is dependent on Molly for more; he was "happier then" because he did not understand how Molly was an illusion that made him feel whole.

Some critics recognize Milly as a double of Molly, which would explain why he alludes to Milly in the last nostalgic episode. Milly is not actively present in the novel but appears through reflections and letters. When viewing Milly as a double of Molly, we can see Milly as another Other of Bloom. Ben-Merre argues:

Milly responds to Bloom's ecstatic vision of her in 'Circe' as a young [Molly] with the recognition, 'It's Papli! But. O Papli, how old you've grown' (*U* 542). In Milly's resemblance to the young Molly, Bloom is confronted with the disparity between the promise of his youth and the kind of life he has created for himself. (440)

Because Milly is presented as a "young Molly," she could also act as a mirror for Bloom; recognition from Milly could be as important as recognition from Molly. Unfortunately for Bloom, throughout the novel he barely receives a gaze from either woman. Simply looking at Milly is a way for Bloom to travel back to a time when he is connected to his past self. Bruns says, "Imagine a mirror that does not tell you what you look like but what you are (or were)"

(574). This is the kind of mirror that Milly, and Molly, are for Bloom. Specifically in the excerpt from the “Circe” chapter Bruns presents, Bloom’s feelings of nostalgia are seemingly short-lived considering how blunt Milly is with him, reminding him of his “old” age in the present. Milly being a resemblance of Molly reminds Bloom of who he was when he was young, and consequently how he has changed since then. As a double of Molly, Milly is unable to bring back the entirety of Bloom’s past self; she can only remind him of who he used to be, and who he is now.

At this point in “Lestrygonians” it appears obvious that Bloom believes he was happier before he and Molly lost Rudy. However, he contradicts these feelings when he states:

I was happier then. Or was that I? Or am I now I?...When we left Lombard street west something changed. Could never like it again after Rudy. Can’t bring back time. Like holding water in your hand. Would you go back to then? Just beginning then. Would you? Are you not happy in your home you poor little naughty boy? (Joyce 137)

This is a reiteration of the past two episodes, with Bloom claiming he is happier while also acknowledging that their relationship has changed since the loss of their son. The way Bloom questions his happiness in the past and present emphasizes the confusion that accompanies nostalgia, making it hard for one to regain a former self when relying on memory. Additionally, Bloom begins to ask himself if he would return to this former state if given the chance. Gallop explains, “In ‘The Mirror Stage’ Lacan writes that ‘this development is lived like a temporal dialectic that decisively projects the formation of the individual into history’...[implying] a natural progression, a succession of present moments or past moments” (122). Lacan’s concept emphasizes the complexity of the formation of self and the dependence on past experiences, present moments, and anticipated futures. By returning to the past, Bloom considers the

happiness that he had in the moment but can also see that it was the beginning of the end of he and Molly's healthy relationship ("Just beginning then"). Therefore, he cannot return to the past because if he did, he would not be able to reach the same amount of happiness with the knowledge he has about the present. Instead, Bloom must accept that he has changed as an individual and cannot embody the person he once was.

Additionally, Bloom's use of 'I' in his contradictions can correlate to Lacan's 'Ideal-I.' Lacan explains the 'Ideal-I' as "the rootstock of secondary identifications" (95). Bloom is questioning who 'I' is and therefore who he is. Bloom is recognizing how he uncovered this 'Ideal-I' in the past. He understands that he lacks a fuller sense of Self which is why he is struggling to maintain his identity in the present. Wilson presents Aden's idea that "nostalgia indicated individuals' desire to regain some control over their lives in an uncertain time" (301). Bloom is not only uncertain about his relationship with Molly and how the affair with Boylan will conclude, but also who he is as an individual. Bloom's return to the time where he was in correspondence with his 'Ideal-I' uncovers the uncertainty he has with his present sense of Self.

Howth Head: Eyes, Flowers, and Submission

In the last nostalgic episode of "Lestrygonians", where Bloom and Molly share a seedcake on Howth Head, Bloom exposes his dependence on the gaze of Molly (the Other). Bloom states, "her hand touched me, caressed: her eyes upon me did not turn away" (Joyce 144). Bloom wants to remember when Molly saw him because he is dependent on being noticed by the Other. Devlin explains, "Bloom is very much concerned with what the other thinks of him, with how the other sees him" (884). Bloom needs to be seen by the Other to feel accepted and fulfilled as an individual; his emphasis that she "did not turn away" proves that he wants her full and undivided attention. Molly is Bloom's Other because when he is seen by her, he is happiest

and most complete. In the present, Molly abandons Bloom, leaving him to reminisce on his more complete former self when her eyes were upon him.

Bloom draws attention to Molly's eyes once more during the same memory, but this time offers himself to them. Bloom remembers, "Flowers her eyes were, take me, willing eyes" (Joyce 144). Here Molly's eyes can be seen as a literal mirror, reflecting the flowers in the scenery around them. Molly's eyes could also be considered as a reflection of Bloom himself due to his constant association with flowers throughout the novel and specifically in "Lotus Eaters." As if the name "Bloom" is not associated with flowers enough, in "Lotus Eaters," floral themes are prevalent as Bloom writes under the pseudonym "Henry Flower." Saldivar argues, "This proxy flower represents a nonexistent figure, for Bloom, even his own *persona*, is always someone other than himself: cuckolded husband of Molly, usurped protector of Milly, dupe of Dublin's Irish citizenry, son-seeking father of Rudy" (399). Bloom's alter-ego of Henry Flower emphasizes his lack of self in the present moment; he can see himself as anyone other than Leopold Bloom. Additionally, "Lotus Eaters" concludes with Bloom seeing himself as a flower in the tub, "a languid floating flower" (Joyce 71). If Bloom can see himself as a flower, perhaps he is literally describing seeing himself in Molly's eyes, which is why he attempts to convince the eyes to take him. It appears that this exact moment on Howth Heath is when Bloom initially identifies himself with Molly. Mambrol explains, "the infant *identifies* with this mirror image. The image is him/herself." Bloom's description of Molly's eyes is not a description of her, but a description of who he is through her gaze.

Bloom begging the mirrors (Molly's eyes) to take him is his attempt at embodying the Other which is impossible since the Other is a mis-recognition of his Self. Bruns explains the relationship between Joyce and the mirror: "In Joyce's fiction, the mirror produces a mis-

resemblance that nevertheless attaches itself to the original...call it a near-self, someone else whom you were or could have been...or someone you might yet become or perhaps are destined but will fail to be” (576). Bloom has attached himself to the ‘near-self’ he sees in Molly. However, this self is a mis-resemblance, or as Lacan says, an instance of “méconnaissance.” Although Bloom does not realize this yet, he is attached to a misrecognition of his Self that he saw in the Other years ago. This misrecognition has followed him since the initial point of contact where he saw what he thought was his full sense of Self but was really an Other. Bloom has yet to realize how the self he sees is an illusion. Bloom wants to embody the Other but has not yet realized that it would be impossible. However, Bloom will eventually realize the Other is a mis-recognition and therefore avoid continuous failure of achieving the impossible.

In Bloom’s reflection on this shared moment with Molly, he described the memory in passives, emphasizing his submissiveness to Molly. Bloom recalls, “her hand touched me...Softly she gave me in my mouth the seedcake...She kissed me. I was kissed” (Joyce 144). Bloom describes this moment in a passive state, making himself the receiver of Molly’s touch and kiss. Clearly, he is gaining a sense of self from the Other simply by being a receiver of her affection. During this point of their relationship, Bloom was receiving some attention from Molly. Now, in the present, their relationship is the opposite, and Molly is constantly on the receiving end of Bloom’s attention and service. This is emphasized throughout the novel as Bloom thinks about buying her birthday presents, a new book, lotion, and whatever else he thinks she might enjoy. For example, in “Sirens” Bloom is still considering Molly’s birthday present even after thinking about how her affair is approaching shortly: “At four, she said. Time ever passing...The violet silk petticoats” (Joyce 214). Even when their relationship is at its worst, Bloom is thinking about how he can serve Molly. He attempts to erase current issues by

either revisiting the past or worrying about the future (like Molly's birthday which is months away). Further, the first time we meet Bloom in the novel he is acting as a servant to Molly:

On quietly creaky boots he went up the staircase to the hall, paused by the bedroom door. She might like something tasty. Thin bread and butter she likes in the morning...He said softly in the bare hall: I'm going round the corner. Be back in a minute. And when he had heard his voice say it he added: You don't want anything for breakfast? A sleepy soft grunt answered: Mn. (Joyce 46)

Without any context behind who Molly is, this passage could be read as a conversation between a master and servant. Bloom is noting what she usually likes to eat in the morning, checking in with her in a soft way not to wake her, and receiving a very brief response. Even as a servant Bloom is unable to receive anything more than a "soft grunt" from Molly. Perhaps this is why he chooses to use passives as he describes their moment on Howth Head; Bloom desires Molly's attention which he once had. Additionally, as seen in his description of retrieving the Malaga raisins for her, Bloom has always acted as a servant to Molly. At one point, Bloom and Molly's master-servant relationship was enough to keep her attention on him. Now, she has lost interest in their usual dynamic, one way or another, and his servitude is no longer enough to gain her recognition.

Bloom's Hidden Desire for Recognition

Bloom wants to understand how the Other sees him, which would explain his dependence on Molly to complete his identity. Devlin states that he "is preoccupied with the eye of the other, wondering at lunch hour, when he sees a man wolfing down food in the Burton, 'Am I like that? See ourselves as others see us'" (882). A similar instance occurs in "Nausicaa" when Bloom sees a man walking down the beach. As he observes the man Bloom considers, "Walk after him now

make him awkward...Still you learn something. See ourselves as others see us" (Joyce 307).

Ultimately, Bloom is describing what he learns from seeing himself as an Other sees him.

Although he is hyperaware of how the Other views him, he eventually becomes less dependent, or less preoccupied, on this view to establish his identity. Rather than viewing himself as only whole if seen through the eyes of the Other, Bloom will come to recognize that this gaze is not a necessity to mediate his own existence.

Bloom's desire to receive recognition is evident in "Circe" where Bloom's unconscious and conscious fears and desires are revealed. Bloom imagines himself as what appears to be a king, and the voices of the crowd say:

A BLACKSMITH: (*Murmurs.*) For the honour of God! And is that Bloom? He scarcely looks thirtyone.

A PAVIOR AND FLAGGER: That's the famous Bloom now, the world's greatest reformer. Hats off!

(*All uncover their heads. Women whisper eagerly.*)

A MILLIONAIRESS: (*Richly.*) Isn't he simply wonderful?

A NOBLEWOMAN: (*Nobly.*) All that man has seen!

A FEMINIST: (*Masculinely.*) And done!

A BELLHANGER: A classic face! He has the forehead of a thinker (Joyce 392-3).

To start, the blacksmith emphasizes Bloom's youthful appearance, which contradicts Milly's statement in the same chapter ("How old you've grown"). These comments allude to unresolved internal issues about time passing and the changes that have accompanied age. The blacksmith's comment is followed by a showering of compliments and praise, where Bloom is described as a "reformer" and "thinker." These terms could easily be applied to a person who is working to

reform, or re-structure, their Self. Additionally, the comments “All that man has seen...And done” signify that he has been through enough to begin to make changes. His past defines who he is now, and he must decide whether he wants to dwell on who he once was or use the past to enhance his sense of self in the present. Lamson explains, “Bloom’s heroism becomes apparent as he begins to excavate his unconscious wishes and desires, and in doing so rescues his lost self from a future of self-defeating stasis” (255). Bringing his desires of praise and acknowledgement to the surface allows Bloom to recognize that he can be there for himself. He does not need Molly’s illusory gaze to inform his understanding of himself because he already knows what he has seen, done, and accomplished individually.

Role Reversal and Bloom’s Emerging Independence

By the end of the novel, Bloom makes the decision to be on the receiving end rather than act as a servant, implying a change of routine and his re-established Self. If his goal was to spike Molly’s interest, he achieved it. Molly says in “Penelope,” “Yes because he never did a thing like that before as ask to get his breakfast in bed with a couple of eggs since the City Arms hotel when he used to be pretending to be laid up” (Joyce 608). Molly acknowledges that the usual roles are being reversed. Bloom is always seen serving Molly, and he realizes he should start being served. Molly exposes how the last time Bloom was requesting service, he was acting “laid up,” which signifies how desperate for attention he must have been. Now, he is completely open in his request and does not appear as timid. Perhaps Molly’s statement in the novel’s conclusion alludes to Bloom’s re-established sense of Self, and therefore, his emerging independence.

Although Molly’s realization of Bloom’s shift is evident in “Penelope,” Bloom’s journey of self-mastery begins in chapters prior. Gallop explains, “the self which must be mastered is the product of an anticipatory illusion. To ‘master’ the self, to understand it, would be to realize its

falsity, and therefore the impossibility of coinciding with one's self" (Gallop 123). Bloom's unmistakable self-discovery, or self-mastery, in the novel is his recognition that the Other is not his true-self, but an illusion. Bloom grapples with who he is in "Nausicaa" when he writes in the sand "I. AM. A." but ultimately decides "No room. Let it go" (Joyce 312). The text explains, "Mr. Bloom effaced the letters with his slow boot" (Joyce 312). When viewing this scene as an attempt to define who he is, clearly Bloom is struggling with how he identifies himself as an individual. This struggle emphasizes that he is working to find himself on his own instead of resorting to who he is according to the Other. His effacement of the letters can signify an effacement of the person he defined himself as before realizing the illusion his identity became dependent on.

Depending on the Other to create his identity would have resulted in Bloom's completion of the sentence; however, because Bloom is attempting to address the Other as illusory, he must re-structure who he is independently. Gallop explains, "The mirror stage is thus high tragedy: a brief moment of doomed glory, a paradise lost. The infant is 'decisively projected' out of this joy into the anxious defensiveness of 'history,' much as Adam and Eve are expelled from paradise into the world" (123). Discovering that the Other is not going to be a solution to one's lack of identity is easily graspable and can be tragic. Bloom must attempt to deal with the knowledge that he cannot depend on Molly to establish himself and instead must use what he knows to enhance his identity apart from her. Part of the reason Bloom accepts that Molly is merely an illusion of his Self is because he has a lack of control over her and what she does. In "Sirens" Bloom considers, "Too late. She longed to go. That's why. Woman. As easy stop the sea. Yes: all is lost" (Joyce 244). Bloom decides that Molly made her decision, and it would be easier to stop the sea than stop her from having an affair. He cannot control what she does; he can only control

what he does independently. He could choose to identify with this lack of control and have a lack of control over himself, or he can take this knowledge and use it to understand that he is an individual apart from the Other.

One other instance where this re-structuring of the Self appears in the novel is in “Eumaeus” when Bloom is referred to as different variations of his name. Throughout this chapter Bloom is referred to as L. Boom, Mr B., Mr B, Mr Bloom, Bloom, and Boom. Bloom is incorrectly referred to as L. Boom in the list of names provided of those in attendance at Patrick Dignam’s funeral. After this misspelling, the text refers to him as Boom “to give him for the nonce of his new misnomer” (Joyce 529). The re-structuring of his name could correlate with his re-structuring of his self. It is not coincidental that the name L. Boom includes the same letters of “Bloom” just in another order. Despite his numerous misnomers in this chapter, “Eumaeus” ends by referring to Bloom as “Bloom” (Joyce 543). This is a similar journey that Bloom has in discovering himself. He starts and ends as Bloom, but in between he reaches gray areas where he is not entirely sure who he is; these are the moments where he is attempting to re-structure his identity after realizing he was forming it on an illusion.

Finally, I want to revisit Bloom’s post-nostalgic reflection where he states, “she kissed me. Me. And me now” (Joyce 144). This is a comparison of Bloom’s past and current Self. This statement can be interpreted in countless ways. Bloom could be sad that he has not embodied the version of his Self he saw in the Other. Maybe he is simply examining the changes that have occurred in his Self since then. Perhaps he is beginning a new period of his life where he re-establishes his Self and is no longer dependent on an Other. If you favor a more depressing theory, perhaps you could imagine Bloom years down the line, replaying the same nostalgic episodes in hope to regain his ‘former self’ never fully accepting that the Other is a

misrecognition, a falsity, and therefore, incapable of establishing himself as an individual independent from Molly, the mirror. Personally, I favor the theory that Bloom is re-establishing his Self in the present, and therefore, detaching from his dependence on the Other.

Conclusion

In conclusion, Joyce's *Ulysses* describes the journey of a protagonist who is struggling with his sense of Self after realizing that he has been reliant on an illusory image to form his identity. Although Bloom's relationship with his wife brings a multitude of hardship and heartbreak, without their break of routine he may have continued to rely on her in an unhealthy manner. Being forced to look at Molly through another perspective gives Bloom the opportunity to re-structure himself and his identity apart from her. Bloom's nostalgic reflections in "Lestrygonians" emphasize his acknowledgement of the impossibility of embodying the Other. Bloom's recognition of Molly as the Other, rather than as his Self, follows him throughout the rest of the novel, which concludes with Bloom's decision to assert more independence in his relationship and rediscover his sense of Self rather than staying in a fixed, dependent mindset.

Works Cited

Ben-Merre, Diana Arbin. "Bloom and Milly: A Portrait of the Father and the 'Jew's Daughter.'" *James Joyce Quarterly*, vol. 18, no. 4, 1981, pp. 439–44. *JSTOR*,

James Joyce Quarterly, vol. 18, no. 4, 1981, pp. 439–44. *JSTOR*,

<http://www.jstor.org/stable/25476392>.

Bruns, Gerald L. "What's in a Mirror: James Joyce's Phenomenology of Perception." *James Joyce Quarterly*, vol. 49, no. 3/4, 2012, pp. 573–88. *JSTOR*,

James Joyce Quarterly, vol. 49, no. 3/4, 2012, pp. 573–88. *JSTOR*,

<http://www.jstor.org/stable/24598622>.

Chrostowska, S. D. "Consumed by Nostalgia?" *SubStance*, vol. 39, no. 2, 2010, pp. 52–70.

JSTOR, <http://www.jstor.org/stable/40801075>.

Devlin, Kimberly J. "'See Ourselves as Others See Us': Joyce's Look at the Eye of the Other."

PMLA, vol. 104, no. 5, 1989, pp. 882–93. *JSTOR*, <https://doi.org/10.2307/462579>.

Gallop, Jane. "Lacan's 'Mirror Stage': Where to Begin." *SubStance*, vol. 11/12, 1982, pp. 118–

28. *JSTOR*, <https://www.jstor.org/stable/3684185>.

Joyce, James. *Ulysses*. Gabler ed., Vintage Books, 1993.

Lacan, Jacques. *Ecrits: The First Complete Edition in English*. New York: W.W. Norton & Co,

2006, pp. 74–81. *University of Pennsylvania*, [https://www.sas.upenn.edu/~cavitch/pdf-](https://www.sas.upenn.edu/~cavitch/pdf-library/Lacan%20Mirror%20Stage.pdf)

[library/Lacan%20Mirror%20Stage.pdf](https://www.sas.upenn.edu/~cavitch/pdf-library/Lacan%20Mirror%20Stage.pdf).

Lamson, Brandon. "Orpheus Descending: Images of Psychic Descent in 'Hades' and 'Circe.'" *Joyce Studies Annual*, 2010, pp. 255–62. *JSTOR*, <http://www.jstor.org/stable/26288763>.

Joyce Studies Annual, 2010, pp. 255–62. *JSTOR*, <http://www.jstor.org/stable/26288763>.

Mambrol, Nasrullah. "Lacan's Concept of Mirror Stage." *Literary Theory and Criticism*, 22 Apr.

2016, <https://literariness.org/2016/04/22/lacans-concept-of-mirror-stage/>. Accessed 11

Nov. 2024.

McLeod, Saul. "Id, Ego, & Superego: Freud & Examples." *Simply Psychology*, 25 Jan. 2024, www.simplypsychology.org/psyche.html. Accessed 5 Dec. 2024.

Saldívar, Ramón. "Bloom's Metaphors and the Language of Flowers." *James Joyce Quarterly*, vol. 20, no. 4, 1983, pp. 399–410. *JSTOR*, <http://www.jstor.org/stable/25476540>.

Smith, Kimberly K. "Mere Nostalgia: Notes on a Progressive Paratheory." *Rhetoric and Public Affairs*, vol. 3, no. 4, 2000, pp. 505–27. *JSTOR*, <http://www.jstor.org/stable/41939629>.

Wilson, Janelle L. "'REMEMBER WHEN...': A Consideration of the Concept of Nostalgia." *ETC: A Review of General Semantics*, vol. 56, no. 3, 1999, pp. 296–304. *JSTOR*, <http://www.jstor.org/stable/42705763>.

History

The Battle of Moscow 1941

Allen McQuade

Project Mentor(s): Melissa Jordine

Department of History, Central Washington University

Abstract: The German Army was diminished after the string of unbroken victories at the start of Operation Barbarossa. The loss of men and machines had become undeniable, and it sapped the offensive strength of their order of battle. The supply lines were at a breaking point and the underdeveloped road and rail system in Russia further exacerbated the problem. The diversion of strength to encircle and capture Kiev cost the Germans precious time before they could restart the offensive. The weather hindered the movement of men and machines and despite the protests of the commanding generals to high command, they were told to press on. The Russians faced the most mobile, technologically advanced army in the world. They were able to survive long enough to learn the lessons necessary to defeat the German strategy in the Battle of Moscow. It was steadfast leadership of Zhukov and his innovative tactics along with the unwavering Soviet civilian and soldier and their sacrifice that ultimately led the Red Army to victory. The Soviet Army was helped by the defense to the last man of many units, and gained the time necessary to complete defensive fortifications around Moscow. This also gave the Russians time to organize new reserve armies and to produce the much-needed equipment to turn to the offensive.

Keywords: World War Two, Operation Barbarossa, Operation Typhoon, Eastern Front, Nazi, Soviet, Wehrmacht

Operation Barbarossa, the German invasion of Russia, began on June 22, 1941. The German invasion achieved tactical and strategic surprise on an unsuspecting and unprepared Russian Army. Joseph Stalin failed to recognize the threat of a German invasion despite

warnings of the impending attack and refused to enhance defensive positions along the border prior to the invasion. Upon being informed of the invasion, he reportedly isolated himself and was unable to effectively lead initially. Relations between Nazi Germany and Soviet Russia had been simmering since the signing of the Molotov-Ribbentrop Pact, a non-aggression agreement signed in August 1939. The Pact included a provision to partition Poland and other parts of eastern Europe between Germany and the Soviet Union. In essence, this temporary pact made Russia and Germany allies, but with a mutual understanding that the alliance would not hold indefinitely. Stalin did not anticipate hostilities with Germany would come as soon as they did.

The German invasion force consisted of three army groups, 3.8 million men, along a 1900-mile front. Army Group North moved towards Leningrad; Army Group South advanced towards Kiev and the Crimean Peninsula; and Army Group Center progressed towards Minsk and Moscow. The Russian armies near the border were quickly encircled and defeated, allowing the Nazi invasion forces to advance virtually unchecked for hundreds of miles. There were strong isolated defenses that slowed the advance and cost Germany valuable time, but the German onslaught progressed through September 1941. Army Group North was eventually stopped at the gates of Leningrad and the long logistical lines slowed the advance in the south. The German army reorganized and reequipped in September 1941 for its final push towards Moscow. A Russian counterattack stopped the German operation within sight of Moscow and then pushed the Germans back over a hundred miles west. The German invasion of Russia culminated in September 1941 in the Battle of Moscow. The struggle between opposing political extremes and involving millions of men, resulted in Soviet Russia's first major victory. The victory was achieved by both German operational and logistical weaknesses and Soviet strengths in reserves and equipment along with careful planning.

German strength was greatly reduced by September 1941 and this resulted in operational and logistical vulnerability. Army Group Center, commanded by Field Marshall Fedor Von Bock, started Operation Barbarossa with fifty divisions, including nine Panzer divisions and six motorized infantry divisions.²⁹ This number was greatly reduced by September and the start of operations towards Moscow. The drive across Russia had been costly for the German Army. In the battles of Minsk and Smolensk casualties had been high, as was the loss of valuable equipment. Operation Typhoon, the plan to encircle Moscow, began on September 30, 1941, with the Second Panzer Army attacking from the southwest. The plan called for Army Group Center to attack along an over 400-mile front from the Smolensk area toward Moscow. The main focus of the attack was two Panzer armies thrust into a pincer movement to meet east of Moscow. The Panzer armies were commanded by General Hermann Hoth and General Heinz Guderian. The Panzer armies achieved breakthrough quickly in the first two weeks of Typhoon to the north and south of Moscow. The forward momentum was stopped in mid-October by typical Russian rains and the offensive did not restart until November 15. The advance was again rapid until Soviet spoiling attacks against the flanks and center slowed the drive. This further upset the German timetables and made their supply situation dire. The Soviet Army counterattacked on December 6, 1941. The advance of the Panzer armies was ultimately repelled within sight of their objective, but given their limitations it is surprising that the German Army advanced as far as they did.

The continued mounting losses in machines had become undeniable to German leadership. German divisions were operating at a fraction of their operational strength from the start of Barbarossa. Panzer Divisions had on average only thirty-five percent of their former strength, with some divisions having as few as fifteen operational tanks. Mechanized infantry

²⁹Albert Seaton, *The Battle for Moscow 1941-1942* (New York, NY: Stein and Day Publishers, 1971), 40.

divisions operated at sixty percent strength.³⁰ Prior to the invasion Germany lacked vehicles in general, but especially vehicles with four-wheel drive capability and tracked vehicles. The truck situation was more dire; from a starting point of 600,000 trucks for transport only 75,000 remained serviceable.³¹ The German machines suffered from a lack of maintenance and poor road and weather conditions. Too few mobile repair stations and a lack of cording to combat the mud and freezing temperatures all made keeping vehicles operational difficult. These losses also posed a problem for German industrial capacity, because Germany could not replace the machines lost at such a sustained rate. Production was also limited, because Germany had not yet ceased production of consumer goods. These factors led to a dilution of strength by the time of the final push towards Moscow.

German supply lines were at a breaking point by the beginning of Operation Typhoon. There had been many logistical challenges at the start of Operation Barbarossa that were exacerbated the further the German forces advanced into Russia. Germany had several different ammunition types for the various infantry weapons and field guns. For Example, Germany produced two calibers for rifles with three different types of bullets, two different mortar tubes with four different shells, and three different anti-tank guns. In September of 1941 the transport of ammunition equaled 240 trains or over 100,000 tons.³² The space needed to ship ammunition was one logistical concern. Transportation also proved difficult for the German Army. Russian infrastructure was far less developed than German roads and railroads, and Russia used a wider railroad track gauge than Germany. In order to use the existing lines, the Germans either had to

³⁰ David Stahel, *The Battle for Moscow* (Cambridge, U.K.: Cambridge University Press, 2015), 90-91.

³¹ *Ibid.*, 102.

³² Jeff Rutherford and Adrian E. Wettstein, *The German Army on the Eastern Front: An Inner View of the Ostheer's Experiences of War* (Barnsley, U.K.: Pen and Sword Books Limited, 2018), 90-91.

capture Russian locomotives or convert the lines to German gauge. This was a great undertaking by an already stretched support service. After lines were converted and made usable, the issue remained that there were very few lines, and the German Army was stretched across a 1900-mile front. To supply the units in the field, trucks and horse drawn carts were used to move the supplies from railhead to troops at the front. This significantly slowed the movement of supplies and created a new challenge in maintaining fodder for the horses. The limited space on these transports could not accommodate the variety of ammunition, which often led to units receiving bullets and shells for weapons they did not possess or the wrong variety for the task.³³ The ammunition and transport situation strained the German Army as it moved eastward. On the eve of the Battle of Moscow, German units had only days' worth of ammunition on hand as they advanced.³⁴

Constant battle took its toll on the German soldiers physically. The German Army advanced over seven-hundred miles in three months leading up to the Battle of Moscow. Many units had not been able to rest with the continuous advance. By November 1941 the German Army had lost twenty percent of its soldiers, and Army Group Center incurred 90,000 casualties in the first month of Operation Typhoon alone. German units faced a Russian Army of over five million men, the Germans captured hundreds of thousands of Soviet soldiers in the first months of the invasion.³⁵ These forces needed to be engaged and defeated before moving on and given

³³ Ibid., 92-93.

³⁴ Another logistical strain on the Germans was the Holocaust by Bullets being waged by the Wehrmacht and SS against Russian Jews. These horrible atrocities committed had affected ammunition supplies and diverted of manpower during the opening months of the Eastern campaign.

³⁵ Catherine Merridale, *Ivan's War: Life and Death in the Red Army, 1939-1945* (New York, NY: Metropolitan Books, 2006), 118.

the vast distances involved it strained not only the physical strength of the German soldier but affected their offensive striking power.

A diversion of armored strength to capture Kiev cost Army Group Center valuable time in the lead up to Operation Typhoon. Adolf Hitler could not be convinced that Moscow was an immediate objective. The original plan had Leningrad and the grain producing region of Ukraine as primary objectives, with Moscow as a secondary target.³⁶ In keeping with his directives, Hitler ordered the Panzer Groups under General Heinz Guderian from Army Group Center to detach and attack South towards Kiev, putting the advance toward Moscow on hold. The remaining Armies were moved into a defensive posture or limited to modest offensive objectives.³⁷ General Guderian protested the diversion of his tanks but was unsuccessful. Guderian feared that to pursue Ukraine would be consequential for Germany lamenting that, “perhaps even the result of the war as a whole.”³⁸ Hitler had made the decision. Although successful, the encirclement of Kiev, removed the Panzer group, the main offensive weapon, from Army Group Center’s order of battle, which delayed the start of Operation Typhoon. “Whatever Hitler’s reasons, the effect was that the impatient von Bock’s Army Group Center ... lay from July to October motionless and virtually passive only 200 miles from the capital.”³⁹ The new start date was hampered further by Russian weather. Rains in September and mud brought traffic to a halt on already unsuitable Russian roads. Guderian asked, “Was there still sufficient time for this to succeed?”⁴⁰ This

³⁶ H.R. Trevor-Roper, ed. *Blitzkrieg to Defeat: Hitler’s War Directives 1939-1945* (San Francisco, CA: Holt, Rinehart and Winston, 1964), 50.

³⁷ Ibid, 90.

³⁸ Heinz Guderian, *Panzer Leader* (New York, NY: Da Capo Press Inc., 1996), 199.

³⁹ Seaton, *The Battle for Moscow 1941-1942*, 77.

⁴⁰ Ibid, 226.

situation was worsened by the lack of suitable four-wheel drive and tracked vehicles to combat poor road conditions. Again, this cost the German Army valuable time as winter weather approached.

Political pressure to continue the attack led to catastrophic results. The strategic situation was not ideal for an attack, but Hitler and the OKW, German High Command Armed Forces, insisted on offensive action. The generals in the field reported their deficiencies to their superiors, but the high command was unmoved, believing they were one battle away from complete Soviet defeat. General Heinz Guderian, commander of the Second Panzer Army, wondered “whether it still possessed sufficient strength to launch a further attack and thus operationally to exploit its tactical victory.”⁴¹ Panzer divisions were operating with thirty-five percent of their strength from June, with limited combat capability. Supply lines were stretched too thin and reinforcements could not replace losses. During the offensive General Kluge of the Fourth Army was summoned to Hitler to report about Army Group Center’s combat situation. Upon his return he reported back to Army Group Center’s commander Von Bock, “Hitler does not, however, permit himself to believe the written reports from Army Group Center with regard to manpower shortages, supply difficulties, impassible roads, and the like. He is very disturbed that Moscow has not yet fallen and considers it impossible that we could not have foreseen all the contingencies.”⁴² Given these limitations, the expectation remained that the German offensive would continue, until a Russian counterattack brought a halt to all offensive operations. The Germans were overextended militarily and simply advanced their way to defeat.

⁴¹ Guderian, *Panzer Leader*, 242.

⁴² Alfred W. Turney, *Disaster at Moscow: Von Bock’s Campaigns 1941-1942* (Albuquerque, NM: University of New Mexico Press, 1970), 131.

By contrast, Soviet strength in tactics and leadership was building leading to the Battle of Moscow. The Soviet Union entered October 1941 in a precarious position, but it learned its lessons. The Soviets had already lost vast tracts of Soviet territory, resulting in the encirclement of whole armies, and leaving hundreds of thousands captured or killed. Losses totaling over three million people.⁴³ At the height of the crisis Soviet Marshall Georgi Zhukov was placed in overall command of the Western Front. Zhukov had combat experience in Manchuria and Leningrad. He had observed the disastrous early battles of the invasion and took a different tactical approach to fighting the Germans. Learning from previous engagements, Soviet leaders devised a new strategy to deter and defeat the German advance. The Germans used encirclement as their main tactic, consisting of strong Panzer thrusts to the north and south of a target and the eventual meeting of the Panzer groups behind the target. Once the enemy was encircled, they sent in the infantry to destroy the enemy troops. On a linear battle line, the thrusts came from the flanks, where the Germans massed the bulk of their strength, to capitalize on sector superiority and achieve a breakthrough. Zhukov recognized that to stop the advance he needed to disrupt the Panzer Group columns. He moved strength away from the center and placed it on the flanks in the vicinity of a predicted German offensive movement. "In the absence of attacks at the center we were able to shift all our reserves, down to divisional reserves, from the center of the front to parry the enemy's strike forces on the flanks."⁴⁴ This method had first been used in the Battle of Smolensk by the Soviet commander, Konstantin Rokossovsky, which enabled him to hold open a corridor for three Soviet armies to escape.⁴⁵ The task for the Red Army was to stop the pincers

⁴³ Merridale, *Ivan's War*, 118.

⁴⁴ Georgi K. Zhukov, *Marshall Zhukov's Greatest Battles* (New York, NY: Harper and Row, Publishers, 1969), 78.

⁴⁵ Rodric Braithwaite, *Moscow 1941: A City and its People at war* (London, U.K.: Profile Books, 2007). 178.

from closing and encircling them. Once these flanks were secured it allowed the Soviets to move towards a counteroffensive. “The immediate aim of the counteroffensive was to eliminate the two wedges on the northern and southern flanks of our front.”⁴⁶

The delaying tactics used by the Red Army gave them time to strengthen fortifications and slow down German timetables. The Soviet forces had been on the defensive since the invasion began, and once the Soviet leadership realized the German Army’s intent was Moscow, they ordered vast lines of defense to be constructed. The Russian Army needed to hold the German advance long enough for soldiers and civilians to construct massive earth works and tank traps to enhance Soviet defensive positions. In October over 500,000 civilians, mostly women and old men, were mobilized to work on defenses. They dug over sixty miles of antitank ditches and five thousand miles of infantry trenches.⁴⁷ The need to hold back the German advance led to encircled troops to hold until the last man, and new troops being deployed to plug holes in the line. Over 200,000 Muscovites joined Peoples Defense Divisions and were hastily trained and marched to the front lines.⁴⁸ “The most important thing for us in the middle of October was to win time in order to prepare our defense.”⁴⁹ The Russians fought with great tenacity to protect their Motherland in its time of need even though they were inexperienced. “Our soldiers were fully conscious of their potential responsibility for the fate of Moscow, for the fate of their homeland, and were determined to die rather than let the enemy through to

⁴⁶ Zhukov, *Greatest Battles*, 82.

⁴⁷ Paul Carrell, *Hitler moves East 1941-1943* (Boston, MA: Bantam Books, 1963), 147.

⁴⁸ Ibid, 147.

⁴⁹ Zhukov, *Greatest Battles*, 51.

Moscow.”⁵⁰ The supreme effort of both soldiers and civilians was effective in slowing the advance enough to complete the defensive positions near Moscow. Historian Catherine Merridale stated, “The Red Army deserves more credit for stalling the Nazi advance... with nothing left but their pride and despair, some soldiers fought with suicidal courage.”⁵¹

The next move for Stalin and his commanders was to mobilize the vast Soviet population to assemble new reserve armies. Stalin stated on November 6, 1941, on the anniversary of the October Revolution, “There can be no doubt that as a result of four months of war, Germany, whose manpower reserves are already becoming exhausted, has been considerably more weakened by the war than the Soviet Union, whose reserves are only now unfolding to their full extent.”⁵² Stalin, in this instance, was correct. The Soviets had a numerical advantage in population that they were able to exploit in the battle and throughout the war. Troops were hastily trained and marched to assembly points in the Moscow sector. Merridale concluded, “The other heroes were the reserve troops- twelve entire armies- that were brought to the front that October.”⁵³

Along with the deployment of reserve armies, modern Soviet equipment proved decisive in victory of Moscow. The T-34 Russian tank, the most effective tank of the war, started to deploy to the front in significant numbers by late 1941. This tank had heavily sloped armor up to fifty millimeters thick, which made it impervious to most German tanks’ main battle guns. The only German weapon that could consistently knock out T-34’s was the 88mm antiaircraft gun.

⁵⁰ Zhukov, *Greatest Battles*, 78.

⁵¹ Merridale, *Ivan’s War*, 118.

⁵² David Stahel, *The Battle for Moscow* (Cambridge, U.K.: Cambridge University Press, 2015), 82.

⁵³ Merrridale, *Ivan’s War*, 120.

The T-34 had a 76mm main gun that was capable of penetrating all German Panzer models currently on the front. One of the best features of the tank was its simple design and interchangeable parts. Red Army tank crews could assemble at the factory and drive the tank out the doors with little training. They also performed better in cold weather because of their gasoline engine, versus the German tanks, which used diesel fuel. Because of their advantages, only a few T-34's, because of its advantages, could control a battleground, which gave infantry men cover and the ability to take ground.

The German advance was halted within sight of Moscow. Because of their weakened formations, they were vulnerable to counterattack. German General Erhard Raus recalled, "At the beginning of December, 6th Panzer Division stood but fourteen kilometers from Moscow and twenty-four kilometers from the Kremlin. At that moment a sudden drop in temperature to -30 F, coupled with a surprise attack by Siberian troops, smashed Third Panzer Army's drive on Stalin's capital"⁵⁴ The counterattack was made possible by the shifting of forces from the Far East as well as the formation of new armies. Zhukov recalls, "By the beginning of December he [the German Army] was exhausted and out of reserves, while our Western Front was reinforced with two newly formed armies... and a number of other units that had been combined into a third army, the Twentieth."⁵⁵ The reserve armies moved first against the pincers of the German attack, Zhukov recalled, "There it [the German thrust toward the Moscow-Volga Canal] was stopped by advance units of the newly formed First Shock Army.... That was the last attempt of the German Forces to break through to the Soviet capital."⁵⁶

⁵⁴Erhard Raus, *Panzer Operations: The Eastern Front Memoir of General Raus, 1941-1945* (New York, NY: Da Capo Press, Inc., 2005), 90.

⁵⁵Zhukov, *Greatest Battles*, 79.

⁵⁶ Zhukov, *Greatest Battles*, 73.

The Soviet victory in the Battle of Moscow was both attributed to Stalin and in spite of him. Effects of Stalin's policies were felt in military terms at the beginning of the campaign. Military leadership has been decimated in the purges of the 1930's, the forced collectivization of Ukraine and Western Russian lands made many view the Germans as liberators and Stalin's inability to grasp the dire nature of the situation with Germany cost many Russian lives. There were also positive aspects of Stalin's policies. The Five-Year Plan rapidly industrialized the Soviet Union, and it was able to produce its own war materials including the T-34 tank. Stalin effectively evoked nationalist feelings and was able to call upon millions of men to defend the Motherland. Unlike Hitler, Stalin mostly listened to his commanders and could take advice from his experts.

Battles, campaigns and wars are often decided as much by the vanquished and their weakness and mistakes as the victors' strength and ability to overcome adversity, along with an element of luck. The Battle of Moscow is no exception. The German Army was diminished after the string of unbroken victories at the start of Operation Barbarossa. The loss of men and machines had become undeniable, and it sapped the offensive strength of their order of battle. The supply lines were at a breaking point and the underdeveloped road and rail system in Russia further exacerbated the problem. The diversion of strength to encircle and capture Kiev cost the Germans precious time before they could restart the offensive. The weather hindered the movement of men and machines and despite the protests of the commanding generals to high command, they were told to press on. The Russians faced the most mobile, technologically advanced army in the world. They were able to survive long enough to learn the lessons necessary to defeat the German strategy in the Battle of Moscow. It was steadfast leadership of Zhukov and his innovative tactics along with the unwavering Soviet civilian and soldier and their

sacrifice that ultimately led the Red Army to victory. The Soviet Army was helped by the defense to the last man of many units, and gained the time necessary to complete defensive fortifications around Moscow. This also gave the Russians time to organize new reserve armies and to produce the much-needed equipment to turn to the offensive. Ultimately, as Zhukov argued, “The German armies, weakened and worn down by fighting, suffered heavy losses and retreated westward under the pressure of our forces.”⁵⁷ The Battle of Moscow was significant as the first and major turning point of the war in the East. This was the first decisive defeat of the German Army. Germany was never able again to put the number of men and machines into action that were employed at the start of operations Barbarossa or Typhoon. After Moscow, only limited offensives were possible. Most historians point to Stalingrad as the decisive turning point of the war, there is a case to be made that turning point happened outside Moscow in December 1941.

⁵⁷ Zhukov, *Greatest Battles*, 90.

Bibliography

Primary

Guderian, Heinz. *Panzer Leader*. New York, NY: Da Capo Press, Inc., 1996.

Raus, Erhard. *Panzer Operations: The Eastern Front Memoir of General Raus, 1941-1945*. New York, NY: Da Capo Press, Inc., 2005.

Trevor-Roper, H.R., ed. *Blitzkrieg to Defeat: Hitler's War Directives 1939-1945*. San Francisco, CA: Holt, Rinehart and Winston, 1964.

Zhukov, Georgi K. *Marshal Zhukov's Greatest Battles*. New York, NY: Harper and Row, Publishers, 1969.

Secondary

Braithwaite, Rodric. *Moscow 1941: A City and its People at War*. London, U.K.: Profile Books, 2007.

Carel, Paul. *Hitler Moves East 1941-1943*. Boston, MA: Bantam Books, 1963.

Harrisville, David A. *The Virtuous Wehrmacht: Crafting the Myth of the German Soldier on the Eastern Front, 1941-1944*. Ithaca, NY: Cornell University Press, 2021.

Merrridale, Catherine. *Ivan's War: Life and Death in the Red Army, 1939-1945*. New York, NY: Metropolitan Books, 2006.

Rutherford, Jeff and Adrian E. Wettstein. *The German Army on the Eastern Front: An Inner View of the Ostheer's Experience of War*. Barnsley, U.K.: Pen and Sword Books Limited, 2018.

Seaton, Albert. *The Battle for Moscow 1941-1942*. New York, NY: Stein and Day Publishers, 1971.

Stahel, David. *The Battle for Moscow*. Cambridge, U.K.: Cambridge University Press, 2015.

Turney, Alfred W. *Disaster at Moscow: Von Bock's Campaigns 1941-1942*. Albuquerque, NM: University of New Mexico Press, 1970.

Music

CWU Horn Club 2025 Northwest Horn Symposium Performance and Presentation

Julia McConnachie, Ellie Brower, Alec Chinnery, Quentin Chamberlain, Alex Coon, Chone Ewell, Jordyn Gribble, Lucy Jacky, Gabrielle Kosoff, Sadie Papp, Eamon Hill, Lillian Record, Tori Seward, Jaeden Tellvik

Project Mentor(s): Jeffrey Snedeker

Department of Music, Central Washington University

Abstract: The CWU Horn Ensemble will give a performance featuring music for 14 CWU Horn Club members led by director, Dr. Jeffrey Snedeker. This performance represents a concert that the ensemble performed at the Northwest Horn Symposium, a regional professional conference hosted by the Northwest Horn Society in April 2025 in Eugene, Oregon. The invited program includes a varied repertoire that stretches both the individuals and the ensemble as a whole. Our program contrasts with the programs of the past several years, which have focused on standard horn ensemble repertoire and experiences. The repertoire is diverse, but a common thread is that these pieces push the boundaries of what our ensemble can do. The program includes an assortment of Renaissance dance music, which is non-standard repertoire for horn ensemble; two pieces by the ensemble's director, Dr. Snedeker, that incorporate improvisation into a group setting: *Ostinati*, where ensemble members are challenged by improvising as a group, as accompaniment, and as soloists, and *Natural Horns*, a piece written for cow horn, ram horn, kudu horns, and conch shells; and concludes with an arrangement of Abreu's Latin jazz hit *Tico Tico* featuring two student soloists. The CWU Horn Club is grateful to have received grants from OUR and foundry10 to make the conference performance possible. ***Recording of the SOURCE 2025 performance:*** <https://www.youtube.com/watch?v=LkEWPszu9BQ>

Keywords: Music, Performance, History, Improvisation

CWU Horn Club 2025 Northwest Horn Symposium Program

Performed for SOURCE on May 14th, 2025

Suite of Renaissance Dances from *Danserye* (1551)

Tylman Susato
(1510-1570)

* Ronde 18/Sauterelle 22

Danse du roy/Bergerette dont vient cela

+ La morisque/Bergerette sans roch

La Bataille

Ostinati (2008)

Jeffrey Snedeker
(b. 1958)

Natural Horns (2007)

Jeffrey Snedeker

Tico, Tico (1917)

Zaquinho Abreu
(1880-1935)
arr. Roger Harvey

Julia McConnachie, Alec Chinnery, *soloists*

CWU Horn Ensemble

Ellie Brower*, Quentin Chamberlain*, Alec Chinnery[#],
Alex Coon⁺, Chone Ewell*, Jordyn Gribble[#], Eamon Hill[#],
Lucy Jacky⁺, Gabrielle Kosoff[#], Julia McConnachie⁺,
Sadie Papp*, Lillian Record*, Tori Seward[#], Jaeden Tellvik⁺

Dr. Jeffrey Snedeker, *director*

Report on CWU Horn Club trip to 2025 Northwest Horn Symposium, April 25-27

The CWU Horn Ensemble was invited to present a performance (based on proposal acceptance) at the 2025 Northwest Horn Symposium, held April 25-27 at the University of Oregon in Eugene. The program included a varied repertoire with a common thread of pushing the boundaries of what the ensemble can do. The 30-minute program included: an arrangement of music not normally associated with horns, Abreu's popular song *Tico Tico* featuring two student soloists, seniors Julia McConnachie and Alec Chinnery; an assortment of Renaissance dance music; and two pieces incorporating improvisation into a group setting, one of which was composed for cow horn, ram horn, kudu horns, and conch shells.

The ensemble gave a performance as part of a series of concerts alongside world class horn players Kevin Newton (Imani Winds, New York freelancer), Danielle Kuhlmann and John Turman (Seattle Symphony), and the LGBTuben Quintet (professional touring group). Other student and community ensembles included University of Oregon, Washington State University, University of Washington, and Emerald City Horn Choir. These concerts featured a wide range of contemporary repertoire, with a theme of under-represented musical voices. Over 100 students, avocational musicians, professional performers, and teachers attended this symposium, hearing presentations on general technique (e.g., guided warmup by a member of the Oregon Symphony), historical instruments and repertoire (e.g., Jonathan Ring, San Francisco Symphony; Sadie Glass, University of the Pacific; Jeffrey Snedeker, CWU), the horn in jazz (Mike Simpson, Seattle), music of Asian composers (Martin King, WSU), as well as a range of contributing artists from various cities and universities in the Pacific Northwest. There were four competitions and CWU students participated in the Northwest Horn Symposium Solo Competition, with CWU senior Julia McConnachie winning the competition for the second year in a row and freshman

Quentin Chamberlain receiving an Honorable Mention. The symposium program is attached separately. This same program was performed at SOURCE.

This program provided new challenges and educational opportunities through the preparation process for our ensemble members, certainly for those who have been in the ensemble for multiple years, but especially for the newest members (six freshmen). The opportunity to try these ideas out on a larger, regional audience was beneficial in terms of the learning process, the execution of the program, and the student reflection, as well as the visibility on behalf of CWU. The performance was well received, and the program helped the students grow in several non-traditional ways (for French horn players)—learning about musical/structural “roadmaps” in Renaissance dance music, a period of time before horns were included in art music; learning about group improvisation, building on studio experiences, group listening, call and response, etc.; creating performances with non-traditional staging and non-traditional musical instruments (shells, horns, etc.); performing in a jazz/Latin style as a group without percussion instruments. The CWU Horn Club raised all the money necessary to attend, applying for and receiving grants from Student Leadership, Involvement, & Community Engagement (SLICE), CWU Office of Undergraduate Research (Presentation and Experiential Research & Immersive Studies in the Arts Grants), and CWU Music Department Music Education Fund for Excellence, as well as significant fundraising on its own through busking and coffee/donut sales.

A YouTube video recording of the SOURCE performance can be found at the following link: <https://www.youtube.com/watch?v=LkEWPszu9BQ>.

College of Education and Professional Studies

The College of Education and Professional Studies had presentations from the departments of **Curriculum, Supervision, and Educational Leadership; Education, Development, Teaching and Learning; Engineering Technologies, Safety, and Construction; Family and Consumer Sciences; Health Sciences; Information Technology Management; and Sport and Movement Studies** at the 2025 Symposium of University Research and Creative Expression (SOURCE).

This volume of the *Journal of the Symposium of University Research and Creative Expression (SOURCE)* features full length submissions from the following departments and programs:

- Health Sciences
- Information Technology Management

Health Sciences

Prevalence of Diabetes Related to Acculturation, Dietary Quality, and Sedentary Lifestyle in Mexican Americans: National Health and Nutrition Examination Survey 2011 to 2018

Kivima Acevedo

Project Mentor(s): David Gee, PhD; Kathaleen Briggs Early, PhD, RDN, CDCES; Katy Williams, MS, RDN

Department of Health Sciences, Central Washington University

Abstract: Objective: This study examined the prevalence of diabetes in Mexican American adults (MA-adults) and how risk factors like acculturation, dietary quality, and sedentary lifestyle contribute to the rising rates of diabetes, using the National Health and Nutrition Survey (NHANES) 2011 to 2018 data. **Methods:** We analyzed the NHANES data of MA-adults and Non-Hispanic White adults (NHW-adults) ($n = 10670$) for the association of diabetes and its risk factors (dietary habits and sedentary lifestyle) by acculturation levels. Diet quality was assessed using the Healthy Eating Index (HEI). **Results:** MA-adults exhibited substantially higher rates of diabetes (12.8%) compared to NHW-adults (8.75%). Key risk factors contributing to diabetes prevalence included age (60+), body mass index ($BMI \geq 25 \text{ kg/m}^2$), and low educational attainment (high school education or below). Highly acculturated MA-adults had poorer diet quality ($HEI = 50.4$). Low acculturated MA-adults had a higher diabetes prevalence (18.2%) despite having the highest diet score ($HEI = 55.4$). MA-adults had higher diabetes rates at all levels of sedentary lifestyle compared to NHW-adults, particularly those reporting over eight hours of sedentary lifestyle. **Conclusion:** In the fully adjusted model, diabetes risk was primarily explained by age, BMI, and low educational attainment. Acculturation, sedentary lifestyle, and diabetes prevalence among MA-adults showed no significant independent relationship. MA-adults with the least amount of sedentary lifestyle behaviors had the lowest prevalence of diabetes. Low-acculturated MA-adults had the highest Healthy Eating Index (HEI) scores, reflecting better dietary quality compared to their more acculturated counterparts.

Keywords: Mexican American, NHANES, Diabetes, Acculturation

Approximately 38 million Americans have been diagnosed with diabetes, with 90 to 95% of those cases classified as Type 2 diabetes (T2D) (Centers for Disease Control and Prevention [CDC], n.d.-e). When comparing by ethnicity, those of Hispanic origin appear to have a significantly higher prevalence of diagnosed diabetes (13%) than non-Hispanic whites (8%) (Hertz et al., 2006). Among subgroups, Mexican Americans (MAs) are ranked as the third highest ethnic group diagnosed with diabetes.

The rise of T2D is thought to be mainly influenced by factors like physical inactivity, poor eating habits, genetics, and excess body weight. In contrast, T1D is an autoimmune disease that occurs when the body's immune system starts to destroy its beta cells. While T1D is not preventable, both types of diabetes can be managed when a healthy weight is maintained. In 1999 to 2000, 30.5% of the population was classified as having obesity (CDC, n.d.-c), and as of March 2017 to 2020, the obesity rate had risen to 41.9%. Among specific racial and ethnic groups, non-Hispanic Black adults had the highest obesity rates at 49.9%, followed by Hispanic adults at 45.6% (CDC, n.d.-c). These rising rates of obesity among the MA population, are concerning, as obesity can worsen diabetes symptoms and increase the risk of related health complications.

Acculturation

In addition to obesity being a contributing factor to the elevated prevalence of diabetes among MA, acculturation might also significantly influence these rates. Acculturation is defined as “a merging of cultures as a result of prolonged contact ” (Merriam-Webster, n.d.). Upon immigrating to the U.S., many individuals begin to adopt Western eating patterns, often abandoning traditional eating habits. This shift in lifestyle is frequently identified as a potential

factor in the disproportionately higher rates of prediabetes and diabetes observed among MAs compared to NHW-adults.

The relationship between acculturation and obesity is unclear. One study using the analysis of the National Health and Nutrition Examination Survey (NHANES) data (1999 -2008) revealed that the lower level of acculturation among MA was associated with a higher prevalence of prediabetes and overweight status (Garcia et al., 2012). In contrast, another study examining a small population in Sacramento, California, found an inverse association between acculturation and the prevalence of DM among MA. However, that study also revealed that immigrant generation status was more significantly associated with the risk of DM than acculturation (Afable-Munsuz et al., 2013). Despite this finding, no significant associations between acculturation and diabetes were observed in either unadjusted or adjusted models (Afable-Munsuz et al., 2013). While the relationship between acculturation and the prevalence of DM in MA remains unclear, previous studies, as mentioned above, suggest notable differences between individuals with low and high levels of acculturation. Low- acculturated MAs tend to have lower rates of diagnosed diabetes but have a greater tendency towards being overweight and prediabetic, conditions that are often precursors to DM. In contrast, highly acculturated (ACC) individuals show higher rates of DMs. These inconclusive patterns underscore the need for further research into the potential association between acculturation and the prevalence of diabetes among MAs.

Dietary Quality and Sedentary Lifestyle

Acculturation in the U.S. often includes the adoption of a Western diet characterized by high intakes of saturated fats, refined carbohydrates, and low intakes of plant-based foods (Nichols, 2023). This eating pattern has been linked to increased rates of obesity, prediabetes,

and DM among the U.S. population, and it may have similar effects among MAs as they become more acculturated. Newly arrived MA immigrants are more likely to adhere to traditional Mexican diets, which generally include a wider variety of fruits and vegetables. However, as they acculturate, they become more exposed to the Western diet, and more access to processed foods with a greater intake of added sugar, salt, and fat. This dietary shift can heighten their vulnerability to non-communicable diseases and reduce their intake of essential nutrients, making it harder to maintain a balanced, healthy diet. Understanding how acculturation may influence their eating habits after five to eight years of living in the U.S is essential for developing effective public health interventions.

Acculturation has also been associated with decreased physical activity levels, partly due to lifestyle changes such as longer work hours spent on computers or increased screen time. As a result, many Americans struggle to meet the recommended levels of exercise, contributing to a more sedentary lifestyle. The Centers for Disease Control and Prevention (CDC) recommends all adults should aim for at least 150 minutes of moderate-intensity physical activity a week, which equals to 30 minutes a day, 5 days a week (CDC, n.d.-b). However, data from a CDC survey in 2017 to 2020, based on the question “During the past month, other than your regular job, did you participate in any physical activities or exercises such as running, calisthenics, golf, gardening, or walking for exercise?” revealed that Hispanic or Latino adults had the highest prevalence of physical inactivity compared to other race/ethnicities (32.1%) (CDC, n.d.-d). This lack of physical activity is a major risk factor of DM, a condition intricately linked to obesity, a sedentary lifestyle, and unhealthy dietary habits. Research has shown that regular physical activity improves insulin sensitivity and can serve as a strong protective factor against DM (Kirwan et al., 2017). Furthermore, a study focusing on older non-Hispanic whites revealed that

prolonged periods of sedentary activity, particularly related to leisure time (such as screen time) and work-like demands, were significant contributors to obesity rates and high sedentary lifestyles, averaging 9.5 hr of sedentary activity (Matthews et al., 2021). Reducing a sedentary lifestyle and incorporating more physical activity can be the best protective measure against DM. Given that a sedentary lifestyle is deeply embedded in the broader American culture, and that MAs are disproportionately affected by diabetes, it is crucial to examine how both acculturation and lifestyle changes contribute to this disease.

Objectives

The purpose of this study is to examine the prevalence of DM in MA adults and examine how risk factors such as acculturation, dietary quality, and sedentary lifestyle can contribute to the rising rates of DM diabetes using NHANES 2011 to 2018 data. Understanding the prevalence of DM is crucial for developing effective policies, treatments, and educational programs that can aid in lowering the prevalence of DM.

Methods

Survey Design and Study Population

In this cross-sectional study, data from the National Health and Nutrition Examination Survey (NHANES) 2011-2018 were used to assess the health and nutritional status of Mexican American adults (MA) and non-Hispanic white adults (NHW). NHANES releases data biannually on the health and nutritional status of the noninstitutionalized civilian population in the United States. The data analyzed accounts for eight years of information and was gathered through personal interviews and standardized physical examinations conducted in the mobile examination center (MEC), which included measurements of height, weight, and blood pressure, along with blood and urine laboratory tests (Zipf et al., 2013). This study included a total of

10,670 participants who self-reported ethnicity of MA or NHW based on survey questions: “What race or races do you consider yourself,” and “Do you consider yourself to be Hispanic, Latino, or of Spanish origin?” Both population samples focused on individuals aged 20 years and older. Participants < 20 years old, as well as pregnant or lactating women, were excluded from this analysis.

Acculturation

Acculturation was assessed on the MA population using their responses to three questions in the questionnaire and demographic datasets: place of birth (DMDBORN4), language spoken at home- Hispanics (ACD040), and duration of residency in the U.S (DMDYRSUS). Acculturation was scored using the responses to the NHANES questionnaire which has been frequently used in previous studies that have measured acculturation (Garcia et al., 2012; O’Brien et al., 2014). The scoring of the three questions used were the following: Participants received (1) point if born in the United States and (0) points if born elsewhere. For the duration of residence, (1) point was awarded for living in the U.S. for more than 20 years, and (0) points for less than 20 years. Regarding language, (1) point was given if English was the only or primary language spoken at home, or if Spanish and English were spoken equally. A score of (0) was assigned for primarily Spanish speakers. The total score ranged from 0 to 3, with (0) indicating the lowest level of acculturation and (3) indicating the highest level of acculturation (0 = Lowest, 1 = Low, 2 = High, 3 = Highest).

A1C Measurement for Diabetes Assessment

In this study, hemoglobin A1c (A1C) levels were measured to reflect participants' average blood sugar levels over the past two to three months. Venous blood draws were administered by a trained medical professional during the patient's visit to MEC on fasted and non-fasted

participants. A1C levels were used to evaluate the susceptibility of prediabetes or diabetes. Using the CDC classifications an A1C level of less than 5.7% is considered normal, 5.7% to 6.4% indicates prediabetes, and levels greater than 6.5% are indicative of diabetes (CDC, n.d.-a). In addition, diabetes status was assessed using the NHANES question (DIQ070) “Are you taking medications to control blood sugar or diabetes?” and (DIQ050) “Are you now taking insulin?” Lastly, these laboratory measures and questionnaires enabled the accurate classification of individuals with diabetes.

Fasting blood glucose (FBG) measurements were not used as the diagnostic criteria for diabetes in this study due to the smaller number of participants who fasted overnight, as only those attending the morning MEC session were instructed to do so. This would have resulted in an insufficient sample size of subjects with diabetes, particularly for the smaller MA sampled population. In addition, FBG measures only the immediate glucose levels and may not accurately represent long-term glucose control. In contrast, A1C provides a comprehensive view of long-term sugar levels and does not require fasting for an accurate reading, making it suitable for our assessment.

Sedentary Lifestyle

The extent of a sedentary lifestyle was assessed based on the self-reported amount of time spent doing activities while sitting on a typical day using findings from the NHANES questionnaire 2011-2018 data. Sedentary behavior is defined as any walking behavior characterized by an energy expenditure ≤ 1.5 metabolic equivalents (METs), while in a sitting, reclining, or lying position (Tremblay et al., 2017). NHANES estimated the amount of daily sedentary lifestyle by asking the following question: (PAD680) “The following question is about sitting at school, home, getting from places, or, with friends including time spent sitting at a

desk, traveling in a car or bus, reading, playing cards, watching television, or using a computer. How much time {do you/does sample participant/person (SP)} usually spend sitting on a typical day?” (CDC, 2017). The responses were recorded in minutes to quantify the sedentary time each participant typically spends during a day. Time spent sleeping was excluded from the sedentary lifestyle measurement. A sedentary lifestyle was then categorized into four “sedentary category” levels based on duration of sedentary time in a 24-hour period: less than 4 hours per day (very low sedentary category), 4 to 6 hours per day (low sedentary category), 6 to 8 hours (moderate sedentary category), and greater than 8 hours (high sedentary category).

Nutrition Assessment and Dietary Quality

To conduct our nutritional assessment, NHANES utilized two 24-hour dietary recalls using USDA’s Automated Multiple-Pass Method (Agricultural Research Service, n.d.). The first recall was administered in person by a trained dietary interviewer fluent in both English and Spanish. The interview took place in a private room within the MEC (Ahluwalia et al., 2016.). The second part of the assessment occurred 3 to 10 days later via phone, also conducted by a trained dietary interviewer. To assist participants in accurately reporting portion sizes during the phone and in-person interview, they were given measuring cups, spoons, a ruler, and a two-dimensional food model booklet with two-dimensional drawings of various portion sizes to accurately determine portion sizes.

In addition, the Healthy Eating Index (HEI) - 2015 components and scoring standards for ages 2 years and over were used to assess whether participants were meeting the dietary guidelines (Food and Nutrition Service, n.d.). The HEI is composed of 13 components. The nine adequacy components evaluated total fruits, whole fruits, total vegetables, greens and beans, whole grains, dairy, total protein, seafood and plants, and fatty acids. The four moderation

components evaluated the consumption of refined grains, sodium, added sugar, and saturated fats. The total HEI scores range from 0 to 100 points. The higher total HEI score reflects a diet more aligned with dietary guidelines.

Covariates

To better understand the association between acculturation and other relevant covariates and the prevalence of diabetes in MA we used the following: gender, age, BMI, abdominal obesity, and acculturation. In addition, we incorporated social health determinants which are non-medical factors that affect health conditions such as poverty- income-ratios, and educational attainments were included due to their strong association with the development of DM. Given their critical role in shaping health, these factors must be considered when evaluating the risk of chronic disease. Furthermore, it is essential to recognize that individuals who experience health disparities and inequities are at increased risk of developing chronic conditions such as DM.

Statistical Analysis

Statistical analysis was conducted using SAS system 9.4 (SAS Institute Inc., Cary, NC, USA) to analyze data from NHANES 2011-2018. Descriptive statistics included means and standard errors for continuous variables and percent prevalence for categorical variables. Logistic regression was used to examine the potential relationships between the prevalence of (DM) and risk factors such as acculturation level and sedentary lifestyle habits over the past eight years. Independent t-tests were used to assess the statistical differences of continuous variables between the two populations to determine the significance of the NHW, MA, and different levels of acculturation among MA. Chi-square tests to determine a significant difference in categorical variables between NHW, MA, and different levels of acculturation amount MA. A significance level of $p < .05$ was established for the statistical differences.

The NHANES protocols were approved by the National Center of Health Statistics (NCHS) Ethics Review Board. Consequently, Central Washington University's Human Studies Review Committee has deemed studies using a secondary analysis of NHANES data as not needing further internal review.

Results

Table 1 presents the descriptive findings. The total sample included 10,670 participants, and of these, 2,853 participants self-identified as MA adults. The MA group was comprised of 53% males and 47% females, while the NHW adults group was comprised of 50 % males and females ($p = .0003$). In our study, the MA population was younger, with an average age of 41 years, compared to the 50-year average in the NHW population ($p < .0001$). Regarding BMI, the MA population exhibited a statistically higher average BMI of 30.7 kg/ m² compared to the NHW population with an average BMI 29.1 kg/m² ($p < .0001$).

Glycohemoglobin levels were also higher in the MA population, with an average of 5.8%, compared to 5.5% in the NHW group. Furthermore, the MA group demonstrated significantly less sedentary behavior in all 4 sedentary behavior categories, while the NHW group engaged in more hours of sedentary behavior.

The MA population exhibited a higher prevalence of DM at 12.9% compared to 9% in the NHW population ($p < .0001$) (Table 2). MA females had the highest prevalence of diabetes at 13%, while NHW males showed the highest rate within the NHW group at 10%, each surpassing their respective gender counterparts. Not surprisingly, the prevalence of DM increased among both ethnic groups as BMI levels rose. However, when comparing MA and NHW, MA had a higher prevalence of diabetes within the normal weight category (6.4 % vs. 2.4%). A similar pattern was observed in the overweight category with a 10 % prevalence among MAs compared

to 6.4% in NHWs. In the obese category, no statistical significance in the prevalence of diabetes was observed between obese MA and obese NHW.

Among the MA population, having normal abdominal obesity based on weight-to-height ratio (WHtR) or abdominal obesity showed no significant difference in the prevalence of DM. However, among the NHW population, those with abdominal obesity were more likely to have DM than those who did not have abdominal obesity (NHW abdominal obesity DM prevalence was 10.1%, and did not have abdominal obesity was 9.7%). Furthermore, MA showed a higher prevalence of DM compared to NHW, particularly in individuals with abdominal obesity. Overall, abdominal obesity was found to be a stronger predictor for DM in both populations, with a more significant impact observed in the MA group (13.3%), compared to NHW (10.1%).

Acculturation was analyzed exclusively within the MA population. The results revealed MA adults with low ACC exhibited the highest prevalence of DM. Conversely, the lowest ACC group was least likely to have DM.

The prevalence of DM in the different poverty-income ratio (PIR) categories was identified as being significantly different in the NHW population, with those in the lowest PIR group having the highest prevalence of DM at 10.3% ($p = .0055$). In contrast, PIR was not associated with a higher prevalence of DM in the MA population as indicated by a p-value of 0.15. However, when comparing the two groups, MA exhibited a higher prevalence of DM than NHW across each PIR category, particularly among those in the low and middle-income levels.

Regarding educational attainment, both MA and NHW groups with higher education attainment was associated with a lower prevalence of DM ($p < .0001$). However, the differences in DM prevalence comparing the two ethnic groups at the same educational levels were not

statistically significant. Overall, MAs were revealed to have a higher prevalence of DM regardless of educational attainment.

There was no statistically significant difference in diabetes prevalence across sedentary lifestyle categories among MAs ($p = .288$). In contrast, among NHW, a significantly higher prevalence of diabetes was associated with an increased duration of sedentary lifestyle ($p = .0091$). However, when comparing the two groups, MAs who engaged in the lowest, low, and moderate sedentary lifestyle had a higher prevalence of DM, compared to NHWs.

Logistic Regression Modeling

Logistic regression models were used to calculate the odds ratio (OR) or the likelihood of having DM based on associated risk factors, as shown in Table 3. Using a simple logistic regression model, individuals with low ACC were found to be 2 times more likely to develop DM than those in the lowest ACC category. MA's in the high ACC category were 68% more likely to have diabetes than those in the lowest ACC category, but this increase was just outside statistical significance. MA's in the highest ACC category were not significantly more likely to have diabetes than those in the lowest ACC category.

However, in the fully adjusted model, the analysis indicated that MA individuals aged 60 years and older were 13 times more likely to develop DM compared to those aged 20-30, suggesting a significant increase in DM risk with advancing age. Individuals classified as obese had a three-fold increased likelihood of developing DM, compared to those of normal weight BMI. Additionally, individuals with less than a high school education and those who graduated high school had more than a two-fold increased risk of developing DM compared to those MA's with a college degree. In contrast, gender, PIR, and acculturation did not demonstrate a

statistically significant association with DM risk compared to their reference groups (females, highest PIR, highest acculturation group).

MAs in the higher ACC categories showed a decline in their diet quality, as demonstrated in Table 4. The lowest ACC group recorded an HEI score of 52.6%, while the highest ACC group exhibited a lower score of 50.4%. This reduction in overall diet quality was associated with increasing ACC levels. However, substantial differences (differences in HEI scores of greater than 10%) were seen in HEI subscores between lowest ACC and high ACC groups: whole grains HEI score increased by 64%, while refined grain rose by 96% for those in the highest ACC group. Additionally, among the highest ACC MAs, reductions in HEI scores were noted in several food groups among the adequacy component those being: whole fruit (-30%), total fruit (-26%), greens and beans (-13%), seafood and plant-based protein (-18%). Additionally, there was an increase in the moderation component of sodium (-24%) and saturated fats (-15%), and a decrease in refined grain consumption (96%), respectively.

Discussion

After adjusting for all other covariates (including obesity rate, age distribution, sedentary category, educational attainment, etc.), our study found no significant association specifically between acculturation and the prevalence of DM among MAs. However, we observed that increasing age, obesity status, and having attained less than a high school education were prominent risk factors for the prevalence of DM. Our study showed that the MA population had a higher susceptibility of being overweight and obese compared to the NHW population. This aligns with Garcia et al.'s study, which analyzed NHANES data from 1999 to 2008 to examine the impact of acculturation on MA men and women and their prevalence of overweight, obesity, and having pre-diabetes, or diabetes. They concluded that MA were significantly more

overweight, and obese, and had a higher prevalence of having diabetes compared to non-white Latinos. Furthermore, they suggest that diabetes and obesity were less prevalent among the least acculturated MAs, which aligns with our study. It is important to note that the measurement of acculturation in this study differed from ours. Garcia et al. assessed acculturation by combining language preference with birthplace, creating four different acculturation groups: US-born (predominately English-speaking or predominately Spanish-speaking) and born in Mexico (predominately English-speaking or predominately Spanish-speaking). Despite these methodological differences, both studies share similar conclusions, reinforcing the relevance of our findings.

These findings are consistent with those of a previous study conducted on Mexican-born Mexican Americans and U.S.-born Mexican Americans. They used language acculturation (the process by which individuals adapt to and adopt the language practices of different cultures by adjusting using speaking, writing, or communicating) as a measurement. They found that higher levels of language acculturation were associated with increased obesity among U.S.-born MAs. However, this relationship did not extend to MAs who were born in Mexico and had been living in the U.S. for a short period of time (Chrisman et al., 2017). This distinction can shed light on the role acculturation plays in shaping health outcomes within the MA population. Immigrants who are new to the U.S. may retain their cultural food practices due to limited exposure to the language and broader American culture. Our study supports this idea, showing that as individuals who become more acculturated, their dietary habits and patterns shift, consumption of total fruits, whole fruits, and greens and beans decreases, while intake of refined grains, saturated fats, and whole grains consumption increases. As MAs acculturate and become more familiar with the

language, and integrate into the majority-American culture, they may more readily adopt dietary habits, which could contribute to changes in health outcomes such as increased BMI status.

Obesity emerged as a notable risk factor for the development of diabetes in our analysis, which is not surprising. It is well established that obesity contributes to an increased risk of T2D and can exacerbate many types of diabetes-related complications. The elevated obesity rates observed among the MA population in our sample showed an association with diabetes mellitus (DM). Supporting this, Bays et al. reported that BMI (therefore, obesity status) was associated with diabetes rates. However, they noted that this relationship does not necessarily imply a direct causal link. Their findings demonstrated that as BMI increased, so did their prevalence of diabetes, hypertension, and dyslipidemia across all BMI categories (Bays et al., 2007). Notably, the highest rates of diabetes were observed among individuals classified as morbidly obese or had elevated hypertension. These finding alongside other studies strengthens the evidence that obesity is a significant contributor to diabetes development (Kaplan et al., 2022; Tobias et al., 2014). It is also important to note that our study did not assess hypertension, which may have been an additional contributing factor. Given its established role in the development of diabetes, the exclusion of hypertension represents a limitation in our analysis. Conversely, a study conducted by Mondragon et al. suggested an alternative explanation for the increased prevalence of diabetes in the MA population. Their research identified parental diabetes as a significant risk factor for T2D independent of age, sex, or adiposity (Velasco Mondragon et al., 2010). Those findings support the notion that individuals may be more likely to develop diabetes due to genetics and lifestyle factors like obesity. In our study, BMI explained the high prevalence of DMs. However, genetics may not fully account for the trends observed in the MA population. As previously mentioned, behavioral factors such as poor dietary habits, particularly high calorie

diets, and physical inactivity also contribute to obesity and, by extension, to the development of diabetes. The findings from our study, along with those from previous research, reinforce the strong relationship between obesity and diabetes. However, further studies looking at the relationship between predisposition, obesity, and diabetes risk, particularly, within high-risk populations such as Mexican Americans are still needed.

Educational attainment was another notable risk factor associated with diabetes, suggesting that higher educational attainment can function as a protective agent against diabetes. One possible explanation is that individuals with greater educational attainment could be more informed about the health complications associated with diabetes, the benefits of early and regular screening for diabetes, and the benefits of physical activity and preventative health practices, which can reduce the risk of developing diabetes. In contrast, those with lower education attainment may have limited exposure to such health-related information.

In addition to greater health awareness and health literacy, higher educational levels are often linked to better employment opportunities, increased financial stability, and better access to healthcare services, including comprehensive health insurance. These advantages play a critical role in preventing and effectively managing diabetes. A study conducted by Langellier et al. (2020), reinforces this connection, showing that individuals with higher levels of education are associated with better healthcare access and a more consistent medical home. Conversely, those with lower education levels face limited healthcare coverage (Langellier et al., 2020). This discrepancy is further reflected in the types of jobs typically held by individuals at different education levels. People with higher education are more likely to secure well-paying jobs that offer good health insurance. On the other hand, individuals with lower educational attainment may work in roles that offer limited insurance coverage, which can restrict their access to

necessary medical care. These systemic differences may help explain why non-communicable diseases, such as diabetes, are more prevalent among populations with lower levels of education.

Lastly, in our analysis, aging was found to be associated with a higher risk of diabetes, with individuals aged 60 years and older being at greater risk. This is not unexpected, as older individuals are generally more susceptible to developing non-communicable diseases such as T2D due to age-related decline in insulin sensitivity. When we examined age distribution across acculturation groups, we found individuals within the low acculturation group were substantially older (Table 5) and exhibited a higher prevalence of diabetes (Table 2). Results from the multiple logistic regression analysis (Table 3) further demonstrated that participants aged 60 years and older had the highest likelihood of diabetes. Although the mean age within the low ACC group was approximately 49 years old, the average ages for the other groups were lower: 37 years for the lowest ACC group, 42 years for the high ACC group, and 40 years for the highest ACC group (Table 3), they had the oldest population compared to the rest of the acculturation groups. Two very diverse studies, one with humans and the other with C57BL/6J mice support the link between aging and insulin sensitivity. Notably, in the human cohort, insulin resistance in MA men was attributed to both increased adiposity and aging, whereas in women, it was primarily linked to increased fat accumulation. In contrast, the decline in insulin sensitivity observed in aged mice occurred independently of changes in body composition. These findings underscore the complex nature of insulin resistance, suggesting that factors beyond obesity, particularly genetic and biological changes associated with aging, likely influence the development of diabetes. The increased risk observed among individuals in the low acculturated group is likely to be more reflective of age-related factors than acculturation duration itself, indicating that age may serve as a more significant determinant of diabetes risk in this context.

Our analysis of diet quality among the MA population revealed that whole grains and refined grains were frequently included in the diets among the highest ACC groups. However, it is important to note that as the MA population became more acculturated, whole grain consumption increased, and refined grain consumption decreased. This is a positive shift towards meeting the U.S dietary guidelines. Whole grains retain the entire grain, preserving essential nutrients such as fiber, B-vitamins, and iron. In contrast, refined grains have the bran and germ removed, leading to the loss of these key nutrients like fiber, B-vitamins, and iron. An umbrella review of 21 meta-analyses suggests that consuming two to three servings of whole grains per day can significantly reduce the risk of T2D and cardiovascular disease, along with modest improvements in body fat, waist circumference, and weight (McRae, 2017). Further supporting these findings, a study conducted by O'Hearn et al., concluded that diet plays a significant role in the high rates of T2D in Latin America and the Caribbean, with one in every three new T2D cases were linked to insufficient whole-grain consumption (O'Hearn et al., 2023). This finding aligns with our results, where, despite high whole-grain consumption in the highest ACC group, we also observed a high intake of refined grains, which lack the beneficial nutrients found in whole grains that help protect against T2D. Despite the well-documented health benefits of whole grains in the management of diabetes, refined grains still remain commonly consumed in the MA population's high ACC group. This could help explain the high incidence of T2D within the MA population, as the consumption of refined grains may offset the potential protective effects of whole grains.

While the improved HEI sub-scores for consumption of whole grains and refined grains were seen with increasing acculturation status, this improvement was not seen for all food groups. Our study identified a decline in the intake of whole fruits as well as greens and beans,

foods that are rich in dietary fiber, which plays a critical role in promoting satiety and preventing excessive energy intake. The fiber found in these food groups helps promote feelings of fullness, which can support weight management. Most importantly, fiber plays a key role in the regulating blood glucose levels by slowing the digestion and absorption of carbohydrates. This process prevents rapid spikes in blood glucose and facilitates the gradual release of glucose into the bloodstream. In addition, the presence of phytochemicals in fruits and vegetables may provide protection from the development of diabetes. A systematic review of 14 studies investigating the relationship between vegetable consumption and weight-related outcomes found consistent evidence of this association. In particular, one longitudinal study conducted among Spanish adults reported that consuming four or more servings of vegetables per day over 10 years was associated with an 82% reduced risk of gaining 3.4 kg (Nour et al., 2018). Collectively, the findings from this review suggest a strong inverse relationship between vegetable intake and the risk of weight gain.

An increase in sodium consumption was observed with increasing levels of acculturation. This high consumption is non-beneficial, as excessive sodium intake is a well-established risk factor for hypertension, cardiovascular disease, and stroke, risks that are further amplified in individuals diagnosed with diabetes, who are already more vulnerable to such complications. Similarly, high intake of saturated fats is associated with increased low-density lipoprotein (LDL) cholesterol, weight gain, and insulin resistance, which are significant risk factors for T2D. Previous studies (Ebbesson et al., 2010; Von Frankenberg et al., 2017) concluded that diets high in total fat and saturated fats can adversely affect insulin sensitivity, thereby contributing to the development of diabetes. Our study observed an increased consumption of saturated fats in those who were highest acculturated. It's important to consider that the effects of acculturation on diet

are complex and may vary, warranting further investigation into specific mechanisms underlying these changes.

It is essential to acknowledge the limitations of this study to maintain its integrity and transparency. One notable limitation is the reliance on self-reported 24-hour totals, despite being collected by trained NHANES dietary interviewers, which are susceptible to potential inaccuracies. Furthermore, NHANES is observational and therefore can not demonstrate causation, but simply associations. To determine causality and better understand the nature of these associations, future research involving interventional or clinical trial designs would be necessary. Additionally, while the study examines diabetes in a general sense, it does not distinguish between type 1 and type 2 diabetes. Despite these limitations, the study's strengths are substantial. Notably, it draws from eight years of data that reflects a large, nationally representative population. Furthermore, the study benefits from the ability to control for key demographic factors, like age, gender, BMI, and acculturation, which are crucial when examining the prevalence of diabetes in Mexican Americans. These strengths contribute to the robustness and relevance of the findings.

To our knowledge, this study is the first to assess the current prevalence of diabetes in MAs while exploring associated risk factors such as acculturation, dietary habits, and sedentary lifestyle. Our findings did not reveal a significance between our three key variables—acculturation, sedentary lifestyle, and diabetes prevalence. Instead, diabetes appeared to be partially influenced by age, BMI, and lower educational attainment, particularly among individuals with only a high school education or less. Interestingly, dietary habits showed no significant correlation with acculturation levels based on total HEI scores, though low acculturated Mexican American (MA) adults had the highest HEI scores. However, when

examining specific food groups, higher acculturated individuals consumed diets significantly higher in sodium and saturated fat, while also consuming fewer fruits and vegetables. The increased intake of sodium and saturated fats could elevate the risk of diabetes among those in the highly acculturated group. Additionally, the high diabetes rates observed in the low acculturated group may be attributed to the fact that this group represents the oldest demographic across all acculturation categories. Older individuals may have improved their dietary habits due to age-related health concerns, including managing existing conditions or preventing further complications. Dietary changes such as increased intake of fruits and vegetables may be adopted to support immune function and bone health, reflecting both preventive and responsive health strategies.

Our study's findings underscore the critical role of public healthcare providers in promoting active lifestyles and striving to help people improve dietary habits, such as increasing the intake of leafy greens and beans, and whole fruits while reducing sodium and saturated fat. These are manageable risk factors for both T1D and T2D, underscoring the need for culturally tailored interventions that promote traditional, nutrient-dense foods and expand access to preventive healthcare, especially among older Mexican American adults.

References

- Afable-Munsuz, A., Mayeda, E. R., Pérez-Stable, E. J., & Haan, M. N. (2013). Immigrant generation and diabetes risk among Mexican Americans: The Sacramento area Latino study on aging. *American Journal of Public Health*, 103(5), e45-52.
<https://doi.org/10.2105/AJPH.2012.300969>
- Agricultural Research Service. (n.d.). *AMPM – Features*. U.S. Department of Agriculture, Agricultural Research Service <https://www.ars.usda.gov/northeast-area/beltsville-md-bhnrc/beltsville-human-nutrition-research-center/food-surveys-research-group/docs/ampm-features/>
- Ahluwalia, N., Dwyer, J., Terry, A., Alanna, M., & Clifford, J. (2016). Update on NHANES dietary data: Focus on collection, release, analytical considerations, and uses to inform public policy. *Advances in Nutrition* 7(1), 121-134.
<https://doi.org/10.3945/an.115.009258>
- Bays, H. E., Chapman, R. H., Grandy, S., & the SHIELD Investigators' Group. (2007). The relationship of body mass index to diabetes mellitus, hypertension and dyslipidaemia: Comparison of data from two national surveys: Relation of BMI to diabetes mellitus. *International Journal of Clinical Practice*, 61(5), 737–747.
<https://doi.org/10.1111/j.1742-1241.2007.01336.x>
- Centers for Disease Control and Prevention. (n.d.-a). *A1C test for diabetes and prediabetes*. U.S. Department of Health and Human Services. <https://www.cdc.gov/diabetes/diabetes-testing/prediabetes-a1c-test.html>

- Centers for Disease Control and Prevention. (n.d.-b). *Adult activity: An overview*. U.S. Department of Health and Human Services. <https://www.cdc.gov/physical-activity-basics/guidelines/adults.html>
- Centers for Disease Control and Prevention. (n.d.-c). *Adult obesity facts*. U.S. Department of Health and Human Services. <https://www.cdc.gov/obesity/adult-obesity-facts/index.html>
- Centers for Disease Control and Prevention. (n.d.-d). *Adult physical inactivity outside of work*. U.S. Department of Health and Human Services. <https://www.cdc.gov/physical-activity/php/data/inactivity-maps.html>
- Centers for Disease Control and Prevention. (n.d.-e). *Type 2 diabetes*. U.S. Department of Health and Human Services. <https://www.cdc.gov/diabetes/about/about-type-2-diabetes.html>
- Centers for Disease Control and Prevention. (2017). *National health and nutrition examination survey (NHANES) Interviewer procedures manual*. (2012, 2018). https://wwwn.cdc.gov/nchs/data/nhanes/public/2017/manuals/2017_Interviewer_Procedures_Manual.pdf
- Chrisman, M., Chow, W.-H., Daniel, C. R., Wu, X., & Zhao, H. (2017). Associations between language acculturation, age of immigration, and obesity in the Mexican American Mano A Mano cohort. *Obesity Research & Clinical Practice*, 11(5), 544–557. <https://doi.org/10.1016/j.orcp.2017.03.005>
- Ebbesson, S. O. E., Tejero, M. E., López-Alvarenga, J. C., Harris, W. S., Ebbesson, L. O. E., Devereux, R. B., MacCluer, J. W., Wenger, C., Laston, S., Fabsitz, R. R., Howard, B. V., & Comuzzie, A. G. (2010). Individual saturated fatty acids are associated with different components of insulin resistance and glucose metabolism: The GOCADAN study.

International Journal of Circumpolar Health, 69(4), 344–351.

<https://doi.org/10.3402/ijch.v69i4.17669>

Food and Nutrition Service (n.d.). *How the HEI is scored*. U.S. Department of Agriculture.

<https://www.fns.usda.gov/cnpp/how-hei-scored>

Garcia, L., Gold, E. B., Wang, L., Yang, X., Mao, M., & Schwartz, A. V. (2012). The relation of acculturation to overweight, obesity, pre-diabetes and diabetes among U.S. Mexican-American women and men. *Ethnicity & Disease*, 22(1), 58–64.

<https://pubmed.ncbi.nlm.nih.gov/22774310/>

Hertz, R. P., Unger, A. N., & Ferrario, C. M. (2006). Diabetes, hypertension, and dyslipidemia in Mexican Americans and non-Hispanic whites. *American Journal of Preventive Medicine*, 30(2), 103-110. <https://doi.org/10.1016/j.amepre.2005.10.015>

Kaplan, R. C., Song, R. J., Lin, J., Xanthakis, V., Hua, S., Chernofsky, A., Evenson, K. R., Walker, M. E., Cuthbertson, C., Murabito, J. M., Cordero, C., Daviglius, M., Perreira, K. M., Gellman, M., Sotres-Alvarez, D., Vasan, R. S., Xue, X., Spartano, N. L., & Mossavar-Rahmani, Y. (2022). Predictors of incident diabetes in two populations: Framingham heart study and Hispanic community health study / study of latinos. *BMC Public Health*, 22(1), 1053. <https://doi.org/10.1186/s12889-022-13463-8>

Kirwan, J. P., Sacks, J., & Nieuwoudt, S. (2017). The essential role of exercise in the management of type 2 diabetes. *Cleveland Clinic Journal of Medicine*, 84(7 suppl 1) S15-S21 <https://doi.org/10.3949/ccjm.84.s1.03>

Langellier, B. A., Martínez-Donate, A. P., Gonzalez-Fagoaga, J. E., & Rangel, M. G. (2020). The relationship between educational attainment and health care access and use among

- Mexicans, Mexican Americans, and U.S.–Mexico migrants. *Journal of Immigrant and Minority Health*, 22(2), 314–322. <https://doi.org/10.1007/s10903-019-00902-9>
- Matthews, C. E., Carlson, S. A., Saint-Maurice, P. F., Patel, S., Salerno, E. A., Loftfield, E., Troiano, R. P., Fulton, J. E., Sampson, J. N., Tribby, C., Keadle, S. K., & Berrigan, D. (2021). Sedentary behavior in U.S. adults: Fall 2019. *Medicine & Science in Sports & Exercise*, 53(12), 2512–2519. <https://doi.org/10.1249/MSS.0000000000002751>
- McRae, M. P. (2017). Health benefits of dietary whole grains: an umbrella review of meta-analyses. *Journal of Chiropractic Medicine*, 16(1), 10–18. <https://doi.org/10.1016/j.jcm.2016.08.008>
- Merriam-Webster. (n.d.). Acculturation. In *Merriam-Webster.com dictionary*. <https://www.merriam-webster.com/dictionary/acculturation>
- Nichols, H. (2023, October 23). *Western diet: How does it impact health?* Medical News Today. <https://www.medicalnewstoday.com/articles/western-diet>
- Nour, M., Lutze, S., Grech, A., & Allman-Farinelli, M. (2018). The relationship between vegetable intake and weight outcomes: A systematic review of cohort studies. *Nutrients*, 10(11), 1626. <https://doi.org/10.3390/nu10111626>
- O'Brien, M. J., Alos, V. A., Davey, A., Bueno, A., & Whitaker, R. C. (2014). Acculturation and the prevalence of diabetes in US Latino adults, National health and nutrition examination survey 2007–2010. *Preventing Chronic Disease*, 11, 140142. <https://doi.org/10.5888/pcd11.140142>
- O'Hearn, M., Lara-Castor, L., Cudhea, F., Miller, V., Reedy, J., Shi, P., Zhang, J., Wong, J. B., Economos, C. D., Micha, R., Mozaffarian, D., & Global Dietary Database. (2023).

- Incident type 2 diabetes attributable to suboptimal diet in 184 countries. *Nature Medicine*, 29(4), 982–995. <https://doi.org/10.1038/s41591-023-02278-8>
- Tobias, D. K., Pan, A., Jackson, C. L., O'Reilly, E. J., Ding, E. L., Willett, W. C., Manson, J. E., & Hu, F. B. (2014). Body-mass index and mortality among adults with incident type 2 diabetes. *New England Journal of Medicine*, 370(3), 233–244. <https://doi.org/10.1056/nejmoa1304501>
- Tremblay, M.S., Aubert, S., Barnes, J.D. Saunders, T.J., Carson, V., Latimer-Cheung, A.E., Chastin, S.F.M., Altenburg, T.M., Chinapaw, M.J.M., SBRN Terminology Consensus Project Participants. (2017) Sedentary Behavior Research Network (SBRN) – Terminology Consensus Project process and outcome. *International Journal of Behavioral Nutrition and Physical Activity*, 14, 75. <https://doi.org/10.1186/s12966-017-0525-8>
- Velasco Mondragon, H. E., Charlton, R. W., Peart, T., Burguete-Garcia, A. I., Hernandez-Avila, M., & Hsueh, W.-C. (2010). Diabetes risk assessment in Mexicans and Mexican Americans. *Diabetes Care*, 33(10), 2260–2265. <https://doi.org/10.2337/dc10-0992>
- Von Frankenberg, A. D., Marina, A., Song, X., Callahan, H. S., Kratz, M., & Utzschneider, K. M. (2017). A high-fat, high-saturated fat diet decreases insulin sensitivity without changing intra-abdominal fat in weight-stable overweight and obese adults. *European Journal of Nutrition*, 56(1), 431–443. <https://doi.org/10.1007/s00394-015-1108-6>
- Zipf, G., Chiappa, M., Porter, K. S., Ostchega, Y., Lewis, B. G., & Dostal, J. (2013). National health and nutrition examination survey: Plan and operations, 1999–2010. *National Center for Health Statistics. Vital Health Stat 1*(56). https://www.cdc.gov/nchs/data/series/sr_01/sr01_056.pdf

Appendix

Table 1

Descriptive Statistics of Sample Population, NHANES 2011 to 2018

	Mexican American (MA)	Non-Hispanic Whites (NHW)	<i>p</i> value *
No.	2853	7817	—
Percentage of Women	47.10%	50.9 %	.0003
Age, y	41.5 ± 0.4	50.2 ± 0.3	< .0001
Weight, kg	82.9 ± 0.4	83.9 ± 0.4	< .0001
Height, cm	164.2 ± 0.2	169.5 ± 0.1	< .0001
Body mass index, kg/m ² [^]	30.7 ± 0.2	29.1 ± 0.1	< .0001
Glycohemoglobin (%)	5.8 ± 0.03	5.5 ± 0.01	< .0001
Sedentary Categories⁺			
Lowest	37.8 ± 1.7	17.1 ± 0.6	< .0001
Low	24.5 ± 1.0	23.2 ± 0.6	< .0001
Moderate	24.9 ± 1.3	32 ± 0.7	< .0001
High	12.6 ± 0.9	27.6 ± 0.7	< .0001

Note. NHANES indicates National Health and Nutrition Examination Survey.

**p* value determined by *t*-tests showed significant difference between Mexican Americans and non-Hispanic Whites.

[^]*p*-value determined by chi-square showed significant difference between Mexican Americans and non-Hispanic Whites.

⁺ Sedentary Categories were measured using this scale: lowest = <4 hours, low = 4 to <6 hours, moderate = 6 to 8 hours, high = >8 hours.

Table 2*Prevalence of Diabetes in MA and NHW, Stratified by Risk Factor Category*

Diabetes risk factor category	Mexican American % + Std Err	Non-Hispanic Whites % + Std Err	P-value
Overall Population	12.9 ± 0.9	9.0 ± 0.4	< .0001
Biological sex			
Male	12.7 ± 1.0	10.5 ± 0.5	.061
Female	13.0 ± 1.0	7.4 ± 0.4	< .0001
Age			
20-39 y	3.8 ± 0.6	1.7 ± 0.2	.0003
40-59 y	17.3 ± 1.4	8.7 ± 0.8	< .0001
60+ y	33.9 ± 2.2	15.8 ± 0.6	< .0001
p-value	< .001	< .001	—
BMI			
18.5 - 24.5 kg/m ²	6.4 ± 1.3	2.4 ± 0.3	< .0001
25-29.9 kg/m ²	10.0 ± 1.0	6.4 ± 0.5	.0006
30+ kg/m ²	16.6 ± 1.0	16.0 ± 0.8	.65
p-value	< .001	< .001	—
Abdominal obesity			
Normal abdominal WHtR	9.7 ± 2.0	4.4 ± 0.6	.002
Abdominal obesity WHtR	13.3 ± 0.9	10.1 ± 0.4	.001
p-value	.13	< .001	—
Acculturation *			
Lowest ACC	10.0 ± 1.0	—	—
Low ACC	18.2 ± 2.0	—	—
High ACC	15.7 ± 2.9	—	—
Highest CC	11.1 ± 0.8	—	—
PIR			
Low- income	13.5 ± 1.1	10.3 ± 0.6	.0058
Middle income	13.4 ± 1.3	10.0 ± 0.7	.021
High- income	9.5 ± 1.5	7.6 ± 0.6	.24
p-value	.15	.0055	—
Education			
Less than a high school graduate	16.7 ± 1.2	13.8 ± 1.3	.10
High school graduate	11.3 ± 1.3	10.8 ± 0.8	.80
Some college	9.8 ± 1.5	9.2 ± 0.6	.66
College graduate or above	6.7 ± 1.4	6.3 ± 0.5	.80
p-value	< .0001	< .0001	—

Sedentary category *			
Lowest	13 ± 1.0	7.0 ± 0.8	< .0001
Low	10.6 ± 1.4	7.3 ± 0.9	.048
Moderate	13.8 ± 1.2	9.7 ± 0.7	.004
High	14.7 ± 2.8	10.6 ± 0.8	.14
p-value	.288	.0091	—

Note. Data is presented as means ± standard deviations. BMI = body mass index; PIR = poverty-to-income ratio; WHtR = weight-to-height ratio; MA = Mexican American; NHW = non-Hispanic White.

*Acculturation score was summed up by the following questions: 1 point if born in the United States, 0 points if born outside the United States. 1 point if lived in the United States >20 y, 0 points if lived <20 y in the United States.

* Sedentary lifestyle was measured using this scale: Lowest = <4 hours, Low = 4 to <6 hours, Moderate = 6 to 8 hours, High = >8 hours

Chi-square analysis indicates significant differences exist within and between the diabetes risk factor category $p < .0001$.

Table 3*Odds Ratio of Diabetes Risk Factors Among Mexican Americans*

Factor	Odds Ratio	95% CI	p-value
Simple Logistic Regression Model			
Lowest ACC	reference		
Low ACC	2.01	1.42 - 2.84	.0001
High ACC	1.68	0.98 - 2.89	.058
Highest ACC	1.12	0.82 - 1.53	.45
Multiple Logistic Regression Model			
Female	reference		
Male	1.13	0.88 - 1.47	.31
Age group 20 - 39	reference		
Age group 40-59	5.2	3.30 - 8.20	< .001
Age group 60+	13.41	8.61 - 20.88	< .001
Normal weight	reference		
Overweight	1.36	0.86 - 2.15	.76
Obese	3.15	1.87 - 5.28	< .0001
College graduate or above	reference		
Some college	1.58	0.91 - 2.15	.0969
High school graduate	2.02	1.25 - 3.28	.0047
Less than high school	2.24	1.23 - 4.08	.0086
High income	reference		
Low income	1.3	0.79 - 2.15	.29
Middle income	1.43	0.87 - 2.36	.14
Lowest Acculturation *	reference		
Low ACC	0.94	0.62 - 1.43	.77
High ACC	1.15	0.66 - 2.02	.60
Highest ACC	0.97	0.66 - 1.41	.87
High PIR	reference		
Low PIR	1.3	0.79 - 2.15	.29
Middle PIR	1.43	0.87 - 2.36	.14
Sedentary lifestyle lowest *	reference		
Low	0.82	0.55 - 1.23	.33
Moderate	1.1	0.80 - 1.52	.53
High	1.29	0.71 - 2.33	.38

* Acculturation score was summed up by the following: 1 point if born in the United States, 0 points if born

outside the United States. 1 point if lived in the United States >20 y, 0 points if lived <20 y in the United States.

* Sedentary lifestyle was measured using this scale: Lowest = <4 hours, Lo = 4 to <6 hours, Moderate = 6 to 8

hours, High = >8 hours

Table 4*Descriptive Statistics of HEI by Acculturation in Mexican Americans*

Food	Max Points	Lowest	Low	% Difference (Lowest & Low)	High	% Difference (Lowest & High)	Highest	% Difference (Lowest & Highest)
Adequacy								
Total Fruits	5	2.7 ± 0.09	2.9 ± 0.09	7%	2.4 ± 0.1	-11%	2.0 ± 0.06	-26%
Green and beans	5	2.3 ± 0.09	2.8 ± 0.1	22%	2.3 ± 0.1	0%	2.0 ± 0.08	-13%
Whole fruits	5	3.0 ± 0.09	3.1 ± 0.1	3%	2.5 ± 0.1	-17%	2.1 ± 0.07	-30%
Whole Grains	10	1.4 ± 0.1	2.2 ± 0.1	57%	2.4 ± 0.2	71%	2.3 ± 0.1	64%
Seafood and Plant Protein	5	3.3 ± 0.08	3.4 ± 0.1	3%	3.0 ± 0.1	-9%	2.7 ± 0.09	-18%
Fatty Acids	10	4.8 ± 0.1	5.0 ± 0.1	4%	5.0 ± 0.1	4%	5.0 ± 0.1	4%
Total Vegetables	5	3.3 ± 0.06	3.4 ± 0.07	3%	3.3 ± 0.07	0%	3.1 ± 0.6	-6%
Total Dairy	10	5.2 ± 0.1	5.3 ± 0.1	2%	4.9 ± 0.22	-6%	5.0 ± 0.1	-4%
Total Proteins	5	4.62 ± 0.04	4.6 ± 0.04	0%	4.5 ± .05	-3%	4.4 ± 0.03	-5%
Moderation								
Refined Grains	10	2.8 ± 0.1	3.6 ± 0.1	29%	4.8 ± 0.2	71%	5.5 ± 0.1	96%
Sodium	10	4.5 ± 0.1	4.4 ± 0.1	-2%	3.9 ± 0.2	-13%	3.5 ± 0.1	-22%
Added Sugar	10	7.0 ± 0.1	7.6 ± 0.1	9%	7.3 ± 0.2	4%	6.7 ± 0.14	-4%
Saturated Fats	10	6.6 ± 0.1	6.5 ± 0.1	-2%	5.7 ± 0.1	-14%	5.6 ± 0.1	-15%
Total Score	100	52.6 ± 0.5	55.4 ± 0.6	5%	52.4 ± 0.6	0%	50.4 ± 0.6	-4%

Note. Data is presented as means ± standard deviations. The low acculturated group is used as a

reference to measure changes in diet quality. HEI = Healthy Eating Index

Table 5*Descriptive Statistics by Acculturation Score (Mexican American, NHANES 2011–2018)*

Variables	Lowest	Low	High	Highest
Age (years)	37.7 ± 0.4	49.4 ± 1.0	42.1 ± 1.0	40.0 ± 0.6
Height (cm)	162.7 ± 0.3	162.7 ± 0.4	164.9 ± 0.8	166.0 ± 0.4
Weight (Kg)	79.5 ± 0.6	79.5 ± 0.7	83.9 ± 1.4	87.1 ± 0.8
BMI (Kg/m ²)	29.9 ± 0.2	30.0 ± 0.2	30.8 ± 0.3	31.5 ± 0.3
Waist	99.2 ± 0.5	100.5 ± 0.6	101.4 ± 0.8	103.3 ± 0.6
WHtR	0.61 ± 0.0037	0.6 ± 0.005	0.6 ± 0.005	0.6 ± 0.004
HbA1c (%)	5.7 ± 0.04	5.9 ± 0.06	5.8 ± 0.1	5.7 ± 0.04
Years in US	3.92 ± 0.05	6.3 ± 0.07	6.9 ± 0.07	—

Note. Data is presented as means ± standard deviations. BMI = body mass index, WHtR = waist-to-

height ratio, HbA1c = hemoglobin A1c.

Focus Group Interview: Perspectives of Virtual Dietary Counseling Methods Post COVID-19 Pandemic

Maria Mendoza

Project Mentor(s): Nicole Stendell-Hollis, Tafere Belay, Katy Williams, Jessica Tyrrell
Department of Health Sciences, Central Washington University

Abstract: The purpose of this study is to examine the perceptions related to different delivery methods of dietary counseling. This qualitative research study will examine the perceptions related to different methods of dietary counseling (telephone calls, video calls, or face-to-face visits). Focus group one contained provider participants (N = 7), which were all RDNs and focus group two hosted patient participants (N = 6). Semi structured interviews were performed asking subjects about any personal experiences related to receiving or providing nutrition education, positive or negative, as they participated in telehealth. Researchers analyzed data through detailed observation and familiarization of transcripts through manual thematic analysis. Following the thematic analysis, three main themes were discovered: the adaptability of telehealth, nuanced perceptions of telehealth, and barriers to effective virtual care. Telehealth as a dietary counseling method is complex and offers a combination of strengths and weaknesses. For the improvement of nutritional care via telehealth, future research should assess the importance of specific applications and developing formal procedures related to virtual care.

Keywords: telehealth, dietary counseling methods, nutrition education, rural, nutrition care

Introduction

The Centers for Disease Control and Prevention (CDC) suggests that the U.S. obesity prevalence has increased from 30.5% to 41.5% from 2000 to 2017.¹ Moreover, health professionals have concerns related to the increase in mortality among U.S. adults related to obesity-related chronic diseases.² In response to the prevalence of morbidity and mortality, studies to avert these conditions in a cost-effective and accessible manner are also increasing.³

Developing new methods to provide nutrition education that are more accessible is critical to reaching individuals who may experience socioeconomic barriers impacting their ability to access healthcare. One method that rural populations would continue to benefit from is the use of telehealth, even after the pandemic.^{4,5} To cope with the COVID-19 pandemic quarantine, applications such as Zoom, and other video communications have become the new normal in several workplaces. This format of nutrition counseling also allows for more frequent sessions as opposed to the traditional consultation that occurs once every month or less.⁵ However, it remains unclear whether this method of intervention impacts nutrition-related outcomes.^{4,6-8} There appears to be a disconnect from recent literature to real-world settings, hence lacking external validity. The disconnect lies between published results and the field-based experiences of registered dietitian nutritionists (RDN). Research involves controlled environments; therefore, they fail to consider practical challenges that hinder the effectiveness of telehealth. For instance, real world application involves considering challenges like diverse client needs, varying digital literacy, and socioeconomic barriers.

Currently, it is unclear whether patients who have received nutrition counseling through telehealth services agree with the proposed benefits of telehealth services to provide nutrition interventions or if they have experienced barriers with services offered virtually. There are also no qualitative studies, to the researcher's knowledge, assessing RDNs perspectives as nutrition professionals who have used telehealth services to provide nutritional services to clients/patients. Further, researchers were curious about the favorable results for telehealth in the Yücel and Yücel study, primarily the approval of the videocall intervention compared to the in-person,³ thus leading to the current research question. How do the individuals utilizing the tool, RDNs and patients, perceive telehealth compared to other methods of dietary counseling? Researchers

plan to engage directly with RDNs and patients to investigate attitudes and perspectives related to virtual dietary counseling methods. The purpose of this study is to examine the perceptions related to different methods of dietary counseling. This research will gather insights from RDNs and patients who have provided or received dietary counseling, respectively through telecommunication technologies and traditional methods.

Methods

Study Design

This qualitative research study examined the perceptions related to different methods of dietary counseling (telephone calls, video calls, or face-to-face visits). This research has gathered insights from registered dietitian nutritionists (RDN) and patients who have provided or received dietary counseling through telecommunication technologies and traditional methods to try to determine the most effective method to provide nutrition education.

Participants

Each focus group was comprised of different participant populations. Focus group one (FG 1) included adult RDNs living in rural, Wenatchee, Washington area between January and February 2025. These individuals worked at Confluence Health providing nutritional services through various methods, including telehealth via telephone, video call, among other virtual services (i.e. patient portals) and traditional face-to-face appointments. Focus group two (FG 2) included adult participants who lived in the rural Wenatchee, Washington area between January and February 2025 who had received nutrition counseling education via telehealth services as well as through traditional procedures. Participants were English speaking adult females. Subjects were included if they met all the following criteria: If the subject participated as a patient had received dietary counseling via at least one method of telehealth (video, phone,

portal, etc.) and traditional, face-to-face. Subjects who participated as an RDN had provided dietary counseling using at least one method of telehealth and traditional, face-to-face. Subjects were excluded if they were under the age of 18, did not speak English, and did not have prior experience with both telehealth and traditional services related to nutrition counseling.

Recruitment

Digital flyers were distributed around Confluence Health located in Wenatchee, Washington presenting the opportunity for participants to join an FG related to dietary counseling methods. The flyers asked for respondents who were interested in sharing about how “individuals perceive different methods of dietary counseling” in order to help “inform dietitians, and other health professionals how to best provide nutrition education”. Flyers contained a QR code providing individuals with more in-depth study details. Interested individuals contacted the lead investigator who screened prospective participants regarding inclusion/exclusion criteria and study details. If the individual qualified and consented, they were invited to participate in the study. Potential participants were told by the lead investigator the FGs consisted of discussion related to nutrition education experiences, positive or negative, in relation to nutrition education and counseling. All FGs were organized for a time suitable for the participants and were held in a private conference room. Participants were offered an Amazon gift card as an incentive. Approval for this study was granted by the Central Washington University Human Subjects Review Program.

Focus Groups

FG 1 hosted the provider participants ($n = 7$) who were all RDNs currently working in the Wenatchee Valley.^{9,10} FG 2 hosted the patient participants ($n = 6$).⁹⁻¹¹ Each group was facilitated by two moderators and lasted 45 to 90 minutes. Subjects were provided with a consent form

prior to their participation in the focus groups as well as a demographics questionnaire. The principal moderator coordinated and led the discussion as a semi-structured interview process where all participants were prompted with eight open-ended questions based on their personal experiences and opinions on telehealth. The assistant moderator documented the discussion on paper, managed the tape recorder, and troubleshooted any other issues.

Although both patients and RDNs participated in the study, they were in separate focus groups. This decision was made by the principal moderator to ensure the privacy and comfort of all participants. The RDNs were asked a different set of questions regarding the barriers of providing online dietary counseling, while participants in focus group two were asked questions related to their perceptions and experiences with receiving telehealth.

Data Collection

The RDNs were asked a different set of questions regarding the barriers of providing online dietary counseling. The interview also included sharing any personal experiences related to receiving nutrition education, positive or negative, as they participated in telehealth. During the focus group, audio was recorded via a tape recorder and was transcribed post-interview by researchers. No identifiers were kept on transcriptions to maintain confidentiality. Once the interview was done the participants were dismissed. Open-ended questions prompted the clients' discussion regarding the benefits, barriers, and facilitators of receiving online dietary counseling. Demographic data was collected and included gender, age, race/ethnicity, marital status, current employment status, highest level of education, maternal estimated height and weight, paternal estimated height and weight.

Data Analysis

Descriptive statistics were presented as a mean $\pm$ standard deviation (SD), while nominal variables were represented as frequencies and percentages (%). Data analysis was analyzed using the SPSS software package (Statistical Package for Social Science, version 29, IBM, Armonk, NY, USA). Data was analyzed by hand using thematic analysis.¹² To amplify authenticity and methodological quality of the findings, the researchers followed the following procedure:¹² 1) two researchers independently read and reviewed the focus group transcripts 2) the researchers individually identified significant and relevant responses and determined appropriate keywords and codes to segments of the data revealing prominent themes 3) the researchers repeated the process for the second focus group transcript 4) both researchers came to the consensus through discussion on the final set of themes that represented the data set. Direct quotes from participants were selected. 5) the finalization of themes occurred with a third researcher.

The researchers determined that a qualitative analysis software was not deemed necessary due to the small number of focus group transcripts. Further, researchers aimed to avoid the preordained processes associated with qualitative software and to emphasize a comprehensive understanding of the data.¹² Researchers were able to accomplish this through detailed observation and familiarization of transcripts through manual thematic analysis.

Results

Two focus groups were conducted with a duration of 50 minutes (FG 1) and 74 minutes (FG 2), respectively. FG 1 consisted of RDN subjects (N = 7), and FG 2 represented patient participants (N = 6). All 13 participants were female with an average age range of 31 to 40 years (Refer to Table 1 and Table 2). Following the thematic analysis, three main themes emerged.

Table 3 provides a summary of the themes with direct quotations to provide additional context.

Table 1. Descriptive Data for Adults Living in Wenatchee Washington (n = 13)

Variable	n (%)
Patient or RDN¹	
Patient	7 (53.8%)
RDN	6 (46.1%)
Age	
18-20	0 (0%)
21-30	3 (23.1%)
31-40	6 (46.2%)
41-50	1 (7.7%)
>50	3 (23.1%)
Gender	
Male	0 (0%)
Female	13 (100%)
Other	0 (0%)
Race/Ethnicity	
American Indian or Alaskan Native	0 (0%)
Asian	0 (0%)
Black or African American	0 (0%)
Hispanic or Latino	1 (7.7%)
Middle Eastern or North African	0 (0%)
Native Hawaiian or Pacific Islander	0 (0%)
White	9 (69.2%)
Mixed/Multiple	3 (23.1%)
Marital status	
Not married	5 (38.5%)
Married	7 (53.8%)
Divorced	1 (7.7%)
Widowed	0 (0%)
Employment	
Currently employed	12 (92.3%)
Not currently employed	0 (0%)
Self employed	0 (0%)
Other	1 (7.7%)
Education	
Did not complete high school	0 (0%)

Variable	n (%)
Completed high school	0 (0%)
AA/AS or trade degree	5 (38.5%)
BA/BS	5 (38.5%)
MA/MS	3 (23.1%)
Terminal degree	0 (0%)
Telehealth applications (provided or received)	
All	6 (46.2%)
Traditional (face-to-face)	
Video call (i.e. Zoom)	
Phone call	
Other	2 (15.4%)
Traditional and video only	2 (15.4%)
Traditional and phone only	3 (23.1%)

¹RDN, registered dietitian nutritionist

Table 2. Chi-Squared Analysis of Continuous Variables (n = 13)

Variable	RDN¹, n (%)	Patient, n (%)	p-value
Age (yr)			0.660
18-20	0 (0%)	0 (0%)	
21-30	2 (28.6%)	1 (16.7%)	
31-40	3 (42.8%)	3 (50%)	
41-50	1 (14.3%)	0 (0%)	
>50	1 (14.3%)	2 (33.3%)	
Gender			a.
Male	0 (0%)	0 (0%)	
Female	7 (100%)	6 (100%)	
Race/Ethnicity			0.034
Hispanic/Latino	0 (0%)	1 (16.7%)	
White	7 (100%)	2 (33.3%)	
Mixed	0 (0%)	3 (50%)	
Marital status			0.529
Not married	2 (28.6%)	3 (50%)	
Married	4 (57.1%)	3 (50%)	
Divorced	1 (14.3%)	0 (0%)	
Employment			0.261
Currently	7 (100%)	5 (83.3%)	
Other	0 (0%)	1 (16.7%)	

Variable	RDN ¹ , n (%)	Patient, n (%)	p-value
Education			0.246
AA/AS	0 (0%)	2 (33.3%)	
BA/BS	4 (57.1%)	2 (33.3%)	
MA/MS	3 (42.8%)	2 (33.3%)	
Method received/provided			0.016
Other	0 (0%)	2 (33.3%)	
All the above	6 (85.7%)	0 (0%)	
Traditional & video	0 (0%)	2 (33.3%)	
Traditional & phone	1 (14.3%)	2 (33.3%)	

¹RDN, registered dietitian nutritionist

a. No statistics are computed because gender is a constant.

Table 3. Summary of Themes Derived from Thematic Analysis of Focus Group Transcripts

Theme	Subthemes	Quotes
1. The adaptability of telehealth	1.1 Increased outreach related to lack of providers	‘It [telehealth] only increases access and that’s the goal. Increases food access, increases access to a dietitian, increases access to removing barriers to care.’ (FG 1)
		‘I don’t think that was something that dietitians were doing before COVID-19. So, it opened more access to care.’ (FG 2)
	1.2 Patients acknowledge the convenience of telehealth	‘We were able to have a long-distance telehealth appointment with a specialist without having to drive over the mountains. So, its [telehealth] super convenient.’ (FG 2)
2. Nuanced perceptions of telehealth	2.1 RDNs only appreciate the resource in specific circumstances	‘That is a big positive because people [clients] will go into their kitchen and get food items and show me, whereas I would think it was something else. It is really nice to see what they're [clients] eating.’ (FG 1)
		‘It [telehealth] is challenging because I can't check weights. I miss some of the assessment part of things that is really important with eating disorders.’ (FG 1)
	2.2 Patients reflect on the dynamic of care	‘I like the use of telehealth because I work from home and I have my kid at home with me, so it's easier to have a 10- or 15-minute phone call with somebody than getting ready, setting up all the things. Instead of putting off appointments like I did for a long time, I'm able to have the appointment that I need.’ (FG 2)

Theme	Subthemes	Quotes
		‘Just as using it [telehealth] as a tool, not to replace the in-person. Just kind of something nice to have.’ (FG 2)
	2.3 RDN’s disappointment with the engagement patients	‘... I’ve had multiple patients who are physically at a different appointment, like just today, like my patient was in the waiting room for a different appointment and I called at our scheduled time.’ (FG 1) ‘I feel like a lot of patients don’t pay attention when it’s like a telephone visit. Video you can engage them a little bit more, but telephone I can hear them driving or I can hear them shopping at the grocery store or they have friends over.’ (FG 1)
	2.4 Patient’s disappointment with the engagement providers	‘The appointment, I felt like he [provider] was almost like rushed. And so, I kind of felt like I was like just thrown to the back burner.’ (FG 2) ‘It’s, like, I do wish that, like, providers would take it seriously and treat it like a real appointment.’ (FG 2)
	2.5 Patients have conflicting feelings with video calls	‘That is a big positive because people [clients] will go into their kitchen and get food items and show me, whereas I would think it was something else. It is really nice to see what they’re [clients] eating.’ (FG 1) ‘It [telehealth] is challenging because I can’t check weights. I miss some of the assessment part of things that is really important with eating disorders.’ (FG 1)
3. Barriers to effective virtual care	3.1 Telehealth is an unintuitive resource for patients/technical issues	‘I really like telehealth, but I can’t get my camera to work, which is kind of embarrassing.’ (FG 2) ‘Technical difficulties and internet problems. Yeah, like either camera, Wi-Fi connection, like there’s lagging, simply the audio stops working.’ (FG 2) ‘I would say difficulties that I’ve faced is not on my end, really, but is on the provider’s end...How do you notify a person that, hey, there’s going to be a wait to your appointment on telehealth, so then you don’t start to question, like, am I in the right Zoom? Am I doing this right, or whatever?’ (FG 2)
	3.2 Virtual appointment etiquette is not yet established with patients or providers	‘I feel like some patients just don’t take it as seriously.’ (FG 1) ‘... I think people like to dance around like the norms, like how do we agree to be together. And I think if that’s something that can start to become a norm of a conversation, especially with telehealth, of this is how you can expect me to

Theme	Subthemes	Quotes
		be as a provider on telehealth.’ (FG 2)
		‘I do wish that, like, providers would take it seriously and treat it like a real appointment.’ (FG 2)

Theme One: Adaptability of Telehealth

Subtheme 1.1 Increased Outreach Related to Lack of Providers

FG 1 participants reported that telehealth enhances outreach and makes nutrition care more accessible particularly for individuals living in rural areas. The RDNs were the main proponents of the versatility and adaptability of telehealth. It was reported that the tool was valuable to their practice as it allowed them to serve a larger community with the lack of providers in their area.

“It [telehealth] only increases access and that’s the goal. Increases food access, increases access to a dietitian, increases access to removing barriers to care.”

The RDNs expressed the needs of rural communities and being able to provide nutritional outreach due to telehealth modalities. It was noted that the adaptability of telehealth was evident during disastrous events such as the COVID-19 pandemic, where providers were able to overcome the social distancing barriers with telehealth and continue to provide care:

“I don’t think that was something that dietitians were doing before COVID-19. So, it opened more access to care.”

Subtheme 1.2 Patients Acknowledge the Convenience of Telehealth

FG 2 participants came to a consensus that the convenience aspect of telehealth was a considerable benefit. It was reported that individuals were able to navigate the challenges of living in a rural area due to telehealth. It was mentioned that traveling is a significant barrier

experienced because of scheduling conflicts, attending college, and traveling long distances during harsh weather conditions. An example quote included:

“We were able to have a long-distance telehealth appointment with a specialist without having to drive over the mountains. So, its [telehealth] super convenient.”

Participants mentioned that having the opportunity to attend online appointments has improved their following up with their care.

Theme Two: Nuanced Perceptions of Telehealth

Subtheme 2.1 RDNs Only Appreciate the Resource in Specific Circumstances

Both groups noted that telehealth is a complex tool. While the tool provides unique advantages, it simultaneously creates a distinct set of complications. FG 1 provided contradicting standpoints related to virtual care. It was reported that telehealth is beneficial for context-specific circumstances as it allows for RDNs to provide personalized and accurate food recalls:

“That is a big positive because people will go into their [clients] kitchen and get food items and show me, whereas I would think it was something else. It is really nice to see what they're [clients] eating.”

Others countered with the inadequacy related to obtaining body measurements (i.e. height and weight) critical for patient assessments:

“It [telehealth] is challenging because I can't check weights. I miss some of the assessment part of things that is really important with eating disorders.”

The differing insights amongst the RDNs related to their participation in diverse nutrition professions. Particular nutrition practices (i.e. community nutrition) were reported to be cohesive with telehealth features, while other areas of practice significantly conflict with virtual modalities.

Subtheme 2.2 Patients Reflect on the Dynamic of Care

Participants in FG 2 communicated that the practicality of telehealth has made individuals more inclined to seek nutritional care. Interestingly, it was reported that individuals found it more difficult to engage with the provider during virtual consultations, yet they were more likely to be consistent in attending their scheduled appointments:

“I like the use of telehealth because I work from home and I have my kid at home with me, so it's easier to have a 10- or 15-minute phone call with somebody than getting ready, setting up all the things. Instead of putting off appointments like I did for a long time, I'm able to have the appointment that I need.”

The selected quote emphasizes telehealth as a facilitator that effectively supports clients as they seek nutritional care. It was important for the group that individuals had the option of telehealth to accommodate all situations, rather than being relied upon as the sole source of healthcare. A typical quote included:

“Just as using it [telehealth] as a tool, not to replace the in-person. Just kind of something nice to have.”

Subtheme 2.3 RDN's Disappointment with the Engagement Patients

FG 1 reported frustrations related to the lack of engagement from their clients. The RDNs felt perceived telehealth as a phenomenal resource; however, it has failed to reach its full potential due to the disengagement of their clients. It was reported that the retention rate has increased at the expense of the quality of appointments. A typical quote included:

“... I've had multiple patients who are physically at a different appointment, like just today, like my patient was in the waiting room for a different appointment and I called at our scheduled time.”

FG 1 came to the consensus that the advantage of conveniently attending an appointment from various locations has negatively impacted the attentiveness of their patients:

“I feel like a lot of patients don't pay attention when it's like a telephone visit. Video you can engage them a little bit more, but telephone I can hear them driving or I can hear them shopping at the grocery store or they have friends over.”

The discussion demonstrated that although clients are connected, they are disengaged, which has been difficult for providers to navigate.

Subtheme 2.4 Patient's Disappointment with the Engagement Providers

Participants in FG 2 reported having differing perspectives related to the provider and patient dynamic through virtual care. FG 2 discussed the poor delivery of care, disengagement, and communication issues from the provider's end. The participants agreed that several appointments felt rushed and low priority:

“The appointment, I felt like he [provider] was almost like rushed. And so, I kind of felt like I was like just thrown to the back burner.”

A typical quote included:

“It's, like, I do wish that, like, providers would take it seriously and treat it like a real appointment.”

The selected quotes reflect the patients and their attitudes towards providers approach to virtual engagement. FG 1 and 2 concur with insights related to the challenges related to building rapport through telehealth. All subjects were in an agreeance that there is a disconnect between the patient and provider which negatively impacts the nutritional care provided and received.

Subtheme 2.5 Patients Have Conflicting Feelings with Video Calls

FG 2 discussed complicated feelings associated with the comfortability of using virtual

applications. Feelings of anxiety were reported related to appearing on camera and having providers observe their residence. A quote from the discussion included:

“I think video, I don't love it as much. I noticed that it does give me more anxiety than when I actually go in person.”

The participants of FG 2 felt that telehealth can potentially be an invasion of privacy which made them uneasy. Specifically, there were complicated feelings towards video consultations:

“One thing that I did experience that I didn't love with telehealth is I had people in the household, right? And there was no way to avoid those people in the household. So, it's like the privacy on my end feels a little uncomfortable.”

Although video calls allowed for patients to receive care from the convenience of their home, they perceived it was done at the expense of their privacy.

Theme Three: Barriers to Effective Virtual Care

Subtheme 3.1 Telehealth is an Unintuitive Resource for Patients/Technical Issues

FG 2 reported often experiencing technical issues when accessing telehealth. The difficulties focused on video forms of telehealth. FG 2 perceived issues that related to audio, video, and internet connection, which led to frustrations and impacted their care if not solved:

“I really like telehealth, but I can't get my camera to work, which is kind of embarrassing.”

“Technical difficulties and internet problems. Yeah, like either camera, Wi-Fi connection, like there's lagging, simply the audio stops working.”

It was discussed that the disruptions occurred on both sides, patient and provider. A direct quote emphasizing this insight included:

“I would say difficulties that I've faced is not on my end, really, but is on the provider's end . . . How do you notify a person that, hey, there's going to be a wait to your appointment on telehealth, so then you don't start to question, like, am I in the right Zoom? Am I doing this right, or whatever?”

FG 1 had no discussion regarding technical difficulties that they have experienced or navigating technological concerns with their patients.

Subtheme 3.2 Virtual Appointment Etiquette is not yet Established with Patients or Providers

FG 1 perceived that inappropriate behaviors such as overlapping appointments can be attributed to the absence of expectations that comes with a video appointment:

“I feel like some patients just don't take it as seriously.”

FG 2 shared similar insights related to the formalities of telehealth. Patients discussed confusion regarding how to approach virtual appointments as they feel more casual compared to an in-person or traditional consultation:

“ . . . I think people like to dance around like the norms, like how do we agree to be together. And I think if that's something that can start to become a norm of a conversation, especially with telehealth, of this is how you can expect me to be as a provider on telehealth.”

It was emphasized that the lack of etiquette also influenced the providers and the care they received:

“I do wish that, like, providers would take it seriously and treat it like a real appointment.”

FG 1 and 2 inadvertently shared an understanding that the barriers reported stem from the lack of formalities related to virtual appointments. Reoccurring insights related to the nonexistent etiquette for telehealth have been a significant barrier for telehealth.

Discussion

In response to the concerning rise of nutrition-related health complications in the U.S., RDNs have been seeking cost-effective and accessible modes of dietary outreach. Nutrition outreach aims to seek and identify hard to reach and vulnerable populations, thus telehealth has been explored as a method to provide healthcare. In this study, researchers aimed to analyze telehealth in a nutritional space with RDNs and recipients of telehealth. Uniquely, the study assessed telehealth and what it has to offer in juxtapose to the traditional in-person interventions. The study took a broad approach by interviewing RDNs of various practices in hopes to fill the gap in literature. Previous studies focus on nutrition and telehealth as a weight management intervention focusing on body composition outcomes.^{7,8,13,14} Few articles have assessed telehealth and general application for dietary counseling.¹⁵ Although obesity has been deemed a major public health issue in the U.S., other nutrition concerns require dietary outreach as well. For instance, limited research has explored telehealth's impact on chronic disease such as diabetes mellitus (DM)¹⁶ or cardiovascular disease (CVD);¹⁷ the leading cause of death in the U.S.¹⁸

According to the results of this study, researchers found diverging interpretations and attitudes related to the efficacy of telehealth between RDNs and patients. Results showed more negative views towards telehealth related to the dynamics of care, engagement, technological issues, and etiquette. Interestingly, patients emphasized their dislike for video applications as they cause anxiety and concern for privacy during virtual appointments. Similarly, Gajarawala and Pelkowski reported identical barriers related to telehealth implementation. For instance, disadvantages identified included: technical difficulties, data accuracy, patient-provider relationships, and patient privacy.⁵ However, results unique to this study found that patients and

providers attribute most of the barriers (i.e., engagement, dynamics of care, formalities) to human error rather than the efficiency of the telehealth technology. RDNs felt that their clients need to approach appointments with more sincerity, while the patients proposed that providers need to create a more personalized experience. The point of contention creates a mixed illustration; therefore, identifying where the issue lies becomes difficult. Nevertheless, both experiences can be true.

The discussion highlighted the impact of environmental factors that significantly impact the effectiveness of telehealth. Previous studies have found telehealth to be an exceptional tool for combating health complications such as obesity. Yücel and Yücel had favorable conclusions related to telehealth and its effectiveness in weight loss during COVID-19. The researchers found that video applications were significantly more effective when addressing weight loss than traditional in-person methods.³ Yücel and Yücel attribute these results to frequent check-ins allowed by video calls and determined that “TeleNutrition” is essential when in-person applications are not available such as during the pandemic. Similarly, Ross et al. found favorable results for telehealth as participants of that study lost an average of 7.4 kg, a 7.2% reduction in body weight from baseline to post-intervention, supporting telehealth as an intervention capable of achieving clinically meaningful benefits.⁷ Researchers infer the cause of the conflicting results between the current study and Ross et al., is related to the timing of the data collection. The current study was conducted five years post COVID-19 pandemic; therefore, the data collected represented insights during a time where patients and providers could take advantage of several intervention options (i.e. in-person, hybrid, virtual). This is opposed to Ross et al. and Yücel and Yücel’s studies, which took place during the midst of a pandemic where providers relied solely on virtual applications to navigate the lockdown restrictions.

Clinical trials can't accurately represent the integration of telehealth, especially in healthcare systems and specific client populations. From the current study, it was found that work environments and hospital frameworks may not be equipped to handle effective and integrative virtual practices such as telehealth. For instance, one RDN noted that they had limited access to educational materials such as meal plans due to their lack of infrastructural resources and security protocols, thus limiting the quality of care they can provide. The lack of generalizability of research to real-world scenarios relates to the variability in clinical environments. Existing research has claimed that telehealth offers more frequent care; however, this is not guaranteed for all hospital arrangements. Depending on the care team and what is deemed necessary, RDNs offer limited telehealth appointments. Although research shows that frequent care and check-ins provide clinically meaningful outcomes, there appears to lack external validity. Real-world barriers not represented in clinical research include healthcare lockdown browsers, security settings, clinical room access, different teaching methods, and conflicts within multidisciplinary teams. Providers engaging as integrative teams may be difficult due to poor collaborative attitudes, thus potential consequences for patient-centered and efficient care.¹⁹ Another disconnect lies in the accountability of patients. As pointed out by the current study and Gajarawala and Pelkowski, patients have negative feelings towards video-calls, as it requires the patient to be on camera causing feelings of anxiety. When a client refuses to turn on their camera, important body language and facial expressions may go undetected, potentially impacting the therapeutic dynamic and contributing to disengagement. Theoretically, telehealth is a solution to many problems; however, this appears to only be true when circumstances are optimal with high-speed internet, trained professionals, and a select population.

Implementation of telehealth services in a rural community may create additional

barriers. Factors such as technology access, insurance coverage, policy issues, socioeconomic variables, workforce training, and patient engagement may all impact provision of services. Existing research has found that telehealth aids rural communities by decreasing direct and indirect costs, increasing provider retention, and decreasing onsite resource utilization.⁴ The following results were associated with positive outcomes for both patients and providers living in rural areas.

Moreover, problems surface for RDNs with the integration of telehealth. The study confirmed the narrow scope of virtual modalities. RDNs expressed their concerns with the inability to conduct nutrition-focused physical exams and the accurate collection of anthropometric measurements necessary to provide personalized education and accurate interventions. The RDNs who spoke with the most negative conviction against telehealth worked in clinical domains, such as weight management with bariatric patients. Once more, the current research found negative associations between telehealth and weight management, while the previous studies found favorable outcomes.^{3,7} The standpoints contradict previous studies assessing telehealth and weight management. While some RDNs disapproved of telehealth, others discussed the importance of virtual modalities to their practice and felt that it was essential. To illustrate, community nutrition RDNs discussed the benefits of telehealth as a tool that allows for frequent care and expanded nutritional outreach. For community nutrition programs, such as the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC), telehealth addresses barriers such as traveling long distances to attend appointments and gain eligibility for benefits. As telehealth is applied to cohesive areas of nutrition, it increases food access and expedites care. Overall, telehealth is an advantageous tool when providing nutrition education, setting goals, and motivational interviewing. These forms of

care focus on verbal and visual education, which can be accomplished through virtual modalities. Additionally, telehealth is appropriate for follow-ups and check-ins after reviewing labs and charts. Future research assessing nutrition education and telehealth applications need to focus on fields other than weight management and weight loss outcomes. It stands to reason that telehealth may be beneficial in some areas such as eating disorders and sports nutrition based on the literature;²⁰⁻²² however, determining which expertise is the most suitable is needed.

Providers may deal with clients who don't prioritize their care, which can be frustratingly amplified through telehealth. Conjointly, patients may experience rushed appointments and disengaged providers. Overall, these experiences led to an area of consensus from both groups that telehealth could benefit from universal adoption of virtual appointment etiquette and social norms. Post-COVID-19, associations such as the American Medical Association (AMA) and the National Consortium of Telehealth Resource Centers (HTRC) have devised checklists and guides to aid providers and their care teams. The resources present standards and considerations to use telehealth at its full potential.²³⁻²⁵ Each of the tools provides recommendations related to equipment, environment, communication, and attire.²⁵ Some of the recommendations are as follows: assuring equipment being used is compatible with various devices and has access to high-speed internet; web cameras, microphones, headphones, and screens should all be adjusted and tested prior to the appointment; the environment should ensure privacy, follow HIPAA compliance, provide adequate lighting, and occur in an appropriate location such as an exam room; the communication between the provider and patient should be uninterrupted (I.e. other devices should be silenced) the webcam should show the provider, and the provider should maintain eye contact; the communication and dynamics between the patient and provider should replicate the professionalism that would be experienced in person; and final considerations

should be focused on professional attire.²⁵ Based on the focus groups within this study, there appears to be a gap in the recommendations for client etiquette and access to this material. Although telehealth etiquette has been established for providers, considerations need to also be focused on patient expectations and the distribution of materials.

Based on this study's results, it is apparent that telehealth is not yet the 'gold standard' or preferred method for dietary outreach and requires improvement. The results from the study imply that patient-provider concerns related to the integration of telehealth among rural areas suggest that future research should determine appropriate nutrition practices suitable for the unique experience of telehealth. Based on the findings, researchers can build upon the current literature and create new recommendations for telehealth as a nutrition outreach tool. An important finding discussed concerns related to the inefficiency of telehealth for specific practices; therefore, recommendations can be developed to offer hybrid models of nutritional care. Telehealth can be encouraged to be used only when the provider deems it appropriate or requires attending the initial consultation in person. Then, transitioning to telehealth services when suitable. Additional suggestions would be to require training to teach individuals how to establish rapport in a virtual environment. The significance of this research applies to RDNs and patient care, as there is limited research focused on telehealth as a nutritional resource. Future research should assess the development and effectiveness of providing digital accountability, such as habit monitoring apps, reminders, and check-ins, to combat the lack of patient engagement.

The study's limitations include the qualitative design of the study via focus groups, as this provides perspective-based data and viewpoints that are not quantified. Another limitation includes the demographic selection, as all subjects in FG 1 were educated white females, thus

reflecting a skewed population. Further, the limited sample size prevents generalizability and reflects potential biases. Strengths of the study include the real-life application of telehealth, which provides perspectives and insights that can't be seen in a randomized controlled trial. Moreover, researchers were able to assess the attitudes of telehealth post-pandemic, which provides new experiences and a direct comparison to in-person appointments. Overall, the qualitative methodology is a strength as it offers an in-depth understanding and emotional viewpoints related to telehealth. Future researchers should aim to replicate the study among more diverse populations, including objective measurements of patient outcomes. Additional focus should be applied to specific areas of nutrition to explore the application of telehealth as it affects different nutritional professions.

Conclusion

Through the focus groups researchers aimed to assess the perspectives of all parties, patients and RDNs, involved in dietary counseling through telehealth. Three significant themes were identified accompanied by detailed subthemes. Overall, there was a strong consensus that the adaptability of telehealth increased dietary outreach and was used out of convenience. Interestingly, it was found that telehealth has a negative impact on the dynamic of care between the provider and patient, thus creating frustrations related to the engagement over virtual appointments. Further, telehealth only accommodated specific nutrition protocols and accessibility may be limited by the healthcare systems. Lastly, significant barriers related to telehealth included technical issues and confusion related to online etiquette. Future research should determine the best practices of nutritional care that are suitable for telehealth modalities and discover the effectiveness of hybrid methods that involve a combination of virtual care as well as traditional. Telehealth as a dietary counseling method is complex and has a long way to

becoming the ‘gold standard’ for nutritional care. Implications of the study suggest practitioners develop formalities and distribute telehealth etiquette resources to manage the disengagement. To continue developing and improving virtual methods, future research should focus on expanding past weight management outcomes and focus on new populations such as working with athletes through telehealth or managing eating disorders virtually.

References

1. CDC. Adult Obesity Facts. Obesity. August 15, 2024. Accessed October 17, 2024. <https://www.cdc.gov/obesity/php/data-research/adult-obesity-facts.html>
2. CDC. About Chronic Diseases. Chronic Disease. October 4, 2024. Accessed November 7, 2024. <https://www.cdc.gov/chronic-disease/about/index.html>
3. Yücel ÜÖ, Yücel M. The effect of phone and video counselling given to participants living with obesity on weight loss and quality of life during the COVID-19 pandemic: a randomised controlled trial. *Journal of Human Nutrition and Dietetics*. 2023;36(4):1417-1424. doi:10.1111/jhn.13126
4. Butzner M, Cuffee Y. Telehealth Interventions and Outcomes Across Rural Communities in the United States: Narrative Review. *Journal of Medical Internet Research*. 2021;23(8):e29575. doi:10.2196/29575
5. Gajarawala SN, Pelkowski JN. Telehealth Benefits and Barriers. *The Journal for Nurse Practitioners*. 2021;17(2):218-221. doi:10.1016/j.nurpra.2020.09.013
6. Brunton C, Arensberg M, Drawert S, Badaracco C, Everett W, McCauley S. Perspectives of Registered Dietitian Nutritionists on Adoption of Telehealth for Nutrition Care during the COVID-19 Pandemic. *Healthcare*. 2021;9:235. doi:10.3390/healthcare9020235
7. Ross KM, Carpenter CA, Arroyo KM, et al. Impact of transition from face-to-face to telehealth on behavioral obesity treatment during the COVID-19 pandemic. *Obesity*. 2022;30(4):858-863. doi:10.1002/oby.23383
8. Rozga M, Handu D, Kelley K, et al. Telehealth During the COVID-19 Pandemic: A Cross-Sectional Survey of Registered Dietitian Nutritionists. *J Acad Nutr Diet*. 2021;121(12):2524-2535. doi:10.1016/j.jand.2021.01.009
9. Amore L, Buchthal OV, Banna JC. Identifying perceived barriers and enablers of healthy eating in college students in Hawai'i: a qualitative study using focus groups. *BMC Nutrition*. 2019;5(1):16. doi:10.1186/s40795-019-0280-0
10. Al-Adili L, McGreevy J, Orrevall Y, Nydahl M, Boström AM, Lövestam E. Setting goals with patients at risk of malnutrition: A focus group study with clinical dietitians. *Patient Educ Couns*. 2022;105(7):2103-2109. doi:10.1016/j.pec.2022.02.015
11. Jayasekara RS. Focus groups in nursing research: Methodological perspectives. *Nursing Outlook*. 2012;60(6):411-416. doi:10.1016/j.outlook.2012.02.001
12. Naeem M, Ozuem W, Howell K, Ranfagni S. A Step-by-Step Process of Thematic Analysis to Develop a Conceptual Model in Qualitative Research. *International Journal of Qualitative Methods*. 2023;22:16094069231205789. doi:10.1177/16094069231205789
13. Herbert J, Schumacher T, Brown LJ, Clarke ED, Collins CE. Delivery of telehealth nutrition

- and physical activity interventions to adults living in rural areas: a scoping review. *Int J Behav Nutr Phys Act.* 2023;20(1):110. doi:10.1186/s12966-023-01505-2
14. Perri MG, Shankar MN, Daniels MJ, et al. Effect of Telehealth Extended Care for Maintenance of Weight Loss in Rural US Communities: A Randomized Clinical Trial. *JAMA Network Open.* 2020;3(6):e206764. doi:10.1001/jamanetworkopen.2020.6764
 15. Vadheim LM, Patch K, Brokaw SM, et al. Telehealth delivery of the diabetes prevention program to rural communities. *Translational Behavioral Medicine.* 2017;7(2):286-291. doi:10.1007/s13142-017-0496-y
 16. Krishna VN, Managadi K, Smith M, Wallace E. Telehealth in the Delivery of Home Dialysis Care: Catching up With Technology. *Advances in Chronic Kidney Disease.* 2017;24(1):12-16. doi:10.1053/j.ackd.2016.11.014
 17. Trivedi R, Elshafie S, Tackett R, Young H, Sattler ELP. Effectiveness and Feasibility of Telehealth-Based Dietary Interventions Targeting Cardiovascular Disease Risk Factors: Systematic Review and Meta-Analysis. *Journal of Medical Internet Research.* 2024;26(1):e49178. doi:10.2196/49178
 18. CDC. Heart Disease Facts. Heart Disease. February 7, 2025. Accessed April 29, 2025. <https://www.cdc.gov/heart-disease/data-research/facts-stats/index.html>
 19. Cullati S, Bochatay N, Maître F, et al. When Team Conflicts Threaten Quality of Care: A Study of Health Care Professionals' Experiences and Perceptions. *Mayo Clin Proc Innov Qual Outcomes.* 2019;3(1):43-51. doi:10.1016/j.mayocpiqo.2018.11.003
 20. Novack K, Chadi N. The hybrid space in eating disorder treatment: towards a personalized approach to integrating telehealth and in-person care. *J Eat Disord.* 2025;13(1):22. doi:10.1186/s40337-025-01211-3
 21. Raykos BC, Erceg-Hurn DM, Hill J, Campbell BNC, McEvoy PM. Positive outcomes from integrating telehealth into routine clinical practice for eating disorders during COVID-19. *International Journal of Eating Disorders.* 2021;54(9):1689-1695. doi:10.1002/eat.23574
 22. Vasco P, Moscatelli F, La Torre ME, et al. Role of Technology Innovation in Telemedicine: Focus on Sport Nutrition. *Applied Sciences.* 2023;13(8):4837. doi:10.3390/app13084837
 23. Maintaining Person-Centered Care: A Guide to Telehealth Etiquette.
 24. National Consortium of Telehealth Resource Centers | Home. National Consortium of Telehealth Resource Centers. March 26, 2025. Accessed April 16, 2025. <https://telehealthresourcecenter.org/>
 25. Telehealth-Etiquette-Checklist.pdf. Accessed April 15, 2025. <https://telehealthresourcecenter.org/wp-content/uploads/2020/11/Telehealth-Etiquette-Checklist.pdf>

Characteristics Contributing to the Risk of Diabulimia in Adults Living in the United States

Danielle Van Hout, Tafere G Belay, Kelly Pritchett, Nicole Stendell-Hollis

Project Mentor(s): Nicole Stendell-Hollis, PhD, RDN (Nicole.Stendell-Hollis@cwu.edu);

Tafere G Belay, PhD; Kelly Pritchett, PhD, RDN, CSSD

Department of Health Sciences, Central Washington University

Abstract: The purpose of this study was to determine the prevalence and factors that contribute to the risk of diabulimia by using the validated Diabetes Eating Problem Survey-Revised (DEPS-R)¹ screening tool in adults living in the U.S., as well as to examine differences in individuals at-risk and not-at-risk for diabulimia. This observational study included a 30-question Qualtrics survey containing the DEPS-R distributed via various social media outlets and flyers on the CWU Ellensburg campus. Participants were required to be 18 years or older, diagnosed with T1DM for more than one year, and living in the U.S to participate. A total of 112 participants, 42 (37.2%) males and 68 (60.7%) females; age: 28.89 ± 10.48 years, were included in analysis. Of the sample, 43.8% were at risk for diabulimia based on the DEPS-R score cutoff. A previous eating disorder diagnosis ($X^2_{(3,112)} = 16.117, p < .001$), insulin restriction ($X^2_{(1,112)} = 31.638, p < .001$), and race ($X^2_{(1,112)} = 13.655, p < .001$) were associated with risk. In conclusion, it is essential to screen all patients with T1DM for diabulimia throughout their lifetime, which may necessitate revisions to current protocols regarding the frequency and content of diabetes education. The current study found contradicting literature on the factors contributing to an increased risk of diabulimia, including a higher prevalence in males than expected. Therefore, this warrants the need for future research and revisions to proposed diabulimia diagnostic criteria.

Keywords: Type 1 Diabetes Mellitus, Diabulimia, Eating Disorders, Diabetes Eating Problem Survey-Revised

Introduction

Type 1 Diabetes Mellitus (T1DM) accounts for approximately 5-10% of individuals with diabetes mellitus². T1DM is an autoimmune disorder characterized by damaged pancreatic beta cells, which leads to impaired insulin production by the pancreas, resulting in dysregulation of blood glucose levels². Thus, individuals will develop prolonged hyperglycemia as evidenced by elevated HbA1C levels³. Although the cause of T1DM is unknown, it is suggested that genetics, a viral infection, or environmental factors may lead to the development of T1DM^{2,4,5}. There is not currently a cure for T1DM thus far, but it can be properly managed through diabetes management education, blood glucose management, a healthy lifestyle, and getting regular checkups². As a consequence of poorly managed T1DM, various short- and long-term complications such as diabetic nephropathy, diabetic ketoacidosis, retinopathy, neuropathy, periodontal disease, cardiovascular disease, and peripheral vascular disease could arise⁶.

Due to the detailed meal planning, restriction of food intake, weight gain, and labeling of “good” and “bad” food, individuals with T1DM may be at an increased risk for eating disorders (ED) and insulin omission (IO) behaviors⁷⁻⁹. It is estimated that individuals with T1DM have a 2-to-3 times higher risk for developing an ED compared to their non-diabetic counterparts^{3,7,10-14}. The prevalence of ED among females with T1DM is approximately 30-40%^{3,15,16}. Although eating disorders are more prevalent in females, it is important not to overlook males in research examining ED behavior, as one study found that 15.9% of the male participants used unhealthy weight control practices¹⁷⁻²⁰. Diabulimia is characterized by the restriction or omission of insulin to lose weight, currently considered a subcategory of eating disorders due to the presence and extent of dietary restraint alongside insulin omission^{4,21,22}. Motives for restricting insulin may include weight dissatisfaction, lack of education, and socioeconomic status^{10,23,24}. The

consequences of IO are similar to those of unmanaged T1DM, with more frequent episodes of diabetic ketoacidosis and increased risk of mortality^{3,21,25,26}. The severity of the complications varies depending on how much and how often an individual restricts insulin.

Many scientific and health care professionals, as well as the American Diabetes Association²⁷, recognize the importance of screening and prevention for diabulimia, and propose that monitoring of eating disorders should be a part of diabetes care¹⁰. Furthermore, it is suggested that diabulimia should be recognized in the Diagnostic and Statistical Manual of Mental Disorders (DSM) criteria²⁸, which is a clinical diagnostic tool that provides standardized criteria for diagnosing mental disorders^{22,29}. However, there are substantial gaps and contradicting literature on the prevalence of diabulimia and IO. Past research in this area is limited in all populations, including studies in the United States. The purpose of this study was to determine the prevalence and associated factors to the risk of diabulimia by using the validated Diabetes Eating Problem Survey-Revised (DEPS-R)¹ screening tool in adults living in the U.S., as well as to examine differences in individuals at-risk and not-at-risk for diabulimia.

Methods

Study Design

This observational study was conducted between February 2024 to February 2025. A Qualtrics survey examining diabetes management, insulin habits, and eating habits was distributed via a variety of social media outlets and word of mouth. Social media outlets such as Instagram, Facebook, Reddit, Discord, and Canvas discussion boards were used. The survey was distributed in various Type 1 Diabetes support groups on Facebook and Reddit. Additionally, the survey was also distributed via fliers with a QR code link to the survey that were placed around the campus of Central Washington University, located in Ellensburg, WA. Lastly, the survey was

distributed to all of the directors of DPD programs at various colleges in the United States. This study was approved by the Human Subjects Review Committee at Central Washington University. All participants were asked to read, electronically sign, and provide consent.

Participants

The inclusion criteria were: (1) self-reported diagnosis of T1DM for more than one year; (2) must be 18 years or older; (3) live in the United States; and (4) have access to an electronic device and internet access.

The exclusion criteria were: (1) individuals with Type 2 Diabetes Mellitus; (2) do not live in the United States; and/or (3) not over the age of 18.

Study Questionnaire

All participants were provided access to the self-administered questionnaire after attaining consent. Participants were asked to complete a 30-question survey that included the validated Diabetes Eating Problem Survey-Revised Questionnaire (DEPS-R)¹. The DEPS-R is a self-administered scale designed to screen for disordered eating behaviors over the past 28 days in patients with diabetes. The original 28-item DEPS was revised and shortened by Markowitz (2009) and was renamed DEPS-R¹. The DEPS-R is a 16-item questionnaire used to screen adolescents and adults with T1DM who may have disordered eating habits. The questionnaire included questions regarding eating habits, diabetes control, insulin misuse, and other behaviors¹. The questionnaire uses a 6-point Likert scale to determine risk (0 = never; 1 = rarely; 2 = sometimes; 3 = often; 4 = usually; 5 = always). Scoring instructions include: (1) Calculate the mean of all non-missing items, (2) multiply this value by 16¹. The total score is out of 80, a score ≥ 20 indicates more disordered eating behavior and warrants referrals and further clinical assessment¹. Depending on the scores of the DEPS-R questionnaire, participants will be placed

into two groups: ≥ 20 is considered at risk for diabulimia, and < 20 is considered not at risk for diabulimia.

Demographic data were gathered, including gender, age, race/ethnicity, last HbA1C percentage, frequency of diabetes education, method of insulin administration, duration since initial diagnosis of T1DM, college student status, diagnosis of an ED, frequency of insulin misuse, and self-reported height and weight. Many protective measures were embedded within the survey to protect against bot infiltration. For example, ballot box stuffing was added to the survey to prevent multiple and duplicate submissions³⁰. In addition, relevant ID and reCAPTCHA scores have also been added to the survey database³⁰. ReCAPTCHA uses Google's invisible reCAPTCHA technology to create a reCAPTCHA score, which is used to determine the probability that a respondent is a bot. The minimum value is 0, and the maximum value is 1.0. A score of greater than or equal to 0.5 means the respondent is likely a human. A score of less than or equal to 0.5 means the respondent is likely a bot³⁰⁻³². As this is an online survey, no identifiers such as name or location were collected. Four \$25 Amazon gift cards were awarded to four random participants as an incentive for completing the survey. Participants voluntarily provided their email if they wanted to be entered into the randomized drawing.

Statistical Analysis

Statistical analysis was completed using SPSS (SPSS Modeler, Version 29, IBM, Armonk, NY, USA). Descriptive statistics (age, gender, ethnicity, duration of T1DM in years, and frequency of insulin misuse) are shown as frequencies and displayed as mean $\pm$ SD. A chi-squared analysis was conducted to determine the relationship between the categorical variables (T1DM duration, BMI, race, etc.) to the risk groups (at-risk or not-at-risk). A logistical regression was conducted to investigate the relationships between the explanatory variables and

the outcome variable, multiple variable logistic regression analyses were employed. The confidence level was set at 95% at an alpha level of <0.05 . Hemoglobin A1c was categorized to assess the differences between participants in the normal category vs. pre-diabetes and diabetes, and vice versa.

Results

In total, there were 116 participants who completed the survey. Of those, two were detected as bots and were excluded. Additionally, two did not fit the inclusion criteria for having a diagnosis of T1DM for at least one year. Therefore, 112 participants were included in the analysis.

The demographic, lifestyle, as well as clinical characteristics of the sample ($n = 112$) are displayed in Table 1. Of the 112 participants, 37.2% were male. The mean age of the population was 29.89 ± 10.48 years, the mean BMI was 26.35 ± 6.73 kg/m², the mean HbA1c percent was 7.03 ± 1.69 , and the mean duration of diagnosis was 14.69 ± 6.73 years. Most of the study participants were White/Caucasian (83.9%), had received diabetes education at least once (87.6%), and were not diagnosed with an eating disorder (84.8%). Of the participants, 43.8% were at risk of diabulimia with a mean DEPS-R score of 21.57 ± 15.14 .

Table 1. Descriptive Characteristics of Study Participants ($n = 112$)

Variable	Mean $\pm$ SD	n (%)
Age (years)	29.9 ± 10.5	
18-25		46 (41.1%)
26-36		40 (35.7%)
≥ 36		24 (21.4%)
Gender		
Male		42 (37.2%)
Female		68 (60.7%)

Variable	Mean $\pm$ SD	n (%)
Race		
White/Caucasian		94 (83.9%)
Hispanic/Latino		5 (4.5%)
American Indian or Alaskan Native		1 (0.9%)
Black/African American		6 (5.4%)
Asian/Pacific Islander		2 (1.8%)
Mixed Race		4 (3.6%)
BMI (kg/m²)	26.4 $\pm$ 6.7	
Underweight		10 (8.9%)
Normal weight		42 (37.5%)
Overweight		32 (28.6%)
Obese (Class 1-3)		27 (24.1%)
HbA1c (%)	7.0 $\pm$ 1.7	
< 6.99%		65 (58.0%)
$\geq$ 7%		41 (36.6 %)
Duration of diagnosis (years)	14.7 $\pm$ 11.7	
0-10 years		50 (44.6%)
11-20 years		31 (27.7%)
21-30 years		18 (16.1%)
$\geq$ 31 years		13 (11.6%)
College student status		
No		68 (60.7%)
Yes		44 (39.3%)
Insulin restriction frequency		
Never		77 (68.8%)
Once per week		12 (10.7%)
Twice per week		9 (8.0%)
More than 3 times per week		14 (12.5%)
Eating disorder diagnosis		
No		95 (84.8%)
Yes		17 (15.2%)
ED diagnosis Type		
None		76 (67.9%)
Anorexia Nervosa		3 (2.7%)
Binge-eating disorder		7 (6.3%)
Bulimia Nervosa		6 (5.4%)
OSFED		4 (3.6%)

Variable	Mean $\pm$ SD	n (%)
Prefer not to say		16 (14.3%)
Insulin administration		
Insulin injections		21 (18.8%)
External insulin pump		65 (58.0%)
Insulin port		2 (1.8%)
Insulin pen		23 (20.5%)
Other		1 (0.9%)
Diabetes education frequency		
No		14 (12.5%)
Yes, once		33 (29.5%)
Yes, a few times		45 (40.2%)
Yes, more than a few times		20 (17.9%)
DEPS-R Score	21.6 $\pm$ 15.1	
Not at risk (≤ 20)		63 (56.3%)
At-risk (> 21)		49 (43.8%)

Abbreviations: SD, standard deviation; BMI, body mass index; HbA1c, hemoglobin A1c; ED, eating disorder; DEPS-R, Diabetes Eating Problem Survey-Revised.

The Chi-squared analysis (Table 2) showed that 38.8% of the group at risk were males. Insulin restriction ($X^2_{(1,112)} = 31.638, p < .001$), eating disorder diagnosis ($X^2_{(1,112)} = 16.117, p < .001$), type of eating disorder ($X^2_{(5,112)} = 18.251, p = .003$), and race ($X^2_{(1,112)} = 13.655, p < .001$) are all significantly associated with risk for diabulimia. Lastly, duration of diagnosis was close to significance ($X^2_{(3,112)} = 7.792, p = .051$).

Table 2. Chi-Squared Analysis of Continuous Variables in Relation to Categorized DEPS-R

Score

Variable	Not-at Risk n (%)	At-Risk n (%)	X² (df,n)	p-value
Gender			0.013 (1,110)	0.532
Male	23 (37.7)	19 (38.8)		
Female	38 (62.3)	30 (61.2)		
College student status			2.139 (1,112)	0.103
No	42 (66.7)	26 (53.1)		
Yes	21 (33)	23 (46.9)		
Insulin restriction			31.638 (1,112)	<0.001
Never	57 (90.5)	20 (40.8)		
1x/wk or more	6 (9.5)	29 (59.2)		
Eating disorder diagnosis			16.117 (1,112)	<0.001
No	61 (96.8)	34 (69.4)		
Yes	2 (3.2)	15 (30.6)		
ED diagnosis type			18.251 (5,112)	0.003
None	51 (80.9)	25 (51.0)		
Anorexia Nervosa	1 (1.6)	2 (4.1)		
Binge-eating disorder	1 (1.6)	6 (12.2)		
Bulimia Nervosa	1 (1.6)	5 (10.2)		
OSFED	0 (0)	4 (8.2)		
Prefer not to say	9 (14.3)	7 (14.3)		
Insulin administration			2.847 (4,112)	0.584
Insulin injections	10 (15.9)	11 (22.5)		
External insulin pump	40 (63.5)	25 (51.0)		
Insulin port	1 (1.6)	1 (2.0)		
Insulin pen	11 (17.4)	12 (24.5)		
Other	1 (1.6)	0 (0.0)		
Diabetes education frequency			0.717 (3,112)	0.869
No	9 (14.3)	5 (10.2)		
Yes, once	19 (30.1)	14 (28.6)		
Yes, a few times	25 (39.7)	20 (40.8)		
Yes, more than a few times	10 (15.9)	10 (20.4)		
Age (years)			1.563 (2,110)	0.458
18-25	24 (39.4)	22 (44.9)		
26-36	21 (34.4)	19 (38.8)		

Variable	Not-at Risk n (%)	At-Risk n (%)	X² (df,n)	p-value
≥ 36	16 (26.2)	8 (16.3)		
BMI			6.004 (0.111)	0.111
Underweight	4 (6.4)	6 (12.5)		
Normal weight	29 (46.0)	13 (27.1)		
Overweight	14 (22.2)	18 (37.5)		
Obese (Class 1-3)	16 (25.4)	11 (22.9)		
HbA1c (%)			0.057 (1,106)	0.530
< 5.69	8 (12.9)	5 (11.4)		
≥ 5.7	54 (87.1)	39 (88.6)		
HbA1c (%)			0.221 (1,106)	0.400
< 6.39	21 (33.9)	13 (29.5)		
≥ 6.7	41 (66.1)	31 (70.5)		
Duration of diagnosis (years)			7.792 (3,112)	0.051
0-10 years	22 (34.9)	28 (57.1)		
11-20 years	19 (30.1)	12 (24.5)		
21-30 years	11 (17.5)	7 (14.3)		
≥ 31 years	11 (17.5)	2 (4.1)		
Race			13.655 (1,112)	0.001
White/Caucasian	60 (95.2)	34 (69.4)		
Other	3 (4.8)	15 (30.6)		

Abbreviations: BMI, body mass index; HbA1c, hemoglobin A1c; ED, eating disorder; DEPS-R, Diabetes Eating Problem Survey-Revised.

Logistical regression analysis (Table 3) displays associations with DEPS-R score after adjusting for variables including insulin restriction, age, BMI, race, and ED diagnosis. Restricting insulin demonstrated a significant association with DEPS-R score (OR = 8.87; 95% CI 2.92, 26.9). Individuals with a race other than White/Caucasian had higher odds of diabulimia (OR = 5.52, 95% CI 1.11, 27.32). Furthermore, the odds of experiencing diabulimia was higher in individuals diagnosed for ED although the association was not significant.

Table 3. Factors Correlating with DEPS-R Score Based on Logistical Regression

Factor	OR (95% CI)	p-value
Insulin restriction		
No	1 (Ref)	
Yes	8.87 (2.92, 26.955)	<0.001
Age (years)		
18-25	1	0.964
26-36	1.01 (0.34, 3.03)	0.980
≥36	0.86 (0.24, 3.03)	0.811
BMI		
Underweight	1	0.482
Normal weight	1.23 (0.13, 12.09)	0.860
Overweight	2.91 (0.28, 30.05)	0.370
Obese (Class 1-3)	2.13 (0.20, 22.63)	0.530
Race		
White/Caucasian	1	
Other	5.52 (1.11, 27.32)	0.037
Eating disorder diagnosis		
No	1	
Yes	4.84 (0.80, 29.42)	0.087

Abbreviations: BMI, body mass index; HbA1c, hemoglobin A1c; ED, eating disorder; DEPS-R, Diabetes Eating Problem Survey-Revised.

Discussion

The prevalence, prevention, and treatment of diabulimia are still not fully understood. Due to the medical complications that can arise after prolonged omission of insulin, it is essential that we identify factors contributing to diabulimia and determine accessible, affordable, and cohesive treatment options for individuals with T1DM. This study aimed to assess the prevalence of diabulimia as well as the factors associated to an increased risk. The study suggests that race, insulin restriction, and a prior ED diagnosis were the main predictor variables associated with an increased risk of diabulimia. Although eating disorder diagnosis was initially significant, it was

no longer a significant factor in further analysis. Additionally, age, gender, BMI, HbA1c, duration of diabetes diagnosis, and frequency of diabetes education were also not significantly associated with the risk of diabulimia.

The prevalence of diabulimia is still being established, as the current literature is contradictory due to different methods used in studies to assess risk, as well as unclear diagnostic criteria. Diabulimia is not recognized in the DSM-5 and is a complex disorder, making it difficult to properly detect and diagnose^{28,29}. A study conducted in the U.S. with 225 participants over the age of 18 with T1DM found that 8.9% were positive for increased risk of diabulimia²¹. Another study conducted in Norway found that of their 770 participants aged 11-19 years old, 33.3% of the female participants were at risk¹⁵. Furthermore, another study conducted in 211 individuals with T1DM aged 13-55 years old found that 60.2% of the sample was at risk for diabulimia³³. In the current study, 43.8% of the participants were identified as being at risk for diabulimia. These findings align with existing literature, which estimates that individuals with T1DM have an approximately 9-60% increased risk of developing diabulimia. Given the lack of formal diagnostic criteria, diabulimia is likely underreported. Thus, this study contributes valuable insight to the existing body of knowledge and may help improve the accuracy of prevalence estimates.

It has been reported that individuals with T1DM, especially females, have an increased risk of ED behavior and are more likely to be at risk for diabulmia^{8,11,12,21,34,35}. This increased risk is found to be due to psychosocial factors such as societal pressures, weight dissatisfaction, and diabetes distress^{3,7,15-18,21,36,37}. The lifetime prevalence of eating disorders among females is estimated to be 8.60%, compared to 4.07% among males^{18,36}. On average, it is estimated that among individuals with T1DM aged 15 to 30, 40% of females and 10% of males misuse insulin⁴,

a risk factor for diabulimia. The current study contradicts these findings, with no significant difference between males and females for increased risk of diabulimia. In fact, of the participants who scored in the at-risk category, 38.8% were male. This may indicate that males are overlooked and underrepresented in diabulimia research, and the prevalence in males may be higher than expected. Based on these findings, it is essential that health care professionals take this into consideration and ensure they are adequately screening all patients for diabulimia.

As mentioned above, individuals with T1DM have an increased risk of developing eating disorders. Specifically, one study found that individuals with T1DM have a 2-to-3-fold higher risk of developing an eating disorder, compared to their non-diabetic counterparts^{3,7,10-14}. The current study's results supported these findings, with a significant association between an eating disorder diagnosis and risk of diabulimia. Furthermore, the researchers also found a significant association between the type of eating disorder (anorexia nervosa, bulimia nervosa, binge eating disorder, and other specified feeding or eating disorder) the participant is diagnosed with and DEPS-R score. Although ED diagnosis was no longer significant in the logistic regression after adjusting for other variables, it remains important to recognize this in clinical practice. Clinicians should avoid assuming that an individual with T1DM and an ED diagnosis also has diabulimia. Nevertheless, awareness of this potential association is crucial when providing nutrition education and discussing treatment options.

The current study found that insulin restriction was associated with an increased risk of diabulimia. Diabulimia is the act of skipping or restricting insulin to lose weight^{4,21}. Thus, the researchers expected insulin restriction to be significant since insulin restriction is a main indicator of diabulimia risk^{35,38}. The study conducted by Ip et al. (2023) found that insulin restriction is associated with poor glycemic control, diabetic ketoacidosis, an increased relative

risk of death, and risk of diabulimia²¹. There are many reasons that an individual may restrict insulin, such as lack of education, socioeconomic status, weight control, and diabetes burnout, which is a state of emotional and physical exhaustion that can occur in individuals with diabetes^{10,37}. More education needs to occur on the dangers and risks of skipping insulin. Depending on the severity and duration of insulin omission, complications may vary. Short-term consequences include hyperglycemia, increased levels of ketones, excessive thirst, fatigue, frequent urination, and cognitive decline^{10,39}. Whereas long-term consequences include poor metabolic control, high HbA1c levels, recurrent diabetic ketoacidosis, microvascular complications, retinopathy, nephropathy, premature death, and increased risk of mortality^{10,21,25,26,40,41}. Diabulimia and eating disorders are complex and involve psychological, social, environmental, and lifestyle factors that contribute to the development of this disorder. Various medical professionals, in different fields, may be a necessary part of treatment depending on the needs of the individual. Therefore, it is important that a multi-disciplinary team is involved in the treatment and prevention of diabulimia and insulin restriction.

It was hypothesized that a higher frequency of diabetes education would be associated with a lower risk of diabulimia; however, this was not observed. This finding may suggest that current diabetes education does not adequately address the importance of appropriate insulin administration in relation to food intake. As a result, Registered Dietitian Nutritionists (RDNs) may need to expand the scope of education provided during these visits. Specifically, 1) increase the frequency of required visits from individuals with T1DM, 2) ensure education on the dangers of restricting insulin, and 3) provide additional resources to patients with an increased risk of these behaviors.

However, more education does not mean that the individual will not restrict insulin. For example, one study examined 128 young adult, Portuguese individuals, where 55 of them had T1DM, and 73 did not have T1DM⁴². The results showed that 20.8% of the individuals with T1DM reported they stopped taking insulin intentionally, and 7.3% said they stopped specifically to lose weight⁴². The participants who omitted insulin were aware of the risks and varied in the duration of insulin omission⁴². Another study conducted in the UK with 45 individuals showed that 39 (87%) of the participants knew how serious the complications of diabulimia were, but continued to restrict insulin regardless²⁸. Many of the participants said they restricted insulin to gain back control, and they knew the consequences of restricting insulin, but found it too difficult to stop²⁸. This suggests that diabulimia and insulin restriction have a large psychological component, and it is important to address this in clinical practice. Moreover, education on insulin restriction could inadvertently introduce individuals to this behavior as a method of weight loss, particularly if they were previously unaware.

Age has also been considered a significant factor thought to contribute to the risk of diabulimia, as it has been suggested that adolescents and early adults are at a higher risk for developing it¹⁵. One study conducted in Canada, including 88 females between the ages of 12 and 18, examined this¹⁴. The results showed that IO to control weight was reported by 18 (14%) of the individuals at baseline, and after a 5-year follow-up, 30 (34%) reported these behaviors¹⁴, suggesting increased risk over time. It is suggested that screening for IO should start in early adolescence and continue through adulthood, as many ED behaviors begin during this time span and can persist for many years⁸. Although the current study did not find significant association between age and risk. Nonetheless, it may be beneficial to screen for diabulimia later in life, when diabetes burnout begins to arise, which could possibly be a factor contributing to IO.

It has been suggested that individuals with T1DM are at a higher risk of body dissatisfaction due to the sudden weight gain they experience after they start treatment¹⁰. As a result, many research studies have suggested that individuals restrict insulin to combat this in an attempt to lose weight^{10,43,44}. A study done by Coleman and Caswell (2020) found that of their participants, 78% stated their main reason for restricting insulin was weight loss²⁸. Body dissatisfaction, weight concern, and fear of gaining weight all contribute to IO in individuals with T1DM, and they may see it as an effective way of weight loss^{8,43,44}. Although the current study found no association between BMI and risk of diabulimia, contrary to previous findings, this discrepancy may be attributed to the use of self-reported height and weight. Further, if an individual has been restricting insulin for a long time, then their BMI may be in the normal range. Conversely, if the individual lies in the overweight or obese category, that does not mean they have or have not restricted insulin. Therefore, it is important to take into account that weight dissatisfaction and body satisfaction may be related to IO, but there are additional factors to consider. Additionally, BMI is not an accurate indicator of body dissatisfaction, and the DEPS-R did not adequately and accurately assess body dissatisfaction and weight concern.

It is suggested that IO and diabulimia are associated with poor glycemic control and an increased risk of morbidity and mortality⁴⁵⁻⁴⁷. The study done by Ip et al. (2023) found that of their study participants, those who screened positive for diabulimia also had higher HbA1c levels²¹. Furthermore, the study conducted by Wisting et al. (2013) found that all of their participants who were at risk also had significantly higher HbA1c levels¹⁵. The current study contradicts these findings by finding no association between HbA1c levels and DEPS-R score. The researchers may not have found a significant result due to the possibility that participants may not have accurately recalled the results of their last HbA1c. Additionally, depending on the

severity and frequency an individual restricts insulin, they may be at risk, but their HbA1c level might not accurately reflect this. Lastly, if the participants recently started restricting their insulin, it may not yet be reflected in their labs. Therefore, high HbA1c levels may be a concerning marker to check for risk, but we should also be screening individuals with normal HbA1c, as they also may be restricting insulin and be at risk for diabulimia.

The researchers hypothesized that the duration of diagnosis would be associated with a higher DEPS-R score. Specifically, those who have been diagnosed for less than ten years, compared to those who have been diagnosed for many decades. Those who were diagnosed for less than ten years may be at a higher risk due to body dissatisfaction, and coping with life, living with a chronic disease^{10,28,43,44}. On the contrary, those who have been diagnosed for many decades may experience diabetes burnout, or depression, and have an increased risk for diabulimia^{10,21,23}. It has been established that there is a bidirectional relationship and a fourfold increase between depression and individuals with T1DM. Specifically, increased depressive symptoms lead to decreased diabetes management, and vice versa^{10,39,48,49}. The current study found that this was close to significance ($p = .051$); therefore, it is possible that with a larger sample size, a significant association between duration of diagnosis and risk of diabulimia would be observed. Other potential factors contributing to this may be experience, familiarity, and adherence. Individuals who have recently been diagnosed may have better adherence to the protocols of proper diabetes management. On the contrary, individuals who have had years of experience in managing their diabetes may be able to manipulate their insulin without consequences. Therefore, it is important to recognize that each experience with managing diabetes is very different, and it remains important to be aware of this and screen all patients for diabulimia regardless of how long they have been diagnosed.

The last significant finding in the current study is race, which was significantly associated with DEPS-R score and remained significant after adjusting for other variables. It is important to note that most (84%) of the study population identified as White/Caucasian. A study conducted in the U.S. included 70 adolescent females and 73 adolescent males with T1DM, found that although it is not significant, and the majority of the study population was White/Caucasian, 66.7% of the nonwhite females reported unhealthy or very unhealthy weight control behaviors, compared to only 31.6% of the White females¹⁹. Although racial disparities among diabulimia are not fully understood, it has been established that nonwhite individuals experience unequal access to diabetes care⁵⁰. There are many possibilities that the current study found an increased risk in nonwhite racial groups. For instance, in many communities, there may be cultural pressures related to body image, and social stigma related to eating disorders and getting treatment. Furthermore, socioeconomic status and equal access to healthcare may prevent these individuals from getting the treatment they require. Therefore, it is important to take this into account when looking at prevention and treatment options for diabulimia. Ensuring equal access to resources for all individuals with T1DM can be beneficial in early detection and adequate treatment options.

This study contributed to the limited research on diabulimia, and characteristics associated with a higher risk; however, it does have limitations. For example, the self-reported nature of this study lacks validity; causality cannot be determined; and finally, the inclusion of a relatively small sample. Strengths of the study include adding to the limited research in this field and providing additional information on the prevalence. Additionally, the current study found contradicting findings on the risk factors associated with diabulimia. Therefore, this highlights the need for frequent screening and aids in developing targeted interventions. Lastly, although

the current study uses the DEPS-R, a validated questionnaire, the findings highlight a need for revisions to the questionnaire's scoring and content.

Based on the findings of the current study, future research is needed to determine a causal relationship between these factors and the risk of diabulimia. Furthermore, it may be valuable to explore the clinical implications and develop more effective strategies to treat and prevent diabulimia, such as adding more detail to the DSM-5. Additionally, based on the finding that males may be at a higher risk than expected, more research in males is required. There are also limited studies in the U.S. in regard to diabulimia research; more longitudinal research studies are warranted. Future research should also primarily be focused on the diagnostic protocol regarding the frequency and duration of IO.

Conclusion

In conclusion, it is essential to screen all patients with T1DM for diabulimia throughout their lifetime, which may necessitate revisions to current protocols regarding the frequency and content of diabetes education. Accurately preventing, screening, and treating diabulimia is crucial and takes a multidisciplinary team of healthcare workers. In the current study, some factors associated with a higher DEPS-R score, thus a higher risk of diabulimia, contradict current literature. Therefore, additional research is needed to accurately determine the factors associated with a higher risk and the clinical implications of these findings, including increased research in males. It has been suggested that there is a bidirectional relationship between T1DM and depression. Thus, research should consider using the Beck Depression Inventory and other validated surveys to assess more factors that could contribute to diabulimia, leading to a greater understanding of the disease. Lastly, future research should primarily be focused on revisions to diagnostic protocols focused on duration and frequency of IO.

References

1. Markowitz JT, Butler DA, Volkening LK, Antisdel JE, Anderson BJ, Laffel LMB. Brief Screening Tool for Disordered Eating in Diabetes: Internal consistency and external validity in a contemporary sample of pediatric patients with type 1 diabetes. *Diabetes Care*. 2009;33(3):495-500. doi:10.2337/dc09-1890
2. CDC. What Is Type 1 Diabetes? Centers for Disease Control and Prevention. September 5, 2023. Accessed April 8, 2024. <https://www.cdc.gov/diabetes/basics/what-is-type-1-diabetes.html>
3. Wisting L, Reas DL, Bang L, Skrivarhaug T, Dahl-Jørgensen K, Rø Ø. Eating patterns in adolescents with type 1 diabetes: Associations with metabolic control, insulin omission, and eating disorder pathology. *Appetite*. 2017;114:226-231. doi:10.1016/j.appet.2017.03.035
4. Diabulimia: What It Is, Symptoms, Risk Factors & Treatment. Cleveland Clinic. Accessed October 16, 2024. <https://my.clevelandclinic.org/health/diseases/22658-diabulimia>
5. Type 1 diabetes - Symptoms and causes. Mayo Clinic. Accessed October 9, 2024. <https://www.mayoclinic.org/diseases-conditions/type-1-diabetes/symptoms-causes/syc-20353011>
6. Diabetes Complications. January 24, 2022. Accessed April 10, 2024. <https://admin.endocrine.org/patient-engagement/endocrine-library/diabetes-complications>
7. Kınık MF, Gönüllü FV, Vatansever Z, Karakaya I. Diabulimia, a Type I diabetes mellitus-specific eating disorder. *Turkish Archives of Pediatrics/Türk Pediatri Arşivi*. 2017;52(1):46. doi:10.5152/TurkPediatriArs.2017.2366
8. Hanlan ME, Griffith J, Patel N, Jaser SS. Eating Disorders and Disordered Eating in Type 1 Diabetes: Prevalence, Screening, and Treatment Options. *Curr Diab Rep*. 2013;13(6):909-916. doi:10.1007/s11892-013-0418-4
9. Colton P, Rodin G, Bergenstal R, Parkin C. Eating Disorders and Diabetes: Introduction and Overview | Diabetes Spectrum | American Diabetes Association. 2009. Accessed January 10, 2025. <https://diabetesjournals.org/spectrum/article/22/3/138/2391/Eating-Disorders-and-Diabetes-Introduction-and>
10. Hall R, Keeble L, Sünram-Lea SI, To M. A review of risk factors associated with insulin omission for weight loss in type 1 diabetes. *Clin Child Psychol Psychiatry*. 2021;26(3):606-616. doi:10.1177/13591045211026142
11. Mannucci E, Rotella F, Ricca V, Moretti S, Placidi GF, Rotella CM. Eating disorders in patients with type 1 diabetes: a meta-analysis. *J Endocrinol Invest*. 2005;28(5):417-419. doi:10.1007/BF03347221

12. Nielsen S. Eating disorders in females with type 1 diabetes: an update of a meta-analysis. *European Eating Disorders Review*. 2002;10(4):241-254. doi:10.1002/erv.474
13. Young V, Eiser C, Johnson B, et al. Eating problems in adolescents with Type 1 diabetes: a systematic review with meta-analysis. *Diabet Med*. 2013;30(2):189-198. doi:10.1111/j.1464-5491.2012.03771.x
14. Rydall AC, Rodin GM, Olmsted MP, Devenyi RG, Daneman D. Disordered eating behavior and microvascular complications in young women with insulin-dependent diabetes mellitus. *N Engl J Med*. 1997;336(26):1849-1854. doi:10.1056/NEJM199706263362601
15. Wisting L, Frøisland DH, Skrivarhaug T, Dahl-Jørgensen K, Rø O. Disturbed eating behavior and omission of insulin in adolescents receiving intensified insulin treatment: a nationwide population-based study. *Diabetes Care*. 2013;36(11):3382-3387. doi:10.2337/dc13-0431
16. Baechle C, Castillo K, Straßburger K, et al. Is disordered eating behavior more prevalent in adolescents with early-onset type 1 diabetes than in their representative peers? *Int J Eat Disord*. 2014;47(4):342-352. doi:10.1002/eat.22238
17. Galmiche M, Déchelotte P, Lambert G, Tavalacci MP. Prevalence of eating disorders over the 2000–2018 period: a systematic literature review. *The American Journal of Clinical Nutrition*. 2019;109(5):1402-1413. doi:10.1093/ajcn/nqy342
18. Team S. Eating disorder statistics in the U.S. in 2020. The Checkup. June 3, 2020. Accessed October 16, 2024. <https://www.singlecare.com/blog/news/eating-disorder-statistics/>
19. Neumark-Sztainer D, Patterson J, Mellin A, et al. Weight control practices and disordered eating behaviors among adolescent females and males with type 1 diabetes: associations with sociodemographics, weight concerns, familial factors, and metabolic outcomes. *Diabetes Care*. 2002;25(8):1289-1296. doi:10.2337/diacare.25.8.1289
20. Eating Disorder Statistics. National Eating Disorders Association. Accessed October 30, 2024. <https://www.nationaleatingdisorders.org/statistics/>
21. Ip EJ, Doroudgar S, Salehi A, Salehi F, Najmi M. Diabulimia: A Risky Trend Among Adults with Type 1 Diabetes Mellitus. *Endocr Pract*. 2023;29(11):849-854. doi:10.1016/j.eprac.2023.08.001
22. dsm-5 criteria.pdf. Accessed October 16, 2024. <https://insideoutinstitute.org.au/assets/dsm-5%20criteria.pdf>
23. Young-Hyman DL, Peterson CM, Fischer S, Markowitz JT, Muir AB, Laffel LM. Depressive Symptoms, Emotion Dysregulation, and Bulimic Symptoms in Youth With Type 1 Diabetes: Varying Interactions at Diagnosis and During Transition to Insulin

- Pump Therapy. *Journal of Diabetes Science and Technology*. 2016;10(4):845. doi:10.1177/1932296816645118
24. Young-Hyman D, Groot M de, Hill-Briggs F, Gonzalez JS, Hood K, Peyrot M. Psychosocial Care for People With Diabetes: A Position Statement of the American Diabetes Association. *Diabetes Care*. 2016;39(12):2126. doi:10.2337/dc16-2053
 25. Goebel-Fabbri AE. Disturbed eating behaviors and eating disorders in type 1 diabetes: clinical significance and treatment recommendations. *Curr Diab Rep*. 2009;9(2):133-139. doi:10.1007/s11892-009-0023-8
 26. Candler T, Murphy R, Pigott A, Gregory JW. Fifteen-minute consultation: Diabulimia and disordered eating in childhood diabetes. *Arch Dis Child Educ Pract Ed*. 2018;103(3):118-123. doi:10.1136/archdischild-2017-312689
 27. Types of Eating Disorders | American Diabetes Association. Accessed June 9, 2025. <https://diabetes.org/health-wellness/mental-health/eating-disorders>
 28. Coleman SE, Caswell N. Diabetes and eating disorders: an exploration of “Diabulimia.” *BMC Psychol*. 2020;8(1):101. doi:10.1186/s40359-020-00468-4
 29. DSM-5: What It Is & What It Diagnoses. Cleveland Clinic. Accessed February 2, 2025. <https://my.clevelandclinic.org/health/articles/24291-diagnostic-and-statistical-manual-dsm-5>
 30. Fraud Detection. Accessed November 27, 2024. <https://www.qualtrics.com/support/survey-platform/survey-module/survey-checker/fraud-detection/>
 31. reCAPTCHA v3. Google for Developers. Accessed November 27, 2024. <https://developers.google.com/recaptcha/docs/v3>
 32. Griffin M, Martino RJ, LoSchiavo C, et al. Ensuring survey research data integrity in the era of internet bots. *Qual Quant*. 2022;56(4):2841-2852. doi:10.1007/s11135-021-01252-1
 33. Deiana V, Diana E, Pinna F, et al. Clinical features in insulin-treated diabetes with comorbid diabulimia, disordered eating behaviors and eating disorders. *European Psychiatry*. 2016;33:S81. doi:10.1016/j.eurpsy.2016.01.029
 34. Dean YE, Motawea KR, Aslam M, et al. Association Between Type 1 Diabetes Mellitus and Eating Disorders: A Systematic Review and Meta-Analysis. *Endocrinol Diabetes Metab*. 2024;7(3):e473. doi:10.1002/edm2.473
 35. Rodin G, Craven J, Littlefield C, Murray M, Daneman D. Eating disorders and intentional insulin undertreatment in adolescent females with diabetes. *Psychosomatics*. 1991;32(2):171-176. doi:10.1016/S0033-3182(91)72088-4

36. Eating Disorder Statistics. Eating Disorder Hope. February 25, 2022. Accessed October 16, 2024. <https://www.eatingdisorderhope.com/information/eating-disorder/statistics-demographics>
37. Apergi K, Romanidou M, Abdelkhalek H, Gonidakis F. Factors Associated with Risk of Diabulimia in Greek Adult Population with Type 1 Diabetes Mellitus. *Dietetics*. 2023;2(1):34-44. doi:10.3390/dietetics2010003
38. Goebel-Fabbri AE, Fikkan J, Franko DL, Pearson K, Anderson BJ, Weinger K. Insulin restriction and associated morbidity and mortality in women with type 1 diabetes. *Diabetes Care*. 2008;31(3):415-419. doi:10.2337/dc07-2026
39. Ruth-Sahd LA, Schneider M, Haagen B. Diabulimia: What It Is and How to Recognize It in Critical Care. *Dimensions of Critical Care Nursing*. 2009;28(4):147. doi:10.1097/DCC.0b013e3181a473fe
40. Levy-Shraga Y, Lerner-Geva L, Modan-Moses D, et al. Benefits of continuous subcutaneous insulin infusion (CSII) therapy in preschool children. *Exp Clin Endocrinol Diabetes*. 2013;121(4):225-229. doi:10.1055/s-0032-1331698
41. Pinhas-Hamiel O, Levy-Shraga Y. Eating disorders in adolescents with type 2 and type 1 diabetes. *Curr Diab Rep*. 2013;13(2):289-297. doi:10.1007/s11892-012-0355-7
42. Falcão MA, Francisco R. Diabetes, eating disorders and body image in young adults: an exploratory study about “diabulimia.” *Eat Weight Disord*. 2017;22(4):675-682. doi:10.1007/s40519-017-0406-9
43. Peveler RC, Bryden KS, Neil HAW, et al. The Relationship of Disordered Eating Habits and Attitudes to Clinical Outcomes in Young Adult Females With Type 1 Diabetes. *Diabetes Care*. 2005;28(1):84-88. doi:10.2337/diacare.28.1.84
44. Polonsky WH, Anderson BJ, Lohrer PA, Aponte JE, Jacobson AM, Cole CF. Insulin Omission in Women With IDDM. *Diabetes Care*. 1994;17(10):1178-1185. doi:10.2337/diacare.17.10.1178
45. Mottalib A, Kasetty M, Mar JY, Elseaidy T, Ashrafzadeh S, Hamdy O. Weight Management in Patients with Type 1 Diabetes and Obesity. *Curr Diab Rep*. 2017;17(10):92. doi:10.1007/s11892-017-0918-8
46. Russell-Jones D, Khan R. Insulin-associated weight gain in diabetes--causes, effects and coping strategies. *Diabetes Obes Metab*. 2007;9(6):799-812. doi:10.1111/j.1463-1326.2006.00686.x
47. Jacob AN, Salinas K, Adams-Huet B, Raskin P. Potential causes of weight gain in type 1 diabetes mellitus. *Diabetes Obes Metab*. 2006;8(4):404-411. doi:10.1111/j.1463-1326.2005.00515.x

48. Bernstein CM, Stockwell MS, Gallagher MP, Rosenthal SL, Soren K. Mental health issues in adolescents and young adults with type 1 diabetes: prevalence and impact on glycemic control. *Clin Pediatr (Phila)*. 2013;52(1):10-15. doi:10.1177/0009922812459950
49. Barnard KD, Skinner TC, Peveler R. The prevalence of co-morbid depression in adults with Type 1 diabetes: systematic literature review. *Diabetic Medicine*. 2006;23(4):445-448. doi:10.1111/j.1464-5491.2006.01814.x
50. Agarwal S, Kanapka LG, Raymond JK, et al. Racial-Ethnic Inequity in Young Adults With Type 1 Diabetes. *J Clin Endocrinol Metab*. 2020;105(8):e2960-e2969. doi:10.1210/clinem/dgaa236

Information Technology Management

Innovation Within Sustainable Technologies: The Future of Energy Conserving Hardware in Data Centers

Brooke Cruz

Project Mentor(s): Susan Rivera

Department of Information Technology Management, Central Washington University

Abstract: The US is confronting a growing energy demand crisis, with analysts projecting a 2.4% rise in data center energy consumption by 2030. Data centers are major energy consumers, with primary usage concentrated in IT equipment and extensive cooling systems. While Power Usage Effectiveness (PUE) remains the leading metric for assessing energy efficiency, it is limited to assessing total facility energy and IT energy use without accounting for environmental and social impacts. Supplementary metrics of data center energy consumption include Water Usage Effectiveness (WUE) and Carbon Usage Effectiveness (CUE), which measure water use and carbon emissions, respectively, per kilowatt-hour (kWh) of IT energy use. These metrics provide insight into the environmental cost of energy sources, however, are limited by variability based on geographic location, energy grid composition, and a lack of standardization. Emerging technologies like the COOLERCHIPS (Cooling Operations Optimized for Leaps in Energy, Reliability, and Carbon Hyperefficiency for Information Processing Systems) program aim to enhance the energy performance of data centers by improving microchip efficiency and optimizing hybrid cooling systems that use both air and liquid coolants. These innovations show promise in reducing energy metric scores, but a more integrated framework is necessary to capture the complexities of sustainable data center operation. This review explores the pressing issue of data center energy consumption in the U.S., critically examines current and emerging efficiency metrics, and emphasizes the need for more holistic, adaptable solutions. As digital infrastructure expands, prioritizing energy and environmental efficiency is vital to ensuring sustainable growth in large-scale industries.

Keywords: Sustainability, Data Centers, Energy Consumption, Digital Infrastructure, Artificial Intelligence (AI)

By 2030, data centers are projected to consume roughly 8% of the United States total power demand, a sharp rise from the 4% consumption in 2024 (Davenport et al., 2024). While this 4% increase may appear insignificant, it showcases the significant shift from the 1.5% energy consumption from 2014 to 2019. This surge is primarily being driven by the expanding need for cloud computing and hyperscale infrastructure, and is being fueled by the rapid integration of Artificial Intelligence (AI) into everyday technologies. Major corporations such as Google, Amazon, and Meta have already begun embedding AI into core user experiences, accelerating the demand for high-intensity data center systems. These new developments rely on increased public awareness and enhanced industry transparency; without these foundational elements, the development of innovative and effective sustainability-focused hardware will remain inefficient.

The Current Impact of Data Center Energy Consumption

The start of the 2020s had a significant shift in power consumption. By 2024, data center energy usage had increased by 200 Terawatt hours (TWh) since 2019 (Davenport et al., 2024). To put this into perspective, one Terawatt has the ability to power roughly 100 million homes for an hour. Such growth will not only threaten to reshape the existing topology of power grids, but also carries broader environmental implications and potential impacts of society's reliance on power.

Energy demand is not the only infrastructure-related concern associated with data centers. Researchers at UC Riverside observed that training a single generative AI model can consume enough energy to evaporate 700,000 liters of water at one Microsoft data center. In 2022, Google and Meta reported 2.2 billion cubic meters of global water withdrawal. This figure is expected to

increase significantly, with experts reporting that “the global AI demand may be accountable for 4.2–6.6 billion cubic meters of water withdrawal in 2027” (Li et al., 2023).

The effectiveness of current sustainability practices within data centers remains a topic of debate among analysts. Traditional sustainability metrics typically measure total energy consumption relative to the energy directed toward IT equipment. This provides insight into how much energy powers core server infrastructure versus auxiliary systems such as lighting and cooling. While this metric has been considered the standard in energy sustainability, some experts advocate for more targeted metrics that could better identify and optimize energy-intensive components.

Current Sustainability Metrics

Current sustainability metrics used to evaluate data center resource consumption include Power Usage Effectiveness (PUE). This metric provides a standardized framework for assessing how much power, water, or carbon is contributing to the overall operation of a facility. While these metrics have advanced efforts to prioritize sustainability within data centers, recent studies suggest they lack sufficient transparency and fail to provide consistent structure on the patterns of resource consumption.

To understand the limitations of these metrics, the definition of PUE compared to how facility managers categorize components is essential. Environmental analysts at Green Grid define PUE as “the ratio of total facilities energy to IT equipment energy.” Total facilities energy includes the equipment such as power generators, cooling towers and AC units, as well as facility lighting (Belady et al., 2013). This metric measures data centers on a scale from 1.0 to 3.0. Data centers with a score of 1.0 provide the most sustainable practices, while data centers with a score of 1.5 or higher are generally considered to have significant inefficiencies and are encouraged to

reevaluate power distribution systems and prioritize technological upgrades to reduce energy waste.

While PUE offers insight to pinpoint which specific technologies consume excessive amounts of energy, challenges appear when categorizing certain equipment as either IT equipment or part of the total facilities infrastructure. For example, Green Grid discusses how cooling technology can be seen “within the IT equipment itself” (Belady et al., 2013). This means that although cooling systems are typically classified under facility infrastructure, the increasing development of cooling components within servers and other IT hardware complicates accurate categorization.

Literary Review: What the Studies Show

To determine the accuracy of PUE is for current data centers, specialists with NVIDIA, a leading AI company, conducted an analysis of four different case studies on an air-liquid hybrid cooling data centers in Baltimore, Maryland. Their goal was to examine how effective PUE is at measuring sustainability within data centers. Each case study examined a different ratio of air to liquid cooling, including “two chilled water, perimeter computer room air handler (CRAH) units with hot-aisle containment” (Heydari et al., 2022).

Case study 1 measured 100% air cooling, with the chilled water, supply air, and secondary inlet temperatures being 45 degrees, 77 degrees, and 89.6 degrees Fahrenheit respectively. Case study 2 measured 61.4% being liquid and 38.6% being air cooled, with a chilled temperature raised to 64.4 F. Supply air and inlet temperatures stayed the same. Case study 3 had a ratio of 68.6% to 31.4%, with the chilled water being raised to 77 F, with air supply raising to 95 F, and inlet temperature maintained at 89.6 F. The final case study had a ratio of 74.9% liquid and 25.1% air, with chilled water and air supply temperatures maintained at 77 F

and 95 F respectively. Only the secondary inlet temperature being raised to 113 F (Heydari et al., 2022).

NVIDIA analysts found that the servers using liquid cooling as the highest proportion of cooling, as done in study 4, produced an 18.1% in overall facility power reduction. Despite the drastic difference in power consumption, PUE calculated a drop from 1.38 to 1.35. Thus, PUE was not able to effectively represent the significant differences between the cooling ratios used within each study. A proposed solution to this discrepancy within the study was the use of a new metric, named Total Usage Effectiveness, or TUE. TUE measures similarly to PUE, except it includes fan power within the IT equipment category, rather than total facilities. When applying TUE to the case study, TUE showcased a 15.5% decrease, compared to PUE's 3.3%. These analysts give valid criticisms about PUE, and how it doesn't produce the best results within sustainability testing (Heydari et al., 2022).

Developing Technologies

While these tactics are helpful for research opportunities and to explain technology power usage, extensive high density equipment are still active problems. Currently, government programs such as the Advanced Research Projects Agency – Energy (ARPA -E) and the COOLERCHIPS program spend roughly 40 billion on research (Department of Energy, 2024).

Examples of these technologies include Extra Efficient Data Centers Using Avionics Cooling Technology. EXTRACT is a research project being developed by researchers at Raytheon Technologies Research Center. They hope to remove the taxing process of heat removal within data centers. Cooling takes up 25% of the total facility equipment energy consumption, which can impact PUE (Department of Energy, 2024). By extracting heat through equipment called Ribbon Oscillating Heat Pipes (RHP), researchers hope to reduce the cooling

requirements of high-power processors. The usage of this developing technology could “enable a transformational reduction in the power consumption of future data centers” (Zhao et al., 2022).

Technologies that focus on growing the capacity of the US power grid are being developed too. Grid Enhanced Technologies (GET), such as topology optimization, and power flow controls are two promising developments. Topology optimization allows the physical layout of the energy grid to be revisited and rerouted to provide relief to congestion areas within the grid. Power flow control tools help “push power away from overloaded lines and pull it towards underutilized ones” (Su et al., 2025). Using multiple GET tools allows for more opportunities to reduce the energy consumption of hyperscale infrastructures such as data centers.

Conclusion

Ongoing discussions among industry experts highlight the need for increased power generation capacity to support the rapid growth of data infrastructure. Fostering public understanding of the environmental and social impacts of data centers on U.S. utility infrastructure is essential for advancing sustainable hardware innovation. Current sustainability metrics and research development are insufficient to mitigate the impending strain that high-intensity data centers and AI training will place on national power grids within the next five years.

A greater emphasis on making information clear and accessible, rather than profit-driven, is necessary. As AI technology remains in a developmental phase with vast potential, its continued evolution will inevitably intensify energy demands. Addressing the exponential increase in AI-related energy consumption requires a coordinated strategy grounded in legislative action and public education. Facilitating open dialogue within communities and engaging with

local and national policymakers are critical steps toward ensuring responsible and equitable data center development.

References

- Belady, C., Berard, S., Bramfitt, M., Cader, T., Coles, H., Cooley, J., Coors, L., Darby, T., Froedje, J., Gruendler, N., Haas, J., Jewitt, E., Long, C., MacArthur, B., Morris, P., Microsystems, S., Ortiz, Z., Pflueger, J., Rawson, A., ... Wofford, R. (2013, February 4). *PUETM: A comprehensive examination of the metric*. The Green Grid.
https://datacenters.lbl.gov/sites/default/files/WP49-PUE%20A%20Comprehensive%20Examination%20of%20the%20Metric_v6.pdf
- Davenport, C. Singer, B. Mehta, N. Lee, B. Mackay, J. Modak, A. Corbett, B. Miller, J. Hari, T. Ritchie, J. Delaney, M. Revich, J. Jaiya, J. Venugopal, V. Cash, N. Halferty, O. (2024, April 29). *Generational Growth: AI, data centers and the coming US power demand surge*. Goldman Sachs Research. <https://www.goldmansachs.com/insights/goldman-sachs-research/generational-growth-ai-data-centers-and-the-coming-us-power-demand-surge>
- Department of Energy. (2024, December 2). *Cooling operations optimized for leaps in energy, reliability, and carbon hyperefficiency for information processing systems: Project descriptions*. Advanced Research Projects Agency – Energy. https://arpa-e.energy.gov/sites/default/files/2025-01/Project%20Descriptions_COOLERCHIPS.pdf
- Heydari, A., Eslami, B., Radmard, V., Rebarber, F., Buell, T., Gray, K., Sather, S., & Rodriguez, J. (2022, December 7). *Power usage effectiveness analysis of a high-density air-liquid hybrid cooled data center*. ASME 2022 International Technical Conference and Exhibition on Packaging and Integration of Electronic and Photonic Microsystems.
<https://doi.org/10.1115/IPACK2022-97447>
- Li, P., Yang, J., Islam, M. A., & Ren, S. (2023). Making AI less “thirsty”: uncovering and

addressing the secret water footprint of AI models. *arXiv*.

<https://doi.org/10.48550/arXiv.2304.03271>

Su, T., Zhao, J., Gomez-Exposito, A., Chen, Y., Terzija, V., & Gentle, J. P. (2025). Grid-enhancing technologies for clean energy systems. *Nature Reviews Clean Technology*, *1*(1), 16–31. <https://doi.org/10.1038/s44359-024-00001-5>

Zhao, X., Zhu, Y., & Li, H. (2022). Micro-Channel oscillating heat pipe energy conversion approach of battery heat dissipation improvement. A Review. *Energies*, *15*(19), 7391. <https://doi.org/10.3390/en15197391>

Global Trends in AI-Driven Product Development: A Cross-Country Analysis

Shilpa Dhananjayan

Project Mentor(s): Hideki Takei

Department of Information Technology Management, Central Washington University

Abstract: Artificial Intelligence (AI) is transforming industries and accelerating global innovation, yet its benefits remain unevenly distributed. A nation's AI readiness—its capacity to adopt and implement AI technologies—plays a crucial role in economic growth and technological advancement. Key determinants of AI readiness include digital infrastructure, data accessibility, government policies, research and development (R&D) investment, and workforce development. This study examines the relationship between AI readiness, AI adoption, innovation, R&D investment of a nation, Digital Infrastructure Index (DII) and Human Capital Index (HCI) using a Random Forest regression model. Findings reveal a strong correlation between AI adoption and innovation ($r = .80$), emphasizing the need for a conducive environment to drive innovation. R&D spending also contributes to innovation ($r = .65$), reinforcing the notion that nations investing in research and development gain substantial benefits. Digital infrastructure emerges as the strongest predictor of AI readiness ($r = .961$), highlighting the critical role of government investment in fostering innovation. However, maximizing its benefits requires well-designed policies and market integration strategies. These findings highlight the critical role of strategic investments in fostering AI-driven innovation. Strengthening digital infrastructure and labor policies can enhance AI preparedness and technological competitiveness. Future research should explore optimization strategies for resource-constrained economies and the long-term impacts of AI-driven growth. **Presentation recording available in the SOURCE 2025 playlist:** <https://www.youtube.com/@cwusource5518>

Keywords: AI Readiness, AI Adoption, Innovation, R&D Investment, Digital Infrastructure, Human Capital Index (HCI), Random Forest Regression, Government Policies, Technological Competitiveness, Economic Growth

AI has emerged as a transformative force, reshaping industries, driving innovation, and enhancing product development across the globe. From automating processes to enabling more informed decision-making, AI has the potential to revolutionize sectors like healthcare, finance, manufacturing, and education. However, the benefits of AI adoption are not distributed equally. The extent to which a country can harness AI's full potential depends largely on its AI readiness, which serves as a key indicator of its economic growth and technological advancement. AI readiness reflects a nation's capacity to adopt, implement, and leverage AI technologies for sustainable development.

Key factors influencing AI readiness include digital infrastructure, access to high-quality data, and a skilled workforce and supportive government policies. A strong research and innovation ecosystem, supported by AI startups, academic institutions, and R&D funding, drives advancements. Public and private sector adoption ensures AI integration across industries, while cybersecurity and data privacy measures protect sensitive information. International collaboration facilitates knowledge sharing, and public trust in AI is essential for widespread adoption and ethical considerations.

Investments in digital infrastructure—such as broadband penetration and access to information and communication technology (ICT)—are foundational for AI adoption. Labor policies that promote workforce adaptability, job reskilling, and AI-driven employment strategies further enhance AI integration. Additionally, R&D investment fosters innovation, while regulatory frameworks shape ethical AI deployment.

Countries with strong AI readiness integrate AI effectively across several sectors, leading to higher productivity, innovation, and economic growth. Conversely, those lacking infrastructure, data access, or a trained workforce struggle to capitalize on the potential of AI,

exacerbating the technological divide between developed and developing economies (Afrin et al., 2025). Addressing these disparities through strategic investments is critical for fostering inclusive AI-driven growth.

This study explores factors influencing AI readiness and the impact of innovation on national development. It examines AI adoption's role in product innovation, the link between R&D spending and innovation output, and how digital infrastructure, labor policies, and human capital enhance AI readiness. By identifying key drivers, the research aims to reduce global AI inequalities and guide policymakers in fostering equitable AI-driven innovation.

Literature Review

AI has swiftly become a catalyst for innovation and product development worldwide. Its potential to revolutionize industries, enhance productivity, and spur economic growth is widely recognized. However, the extent to which countries benefit from AI adoption varies significantly, influenced by factors such as national AI readiness, R &D investment, and the strength of their technological infrastructure. While some nations have positioned themselves as global leaders in AI research and implementation, others face substantial challenges in integrating AI into their economies.

Several barriers hinder widespread adoption, including limited technical expertise, regulatory complexities, and infrastructural constraints (Firdaus et al., 2024). In many developing economies, a lack of skilled professionals and inadequate digital infrastructure restrict progress. Additionally, evolving regulations and concerns over data privacy, security, and ethical deployment create further obstacles. These disparities shape technological advancement, widening the global digital divide. Addressing these challenges is essential to ensuring equitable participation in the AI-driven economy.

AI readiness is a key determinant of a country's ability to leverage AI technologies and drive progress. Studies indicate that nations with well-developed AI readiness frameworks exhibit higher innovation outputs, including increased patent filings, greater R&D investments, and the rapid development of new products and services (Smith et al., 2020). These frameworks typically include regulatory policies, digital infrastructure, and workforce preparedness, which collectively enable seamless AI integration across industries. In contrast, countries with weaker AI readiness struggle to adopt and scale AI solutions, widening the global innovation divide (Johnson & Lee, 2021). Strengthening AI readiness is therefore essential for promoting innovation and ensuring equitable access to AI's benefits.

Investment in R&D play a crucial role in shaping national AI capabilities. Governments that prioritize AI-focused R&D funding tend to experience accelerated technological progress, as these investments drive the development of cutting-edge technologies and support foundational research (Brown et al., 2019). Such funding fosters an innovation-friendly environment, stimulating economic growth and technological breakthroughs. However, disparities in public R&D spending exacerbate global inequalities, as resource-limited nations struggle to compete with wealthier countries in AI advancements (Chen & Zhao, 2022). Ensuring equitable development requires sustained public investment in research and technology.

Beyond R&D spending, investments in technology infrastructure are critical to advancing AI readiness and sustaining long-term innovation. Digital infrastructure—such as broadband, cloud computing, and ICT—provides the necessary foundation for AI adoption and integration across industries.

Research shows a strong positive correlation between technology infrastructure investment and innovation outcomes, with nations prioritizing these areas achieving greater

driven technological growth (Martinez & Gupta, 2021). However, disparities in access to these resources hinder AI adoption in developing nations, reinforcing global inequalities. Bridging these gaps in infrastructure investment is crucial for fostering inclusive and equitable AI-driven innovation worldwide.

Research Questions

This research investigates what factors contribute to a country's overall AI readiness and its capacity to leverage AI for sustainable innovation. By examining these relationships, the research will provide valuable insights into how nations can strengthen their AI ecosystems and improve their competitive position in the global AI innovation landscape.

The first objective of this research is to examine the relationship between AI adoption and product innovation. AI technologies possess the potential to enhance operational efficiency, automate complex processes, and enable data-driven decision-making (Brynjolfsson & McAfee, 2014). To examine this connection, the study will analyze the correlation between AI readiness and innovation outputs. Specifically, the analysis will utilize data from the 2024 Government AI Readiness Index, which provides AI readiness scores for over 170 countries, and the Global Innovation Index (GII), which includes metrics on innovation outputs such as patents, high-tech exports, and R&D investments. By evaluating these datasets, the research will explore how AI readiness influences a country's ability to drive innovation and produce competitive products.

The second objective is to examine the relationship between a country's R&D spending and its innovation output, with a particular focus on AI-driven technologies. Government investments in R&D are crucial for fostering technological advancements and driving innovation (Aghion, Akcigit, & Howitt, 2015). This study will analyze how increased public spending on R&D influences a country's innovation outcomes by exploring data from several key sources.

These include national public R&D expenditure data from the Organization for Economic Co-operation and Development (OECD), which provides insights into the allocation of resources toward technological development, and the GII, which tracks innovation performance through metrics such as patents, high-tech exports, and R&D investments. Additionally, data from the World Intellectual Property Organization (WIPO) on AI-related patent filings will be used to assess the output of AI innovations. By analyzing the correlation between R&D investments and innovation outcomes, the study aims to identify the impact of government funding on a country's ability to generate breakthrough innovations and enhance its global competitiveness, especially in the rapidly advancing field of AI.

The third objective examines how the Digital Infrastructure Index influences AI readiness and innovation. A country's ability to adopt and utilize AI effectively depends on investments in broadband penetration and access to information and communication technology (ICT). These factors, which define the Digital Infrastructure Index, enable seamless AI integration across industries. This research evaluates their impact on AI readiness and a nation's capacity for sustainable innovation and economic growth.

In summary, this research seeks to explore whether AI readiness positively correlates with a country's innovation outputs, structured around the following hypotheses:

- **H1:** AI adoption positively impacts product innovation, leading to the development of new and enhanced products.
- **H2:** There is a positive relationship between a country's R&D spending and its innovation output.
- **H3:** Digital infrastructure significantly influences a country's AI readiness and its ability to leverage AI for innovation and sustainable growth.

Methodology

Data Collection and Preprocessing

The study used datasets containing AI preparedness scores, innovation output, R&D spending, and Infrastructure index for multiple countries. Data was sourced from the International Monetary Fund (IMF, 2023), the World Bank (2023), and the World Intellectual Property Organization (WIPO, 2024) and other sources cited in Appendix of this paper. Preprocessing involved handling missing values by omitting incomplete records and normalizing numerical variables to ensure comparability across different scales.

AII assessed a country's readiness to adopt AI, while the Innovation Output Index measured technological advancements. The Digital Infrastructure Index evaluated a nation's ability to seamlessly integrate new technologies. Data were cleaned to remove missing values, standardized for consistency, and normalized to ensure comparability across different scales.

Building a Random Forest Model

A Random Forest regression model was employed to analyze the predictive relationships between AI readiness, innovation, R&D spending, and public investment in education and technology. The dataset was divided into training (70%) and test (30%) sets using stratified sampling. Three separate models were trained to evaluate different hypotheses. The Random Forest algorithm was chosen due to its robustness against overfitting and ability to capture complex, nonlinear relationships (Breiman, 2001). Each model was built using 500 trees, and the number of variables considered at each split was optimized using the `mtry` parameter.

Model Building Steps

1. **Data Splitting.** The dataset was divided into training (70%) and test (30%) sets.

2. **Model Training.** A random forest model was trained to examine the relationships between AI readiness, innovation, and economic integration. The first analysis explored the impact of AI readiness on innovation, with the Innovation and Economic Integration Index (2023) as the dependent variable and the AI Preparedness Index as the independent variable. The second analysis assessed the effect of AI R&D spending on innovation, using the same dependent variable while considering AI R&D spending as the independent variable. Finally, the model evaluated the influence of digital infrastructure spending on AI readiness, where the AI Preparedness Index served as the dependent variable, and the Digital Infrastructure Index, along with human capital and labor market policies, were the independent variables.
3. Each model is trained using Random Forest Regression, and performance is evaluated based on variance explained (% Var Explained), Mean Squared Residuals (MSR), and correlation coefficients.
4. **Feature Importance.** Variable importance scores were extracted to determine which factors have the greatest impact on AI readiness.

Model Evaluation

The result from the model confirms that AI readiness, R&D investment, and public funding in education and technology are strong predictors of innovation. Nations prioritizing AI preparedness, digital infrastructure, and human capital investment demonstrate superior technological progress. These insights underscore the importance of integrated national strategies that align AI policies with economic frameworks to ensure sustained innovation and long-term global competitiveness.

Analysis

Cluster Analysis

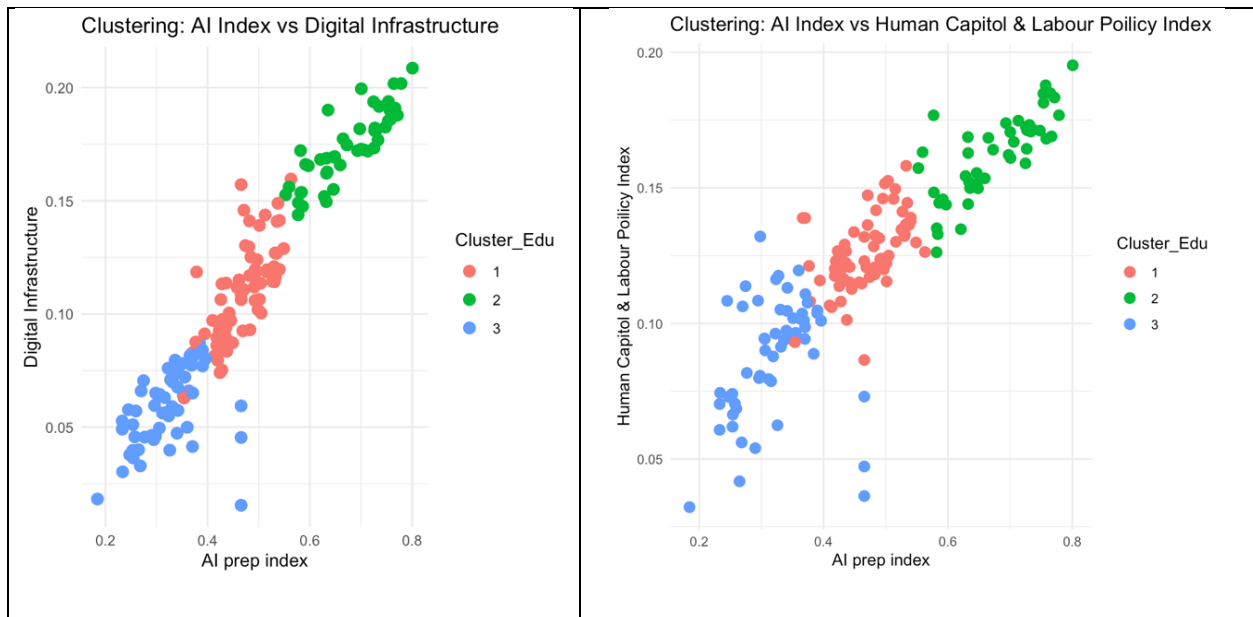
AI Readiness vs. Digital Infrastructure and AI Readiness vs. Human Capital Index

The cluster analysis of AI preparedness and digital infrastructure spending reveals distinct groupings among countries based on their investment levels in digital infrastructure and human capital. As illustrated in Figure 1, the data is categorized into three clusters.

Cluster 1 (Red Data Points). Countries in this group exhibit moderate AI preparedness (0.3–0.55) and medium investment in human capital, labor policies, and digital infrastructure (0.10–0.15). Their balanced investment strategy suggests that increasing digital infrastructure spending could further enhance AI readiness.

Figure 1

Cluster Analysis



Cluster 2 (Green Data Points). These nations demonstrate high AI preparedness scores (above 0.55) and strong labor policies (above 0.15). The positive correlation between digital infrastructure investment and AI readiness highlights the critical role of robust labor policies in fostering AI adoption and innovation.

Cluster 3 (Blue Data Points). Countries in this category have low AI preparedness scores (below 0.4) and limited human capital investments (below 0.10). Insufficient investment in digital infrastructure and labor market policies may hinder AI adoption, indicating a need for targeted policy interventions to support technological growth.

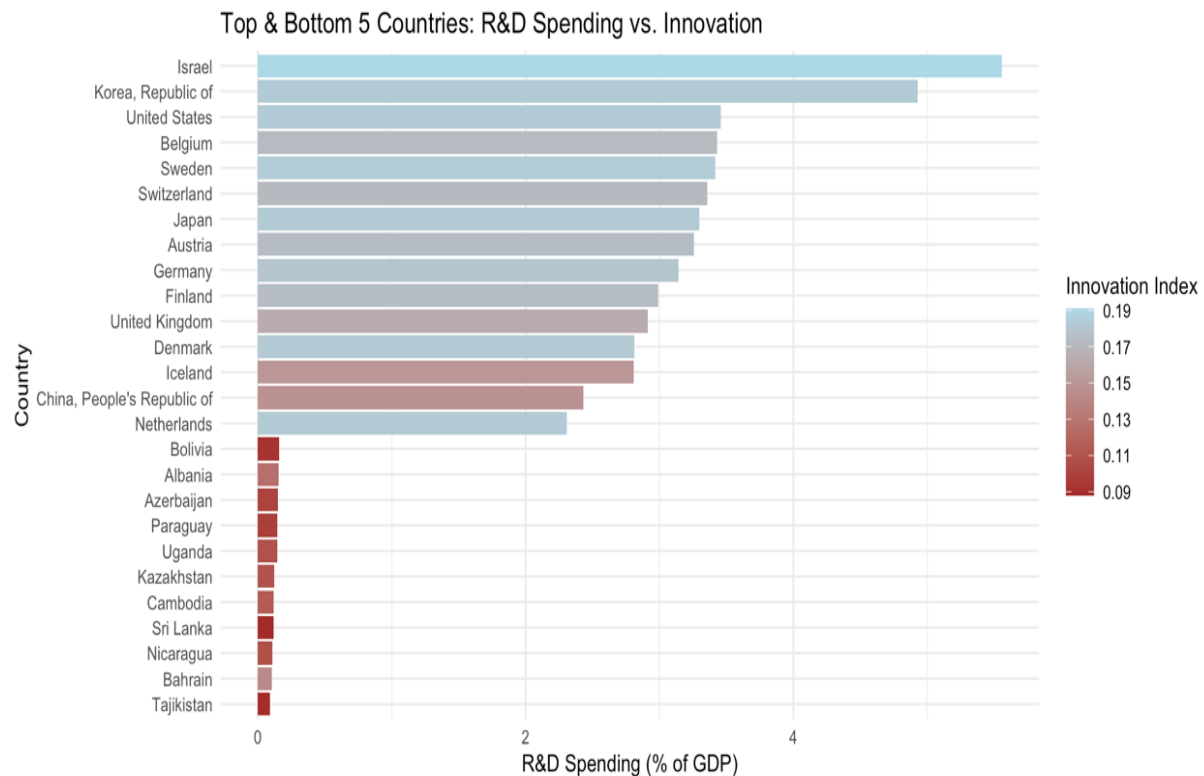
The clustering results suggest a clear relationship between AI readiness and digital infrastructure investment. Nations in Cluster 2 exemplify the benefits of higher public spending on human capital development, whereas countries in Cluster 3 may need targeted interventions to improve AI adoption. These findings align with existing research emphasizing the role of digital infrastructure in driving AI readiness and technological innovation.

Comparative Analysis of R&D Spending and Innovation Outcomes

Investment in research and development (R&D) is a key driver of innovation and technological progress. The scatter plot (Figure 1) illustrates the relationship between R&D spending as a percentage of GDP and innovation outcomes, demonstrating a positive correlation. Countries with higher R&D investments tend to achieve greater innovation performance, as indicated by the regression line. The inclusion of country labels allows for a comparative analysis of national differences, further highlighting the association between R&D expenditure and innovation levels. This trend is shown in the Figure 2.

Figure 2

Top and Bottom Spending Countries vs the Innovation They Produce

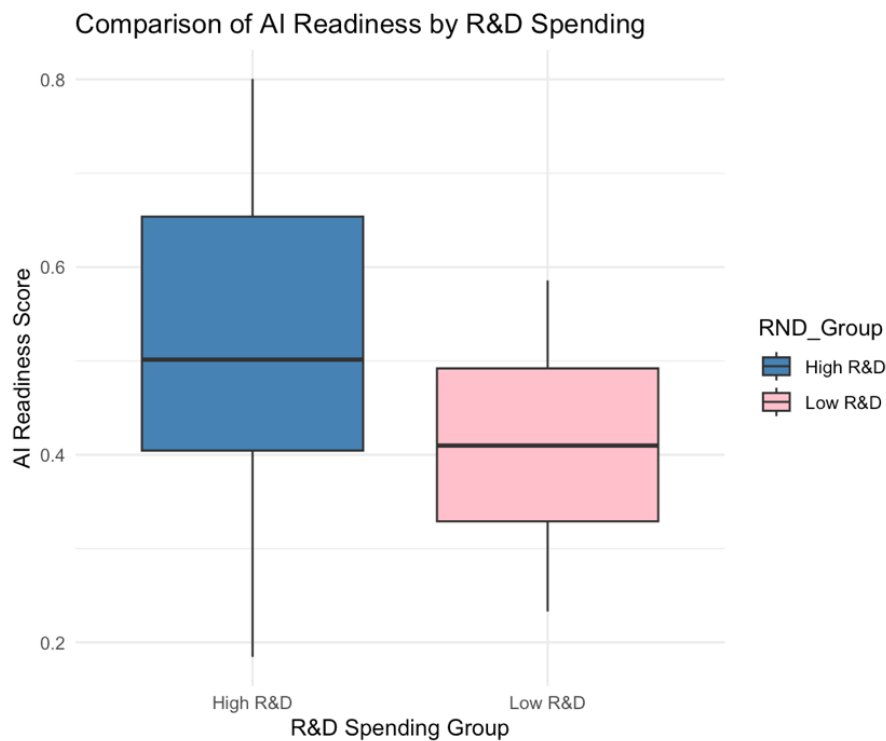


The box plot (Figure 3) categorizes countries into high and low R&D spending groups to examine differences in AI readiness scores. The results indicate a significant distinction between the two groups, with high R&D spenders exhibiting a greater median AI readiness score and a wider interquartile range. This suggests that nations allocating more resources to R&D are better positioned for AI adoption and innovation-driven growth.

These findings reinforce the argument that strategic investment in research and digital infrastructure fosters national competitiveness in AI and technological advancements (International Monetary Fund, 2023).

Figure 3

Countries Grouped into High and Low R&D Spending Groups vs AI Readiness Score



The combination of both visualizations provides a comprehensive perspective on the impact of R&D spending on innovation outcomes. The scatter plot highlights the strength of the correlation, while the box plot underscores the disparities in AI readiness between high and low R&D spending nations. These insights suggest that policymakers should prioritize sustained investment in R&D to enhance national innovation capacity and close the gap between emerging and advanced economies. As previous studies indicate, fostering an environment that supports research funding and technological infrastructure is crucial for long-term economic and innovation growth (World Intellectual Property Organization, 2024).

Feature Importance Analysis

Variable importance scores extracted from the models indicated that digital infrastructure had the highest impact on AI readiness, followed human capital and labor policies. The innovation model further confirmed that AI preparedness and R&D spending were the strongest predictors of technological advancements. These insights emphasize the critical role of public investment in fostering AI-driven innovation.

The findings suggest that AI readiness and public investment in digital infrastructure are significant predictors of innovation. Countries with strong AI policies and higher R&D spending demonstrate superior technological outcomes. The study highlights the importance of national strategies that integrate AI preparedness with economic policies to drive sustainable innovation. Future research could explore the long-term impact of AI-driven policies on global competitiveness.

The results suggest a strong positive relationship between AI readiness and investments in human capital and digital infrastructure. The clustering analysis further supports the trend that high AI-preparedness countries allocate more resources to digital infrastructure, while lower-performing nations may require policy interventions to enhance AI adoption.

Research and Model Results

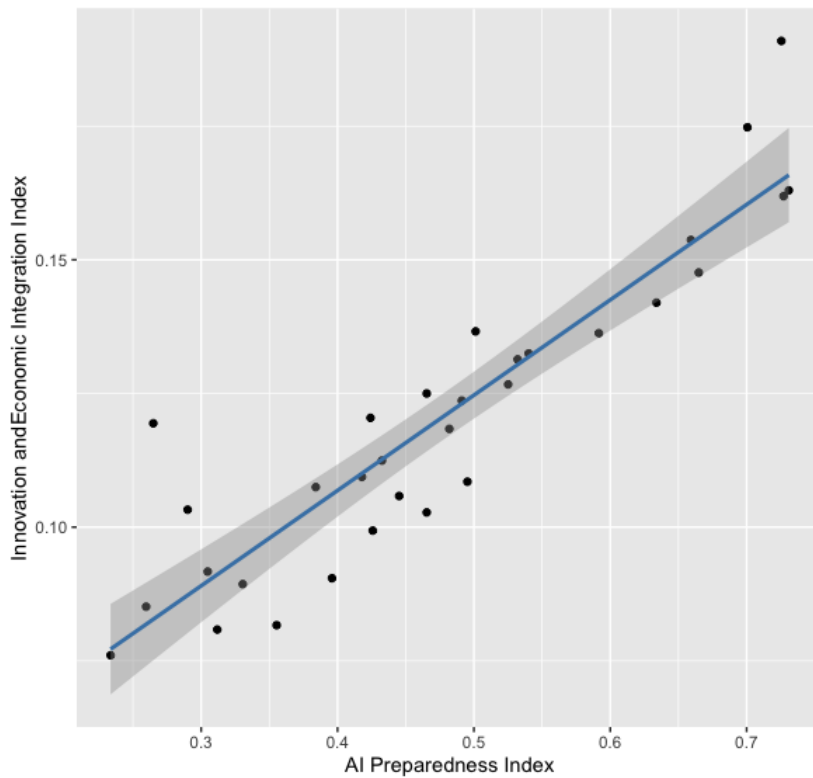
This study employed a Random Forest regression model to examine the relationships between AI readiness of a country to innovation, R&D spending, and public investment in digital infrastructure. The findings highlight the critical role of AI preparedness and strategic investments in fostering innovation and economic growth.

AI Readiness and Innovation

The first hypothesis tested the impact of AI readiness on innovation, revealing a strong positive correlation ($r = .80$). The model explained 65.68% of the variance, with a Mean Squared Residual (MSR) of 0.000361, indicating high predictive accuracy.

Figure 4

AI Readiness and Innovation



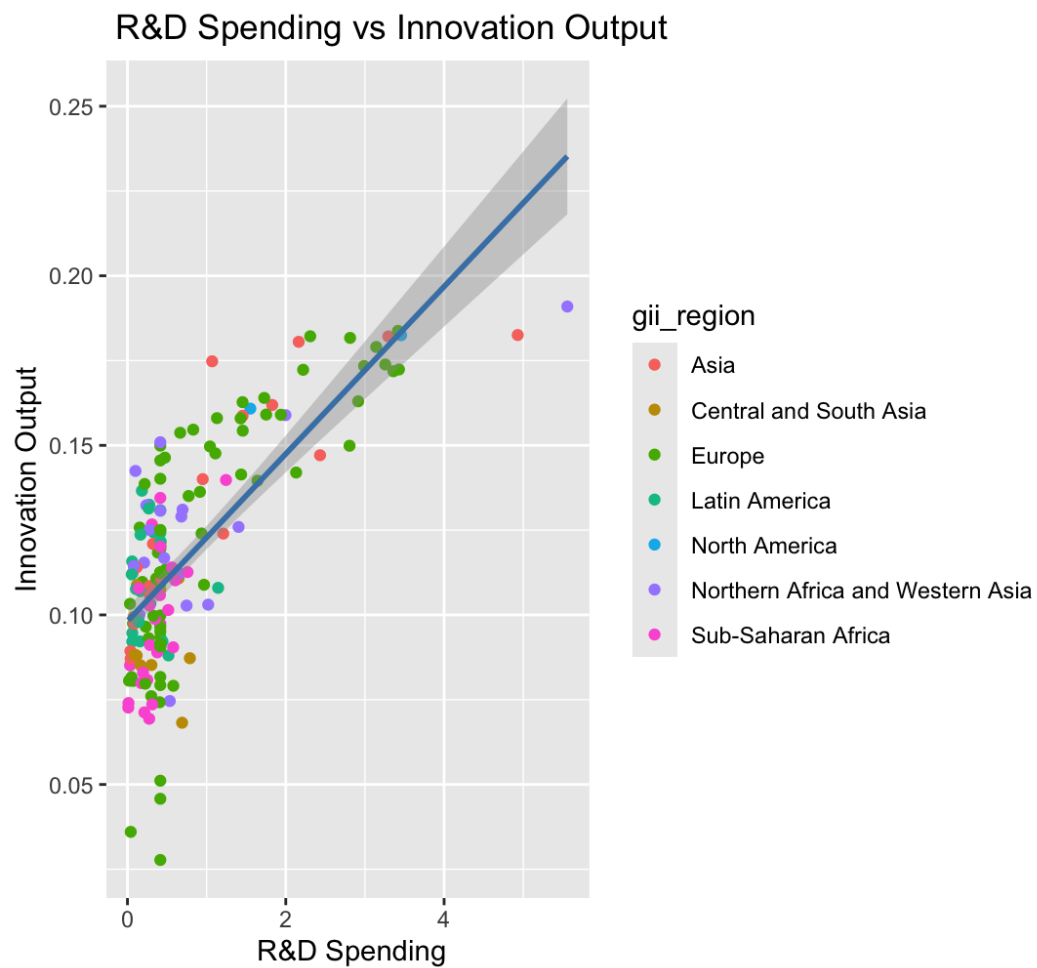
Feature importance analysis identified digital infrastructure and workforce development as key drivers of AI readiness, reinforcing their role in fostering technological progress and industrial competitiveness.

AI R&D Spending and Innovation

The second hypothesis explored the influence of AI R&D spending on innovation, showing a moderate correlation ($r = .65$) and 47.13% variance explained. The MSR was 0.000556, confirming model accuracy.

Figure 5

AI R&D Spending and Innovation



While R&D investment contributes to innovation, other factors—such as regulatory frameworks, talent availability, and market adoption of AI solutions—also play significant roles.

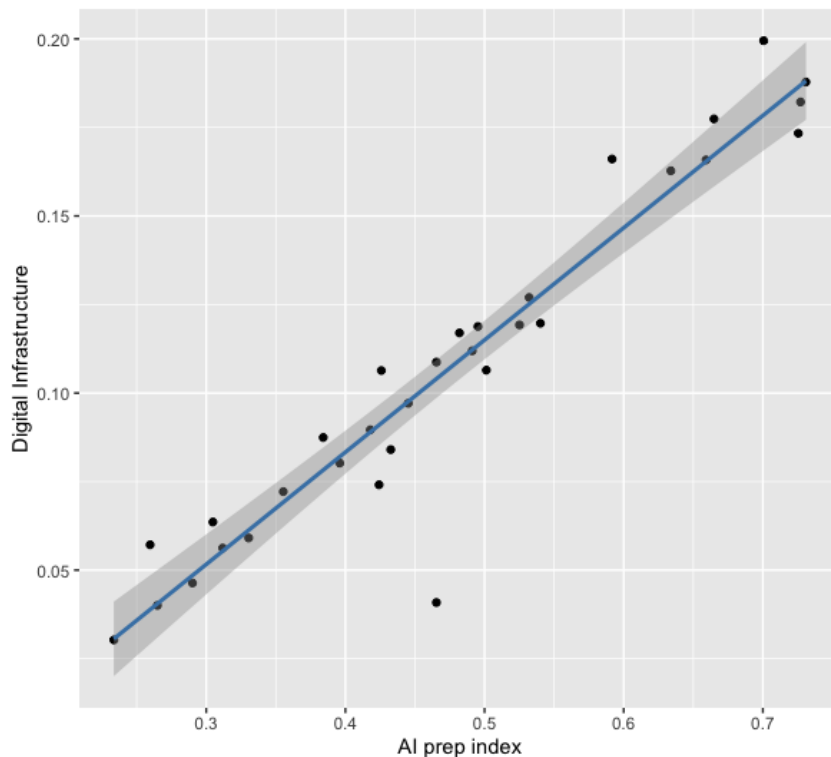
These findings align with previous research showing that higher R&D spending correlates with increased patent generation and technological advancement (World Bank, 2023).

Digital Infrastructure and AI Readiness

The final hypothesis assessed the impact of public investment in digital infrastructure on AI readiness, revealing a very strong correlation ($r = .961$). The model explained 84.16% of the variance, with an MSR of 0.00356, further validating its predictive strength. Feature importance analysis identified digital infrastructure, and human capital policies as the most significant contributors to AI preparedness.

Figure 6

AI Prep Index vs Digital Infrastructure



These findings underscore the importance of broadband access in fostering AI-driven innovation (International Monetary Fund, 2023).

Discussion and Implications

The results confirm AI readiness as a key driver of national innovation and economic growth. The strong correlation between AI preparedness and innovation output suggests that nations investing in AI-centric policies and digital infrastructure achieve superior technological advancements.

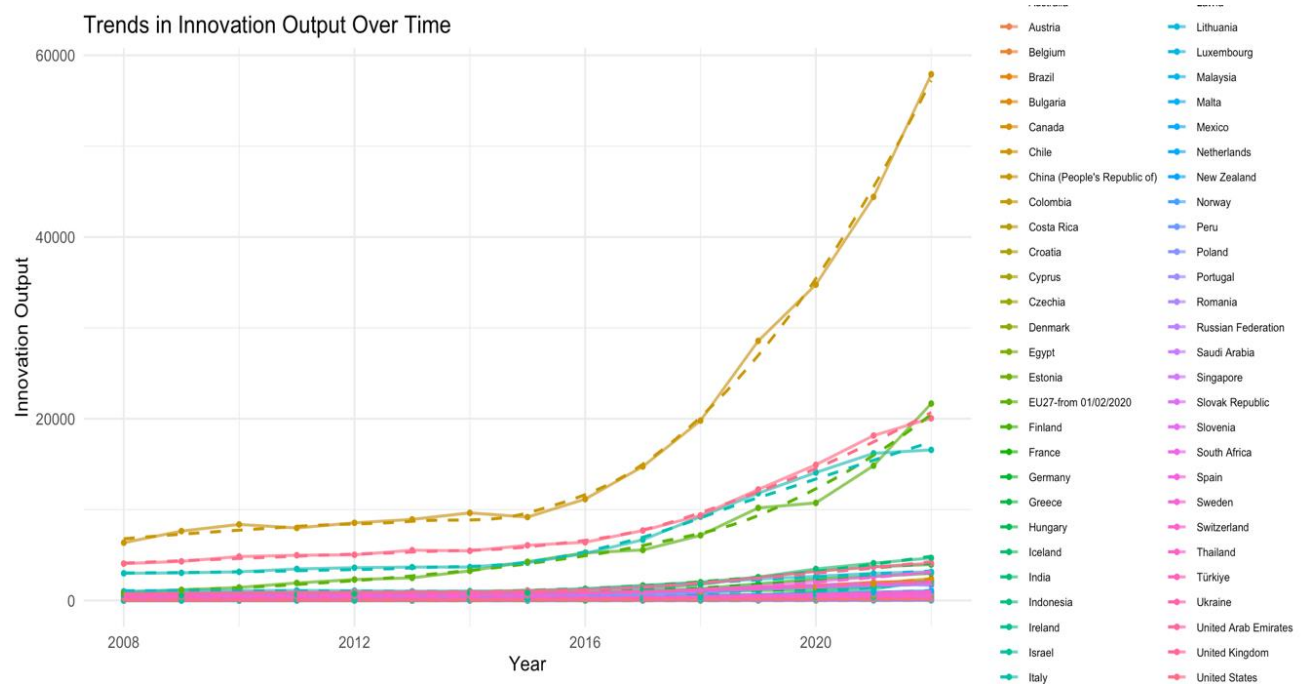
While public R&D investment positively influences innovation ($r = .65$), the variance explained (47.13%) suggests that funding alone is insufficient. Effective policy incentives, skilled workforce development, and market adoption strategies are essential for maximizing innovation outcomes.

One of the most striking findings is the exceptionally strong link between public investment in digital infrastructure and AI readiness ($r = .961$). With 84.16% of variance explained, this underscores the crucial role of digital access and human capital development in fostering AI adoption and economic transformation (Martinez & Gupta, 2021).

The graph in Figure 7 illustrates a notable surge in China's innovation output beginning in 2016, coinciding with increase in digital infrastructure (World Bank, 2023). This correlation suggests that advancements in connectivity and technological infrastructure have played a pivotal role in fostering innovation and technological progress.

Figure 7

Trends in Innovation Output Over Time



Cluster analysis further reveals disparities in AI readiness across economic groups. High-income nations with advanced digital infrastructure exhibit the highest AI preparedness, while resource-constrained countries lag behind. Without targeted interventions, lower-income nations risk falling further behind in the global digital economy.

Limitations and Future Research

While this study provides strong empirical evidence on AI readiness and innovation, it has limitations. Reliance on secondary data introduces potential biases, as methodologies for measuring AI preparedness and innovation vary across organizations. Additionally, national policy differences—critical to AI adoption—are not explicitly accounted for. Social influence, along with perceived usefulness and ease of use, also plays a key role in shaping citizen intentions toward AI adoption (Alzebda & Matar, 2024).

Future research should incorporate qualitative assessments of AI policies and conduct longitudinal studies to examine the sustained impact of AI investments on national competitiveness. Further exploration of regional and sector-specific AI adoption patterns could provide insights into optimizing AI strategies for sustainable innovation.

Research Gaps

AI Readiness in Diverse Economies

Existing research focuses primarily on high-income nations, with limited exploration of AI readiness in emerging economies. Further studies should examine how regulatory frameworks, cultural contexts, and economic constraints influence AI adoption and innovation (Johnson & Lee, 2021).

Optimizing R&D Investments in Resource-Constrained Nations

While public R&D spending fuels AI-driven innovation, limited research addresses cost-effective and scalable strategies for nations with constrained resources. Identifying best practices for optimizing AI-related R&D in these contexts is crucial to ensuring sustainable innovation and technological progress (Chen & Zhao, 2022).

Educational Inequalities in AI Skill Development

Despite well-documented links between education and innovation, disparities in access to AI-focused education and their impact on global competitiveness remain underexplored. Strategies to bridge educational gaps and build an inclusive AI-skilled workforce warrant further investigation (Davis & Patel, 2020).

Emerging Technologies and Technological Disparities

Research has largely emphasized traditional infrastructure investments, such as broadband and cloud computing, with limited focus on emerging technologies—such as 5G,

blockchain, and edge computing—in reducing technological disparities. Evaluating their role in democratizing AI adoption and innovation is a critical research avenue (Martinez & Gupta, 2021).

Longitudinal Studies on AI-Driven Innovation

Most studies provide cross-sectional analyses of AI readiness and innovation, lacking insights into long-term effects. Longitudinal research is needed to assess how sustained investments in R&D, education, and technology infrastructure influence innovation over time (Smith & Brown, 2020).

Effectiveness of Policy Interventions

Despite policies being key to AI readiness, limited research evaluates their effectiveness in fostering equitable innovation. Comparative analyses of AI policies across nations with varying levels of readiness could offer valuable insights into best practices for inclusive AI-driven growth (Brown et al., 2019).

Conclusion

This study provides empirical evidence of AI readiness as a key driver of national innovation and economic growth. The findings highlight strong correlations between AI preparedness, digital infrastructure, and innovation output, emphasizing the need for strategic investments in these areas. AI adoption accelerates product innovation, R&D spending fuels technological progress when supported by strong policies, and digital infrastructure and labor policies create a foundation for sustainable AI integration. However, disparities in AI readiness deepen the global digital divide, limiting equitable access to AI-driven benefits.

Bridging this gap requires policymakers to prioritize digital infrastructure, talent development, and regulatory frameworks that foster entrepreneurship and industry collaboration.

International cooperation is also crucial in supporting AI adoption in developing economies and promoting inclusive innovation.

Future research should examine the long-term impact of AI policies, assess different governance models, and analyze regional variations in AI adoption. Advancing these discussions will help shape a more equitable and innovation-driven global AI landscape.

References

- Afrin, S., Roksana, S., & Akram, R. (2025). AI-enhanced robotic process automation: A review of intelligent automation innovations. *IEEE Access*. Retrieved from <https://www.semanticscholar.org/paper/be0eca5c530360663d31c41d4ef1257e49bd4e1f>
- Alzebda, S. & Matar, M.A. (2024). Factors affecting citizen intention toward AI acceptance and adoption: the moderating role of government regulations. *Competitiveness Review: An International Business Journal*.
- Brown, T., Johnson, K., & Lee, P. (2019). *The impact of public R&D investments on AI innovation*. *Journal of Global Technology*, 12(3), 45–62.
- Breiman, L. (2001). Random forests. *Machine Learning*, 45(1), 5-32.
- Chen, L., & Zhao, M. (2022). Global disparities in AI readiness and their impact on innovation outputs. *AI Policy Review*, 8(1), 15–32.
- Davis, L., & Patel, S. (2020). The future of STEM education: Preparing the workforce for AI innovation. *Journal of Education Policy*, 51(1), 45-64.
<https://doi.org/10.1080/02021839.2020.1718391>
- Davis, R., & Patel, S. (2020). Education for the AI age: Bridging the skills gap. *International Journal of Education and Technology*, 7(4), 89–102.
- Firdaus, D. U., Roslan, N. A., Saferdin, W. F., Zulkarnain, I. F., & Samasu, N. F. (2024). AI integration in Malaysian public administration for improved governance. *International Journal of Research and Innovation in Social Science*.
- Johnson, K., & Lee, P. (2021). AI readiness as a determinant of national innovation performance. *Journal of Innovation Studies*, 14(2), 33–50.

- Johnson, M., & Lee, S. (2021). Bridging the AI gap: How AI readiness influences innovation outcomes. *Global Innovation Review*, 9(3), 302-315.
<https://doi.org/10.1002/gir.2021.0457>
- Jrad, M. (2023). A role of artificial intelligence in the context of economy: Bibliometric analysis and systematic literature review. *International Journal of Membrane Science and Technology*. <https://doi.org/10.15379/ijmst.v10i3.1756>
- Martinez, R., & Gupta, A. (2021). The role of education and technology investments in fostering innovation. *Technology and Society*, 9(3), 102–118.
- Masod, M. Y. B., & Zakaria, S. F. (2024). Artificial intelligence adoption in the manufacturing sector: Challenges and strategic framework. *International Journal of Research and Innovation in Social Science (IJRISS)*, 8(10), 150-158.
<https://dx.doi.org/10.47772/IJRISS.2024.81000013>
- RSIS International. (n.d.). Artificial intelligence adoption in the manufacturing sector: Challenges and strategic framework. *International Journal of Research and Innovation in Social Science*. Retrieved from
<https://rsisinternational.org/journals/ijriss/articles/artificial-intelligence-adoption-in-the-manufacturing-sector-challenges-and-strategic-framework/>
- Shahvaroughi Farahani, M., & Ghasemi, G. (2024). Artificial intelligence and inequality: Challenges and opportunities. *Qeios*.
- Smith, L., Johnson, T., & Cheng, Y. (2020). AI readiness and its impact on national innovation outputs. *Journal of Global Innovation*, 13(2), 105-122.
<https://doi.org/10.1016/j.jgi.2020.02.002>

Smith, J., & Brown, T. (2020). Assessing AI readiness: A global perspective. *International Journal of AI and Society*, 11(2), 56–73.

World Bank. (2023). *Fixed broadband subscriptions (per 100 people) – China*. Retrieved from <https://data.worldbank.org/indicator/IT.NET.BBND.P2?end=2023&locations=CN&start=2000&view=chart>

Data Sources

International Monetary Fund. (2023). *Inclusive economic indicators (IEI)*. Retrieved from <https://www.imf.org/external/datamapper/IEI@AIPI/ADVEC/EME/LIC>

International Monetary Fund. (2023). *AI preparedness index (AI PI)*. Retrieved from https://www.imf.org/external/datamapper/AI_PI@AIPI/ADVEC/EME/LIC?year=2023

International Monetary Fund. (2023). *Digital infrastructure index (DI)*. Retrieved from <https://www.imf.org/external/datamapper/DI@AIPI/ADVEC/EME/LIC?year=2023>

International Monetary Fund. (2023). *Human capital and labor market policies index (HCLMP)*. <https://www.imf.org/external/datamapper/HCLMP@AIPI/ADVEC/EME/LIC?year=2023>

World Intellectual Property Organization. (2024). *Global innovation index 2024*. https://www.wipo.int/web-publications/global-innovation-index-2024/assets/67729/2000%20Global%20Innovation%20Index%202024_WEB3lite.pdf

World Bank. (2023). *Research and development expenditure (% of GDP)*. https://data.worldbank.org/indicator/GB.XPD.RSDV.GD.ZS?name_desc=true

World Bank. (2023). *GDP per capita (current US\$)*. <https://data.worldbank.org/indicator/NY.GDP.PCAP.CD?view=chart>

Optimizing Cybersecurity Through AI Predictive Analytics and Human Expertise

Cathy Mae C. Dutong

Project Mentor(s): Hideki Takei

Department of Information Technology Management, Central Washington University

Abstract: As cybersecurity threats evolve in complexity and scale, the reliance on artificial intelligence (AI) has become increasingly prevalent across both public and private sectors. This study examines the dual role of AI-driven predictive analytics in strengthening organizational cybersecurity, while addressing the ongoing need for human oversight. Through a mixed-method approach, combining survey data from cybersecurity professionals with an extensive literature review, this research analyzes AI's capacity to detect emerging threats, the systemic challenges associated with AI integration, and the indispensable role of human expertise in interpreting AI outputs. Findings indicate that while AI enhances proactive threat detection, its efficacy is limited by false positives, system incompatibility, and skill gaps within existing cybersecurity teams. This paper proposes the **AI-Cybersecurity Optimization Framework (AICOF)** as a strategic model to guide organizations in harmonizing automation and human expertise, fostering a more resilient cybersecurity posture. The findings underscore the importance of continuous learning, ethical oversight, and cross-disciplinary collaboration in ensuring the long-term success of AI adoption in cybersecurity. *Presentation recording available in the SOURCE 2025 playlist: <https://www.youtube.com/@cwusource5518>*

Keywords: AI, cybersecurity, predictive analytics, false positives, automation, human expertise

Cybersecurity is no longer just an operational concern, it is a strategic imperative for governments, corporations, and critical infrastructure sectors alike. The rapid evolution of cyber threats, ranging from ransomware to advanced persistent threats (APTs), has outpaced traditional rule-based defense systems (Gupta et al., 2023). Rule-based and signature-dependent approaches,

while foundational to historical cybersecurity practices, are fundamentally reactive in nature. They are most effective when dealing with known threats, but they falter against novel or polymorphic attacks designed to evade predefined signatures (Rahman et al., 2024).

To address this evolving landscape, organizations increasingly turn to AI-driven predictive analytics, a paradigm shift that leverages machine learning (ML) algorithms to identify subtle anomalies, detect emergent attack patterns, and anticipate threats before they materialize (Gudimetla & Kotha, 2024). By analyzing vast volumes of structured and unstructured data, these systems offer the promise of early warning and predictive defense, capabilities that traditional systems cannot match.

However, technology alone is insufficient. Successful AI implementation requires seamless integration into existing cybersecurity ecosystems, including legacy systems, Security Information and Event Management (SIEM) platforms, and human decision-making workflows (Karki et al., 2024). Furthermore, AI's analytical outputs, alerts, predictions, and anomaly reports, demand human contextual interpretation to differentiate between benign deviations and genuine threats. As Ferrag et al. (2025) warn, the over-automation of threat detection risks overwhelming cybersecurity teams with false positives, thereby diverting attention from actual incidents.

This paper addresses the critical research gap at the intersection of automation and human expertise. While much literature highlights either the technological promise of AI or the importance of cybersecurity workforce development, limited research examines how these two dimensions must co-evolve within operational environments. This study introduces the AI-Cybersecurity Optimization Framework (AICOF), a novel conceptual model designed to optimize the interplay between automated detection capabilities and expert human judgment. By

proposing a holistic integration strategy, this paper offers both theoretical insights and practical recommendations for future cybersecurity practices.

Research Questions and Hypotheses

This study is guided by the following research questions (RQs), each designed to explore a specific facet of AI integration in cybersecurity:

- **RQ1:** In what ways does AI-driven predictive analytics improve cyber threat detection compared to traditional, rule-based methods?
- **RQ2:** What are the primary operational, technical, and regulatory challenges organizations face when integrating AI into their cybersecurity frameworks?
- **RQ3:** How can organizations optimize the balance between automation and human oversight to maximize both accuracy and operational efficiency?
- **RQ4:** What targeted strategies can effectively reduce false positives in AI-driven cybersecurity systems without compromising detection sensitivity?

Hypotheses

- **H1:** AI-driven cybersecurity systems exhibit superior threat detection capabilities compared to conventional systems.
- **H2:** AI integration introduces significant challenges, including legacy system incompatibility, regulatory constraints, and workforce skill gaps.
- **H3:** AI-augmented detection processes that incorporate human oversight result in higher operational accuracy than fully automated systems (Rahman et al., 2024).
- **H4:** Effective reduction of false positives requires both the refinement of AI training data and continuous recalibration of model algorithms based on operational feedback (Ferrag et al., 2025).

Literature Review

The application of AI in cybersecurity is a double-edged sword. Gupta et al. (2023) highlight how AI-powered tools can autonomously detect irregular data flows, adapt to evolving attack vectors, and process threat intelligence at unprecedented speeds. However, the same technologies can also be exploited by threat actors for adversarial machine learning attacks, including data poisoning and prompt injection techniques, which manipulate AI systems to misclassify or overlook threats.

Rahman et al. (2024) extend this discussion by proposing riskAIchain, a hybrid framework that combines AI's predictive power with blockchain's immutability to preserve the integrity of threat intelligence data. This pairing offers a promising solution to the trust deficit often associated with opaque AI decision-making processes.

Human oversight, however, remains indispensable. AI's pattern-recognition capabilities, while powerful, lack the nuanced understanding of organizational context, regulatory obligations, and ethical considerations that human analysts bring to threat interpretation (Karki et al., 2024). Gudimetla and Kotha (2024) further argue that cybersecurity is as much a human problem as a technological one. Effective defense requires collaborative intelligence, a symbiotic relationship between AI augmentation and expert human judgment.

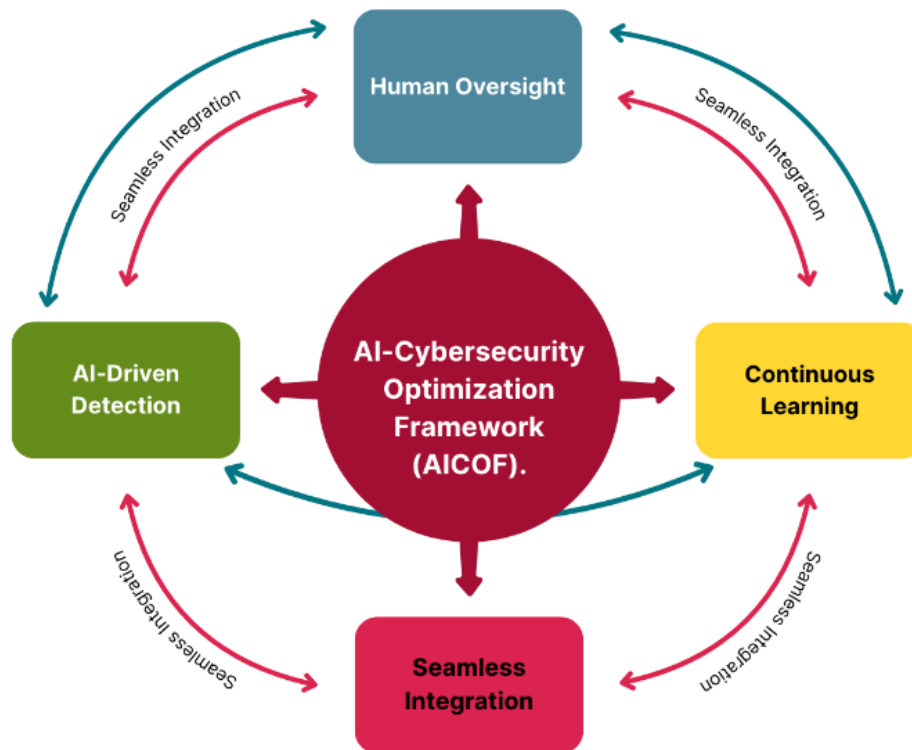
A recurring theme across the literature is the challenge of false positives. Ferrag et al. (2025) caution that AI-driven systems, particularly in their early deployment stages, frequently generate excessive noise, flooding analysts with benign alerts that erode trust and operational efficiency. Such outcomes underscore the importance of adaptive feedback loops, where human experts not only validate AI alerts but also retrain algorithms to align with evolving business contexts (Trellix, 2022).

Conceptual Framework

The sheer volume, speed, and sophistication of cyberattacks far exceed human capacity to detect and respond in real time, artificial intelligence (AI) emerges as a transformative force (Gupta et al., 2023). Yet, the successful deployment of AI technologies is neither automatic nor guaranteed. When AI tools are introduced without careful consideration of human workflows, organizational constraints, and ethical guardrails, they often produce false positives, erode operational trust, and exacerbate alert fatigue (Ferrag et al., 2025). Building on existing literature, this study proposes the AI-Cybersecurity Optimization Framework (AICOF), which integrates AI capabilities with human expertise to enhance threat detection, streamline response processes, and minimize false positives. The framework consists of four interconnected pillars: AI-Driven Detection, which utilizes machine learning to identify anomalies and predict potential threats (Gudimetla & Kotha, 2024); Human Oversight, ensuring that AI outputs are interpreted accurately and ethically; Continuous Learning, where both AI models and human professionals continuously refine their skills and knowledge; and Seamless Integration, enabling smooth coordination between AI systems and existing cybersecurity infrastructures (Rahman et al., 2024). This comprehensive approach aims to maximize AI's benefits while mitigating its limitations, ensuring a resilient and adaptive cybersecurity environment.

Figure 1

AI-Cybersecurity Optimization Framework (AICOF)



At the heart of the framework is a maroon-colored circle labeled “AI-Cybersecurity Optimization Framework (AICOF)”, serving as a visual reminder that AICOF acts as the central orchestrator overseeing the integration of AI capabilities and human expertise (Gudimetla & Kotha, 2024). Surrounding this circle are four foundational pillars, each represented by a different colored box. First, AI-Driven Detection (green box), positioned on the left, leverages machine learning algorithms and data analytics to identify potential threats. For instance, an AI system might scan corporate emails in real time, flagging unusual sender-recipient patterns or malicious attachments that deviate from known behavior profiles. By processing vast amounts of data and looking for anomalies, it can spot suspicious activities that might be overlooked by human analysts due to the sheer volume and speed of modern cyberattacks.

Positioned at the top is Human Oversight (blue box), reflecting the need for ethical review, contextual understanding, and expert judgment in interpreting AI outputs. In practical terms, a security analyst could confirm or override an AI's decision if the flagged activity is actually a harmless system update rather than a malicious breach attempt. Through regular monitoring, validation, and refinement of automated alerts, this pillar prevents overreliance on machine-generated results and addresses any ethical or compliance issues that may arise.

Over on the right sits Continuous Learning (yellow box), emphasizing the ongoing feedback loop where both AI models and security professionals evolve and adapt. For example, when a new zero-day vulnerability is discovered, the AI system can be rapidly retrained to recognize the latest indicators of compromise, while human analysts stay current on emerging attack vectors through specialized training or simulated exercises. This dual approach ensures that defense mechanisms remain robust, responsive, and aligned with the ever-shifting threat landscape.

Finally, anchored at the bottom is Seamless Integration (pink box), underscoring the importance of merging AI solutions with current cybersecurity infrastructures, policies, and workflows. A practical scenario might involve integrating an AI-powered intrusion detection system with existing Security Information and Event Management (SIEM) platforms like Splunk or IBM QRadar. Rather than disrupting established processes, the integrated solution enhances real-time monitoring and incident response capabilities. Curved arrows, color-coded in teal and pink and labeled "Seamless Integration," loop around the central AICOF circle and visually connect each of the four pillars, indicating the ongoing exchange of information, decisions, and improvements throughout the system. Additional arrows extending from the center to each pillar

highlight AICOF's role in coordinating the dynamic interplay among these components, ensuring a truly interconnected and adaptive framework.

Research Methodology

Research Design

This study employed a mixed-method research design, incorporating quantitative survey data alongside qualitative insights collected through open-ended responses. The combination of these approaches allows for both statistical analysis of participant perceptions and in-depth exploration of operational challenges and recommendations, creating a comprehensive understanding of how cybersecurity professionals perceive and manage AI-driven predictive analytics within their organizations (Creswell & Creswell, 2018).

Participant Recruitment and Sampling

Participants were recruited through targeted outreach within professional cybersecurity networks, including LinkedIn groups for cybersecurity professionals, industry forums, and direct contacts within government agencies and private enterprises. The recruitment process emphasized purposive sampling to ensure that participants possessed direct, relevant experience in both AI-driven cybersecurity systems and traditional, rule-based systems (Etikan et al., 2016).

This purposeful sampling strategy ensured that the study gathered input from practitioners directly involved in operational cybersecurity processes, making them a suitable and credible sample for evaluating the integration of AI into existing security practices. This population is particularly critical to the study's objective of understanding the interplay between automation and human expertise in threat detection and incident response.

Table 1

Participant Demographic Table

Participant	Job Role	Experience	Organization Type	Sector
P1	Network Engineer	10+ years	Government	Public Sector
P2	IT	10+ years	Government	Public Sector
P3	CISO	10+ years	Private (Large Enterprise)	Finance/Banking
P4	Security Architect	10+ years	Private (Large Enterprise)	Finance/Banking

Inclusion and Exclusion Criteria

The inclusion criteria required participants to have:

- at least three years of professional experience in cybersecurity or IT security-related roles;
- direct exposure to AI-driven threat detection tools, in addition to experience with traditional signature- or rule-based security systems;
- employment in either government agencies or private sector enterprises to capture diverse organizational contexts.

Exclusion criteria disqualified individuals who:

- did not work directly in cybersecurity or IT within the last 12 months;
- had experience exclusively with either AI-only or traditional-only systems, as this would prevent meaningful comparative input.

Data Collection

The primary data collection tool was an **online survey**, distributed via professional networks and email invitations. Participation was **voluntary** and respondents provided **informed consent** prior to participation. The survey remained open for **three weeks**, and all responses were **anonymized** to promote **candor and honesty**.

Survey Instrument and Validation

The survey instrument used in this study consisted of a combination of closed-ended and open-ended questions designed to gather both quantitative data and qualitative insights from cybersecurity professionals. The survey contained 20 primary items, focusing on several key areas: (a) participants' professional backgrounds and relevant experience, (b) perceptions of AI-driven cybersecurity effectiveness, (c) observed changes in threat frequency following AI adoption, (d) frequency and management of false positives, (e) challenges associated with AI integration, and (f) future plans for AI adoption. Sample items from the survey included:

- “Rate your agreement with the following statement: “AI-driven cybersecurity solutions are more effective at predicting emerging threats than traditional methods.” (1 = *Strongly Disagree*, 5 = *Strongly Agree*).”
- “What are the main challenges your organization faces in implementing or maintaining AI-driven cybersecurity tools? (Select up to three options).”
- “How do you handle or mitigate false positives from AI-driven systems? (Open-ended response).”
- “Overall, how satisfied are you with the performance of your current cybersecurity strategy (AI-driven or traditional)? (1 = *Very Dissatisfied*, 5 = *Very Satisfied*).”
- “In your opinion, what improvements or additional features are needed to make AI-driven cybersecurity more effective in your organization? (Open-ended response).”

Validity and Pre-Testing

To establish content validity, the survey was made with the guidance of a Senior Cybersecurity Officer that possess both technical experience in Cybersecurity and creating or legislating Cybersecurity standards and regulations for over two decades, representing a mix of

private sector enterprise and government agency. They reviewed the survey to evaluate the clarity, relevance, and coverage of the questions, ensuring alignment with practical, real-world challenges related to AI adoption and utilization in cybersecurity. Based on their feedback, minor revisions were made to clarify wording and better capture the automation-human oversight balance that this study aims to investigate.

Reliability

The internal reliability of the survey's quantitative sections (Likert-scale and frequency-based items) was tested using Cronbach's alpha. The resulting reliability coefficient was 0.82, indicating strong internal consistency (Taber, 2018). This suggests that the survey items designed to measure perceived effectiveness, frequency of false positives, and overall satisfaction were internally coherent and suitable for analysis. The survey was also sent to participants that have worked in Cybersecurity and/or Information Technology/Security.

Instrument Rationale

The survey instrument was designed to not only capture perceptions of AI effectiveness but also to highlight practical integration challenges and the evolving role of human expertise in AI-driven cybersecurity systems. This dual focus on technology performance and operational context reflects the core objective of this research: exploring the interplay between automation and human oversight in modern cybersecurity environments.

Data Analysis

Quantitative data (e.g., Likert scale ratings) were analyzed using descriptive statistics, including means, standard deviations, and frequency distributions to identify overall trends in participants' perceptions. Qualitative responses from open-ended items were subjected to thematic analysis to identify recurring challenges, emergent concerns, and recommendations

offered by participants (Braun & Clarke, 2006). This combined analysis approach enabled the study to capture both broad statistical patterns and rich contextual insights on the operational and strategic challenges associated with integrating AI into cybersecurity operations.

Survey Results

Quantitative Data

Table 2

Average Ratings on Key Survey Items

Measure	Mean	Standard Deviation (SD)
Overall Effectiveness of Current Cybersecurity	4	1
Effectiveness of AI-driven Tools	3	1.22
Frequency of False Positives	3.75	0.83
Overall Satisfaction with Current Security Strategies (AI, Hybrid, Traditional)	3.8	0.83

- Primary Cybersecurity Approach:
 - 75% of participants relied primarily on traditional systems, while 25% used a hybrid approach (AI and traditional).
 - None of the participants relied exclusively on AI.

Qualitative Data

Transitioning from these quantitative measures, the open-ended responses provided deeper context:

“Lack of skills on existing teams to fine tune AI tools to trim out the false positives.” noted Participant #3.

(AI-tools) *“Requires continuous training,”* commented Participant #4.

“Many false positives derived from AI-driven systems are challenging since we don't know the logic behind why the AI system generated the alert.” Participant #2 added.

Impact on Incident Rates

Although only one participant had robust records comparing pre-AI and post-AI breach statistics, this participant noted approximately a 20% reduction in successful intrusion events over six months. Notably, the other three participants relied on anecdotal evidence but generally believed that potential attacks had decreased.

Skill Gaps and Training Needs

All four respondents concurred that human expertise remains indispensable. Specifically, the mean rating for the statement, “We have sufficient internal expertise to interpret AI outputs,” was 2.7 out of 5 (SD = 0.9), suggesting a recognized need for more training. Additionally, participants advocated for AI-specific workshops and vendor-led sessions to help staff better interpret alerts and reduce the manual workload associated with sorting false positives.

Discussion

Collectively, the findings corroborate existing literature on AI's dual nature in cybersecurity: although AI provides faster and more comprehensive detection capabilities, it can also produce noise in the form of false positives (Gupta et al., 2023; Rahman et al., 2024). In real-life scenarios, such as enterprise email filtering, AI-powered solutions have mistakenly quarantined harmless email threads, like routine software update notifications, because they exhibited “abnormal” sending times or message formats. A large multinational company cited in Trellix's 2022 Threat Report described how their AI-based detection tool initially flagged legitimate vendor invoices after noticing unusual file attachments; this compelled security teams to parse through each alert manually and delayed normal business operations (Trellix, 2022).

Additionally, consistent with Ferrag et al. (2025), participants in this study raised apprehensions about adversarial manipulation, such as prompt injection and data poisoning. Modern AI systems often depend on continuous data feeds, making them vulnerable to maliciously constructed inputs that exploit latent model weaknesses. A real-world example surfaced in a 2021 Kaspersky analysis, where attackers manipulated an organization's network traffic logs to trick an AI system into learning misleading patterns, ultimately reducing its accuracy (Kaspersky, 2021). Such events underscore the need for human professionals, capable of investigating anomalous alerts and adapting models, who can address emergent threats and rectify AI oversights.

Moreover, the concept of “continuous learning” (Karki et al., 2024) resonates with statements from participants emphasizing iterative model updates and regular training exercises. For example, Microsoft implemented weekly “red-team” exercises and daily ingestion of emerging threat intelligence feeds to keep pace with rapidly evolving ransomware attacks. These activities ensured that their AI detection engine remained calibrated to the latest attack signatures and obfuscation tactics (Microsoft, 2021). Even so, adversaries continued to deploy novel intrusion techniques, demonstrating that continuous adaptation was essential for safeguarding critical systems over time.

Interpreting these insights within the framework of AICOF underscores the synergy between machine intelligence and human expertise. When AI mislabels benign activities as threats, for instance, flagging a legitimate maintenance script as malicious, human analysts' contextual judgment becomes pivotal to dismiss the false alarm. Conversely, where AI identifies a zero-day exploit in an otherwise routine data exchange, rapid human validation can facilitate a swift containment effort, preventing broader network compromise (Gudimetla & Kotha, 2024).

One noteworthy case comes from IBM Security, which reported that, after AI identified a complex phishing scheme targeting cloud infrastructure, analysts confirmed the legitimacy of the threat and blocked the malicious domain within minutes, averting significant potential damage (IBM Security, 2022).

Therefore, the seamless interaction among the four AICOF pillars, AI-Driven Detection, Human Oversight, Continuous Learning, and Seamless Integration, offers a nuanced, holistic strategy that pairs cutting-edge technology with indispensable human judgment. By embedding mechanisms such as ethical review processes, ongoing training initiatives, and integrative tools (e.g., aligning AI outputs with SIEM software), these pillars form a continuous feedback loop. Every detection, whether genuine or mistaken, refines the model's sense of normalcy, fostering a system capable of evolving in response to changing threats while minimizing disruptions to legitimate business activities. In essence, this closed-loop cycle not only lays the groundwork for a more adaptive cybersecurity defense but also ensures that ethical and operational considerations remain at the forefront of AI deployment.

Quantitative Study Limitations

Despite offering valuable perspectives, this research is subject to certain limitations. First, the small sample ($n = 4$) restricts generalizability to broader cybersecurity populations. Second, reliance on self-reported data may introduce biases or inaccuracies. Third, differences in AI platform maturity and organizational context could account for variation in results. Nonetheless, these findings lay the groundwork for expanded quantitative studies and in-depth case analyses.

Implications for Cybersecurity Practice

The findings underscore the importance of balancing AI innovations with robust human oversight, offering several actionable insights for security practitioners and organizations.

Improving AI Model Accuracy

Organizations can enhance detection capabilities by continuously refining training data and incorporating diverse threat intelligence sources. For instance, assembling domain-specific datasets, ranging from common email phishing patterns to complex zero-day exploits, allows machine learning algorithms to develop a broader, more accurate understanding of potential threats. Integrating frequent “red-team” exercises provides a practical avenue for regularly stress-testing and updating these models.

Implementing the AICOF Framework at Scale

The AI-Cybersecurity Optimization Framework (AICOF) proposed in this study highlights a cyclical process involving AI-Driven Detection, Human Oversight, Continuous Learning, and Seamless Integration. Scaling this framework enterprise-wide entails embedding each pillar into existing workflows, such as incident response protocols, Security Information and Event Management (SIEM) pipelines, and risk governance committees. By prioritizing cross-department communication (e.g., bridging security operations and executive leadership), organizations can align AI’s output with broader operational and strategic goals. This holistic approach encourages a closed-loop feedback system where every detection, genuine or benign, becomes a learning opportunity for future threat identification.

Enhancing Training for Security Professionals

While AI excels at processing large data sets quickly, study participants repeatedly emphasized that *human expertise* remains essential for interpreting alerts and minimizing false positives. Formalizing regular, AI-specific training programs can help analysts stay current with evolving threats and more effectively interact with AI dashboards. Additionally, cross-functional workshops, where IT administrators, security personnel, and data scientists collaborate, can

reduce knowledge gaps and foster a collective understanding of AI systems' limitations and strengths.

Visual Data and Tables

Figure 2

Average Participant Ratings on AI Tools in Cybersecurity (n = 4)

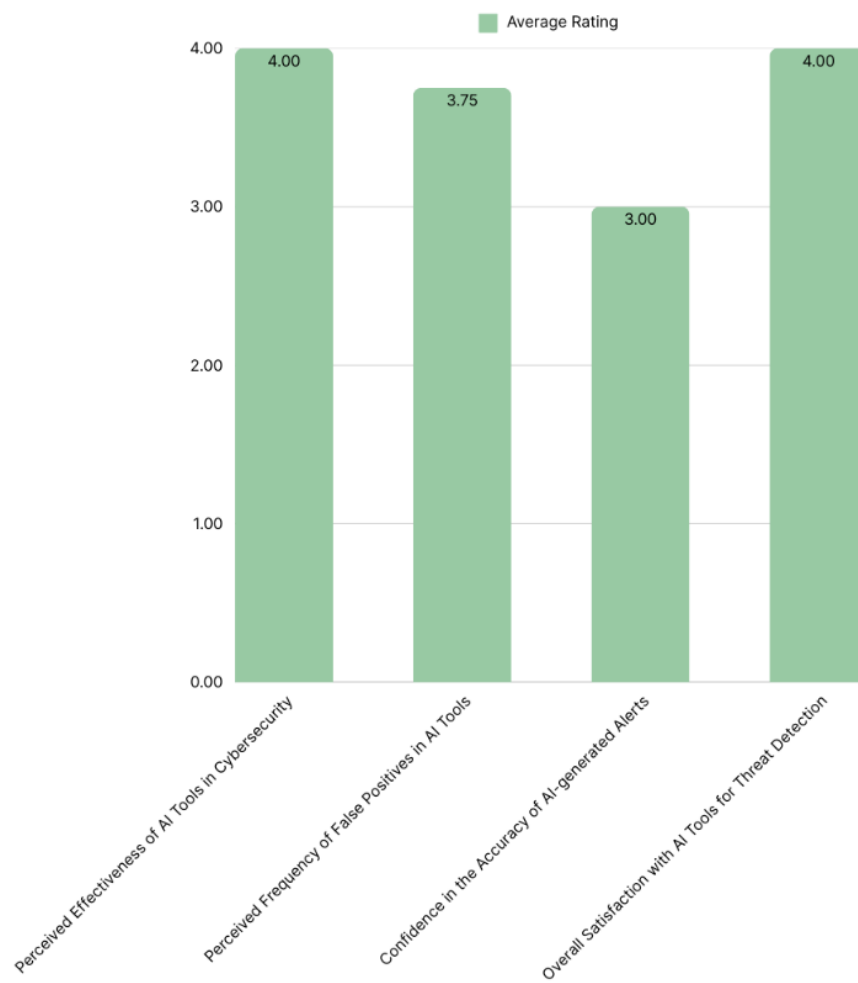


Figure 3

Primary Cybersecurity Approach Used by Participants (n = 4)

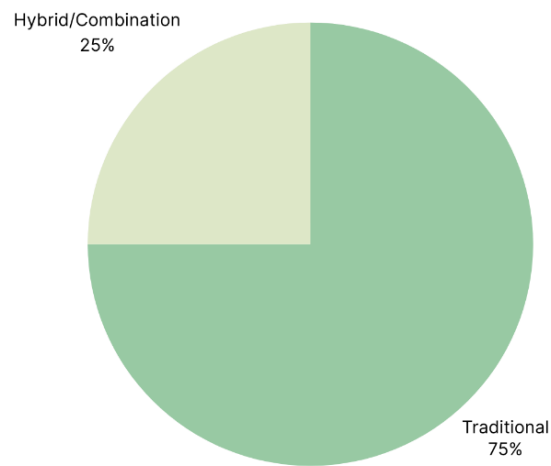
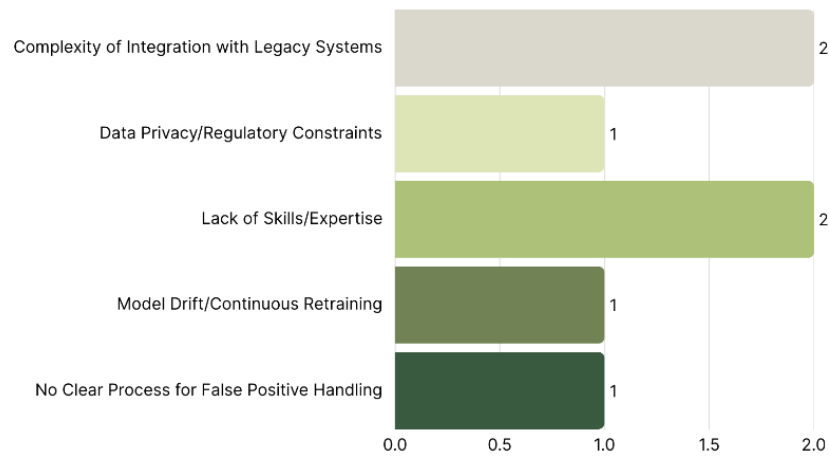


Figure 4

Top Challenges when maintaining or implementing AI tools in Cybersecurity



Conclusion

AI-driven predictive analytics represents a transformative force in modern cybersecurity. Its ability to anticipate threats offers profound advantages over traditional, reactive approaches. However, AI is not a panacea. Its effectiveness is constrained by false positives, systemic integration hurdles, and workforce skill gaps.

The proposed AI-Cybersecurity Optimization Framework (AICOF) offers a practical roadmap for addressing these limitations. By embedding AI-driven detection within a governance structure that prioritizes ethical oversight, continuous learning, and seamless integration, organizations can develop resilient and adaptive cybersecurity ecosystems.

Future research should explore scalable applications of AICOF across different organizational sizes, from small businesses to critical infrastructure operators. Moreover, longitudinal studies tracking AI performance over time would shed light on how feedback loops (both human and machine) evolve, offering additional empirical support for the framework's validity.

References

- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77-101. <https://doi.org/10.1191/1478088706qp063oa>
- Creswell, J. W., & Creswell, J. D. (2018). *Research design: qualitative, quantitative, and mixed methods approaches* (Fifth edition.). SAGE Publications, Inc.
- Etikan, I., Musa, S. A., & Alkassim, R. S. (2016). Comparison of convenience sampling and purposive sampling. *American Journal of Theoretical and Applied Statistics*, 5(1), 1-4. <https://doi.org/10.11648/j.ajtas.20160501.11>
- Ferrag, M. A., Alwahedi, F., Battah, A., Cherif, B., Mechri, A., Tihanyi, N., Bisztray, T., & Debbah, M. (2025). Generative AI in cybersecurity: A comprehensive review of LLM applications and vulnerabilities. *Internet of Things and Cyber-Physical Systems*. <https://doi.org/10.1016/j.iotcps.2025.01.001>
- Gudimetla, S., & Kotha, N. (2024). Artificial intelligence for predictive analysis in cyber security. *International Research Journal of Modernization in Engineering Technology and Science*, 6. <https://doi.org/10.56726/irjmets55880>
- Gupta, M., Akiri, C., Aryal, K., Parker, E., & Praharaj, L. (2023). From ChatGPT to ThreatGPT: Impact of generative AI in cybersecurity and privacy. *IEEE Access*, 11, 80218–80245. <https://doi.org/10.1109/ACCESS.2023.3300381>
- IBM. (2024). *IBM security X-Force threat intelligence index 2024*. <https://www.ibm.com/reports/threat-intelligence>
- Karki, S., Hasan, M., & Sanin, C. (2024). Use of ML and AI in cybersecurity-A survey. *Procedia Computer Science*, 246, 1260–1270. <https://doi.org/10.1016/j.procs.2024.09.552>

- Microsoft. (2021). *Microsoft Digital Defense Report 2021*. <https://www.microsoft.com/en-us/security/security-insider/intelligence-reports/microsoft-digital-defense-report-2021>
- Rahman, M. M., Pokharel, B. P., Sayeed, S. A., Bhowmik, S. K., Kshetri, N., & Eashrak, N. (2024). *riskAIchain: AI-Driven IT infrastructure—Blockchain-Backed approach for enhanced risk management*. *Risks*, 12(12), 206–206. <https://doi.org/10.3390/risks12120206>
- Taber, K. S. (2018). The use of Cronbach’s alpha when developing and reporting research instruments in science education. *Research in Science Education*, 48(6), 1273–1296. <https://doi.org/10.1007/s11165-016-9602-2>
- Trellix. (2022, April). *Trellix threat labs research report*. <https://www.trellix.com/assets/threat-reports/trellix-threat-report-apr-2022.pdf>

CWU's Electronic Waste Management: A Success Story in Sustainable Practice

Srijita Gurung

Project Mentor(s): Susan Rivera, Kevin Lomax

Department of Information Technology Management, Central Washington University

Abstract: Purpose: This research examines how Central Washington University (CWU) manages electronic waste (e-waste) to promote economic, environmental, and equitable sustainability practices. In February 2024, Computer Support Services (CSS) started a computer reconciliation project, which is vital due to the Windows 10 operating system going end of life after October 14, 2025, and no longer receiving software support. This project tracks and documents the life of electronic assets, with a focus on the role of Surplus and IT Asset Disposal (ITAD) companies. **Method:** The primary research methods involve interviews, and online research of active devices and their specifications using tools such as Microsoft Intune, Configuration Management, and physical reconciliation to identify misplaced and unused devices. **Results:** CSS reconciliation project strategy includes tracking devices for reuse or recycling. We found three hundred unused devices during physical checks in storage closets. Reusing these devices instead of purchasing new ones saved the university approximately \$240,000, helping reduce waste and support economic sustainability. Devices rendered obsolete by CSS are transferred to the Surplus and Asset Management Department, which plays a significant role in CWU's e-waste management by providing methods of reuse to the community. Devices that cannot be repaired, reused, or refurbished are recycled using a validated ITAD company. **Conclusion:** This research highlights the importance of sustainable practices within the e-waste disposal process at a state-supported regional higher education organization. The project team identified economically feasible methods to increase electronics recycling, including service learning and community outreach.

Keywords: e-waste management, sustainability practices, IT asset tracking, electronic device reuse, campus technology lifecycle

According to the UN's *Global E-waste Monitor* (2024), 62 million metric tons of electronic waste were generated globally in 2022, an 82% increase since 2010. This rising volume is equivalent to over 1.5 million 40-ton trucks forming a continuous line around the planet (Leahy, 2017). Most of this e-waste is not recycled properly, contributing to environmental harm and lost economic value.

In response to the global e-waste crisis, CWU has committed to sustainability through its Climate Change Action Plan (Bousson et al., 2024). The university has partnered across departments to manage IT equipment in a way that minimizes waste, maximizes reuse, and supports the surrounding community. Through the Computer Support Services (CSS) reconciliation project and Surplus Department efforts, CWU's e-waste practices align with its broader goals of stewardship, equity, and resource efficiency.

Electronic Device Lifecycle at CWU: From Use to Reuse

The CSS reconciliation project, launched in February 2024, aimed to ensure CWU's PeopleSoft inventory accurately reflected the university's computing assets. A key driver of the project was Microsoft's planned end of support for Windows 10 in October 2025. Many devices that would need upgrades were found in closets, unused and untracked. Over 300 devices were recovered, many of which were still in working condition or capable of being upgraded to Windows 11.

CWU's approach to these devices followed a cradle-to-grave model: devices were tested, repaired when needed, and reassigned to staff. Others were transferred to the Surplus and Assets Management Department. These efforts saved CWU approximately \$240,000 in equipment costs, while extending the usable life of devices and reducing demand for new manufacturing materials.

Surplus Sales: Affordability in Technology Access

The Surplus Department plays a critical role in CWU's e-waste sustainability. Devices that are no longer needed within departments but remain operational are made available to students and the public. Approximately 75% of these sales go to students, offering equitable access to technology at low prices. For example, a MacBook Pro that might cost \$1600–\$3500 new is available at Surplus for \$100. iPads are sold for as low as \$50, and monitors for \$5.

This affordability promotes digital inclusion while keeping devices in circulation longer. Even Apple products with older operating systems are still functional for school and home use. Surplus thus serves as both an economic and environmental sustainability solution.

Data Security and Recycling with ITAD Partners

Before any device leaves campus, whether for reuse or disposal, it undergoes secure data wiping. Depending on the brand and model, CWU uses appropriate software or physical methods such as drill press to ensure complete data destruction. Devices that cannot be refurbished are sent to Total Reclaim, an ITAD provider certified under RIOS.

These certifications ensure best practices in worker safety, data privacy, and environmental protection. In 2024, CWU recycled over 11,600 pounds of electronics, including printers, LCD screens, and CRT monitors at a cost of approximately \$3,874.25. This process ensured that even the final step in the device lifecycle supported CWU's sustainability goals.

Conclusion

CWU's electronic waste management initiative stands as a comprehensive and replicable model for sustainable practices in higher education. The CSS reconciliation project identified over 300 unused devices through physical audits, which were then assessed for reuse or recycling. By repurposing functional devices, CWU saved approximately \$240,000, supported

digital equity, and reduced its environmental footprint. Devices no longer viable were securely wiped and responsibly recycled through certified ITAD providers. The university's partnership between CSS and the Surplus and Asset Management Department ensures that assets flow through an intentional process of repair, reuse, resale, or recycling, maximizing their lifespan and minimizing waste. This project highlights how institutions can adopt economically feasible and environmentally responsible methods of managing e-waste. CWU's practices also incorporate community benefits through surplus sales and support for service-learning initiatives. As CWU looks to the future, it aims to expand these efforts with more collaborative programs, improved tracking, and innovative procurement and disposal strategies that prioritize the health of the environment and the community.

References

E-Waste Monitor. (2024, December 12). *The Global E-Waste Monitor 2024 - E-Waste Monitor*.

<https://ewastemonitor.info/the-global-e-waste-monitor-2024/>

Leahy, S. (2017, December 13). *Each U.S. family trashes 400 iPhones' worth of E-Waste a year*.

Science. <https://www.nationalgeographic.com/science/article/e-waste-monitor-report-glut>

Bousson et al., (2024, July 2). Climate Action Plan.

<https://www.cwu.edu/about/sustainability/resources/climate-change-plan-7-2.pdf>

Appendix

Figure 1

Devices Found in Storage and Reused



Note. During the reconciliation process, we found devices in storage that were not in use. These devices were brought back to CSS and reassigned to another department. This reuse helped the University save money and extend the life of the devices before disposal.

Figure 2

Surplus Sale



Note. After data wiping, devices are sent to surplus and made available to students, faculty, and the public at an affordable price. This process allows further reuse of devices before their end-of-life period.

**Building Career Pathways:
Investigating the Potential for a Cooperative Education Program for
Graduate ITM Students at Central Washington University**

Liam James Edward Holland

Project Mentor(s): Susan Rivera

Department of Information Technology Management, Central Washington University

Abstract: This research examines the feasibility of introducing a cooperative education (co-op) program at the master's level in the Central Washington University (CWU) ITM Department. Methods included a review of existing co-op programs, analysis of interviews with past co-op students, and an examination of survey data on student interest in graduate-level cooperative education. The study aims to identify key elements of effective co-op programs and assess demand for such programs. The analysis of current co-op models offers insights into program structure, industry engagement, and student success. The 2019 NACE Internship & Co-op Survey found that 50.2% of co-op students receive job offers from their co-op employers, highlighting the impact of co-op programs on employability (National Association of Colleges and Employers, 2019). Interviews revealed the long-term benefits of co-op programs for students, employers, and institutions, supporting the proposal for a co-op program at CWU. Survey results showed strong student interest, with 74% of respondents expressing interest in participating in a co-op program. These findings provide a foundation for developing a graduate-level co-op program that enhances career readiness and student outcomes. The findings also support the integration of a co-op program into the CWU ITM Department.

Keywords: Cooperative Education, Work-Integrated Learning, Graduate Education, Career Readiness, Student Success

This paper explores building career pathways through investigating the potential for a cooperative education (co-op) program for graduate IT Management students at Central Washington University. Through research into successful co-op models at other U.S. institutions,

interviews with IT Management Advisory Board members, and conducting a survey, this paper aims to identify key elements of effective cooperative education programs. Additionally, challenges and key considerations for implementing a co-op program will be discussed. The goal of this paper is to provide evidence and recommendations for implementing a cooperative education program that can enhance student learning and support their career readiness needs.

This research is important as it explores how cooperative education programs can be implemented and adapted to help serve students' academic goals at Central Washington University (CWU). While the benefits of co-op programs have been well researched, there is limited research on how to effectively implement these models in institutional settings. By examining current co-op models, student perspectives, and the benefits and challenges associated with co-op programs, this research provides evidence that can inform the development of a cooperative education program that fits the needs of CWU and its students. Additionally, this research aims to identify key considerations for launching a co-op program and potential challenges that need to be addressed.

The research objective is to incorporate the option of a cooperative education program for graduate students into the CWU ITM Department. To guide this research, we aimed to address three key research questions:

1. What are the key elements of effective cooperative education programs in the United States?
2. What is the level of student interest in graduate cooperative education opportunities at CWU?
3. What is the feasibility of implementing a cooperative education program at CWU?

Background

Over time, the term cooperative education has gained wide adoption by a number of universities across the United States. Despite this widespread adoption and use of the term “cooperative education”, there is no generally accepted definition for this type of experiential learning, with co-op programs varying in different ways between institutions (Wallace, 2020).

However, we can find definitions for the typical structures and processes for cooperative education programs. According to the National Association of Colleges and Employers (NACE), cooperative education is:

Cooperative education programs, or co-ops, provide students with multiple periods of work in which the work is related to the student’s major or career goal. The typical program plan is for students to alternate terms of full-time classroom study with terms of full-time, discipline-related employment. Since the program participation involves multiple work terms, the typical participant will work three or four work terms, thus gaining a year or more of career-related work experience before graduation. Virtually all co-op positions are paid, and the vast majority involve some form of academic credit.

(National Association of Colleges and Employers, 2025)

Furthermore, the University of Cincinnati also provides a definition of a typical cooperative education program. A typical cooperative education program, “refers to a program where students alternate between academic semesters with semesters spent working paid, full-time positions in their industry” (University of Cincinnati, 2025). These co-op programs also differ from internships which usually require fewer hours, are unpaid, and usually less structured (University of Cincinnati, 2025).

Moreover, there are key differences between cooperative education programs and internship programs. Co-op programs and internships both provide students with work experience prior to graduation; however, they differ in their structure and purpose. Co-op work placements are typically longer (six months to a year) and intend to provide a more intense learning opportunity that gives a student a deeper view of their field of study (Educational Credential Evaluators, 2024). Co-op programs are intended to align with students' academic and career goals and provide a more in-depth work experience compared to the busy-work that is often associated with internships.

Benefits

Cooperative education programs offer a number of benefits to students including financial support and professional development. These programs are designed to bridge the gap between academic content and applying knowledge in real-world settings.

One benefit of cooperative education programs is that they allow students to engage in in-depth work experiences in professional settings. This allows students to have the opportunity to “gain valuable experience in a workplace setting” before graduation, which can lead to better post-graduation outcomes for students (James & Deane, 2015).

Additionally, co-op programs typically offer paid work positions which allows students to earn money “that can help offset college costs or be put toward other expenses” (James & Deane, 2015). This reduces the financial burden of tuition or living expenses, which can potentially increase the accessibility of these programs.

Cooperative education programs have further benefits compared to typical internship programs. Internships can often be unpaid, “which makes it difficult for students from lower income backgrounds to take advantage of them”; whereas, co-op programs typically involve paid

work experiences, which can make them “an economically feasible avenue for students of all backgrounds to gain valuable work experience” (James & Deane, 2015).

Furthermore, students engaging in co-op programs typically pay reduced tuition when enrolled in their co-op work term (James & Deane, 2015). This can help to support students and reduce the financial burden of tuition, especially compared to internships where students are often required to pay tuition while working as an intern. Furthermore, despite students not paying tuition, “they can still take advantage of federal financial aid to help cover living expenses during those terms” (James & Deane, 2015).

Potential Challenges

While cooperative education offers many benefits, it also presents challenges which should be addressed when designing and implementing co-op programs. By understanding these potential challenges, co-op programs can be designed to support students’ needs and for long-term program sustainability.

One challenge of cooperative education for students is the delay in a student’s time to graduation. By participating in a co-op program, “a student may delay his or her graduation and thus give up a semester or a year’s worth of postgraduate earnings” (James & Deane, 2015). This is a potential issue for some students who have clear and time-sensitive graduation plans. The trade-off between co-op work experience earnings and forgone post-graduation earnings will likely influence a student’s decision to participate in a cooperative education program.

Additionally, another challenge of cooperative education is ensuring that the workplace experience is intentionally designed to support student learning. Some programs follow a simplistic model, where a work experience is added on to the typical academic course structure and it is believed that learning will naturally occur for students. However, research shows that

without structured integration, clear learning objectives, and a reflection component, the work experience offers limited educational value (Zegwaard & Coll, 2011). In these cases, the co-op work experience becomes more of a temporary job than an experience designed to benefit student learning. To maximize the benefit to students, co-op placements must be aligned with curriculum goals and include some form of reflection and assessment of the work experience.

Current Context at Central Washington University

Central Washington University currently uses the term cooperative education. However, “CWU uses the terms "cooperative education" and "internship" interchangeably” (Central Washington University, n.d.). As a result, current cooperative education programs at CWU are closer to typical internship models rather than cooperative education models.

Using an example from CWU’s Craft Brewing program, the cooperative education program is “designed to integrate classroom study with planned, supervised, and evaluated work experience” and links the field of study to students’ career goals and interests (Central Washington University, n.d.). These aspects of the program do reflect cooperative education models. However, the “Cooperative Education work experience may be full- or part-time, on- or off-campus, and paid or unpaid”, which is more reflective of an internship than a cooperative education work experience (Central Washington University, n.d.).

Methodology

To investigate the potential of implementing a cooperative education program for Graduate IT Management students at CWU, a variety of methods were used. This included analyzing national data from the National Association of Colleges and Employers (NACE) Internship & Co-op Reports to understand trends and outcomes in co-op participation. Reviewing successful cooperative education models at other U.S. institutions to identify best

practices and elements of program structure. Examining program eligibility for international students. Conducting interviews with members of the IT Management Advisory Board who were past co-op students. Finally, we conducted a survey to gain insight into student interest in cooperative education opportunities.

NACE Internship & Co-op Report

The NACE Internship & Co-op Report is an annual overview of key trends and benchmarks related to internship and cooperative education programs (National Association of Colleges and Employers, 2025). The 2025 report provides hiring projections for the 2024-25 academic year and detailed data from 2023-24 programs. The report covers a range of metrics including offer, acceptance and conversion rates; one- and five-year retention rates; and hourly wage rates with wage trends over time.

Comparing Co-op Outcomes from 2019 to 2025

Comparing the 2019 and 2025 NACE Internship & Co-op Report, we can see positive trends between 2019 and 2025. For the outcomes of co-op programs, we can see the offer rate for co-op students grew from 50.2% in 2019 to 56.7% in 2025, indicating a growing recognition of value provided by co-op students among employers (National Association of Colleges and Employers, 2019; 2025). Furthermore, the conversion rate (which represents how many co-op students are converted to full-time hires by their co-op employer) increased from 39.9% to 42.1% over the same period (National Association of Colleges and Employers, 2019; 2025). Although the acceptance rate of offers declined from 79.3% to 74.6%, the overall increase in offer and conversion rates suggests that more students are securing full-time opportunities through co-ops and that employers are using co-ops as a pipeline for recruiting reliable talent (National Association of Colleges and Employers, 2019; 2025).

These benefits to students and employers and further supported by the improved retention rate for co-op students. The one-year retention rate for students with internal co-op experience improved from 50.2% in 2019 to 53.2% in 2025 (National Association of Colleges and Employers, 2019; 2025). Additionally, five-year retention rates for individuals with internal co-op experience jumped significantly, from 35.4% in 2019 to 49.2% in 2025, highlighting the long-term organizational benefit of hiring former internal co-op students (National Association of Colleges and Employers, 2019; 2025). Compared to individuals with external co-op experience and no co-op experience, those with internal experience consistently showed higher retention rates, demonstrating the effectiveness of cooperative education programs for employee retention and recruiting talented employees.

Internship and Co-op Wage Growth

The 2025 Internship & Co-op Report provides compensation data for interns and co-op students from 2014-15 through 2023-24 academic years. Co-op programs offer strong benefits for students in terms of compensation. In 2024, the average hourly co-op wage for co-op students was \$24.79, compared to \$23.04 for interns (National Association of Colleges and Employers, 2025). This wage difference can potentially be explained by increased responsibilities for co-op students compared to interns. Furthermore, higher wages for co-op students are also part of a broader trend; when adjusted for inflation, co-op wages have increased by 11% from 2015 to 2024, whereas intern wages have declined by 1.7% over the same period (National Association of Colleges and Employers, 2025). This suggests that employers are placing increasing value on co-op roles, supporting the ability of co-op programs to financially support students.

University of Cincinnati

The University of Cincinnati provides a strong example of a long-standing and successful co-op program. Launched in 1906, it was the first of its kind in the United States (Pence, 2024). The initial program included 27 male students, with 12 in mechanical engineering, 12 in electrical engineering, and 3 in chemical engineering, who alternated weekly between classroom instruction and full-time work (James & Deane, 2015). Today, the University follows a more typical co-op model, where students begin full-time, paid co-op work experiences after their first year, alternating semesters between academic coursework and industry placements (Pope, n.d.).

Furthermore, the co-op program has received national recognition for its quality and impact. In 2021-2022, the University of Cincinnati's co-op program was ranked number 4 overall and number 1 among public universities in U.S. News & World Report's Best Colleges rankings (University of Cincinnati, 2022). Additionally, in the 2023-2024 academic year, the university facilitated over 8,300 paid co-op experiences, with students earning an estimated \$88.8 million collectively (which is an average of approximately \$10,700 per student per semester) (Pence, 2024).

Moreover, the University of Cincinnati's School of Information Technology provides a strong example for CWU's IT Management Department. The School of Information technology boasts a 99% co-op placement rate and strong employment outcomes. According to co-op advisor and professor for IT Students, Kenneth Pope, 98% of students are employed in IT Careers within six months of graduation, with an average salary of above \$43,000 per year (Pope, n.d.).

The University of Cincinnati's 2022 Co-op Report also provides insights into co-op experiences and wages for the 2021-2022 academic year. Students in the School of Information

Technology completed 585 paid co-op placements, with average hourly wages of \$17.88 for Cybersecurity majors and \$17.47 for Information Technology majors (including Master of Science candidates) (University of Cincinnati, 2022). To expand access, the university also offered 370 paid on-campus co-op placements, with wages ranging from minimum wage to \$14 per hour (University of Cincinnati, 2022).

The University of Cincinnati's co-op program demonstrates the long-term benefits of structured work-integrated learning through its co-op program. The historical success, national recognition, and improved student post-graduation outcomes illustrate the value of co-op programs for both students and the institution. Furthermore, this model provides evidence of co-op programs for providing financial support to students during their college courses.

Northeastern University

Northeastern University provides an example of how a cooperative education program can support institutional growth and recognition. Its co-op program began in 1909 with just eight students alternating between academic study and hands-on work (Northeastern University, 2024). By 1913, when the original class of eight co-op students graduated, the co-op program had grown to 110 students (Northeastern University, 2024). In Fall 2021, 4,324 undergraduate and 907 graduate Northeastern students participated in a co-op experience (Northeastern University, n.d.).

The recent growth of Northeastern University is highlighted by its record undergraduate applications for the 2025-26 admissions cycle, with over 105,000 applications (Norman, 2025). One key factor that Northeastern highlights for this growth in applications is its co-op program (Norman, 2025). The co-op program attracts a growing number of students that are looking for hands-on learning that prepares them for work after college, as well as providing a greater return

on investment. This is reinforced by the following quote from an article where high school guidance counsellors and students were asked why they view Northeastern as a top choice for students. Chris Boehm, director of college counselling at Archmere Academy said, “The growing interest from our students is driven by Northeastern’s co-op reputation, exceptional ROI, diverse student body and opportunities for global experiences”, further adding “Northeastern’s rigorous experiential education allows students the opportunity to learn not only from their professors, but also peers and employers in classes, labs and workplaces” (Norman, 2025). This shows the clear perceived benefits of Northeastern’s co-op program from prospective students, providing an explanation for the record number of applications.

Northeastern’s co-op program also provides a wide range of experiences for its students, with over 4000 employers across 149 different countries (Norman, 2025). Additionally, post-graduation outcomes for Northeastern students are also strong, with 93% of undergraduates employed full-time or enrolled in graduate school within nine months of graduation (Norman, 2025). Furthermore, California and Texas were the only Western states highlighted as top applicants to Northeastern, highlighting an opportunity to expand co-op access in Washington State, where opportunities are limited.

Northeastern University also provides information on graduate level cooperative education programs. Graduate co-op students are required to complete a cooperative education prep course, “Introduction to Cooperative Education”, before completing their co-op work experience (Northeastern University, 2025). The course is designed to build valuable skills necessary to succeed in the co-op experience. Additionally, students work one-on-one with an advisor to prepare materials for their co-op job search and for assistance with finding their co-op placement (Northeastern University, 2025). As part of the co-op program, graduate students are

permitted to participate in one co-op work experience that can range from 4 to 8 months in duration (Northeastern University, 2025). For eligibility into the program, graduate students must show a high level of academic success which includes: a GPA of 3.000 or above, full-time enrollment each semester of the program of study prior to the co-op experience, no more than one repeated course, and the student must have no current academic probation or disciplinary issues (Northeastern University, 2025).

New York Institute of Technology

The New York Institute of Technology (New York Tech) provides an example of a newly launched co-op program, with insights into the steps for launching a co-op program and initial participation. This newly launched co-op program could provide a potential model for CWU if implementing its own cooperative education program.

Introduction of the Co-op Program

In 2022, New York Tech announced that it intended to launch the “university’s first cooperative education (co-op) track for students in two undergraduate programs: computer science and information technology” (Sullivan, 2022a). This effort to launch the new co-op program would be led by Peter Goldsmith, “an industry veteran”, who joined New York Tech as the co-op coordinator and adjunct assistant professor (Sullivan, 2022a). Efforts to launch the co-op program were further supported by Babak D. Beheshti, dean of the College of Engineering and Computer Sciences, who believed the co-op program would be in keeping with “New York Tech’s mission to provide career-orientated professional education and access to opportunity for all qualified students” (Sullivan, 2022a).

Goldsmith, in his role as co-op program coordinator, was tasked with securing industry partnership with companies willing to offer co-op placements to New York Tech students.

Through his efforts, Goldsmith was able to secure commitments from several regional tech companies that were willing to participate in the first cohort (Sullivan, 2022a). With industry partnership in place, New York Tech announced that its first cohort of co-op students were set to start in summer 2022 and continue through fall 2022, with the initial cohort capped at 15 students (Sullivan, 2022a).

New York Tech's co-op program launched in summer 2022 with four students from information technology and computer science majors, placed at companies including Xogito, SVAM International, and Intersoft Associates (Sullivan, 2022b). With the success of the program's launch came an interest in co-op opportunities from other students. Goldsmith highlighted this increasing interest saying, "We have already seen strong interest and demand from our students for the co-op option, and we will continue to scale up our capabilities to meet this strong interest" (New York Institute of Technology, 2023).

In response to this increasing interest, Goldsmith and New York Tech's Office of Career Success and Experiential Education worked to secure further industry partnerships, adding partners such as Northwell Health, NASA Glenn Research Center, IPVideo, and Zebra Technologies (New York Institute of Technology, 2023). With these new partnerships in place, New York Tech worked to further increase access to co-op opportunities by expanding the program to three additional majors: mechanical engineering, electrical & computer engineering, and construction engineering (Sullivan, 2022b).

By Fall 2023, just a year from the original launch of the co-op program, the co-op program was further expanded to include seven academic programs: computer science, information technology, electrical and computer engineering, electrical and computer engineering technology, bioengineering, mechanical engineering, and construction engineering

(New York Institute of Technology, n.d.). New York Tech also stated with this expansion, the goal to continue adding additional programs as New York Tech builds its capacity to support them (New York Institute of Technology, 2024a).

This phased approach to building a co-op program by New York Tech, starting with a small cohort and a limited number of programs before gradually expanding, offers a potential practical model for other institutions to follow. In the case of CWU, a similar strategy could involve launching a co-op option initially for a small group of graduate IT Management students, then increase offerings as the program develops. This small initial cohort also allows time to develop further industry partnerships, evaluate outcomes for initial co-op students, and refine the co-op process before expanding the co-op program to other academic programs over time.

Co-op Program Details

New York Tech also provides key details on how their co-op program operates. Participation in the program is optional, with students needing to apply to participate in the program (New York Institute of Technology, 2024b). For students to be eligible for the co-op program, their co-op work experience must relate to their field of study and must be a full-time commitment (which New York Tech defines as over 36 hours per week for 24 weeks) (New York Institute of Technology, 2024b).

Students at New York Tech are given the option to take either Summer and Fall or Spring and Summer co-op work experiences, where no other internships or classes are allowed during this time (New York Institute of Technology, 2024b). Before students engage in their co-op work experience, they must first complete ETCS-300, a co-op prep course (New York Institute of Technology, 2024b). After completing ETCS-300, students can engage in their co-op work experiences. Students enroll in ETCS-301, a zero-credit course, during their co-op work

experience. This course allows students to engage in their co-op work experiences and includes that a “culminating project is required to bring together industry and academic knowledge and showcase the work and skill development throughout the Co-op work experience” (New York Institute of Technology, 2025).

Furthermore, the New York Tech Co-op program incorporates financial benefits and accessibility for students. While engaging in their co-op work experience, students pay no tuition; instead, students are required to pay a \$525 part time student fee and must maintain their health insurance (New York Institute of Technology, 2024b). Additionally, students experience further financial benefits from the co-op program as the co-op positions are paid, where students receive a salary directly from their co-op employer (New York Institute of Technology, 2024b).

Co-op positions for students are defined by employers, with salary ranges and job descriptions (New York Institute of Technology, 2024b). These positions are then posted by New York Tech’s Office of Career Success, functioning in a similar way to how jobs are posted on the Wildcat Career Network through Career Services at CWU. Students are then expected to apply, interview, and accept their job offers and receive help through this process by coordinating with their co-op advisor (New York Institute of Technology, 2024b).

Summary

New York Tech’s co-op program shows an example of successfully launching a co-op program through a phased approach. By starting small and slowly growing student interest and industry partnership networks, New York Tech has built a program that enriches the student learning experience. Additionally, New York Tech offers a practical approach that can be followed for implementing similar cooperative education programs. Starting with a small group of students and growing industry partnerships before scaling to further programs allows for

additional time for improvements to the program, while also minimizing the risks associated with incorporating too big of a program too quickly.

IT Management Advisory Board Interviews

To help better understand cooperative education programs, their benefits, and considerations for implementation, we conducted interviews with two members of the IT Management Advisory Board who were past co-op students. The first member interviewed attended University of Illinois Urbana-Champaign. The second member interviewed attended Northeastern University. The goal of these interviews was to discuss co-op program structures, benefits, and experiences, while gathering insights for implementing a co-op program at CWU.

During the interviews we were able to understand the differences between internships and co-op work experiences, with both members noting that co-op work experiences are longer in time span and provide more meaningful work tasks than an internship. Additionally, we were able to understand how co-op programs benefit students financially through paid work experiences, which can reduce the financial burden students face while attending college. We were also able to understand how these programs are structured, with longer work placements (from 4 to 6 months) and the common practice of returning to an employer for multiple work experiences for undergraduate co-op programs.

When discussing potential implementation of a co-op program at CWU, the first interviewee identified the challenge of securing local employer partnerships for the program. This board member highlighted that smaller and companies local to the CWU main campus area may not offer co-op programs, meaning that employer partnerships would need to be secured from other areas such as Seattle. This was discussed as a minor challenge, however, something to

be aware of as students may need to travel long distances or relocate for their co-op experiences (which is not uncommon for co-op students).

Furthermore, during our interview with the second board member, they emphasized the importance of Northeastern University's co-op program from growing the university's size and reputation. Highlighting the potential for CWU to follow this model as a method for increasing student enrollment and interest in programs at CWU. Additionally, adding how there were limited co-op opportunities available in Washington State, which provides the opportunity for CWU to be a leader in this area and attract more students due to a co-op program.

Cooperative Education Survey

To better understand student interest in cooperative education opportunities at CWU, a survey was developed and conducted using the Qualtrics Survey Tool. The survey consisted of 14 questions, including four demographic questions and ten questions to gather insights on student perceptions and interest in cooperative education. An additional question was also presented to participants who identified themselves as international students to capture the unique perspectives of this group. To help ensure that all respondents had an understanding of the topic, a description of cooperative education was provided at the beginning of the survey before participants answered any questions.

Survey Distribution

The survey was made accessible through a survey link and QR code to allow flexible access between platforms. Additionally, the survey was distributed through a number of methods to maximize participation from students in the CWU IT Management Department. The survey was emailed to over 800 past and present ITM students, with an additional follow-up email sent only to graduate students. Moreover, the survey link was posted through a Canvas announcement

to reach undergraduate IT Management students. To further expand access to the survey, posters were created with a QR code linking to the survey, and several IT Management professors shared the QR code in their classes.

Survey Response

The survey received a total of 120 responses, with 73 participants accessing the survey through the direct link and 47 participants through the QR code. Of these, 119 participants consented to participate, while one participant declined. All of the 119 consenting respondents provided an answer to the first question, with a total of 94 participants completing the entire survey – yielding a completion rate of 78.99%.

Survey Demographics

The 119 survey respondents represented a diverse group across age and gender. Regarding age distribution: 27% were 20 years old or younger, 36% were between 21 and 25, 12% between 26 and 30, 6% between 31 and 35, 17% were 36 or older, and 2% chose not to disclose their age. For gender distribution: 55% identified themselves as male, 37% as female, and 4% as non-binary. Additionally, 2% of participants chose not to disclose their gender and 1 participant chose to self-describe as “Male”.

Additionally, participants represented a range of educational backgrounds. For student status, 14% identified themselves as international students, 83% were domestic US students, and 3% were no longer a student. Regarding the distribution for the highest level of school completed, 7% had a graduate degree, 23% had a bachelor’s degree, 24% had an associate’s degree, 35% had some college but no degree, 10% had a high school diploma or equivalent, and no participants had less than a high school degree.

When identifying if participants had participated in cooperative education programs before, 22% responded saying they had participated, while 78% of participants had not participated in cooperative education programs.

Survey Results

While the survey included a range of questions, this paper highlights the results that directly relate to student interest in cooperative education opportunities and considerations for program structure.

Question 4: What type of additional education would help you to achieve your career goals?

The majority of respondents (57%) indicated that a co-op program would best support their career goals. Graduate certificate programs were the next most selected option (21%), followed by conventional master's programs (18%) and doctoral or PhD programs (4%). These results show a strong student interest in an experiential learning model over the traditional academic pathways, supporting the value of offering a co-op program for graduate students.

Question 5: What is your level of interest in participating in a cooperative learning program?

Interest in participating in a co-op program showed a strong positive response. A combined 74% of respondents reported being "very interested" or "somewhat interested", while only 3% expressed that they were "not interested" and no respondents selected "not interested at all". Additionally, 23% identified themselves as "unsure", indicating potential opportunities to increase interest in participation through further communication and clarification of the program benefits. The results suggest a strong interest in participation of cooperative education programs.

Question 6: How important would the ability to earn money during the work period of a cooperative learning program, while having your tuition waived, be to your decision to participate?

The results indicate that financial support for students (through wages and waived tuition) plays a significant role in participants' decision to participate in a co-op program. With 90% of participants indicating that the ability to earn money, while having tuition waived, as either "very important" (67%) or "somewhat important" (23%) to their decision to participate. The remaining 10% of participants were either neutral or did not find this benefit important to them. These results suggest that incorporating financial support, such as paid work placements and tuition free co-op work terms, would be a strong incentive for attracting students to the program.

Question 8: If given the option, what is your preference for the length of a cooperative learning program?

When asked about preferred program length, the most popular choice was 12 months with 66% of participants selecting this option. Additionally, 26% of participants preferred an 18-month program, while just 7% preferred a 24-month program. Although 12 months was identified as the most appealing option for participants, possibly due to shorter commitment and a faster path to graduation, this option is unlikely to provide sufficient time for students to gain the in-depth experience that is a core part of the co-op model. To balance ensuring a meaningful work placement and completion of the academic classes, the program will likely need to adopt an 18-month structure.

Question 9: What aspects of a cooperative learning program would you find appealing compared to traditional programs? (Select top 3)

When respondents were asked to rank the top three appealing aspects of a co-op program, the most popular selection was opportunities for real world application of knowledge with 62 selections. This was followed by tuition waived while working during the program with 48 selections and better networking with professionals and peers with 46 selections. The ability to get paid work during the program and a more interactive learning environment were also popular with 42 selections each. The least popular aspect was improving job prospects with 30 selections. These responses suggest students prioritize the practical, hands-on learning aspects of co-op programs and the financial benefits that these programs can provide.

Question 11: What skills or experiences do you feel are most important in your future career? (Select all that apply)

When asking participants the skills or experiences they feel they need in their future career, the most selected option was gaining hands on experience in the workplace (32%), followed by opportunities to network with organizations in the field of study (28%). This highlights key areas that students believe are important to them, that could be supported by providing co-op opportunities. Furthermore, peer to peer interactions during an academic program and classwork activities both had 14% of the selections, while academic material learnt in the classroom had the least number of selections (12%). These results indicate that students are placing a high value on practical real-world experiences that provide opportunities for career development.

Question 1.1: As an international student, do you believe a cooperative learning program would help you access work opportunities?

Question 1.1 was asked to participants that responded that they were international students in question 1. Participants were able to respond “yes” or “no” with the option of explaining their answer in a text box provided. All participants who were asked this question responded that a co-op program would help them to access work opportunities. Participants also provided explanations for their responses and noted how co-op programs satisfy their visa requirements, which can aid in finding work opportunities as an international student. Additionally, participants provided further insights on their thoughts regarding co-op programs such as how these programs could provide opportunities for hands on experience which can help these students prepare for the American work culture. Participants also noted how a co-op program could increase their job prospects after graduation.

Findings

This section highlights the key takeaways from the survey, interviews, and research into other U.S. institutions. Within this section, we discuss what the findings from this research reveal about student interest in co-op programs, the benefits of co-op programs, and potential opportunities and challenges associated with launching a co-op program.

Results from the survey displayed a strong student interest in cooperative education. This is highlighted in question 4 from the survey, where 57% of participants selected a co-op program as the preferred option for helping them achieve their career goals. This interest is further supported in question 5, where 38% of participants selected that they were “very interested” and 36% “somewhat interested” in participating in a co-op program. These findings suggest an interest from students in co-op programs and their ability to aid students in achieving their career

goals. This is further supported by responses to question 11, where participants were asked to identify the skills they feel are most important in their future career. The most frequently selected responses were gaining hands-on experience in the workplace (32%) and opportunities to network with organizations in the field of study (28%). These responses highlight students' desire for practical experience and opportunities to engage deeper with their field of study, which are elements that a cooperative education program can provide to students.

Insights gained from interviews with ITM Advisory Board members further emphasized the value of co-op programs for preparing students for post-graduation employment. Both members highlighted how co-op experiences can help students prepare for the workforce and bridge the gap between academic content and real-world application, helping to give co-op students an advantage when entering the job market. Furthermore, these interviews highlighted areas for consideration when trying to launch a cooperative education program at CWU. This included recommendations for securing industry partnerships and being aware of possible travel and relocation commitments for students.

Additionally, cooperative education programs are linked to enhanced job opportunities for students. Information provided from the NACE Internship and Co-op Survey Reports shows the increased offer rate and retention rate for co-op students compared to those without co-op experience. These findings support the value of co-op programs as a tool to support career pathways for students and enhance their post-graduation job prospects. As co-op experiences allow students to gain relevant work experience, build their professional networks, and demonstrate their capabilities to potential employers, these programs can play a strong role in helping to improve students' post-graduation employment opportunities.

Furthermore, evidence from other U.S. institutions supports the value of co-op programs for student outcomes and institutions success. The University of Cincinnati and Northeastern University both demonstrated how cooperative education programs contribute to higher post-graduation employment rates for students and strong employer partnership networks for the university. Evidence from Northeastern University also supported how co-op programs can boost the reputation of the university and student enrollment, with current high school students placing a high value on co-op programs. The success of these institutions, with the recent success of New York Tech's new co-op program, show how co-op models can provide an advantage to universities wanting to enhance their students' career readiness and expand their impact beyond typical classroom settings.

Direction for Future Research

The direction of future research should focus on how to effectively incorporate a cooperative education program at CWU. One key aspect of this is identifying and engaging in conversations with relevant campus stakeholders who would be involved in designing, supporting, coordinating, and approving the program. Initial informal conversations with Career Services have already taken place; however, further engagement with administration, faculty, and key decision makers is required.

Additionally, future research should aim to explore potential industry partners interested in taking on co-op students. These partnerships should aim to be aligned with ITM specializations to ensure relevant and meaningful work opportunities for students. Furthermore, if the co-op model was adopted campus-wide or by other departments, additional partnerships would need to be formed to support students from other academic programs.

Another key area for future investigation is program funding and coordination. This area includes identifying sources of financial support for aiding in program coordination and providing possible support to students for travel and housing needs during their co-op placement. A possible source for this information could be understanding how other current co-op programs provide this support and how this could provide a potential model for CWU.

Conclusion

In conclusion, this paper has explored current practices and potential implementation strategies for a cooperative education program; with a focus on insights from national trends, successful models at other institutions, stakeholder interviews, and survey data.

The NACE Internship & Co-op Report analysis highlighted how employers are placing an increasing value on work-integrated learning experiences. Additionally, clear benefits for students in these experiences were highlighted, such as longer and more in-depth work experiences, alignment with the students' field of study, increased responsibilities in the workplace, financial benefits from paid wages, and improved post-graduation outcomes. These findings support that co-op programs can improve student employability post-graduation and increase their workforce readiness.

Furthermore, examples for the University of Cincinnati and Northeastern University (who are both leaders in cooperative education) emphasize both the academic and institutional benefits of co-op programs. The University of Cincinnati shows how a long-standing and structured co-op program can provide students with paid, career-relevant experiences that enhance post-graduation outcomes. Northeastern University highlights how a co-op program can support institutional growth and national recognition. Northeastern's emphasis on experiential learning has led to record undergraduate applications and strong post-graduation outcomes.

Together, these models show how a co-op program can increase student career readiness, reduce financial burden through paid placements, and raise the recognition of an institution.

Additionally, the New York Institute of Technology provided a valuable example of how an institution can launch and scale a co-op program. By starting with a small cohort and limited number of programs, New York Tech was able to pilot its program, gather early feedback and refine the program structure before expanding. The phased approach taken by New York Tech minimized risk associated with the programs launch and allowed the institution to build student interest and employer partnerships. The program included clear eligibility criteria, preparatory coursework, and a culminating project which contributed to the program's early success. Furthermore, the program's inclusion of reduced tuition during the work experience with paid wages for students increased its accessibility. For institutions looking to launch their own co-op program, this model demonstrates the feasibility of launching a co-op program and how to scale the program from starting with a small cohort of students.

Interviews with advisory board members who were co-op participants also offered valuable insights into launching a co-op program. Both members interviewed emphasized how co-ops provide a deeper learning experience for students compared to internships and offer significant financial benefits to students. Further elements were discussed such as how co-ops provide longer work experiences with students returning to the same employer multiple times (at the undergraduate level), which contribute to strong career development. While CWU is limited in its geographic location for securing industry partnerships near the main Ellensburg campus, interviewees suggested this was manageable and consistent with other co-op models where students often relocate for their work experiences. One interviewee also mentioned

Northeastern's success from growing its co-op program, suggesting CWU could position itself as a leader in co-op experiences in Washington State, where co-ops are currently limited.

Survey results showed strong interest and support for a cooperative education program at CWU. Respondents showed interest in gaining hands-on experience in their field of study, with an emphasis on how these programs can support students through paid wages which can reduce financial burdens. Many students also emphasized the value of industry connections and the ability to gain work experience that will prepare them for their career. Overall, the survey results reinforced the idea that co-op programs can support students' needs and enhance their career readiness through real-world hands-on experience.

Considerations for Implementation

The findings from this study present a number of critical steps that should be addressed when implementing a successful co-op program. Firstly, considerations must be made for how the co-op experience is integrated into the academic structure. This includes considering how the co-op would be structured, such as having required co-op work terms or offering flexibility in when students can take their co-op experience. Additionally, whether to include a co-op prep course to prepare students for their work experience should be considered. Considerations should also be made for how the co-op work experience would operate, such as providing a zero-credit co-op class while on the experience; where students would not pay tuition and instead would pay a part-time student fee (co-op fee). Finally, for considering the integration of the co-op program, the co-op experience should include some form of reflection and evaluation from the student to ensure they take something away from their work experience.

Moreover, partnerships with employers should also be formed. By forming employer partnerships this ensures that placement opportunities are aligned with the students' field of study

and that the experience reflects industry needs. Forming industry partnerships should not limit students to applying to only these employers for their co-op experience but should provide possible options for students to apply to. Additionally, students should not be provided their co-op experience and are instead expected to search, apply, interview, and accept job offers as they would with any other job.

Developing support structures for students should also be considered when implementing a co-op program. This support structure could possibly include a co-op advisor or coordinator who would be able to assist students with finding their co-op work experience. Considerations should also be made for supporting students in attending their co-op experiences. Co-op experiences are likely to require travel or relocation for students, therefore support structures could be developed to support students in navigating their new experience and possibly providing financial support for relocation and travel costs.

Taking all of this into account, these insights provide a blueprint for launching a pilot co-op program that draws on success from other institutions and reflects the needs of students at CWU. With structured planning and stakeholder engagement, a co-op program can enhance the student learning experience and better prepare them for long-term career success.

References

- Central Washington University. (n.d.). Central Washington University | Internships.
<https://www.cwu.edu/academics/craft-brewing/information-for-students/cooperative-education-and-internships.php>
- Educational Credential Evaluators. (2024, December 19). Your complete guide to co-ops | Benefits, tips & applications. ECE. <https://www.ece.org/Blogs/co-ops.htm>
- James, K. J., & Deane, K. C. (2015). Enroll in school to go to work: Cooperative education programs. In A. P. Kelly, K. J. James, D. K. Lautzenheiser, K. C. Deane, & R. Columbus, Building paths to the middle class: Innovations in career and technical education (pp. 18-28). American Enterprise Institute.
- National Association of Colleges and Employers. (2019). 2019 Internship & co-op survey report. In *National Association of Colleges and Employers*.
<https://www.nacweb.org/uploadedfiles/files/2019/publication/executive-summary/2019-nace-internship-and-co-op-survey-executive-summary.pdf>
- National Association of Colleges and Employers. (2025). 2025 NACE internship & co-op report. In *NACE*. <https://nacweb.org/store/2025/research-reports/2025-nace-internship-and-co-op-report-and-dashboard>
- New York Institute of Technology. (2023, February 14). *Co-op program exceeding expectation*. New York Tech Blogs. https://blogs.nyit.edu/inside_engineering/co_op_program_exceeding_expectation
- New York Institute of Technology. (2024a, August 26). *Co-OP (Cooperative Education) programs* | New York Tech. New York Tech. <https://www.nyit.edu/academics/engineering-and-computing-sciences/cooperative-education-programs/>

New York Institute of Technology. (2024b, August 26). *Information for students* | *New York Tech*.

New York Tech. <https://www.nyit.edu/academics/engineering-and-computing-sciences/cooperative-education-programs/information-for-students/>

New York Institute of Technology. (2025). *Curriculum requirements for B.S. in Information Technology, Information and Network Security Option* | *College of Engineering and Computing Sciences* | *New York Tech Catalog 2025–2026*. New York Tech.

https://catalog.nyit.edu/engineering/information_technology/curriculum

New York Institute of Technology. (n.d.). *Co-op track information*. New York Institute of Technology College of Engineering and Computer Sciences.

<https://sites.google.com/nyit.edu/nyit-coecs-co-op-track-info/home>

Nordman, D. (2025, February 3). What's behind Northeastern's surge in applications? We asked high school students and guidance counselors. *Northeastern Global News*.

<https://news.northeastern.edu/2025/01/12/undergraduate-applications-fall-2025/>

Northeastern University. (2024). Celebrating Our Success, Propelling the Future. In *Northeastern University College of Engineering*. [https://coe.northeastern.edu/wp-](https://coe.northeastern.edu/wp-content/uploads/pdfs/coe/coop/coop115-1.pdf)

[content/uploads/pdfs/coe/coop/coop115-1.pdf](https://coe.northeastern.edu/wp-content/uploads/pdfs/coe/coop/coop115-1.pdf)

Northeastern University. (2025). *Master's Co-op*. Northeastern University College of

Engineering. <https://coe.northeastern.edu/academics-experiential-learning/co-op-experiential-learning/co-op/graduate-co-op/masters-co-op/>

Northeastern University. (n.d.). Facts and Figures 2021. In *Northeastern University*.

<https://facts.northeastern.edu/assets/pdf/NU-Factsheet-2021.pdf>

- Pence, K. (2024, August 26). *UC's cooperative education program continues to grow*. UC News. <https://www.uc.edu/news/articles/2024/08/cincinnati-business-courier-highlights-ucs-new-co-op-student-earning-numbers.html>
- Pope, K. (n.d.). *Co-op education*. University of Cincinnati. <https://cech.uc.edu/schools/it/future-students/coop-education.html>
- Sullivan, L. (2022a, March 30). *On track: New York Tech launches co-op education experience*. New York Tech. https://site.nyit.edu/news/features/on_track_new_york_tech_launches_co_op_education_experience
- Sullivan, L. (2022b, August 9). *New York Tech expands co-op education offerings*. New York Tech. https://site.nyit.edu/news/features/new_york_tech_expands_co_op_education_offerings
- University of Cincinnati. (2022). *2022 Co-op report*. Campus Life. <https://www.uc.edu/campuslife/careereducation/about/publications/2022-co-op-report.html>
- University of Cincinnati. (2025, February 24). What is a co-op? Learn & hire co-op students. UC News. <https://www.uc.edu/news/articles/2023/04/what-is-co-op.html>
- Wallace, M. (2020, February 1). Understanding cooperative education. *National Association of Colleges and Employers*. <https://www.nacweb.org/career-development/internships/understanding-cooperative-education/>
- Zegwaard, E., & Coll, K. (2011). Exploring some current issues for cooperative education. *Journal of Cooperative Education and Internships*, 45(02), 8–15.

College of the Sciences

The College of the Sciences had presentations from the departments of **Anthropology; Biological Sciences; Chemistry; Computer Science; Craft Brewing; Cultural and Environmental Resource Management; Environmental Studies; Geography; Geological Sciences; Law and Justice; Mathematics; Physics; Political Science; Primate Behavior and Ecology; Psychology;** and **Sociology** at the 2025 Symposium of University Research and Creative Expression (SOURCE).

This volume of the *Journal of the Symposium of University Research and Creative Expression (SOURCE)* features full length submissions from the following departments and programs:

- Biological Sciences
- Law and Justice
- Physics
- Psychology
- Sociology

Biological Sciences

Effect of Coniferous Trees and Water Availability on Soil Acidification

Jessica Ann Cheever

Project Mentor(s): Mary Poulson

Department of Biological Sciences, Central Washington University

Abstract: Water availability and coniferous tree species can cause acidification and a change in soil fertility. Previous research in European forests found that rainfall, soil acidity, and conifer prevalence influenced soil quality and biodiversity. However, not much is known about these effects in the Pacific Northwest's forests. Three forests were chosen based on a gradient of annual precipitation. The Hoh Rain Forest, the Tiger Mountain State Forest, and the Okanogan-Wenatchee National Forest were used for wet, mesic, and dry conditions, respectively. Each location had a three-by-six grid spaced 50 meters between each plot. The location was marked, and a six-inch hole was dug at the base of the nearest tree to collect a soil sample. Collected soil samples were tested for pH, water content, and nutrient content. Soil pH ranged from 5.5 at Okanogan-Wenatchee National Forest, 6.0 at Tiger Mountain State Forest, and 6.5 at the Hoh Rain Forest. Douglas-fir, ponderosa pine, western red cedar, bigleaf maple, and red alder were grown in the CWU Biology Greenhouse. Trees were grown in simulated soil moisture regimes to those of the chosen sites. Results of this study indicate that the occurrence of coniferous tree species, particularly ponderosa pine, and increased soil water content will contribute to soil acidification. This study provides insight into the environmental interactions occurring in Washington's forests and will allow for better forest management practices.

Keywords: Soil Acidification, Water Availability, Pacific Northwest

Soil quality is a critical part of the health of a forest's ecosystem, which supports both plant and animal life. While there are many factors that influence soil quality, pH can affect the chemical, physical, and biological processes of the soil. This can have a direct impact on plant

growth, biodiversity, for both flora and fauna, and can even deteriorate surface water quality (Augusto et al., 1998).

The dominance of conifers or deciduous trees in a forest has been found to influence the soil's acidity and fertility. The C:N ratio, carbon to nitrogen ratio, of litter has been found to be drastically different between conifers and hardwoods. Coniferous tree species have been found to produce a litter with a higher C:N ratio compared to hardwoods (Augusto et al., 1998).

Coniferous litter decomposes at a slower rate which leads to the higher accumulation of carbon in the soil. A balanced ratio is roughly twenty to twenty-five carbons to one nitrogen. While a ratio of thirty or higher carbon to one nitrogen is high. An unbalanced ratio can impact plant growth due to its influence on nutrient availability and decomposition rates. These high levels can lead to nitrogen immobilization, which is a process when a plant is unable to take up nitrogen due to microbes in the soil using and converting any available nitrogen. Microbes will convert inorganic nitrogen, ammonium or nitrate, into organic matter and microbial biomass. This results in nitrogen becoming unavailable to plants, which leaves little nitrogen for plants to use for their own processes.

Soil pH in forest ecosystems was also found to influence key steps in nitrification (Sawada et al., 2023). Nitrification, the process in which ammonium is converted into nitrate, is a crucial process for plant growth. This results in the accumulation of organic acids, which leads to an increase in soil acidification and nutrient loss. The chemistry of coniferous tree litter has been found to promote the loss of earth alkaline cations, further affecting the soil's composition (Augusto et al., 1998). While broadleaved species, leaf litter has been found to be rich in nutrients which can help neutralize acidity and promote nutrient cycling. Conifers tend to have a shallower and widespread root system compared to deciduous trees. Broadleaved species have

deep roots which help buffer against acidity in the soil as the roots can bring neutralizing ions to the surface. While also storing cations in excess in both biomass and organic matter. (Han et al., 2025).

Tree species have been shown to influence the soil's fertility and acidity (Augusto et al., 1998). Research done in European forests found that increased rainfall, soil acidity, and the prevalence of conifers was correlated with soil quality. This resulted in more alkaline soil and an increase in the biodiversity of European forests (Koptsik et al., 2001; McCollough et al., 2012; Seliger et al., 2023). Conversely, broadleaf tree species have been shown to have the opposite effects of conifers, specifically when it comes to soil pH and water retention. A recent study in southern China found that underplanting broadleaf species in *Pinus massoniana* plantations caused a significant elevation in the soil's pH, and an overall reduction in acidification (Han et al., 2025). Broadleaf species can enhance a forest's ability to decrease anions, acids, and hydrogen ions from entering the soil. Broadleaf species can increase soil water content due to having a denser canopy, this reduces runoff when compared to conifer-dominated forests, where larger gaps in the canopy promotes runoff and water loss through channel formation (Han et al., 2025). Due to this, I hypothesize that coniferous tree species will result in an overall decrease in the pH of the soil compared to deciduous trees, and that water availability will significantly influence soil pH.

Materials and Methods

Site Description and Sample Collection

To study a gradient of annual precipitation, three forests were chosen across Washington State. The Hoh Rain Forest, the Tiger Mountain State Forest, and the Okanogan-Wenatchee National Forest were chosen for their wet, mesic, and dry conditions, respectively.

The dominant tree species at the Hoh Rain Forest sites were Douglas-fir (*Pseudotsuga menziesii*), western hemlock (*Tsuga heterophylla*), bigleaf maple (*Acer macrophyllum*). The understory was very crowded with a high number of ferns and bushes. The dominant tree species at Tiger Mountain State Forest sites were Douglas-fir, western red cedar (*Thuja plicata*), bigleaf maple, and red alder (*Alnus rubra*). The understory was fairly covered with some bushes, but was majority covered by ferns. The dominant tree species at the Okanogan-Wenatchee National Forest sites were ponderosa pine (*Pinus ponderosa*), and lodgepole pine (*Pinus contorta*). The area had very little understory and was mainly made up of grasses.

A uniform grid pattern was used when gather soil samples across these three forests. Each location had three sample sites, with a three by six grid plot with fifty meters in between each plot. At each plot the nearest tree would be located, roughly fifty meters from the last, and a six-inch hole would be dug at four different points around the base of the tree. The soil collected was placed into clean plastic bags to preserve the moisture content of the soil during transportation. Fifty-four samples were collected in total, with eighteen samples being collected at each location.

Field Sample Preparation

Samples were transported back to the lab to calculate the water content and pH of the soil. To calculate the water content each sample was placed in a paper sleeve and weighed to find its wet weight. Samples were then dried in a drying oven. Once completely dried, each sample was then weighed once more to find its dry weight. These two weights were then used to find the water content of each sample, and the averages were taken of the area. To determine the pH, all samples from the same location were combined in a container and allowed to air dry. Once fully dried, the samples were filtered until very fine, and then a Lovibond Soil pH Test Kit and

Rapitest nutrient kits were used to record the pH and nutrient levels. Specifically, the levels of potassium, phosphorus, and nitrogen were tested.

Greenhouse Experiment Methods

To narrow down what might be the cause for a change in soil pH levels, I conducted a controlled greenhouse experiment. Six of each of the following species were grown: ponderosa Pine, western red cedar, red alder, and bigleaf maple. All trees were approximately one year old at the time of the experiment, and each tree was separated into individual pots. The soil the saplings grew in was retained throughout the entirety of the study, and no fertilizer was used on the trees. This was done to prevent any additional variables that may alter the soil's pH. All plants were grown underneath grow lights that were on for roughly eight hours daily. Saplings were divided into three different watering groups that were meant to mimic the water gradient observed at the three different locations across Washington State. Each group had two saplings of each species, with the first group being watered 100 mL, the second group being watered 70 mL, and the third group being watered 40 mL of water. All plants were watered using tap water from the greenhouse hose, which had an average pH of 7.0, and were watered twice a week.

Before any measurements were taken, all plants were allowed to grow undisturbed for two weeks to allow for acclimation. After this period, soil pH was monitored for five weeks using an Apera GS2 Soil pH Tester. A pH probe was used so that it would not be necessary to any soil from the pots. Before each session, the tester would be recalibrated to ensure the accuracy of the readings. The probe would be inserted into the soil at four different points around the pot to get an average reading of the soil. After each use, the tip would be rinsed off with clean water and left to air dry before being used again. Once the collection of data was completed the

average pH for each plant was calculated. A Two-Way ANOVA was used to evaluate the effects of tree species and watering gradients, and their interaction on soil pH levels.

Results

Soil pH levels varied greatly across the three field sites. Okanogan-Wenatchee National Forest had the most acidic soil with an average pH of 5.5. While the Hoh Rain Forest had the most basic soil with an average pH of 6.5. While Tiger Mountain State Forest fell in between the other two with an average pH of 6.0 (Table 1). Average soil water content followed a similar trend across the three sites. With the Okanogan-Wenatchee National Forest having an average water content of 22.40%. Tiger Mountain State Forest had an average of 39.43%, and at the Hoh Rain Forest the average was 93.35% (Table 1). It is important to note that some of the samples from the Hoh Rain Forest exceeded a hundred percent water content. That is likely due to the extreme soil saturation at the time of collection. Potassium, phosphorus, and nitrogen levels were also analyzed, but there was little to no significant variation between the three sites.

Table 1

Soil pH and Water Content (%) at Three Different Testing Sites Across Washington State

Testing Site	pH	Water Content (%)
Okanogan-Wenatchee	5.5	22.4
Tiger Mountain	6.0	39.43
Hoh Rain Forest	6.5	93.35

Note. The values shown are averages from eighteen samples taken at each site.

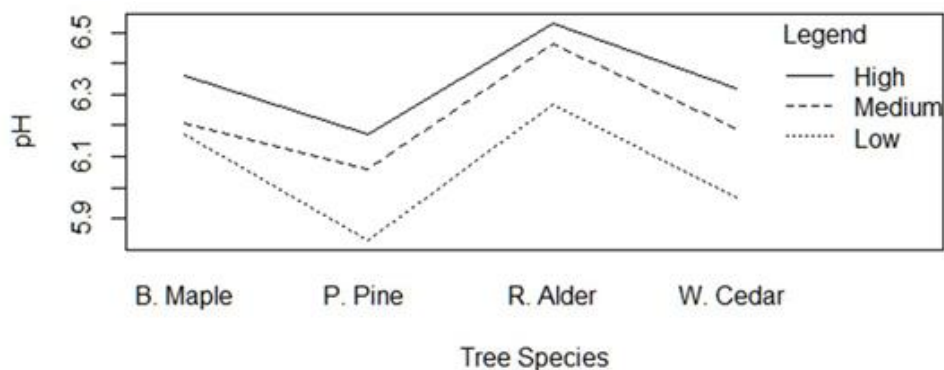
In the greenhouse experiment, soil pH appeared to differ among the tree species and the different watering treatments. Deciduous tree species, bigleaf maple and red alder, exhibited a higher average soil pH when compared to the coniferous tree species, ponderosa pine and

western red cedar (Figure 1). Watering treatments also had a visible effect on soil pH. Across all four species, higher watering levels were associated with an increase in the soil pH. While lower watering levels were associated with a decrease in the soil pH level. The medium watering level remained between the average of the other two groups (Figure 1).

The average pH level for bigleaf maple was 6.36 with high watering, 6.21 with medium watering, and 6.17 with low watering. Ponderosa pine showed the lowest overall values, with average pH levels of 6.17, 6.06, and 5.83. Western red cedar had average pH values of 6.32, 6.19, and 5.97. Red alder showed the highest values overall, with average pH levels of 6.53, 6.46, and 6.27 (Figure 1).

Figure 1

Effect of Watering Treatment and Tree Species on the pH Value of the Soil



Note. Each species had six saplings that were over a year old at the time of the experiment.

Saplings were split into three different watering categories: Heavy watering (100 mL, solid line), moderate watering (70 mL, dashed line), and little watering (40 mL, dotted line). Plants were watered twice a week for a period of four weeks. Values represent the average soil pH over time for each watering category (n = 18).

A two-way ANOVA was then conducted to assess the effect that watering treatment and tree species had on the pH of the soil. The analysis found that both factors were statistically relevant. With watering treatment having a p-value of .000542, and the tree species having a p-value of .000351. Since both p-values are less than .05, the null hypothesis can be rejected.

Conclusion

Soil quality plays a large role in the general health of a forest's ecosystem. The pH of the soil can affect plant growth through nutrient availability, and in turn, results in a decrease in biodiversity. In acidic soils, nutrients like phosphorus and calcium can be less available. Microbial activity can also be decreased as a neutral pH is required for a more diverse microbial community. Acidification of the soil can lead to a decrease in understory vegetation and a reduction in habitat quality. Maintaining a neutral pH level of 6.5 to 7.0 is essential for supporting a healthy and diverse forest.

This study indicates that both environmental and biological factors have a significant effect on soil pH. Data collected from the field shows that pH correlated with the percentage of water in the soil. The driest site, the Okanogan-Wenatchee National Forest, maintained the lowest pH. The wettest site, the Hoh Rain Forest, maintained the highest pH among the three sites. It is possible that an increase in soil moisture results in the dilution of acidic inputs. It is also important to note that each site has a distinct composition of species. The Hoh Rain Forest had a mix of conifers and maples. While Tiger Mountain State Forest was dominated by Douglas-fir, with some deciduous species. Finally, the Okanogan-Wenatchee National Forest was dominated by ponderosa pine and other conifers. This pattern suggests that both soil moisture and tree species influence the pH level of the soil.

The experiment done in the greenhouse only further supported my hypothesis that soil pH was influenced by both the amount of water and the type of tree. Red alder and bigleaf maple, both deciduous trees, consistently had a more alkaline pH level when compared to the coniferous trees, ponderosa pine and western red cedar. Additionally, higher watering volumes were associated with increased pH levels across all species. With an observable decrease in the pH levels as the amount of water decreased. An analysis was conducted using a two-way ANOVA, which confirmed that both tree species and water treatment had a statistically significant effect on the soil's pH. This suggests that conifers will decrease the pH level of the soil more than deciduous tree species will, and that the amount of water available can significantly impact the pH of the soil.

This study faced a few limitations that could be addressed in future research. Increasing the number of replicates in the greenhouse experiment would allow for an increase in reliability. As well as increasing the number of field sites to get a more accurate look of Washington's precipitation gradients. Additionally, future research could benefit from longer study periods, a range of soil types, and different tree species to better understand how these different variables may have an impact on the acidity of the soil.

Understanding the effect of tree species and water availability on soil pH will allow for better future forest management practices in the Pacific Northwest. These findings suggest that changes in precipitation and shifts in the composition of species could potentially result in a change in pH level of the soil, which can impact biodiversity and the overall health of the soil.

References

- Augusto, L., Bonnaud, P., & Ranger, J. (1998). Impact of tree species on forest soil acidification. *Forest Ecology and Management*, 105(1-3), 67–78. [https://doi.org/10.1016/s0378-1127\(97\)00270-3](https://doi.org/10.1016/s0378-1127(97)00270-3)
- McCullough, S. A., O’Geen, A. T., Whiting, M. L., Sarr, D. A., & Tate, K. W. (2012). Quantifying the consequences of conifer succession in aspen stands: decline in a biodiversity-supporting community. *Environmental Monitoring and Assessment*, 185(7), 5563–5576. <https://doi.org/10.1007/s10661-012-2967-4>
- Seliger, A., Ammer, C., Kreft, H., & Zerbe, S. (2023). Changes of vegetation in coniferous monocultures in the context of conversion to mixed forests in 30 years – Implications for biodiversity restoration. *Journal of Environmental Management*, 343, 118199–118199. <https://doi.org/10.1016/j.jenvman.2023.118199>
- Han, X., Ali, I., Ullah, S., Zhang, Y., Xu, Y., & Yang, M. (2025). Ecological benefits of integrating broadleaf tree species into *Pinus massoniana* monocultures and their impacts on soil fertility microbial diversity and network stability. *Forest Ecology and Management*, 586, 122712. <https://doi.org/10.1016/j.foreco.2025.122712>
- Vacek, Z., Cukor, J., Vacek, S., Linda, R., Prokúpková, A., Podrázský, V., Gallo, J., Vacek, O., Šimůnek, V., Drábek, O., Hájek, V., Spasić, M., & Brichta, J. (2021). Production potential, biodiversity and soil properties of forest reclamations: Opportunities or risk of introduced coniferous tree species under climate change? *European Journal of Forest Research*, 140(5), 1243–1266. <https://doi.org/10.1007/s10342-021-01392-x>

Antibiotic Resistance Trends in Coliform Bacteria of Kittitas County Waters

Kaitlyn Holbrook, Bella Blasingim, Cruz Veronica Guillen Mejia, Holly Pinkart

Project Mentor(s): Holly Pinkart

Department of Biological Sciences, Central Washington University

Abstract: Since the mid-1900s, antibiotics have been developed to help fight against bacterial pathogens. However, bacteria can evolve rapidly and have evolved resistance to many types of antibiotics. Using coliform bacteria collected from waters around Kittitas County, BIOL 323 students at Central Washington University have identified a variety of antibiotic-resistant bacteria in Kittitas County streams and canals. Antibiotic resistance was measured from 2014-2019 and compared to data collected in 2024. This study focuses on three antibiotics, ampicillin, kanamycin, and trimethoprim-sulfamethoxazole. In the past (2014-2019) we saw no change in the trend of antibiotic resistance in collected data for ampicillin, an upward trend of antibiotic resistance in data collected for kanamycin, and an upward trend of antibiotic resistance in data collected for trimethoprim-sulfamethoxazole. When compared with the data collected in 2024, we see no significant increase in antibacterial resistance for ampicillin, a significant increase in antibacterial resistance for kanamycin, and a significant increase in antibacterial resistance for trimethoprim-sulfamethoxazole. The results of this research can be used to further study antibiotic resistance in the environment, and the data will be submitted to the WISAR (Washington Integrated Surveillance for Antimicrobial Resistance) database.

Keywords: Antibiotic Resistance, Bacteria, Irrigation

Many pathogens can be transmitted by water. These microbes can be bacteria such as *Vibrio cholerae* and *Salmonella*, viruses such as poliovirus, or protozoa such as *Cryptosporidium parvum*. Most of these organisms enter the water supply through contamination with sewage or other sources of fecal matter. Once ingested, the organisms multiply in the intestinal tract and are again shed in feces. Fecal pollution of water used for recreational purposes and drinking can then

transmit infectious microorganisms. The significance of this was recognized in the early 20th century when filtration and disinfection of drinking water was instituted. As a result, typhoid fever (caused by *Salmonella typhi*) and cholera (caused by *Vibrio cholerae*) have been virtually eliminated in the developed world. Routine examination of water for the presence of intestinal pathogens would be a tedious, difficult and expensive task. Pathogens are generally present in much lower numbers than other organisms associated with fecal matter. It is much easier to demonstrate the presence of some of the nonpathogenic intestinal types such as *Escherichia coli* and *Streptococcus faecalis*. These organisms are always found in the intestines but are not normally found in soil and water. Therefore, if they are detected in water, it is likely that the water has had some contact with fecal material. Coliform bacteria are a group of bacteria that resemble *Escherichia coli* (*E. coli*) in form and function. These organisms occur normally in the intestines of humans and other warm-blooded animals, and in some fowl. They are discharged in great numbers in feces, generally constituting $\sim 1/8$ of the fecal matter. In polluted water, coliform bacteria are found in densities roughly proportional to the degree of fecal pollution. When members of the coliform group are present, pathogens may be present as well. Coliform bacteria tend to be hardier than pathogens, so their absence indicates that water is bacteriologically safe for human consumption. Their presence indicates that water is unsafe to drink. While irrigation water is not used for direct human consumption, this water is used to water various crops like hay, vineyards, and orchards, as well as both dairy and beef cattle.

Since the discovery of penicillin in 1928 and the discovery of penicillin-resistant bacteria in 1940, we've seen a rise in antibiotic resistance. Bacteria use several methods to resist the antibiotics that modern medicine throws at them. There are four ways that scientists have observed bacteria gaining genes for antibiotic resistance (Andersson & Hughes, 2017; Bennett,

2008; Normark & Normark, 2002). The first method of acquiring these genes is transduction of which there are two types. The first is generalized transduction, where a section of host DNA containing the genes for the antibiotic resistance traits are accidentally packaged by a bacteriophage. The second is specialized transduction, during which there is an improper cut out of phage DNA by a lysogenic phage. The second method of acquiring antibiotic resistance is conjugation, where the genes are transferred in a one-way exchange of fertility plasmid. The third method of acquiring genes is transformation, in which the bacteria take up DNA containing the genes for antibiotic resistance from the environment. The fourth and final method in which bacteria can acquire antibiotic resistance genes is during spontaneous mutation. Through these many methods, multiple antibiotic resistance genes have been acquired and evolved throughout our studied history, scientists currently recognize five mechanisms of resistance that bacteria have evolved (Lin et al., 2015). The first method of resistance observed in bacteria is mutations in the bacterial ribosomal sequences to alter attachment structures, to result in an altered attachment target. The second method of resistance mechanism observed in bacteria is enzymatic inactivation, in which a bacteria can add carbon groups or phosphorylate, to produce enzymes that can break or alter antibiotics. The third observed mechanism of resistance is bacterial alteration of membrane or cell wall permeability, resulting in the inability of an antibiotic to enter the bacterial cell. The fourth method of resistance mechanisms observed in bacteria is the ability to activate an efflux pump, which can pump the antibiotics out of the bacterial cell before they can take effect. The fifth and final mechanism of resistance observed in bacteria is the ability of the bacterial cells to create new biochemical pathways to avoid being targeted by the antibiotic all together. This study focused on the antibiotic resistance trends of three common antibiotics. The first antibiotic being ampicillin, a first line antibiotic belonging to the penicillin family

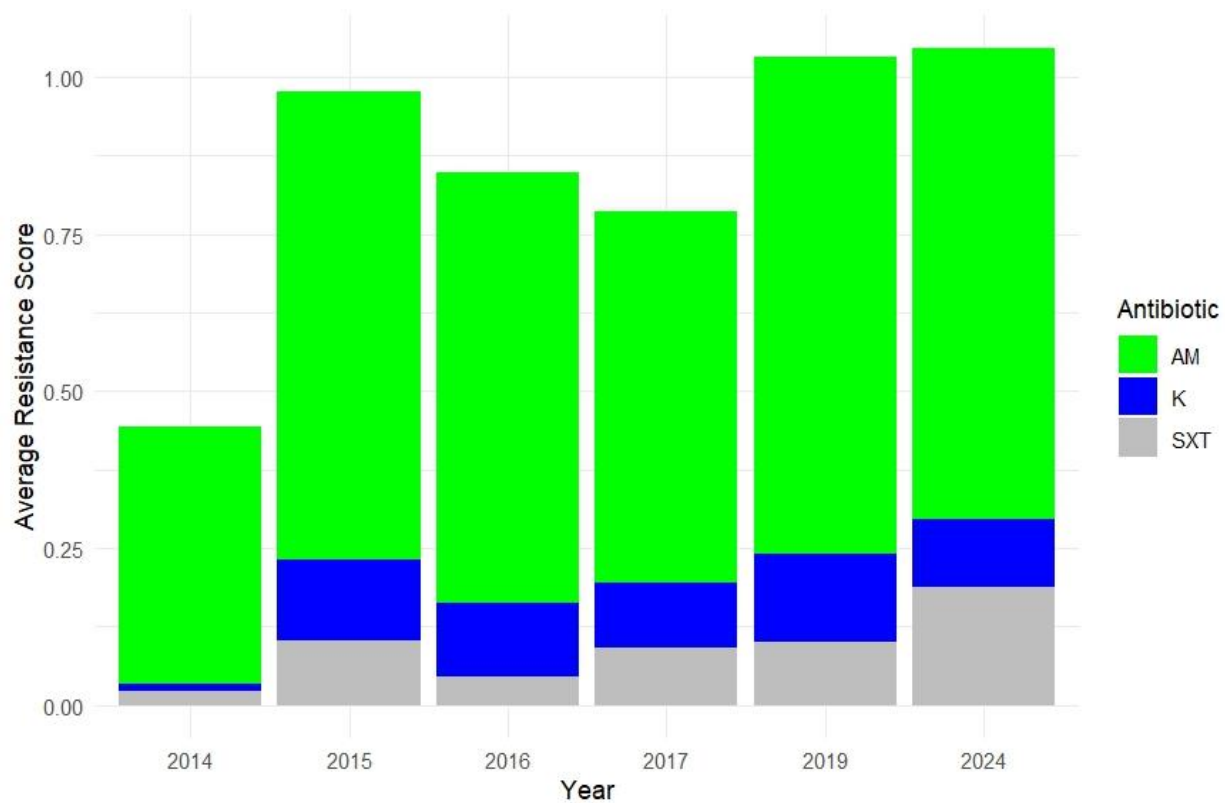
(Bereda, 2022; Seligman & Hewitt, 1963). Ampicillin works by inhibiting the cell wall synthesis of bacteria, specifically targeting the penicillin binding proteins (PBP's) that play a role in some bacteria's peptidoglycan layer within their cell wall. The drug binds the PBP's which inhibits peptidoglycan synthesis and weakens the bacterial cell wall, leading to cell lysis and cell death. The second antibiotic focused on was kanamycin, a second line antibiotic belonging to the aminoglycoside family (Nishimura et al., 1962; Tanaka, 1982). Kanamycin works by inhibiting bacterial protein synthesis by binding to a subunit of bacterial ribosome, resulting in an altered structure and disruption of mRNA translation. The result of the disrupted translation is the insertion of an incorrect amino acid, which shifts the bacterial reading frame and produces nonfunctional proteins, leading to cell death. The third and final antibiotic focused on in this study is trimethoprim-sulfamethoxazole (SXT), which is used as both a first line and second line antibiotic, determined symptomatically, and a part of the sulfonamide and antifolate families (Burchall, 1973; Smilack, 1999). SXT works by inhibiting the folic acid synthesis of the bacterial cell. The two drugs that compose of the combination drug of SXT inhibit two sequential steps in the folic acid pathway. Preventing the production of the tetrahydrofolate that is needed for the bacterial cell survival. Regardless of these antibacterial mechanisms of action, our study still observed antibacterial resistance to all three of our antibiotics of focus. This project focuses on resistance data collected in the years 2014-2019 by BIOL 323 students as part of their coursework. This data was compiled and analyzed, and then compared to data collected in 2024, to determine antibiotic resistance trends throughout the years.

Results

Once organisms were identified, data for the resistance patterns were analyzed in R studios using the Kruskal-Wallis test and the chi-squared test. Using the data analyzed in these tests we created a stacked bar plot, and a heat map.

Figure 1

Average Resistance Score per Antibiotic per Year

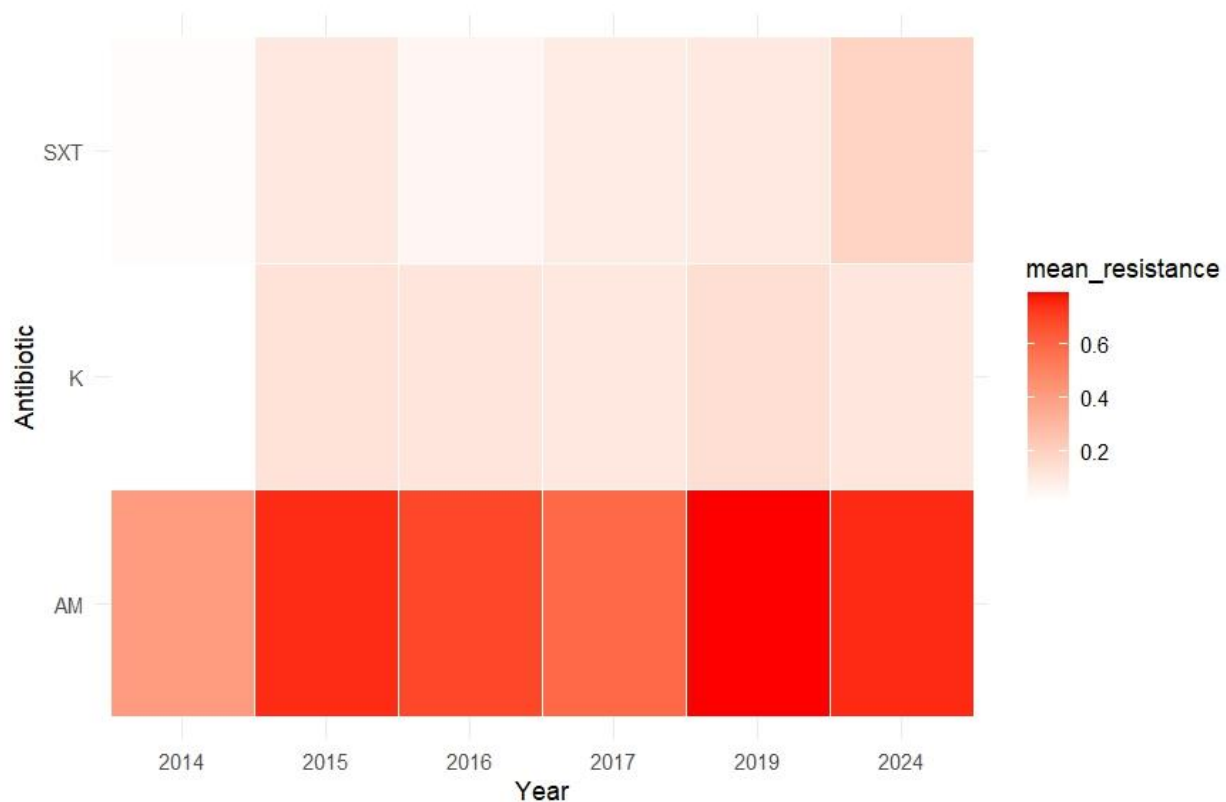


Note. The average resistance score of the Ampicillin, Kanamycin and Trimethoprim-Sulfamethoxazole tested from 0-1. Resistance scores are assigned a number 0-1 for each individual bacterial species and then the numbers are averaged to assign a score to each year.

Using this bar plot the resistance scores were averaged for the years 2014-2019 and compared them with the resistance scores from the 2024 samples. While the data for ampicillin resistance may look dramatic in 2015, it did not carry any statistical significance. However, following the visual trend the increase in antibiotic resistance to both Kanamycin and Trimethoprim-sulfamethoxazole are statistically significant ($p < 0.05$).

Figure 2

Resistance Heatmap



Note. Heat map visualizing antibiotic resistance per antibiotic agent over the years 2014-2024. K, Kanamycin; AM, Ampicillin; SXT, Trimethoprim-Sulfamethoxazole.

This heat map allows for easy visualization of patterns in our data. Ampicillin has not exhibited much change over the ten year time span, while we see that kanamycin and trimethoprim-sulfamethoxazole are both getting deeper in color, implying that the bacterial resistance is increasing.

After running our data through statistical tests in R studios we were able to draw conclusions about the trends in antimicrobial resistance seen in the coliform bacteria of Kittitas County waters. When compared with the data collected in 2024, we see no significant increase in antibacterial resistance for ampicillin, a significant increase in antibacterial resistance for kanamycin, and a significant increase in antibacterial resistance for trimethoprim-sulfamethoxazole. We also compared the sites to see if there was any correlation with the antimicrobial data and found no significant differences between the sampled sites. The results of this research can be used to further study antibiotic resistance in the environment, and the data will be submitted to the WISAR (Washington Integrated Surveillance for Antimicrobial Resistance) database.

Discussion

This study allowed the research team from Central Washington University to work with the University of Washington's One Health Washington (OHW) team of researchers. The OHW team has been compiling data on antibiotic resistance seen in bacteria isolated from humans and animals in hospitals throughout the state, however, they did not have any environmental data. While monitoring the overuse of antibiotics in hospitals and the resulting resistance issues that is causing is very important, our environment is also a huge factor that deserves proper monitoring as well. While the irrigation water tested in our study is not being directly consumed, it is being distributed onto consumable crops as well as to our beef and dairy cattle. Kittitas County was a

good place for the pioneering environmental study as it's a highly agricultural, and the top producer of Timothy Hay in Washington state. The sheer number of bacteria that was resistant to three or more antibiotics should be considered alarming as the study collected 180 separate isolates in six months of sample collection. The environmental antibacterial resistance should continue to be monitored and hopefully the result of our study prompts further environmental research to be conducted across the state.

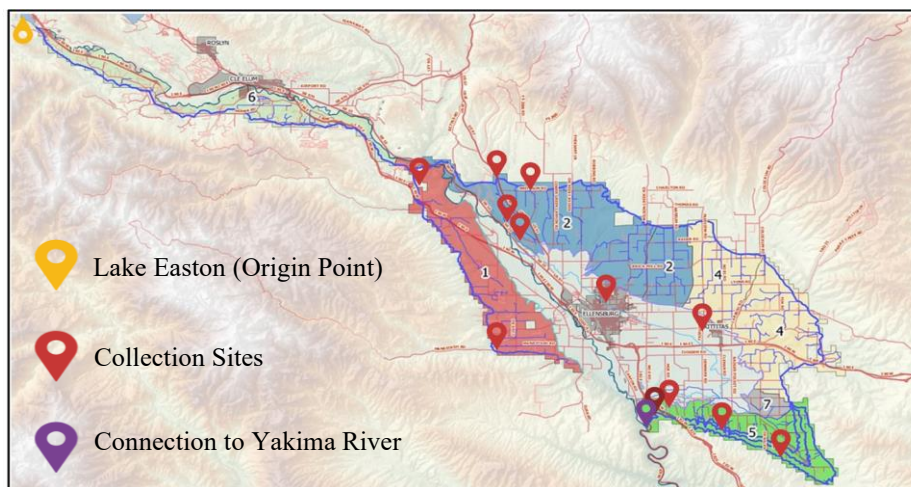
While a 2011 study concluded that no widespread emerging antimicrobial resistance was being seen in dairy cattle (Oliver et al., 2011) more recent studies have been conducted that raise a red flag. In a more recent 2024 study, it was concluded that our cattle industry is seeing an increase of antibiotic use, especially in beef cattle on farms with more than 250 cows (Kupczyński et al., 2024). This has subsequently been correlated with higher disease rates on large farms as the over usage of antibiotics is leading to antibiotic resistance to common bacterial ailments. As Kittitas County contains large numbers of both dairy and beef cattle, I think a follow up study could be performed to measure the number of bacteria displaying antibiotic resistance passed through cattle. Water being offered to the cattle would be tested to isolate coliform bacteria, identify to genus and species, and perform the Kirby-Bauer antibiotic resistance test. The same tests would be performed on coliform bacteria isolated from fecal matter of the cattle. These tests would serve the purpose of quantifying the number of antibiotic resistant bacteria that are picked up by our cattle from the environmental factor of their water. Additionally, it would be interesting to see these results compared between organic and non-organic herds to see the difference modern medicine has on the prevalence of antibiotic resistant bacteria. As well as a study on lactating cows, milk to see if the bacteria is present in the milk as well.

Materials and Methods

Historical samples collected included samples from Manastash Creek, Currier Creek, Wilson Creek, the Yakima River, and a variety of local irrigation canals. The current sampling collects collecting monthly water samples from 12 different locations amongst the Kittitas County Irrigation System (Figure 3). We took autoclave sterile bottles to our sites and lowered them into the water before opening the lids under water and collecting our water samples.

Figure 3

Irrigation Canals and Zones of Kittitas County



Note. The irrigation canals and zones of Kittitas County with red location markers on each site sampled in this research.

To determine whether coliforms are present in a water sample, a presumptive test is performed. One of the most common tests is the Most Probable Number (MPN) test. This test utilizes a selective medium which will cultivate coliforms, but not other types of bacteria. A moderately selective lactose broth medium (Lactose Lauryl Tryptose Broth), containing a

Durham tube, is first used in the presumptive test to encourage the recovery and growth of potentially stressed coliforms in the sample. Colonies from MPN tubes were then streaked for isolation on MacConkey agar, which is selective for gram negative bacteria, and can differentiate bacteria that ferment lactose. Streak for isolations were continuously performed, until a pure culture was observed on a gram stain. Our pure cultures were then grown and maintained on tryptic soy agar slants.

Antibiotic resistance was determined using the Kirby-Bauer Method. After a bacterial lawn of a particular bacterial species is produced on a plate of Mueller-Hinton agar (MHA), a small disc impregnated with one of the antibiotics to be tested is placed onto the lawn (Figure 4). The antibiotics used in this study were Ampicillin, Amoxicillin with Clavulanic Acid, Nitrofurantoin, Gentamycin, Kanamycin, Cephalothin, Tetracycline, and Trimethoprim-Sulfamethoxazole. The antibiotic will diffuse into the agar of the plate where it interacts with the bacteria. After incubation, antibiotics that are effective will have areas around the disc where the lawn no longer grows. These areas are called “zones of inhibition.” Measuring the diameter of the zone (in mm) in relation to the disc helps determine the amount of effectiveness that the antibiotic may provide. A standard table of antibiotics and measurements is used. Discs with very small zones or no zones of inhibition mean that the bacterium is not susceptible to the antibiotic. Large zones indicate high levels of susceptibility. There are three results: susceptible (S), intermediate (I), or resistant (R). Each tested organism is rated using these criteria. As our study focused on bacteria that displayed antibiotic resistance, the following identifying tests were only performed on bacteria that displayed antibiotic resistance to three or more antibiotics.

Figure 4

Antibiotic Resistance Assessment of a Bacterial Strain From the Gravity Canal, August 29, 2024

Sampling Time



Note. A Mueller-Hinton plate with a Kirby-Bauer antimicrobial resistance test, displaying zones of inhibition as well as spontaneous mutation.

Following the Kirby-Bauer antimicrobial tests, each of the isolates was identified to genus and species level. This involves performing a series of biochemical tests that allow for identification. The first tests performed were the IMVC tests and the TSI test. The IMVC is a series of four tests conducted together with the TSI test that are commonly used for identifying bacteria. The four tests that make up the IMVC series are the Indole test, Methyl Red test, Voges-Proskauer test, and the Citrate test. The Indole test is a tryptone broth that is inoculated,

incubated, and Kovac's reagent is added to the tube. The test is looking for the presence of indole production from tryptophan, which is made by a bacteria with the tryptophanase enzyme. If the bacteria produces indole, the addition of Kovac's reagent will produce a red ring at the top of the tube. The Methyl Red test is looking for the production of acidic products from a glucose medium. After the glucose broth is inoculated and incubated, 5 drops of a methyl red indicator is added, and will turn the broth red under acidic conditions. The third test, the Voges-Proskauer test, looks for the production of acetoin from a glucose medium. The glucose medium is inoculated and incubated, and then 5 drops of the reagents KOH and α -naphthol are added. After 20-30 minutes a red color will develop in the broth if acetoin was produced. The final test of the IMVC series is the Citrate test, which looks for citrate utilization. When the bacteria utilize the citrate and phosphate in the slant, the products released into the medium will turn the media blue if they increase the pH, indicating a positive test. A common companion test that we performed with the IMVC series is the Triple Sugar Iron (TSI) test. The TSI test contains the three sugars glucose, sucrose, and lactose, along with ferrous ammonium sulfate, sodium thiosulfate, peptone, and the pH indicator phenol red. This test is performed on an agar slant that is stabbed to create an anaerobic growth opportunity for the bacteria. This test can differentiate bacteria based on their ability to ferment glucose, lactose and/or sucrose, and to reduce sulfur to hydrogen sulfide. When a culture ferments only glucose, the medium will turn yellow. If the culture cannot ferment the other 2 substrates, it will start to utilize the peptone, and the slant will turn red (butt stays yellow). If it can ferment lactose and sucrose, then the entire tube will remain yellow. Gas production will result in the medium becoming broken or pushed up the tube. If the organism can produce sulfide from reduction of the thiosulfate, the sulfide will react with the iron and create a black precipitate. Accompanying these tests was a sugar fermentation assay containing twelve

sugars. The sugars used in the fermentation assay were, Arabinose, Cellobiose, Maltose, Mannitol, Raffinose, Rhamnose, Salicin, Sucrose, Sorbitol, Xylose, Trehalose, Dulcitol. A PBS broth containing the bacterial sample is added to a phenol red broth containing the sugar solution and then incubated, allowing the bacteria a chance to ferment the provided sugars. The sugar media start red and will turn a yellow color as the result of products produced during fermentation, and gas production can also be observed as a product of fermentation.

Following the completion and interpretation of these tests, our study turned to the ABIS online database. The results of the listed tests are entered into the database, and it produces an identity of our bacteria. Along with the identity ABIS produces a probability score. For our study we were looking for a score of 95% probability or higher. If our bacteria did not reach this score after the preliminary tests, the ABIS database has an encyclopedia on the bacteria with further identifying characteristics. Using this encyclopedia further biochemical tests for amino acid utilization, metabolite production, and enzyme production were preformed until we had a bacterial identity with a probability of 95% or higher.

Acknowledgements

Dr. Holly Pinkart for an incredible amount of mentorship, never ending knowledge, and desire to fulfill our curiosity and grow our passion for science

CWU: College of the Sciences and Office of Undergraduate Research

Elaina Mitchell and the CWU Media Prep team

BIOL 323 Students 2014-2024

One Health Washington: University of Washington

References

- Andersson D. I. & Hughes D. (2017). Selection and transmission of antibiotic-resistant bacteria. *Microbiology Spectrum* 5(4). <https://doi.org/10.1128/microbiolspec.mtbp-0013-2016>
- Bennett, P.M. (2008), Plasmid encoded antibiotic resistance: acquisition and transfer of antibiotic resistance genes in bacteria. *British Journal of Pharmacology*, 153, S347-S357.
<https://doi.org/10.1038/sj.bjp.0707607>
- Bereda, G. (2022). Clinical pharmacology of Ampicillin. *Journal of Pharmaceutical Research & Reports*, 3(3), 1-3. [https://doi.org/10.47363/JPRSR/2022\(3\)129](https://doi.org/10.47363/JPRSR/2022(3)129)
- Burchall, J. J. (1973). Mechanism of action of Trimethoprim-Sulfamethoxazole—II, *The Journal of Infectious Diseases*, 128(Supplement_3), S437–S441.
https://doi.org/10.1093/infdis/128.Supplement_3.S437
- Kupczyński R, Bednarski M, Sokołowski M, Kowalkowski W, & Pacyga K. (2024). Comparison of antibiotic use and the frequency of diseases depending on the size of herd and the type of cattle breeding. *Animals*, 14(13), 1889. <https://doi.org/10.3390/ani14131889>
- Lin, J., Nishino, K., Roberts, M. C., Tolmasky, M., Aminov, R. I., & Zhang, L. (2015), Mechanisms of antibiotic resistance. *Frontiers in Microbiology*, 6, 34.
<https://doi.org/10.3389/fmicb.2015.00034>
- Nishimura, T., Tanaka, N., & Umezawa, H. (1962). Inhibition of protein synthesis by Kanamycin. *The Journal of Antibiotics, Series A*, 15(5), 210-215.
https://doi.org/10.11554/antibioticsa.15.5_210
- Normark, B.H. & Normark, S. (2002), Evolution and spread of antibiotic resistance. *Journal of Internal Medicine*, 252, 91-106. <https://doi.org/10.1046/j.1365-2796.2002.01026.x>

- Oliver, S. P., Murinda, S. E., & Jayarao, B. M. (2011). Impact of antibiotic use in adult dairy cows on antimicrobial resistance of veterinary and human pathogens: A comprehensive review. *Foodborne Pathogens and Disease*, 8(3), 337-355.
<https://doi.org/10.1089/fpd.2010.0730>
- Seligman, S. J., & Hewitt, W. L. (1963). Kinetics of the action of ampicillin on *Escherichia coli*. *Journal of Bacteriology*, 85(5). <https://doi.org/10.1128/jb.85.5.1160-1164.1963>
- Smilack, J. D. (1999). Trimethoprim-Sulfamethoxazole, *Mayo Clinic Proceedings*, 74(7), 730-734. <https://doi.org/10.4065/74.7.730>
- Tanaka, N. (1982). Mechanism of action of Aminoglycoside Antibiotics. In: H. Umezawa, L. R. Hooper (Eds.) *Aminoglycoside Antibiotics. Handbook of Experimental Pharmacology*, vol 62. Springer, Berlin, Heidelberg. https://doi.org/10.1007/978-3-642-68579-8_5

Law & Justice

Examine Supreme Court Decisions That Have Influenced the Gender Salary Gap

Shinhae Hwang

Project Mentor(s): Rodrigo Murataya

Department of Law and Justice, Central Washington University

Abstract: Despite significant advancements in gender equality policies and legal frameworks, women consistently earn less than men across various industries and job positions (Blau & Khan, 2017). As of 2023, median weekly wages of full-time women are 83.6 percent of the median weekly wages of men, an increase of just three percentage points since 2004 (BLS 2024). This stalled convergence in the gender gap in wages has led to a large and vibrant research literature that seeks to understand why change has been so slow (England 2010). This paper explores the impact of legislative acts such as the Equal Pay Act of 1963, Title VII of the Civil Rights Act of 1964, and the Lilly Ledbetter Fair Pay Act of 2009 and Supreme Court decisions which affect the gender salary gap. The major goal of this research is to understand how legislation and supreme court rulings have impacted the gender salary gap. The findings suggest that although legislative policies and Supreme court rulings have laid a foundation and have impacted the gender salary gap, they have not been sufficient to eliminate the gender salary gap entirely.

Keywords: Gender Salary Gap, Supreme Court

The gender salary gap remains a persistent issue, despite decades of legislative reforms and judicial intervention. The Supreme Court laid the legal foundation through the 1970s for how the Constitution and newly enacted laws, such as the Equal Pay Act of 1963 (Equal Pay Act, 1963) and the Civil Rights Act of 1964 (Civil Rights Act, 1964), were to be construed in the

context of gender discrimination (Goldstein, 1989). These two statutes tried to solve gender discrimination.

This paper analyzes the effects of legislative policies and Supreme Court rulings in narrowing the gender salary gap. Through a content analysis of selected Supreme Court ruling, this research examines how Supreme Court decisions have established legal precedents that shape policy creation and impact the gender salary gap.

Equal Pay Legislation

Legislative reforms have played a critical role in narrowing gender pay disparities. The Equal Pay Act was enacted in 1963 which was a landmark U.S. policy aimed at eliminating wage discrimination based on gender (Alkadry & Tower, 2011). This was followed by Title VII of the Civil Rights Act of 1964, which prohibited employment discrimination based on sex, among other factors (Burstein, 1985). These legislative actions laid the groundwork for subsequent policies addressing gender wage gaps, yet enforcement challenges and loopholes have limited their full impact (Blau & Kahn, 2017).

Bailey, Helgerman, and Stuart (2024) argue that federal anti-discrimination legislation led to striking gains in women's relative wages, which were concentrated among below-median wage earners. Blau and Kahn analyzed that the Equal Pay Act and potentially Title VII increased women's wages and halted the growth in the gender gap that would have occurred with the increasing supply and changing composition of women workers during the 1960s and 1970s. Bailey et al. (2024) has noted the roles of Title VII and federal affirmative action mandates under Executive Order 11375 in facilitating women's wage and employment gains and increasing their enrollment in colleges and professional schools in the 1970s and later (Beller, 1979; Beller

1982a,b; Leonard, 1984; Carrington, McCue, & Pierce, 2000; Kurtulus, 2012; Blau & Kahn 2017; Helgerman, 2023).

Family and Medical Leave Act (FMLA) affected the lives of women as mothers and workers by being the first federal law to grant unpaid maternity leave to women in every state in the U.S. Signed in January of 1993, the law actually went into effect on August 5, 1993 (Rossin, 2011). Before the FMLA, many American women left their jobs after childbirth, either exiting the labor force or switching jobs after a short break (Hofferth & Curtin, 2006). The FMLA requires unpaid, job-protected leave after the birth or adoption of a child, when facing a serious health condition, or when caring for a child, spouse, or parent with a serious health condition. Coverage is limited to employees with at least 12 months of tenure, who have worked at least 1250 hours (i.e., an average of 25 hours per week), and whose employer has at least 50 employees in that establishment or within 75 miles. Roughly 56% of U.S. employees were covered by the FMLA as of 2018 (Brown et al., 2020).

The Lily Ledbetter Fair Pay Act is a federal law that broadened the ability of employees to sue for discriminatory pay practices. It allows employees to file an equal-pay lawsuit within 180 days of each new paycheck affected by the discriminatory act. (U.S. Equal Employment Opportunity Commission, n.d.). Lily Ledbetter Supreme court case became the basis for the 2009 Lilly Ledbetter Fair Pay Act, which removed the statute of limitation for pay discrimination lawsuits (Phillips, 2009).

Supreme Court Decisions related to Gender Salary Gap

The Supreme Court played an especially active role in this process as the new feminist movement, like the civil rights movement, frequently brought its grievances to the judicial system (Burstein, 1991; Walsh, 1998; Ferree & Hess, 2000).

Muller v. Oregon (208 U.S. 412 [1908]) is the important Supreme Court case involving protective labor laws brought by the owner of an Oregon laundry. It advocates protective labor legislation for women, when the Supreme Court upheld an Oregon statute that limited the hours of women in some industries. In 1903, Oregon passed a law that limited the hours of women in industrial work to ten per day. Two years later, the state prepared a case against laundry owner Curt Muller for violation of the law. Muller took the case to the U.S. Supreme Court. The Supreme Court concludes that “woman’s physical structure and the performance of maternal functions place her at a disadvantage in the struggle for subsistence.

In *Geduldig v. Aiello* (417 U.S. 484 [1974]) four women filed a claim arguing that the California statute defining disability violated equal protection. The four women had all been denied disability coverage during their pregnancies, and their claim argued that the failure to include pregnancy under the rubric of disability perpetuated sex-based discrimination in the workplace (Bender & Braveman, 1995). The Court upheld a state disability insurance plan that excludes claims related to normal pregnancy. Justice Stewart, was concerned with a state disability insurance program which excluded normal pregnancies from its insurance scheme. As the majority saw it, no one was being excluded from a benefit because of gender; rather, it merely removed one physical condition from the list of compensable disabilities (Levin, 1975). The Supreme Court failed to give sufficient attention to developing a consistent approach to sex-based discrimination as a constitutional problem (Bartlett, 1974).

In *Ledbetter v. Goodyear Tire & Rubber Co.* (550 U.S. 618 [2007]), the Supreme Court held that an employee was barred from suing her employer for pay discrimination under Title VII. The Supreme Court limits the time period to file for wage discrimination. The Supreme Court sided with Goodyear over Lilly Ledbetter in her claim of gender pay discrimination. The

Supreme Court determined that pay discrimination claims involve discrete acts that must be challenged promptly.

In *Walmart Stores, Inc. v. Dukes* (564 U.S. 338 [2011]), a class of current and former female employees of Walmart stores alleged that local supervisors made discretionary and discriminatory promotion and payment decisions in violation of Title VII.²⁴ The putative class argued that because Walmart afforded supervisors this discretion and was aware of the discriminatory effect it had on women, but failed to take steps to limit or eliminate the discretion, Walmart was responsible for the alleged disparate treatment. The Supreme Court curbed plaintiffs' use of implicit bias as evidence in support of the commonality requirement of Rule 23. The Court rejected a claim for class certification by women workers at Walmart. In *Duke*, Post-*Dukes*, plaintiffs have looked for creative ways to leverage scientific development in implicit bias within the legal framework of employment discrimination law (Jones, 2017).

Conclusion

These legislative actions laid the groundwork for subsequent policies addressing gender salary gaps (Guy & Fenley, 2013; Kerrissey & Meyers, 2022; United States Government Accountability Office, 2020). More than 40 years after the passage of the Equal Pay Act of 1963, pay disparities between men and women persist in the U.S. workforce (Gibelman, 2003). Despite these legislative milestones, the persistence of wage disparities underscores the need for stronger enforcement mechanisms, transparency in pay structures, and cultural shifts in workplace norms (Clark Blickenstaff, 2005).

Barriers to pay equity are complicated because organizational barriers are interconnected with sociocultural and human capital barriers (Alkadry & Tower, 2006). Gibelman (2003) has suggested that a multi-pronged response is needed that would include (a) education and

advocacy activities (e.g., to broaden professional and public awareness of the wage gap); (b) group activity (e.g., women working together within and with employers, government, women's organizations, and unions); (c) professional activity (e.g., collaboration among professional groups to address the wage gap); and (d) policy activity (e.g., comparable worth, which seeks to influence position and agency segregation).

To meaningfully narrow the gender salary gap, better enforcement of existing laws (e.g., the Equal Pay Act and Title VII) and regulations (i.e., affirmative action), as well as stronger laws (i.e., the Paycheck Fairness Act and Fair Pay Act) are needed to address this issue (Alkadry & Tower, 2006).

References

- Alkadry, M. G., & Tower, L. E. (2011). Covert Pay Discrimination: How Authority Predicts Pay Differences between Women and Men. *Public Administration Review*, 71(5), 740–750. <https://doi.org/10.1111/j.1540-6210.2011.02413.x>
- Bailey, M. J., Helgerman, T., & Stuart, B. A. (2024). How the 1963 Equal Pay Act and 1964 Civil Rights Act shaped the gender gap in pay. *The Quarterly Journal of Economics*, 139(3), 1827–1878. <https://doi.org/10.1093/qje/qjae006>
- Bartlett, K. T. (1974). Pregnancy and the Constitution: The uniqueness trap. *California Law Review*, 62(5), 1532–1566. <https://doi.org/10.2307/3479872>
- Beller, A. H. (1979). The impact of equal employment opportunity laws on the male-female earnings differential. In C. Lloyd, E. Andrews, & C. Gilroy (Eds.), *Women in the Labor Market* (pp. 304-330). Columbia University Press. <https://doi.org/10.7312/lloy94662-021>
- Beller, A. H. (1982a). The impact of equal opportunity policy on sex differentials in earnings and occupations. *American Economic Review*, 72(2), 171-175.
- Beller, A. H. (1982b). Occupational segregation by sex: Determinants and changes. *The Journal of Human Resources*, 17(3), 371–392. <https://doi.org/10.2307/145586>
- Bender L., & Braveman D. (1995). *Power, privilege, and law: A civil rights reader*. West Pub. Co.
- Blau, F. D. & Kahn, L. M. (2017). The gender wage gap: Extent, trends, and explanations. *Journal of Economic Literature*, 55(3), 789–865.
- Brown, S., Herr, J., Roy R., & Klerman, J. A. (2020). *Employee and worksite perspectives of the family and medical leave act: Results from the 2018 surveys*. Chief Evaluation Office,

- U.S. Department of Labor. https://www.dol.gov/sites/dolgov/files/OASP/evaluation/pdf/WHD_FMLA2018SurveyResults_FinalReport_Aug2020.pdf
- Bureau of Labor Statistics. (2024). *Women's earnings were 83.6 percent of men's in U.S. Department of Labor*; The Economics Daily. Retrieved June 27, 2025, from <https://www.bls.gov/opub/ted/2024/womens-earnings-were-83-6-percent-of-mens-in-2023.htm>
- Burstein, P. (1985). *Discrimination, jobs, and politics*. University of Chicago Press.
- Burstein, P. (1991). Legal mobilization as a social movement tactic: The struggle for equal employment opportunity. *American Journal of Sociology* 96(5), 1201–25.
- Carrington, W. J., McCue K., Pierce B. (2000). Using establishment size to measure the impact of Title VII and affirmative action. *Journal of Human Resources*, 35(3), 503–523. <https://doi.org/10.2307/146390>
- Civil Rights Act of 1964, Pub. L. No. 88-352, 78 Stat. 241 (1964). <https://www.govinfo.gov/content/pkg/STATUTE-78/pdf/STATUTE-78-Pg241.pdf>
- Clark Blickenstaff, J. (2005). Women and science careers: leaky pipeline or gender filter? *Gender and Education*, 17(4), 369–386. <https://doi.org/10.1080/09540250500145072>
- England, P. (2010). The gender revolution: Uneven and stalled. *Gender & Society*, 24(2), 149-166. <https://doi.org/10.1177/0891243210361475>
- Equal Pay Act of 1963, Pub. L. No. 88-38, 52 Stat. 1062 (1963). <https://www.govinfo.gov/content/pkg/STATUTE-77/pdf/STATUTE-77-Pg56.pdf#page=1>
- Ferree, M.M., & Hess, B. (2000). *Controversy and coalition: The New Feminist Movement across four decades of change*. Routledge.
- Geduldig v. Aiello*, 417 U.S. 484 (1974).

- Gibelman, M. (2003). So how far have we come? Pestilent and persistent gender gap in pay. *Social Work* 48(1), 22-32
- Goldstein, L. F. (1989). *The constitutional rights of women*. University of Wisconsin Press.
- Guy, M. E., & Fenley, V. M. (2013). Inch by inch: Gender equity since the Civil Rights Act of 1964. *Review of Public Personnel Administration*, 34(1), 40-58.
<https://doi.org/10.1177/0734371X13510379> (Original work published 2014)
- Helgerman, T. (2023). *Health womanpower: The role of federal policy in women's entry into medicine*. (Working Paper). University of Michigan.
- Hofferth, S. L., & Curtin, S. C. (2006). Parental leave statutes and maternal return to work after childbirth in the United States. *Work and Occupations* 33(1), 73–105.
<https://doi.org/10.1177/0730888405281889>
- Jones, A. L. (2017). Implicit bias as social-framework evidence in employment discrimination. *University of Pennsylvania Law Review*, 165(5), 1221–1243.
<http://www.jstor.org/stable/26600619>
- Kerrissey, J., Meyers, N. (2022). Public-sector unions as equalizing institutions: Race, gender, and earnings. *ILR Review*, 75(5), 1215–1239.
- Kurtulus F. A. (2012). Affirmative action and the occupational advancement of minorities and women during 1973–2003. *Industrial Relations: A Journal of Economy and Society*, 51, 213–246.
- Ledbetter v. Goodyear Tire & Rubber Co.*, 550 U.S. 618 (2007).
- Leonard J. S. (1984). The impact of affirmative action on employment. *Journal of Labor Economics*, 2(4), 439–463.

- Levin, B. (1975). “Woman’s place” in the Constitution: The Supreme Court and gender discrimination. *The High School Journal*, 59(1), 31–45.
<http://www.jstor.org/stable/40366205>
- Muller v. Oregon*, 208 U.S. 412 (1908).
- Phillips, M. (2009, January 25). Now comes Lilly Ledbetter. *White House Blog*
<https://obamawhitehouse.archives.gov/blog/2009/01/25/now-comes-lilly-ledbetter>
- Rossin, M. (2011). The effects of maternity leave on children's birth and infant health outcomes in the United States. *Journal of Health Economics*, 30(2), 2011, 221-239.
<https://doi.org/10.1016/j.jhealeco.2011.01.005>
- Selected Supreme Court decisions 1971 - 1999. (n.d.). US EEOC.
<https://www.eeoc.gov/history/selected-supreme-court-decisions-1971-1999#>
- U.S. Equal Employment Opportunity Commission. (n.d.). *Notice concerning the Lilly Ledbetter Fair Pay Act of 2009*. Retrieved April 9, 2019, from
https://www.eeoc.gov/laws/statutes/epa_ledbetter.cfm
- United States Government Accountability Office. (2020). *Gender pay differences: The pay gap for federal workers has continued to narrow, but better quality data on promotions are needed*. <https://www.gao.gov/products/gao-21-67>
- Walmart Stores, Inc. v. Dukes*, 564 U.S. 338 (2011).
- Walsh, A. (1998). Ruth Bader Ginsburg: Extending the Constitution. *John Marshall Law Review*, 32, 197–225.

Physics

Construction, Optimization, and Characterization of an Undergraduate Cold Cathode Table-Top Electron Accelerator for Radiation Physics Education

Caitlin Balmer, Mason Skeath, Mehran Zaini, Peter Zencak, Erin Craig

Project Mentor(s): Mehran Zaini

Department of Physics, Central Washington University

Abstract: Rising cancer cases spurred advancements in radiation therapy modalities, including electron accelerators. In this report, descriptive and diagnostic analysis was utilized to develop and characterize a functional, low energy cold cathode table-top electron accelerator for radiation physics experimentation in Central Washington University's (CWU) undergraduate radiation lab. The device features a tungsten cathode (TC), brass anode, and copper Faraday Cup (FC) in a vacuum, enclosed by blue-tinted polyvinyl chloride (PVC). TC electron emission was facilitated by applied electric fields from input voltages of 1000 V to 5000 V. FC collected electron current in the range of 0 μA to 100 μA . Baseline measurements exhibited a Fowler-Nordheim relationship for low input voltages, transitioning to linear step correlations for higher input voltages. This behavior was thoroughly investigated using a quantum mechanical approach in MATLAB. With the introduction of an aluminum attenuator, an exponential decrease in beam current with respect to attenuator thickness was observed; moreover, input voltage of 4500 V produced oscillatory current output, ranging from 0 μA to 24 μA with a 6 second period. Oscillation is thought to be caused by space-charge effects that are attempted to be eliminated via grounding of the attenuator. This optimization and characterization of an electron accelerator demonstrated the potential for radiation physics experimentation at CWU. Future research should aim to enhance beam quality, visualize beam dynamics, and further investigate quantum mechanical properties.

Keywords: Electron Accelerator, Cold Cathode Electron Field Emission, Electron Attenuation, Radiation Physics, Fowler-Nordheim Relationship

I. INTRODUCTION

Electron accelerators (EAs) have been an essential component in many scientific, industrial, and medical applications. In the scope of medicine, typical radiation oncology departments employ linear accelerators (linacs) to

deliver highly energetic photons or electrons to cancer lesions through the process of external beam radiation therapy (EBRT). Over the years, cancer cases have increased substantially, leading to rapid advancement in radiation therapy modalities, including EAs. Therefore, a functional, low-energy, cold-cathode, table-top, field-

emission EA was developed in the Central Washington University's (CWU) undergraduate radiation lab to teach radiation physics concepts behind EAs and radiation therapy treatments.

A. Emission types

In general, EAs accelerate electrons emitted from a metallic element, called the cathode, within a vacuum chamber. There are three typical electron emission processes present in most EAs: thermionic emission, photoelectric emission, and field emission.² Thermionic emission is the release of electrons from a metal filament after it is heated to a sufficient temperature.² Photoelectric emission, on the other hand, is the emission of electrons from a material once they are stimulated with electromagnetic radiation via the photoelectric effect.²

Field emission will be the primary emission mechanism discussed in this paper. Field emission facilitates electron emission via the application of a very strong electric field created by a potential difference between the cathode and a metal anode.² This electric field essentially “pulls” the electrons off the cathode and into “free space,” which is defined here as space outside the cathode material.

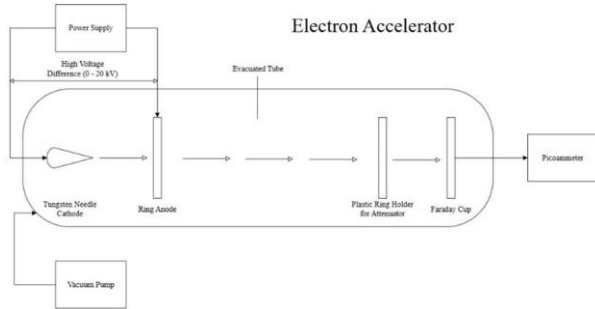


FIG. 1. A schematic diagram of basic electron accelerator design that includes essential components, measurement devices, and the general parameters of the system.

B. Current measurement and governing physical principles

Once the electrons are emitted from the cathode, coulomb forces “pull” and “concentrate” the negatively charged particles to a positively charged anode, accelerating them into a refined beam. This electron current may be measured using different detectors, like a Faraday Cup (FC). A basic schematic of a field emission EA is shown in Figure 1.

Typical EAs governed by field emission exhibit a Fowler-Nordheim relationship (FN), as expressed in Equation 1.¹

$$J(E) = AE^2 \cdot \exp\left(-\frac{B}{E}\right) \quad (1)$$

$J(E)$ is the current density in $\frac{A}{m^2}$, E is the electric field strength in $\frac{V}{m}$, and A and B are constants dependent on cathode geometry. The current density is given by the EA's current in amperes divided by the inner area of the anode. Two more EA parameters may be extracted from the FN relationship using an alternate form of Equation 1.¹

$$I = \alpha V^2 \cdot \exp\left(-\frac{b\phi^{\frac{3}{2}}}{\beta V}\right) \quad (2)$$

Equation 2 includes the work function, ϕ , field enhancement factor, β , and two more constants, α and b . The work function of the material is the minimum energy needed for an electron to overcome the potential barrier of the cathode and be emitted into free space.² β is an empirically computed constant dependent on the geometrical properties of the experimental system.¹ α and b are sub-constants of A and B and will not be discussed in the present report.

These FN relationships indicate that the current density of the beam will grow exponentially with increasing input voltage, thus increasing anode charge, after a threshold electric field strength is reached. This rapid increase in current is a direct result of the inverse square relationship associated with electric fields. In other academic articles, the FN relationship is often linearized on a plot of $\ln\left(\frac{I}{V^2}\right)$ as a function of V^{-1} .¹

C. Attenuation data and depth dose curves

Following the characterization of the EA, attenuation measurements may be performed to further characterize the electron beam's energy. Attenuation is a measure of the interplay between a material's ability to reduce the flow of particles and the particle beam's characteristics. Attenuation measurements may be taken by the placement of an attenuator—a thin slice of metal or insulator—in front of the electron beam's path to reduce the number of electrons that reach the current measurement device.

Characteristic attenuation curves for electrons—percent depth fluence curves—consist of a build-up region followed by a decrease in electron fluence with increasing material thickness. The build-up region is a direct result of multiple coulomb scattering, especially for low-energy EAs. The decrease in current as material thickness increases occurs because the attenuator reduces the electrons' energy, eventually capturing them within the material.

As a result of the physics involved with EA development and interactions, an EA was constructed, optimized, and characterized for experimentation at CWU to provide teaching opportunities in undergraduate radiation physics and practice with medical physics concepts. Medical physicists are actively employed by radiation oncology practices to treat, evaluate, and maintain optimal linac operation.

II. METHODS

A. Laboratory and radiation protection

The development and testing of the EA were performed in CWU's radiation physics laboratory. Radiation practices and shielding were developed to ensure no exposure to students working with the device. The radiation shield was constructed of copper and a lead panel; it was also grounded to reduce electrostatic interference between the experimental components. In addition, radiation readings recorded with a M44-3 probe attached to a Ludlum 3001 survey meter during device operation were in agreement with typical natural background radiation levels.

B. Device specifications and improvements

Regarding the EA's specifications, the device features a tungsten cathode (TC), brass anode with a radius of 0.5 cm (± 1 mm), and copper Faraday Cup (FC) in a vacuum generated by an Edwards RV8 Rotary Vane Vacuum Pump, enclosed by blue-tinted polyvinyl chloride (PVC). The evacuated tube had a consistent vacuum of 4.5 mmHg as measured by a Robinair Pressure Device. TC electron emission was facilitated by applied electric fields from input voltages of 1000 V to 5000 V by a Stanford Research Systems Model PS370 High Voltage Power Supply. FC collected electron current in the range of 0 μA to 100 μA as measured by a Keithley Instruments Model 480 Picometer. The device also had different distances between the cathode and the anode: 21 mm, 28 mm, and 43 mm (± 2 mm). These distances were formulated using the following tube lengths, 5.30 cm, 6.50 cm, and 7.85 cm (± 1 mm). For detailed three dimensional renderings and images of the EA's architecture, see Appendix A.

Previous cohort's data was utilized to develop several optimizations on the device. The alterations are summarized below:

1. The white PVC was switched to blue-tinted PVC for electron beam observability and qualitative investigation of the EA's behavior.
2. A plastic ring holder was developed to provide structural integrity to introduced attenuator materials.
3. The anode structure was enhanced by enlarging its radius to facilitate improved field emission from cathode.
4. A faraday cage was developed to reduce electro-static interference between components.
5. Coaxial cable was introduced for further electro-static interference reduction.
6. An oscilloscope was integrated into the circuitry of the experimental setup to measure the output waveform of the FC.

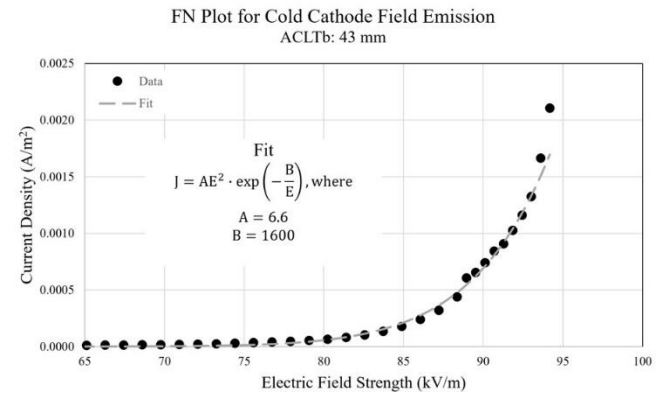


FIG. 2. A plot of current density as a function of electric field strength at cathode. FN theory fit is also plotted to extract constants A and B.

C. Measurements and analysis

Once the device was constructed and optimized, measurements of the input voltage and output current were performed and fitted with the FN relationship. A MATLAB program was also developed to understand the quantum mechanical nature of the system. These readings and results were recorded in a logbook stored in the radiation laboratory and an Excel file accessible by the current student cohort. Furthermore, an attenuator of varying thicknesses was introduced into the beam's path and plotted in the Excel file to determine an approximate attenuation curve for the emitted electrons.

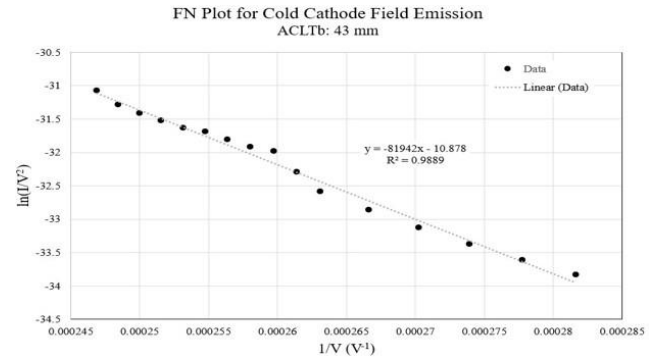


FIG. 3. A plot demonstrating the linearized form of the FN relationship common in the corresponding subject literature.

III. RESULTS AND DISCUSSION

Baseline measurements demonstrated a Fowler-Nordheim (FN) relationship at low input voltages (as illustrated in Figure 2) and linear step correlations at higher input voltages. Further analysis of the FN plot indicated the presence of a threshold electric field strength required for significant electron emission. Parameter values A and B were extracted. Schottky-Nordheim theory was applied to Equation 2 to obtain an experimental work function value of 1.47 eV. This value is approximately equal to the accepted work function for tungsten, which is 4.63 eV.² The

linearized FN plot, presented in Figure 3, further supports the correlation of the EA with FN theory; there was a high R^2 linear agreement between the data points. The field enhancement factor, β , was not calculated.

A computational quantum mechanical analysis of the emitted electron wave functions and probability distributions in MATLAB provided two similar general conclusions. First, lower values of ϕ resulted in an increased transmission probability of the electrons through the potential barrier of the tungsten cathode. This increase in transmission probability, thus measured current, was represented by the decreased amplitude of the electrons' wave functions and probability distributions following their transmission through a triangular potential barrier.² Figure 4 highlights these observations for different value of ϕ . Increased transmission probability was observed to be a direct result of the reduced absolute maximum of the potential barrier that the electrons must surpass; the absolute maximum of the potential barrier is directly proportional to ϕ , as shown by the height of the triangle in Figure 4. Table 1 quantitatively summarizes the qualitative results of Figure 4.

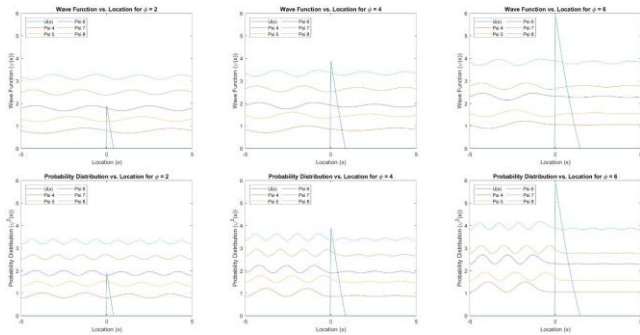


FIG. 4. A series of diagrams illustrating the results of increasing ϕ (left to right) on the emitted electrons' wave functions (top) and probability distributions (bottom).

ϕ	$\text{Max} \Psi_{n,bb}^2(x) $	$\text{Max} \Psi_{n,ab}^2(x) $	T
2	0.2215	0.1796	0.8110
4	0.3327	0.0737	0.2214
6	0.4044	0.0156	0.0385

TABLE I. A table summarizing probability distribution amplitudes and transmission probabilities for work functions before and after potential barrier, as depicted in Figure 4. The charge on the anode (q) and electron wave function for the n^{th} energy state ($\Psi_n(x)$) were fixed: $q = 0.050$ and $\Psi_n(x)$ for $n = 3$.

Second, transmission probability also increased with an increase in anode charge. Electromagnetic theory can explain this relationship. The electric field strength exhibited by a charged object is proportional to the charge of the object.² As a result, as the anode charge increases, the electric field strength at the cathode increases, thus allowing more electrons in the cathode to occupy high transmission probability energy states. Since the charge on the anode is also proportional to input voltage, the quantum mechanical model results in Table 2 and Figure 5 are consistent with measured values plotted in Figure 2. It should be noted here that an increase in transmission probability of the

electrons in the MATLAB program for increasing anode charge was modeled by reduced potential barrier width.

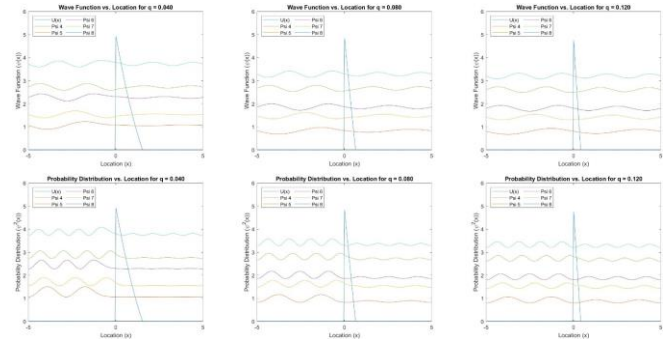


FIG 5. A series of diagrams illustrating the results of increasing q (left to right) on the emitted electrons' wave functions (top) and probability distributions (bottom)

q	$\text{Max} \Psi_{n,bb}^2(x) $	$\text{Max} \Psi_{n,ab}^2(x) $	T
0.040	0.3788	0.0269	0.0711
0.080	0.3189	0.0870	0.2729
0.120	0.2603	0.1423	0.5465

TABLE II. A table summarizing probability distribution amplitudes and transmission probabilities for various anode charges before and after potential barrier, as depicted in Figure 5. ϕ and $\Psi_n(x)$ were Fixed: $\phi = 5$ and $\Psi_n(x)$ for $n = 3$.

Another general finding from the quantum mechanical analysis was the prediction of a threshold energy state among the electrons before sufficient transmission probability. These findings are summarized in Table 3 and Figure 6. The presence of this threshold energy phenomena is thought to be a strong indicator for the electron behavior summarized in Figure 2 and that predicted by the FN relationship.

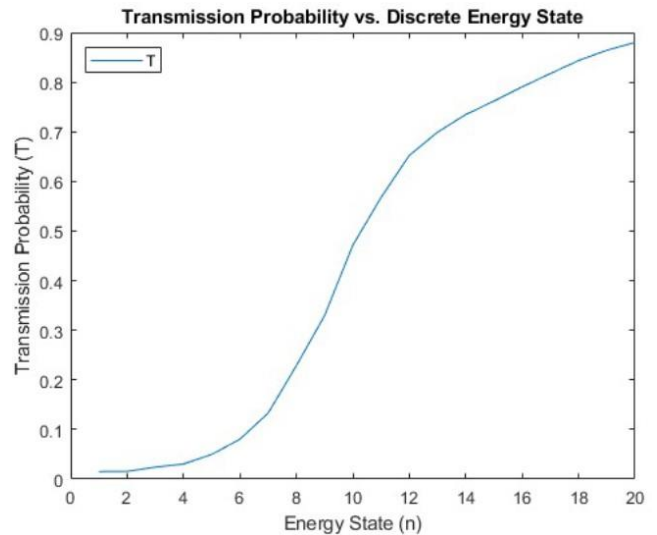


FIG. 6. A plot demonstrating the impact of the energy state of an electron on its transmission probability. There exist three regions of transmission probability: low (left), threshold (middle), and high (right).

$\Psi_n(x)(n)$	$\text{Max} \Psi_{n,bb}^2(x) $	$\text{Max} \Psi_{n,ab}^2(x) $	T
4	0.4159	0.0126	0.0304
5	0.3507	0.0174	0.0497
6	0.3810	0.0307	0.0806
7	0.3280	0.0437	0.1331
8	0.3175	0.0726	0.2287

TABLE III. Probability distribution amplitudes and transmission probabilities for various discrete energy levels before and after potential barrier. q and ϕ were fixed: $q = 0.050$ and $\phi = 5$.

Figure 7 shows the EA's output current as a function of input voltage for the different tube lengths substituted into the EA's design. The plot highlighted that shorter tubes required less input voltage for an equivalent current output, a phenomenon explained by a greater electric field strength at the cathode caused by its reduced distance from the anode. Furthermore, it was thought that electron blooming effects further reduced current output measured with the 43 mm and 28 mm tubes compared to the 21 mm tube; the electric field geometry within the device potentially directs a portion of the beam into the surrounding PVC. The shortest tube length, however, also presented instability at high input voltages.

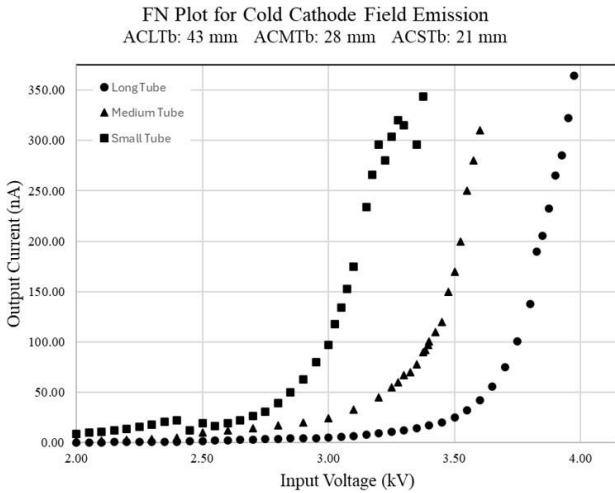


FIG. 7. A plot of output current of the EA as a function of the input voltage for different tube lengths.

A comparative analysis of the current cohort's data against that of the previous cohort confirmed an improvement in the performance of the EA. Enhancements were achieved primarily through the optimizations outlined in the methods section, resulting in about an 80% increase in beam efficiency due to reduced noise and improved consistency across trials. Specifically, the current cohort maintained vacuum pressures around 4.5 mmHg, compared to 70 mmHg in the previous cohort. Additionally, the beam's output was more consistent and focused, allowing for the establishment of more refined and direct relationships between parameters.

Attenuation measurements demonstrated an exponential decrease in beam current with respect to attenuator thickness (Figure 8). The lower the input voltage (thus electron energy) the steeper the falloff of the attenuation curve, indicating low electron

penetration depth. Moreover, an input voltage of 4500 V produced an oscillatory current output, ranging from 0 μA to 24 μA with a 6 second period. Oscillations are thought to be caused by space-charge effects that are attempted to be reduced via grounding of the attenuator in future experiments.

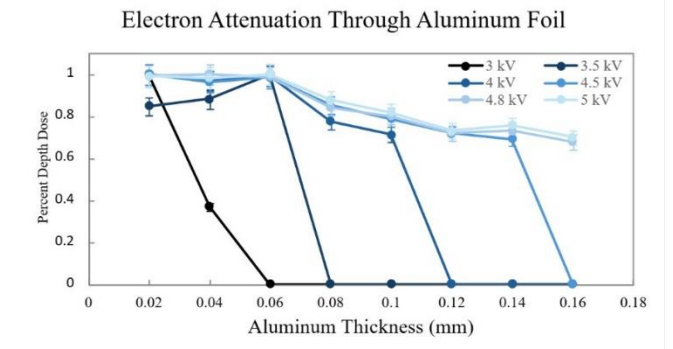


FIG. 8. A plot of the attenuation curves for various input voltages as a function of attenuator thickness, which in the present report was aluminum.

IV. CONCLUSION

This optimization and characterization of an electron accelerator demonstrated the potential for radiation physics experimentation at CWU. Through both experimental and theoretical analysis, continuous improvements in performance, vacuum conditions, beam focusing, and measurement accuracy have been made and are continuously being implemented. The implementation of design changes such as expanding the anode, improved grounding and electromagnetic shielding with a faraday cage played a crucial role in reducing interference and maximizing transmission efficiency. Quantum mechanical modeling also provided valuable insight into characteristics of emission. Moving forward, future research will aim to (1) enhance visualization of beam dynamics through two-dimensional detection mediums like a film, (2) further reduce noise, (3) explore the source of oscillatory behavior of the FC readings, and (4) correlate the experimental values with other theoretical frameworks, among others. A Wehnelt cylinder may also be fabricated to mitigate the electron blooming effects. These enhancements will deepen the understanding of radiation physics principles and further optimize the tabletop electron accelerator at CWU.

REFERENCES

1. Leonard, Chapter 6: Field Emission (Office of Scientific and Technical Information [OSTI], 2008).
2. Thornton T. S. and Rex A., *Modern Physics for Scientists and Engineers* (Cengage Learning, 2013), Vol. 4.

Appendix A

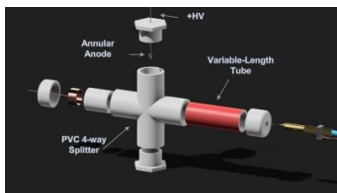


FIG. 9. A three-dimensional rendering of the EA. The image contains the following essential components to the EA: cathode (right), anode (top middle), Faraday Cup (metallic material on the left), and PVC covering.

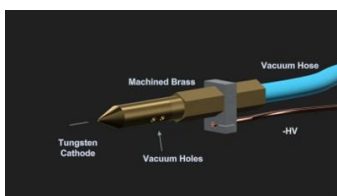


FIG. 10. A zoomed image of EA components before tungsten cathode. The vacuum holes and vacuum hose depicted in this image are essential for generating vacuum within the EA tube to minimize electron interactions with air.

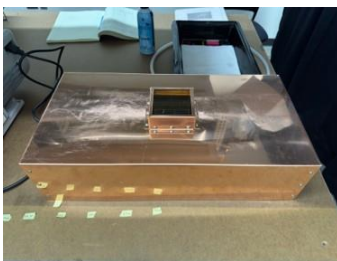


FIG. 11. An image depicting the designed shield to prevent any possible leakage radiation from the device. It should be noted here that procedural operation of the device results in no leakage radiation as measured by a survey meter.



FIG. 12. An image of the physical EA. Some additional EA components included in this image include plastic ring holder for attenuator material (inside left PVC T-junction), broadened anode (inside right PVC T-junction), and clear PVC for qualitative investigation of electron beam behavior.

Psychology

Emotion Recognition Accuracy With Fully Occluded Faces: Do Eye Gaze Patterns and Fixation Durations Shift When We're Wrong?

Dominique Martinez-Driscoll, Michael Cicero, Malcolm Jasmin, Mary Radeke, Anthony Stahelski

Project Mentor(s): Mary Radeke, Anthony Stahelski
Department of Psychology, Central Washington University

Abstract: Prior research on facial expression recognition (FER) has shown that the use of face masks significantly impairs the ability to correctly identify facial expressions, especially those that engage the lower regions of the face such as disgust and anger (Carbon, 2020; McCrackin et al. 2022). Not only does FER accuracy decrease with a masked or occluded face, but gaze patterns also shift and dwell time increases from those areas that are covered (mouth) to areas uncovered (eyes) (Rabadan, et al. 2022). In situations where both eyes and mouth are covered, the gaze patterns shift and dwell time increases to the area between the eyes. Fixation patterns and dwell times of occluded faces also differ depending on the facial expression. This study explored the effect of FER accuracy on eye scan patterns and fixation time. Using a repeated measures design, participants viewed images of anger, fear, sad, and neutral models with eyes and mouth occluded. Participants' eye movements were recorded using Imotions eye tracking technology. Participants responded to an emotion recognition question to identify correct and incorrect assessments of the facial expressions. All facial expressions were divided into correct and incorrect recognition categories and collapsed across facial expressions. Eye scan patterns using Time to First Fixation measures (TTFF) and Dwell time (DT) were compared for the correct and incorrect categories.

Keywords: Facial Expression Recognition, Eye Gaze Patterns, Eye Gaze Dwell Time

This study examined the sequence of eye gaze patterns and the duration of gaze (dwell time) when participants correctly versus incorrectly identified facial expressions on fully occluded faces using sunglasses and surgical masks. Prior research on facial expression recognition (FER) has shown that the use of face masks significantly impairs the ability to correctly identify facial expressions, especially those that engage the lower regions of the face such as disgust and anger (Carbon, 2020; McCrackin et al. 2022). Not only does FER accuracy decrease with a masked or occluded face, but gaze patterns also shift and dwell time increases from those areas that are covered (mouth) to areas uncovered (eyes) (Rabadan, et al. 2022).

Not only does this research relate to the use of face masks in public settings, but previous studies have also shown that the increased use of masks due to COVID-19 has led to significant miscommunication with patients in hospital settings (Marler & Ditton, 2021).

We analyzed gaze sequence, dwell time, and accuracy in identifying fully occluded angry, fearful, neutral, and sad facial expressions to determine if there were significant differences between correct and incorrect assessments of the facial expressions.

Method

Participants

The participants for this study were college students between the ages of 18 and 60 years of age ($N = 92$). Participants identified as female (67%), male (29%) and non-binary (4%). Race and ethnicity were not noted for this study.

Materials

The photos used for this study consisted of middle aged ($M = 43$ years) male and female models exhibiting anger, fear, sad, and neutral facial expressions (FACES; Ebner, Riediger, & Lindenberger, 2010). The faces were obstructed using shaded sunglasses and a surgical face

mask that was superimposed on each image using Adobe Photoshop. Imotions software and a SmartEye X eye tracking device were used to capture the participants' eye movements while viewing the images on a computer screen.

Design

All facial expressions were divided into correct and incorrect recognition categories and collapsed across facial expressions. Participants responses (correct or incorrect) to the emotion label question became the independent variable. Eye gaze sequence and dwell time duration were then compared.

Dependent Variables

The dependent variables for this study were eye gaze sequence and dwell time. Eye gaze sequence was defined as the order of predetermined areas of interest (AOIs) based on time to first fixation (ms, TTFF). Dwell time was defined as time (ms) spent fixated on three areas of interest (AOIs); the area between the eyes (ABE), eyes, and mouth.

Procedure

Participants viewed each fully occluded face for six seconds and then answered a forced-choice emotion recognition question. Response options included anger, disgust, fear, happy, sad, surprise, and neutral. While viewing the face, the eye tracker tracked pupil movement to and from three predetermined AOIs. This study was approved by the CWU IRB. Informed consent and debriefing protocols were followed.

Results

Correct Compared Incorrect Facial Expression Recognition

Dwell time for correct and incorrect FER were analyzed across three AOIs; area between the eyes (ABE), eyes, and mouth. For ABE, there was no significant difference in dwell time

when participants were correct or incorrect. Similarly, there was no significant difference for the mouth area. However, for the eyes, the dwell time for the left eye when participants correctly identified the facial expression was significantly longer than when they incorrectly identified the facial expression ($p < .001$).

In terms of gaze sequence, participants looked at the ABE before the right eye and the mouth compared to when they were incorrect ($p = .008$). No differences were noted between correct and incorrect for the mouth and eyes. See Figures 1, 2, and 3.

Overall Results for Correct and Incorrect

Overall, when participants were correct the results revealed that dwell time was longer on ABE than mouth ($p < .001$), longer on the left eye than ABE ($p < .001$), and mouth ($p < .001$), longer on left eye than right eye ($p < .001$), and longer on right eye than the mouth ($p < .001$).

Overall, results when participants were incorrect, the results revealed that participants looked at the ABE before mouth, left eye was looked at before the ABE and the mouth ($p = .02$). Additionally the right eye was looked at before the ABE and mouth ($p < .001$). When participants were correct, more time was spent on the eyes as compared to other areas of the face. The eyes were also prioritized first with gaze sequence when participants were incorrect ($p < .001$). It was also found that there was a bigger difference in the AOI scan sequence when participants were correct versus Incorrect ($p < .001$).

Figure 1

Gaze Sequence

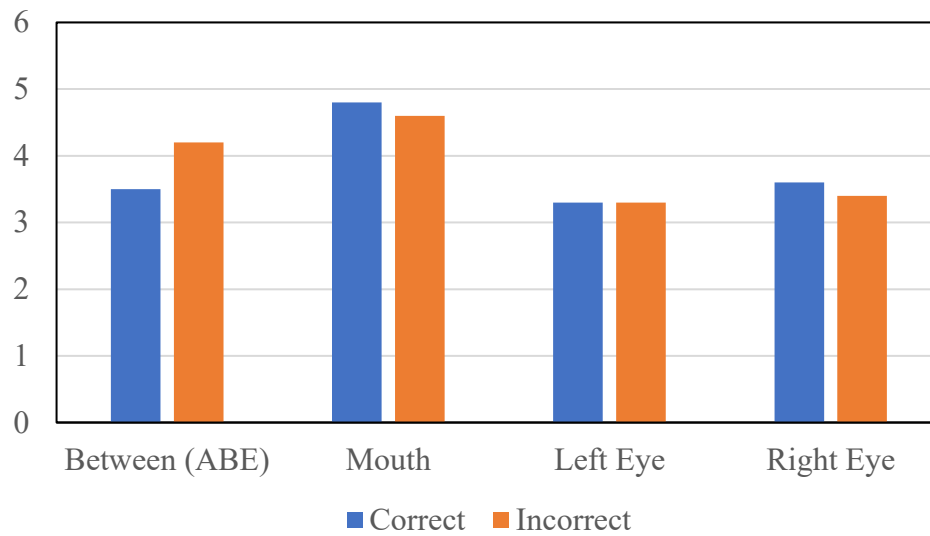


Figure 2

Dwell Time (Fixation ms)

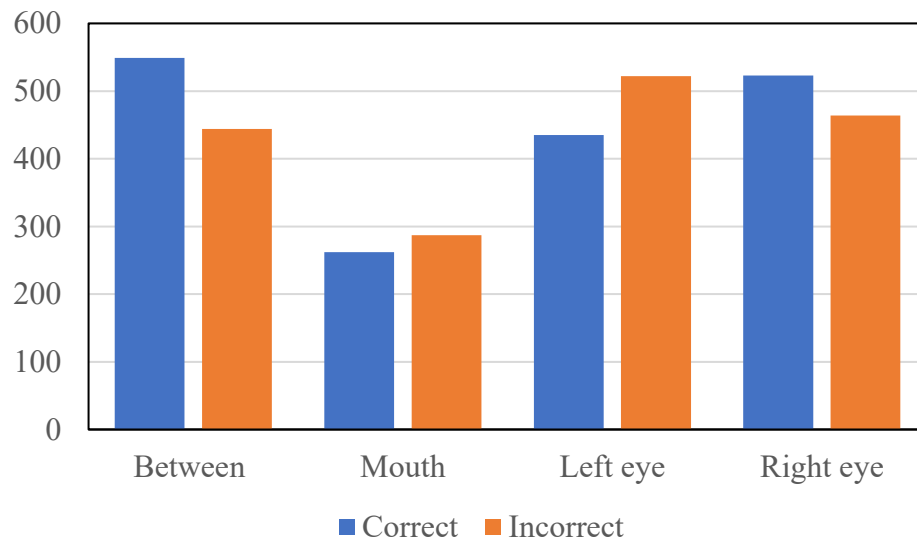
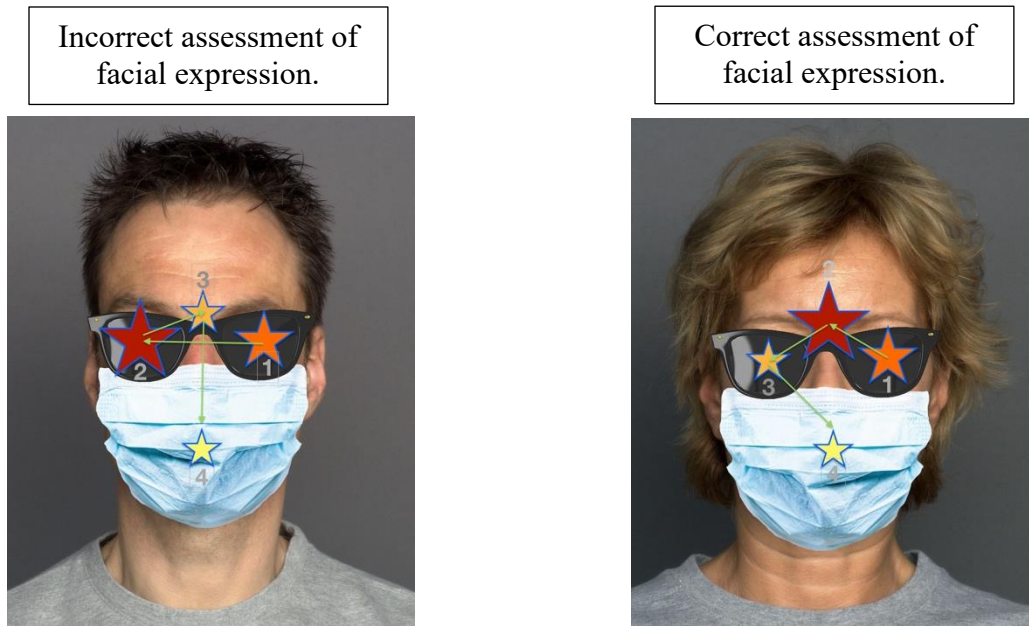


Figure 3

Gaze Sequence and Dwell Time Illustration



Discussion

Carbon's (2020) research aligned with our results regarding the mouth area. When correct, participants focused on both the left eye and ABE longer than anywhere else. Rabadan (2022) found that eye gaze migrated to unoccluded areas of the face. Similarly, in our study, when the most important areas for FER were occluded, participants looked more at ABE and eyes, before the mouth. Interestingly, the only significant difference found between the correct and incorrect comparison was with the ABE.

Unlike dwell time, more differences were found between eye gaze sequences when participants were incorrect. Also of note, regardless of whether participants were correct, the second area of the face they looked at had the longest dwell time, third place they looked had same amount of dwell time, fourth place they looked had same dwell time.

References

- Carbon, C.-C. (2020). Wearing face masks strongly confuses counterparts in reading emotions. *Frontiers in Psychology, 11*, Article 566886. <https://doi.org/10.3389/fpsyg.2020.566886>
- Ebner, N., Riediger, M., & Lindenberger, U. (2010). FACES – A database of facial expressions in young, middle-aged, and older women and men: development and validation. *Behavioral Research Methods 42*, 351–362. <https://doi.org/10.3758/BRM.42.1.351>
- Grundmann, F., Epstude, K., & Scheibe, S. (2021). Face masks reduce emotion-recognition accuracy and perceived closeness. *PLOS ONE, 16*(4), Article e0249792. <https://doi.org/10.1371/journal.pone.0249792>
- Marler, H., & Ditton, A. (2021). I'm smiling back at you: Exploring the impact of mask wearing on communication in healthcare. *International Journal of Language & Communication disorders, 56*(1), 205-214. <https://doi.org/10.1111/1460-6984.12578>
- McCrackin, S. D., Capozzi, F., Mayrand, F., & Ristic, J. (2023). Face masks impair basic emotion recognition: Group effects and individual variability. *Social Psychology, 54*(1–2), 4–15. <https://doi.org/10.1027/1864-9335/a000470>
- Noyes, E., Davis, J. P., Petrov, N., Gray, K. L. H., & Ritchie, K. L. (2021). The effect of face masks and sunglasses on identity and expression recognition with super-recognizers and typical observers. *Royal Society Open Science, 8*(2), Article 201169. <https://doi.org/10.1098/rsos.201169>
- Rabadan, V., Ricou, C., Latinus, M., Aguillon-Hernandez, N., & Wardak, C. (2022). Facial mask disturbs ocular exploration but not pupil reactivity. *Frontiers in Neuroscience, 16*, Article 1033243. <https://www.frontiersin.org/journals/neuroscience/articles/10.3389/fnins.2022.1033243/full>

Sociology

Appropriate Blackness: Feminism, CRT, Marxism & Boxing

*Olene Togiailua*¹

Project Mentor(s): Cynthia Pengilly²

¹ Department of Sociology, Central Washington University

² Department of English, Central Washington University

Abstract: Black people of the Progressive era were concerned with how to regulate their behavior to better their position in society. This research will examine the synthesis of gender performativity, critical race theory, Marxism, and psychoanalysis to create an assimilation identity strategy called “Appropriate Blackness” and how it is demonstrated through the sport of Boxing. The case study subject of all these different frameworks is the first Black Heavyweight champion of the world, Jack Johnson, who was the premier Black celebrity during the Progressive Era and thus an example for a specific gender strategy many working-class Black men adopted. His contribution to culture still exists today in how rappers portray themselves. The study's results found depictions of Johnson to be conflicting based on class and assimilation strategies; however, the prevailing ideological camps of assimilationist and confrontationalist both had the understanding that Johnson, as their racial representative, deserved better treatment, as do many Black people. The “Appropriate Blackness” framework can be applied to other Black celebrities and civilians in various fields to test its validity. The identity of Whiteness remains unexamined, and how it is related to the concept of “Appropriate Blackness”. The results further illustrate the social construction of race and masculinity within the purview of White acceptance. The implications of the results underscore the need for further scholarship on the dialectical relationship between Blackness and Whiteness, as these identities are fundamentally opposed to one another. There is also a need to correlate the results with the development of racial identity in the 21st century.

Keywords: Race, Performativity, Feminist Analysis, Class Conflict

Jack Johnson's impact on culture can be felt across all parts of civic life, from racist legislation passed about his actions outside of the ring, to generations of Black fighters having to contend with his behavior as their racial & masculine representative to White supremacy as an ideology. Jack Johnson's primary impact, first and foremost, was inside the boxing ring, the riches attained from boxing as a form of labor. For Johnson, who had no White manager curating or controlling his media image, boxing is one of the few avenues afforded to Black men to be their boss (Runstedtler, 2013; Ward, 2015). White media has thus deemed him and his actions as what I posit as "Inappropriately Black". This concept can be understood in the coercive legislation and scrutiny he received once he was crowned the heavyweight champion of the world. Implying that financial success is attained by Black people with the understanding of how appropriately or inappropriately Black their behavior is in the labour market, due to their proximity to Whiteness. This conceptual framework of a relational maleable Black identity, aimed at securing success, particularly in sports, can be applied more broadly to other Black athletes with differing circumstances. As posited by different theorists, Blackness cannot be understood without a constant juxtaposition to the identity of Whiteness; thus, the framework operates off the presumption that Blackness is curated by its racial counterpart.

The conceptual framework of Appropriate Blackness is supplemented by critical race theory, in that race is a social construction that is "real" because policies and laws are produced to reinforce it. Marxist theory is also embedded within the framework due to the conflicting social class elements that permeate boxing as a profession. Feminist theory, particularly performativity, remains an integral part of Appropriate Blackness due to the gender dynamics negotiated and interpreted between institutions and individuals. Psychoanalysis comes into play

as the definition of self is informed by others and is an ongoing discourse, especially when accounting for social scripts and racial identity.

Johnson's gender strategy defied White supremacy on multiple fronts, sexually, physically, psychologically, and culturally. The White body politic of the era dictated that Black men were supposed to be a subservient precariat class that was poor and not to challenge White men in the ring, as well as the sexual arena. His prominence as the premier Black celebrity across the globe was a threat to the social Darwinism and eugenics of the time (Moore, 2017; Painter, 2011). His impact was not limited to the United States, but globally, as footage of Johnson knocking out his White opponents was banned in places as far as India and South Africa (Runstedtler, 2013). Johnson was so subversive that the progenitor of the Federal Bureau of Investigation had informants infiltrate his entourage and surveil his movements abroad, as he found himself rubbing shoulders with socialist adjacent thinkers and political parties (Ward, 2015). Economic freedom, sporting success, blatant disregard for White supremacist racial/gender scripts, and critiques of racism are what set Johnson as a subversive figure.

Jack Johnson came onto the boxing scene during a period when many Black fighters were making waves across the sport. Particularly non-American-born Black fighters such as Peter Jackson, George Godfrey, Joe Walcott, and the most successful boxer of the late 1890s, George Dixon. These fighters themselves paved the way for the integration of Black fighters to be taken seriously in the sport of boxing. For Johnson and other Black fighters, boxing was one of the few professions that allowed Black men to hold direct control over their earnings and their image in the media. Boxing as a job was revolutionary for many Black Americans, in particular, because many were one generation removed from slavery (Moore, 2017). George Dixon was the first Black person across the globe to hold a boxing championship, and his success would be a first

for any Black person to have won any type of accolade or recognition (Winders, 2021, p. 4). Jack Johnson's impact was not unprecedented; instead, his trajectory was a natural consequence of the material gains that other working-class Black fighters had fought for, both figuratively and literally (Moore, 2017; Runstedtler, 2013).

Compared to his contemporaries, Johnson's rise can be seen as exceptional because he was a heavyweight boxer. Boxing during this time period was seen as a vehicle not only to prove one's manliness and toughness but also as a way for many White men to affirm their race, in a social Darwinistic way (Moore, 2017; Ward, 2015). Boxing, being so masculine-coded, appealed to the American notion of meritocracy, where, despite the barriers, there is a need to fight for resources for one's survival. Before the sport of baseball became popular, boxing was the number one sport for many Americans to consume. Off of those assumptions, the Heavyweight title carried a lot more prestige, and in Johnson's case, notoriety, with it when compared to the lower weight classes. It was thought that because the men competing in the weight class were larger, the stakes of the fight would be more amplified. Taking into account that mixed-race bouts were more profitable, in addition to the larger boxers in heavyweight bouts, you have the recipe for success that Johnson had (Cleaver, 1968, pp. 111-112; Moore, 2017). His forebearers in Black boxing often struggled to maintain their independence due to many White managers taking advantage of the networking and promotional skills that early Black Boxers lacked access to. Jack Johnson took advantage of the interviews with journalists and self-promotion that other fighters like George Godfrey and Joe Gans had done first (Moore, 2017; Winders, 2021).

Boxing Theory and Application

Inside the ring, Johnson had a lot of success pugilistically tying up his fighting opponent's arms from a clinching position and punching off it. Being six feet tall and weighing 210 pounds

in his prime, with a 74-inch reach, also contributed to the success of his tactics in the ring, often being the bigger man against most of his opponents. His stance was similar to that of sprinters, with the left foot in front of the right, presenting more of his chest and face towards his opponent. His back foot oscillates between a flexed position with the right heel off the ground, serving as a springboard into a powerful rear-hand uppercut or cross, or a flat foot to maneuver laterally. This was a classic feature of the previous bare-knuckle boxing era, having one's feet ready to dart in and out on straight lines.

Another relic of the bare-knuckle era was the need to mill at your opponent. The gloves of Johnson's day were shaped like mittens with a thumb free from the rest of the hand. The significance of the shape regarding milling is that wrestling was still a very big part of boxing, and the free thumb allowed for frequent instances of clinching. This means a boxer had to keep his hands out, rotating them in a circular motion to account for any offensive strikes as well as defensive wrestling tactics, which is the definition of milling. Johnson was very savvy with this tactic, blending his offense and defense off the smokescreen of milling.

Johnson's palms would be out towards his opponent, waiting to catch hold of his opponent's punches in the hopes of pulling them into a grip, usually at the biceps or triceps. From there, Johnson would try to outwrestle his opponent, wearing them down by carrying his weight and keeping them off balance with his pushing tactics. Johnson's hands would prevent punches by stiffening and pushing his palms against the inside of his opponent's elbows, stopping the punch at its origin (Slack, 2015). Once flustered or fatigued by the tactics above, he lands flurries of uppercuts/hooks from the previous bicep or tricep holds, catching many opponents off guard, expecting a lull in the fight. When Johnson did not clinch, he would take extraordinary

precautions to stay on the outside range, punching off his splayed hands towards his opponent, eventually looking to dominate opponents in the inside range.

This would also have Johnson smothering punches and catching them mid-air. Occasionally, he would dart forward with a skewering lead jab, but all in service for the clinch and prevention of his opponents from throwing punches at him. His right hand would reach out to neutralize his opponent's left jab, limiting the number of attacks and sequences that could be pursued against Johnson. For his part his left hand would serve with dual functions, poking and prodding at the guard of his opponent and striking when there were openings.

Part of the psychology of Johnson's *modus operandi* in fighting was a response to the limitations of being a Black fighter during that era of boxing. Many Black fighters like Johnson would be expected by boxing promoters, managers, and fans to throw fights or hold back against White opponents so as not to disrupt the social order of white supremacy at the time period (Moore, 2017; Runstedtler, 2013; Ward, 2015). A contemporary of Johnson, Joe Gans was known for his defensive boxing abilities rather than his knockout abilities, for this very reason. A young Johnson would develop into a defensively minded fighter as a natural result of the barriers he faced.

However, where he succeeded compared to his contemporaries was in subverting the narrative of the Black boxer in the ring. He could not have changed the handicap of not knocking out his opponent; he would respond by prolonging the fight so that many of his opponents would have to go the usual 20 rounds contracted. Especially against white opponents, he would beat them with the expressed objective not only to give a good show but also to humiliate them. His need to resist White supremacist narratives of the weaker, less intelligent fighter was what made Johnson so polarizing. For example, during his title fight against Tommy Burns, "Johnson took

another big gulp of water—and sprayed it over the reporters nearest his corner. They ducked. Johnson laughed. ‘Come right on!’ he shouted at the bell, and as Burns rushed toward him, Johnson moved his head just enough to allow Burns’ right hand to whistle past, then landed another uppercut on the champion’s chin (Ward, 2015, p. 123).

Johnson’s actions in the ring can not only be considered subversive but also defiant and resistant to the prescriptions of how Black men were to conduct themselves against White supremacy. This “resistance capital” was considered unheard of at the time, when many Black people across the nation were being lynched without any aspirations of Black excellence as a narrative (Ward, 2015; Yosso, 2005). A dangerous precedent to set when the very nature of your society is built on the subjugation of Black people.

Smiling and jeering his opponent mid-fight was not unheard of, but was taken with a lot of offense towards the majority of White audiences. Having broken the color barrier to the heavyweight title, Johnson was interpreted as the catalyst for controversy with his need to subvert expectations placed upon Black fighters, by imposing his will on his White opponents with the clinch and punching freely off it. His actions displayed a lack of seriousness and disregard for good white fighters, such as Jim Jeffries, Tommy Burns, and Al Kaufman (Runstedtler, 2013; Ward, 2015). This pugilistic success of securing the clinch and punching off it would lead to changes in the rules of boxing as time went on, with referees being more strict about wrestling after Johnson’s title reign. This is evident in the younger fighters following Johnson’s reign, particularly with the popularity of Jack Dempsey’s all-action-oriented, pressure-based offensive style, characterized by head bobbing. Additionally, newer racial stereotypes, such as the “Black Brute,” were created because of Johnson’s ring success (Runstedtler, 2013; Ward, 2015).

The Social Constructions of Race & Gender During the Progressive Era

The importance of Jack Johnson's iconography and his cultural significance needs to be prefaced with two relational concepts. The social construction of race and the social construction of gender. Social constructions can be described as the idea that materials are made *real* with the agreement of numerous parties engaging in such construction (Berger & Luckmann, 1966; Searle, 1995). The social construction of race during the Progressive era was that Black people, specifically men, were of the precariat class and thus needed to be behaviorally subservient because their economic status was dependent on their relation to White supremacy. There were versions of Black masculinity that were reinforced or encouraged, such as being docile, showing deference towards White authority figures, impotence, servility, timidity, and silent reluctance (Moore, 2017; Runstedtler, 2013). Ideas of race and ethnicity have evolved, with characteristics becoming salient and contextual to specific times and places (Obach, 1999; Painter, 2011; Smaje, 1997). In my research, I posit that the concept of Appropriate Blackness has evolved, as evident in the contrasting treatment of Jack Johnson and Joe Louis in their news coverage.

Boxing as a construct functionally operates as a gendered institution, having rules that emphasize the dominance of one man over the other. In other words, it affirms the gender of the participants, which, by consequence, touts androcentrism (Moore, 2017; Wade & Ferree, 2021). Hegemonic masculinity, as a construct, can be best described by Sociologist Allan G. Johnson with characteristics such as "Control, strength, competitiveness, toughness, coolness under pressure, logic, forcefulness, decisiveness, rationality, autonomy, self-sufficiency, and control over any emotion that interferes with other core values" (A. G. Johnson, 1997, p. 7).

The importance of boxing lies in the material conditions of the world during the late 1800s, when industrialization altered the concept of men's relationship to the expression of their

gender. Often, work was physically intensive on farmlands or in industrial factories. The prevalence of these jobs declined with the globalization of world trade. This alienation from one's physical prowess in the fields or factories caused many White men to gravitate to boxing as a newer outlet to express their masculinity (Runstedtler, 2013; Ward, 2015). The Victorian ideals of the past, when combined with global trade, led to men defining themselves as "breadwinners" for their families. This gender expression was rendered obsolete by the Progressive Era (Moore, 2017).

Boxing had been around for centuries, but the sport's newfound popularity stemmed from the masculinist trend to revive a socially constructed tradition of hunter-gatherer societies and embody one's values through physicality. Theodore Roosevelt was famously a proponent of muscular Christianity, often espousing that boxing was the way to get in touch with masculinity and thus God (Runstedtler, 2013; Ward, 2015). To combat the idea that men were disempowered via their working conditions, they needed to reestablish their hegemony so as not to be likened to women (Cohen & Brodie, 2007). This loss of status can be understood with the idea of "doing gender", or in other words, understanding that there is a performance aspect geared towards how one presents themselves, and in this case, how men gravitated towards boxing as a way to reestablish their sense of control over their lives (West & Zimmerman, 1987).

Post-researcher Travis Satterlund put the perspective of boxing and gender performativity thus:

Men whose work experience induces feelings of powerlessness are often trapped in patriarchal notions of what being a man is about. Patriarchal culture teaches men to expect work to provide wealth, status, and power. In fact, a capitalist class structure guarantees that few men will be able to derive much wealth, status, and power from their

work. Yet the desire to signify manhood remains strong, and is perhaps even exacerbated by economic powerlessness. (Satterlund, 2007, p. 151)

The sport of boxing was also an economic avenue that many working-class men gravitated to. The success of John L. Sullivan is a prime example of a rags-to-riches story with mass appeal, as Sullivan was the son of Irish immigrants and the first gloved heavyweight champion (Sampson, 2003; Ward, 2015). Even within the realm of masculine performativity, from breadwinner to boxer, there were more subcategories that different men subscribed to, which led to the cultural impact of Jack Johnson.

Working Class Black Masculinity and “Appropriate Blackness”

Jack Johnson was the most famous Black man globally during his heyday. His victories carried weight for Black and Brown communities everywhere, as evidenced by the numerous riots and bannings of his fight films of his triumphs over White fighters (Runstedtler, 2013; Ward, 2015). Even before his rise to fame, there was considerable debate within the Black community about the best practices for assimilating into the United States. One ideological camp I found can be dubbed the ‘accommodations’, which espoused skilled industrial labor, nonconfrontation against White supremacy, emphasis on “working hard” to cultivate Black acceptance, and temperance in all aspects of life. The most prominent proponent of this racial uplift strategy was Booker T. Washington. Another opposed assimilationist strategy I have dubbed the “confrontationist” perspective, which focuses on demanding rights immediately, the explicit pursuit of education and academics for betterment, outwardly critical of the inequities of Jim Crow U.S./White supremacy, and emphasis on intellectualism to garner Black acceptance. The ideological figurehead was sociologist Dr. W.E.B. DuBois.

These advocates and their ideas are important to note with regard to Johnson because they both had a vested interest in how Johnson's actions affected the Black community at large, especially in the United States (Runstedtler, 2013; Ward, 2015). There was a constant discourse about how one is supposed to conduct oneself in the face of White supremacy. How are certain behaviors incentivized or chastised for making the entire race look bad? That is the definition of Appropriate Blackness, a Black person's palatability towards a majority white audience. There was also a financial incentive for both men to invest in Johnson's celebrity and the concept of Appropriate Blackness, as Washington financially backed a significant number of Negro newspapers, either fully or partially, and DuBois served as editor of his magazine, *The Crisis*, and wrote freelance for other publications (Campbell, 1981; Gilmore, 1975; Ward, 2015). Their perspectives were often disseminated in publications that were bought primarily by the Black middle-class population of the United States. This meant that the working-class assimilation strategy was not always communicated directly. Working-class prescriptions of how to be a Black man were often chastised by more conservative accommodationist papers, often blaming ills of one's behavior on either working-class culture or the individual morals of specific individuals (Moore, 2017, p. 34).

Sporting Man Gender Strategy and Jack Johnson

Where working-class Black men lacked access to publications that communicated how they chose to assimilate into American white culture, they made up for it in pop cultural appeal and through media coverage. Jack Johnson was the most prominent example of what he and other working-class black men termed "Sports/Sporting men". This gender strategy emphasized physicality, a blasé attitude, free-wheeling with money, financial independence, and embodied affluence via jewelry, fine clothes, and fast cars (Moore, 2017). Johnson was known for being a

dandy to the extent that many white media personnel took his sense of style and affluence as a personal insult. Historian Geoffrey Ward describes how one White publication characterizes this offense at Johnson's appearance, "Johnson continues to dress up in his dandy togs...He looks like a Rah! Rah! Kid from some Ethiopian College with his fancy duds and loud hosiery" (Ward, 2015, p. 281). This gender strategy countered narratives thrust upon Black men as being poor sharecroppers or country bumpkins who could not afford the nicer things in life. This can be viewed as a defense mechanism, displaying symbolic power over a Black man's life, when there were few other avenues to demonstrate a sense of cool or control (R. Majors & Billson, 1993, p. 27; Runstedtler, 2013, p. 149).

This act of resistance via racial/gender expression was not always seen as subversive to patriarchy, only inconvenient for certain strains of White supremacy. Sporting Men were known to be bachelors who often sought the companionship of beautiful women and gambled at will. Still propping up the narrative of chasing women as a heterosexual conquest (Moore, 2017, pp. 5-7). White boxers who participated in this practice of being Sporting Men were not classed as such by White media; it was considered acceptable behavior when White former heavyweight champs Jim Corbett and John L. Sullivan participated in drinking, womanizing, flashy clothing, and gambling. They had greater control of their media depictions, and that side of them would not be shown in the papers (Ward, 2015, pp. 58, 139). The problem was never with the acts themselves, but rather the contention was that Johnson did these acts with White women openly and did not have any remorse about it. He was defying the racial conventions of the period. Johnson threatened the "physical health of white men and white women's purity" with his success in the ring and outside of it (Runstedtler, 2013, p. 37).

This understanding of gender and race speaks to how subjugated women were towards the ideals of White men, assuming that there could be a non-consensual relationship between a Black man and a White woman, on top of the implication that White women belonged solely to White men. On top of that, Johnson's example of toppling White fighters in the ring can break the narrative of White superiority, which many imperialist colonial nations structured their society around (Runstedtler, 2013, p. 128). If previously servile populations had the chance to perceive the inherent contradictions of such an ideology, not only would said population cease to function in its current form, but Whiteness as an ideology would cause the benefactors to contend with the fact that White supremacy has dehumanized them in the process of upholding racist superstructures. Critical White Studies scholar Zachary Casey describes this phenomenon as "Brokenness". A socio-emotional state in which White people contend with "their inability to live up to their full human potential" (Casey, 2021, p. 80). Whiteness as an identity strips one of their previous cultural heritage, Irish immigrants becoming White, for example, and what is left to contend with is the idea that there is nothing else to one's being other than the rejection of other races. I think that would be the harder thing for many to deal with during the Progressive Era, not the supposed revenge from minorities that some White folks in power feared mongered over (Runstedtler, 2013).

Special vitriol was reserved for Johnson when compared to predecessor, Black champions. Joe Gans was the first African American to win the lightweight title in 1902. The way he presented himself was very similar to Johnson's. The only difference was that White audiences received Gans more favorably. History Professor Louis Moore documents this difference in opinion stemming from Gans' portrayal as a responsible patriarch to his family, which counters racial depictions (Moore, 2017, p. 52). Gans also benefited from having a White

manager curate his media image. Johnson, for his part, did try to appeal to moderation and disavow gambling. Still, he was heavily scrutinized for having a White wife and soliciting the services of White prostitutes (Moore, 2017, p. 54; Ward, 2015, pp. 302, 311). Gans was known to be a devout family man who doted on his wife and mother whenever he had the opportunity. It also helped his image to have married a black schoolteacher, further appealing to the mostly white middle-class audience (Aycock, 2014, pp. 187, 219; Montrose Daily Press, 1910).

To many White audiences, Gans was Appropriately Black, emphasizing the need to work hard and communicating the need for self-determination. All of this behavior is without the tone of direct systemic criticism of White supremacy. Booker T. Washington himself was a big fan of Gans and his version of Appropriate Blackness. Moore quotes Washington talking about the significance of Gans' title win:

If he had only moaned about his downtrodden race, and gone around with the same old whine, the same old backache, the same old tale of woe and hard luck, would he have won or would he have been supported? One exhibition of accomplishment will do the race more good than all the indignation meetings you can hold from now to doomsday. (Moore, 2017, p. 42)

Gans himself appealed to White people's sense of fairness and the meritocratic values within American culture. When interracial bouts were banned in his hometown of Baltimore, he appealed to the White mayor, saying:

I am a taxpayer here; and am, and have always been, a law-abiding citizen. I regard my means of gaining a livelihood as legitimate and honorable as any man's... In regard to the Mayor's compromise to allow contests between white men and colored champions only...I take it to mean he will permit white men following the color line to meet me

until my laurels are snatched from me, and then I will be given no chance to regain them. I ask, is that sportsmanlike? Is it fair play [?] . . .What opportunity does that give to poor colored lads who, like me, are trying to climb the pugilistic ladder? (Moore, 2017, pp. 144-145)

By stark contrast, Johnson was very critical of the color line and how White fighters used it to avoid Black fighters. In his 1911 musings to a French magazine, he notes his plight of not getting a title shot similar to other Black fighters:

Several years ago, some very good feather weights brought up his hatred of the black man so as to avoid having to fight marvelous little George Dixon... Tommy Ryan's thoughts about the color question were without a doubt provoked by Joe Walcott and everyone in sporting circles knows it... even poor old John L Sullivan... dressed himself up in that prejudice called the color line ...Peter Jackson was at the top of his form at that point... I will bet dollars to Donuts that Jimmy Britt's performance for the imaginary color line was inspired by Joe Gans. (J. Johnson & Rivers, 2009)

By contrast, Johnson was more willing to be polemical compared to Gans, which is reflected in the disproportionate negative news coverage of Johnson. Johnson criticized the idea of White families telling their family stories as if they were true and tried to rehabilitate the resistance capital that his handicapped father possessed despite being of diminutive size (J. Johnson & Rivers, 2009, p. 2; Runstedtler, 2013, p. 146). Johnson's first memoir functioned as an alternative to White narratives and their structure. Drawing upon the resilience and communal capital of his upbringing in Galveston, he helped his father search for work and participated in the street gambling culture. Narratives of the Black working class were rarely, if ever, given credence by

the White media beforehand. These publications about his life resonated with Black readers worldwide (Runstedtler, 2013, pp. 148-149).

Another episode of Johnson's polemics can be seen in his adversarial relationship with Booker T. Washington. With Washington, Johnson mocked his manliness and legitimacy by alluding to a story of when Washington was allegedly caught peaking into the room of a White woman by saying, "I never got caught in the wrong flat. I never got beat up because I looked in the wrong keyhole" (Ward, 2015, p. 308). The feeling was mutual for Washington; he often described Johnson as fiscally irresponsible, saying "and Johnson, fortunate or rather unfortunate, it seems, in the possession of money, is doing a grave injustice to his race" (Ward, 2015, p. 307).

This exchange can be understood as a section of the Black middle class, represented by Washington, that had conflicting ideas with the Black working class, particularly in the form of the Sporting Man's gender strategy, as exemplified by Johnson. The body politic of each man was considerably different. Appropriate Blackness manifested itself differently from each man's respective generation and class stature. Patriarchy as a system has a way of nurturing the symbolic power of marginalized versions of masculinity, in this case, the Sporting Man type of gender expression (Wade & Ferree, 2021). Whereas Washington and, through proxy, Gans, appealed to respectability, Johnson's approach is seen as more brash and grounded in the newer understanding of Black working-class masculinity with the use of idioms, satirical and irreverent tone, and witty remarks at the expense of unjust authority.

DuBois' take on the matter of Johnson was in the spirit of solidarity, not an advocate for professional sports (Moore, 2017); he nonetheless weighed in on the hypocrisy with which Jack Johnson received negativity from the White mainstream media for winning the heavyweight title saying:

Boxing has fallen into disfavor—into very great disfavor ... The cause is clear: Jack Johnson ... has out-sparred an Irishman. He did it with little brutality, the utmost fairness and great good nature. He did not “knock” his opponent senseless. Apparently he did not even try. Neither he nor his race invented prize fighting or particularly liked it. Why then this thrill of national disgust? Because Johnson is black. Of course, some pretend to object to Mr. Johnson’s character. But we have yet to hear, in the case of White America, that marital troubles have disqualified prize fighters or ball players or even statesmen. It comes down, then, after all to this unforgivable blackness. (Ward, 2015)

The “unforgivable blackness” Du Bois posits is what I would term Appropriate Blackness; other versions of Black male masculinity are seen as less threatening to the status quo. Johnson’s version is seen as unforgivable. Other Negro publications espoused similar sentiments when faced with the White middle-class reception of Johnson as the Heavyweight champion of the world. A contribution from the *Chicago Defender* in support of Johnson’s exile from the United States to escape the Mann Act conviction of White slavery, saying “Jack Johnson is Crucified for His Race” (Gilmore, 1975, p. 128). Dr. M.A. Majors, a physician and civil rights activist, wrote about the state of White media reception in the *Defender* by saying:

At first it would never do to exhibit the moving pictures, letting white children see as conqueror in the fistic science a big black samson. That would make the white children grow up with a certain fear or dread of the colored boy. it is the negro boy that would have to fear the white boy. Jack did for his race what great nature did for him reverse the lever of what the white man considered right. Next they must discredit him since they failed to kill him at Reno. Jack Johnson has done no different from any Big Rich sport, and he hasn't disgraced sport in any particular, unless it reproached him for marrying a

pretty white woman who looks like any Banker's wife robbed in diamonds and dressed in the Parisian styles. of course, no very sensible negro can envy him for suiting himself.

(M. A. Majors, 1913)

On the reception to race relations and social/racial behavioral Scripts Majors philosophizes:

It is no harm for the country to be flooded with mulattos - children without legal fathers ranging over a period of three centuries - but it is a crime against nature for a negro to marry a white woman by her own consent. (M. A. Majors, 1913)

Majors would go on to critique the double standards placed on Johnson by referring to White men being with Colored women and how the Sporting lifestyle was not unique to Johnson.

Additionally, he described how the gambling and the perceived ostentatiousness of Johnson's spending habits are part and parcel of being a celebrity. He reinforces the idea by saying:

It is all very easy to imagine, and jump at conclusions and find fault. The only crime Jack Johnson has committed in is doing little things like big men. he is invited the Envy of his own race and pricked the ever-going abscesses of American Prejudice by spending his money like he had a plenty, and mixing somewhat with a big white sports, many of whom are sober, sensible, and possess but very little prejudice against a man for being what God made him. (M. A. Majors, 1913)

What can be gathered from this is that for many, Jack Johnson was a hero within the Black and Brown communities. The sensationalism with which the White media covered Johnson can thus be understood within the context of gender performativity and racial behavioral social scripts. Considering all of the above, what remains to be pondered is the descriptions of what a White identity is supposed to mean. As mentioned numerous times, Black male identity stems from having to define itself from the White mainstream, often middle-class, coded society. Black

identity, then, should be understood as relational and codependent on the social construction of race. To further illustrate this point writer and civil rights activist James Baldwin wrote on this same phenomenon saying “What white people have to do is try and find out in their own hearts why it is necessary to have a 'nigger' in the first place, because I'm not a nigger. I'm a man. But if you think I'm a nigger, it means you need it” (Baldwin, 2018).

Appropriate Blackness & White Identity

It is essential to consider the structure of society, specifically the United States of the past and its current structure. White Supremacy has been pervasive since the inception of the United States. Here, other studies of Jack Johnson have not yet fully highlighted the nature of White Identity and why Johnson’s actions are treated as exceptional. The United States is coded with White identity as the default. On this state of defaultness, University of Wisconsin-Whitewater professor Jenna Cushing-Leubner describes the pervasiveness of the White identity as follows; “The project of maintaining whiteness- as capital and as nationhood - is collectively imagined, materially asserted and maintained, and necessary for the survival of the state in its current form. these discursive performances of whiteness are numerous and evolve to fit the needs of the particular pressures of the socio-political moment. Aspects of two overarching performance discourses are outlined here: emotionality and social positioning” (Cushing-Leubner, 2020).

James Baldwin also held a similar opinion positing, “History is not the past. It is the present. We carry our history with us. We are our history. If we pretend otherwise, we are literally criminals. I attest to this: the world is not white; it never was white, cannot be white. White is a metaphor for power, and that is simply a way of describing Chase Manhattan Bank” (Baldwin, 2018). Similarly, race scholar Professor Timothy J. Lensmire highlights the

importance of the social construction of White identity through the writings of novelist Ralph Ellison.

Lensmire synthesizes Ellison's theory thus:

For Ellison, racist stereotypes should also be recognized as a particular example or instance of a broader category of scapegoating rituals in which white people participated, as part of creating and maintaining their sense of themselves as white...Another example of scapegoating that Ellison analyzed was lynching, in which white people – in contrast to the symbolic killing performed by racist representation – literally killed black people in a 'primitive blood rite of human sacrifice'...For Ellison, scapegoating rituals had three parts or moments. In the first, the scapegoat was thought of as part of or as a stand-in for the group. Then, in the second moment, the scapegoat was separated or pushed out from the group, was declared an Other. Finally, in the third moment, the group experienced a renewed and strengthened sense of its own identity. (Lensmire, 2020)

Concerning Johnson, it was not only a moral imperative for White authority figures to undermine and sabotage his cultural impact, but also an integral part of state interference aimed at impeding this impact. For example, the United Society of Christian Endeavor, a fraternal group modeled on the betterment of humanity through the teachings of Christ, was made up of four million members nationwide, sent out a telegram to governors in all the states talking about the racial and moral harm displaying the Johnson vs Jefferies fight would cause chaos. This amount of pressure would cause the fight footage to be suppressed. Other similar religious organizations also condemned Johnson's victory. Famously, Theodore Roosevelt told friends how excited he was to see the fight, now calling for the banning of the footage (Ward, 2015).

Other examples of state interference include the numerous paid informers in his entourage who provided information on his movements abroad, as well as his close monitoring during his sojourn in Mexico, when he spoke to individuals with socialist sympathies (Runstedtler, 2013; Ward, 2015). The state in question is therefore built off of the body politic of White identity in the oppression of Johnson, and in turn, Black people. Especially since he was the premier Black celebrity at the time, being understood as a literal and cultural icon for many different social constructions, such as race, masculinity, and working-class social scripts.

The curtailment of the cultural capital of Black people cannot be understood without the psychoanalysis of White identity. On this note, Professor Cushing-Leubner describes a phenomenon that contributes to the interpolation of Johnson's and other Black people's actions. One phenomenon is called "emotionality." She describes emotionality as:

Whiteness is sometimes construed as emotionally rational, by bifurcated from the raw emotions that it claims reveals the Lesser intellectual control of racialized others.

However, whiteness is also deeply shaped by an emotional range that has been weaponized to defend and protect the social positioning of being white, woven into the material benefits and safeties that whiteness provides. when whiteness is performed, this range of emotionality includes fragility, vulnerability, brokenness, and endangerment; guilt and shame; entitlement and privilege; desire; an ambivalence. (Cushin-Luebner, 2020, p. 142)

Cushing-Leubner further describes how those psychoanalytic preconditions make it a lot easier to justify and enact the subjugation of other groups. Meaning that there is an inherent need to malign and punish those who do not conform to the tenets of Whiteness and White Supremacy.

This can be seen in the case of Jack Johnson during his title reign, especially with the interpolation of every act he did being received negatively.

Whilst Johnson was pugilistically sound enough to retain the heavyweight title, there was another social construction that was created to compensate for the loss in the social capital of White male identity and White Supremacy. In 1913, the “World White Heavyweight Championship” was created and thrust upon a young heavyweight hopeful named Luther McCarty. At age 21 many touted this fighter to defeat Jack Johnson and return to the status quo. The excitement with which McCarty’s potential was received can be felt in a brief quote; “In time the White title will be considered the real thing” (Baker, 2020, p. 95).

Additionally, tournaments were held with the hope of dethroning Johnson for the White race. Such tournaments were met with amusement by Johnson himself; however, for others, it was of the utmost importance to see a triumphant White heavyweight topple Johnson. Touted as “White Hopes,” any White Heavyweight who was relatively successful from 1910 to 1915 would be met with the highest praise. Often, many White media outlets would be fickle with the milieu of contenders, seemingly complementary in one moment and dismissive in the next when said contender lost (Lardner, 1951, p. 55; Ward, 2015).

The positionality of the White body politic has created the need to not only compensate for the loss of prestige in the regular title but also culturally gives ground to the idea that the original Heavyweight title, that Johnson won fairly by following the rules of a boxing match, is not worth recognition once a Black man holds it. Meaning that the value in the title only has significance when it is used as a status symbol at the expense of other races. The fragility of such an ideology being threatened by one man can be fully understood to be deviant in a White Supremacist society, on top of not appealing to the middle-class values that many lent credence

to. Johnson was perceived as being Black inappropriately in his era and may still be viewed as such in the modern one.

There was a Black heavyweight champion of the world, but only because the original heavyweight title was not allowed to be contested in an interracial contest before Johnson's win on July 4th, 1908 (Baker, 2020). This social construction of the heavyweight title is a form of resistant capital and potential wealth (Yosso, 2005). The need to prove who is the best amongst Black men and the need to create their own prestige was only possible because of discrimination by the White population. The social construction of the White heavyweight title can be seen as reactionary and indicative of Whiteness as an identity. Instead of adhering to meritocratic values, before Johnson's title win, the need to reject the original symbol, the original heavyweight, was easier to ignore than to confront the fact that a minority held the highest prestige. The fragility being communicated here is that it is culturally easier for White people to reject, ignore, or discredit the achievements of Black people within the context of White supremacy.

On that fragility, it is understood that White Supremacy affects White people in the sense that, because they are the cultural default there is the expectation to be or perform that role of perfection. When one is taught that the world is made for them and that they can do whatever it is they set their mind to, and said individual cannot live up to that societal pressure, that is where White Supremacy afflicts those whom it is supposed to benefit (Casey, 2021; Cushing-Leubner, 2020; Wise, 2011). In the case of Johnson holding the title and the stable of White Hope fighters, many of them were left distraught, disheartened, and disengaged from boxing, ultimately struggling or destitute due to the poor performance of their careers after losing to Johnson or other fighters on their path to the title (Baker, 2020; Lardner, 1951; Ward, 2015). Creating a self-fulfilling prophecy of discord between groups of people, often trying to create and justify the

symbolic interactions and social constructions of White Supremacy, classism, machismo, and gender inequality.

Appropriate Blackness in a Post-Johnson Era

Many within the Black community saw Johnson's loss as an occasion of mourning. The high point of his celebrity immediately waned when he was defeated in Havana, Cuba, on April 5th, 1915. Numerous Negro publications, usually a bastion of Black middle-class values similar to Washington's respectability politics, either chose to omit opinion of Johnson's loss or lament about the bravery he showed against his six foot-six opponent. For example, Negro publications said of Johnson; "The following hero who is piteously persecuted and scorned by the white race simply because he is black" (Gilmore, 1975, p. 139). One publication was antagonistic about the disproportionate attention paid to Johnson's cultural reception; of White people "Who were quite willing that the Negro should be hewer of wood and drawer of water..." not as "a hewer of solar plexus and the drawer of blood from the nose of a white man" (Gilmore, 1975, p. 140).

Gilmore highlights civil rights activist James Weldon Johnson in his article on Johnson's significance, saying:

Johnson fought a great fight. He showed no sign of the yellow streak, and it must be remembered, too, of one lone black man against the world... The white race, in spite of its vaunted civilization, pays more respect to the argument of force than any other race in the world. As soon as Japan showed that it can show that it could fight, it immediately came to respect and admiration of the white race. Which Jack Johnson compelled some of the same sort of respect and admiration in an individual way. (Gilmore, 1975; J. W. Johnson, 1915)

James Weldon Johnson being a personal friend of the former champion, probably had the most sympathetic portrayal of Johnson than contemporary Negro publications. Booker T. Washington himself was a significant contributor to the paper that J.W. Johnson wrote for. The accommodationist bent to Appropriate Blackness was heavily disseminated through its earlier coverage of Jack Johnson (Gilmore, 1975, p. 52).

J.W. Johnson's offering an olive branch toward Johnson's cultural significance was a broad acknowledgment by that section of the Black middle class, the more conservative side, that Johnson's loss meant a lot to the Black community. Despite his perceived transgressions from that section of the Black community, Johnson's public image did not exactly fade into obscurity (Ward, 2015). After his sojourn in Europe, he returned to the U.S., eventually trying to reform his image, which was akin to the prescriptions of the accommodationist perspective. He would continue his career into his late 60s, boxing on exhibitions and cards of lower prestige (J. Johnson, 2007; Ward, 2015).

Johnson's 1927 memoir, *In The Ring and Out*, communicates the Accommodationist perspective by attempting to contextualize his marriages through appeals to middle-class values of cleanliness and traditional masculine norms, portraying his relationships as those of a doting and responsible husband (J. Johnson, 2007, p. 164). This was during a period in his life when he was trying to rehabilitate his image. The illustrious fights and big purses were gone, and he was constantly trying to clear his name and make one last push at the heavyweight title (Ward, 2015). He contextualizes his win over Burns for the heavyweight title: "I was supremely glad I had to change the championship but I kept this feeling to myself. I did not gloat over the fact that a white man had fallen" (J. Johnson, 2007). In this way, Johnson is trying to diminish his perceived arrogance by the White media and the Black middle class. In his younger years, he was largely

unconcerned with the reception he received for his antics in the ring and his comments about his opponents (Ward, 2015).

This revisionist memoir serves as a hybrid of his gender strategy and the Accommodationist and Confrontationalist perspectives. Throughout the memoir, he continues to emphasize his physical prowess and witty remarks. However, he minimizes his extravagant lifestyle and free-wheeling spending, on top of being critical of those who were racially prejudiced against him (J. Johnson, 2007; Runstedtler, 2013; Ward, 2015). In my research on the project, I found that Johnson's gender strategy persisted until the 1930s. The Great Depression had occurred, and money was very short for Americans, especially Black Americans. The expensive suits, sports cars, and prime real estate were all things many Americans could not relate to in Johnson's public portrayal. His success as a boxer was diminished. His lifestyle was also challenging to maintain, especially with the vaudeville shows he was relegated to in his later years (Ward, 2015).

The carefully curated young Black heavyweight contender Joe Louis came into prominence in stark contrast to Johnson (Hietala, 2002). Louis was built up to be the opposite of Johnson, considered humble, courageous, and the new image of Appropriate Blackness. Johnson did, in fact, try to mentor and exclusively manage the future second Black heavyweight champion; however, he was thoroughly turned down by Louis and his team (Ward, 2015). By the 1930s and the 1940s was seen as a pariah in the Black community. He would publicly chastise Louis' boxing form and often picked against Louis in many heavyweight bouts, a few times training opponents of Louis (Ward, 2015, pp. 437, 445). Johnson once even fought Black Louis fans during Louis' first loss. Johnson bet heavily on Louis' opponent and was too cheerful for the fans, waving his earnings from the bet in their faces and getting into a brawl with them. The

police were called to save Johnson. This turn on Johnson was felt by the Negro press as well; “Once the hero of his race, he is now the most despised man in it.” Another publication put it:

Jack Johnson felt the full brunt of his own people’s disapproval of him. Johnson attempted to make a speech, but such a salvo of boos greeted him, he stood in embarrassment for five minutes, while the crowd refused to give him a chance to talk. (Ward, 2015, p. 441)

Ideologically, many blamed Johnson himself for the hard times cast upon the Black population. Especially when alluding to Louis’ success:

Dear readers, I must take time out to laugh out loud at old man Jack Johnson (He’s the guy whose conduct as the world’s heavyweight champion, made it so hard for colored fighters to get another chance at the title). Yeah, we should laugh at him because he hated to see our Joe Louis show him up as a fighter, as well as a gentleman. (Roberts, 1937)

Johnson’s parents were slaves which attributed a lot to his marginalization to begin with. This was a symptom of U.S. policy directly impacting the socio-economic position that he and others had to begin from. Without the understanding that Black marginalization was codified into law and in the U.S. constitution, there can be no coherent sense of understanding racism (Bell, 1973; Bush, 1997). With that understanding, it makes more sense to understand that some of the earliest psychological and material formation of American White Identity was built off the distinction of being free and not enslaved. Especially with the importation of Africans into the colonies, the identity of Blackness was synonymous with being in bondage. The ever-elusive freedom, attained by hard work and meritocracy, was dangled in front of the slaves as a way to attain freedom, i.e. Whiteness (Painter, 2011).

This solidified meritocracy as a virtue for further generations of Americans, both free and enslaved. Thus, creating the framework to individualize marginalization, making it a lot easier for many to attribute problems to the fault of the person rather than the system that they were born into and inherited. Further development of racial formation in the progressive era has suggested subservience to White hegemony. Which includes psychological values on top of the White body politic (Steedman, 2008). Taking that into account, the disavowal of Johnson can be better understood as a way to gain middle class White respectability by individualizing Johnson. If Johnson is an individual, he is not a representative of Black people and can be viewed as a lone force of pride and vanity rather than the product of generations of slavery and poverty, that so happened to find success through pugilism and defying racial and gender scripts.

Conclusion

If Louis' success was to be touted, and Gans' career was to be similarly accepted by the White media. Then, by implication, the reception of Johnson was that he had failed. His gender strategy and his version of Appropriate Blackness were considered obsolete by the end of the Depression era. The need to amplify the physicality of Louis by Negro publications still communicated the need to display athleticism, just not the fancy clothing, braggadocio, luxury cars, and unrepentant love of White women in the public eye (Hietala, 2002; Ward, 2015). Louis went on to be beloved by Black and White populations of the U.S., especially during World War II. There were posters of Louis for war propaganda (Hietala, 2002). Patriotism, curated silence and social and racial scripts not being challenged were the winning recipe for Louis, and as a result, casting Johnson as "That fool nigger with his white women, acting like he owned the world" (Ward, 2015, p. 438).

Boxing may have brought Johnson to prominence, transforming a working-class laborer, son of former slaves, into a millionaire in today's currency; however, the cultural and racial scripts of the Progressive Era were too pervasive. Having White women in his arms, having gold teeth, and driving luxury cars when most people did not own one was received entirely negatively by the majority of the White population. Additionally, Johnson was highly vocal about racism during his reign as the heavyweight champion, to the discomfort of many White supremacist colonial nations. Contemporary Black fighters like Jack Blackburn and Battling Siki were similarly conducting themselves, with White wives, fancy clothes, and showman-like personalities, neither of them fought at heavyweight, nor garnered the same success as Johnson did (Aycock, 2014). In this way, Johnson's cultural impact can be understood as exceptional and worthy of further study when examining the intersections of social constructions of race and gender.

The concept of "Appropriate Blackness" has evolved, with different generations and material conditions defining which assimilation strategy would garner the best reception from the White majority for the Black population. The second Black heavyweight champion, Joe Louis, and his career shed light on the ever-changing ideas of Appropriate Blackness over the course of time. The respectability politics of Louis and Johnson's Sporting Man strategy are evident in the lives of contemporary Black athletes, entertainers, and rappers. This indicates that Black people, in particular men, still have not been accepted into American society on a cultural level. As a byproduct, the identities of Black and White are relational and cyclical. One cannot describe one identity without the existence of the other, creating a dialectical relationship. The meanings of which, and their gendered social scripts, lead more to the symbolic interactionist understanding of the social constructions of race and gender.

Whiteness functions as a societally salient factor in how the U.S. operates organizationally, and behavior is often devoid of this implication, which can be observed in Johnson's career on the micro level. This factor has not been previously explored in the sociology of sport, boxing, race, and gender. Further studies could help uncover more of the intersections of social class, gender, and race. Critical theory, as applied to Johnson's career and that of other athletes, could reveal sports as a vehicle for change or even a reflection of society and its values. Appropriate Blackness can be applied across various media, including music, movies, and internet culture. Muhammad Ali had a contentious relationship with Joe Louis, calling him a "Uncle Tom" for not being as outspoken and confrontational towards White supremacy (Reed, 2015, p. 581). This illustrates another example of Confrontationalist versus Accommodationist perspectives on Appropriate Blackness. The broader implications of this study demonstrate that acceptance into American culture is conditional; there are only specific versions of Appropriate Blackness that are incentivized and rewarded by White supremacist Capitalist society. With images of rappers like Bobby Shmurda performing his hit song in a board room of White music executives dancing on the table like minstrel shows of Jim Crow, to the disproportionate media depictions of Black masculinity being synonymous with criminality and gangsterism in TV shows like *The Wire* and *BMF*, one is left with the question of whether or not we truly live in a post racial society. Post George Floyd protests, the pathology of the defaultness of White identity remains unexplored. Until parity can be found within our society, Appropriate Blackness will always persist. There will always be a precariat class bending to the will of an upper class if there is no confrontation of race and its social construction/stratification of our society.

References

- Aycock, C., Scott, M. (2014). *Joe Gans: A biography of the first African American world boxing champion*. McFarland & Company.
- Baker, M. A. (2020). *The world colored heavyweight championship, 1876–1937*. McFarland & Company.
- Baldwin, J. (2018). *I am not your negro*. (Vol. 5389). 10/18.
- Bell, D. (1973). *Race, racism, and American law*. Little, Brown and Company.
- Berger, P. L., & Luckmann, T. (1966). *The social construction of reality: A treatise in the sociology of knowledge* (1st ed.). Doubleday.
- Bush, J. A. (1997). The British constitution and the creation of American slavery. In P.Finkelman (Ed.) *Slavery and the Law* (1st ed., pp.379-410). Madison House.
- Campbell, G. M. (1981). *Extant collections of early Black newspapers: A research guide to the Black press, 1880-1915, with an index to the Boston Guardian, 1902-1904*. The Whitston Publishing Company.
- Casey, Z. A. (Ed.). (2021). *Encyclopedia of critical whiteness studies in education*. Brill Sense.
- Cleaver, E. (1968). *Soul on Ice*. McGraw-Hill.
- Cohen, M. G., & Brodie, M. J. (2007). *Remapping gender in the new global order*. Routledge.
- Cushing-Leubner, J. (2020). Discourse and whiteness. In Z. A. Casey (Ed.), *Encyclopedia of critical whiteness studies in education* (pp. 133-143). Brill.
- Gilmore, A.-T. (1975). *Bad nigger! The national impact of Jack Johnson*. Kennikat Press.
- Hietala, T. R. (2002). *The fight of the century: Jack Johnson, Joe Louis, and the struggle for racial equality*. M.E. Sharpe. <https://doi.org/10.4324/9781315704364>

- Johnson, A. G. (1997). *The gender knot: Unraveling our patriarchal legacy*. Temple University Press
- Johnson, J. W. (1915). The passing of Jack Johnson. In *James Weldon Johnson: Writings* (p. 615).
- Johnson, J. (2007). *Jack Johnson: In the ring and out*. Kessinger Publishing.
- Johnson, J. & Rivers, C. (2009). *My life and battles*. Potomac Books.
- Lardner, J. (1951). *White Hopes and Other Tigers*. (1st ed.). Lippincott.
- Lensmire, T. J. (2020). Ellison, Ralph. In Z. A. Casey (Ed.), *Encyclopedia of critical whiteness studies in education* (pp. 167-170). Brill.
- Majors, M. A. (1913, July 5). Jack Johnson is crucified for his race. *The Chicago Defender (Big Weekend Edition) (1905-1966)*. <https://www.proquest.com/newspapers/jack-johnson-is-crucified-his-race/docview/493202067/se-2?accountid=10389>
- Majors, R. & Billson, J. M. (1993). *Cool pose: The dilemmas of black manhood in America*. Touchstone Books.
- Montrose Daily Press. (1910, August 12). Volume 28, Number 30.
- Moore, L. (2017). *I fight for a living: Boxing and the battle for black manhood, 1880-1915*. University of Illinois Press.
- Obach, B. K. (1999). Demonstrating the social construction of race. *Teaching Sociology* 27(3), 252. <https://doi.org/10.2307/1319325>
- Painter, N. I. (2011). *The history of white people*. W.W. Norton.
- Reed, I. (2015). *The complete Muhammad Ali*. Baraka Books.

- Roberts, P. (1937, Jul 03). Praise and criticism. *The Pittsburgh Courier (1911-1950)*.
<https://www.proquest.com/newspapers/praise-criticism/docview/202015657/se-2?accountid=10389>
- Runstedtler, T. (2013). *Jack Johnson, Rebel Sojourner: Boxing in the shadow of the global color line*. University of California Press.
- Sampson, R. (2003). *John L. O'Sullivan and his times* (1st ed.). Kent State University Press.
- Satterlund, T. D. (2007). *Fighting for an authentic self: An ethnographic study of recreational boxers* (Vol. 67, Number 12). [Doctoral dissertation].
- Searle, J. R. (1995). *The construction of social reality*. Free Press.
- Slack, J. (2015). *Finding the art: Essays on the principles, tactics, and techniques which govern combat sports*. [Kindle version]. Amazon.
- Smaje, C. (1997). Not just a social construct: Theorizing race and ethnicity. *Sociology* 31(2), 307-327. <https://www.proquest.com/scholarly-journals/not-just-social-construct-theorising-race/docview/61487143/se-2>
- Steedman, M. D. (2008). How was race constructed in the new south? *Du Bois Review: Social Science Research on Race* 5(1), 49-67 <https://doi.org/10.1017/S1742058X08080053>.
- Wade, L. & Ferree, M. M. (2019). *Gender: ideas, interactions, institutions* (2nd ed.). W.W. Norton & Company, Inc.
- Ward, G. C. (2015). *Unforgivable blackness: The rise and fall of Jack Johnson*. Yellow Jersey Press.
- West, C. & Zimmerman, D. H. (1987). Doing gender. *Gender & Society*, 1(2), 125–151.
<https://doi.org/10.1177/0891243287001002002>

- Winders, J. (2021). *George Dixon: The short life of boxing's first black world champion, 1870-1908*. University of Arkansas Press.
- Wise, T. J. (2011). *White like me: Reflections on race from a privileged son* (2nd ed.). Soft Skull Press.
- Yosso, T. J. (2005). Whose culture has capital? A critical race theory discussion of community cultural wealth. *Race, Ethnicity and Education*, 8(1), 69–91.
<https://doi.org/10.1080/1361332052000341006>

William O. Douglas Honors College

The William O. Douglas Honors College (DHC) is an interdisciplinary program and complements all majors. Students from several departments presented projects at the 2025 Symposium of University Research and Creative Expression (SOURCE).

This volume of the *Journal of the Symposium of University Research and Creative Expression (SOURCE)* features full length submissions from select Douglas Honors College students.

Tassel Turning Versus Tossing in the Towel: An Analysis of Undergraduate Student Persistence and Challenges

*Josie Ambur*¹

Project Mentor(s): Pamela McMullin-Messier², Bernadette Jungblut³

¹ The William O. Douglas Honors College, Central Washington University

² Department of Sociology, Central Washington University

³ Department of Political Science, Central Washington University

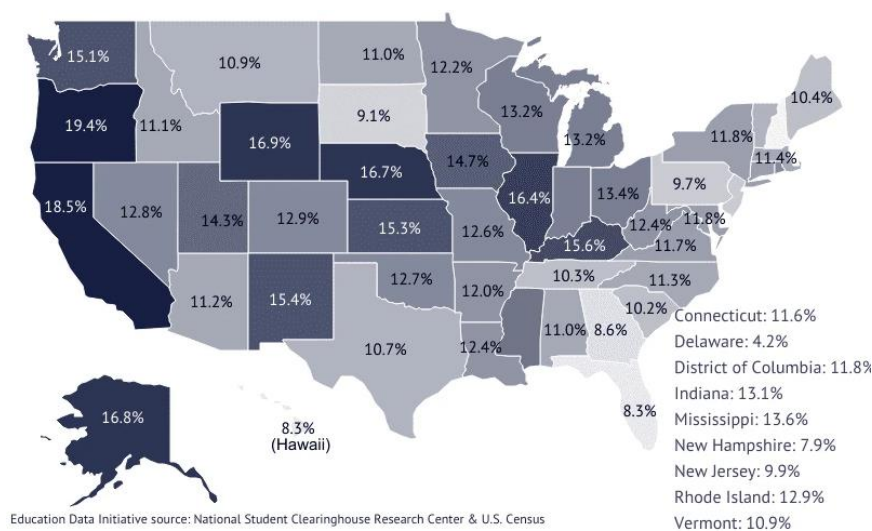
Abstract: Completing college is no easy feat. All higher education has barriers and obstacles students must face and overcome. Observations have been used to gather various student perspectives that have been compiled alongside research in the field to create a picture of what student barriers look like at Central Washington University specifically. Some of these barriers include navigating academic requirements, challenges with academic advisors, unique challenges first-generation students face, and financial challenges including balancing employment and academics. Within the personal lives of students, there are several internal factors that impact their success such as their persistence, grit, and stress levels. All aspects work together to impact student well-being and student success. As an institution, there are ways to improve conditions that impact student success. Academic advising is a critical part of a student's ability to complete their degree. Training advisors to be able to accurately answer student questions or to direct students to the right department or resources to assist them is one way this barrier to student success can be improved. Integrating financial literacy learning into beginning student classes can be one way to aid students in learning to manage the additional financial stressors that come with moving to college. Individual experiences are at the core of student success and retention, which is why individual student perspectives are the most important ones to gather. This study aims to produce suggested solutions for institutional change to help improve student success and outcomes.

Keywords: Retention, Persistence, Student Perspectives, Barriers, Success

In the United States, 39% of undergraduate students who are seeking their first degree will not finish it within eight years (Hanson, 2024). In 2022 there were 41.9 million Americans who had dropped out of college and not returned (Hanson, 2024). One in four college students seriously consider dropping out (Hanson, 2024). Students report a variety of factors influence their decisions to pause or discontinue their degree. Marken (2022) found that the most common reason students were seriously considering stopping their education was emotional distress with 76% of students in their study identifying this as the main reason they were considering it. Beyond mental health concerns there are many other reasons why students are struggling with their academic success. Several external barriers exist outside of students' control. These barriers range from institutional barriers such as academic advising and requirements to financial barriers including costs of living and attending college as well as struggles balancing employment and academics. Not all barriers are external; plenty of internal factors affect students, such as, persistence and grit affect retention rates as well as student mental health. As stated by Marken (2022), mental health is crucial in students' efforts to persist to graduation. For most students, graduating and receiving a degree is the primary purpose of attending a university. Despite this, 15.1% of individuals in Washington State have started college but do not have a degree (Hanson, 2024). Examining the barriers students face can assist in producing solutions that will increase persistence, retention, and graduation rates.

Figure 1

Approximate Percentage of Population with Some College No Degree



Note. Sourced from Hanson (2024)

Literature Review

External Barriers

The majority of the student experience is going to class, completing coursework tasks, and achieving passing grades on work done in each course. This tends to be straightforward, with professors outlining requirements and students knowing precisely who to ask if something is not clear or does not make sense. In these interactions, the professor knows what they are asking of the student and is the one who regulates the criteria on which students will be graded. Given these circumstances, the student is able to get helpful feedback that accurately leads them toward the answers they are looking for. Many other aspects of the student experience are not nearly as straightforward and open the floor for misguidance and misunderstanding. One of the resources students are directed toward when they are having challenges with navigating the ins and outs of college requirements are their advisors. Being such an important source of information creates a lot of responsibility. Misdirecting or misleading students can cause challenges in their ability to persist to graduation. Other areas that factor into a student's ability to persist to graduation are

their financial situation and their employment status. Between the costs of higher education and living expenses, being a college student is expensive. Working to pay for these expenses may be necessary but can have adverse effects on the student's experience and success. Student success is more than completing coursework. Student success is also about selecting a major the student is passionate about and being accurately guided toward graduation. Ultimately, a student should be set up to not only maintain academic progress and earn good grades on their schoolwork but also be prepared to graduate and go into their field or desired further education post-graduation.

Challenges with Advisors

For many students, academic advisors are trusted to know the ins and outs of the university and the requirements of different degrees. Young-Jones et al. (2012) found that students who receive supportive academic advising that fulfills their needs were more likely to graduate and were more likely to have higher grade point averages. These results were most significant when advisors assisted students in areas such as student responsibility, study skills, perceived support, and self-efficacy. This study investigated the relationship between student needs, student expectations of advisors, and student outcomes. When engaged with students in effective interactions about academics and other student struggles, advisors were able to incorporate and facilitate positive changes that improved student confidence and the students' belief in their capabilities (Young-Jones et al., 2012).

There are several unique barriers for first-generation college students. One of those being that a first-generation college student may not arrive at their university with any background knowledge about what to expect. Molina and Mabrey (2023) note that one of the most integral parts of students successfully overcoming individual barriers and challenges is their access to a support system that meets their needs. They state that supportive academic advising is crucial to

student success and retention, while emphasizing that part of this support should look like having an environment where students feel safe and welcome to ask questions and be vulnerable. It is no surprise that giving students the help they need navigating the complex system that is college requirements helps boost student success and retention.

Finances

It is widely known that a college-level education comes at a high price tag. Due to this price tag, many students are employed in order to pay for their education and/or living expenses. Perna and Odle (2020) found that 43% of full-time students were working and 81% of part-time students were working while actively pursuing their undergraduate degrees. Monthly costs for students are an average of \$2,932 (Broulliard, 2024). Financial aid was used by many students to help them with the expenses that they accrue. About 30% or \$670 of the student budget is food per month. Estimated on-campus housing costs range from \$9,970 for public universities to \$14,650 for private universities for the school year. Off-campus housing ranges wildly depending on location from \$872 a month in Pennsylvania to about \$2,649 in California. Those who drive can expect monthly gas costs to be about \$164 a month. Students have additional expenses on top of these that include but extend far beyond entertainment, clothing, gifts, bills, hygiene and grooming needs, insurance plans, and many other expenses (Broulliard, 2024).

With all of these expenses in mind, it is important to look at the income a student is expected to have if they are employed. A student can expect to make an average income of \$2,872 per month (ZipRecruiter, 2024). The low point of student income is \$1,250 while the high is \$4,208. The majority of students are not making the average amount and there are several outliers skewing these results (ZipRecruiter, 2024). Given that the average student expenses are higher than the average student income, it is easy to see why financial issues and stress are so

commonly recognized and discussed. Looking at these numbers, it can be deduced that a student is not likely to be able to work to pay for all of their needs without external assistance.

Employment

Many people view higher education as an opportunity for social mobility and advancing their socioeconomic status. However, due to the drastic increase in tuition and schooling costs and the marginal increase in family incomes people who are trying to benefit from education are more likely to see adverse effects (Perna & Odle, 2020). This study points out that students who work less than 20 hours a week have better academic outcomes than those who work over 20 hours per week. The average number of hours worked per week by employed students was 28.3 hours. Students who come from low-income families are more likely to be employed and more likely to work more hours (Perna & Odle, 2020). Paulson (2021) found that students who are working 20 or more hours a week and are both full and part-time students receive slightly lower marks and have lower GPA's than those who do not work. Nurius et al. (2023) found a connection between working students and higher levels of stress and a negative correlation between stress levels and resilience. As mental health concerns rose due to stress-related factors and high levels of stress exposure, student resilience decreased (Nuris et al., 2023).

A study done by Nieman (2023) addresses the correlation between lower educational attainment and lower socioeconomic status. A connection is drawn to the challenge of being first-generation because it is more likely for them to have lower socioeconomic status. This study addresses the increased likelihood that those with lower socioeconomic status will need to work while attending school. Students who are first-generation college students have a graduation rate of 20% within six years while those who have a parent who has earned a bachelor's degree have a 49% likelihood of completing their undergraduate degree within six years (Nieman, 2023).

Internal Barriers

Students lead complex lives outside of school and are individually complex people. These factors all come into play when a student is working toward their degree. Everything down to the way a student sees their stress levels plays a role in their success. Persistence, grit, and stress all affect a student's ability to persist to graduation and their academic success in individual classes. The financial impact that a college education has on a student can also cause significant stress increases that affect students' abilities to be academically successful.

Persistence, Grit, and Stress

Being a student is a challenging and stressful experience. The more perceived stress a student has the less likely they are to persist at a university (Saunders-Scott et al. 2018). Saunders-Scott et al. (2018) found that non-traditional factors like stress, grit, perseverance, and passion for long-term goals were some of the best predictors of graduation potential. The greater the amount of perceived stress predicted lower amounts of grit. This study found that perceived stress was the best predictor of retention. Grit is another one of the most important factors found to influence retention (Saunders-Scott et al. 2018).

The social aspect of college life is a large contributing factor to mental health and student success. Bradley et al. (2023) examined evidence that proved the more a student is involved with activities outside the classroom the more likely they are to achieve professional success and achieve personal goals. Additional findings of Bradley et al. (2023) showed that students who were able to dedicate more time to studying and preparing for classes had higher success rates per course than those who dedicated less time to such activities. Another finding by Bradley et al. (2023) is that students are more willing to put in effort and more likely to be engaged with their schoolwork when they are significantly interested in the content and felt it would contribute

positively to their lives later on. A factor they found that caused decreased retention was elevated stress levels (Bradley et al., 2023).

Tinto (2017) discusses the perspective of students and how their goals are different than university goals. Tinto (2017) talked about students and their motivations and how important this is to their desire to persist through college. He uses a definition of self-efficacy that defines it as a person's belief in their ability to be successful at something. Self-efficacy is the learned skill that allows people to overcome hardships by perceiving themselves as capable and as though they have control over the things that happen to them. Tinto (2017) addresses how self-efficacy promotes goal attainment and increases the amount of effort a person is willing to put into a task.

Financial Stress

Money is a big factor in students' lives. Some students reported that at times they felt they had to neglect their studies to focus on paying their bills (Grabmeier, 2018). This study found that 17-19% of students relied mostly on loans instead of receiving financial help from their families. Twenty-four percent of students expected to owe \$30,000-\$50,000, 14% expected to owe \$50,00-\$80,000, and 7% expected to owe more than \$80,000 (Grabmeier, 2018).

Financial Literacy Courses. There are a few things that can be done to help students with their finances and make paying for college more easily manageable. Eichelberger et al. (2018) found that students who took a personal finance class in college were more likely to continue at their university and to graduate with an undergraduate degree. They identified that a large reason why students are dropping out of college is financial concerns. Additionally, their findings showed that those who took a personal finance class had an 11.3% greater chance of graduating than those who did not take one (Eichelberger et al., 2018).

Feeding Student Motivation

There is a significant amount of research that studies the importance of nutrition on productivity, some studies focus on the academic side of productivity. Carvagno (2024) did a study on this with a specific interest in student outcomes and capabilities. She found there was a significant difference in participant response times based on their hunger levels. Participants “overwhelmingly reported negative perceptions of the effects of hunger on themselves, with important themes of lack of concentration, physical effects, altered moods and personal interactions, delayed or abandoned work, and negative performance quality appearing” (Carvagno, 2024). Based on this research, providing students who are hard at work studying and working on classwork will help improve their focus, their mood while doing schoolwork, and improve the quality of work they are producing.

Additionally, creating a positive association with studying can help motivate students to work on coursework. Operant conditioning is a method of enforcing or discouraging behaviors by adding or removing a stimulus from a subject (Cherry, 2024). An example of adding a stimulus to encourage a behavior is giving students who are studying in the library pieces of pizza (Cherry, 2024). This means that those who are given something to eat are having a positive experience with studying and are therefore more likely to want to both continue that behavior as well as engage in it again. Adversely, if a student spends their time studying in a stressful environment or in a state of hunger, they are more likely to have negative feelings around studying and study spaces. This would in turn make them less likely to want to study, eventually affecting their academics and potentially influencing their decision to withdraw. Creating a greater draw to study spaces can help student outcomes. Creating a positive association between the students and the library will help increase academic success and the usage of the library.

Methods

As indicated above, the research shows there are significant barriers to student success in higher education; my project connects this research to CWU specifically by using the methodology of autoethnography as a lens to illustrate observed experiences. Autoethnography is a research method that takes research studies and analyzes their connections to real-world problems and lived experiences (Poulos, 2020). Research informs issues that relate to a variety of populations. The autoethnographic approach combines research and experiences and observations to address complex issues as they relate to a specific environment (Salmons, 2023). This approach draws a direct connection between what the literature says and what lived experience shows (Poulos, 2020). The autoethnographic method centers the researcher's lived experience with the purpose of highlighting its connection to gathered data (Poulos, 2020). When writing about topics that pertain to groups a researcher is a member of, using the autoethnographic methodology allows a researcher to use first-hand observations as qualitative reasoning toward their point (Tilley-Lubbs and Calva, 2016). Using qualitative data is important when examining subjective experiences, such as challenges to students in higher education.

Research shows there are several barriers in higher education; this project connects the research to CWU students. This project proposes improving student support systems and creating resource changes to CWU that will positively impact student success by focusing on the student view. Stories from my personal life, as well as observations I have made are used in this project to showcase the issues proven in the literature. This project incorporates several of these stories that were told in casual conversation, without the use of surveys or interviews.

This project started after I noticed a correlation between my coworkers with more scheduled hours and their increased likelihood of taking breaks from school or dropping out. I

wanted to dive into the reasoning behind why one or two more shifts each week was drastically impacting their academic success. This project started out only looking at those factors. Then I realized there was much more at play and broadened my scope. I realized that acknowledging and studying the problem was only the first step. There is work to be done to reduce the problem, instead of simply continuing to collect data about it. That is why I chose to make this project solution oriented. I want this project to help change the culture and improve student success by addressing areas for change. The areas I examined were student employment, academic advising, and mental health concerns.

Discussion

The Work to Towel Tossing Pipeline

As explained above, research shows that those who work more than 20 hours a week are less likely to persist and more likely to receive lower grade marks than those who work less than 20 hours a week (Paulson, 2021). At my job in Ellensburg, we consistently hire college students. A shift lead is scheduled for one or two additional shifts beyond the base-level employees. As a base-level employee, during the academic year, I expect to work around the 20-hours. Of those who work this level with me, the majority have continued their education without taking breaks. Shift leads have been known to get between 35 to 40 hours a week. Of the seven shift leads only one has continued their education without taking a break or stopping school entirely.

There was a time when I was considering doing a work study program on campus. After talking with peers who were working on campus it became clear that this would not be the right move for me. The first reason is due to having an apartment I need a job that I can work year-round. Another reason this did not appeal to me is that many of the individuals participating in work study did not have anything good to say about their work experiences. Picking up an off-

campus job means having to do additional work when it comes to balancing it with school but to me it was worth it to find a job that both fit my year-round needs and brought me joy.

Tussling with the Tassel

For each college, there are unique requirements a student must complete in order to graduate with their desired degree. Offering a variety of courses that cater to a variety of interests is something CWU does well. Unfortunately, this seemingly positive aspect repeatedly mixes up requirements for students. Several of my peers and I have had the misfortune of being fed misinformation. At the end of my sophomore year, I met with my major-specific advisor to plan the rest of my academic career at CWU. Given that my advisor is specific to my major, I figured that asking for help planning the courses I would need to take for my major to graduate would be well within my advisor's knowledge base and abilities.

For the psychology major part of the course requirements includes five categories where students must pick and choose a course that will satisfy the category. In a meeting with my academic advisor we were planning out my future courses and viewing the requirements I needed to fill through my MyCWU portal. During this meeting we planned out the courses I would need to take to fulfill all my requirements and keep me on track to graduate on time. The following academic year I realized the classes I had been told would fulfill categories four and five were both from category three, which I had filled before meeting with my advisor. I had to quickly drop classes and pivot to get the right requirements filled to graduate on time.

If I had not caught this on my own I likely would have gotten to the point of applying for graduation, thinking everything was in order because I followed my advisor's instructions precisely, and then been told I could not graduate because I had not fulfilled my major's requirements. Luckily, I did figure it out on my own. After figuring it out I felt frustrated and

angry. Once I started talking more with my peers about the trouble I had with my own advisor I started to learn just how common it was to have advisors encourage students to take classes that would either not get them any closer to their degree or put them behind schedule to graduate.

Career Goal Hurdles

Knowing how to help a student seeking help is important. However, sometimes the person they are asking does not have the information they need. Knowing where to send the students to receive the help they need would be extremely helpful for advisors. In the circumstance that an advisor does not have the answer a student is looking for it would be helpful if they could lead to student to the right department or correct resource to help them.

Within the field of psychology, there is not much a person can do with their degree if they do not pursue graduate school. There are still several great avenues a person can take with a psychology degree, but the options are limited. During my junior year I learned that one such path is by becoming a college academic advisor. I learned this by asking my advisor what steps I should be taking to apply to graduate schools and how a person begins that process. I talked about my career goals and the master's degree I needed, the main problem being that I had no clue how to apply to graduate school and needed help figuring out the process. Instead of trying to help or pointing me in the direction of someone who could help I was told, "I don't know, I didn't get a master's. You could probably Google it though." I went in needing help and walked out being told that the internet would be more useful to me than them.

Six months later, I learned that CWU has a career center. Then, several months went by before I learned that the career center helps with graduate school applications. I do not expect everyone I ask for help to know the answers, but I would have preferred being told that they did not know and been directed to the career center than told the internet was the best help I was

going to get. Training advisors to direct students to appropriate resources would immensely improve the student experience and their ability to be successful.

Advisors who have been helpful have demonstrated a deep understanding of the curriculum and the requirements that must be met. These helpful advisors steer students toward correct classes and available resources to help them be successful. At the point I figured out the mix-up with my requirements, I had enough time to pivot and graduate within my own personal timeline. However, not all of my peers have been lucky enough to get to pivot like I did. This leaves them either graduating later than their timeline or, in some cases, not graduating at all.

A Tale of Tossing in the Towel

A friend and past CWU student dropped out of Central toward the end of her third year. When asked, she says was because of her advisor. She wanted to be a teacher. She would have made a great teacher. She came into work mad. She told us about what happened. Two years at a college in another state—only a few credits short of her associate’s degree —and almost a full year at school at Central and she was told she spent her whole year at CWU in the wrong classes, meaning that nothing she had taken would count toward her degree. At the beginning of that academic year her advisor told her she would be in school longer than the traditional four years because of the transfer but that she would be able to do it in three more if she only took all the right classes. So together they planned a calculated schedule of every class she needed to take.

This friend went to her advisor at the end of that academic year, right before enrolling in her next quarter of classes, to ensure she was still on track. At this follow-up meeting, her advisor told her that the classes she spent that academic year taking ended up overlapping requirements that her transfer credits had already filled. Essentially, nothing she took that academic year counted toward anything. Her advisor proceeded to tell her that she was no closer to her three-

year timetable than she was when she walked into CWU. Maybe another three years would not be so bad. Except that she could go another year of schooling—put all that time, money, and effort into her degree—and once again be told that it meant nothing. She trusted her advisor to set her up for success, but instead, she was led astray. Supporting herself for the last three years of doing school and work had been hard enough. She said she did not think she could survive going another three. She looked me in the eyes right before getting into her car after our shift that day and said with certainty that she was dropping out of college when she got home. I told her she would make a great teacher if she kept going but that I understood if she gave up. I told her if I were in her shoes, I would likely toss in the towel too. She went home from work that night, withdrew from Central, and had to come up with a different life plan for herself.

Mental Health

As Marken (2022) found, mental health is one of the main reasons why students do not complete their degrees. Mental health counseling at CWU does not currently meet the needs of the student population. It is well known that trying to get an appointment at the counseling center will take weeks to months to happen. This discourages many students from attempting to make an appointment. The counseling center appears to be aware of this issue but does not have the resources to remedy the problem. The current solution appears to be a focus on group therapy and trying to encourage students to do group work. While group therapy can be helpful, it is not for everyone. Many people are intimidated by group therapy and are unlikely to seek this modality of counseling. The harsh reality of the matter is that CWU does not have enough counselors on staff to help the volume of students on campus who need mental health care.

Bringing on the volume of staff needed to help the number of CWU students is a lofty goal that is worth working toward but would understandably take time. CWU used to use the

Timely Care mental health resource. This resource allowed students to seek mental healthcare at any point they felt they needed it through the Timely Care online platform. In Timely Care's (2025) study of its effectiveness, the company found that 78% of students in bachelor's degree programs reported that they were more likely to continue their enrollment in their university. This report also found that on average students who entered a state of active care with clinical-level symptoms would drop one severity ranking within their first three counseling or psychiatry visits (Timely Care, 2025). Having access to mental healthcare significantly positively impacted these students and their ability to succeed in their academics. Mental healthcare is essential in the efforts to help students get their tassels turned. Timely care has shown that mental healthcare being readily available to students helps them reach tassel turning time.

Limitations

This study is centered around my own perspective. Using a personal lens is limiting to research. Using an autoethnographic approach helps bridge the gap between my personal experience and research findings. Backing up personal experiences with research data helps combat confirmation bias. The research ensures that I am not only stating my thoughts and perceptions on this topic. Another way I combated confirmation bias was by discussing my research and ideas with my peers to ensure I was not only speaking about experiences that were exclusive to me. Perspectives that disagreed with mine were welcome and all varieties of perspectives that were shared with me were included. The majority of the feedback I received on all ideas I presented to others were positive and agreed with both my assessments of the issues within CWU as well as agreed that the changes I proposed would positively impact CWU students. Although I took steps to minimize any confirmation bias, this paper remains from my personal perspective and is therefore likely to retain traces of my personal bias.

Using a personal lens interferes with generalizability. Talking with peers and fellow students also helped me ensure that the experiences I was having were not unique to me. Including perspectives, opinions, and experiences that relate to others helps ensure that the issues I talk about are generalizable to a broader population of CWU students. In the discussions I had at SOURCE, I was able to receive positive feedback from many new individuals who I had not yet crossed paths with. After hearing many of these new individuals talk about their experiences and react positively to my suggestions for changes, I feel confident that I was able to successfully identify challenges and propose solutions that are generalizable to much of CWU's student body. These ideas could likely be helpful to a broader population beyond CWU but this paper only aims to look at specific issues within CWU.

SOURCE

During the SOURCE presentation for this project, I was able to connect with a broader group of CWU students and faculty beyond the individuals I personally know. The majority of students, parents, and faculty members shared positive thoughts about the mental health program suggestions. Many students stated they would use this resource if it was available to them. Of the students who interacted with me on the topic, many had their own stories about their advisors. The consensus was that academic advising at CWU is not meeting student needs. Students also agreed that adding resources to help them with meals would be a financial relief to them.

There were a few rebuttals to the ideas I proposed. These were given by individuals who did not appear to me to be students. My justification for not perceiving them as students is that they were far older than many of my peers and in my eyes seemed to be either faculty members or parents of my peers. One of the concerns brought to my attention was the cost of implementing changes. My response to this was that these changes are an investment in CWU

students' success and retention. Investing in programs that help keep students enrolled will in the long run be more financially beneficial than taxing to CWU as an institution. Another concern was that these changes would not do enough to make a difference for students. The responses from students show me that this would not be the case. Students, which is the focus of this project, responded in ways that showed these changes would have helped them.

In discussions with CWU students, the concept of having someone they can reach out to for brief help was very well received. One student stated that this resource would fulfill her mental health needs. She described her needs as not being to the extent that she felt she needed in-person therapy and therefore did not want to take the spot of someone who did need in-person therapy but that her mental health was not where she wished it was. She said having a person she could reach out to with needs she deemed as "not urgent" could help her. Another student highlighted the importance of having a person students can go to, especially during intermittent times when they are not able to be in in-person therapy. This student said they have gone through therapy at CWU and during intermittent times, both before getting in to make their first appointment and after their nine appointments for the year ran out, they felt pushed to the side and like their mental health was unimportant to CWU at these times. This student emphasized not all mental health concerns can be helped within the nine allotted sessions per academic year. Feeling unimportant to the mental health resource at CWU and like they could not seek any additional mental healthcare had a negative impact on their mental health. This student stated their personal favorite part of the suggested changes was the increased accessibility to mental health resources and if this had been an option for them, they would utilize it.

When discussing adding more library meals to CWU's calendar, three students who had previously attended these library meals expressed that they had spent more time in the library

during the following quarter than they had before attending the event. Others who were learning about these events for the first time expressed that they believe they could benefit from attending these events. After hearing the data about eating before engaging in schoolwork, many students expressed that they were realizing that this was correct for them as well. Without knowing what was causing improvement, these events helped students during finals week. Finals are not the only time students could use additional support and a helping hand. It was widely agreed upon by students that their grades throughout the quarter could be better if they had a meal while doing their schoolwork.

Of the students who shared stories about their academic advisors, all agreed that implementing changes was necessary to student success. Several juniors and seniors expressed that they thought that with some training, they would be able to take on advising roles under their major-specific academic advisors. Students agreed that advisors have too many students to be able to build personal connections with students. Students felt like they had little to no relationships with their advisors and that this negatively impacted their ability to get help working toward their personal post-graduation goals.

Overall, students received these institutional changes positively. Students who gave opinions on the matter agreed that the proposed changes would help them mentally and academically. These changes are an investment in student success, and one that the students expressed that they both want and would utilize.

Conclusion

Setting students up for success after graduation is an important part of the university's responsibilities. The resources a university provides to students should help fill in for the needs they have outside their classrooms. CWU has a wide variety of resources available to students

who go looking for them. The perceived accessibility of different resources varies depending on what the resource is. The CWU pantries are perceivably very accessible. They are clearly marked and students are able to utilize them on their own at posted times of open hours. However, other resources like the counseling center are notoriously difficult for students to access, while other resources like the career center are broadly unknown by students. These resources exist for a reason and are very helpful to students who know about them and are able to access them.

Career Services

Students do not always know what they want to do once they finish college. Some students walk in the door with a clear idea about what they want their careers to look like. Many students begin unsure then find their way to their passion and get into a field they are interested in. However, many do not have a clue about what they will do once they get their degree. Other students who know what they want to do hit roadblocks with things like needing further education or needing years of practical job experience. There is already a great resource on campus that helps students with all this and more, yet many of them do not know about it. When mentioned, many students did not know CWU had a career center and those that did were not aware of many of the services they have available. Having a direction and a goal helps students visualize what they are working toward and can be a big factor in their motivation.

One of the main motivating factors for me has been the knowledge that without this degree, I could not pursue a career in mental health counseling. Of those surveyed by Marken (2022), 12% said that they considered withdrawing from their bachelor's degree program because they did not believe that it would help them achieve their future career goals. Having students at the sophomore or junior level work with the career center could help them map out what their lives will look like post-degree and help keep them motivated to finish their degree.

They could begin creating a professional-level resume and go into the workforce more prepared for the profession they want to enter.

Suggestions for Changes

Central Washington University has several great resources in place for its students. However, there is room for improvement, including several new resources that can help improve student success. Adding more advisors would give them more time with each student and allow them to build better relationships with students, which would increase student success. Creating a bigger draw to study spaces like the library while simultaneously helping students with other barriers like access to food can help improve student focus and grades. Increasing access to work-study programs and on-campus jobs can help reduce stress and manage workloads for students. Improving mental health services and creating more access to mental health services will increase student retention and reduce student stress, helping improve student grades and outcomes.

Adjustments to Advising

The academic advising department at CWU needs to implement changes that will help improve efficiency and accuracy. First and foremost, advisors need to know the coursework the students they are advising need to take. With some students being moved to advisors in other departments, this becomes even more challenging. In challenging moments when an advisor is in over their head or does not know the information, they should be able to direct students to either someone or a resource that can help them. Training on the ability to redirect students would help improve the advising system that is already in place.

Creating job positions for students to work under advisors as peer academic advisors would help add to the number of available people who can assist in the advising department

without having to hire as many full-time, long-term faculty members. Students would be able to make appointments with fellow students who are trained by advisors to know their way around the requirements for their own majors. This could also help with students' financial issues by creating more on-campus jobs. This solution would help alleviate the issue with students needing better access to advisors, students needing advisors who understand the requirements they are trying to navigate, and creating more student jobs. Students who work in advising would be able to work in their own major's department and could be either juniors or seniors who are confident in their understanding of and ability to navigate requirements.

Another solution is hiring more qualified advisors so students can have easier access to their advisors. In this situation, advisors would have fewer students and therefore more time for the students they do have. With fewer students, they would also have more time for training that could help teach and solidify their knowledge of their departments' requirements. Either way, the advisors at CWU need to be better trained on the requirements for their department and for the departments of any students they advise.

Fueling Tassel Turning

During finals week, the library often has some sort of food available on one of the days for free in the Fishbowl. Finals week is already one of the busiest times for the library but there is certainly never a shortage of students around when the food is being served. Providing students with free food—a resource many of them seek because of financial constraints—while the students are placed in a study-heavy environment can help students be more productive. The proposed solution here is to have more of these instances where students can get a bite to eat without having to worry about the cost in this study-centric environment. This could look like a few pop-ups throughout the quarter at busy library times to encourage those who are studying

and to motivate those who are not in the library to come to this study environment. The food provided could be anything from a treat—like how ice cream has been provided in the past—to a more filling meal—like the pizza provided earlier in the 2024-2025 school year. Helping satiate students can help them focus, reduce stressors like hunger, and draw them to the library environment which helps improve academic performance.

Measuring up to Mental Health Needs

Helping take the load off one of a student's many stressors can help improve their academics and increase their motivation to continue with their education. In line with the type of mental healthcare that Timely Care provides, CWU could bring on a staff member who runs what is essentially a non-suicide help line in order to more effectively and efficiently assist students with mental health needs. This could be done with a specific email account that students are able to reach out to with a range of needs. This could range from questions about their mental health, seeing if in-person therapy is for them, or providing a bridge until the student is able to begin counseling. Ideally, this would be a mental health professional who is able to give mild counseling—within the laws of the state—and direct students toward resources that may help them. Some of these resources already exist in the mental health center and could be distributed to students who reach out asking for help in areas such as seeking methods of reducing stress. If the student has questions about the resources provided or finds that the resources provided did not work for them, they could reply to the email asking for further help. Not only would the student benefit by having attainable access to mental health resources, but they would also benefit from the human connection that comes with talking to a person.

Bringing on this resource makes mental health care more accessible to students. For students whose needs revolve more around finding resources, this would help meet those needs

without them needing to wait weeks to months to get their first appointment. For students who are waiting for in-person therapy and struggling with their mental health while waiting they would have somewhere to turn for brief help and support. Additionally, this would be a person who could give rough estimates about the wait time a person has left before they are able to receive in-person counseling. This would also make it much less intimidating and scary for students to seek mental health care. Therefore, more students would be able to receive care.

At the moment, the counseling center gives a rough estimate as to when a person will be offered the opportunity for in-person counseling at the intake appointment. The student then waits weeks to months to hear back about when they will be offered the opportunity to schedule an appointment. For someone who is deeply struggling with their mental health, not knowing when they will be able to get an appointment can make them feel like they have been abandoned by those they reached out to for help. The person in this role could give more accurate updates to students about their time left on the waitlist so they will have something to look forward to and make them feel less like they have been abandoned in limbo. This new resource would not take the place of the existing mental health care that CWU has but would enhance its ability to provide for students. This service is different from telehealth because the student would be able to reach out any time with their needs and be answered within a few days and differs from Timely Care because it would be administered through CWU and not an outside company.

Informing students that this resource does not take the place of in-person counseling would be an important part of integrating this into the counseling center without giving students the false impression that this is a formal form of therapy they are receiving. Email signatures are commonly used among CWU faculty and can be created with a list of disclaimers at the bottom that would ensure appropriate laws regarding health care are being abided by.

As mentioned above, this resource would help CWU students because they would still be interacting with a person who has an interest in their well-being. Given the recent shift in some parts of the mental health field to include artificial intelligence, it is important to note that this proposed solution to the issue of accessibility to mental health resources on campus in no way advocates for the use of AI when working with students and their mental health. One of the key aspects of this proposed solution is the fact that a real human will be behind the information being given to students and will be the one talking to students. If a student wanted to interact with AI or wanted to know answers that they could receive from the internet, they would seek out those resources separately as they are already free online resources. Students seeking the counseling center are seeking human help and empathy. It is crucial that this bridge between reaching out for mental health care and beginning to receive in-person counseling come from a person who is passionate about the well-being of those reaching out.

Implementing these changes not only helps students reach tassel turning time but also helps better prepare them for life after graduation. Learning to advocate for and seek help in instances where a person needs additional help is a great life skill to have both inside and outside of the academic world. Having a positive advising relationship will help teach students how to appropriately ask for the help they need in their future profession. Learning to manage their finances at a younger age is important because it helps good habits form earlier on and when the students who are coming into CWU right out of high school get to the age where they are looking at bigger financial purchases, they will already have learned to budget and financially plan. Mental health is an issue that does not go away with age. Learning that it is okay to seek mental health care is an important part of learning to take care of oneself and cope with the stressors of life. When students learn good mental health habits young they can continue them

throughout their lives. Students at Central Washington University are putting in immense amounts of time, energy, and effort into their degrees. Making the proposed changes can help improve both student life and university retention.

Suggestions for Future Research

In the future, it would be useful to explore the relationship between job type and student retention. Several studies exist that give statistics about a person's likelihood of dropping out of college based on how many hours they work. Testing to see which types of jobs cause more challenges to academics would be a useful study to conduct. After implementing the proposed changes CWU could investigate the rate of effectiveness and usefulness they have by surveying students who partake in the usage of these resources.

Tassel Turning Time

It takes a lot of perseverance and grit to make it to graduation day. I started my college experience in Colorado. There was a point when I was excited to be there, but after a long series of confounding variables it was no longer the right place for me. I am not sure if I had an academic advisor there, it was nobody I ever met or talked to. When I started enrolling in classes it was all up to me to figure out the enrollment system and find online what the requirements were for undergraduate students. After figuring that out and actually starting school it was hard to focus and do schoolwork. It was hard to be in a new place, a thousand miles away from anyone I knew. The few friends that I did make had very different interests and backgrounds than me. We got along but never really clicked. The last nail in the coffin came from my therapist. I told her I was struggling. She told me I was an adult now and should get over it. I did not go back to therapy while there. Being somewhere new without a clue if I was taking the right classes, feeling isolated, and now out of the mental health care I needed was the perfect recipe

for dropping out of college. I told my mom that I did not know what to do, but that I could not stay there, so I left. The following fall quarter I started at CWU. Two of my best friends from my hometown went to CWU. One of them was in the Douglas Honors College (DHC). I was able to sit down with an advisor from the DHC who helped me understand the requirements and enroll in classes. I integrated well into the friend groups of the people I knew before coming to CWU.

One of the biggest factors in my own persistence was finding a sense of community and finding the right people to help me through the most difficult parts of college. As a student in the DHC I had a unique set of general education requirements and had an advisor who was an expert at understanding them. Another aspect of the DHC that helped me persist was having the same peers in many classes throughout my time here. This has helped me make friends and find people I can relate to. This past year I utilized the counseling center. After the over a month long wait I was able to get regularly scheduled visits which helped improve my mental health significantly.

Even though college in Colorado did not work out for me I knew I could not give up entirely. I knew in high school that I wanted to work my way to becoming a licensed mental health practitioner. I also knew that the first step to that dream was a bachelor's degree. Without this degree, there would be no opportunity to keep working forward. Failure was never an option. Every time my education became harder than I thought I could manage, I remembered my goals. I would tell myself that no matter how difficult the challenges became, I had to keep going. Persisting to tassel turning time was important for my future and was made possible by the support systems I found along the way. I was just as determined to be successful in Colorado as I was at CWU; the defining factors in my success here were areas of support that I was able to seek out. If students are not supported, regardless of how determined they are, they might not persist to turning their tassels.

References

- Bradley, M., Brian, M., McChesney, J., & West, S. (2023). Considerations to improve college student involvement and retention. *Kentucky SHAPE JOURNAL*, 61(1), 44–50.
- Broulliard, K. (2024, March 11). *How much does a college student spend a month?* SoFi. <https://www.sofi.com/learn/content/how-much-does-college-student-spend-month/#:~:text=According%20to%20the%20College%20Board,%2C%20housing%2C%20and%20other%20expenses>
- Carvagno, N. (2024). *The impact of hunger on productivity*. [Poster presentation]. EURēCA 2024. <https://symposium.foragerone.com/eureca-2024/presentations/64749>
- Cherry, K. (2024, July 10). *What is operant conditioning?* Verywell Mind. [https://www.verywellmind.com/operant-conditioning-a2-2794863#:~:text=Operant%20conditioning%2C%20sometimes%20referred%20to,or%20positive\)%20for%20that%20behavior](https://www.verywellmind.com/operant-conditioning-a2-2794863#:~:text=Operant%20conditioning%2C%20sometimes%20referred%20to,or%20positive)%20for%20that%20behavior)
- Eichelberger, B., Gerbing, D., & Gillpatrick, T. (2019). Financial education, college retention, and graduation rates. *College Student Journal*, 53(4), 479–489.
- Fostering college student mental health and resilience*. (2023, August 15). APA Blogs. <https://www.psychiatry.org/news-room/apa-blogs/fostering-college-student-mental-health-and-resili>
- Grabmeier, J. (2018, July 12). *70 percent of college students stressed about finances*. Ohio State News. <https://news.osu.edu/70-percent-of-college-students-stressed-about-finances/>
- Hanson, M. (2024, August 16). *College dropout rates*. Education Data Initiative. <https://educationdata.org/college-dropout-rates#wa>

Marken, S. (2022, April 19). A third of U.S. college students consider withdrawing. *Gallup Blog*.

<https://news.gallup.com/opinion/gallup/391823/third-college-students-consider-withdrawing.aspx>

Molina, R. M., & Mabrey, P. E. (2023, June 12). Field notes: From enrollment to graduation - part 1: Identifying and addressing barriers to student success. *AACRAO*.

https://www.aacrao.org/resources/newsletters-blogs/aacrao-connect/article/field-notes-from-enrollment-to-graduation---part-1-identifying-and-addressing-barriers-to-student-success?https%3A%2F%2Fwww.aacrao.org%2Feventstraining%2Fmeetings%2Fannual-meeting&gad_source=1&gclid=CjwKCAiAlPu9BhAjEiwA5NDSAww9QpCmUHLzrCxOkOGG52_U-WW9KI_Z_3CZ5QD7IUt9ASqF9Q-GuIRoCdCwQAvD_BwE

Nieman, R. D. (2023). *Retention and persistence of low-income, first-generation rural college students from West Virginia*. [Doctoral dissertation, West Virginia University]. ProQuest Dissertations & Theses. <https://doi.org/10.33915/etd.11964>

Nurius, P. S., Sefidgar, Y. S., Kuehn, K. S., Jung, J., Zhang, H., Figueira, O., Riskin, E. A., Dey, A. K., & Mankoff, J. C. (2023). Distress among undergraduates: Marginality, stressors and resilience resources. *Journal of American College Health*, 71(5), 1445–1453. <https://doi-org.ezp.lib.cwu.edu/10.1080/07448481.2021.1935969>

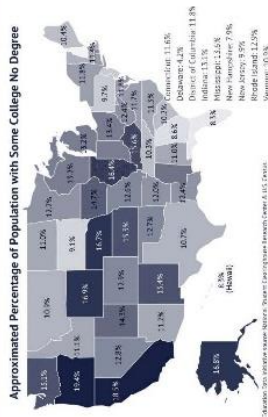
Paulson, M. (2021, October 6). College employment and student performance. *Penn Wharton Budget Model*. <https://budgetmodel.wharton.upenn.edu/issues/2021/10/4/college-employment-and-student-performance>

Perna, L. W., & Odle, T. K. (2020, February 6). Recognizing the reality of working college students. *Academe Magazine*, 106(1). <https://www.aaup.org/academe/issues/106-2/recognizing-reality-working-college-students>

- Poulos, C. N. (2020). *Essentials of autoethnography*. American Psychological Association.
<https://doi.org/10.1037/0000222-001>
- Salmons, J. (2023, June 22). When you are the researcher and the participant with autoethnography. *Sage Research Methods Community*.
<https://researchmethodscommunity.sagepub.com/blog/when-you-are-the-participant-collecting-autoethnographic-data>
- Saunders-Scott, D., Braley, M. B., & Stennes-Spidahl, N. (2018). Traditional and psychological factors associated with academic success: investigating best predictors of college retention. *Motivation & Emotion*, 42(4), 459–465. <https://doi-org.ezp.lib.cwu.edu/10.1007/s11031-017-9660-4>
- Tilley-Lubbs, G. A., & Calva, S. B. (Eds.). (2016). *Re-telling our stories*. SensePublishers, Rotterdam. <https://doi.org/10.1007/978-94-6300-567-8>
- Timely Care. (2025). *Mental health outcomes swift and significant results for college and university students*.
- Tinto, V. (2017). Reflections on student persistence. *Student Success*, 8(2), 1–8.
<https://search.informit.org/doi/10.3316/informit.593199291602507>
- Young-Jones, A. D., Burt, T. D., Dixon, S., & Hawthorne, M. J. (2012, January 21). Academic advising: Does it really impact student success? *Quality Assurance in Education*. 21(1), 7-19. <https://doi.org/10.1108/09684881311293034>
- ZipRecruiter. (2024). *Student salary: Hourly rate May 2024 United States*. ZipRecruiter.
<https://www.ziprecruiter.com/Salaries/Student-Salary#Monthly>

Introduction

All higher education has barriers and obstacles students must face and overcome. The purpose of this project is to propose solutions to these barriers that can be implemented at CWU. In the United States, 39% of undergraduate students who are seeking their first degree will not finish it within eight years (Hanson, 2024).



Methods

The autoethnographic approach combines research and experiences and observations to address complex issues as they relate to a specific environment (Salmons, 2023). Research shows there are several barriers in higher education; this project connects the research to CWU students. This project proposes improving student support systems and creating resource changes to CWU that will positively impact student success by focusing on the student view.

Discussion of Barriers

Academic Advising

- Student support systems are critical to success in overcoming individual challenges (Molina and Mabrey, 2023)
- Student GPAs and self-efficacy improve with positive and helpful advisor interactions (Young-Jones et al. 2012)

Student Motivation

- Study spaces improve student outcomes and learning engagement (Zheng et al., 2024)
- Lack of proper nutrition negatively impacts students' abilities to focus and get schoolwork done (Garvagno, 2024)

Financial Needs

- Students who work more have higher stress levels than those who do not, which increases mental health struggles (Nuris et al., 2023)
- Working for more than 20 hours a week reduces academic success and retention (Perna & Ode, 2020).

Mental Health

- A top reasons students withdraw from college is their mental health (Marken, 2022)
- 72% of students reported moderate or severe psychological distress (American Psychiatric Association, 2023)

Proposed Solutions

Adding more advisors would give them more time with each student and allow them to build better relationships with students, which would increase student success. Creating a bigger draw to study spaces like the library while simultaneously helping students with other barriers like access to food can help improve student focus and grades. Increasing access to work-study programs and on-campus jobs can help reduce stress and manage workloads for students. Improving mental health services and creating more access to mental health services will increase student retention and reduce student stress, helping improve student grades and outcomes.

References

Reasons for dropping out	Unenrolled adults with some postsecondary education %
Cost of attendance	25
Emotional stress	18
Got a new job	11
Courses were not relevant to intended career	7
Lost job	5
Coursework was too difficult	5
Education receiving was low quality	3
Data based on data from the National Student Clearinghouse Research Center, U.S. Census Bureau, 2024	

COVID's Impact on our Youngest Learners

Scottie Ellsworth¹

Project Mentor(s): Amanda Obery², Wendie Castillo²

¹William O. Douglas Honors College, Central Washington University

²Department of Education, Development, Teaching and Learning

Abstract: The COVID-19 pandemic profoundly disrupted education, leaving lasting effects on elementary students' academic development, particularly in literacy and reading comprehension. This research investigated the long-term educational impacts of the pandemic by drawing on qualitative insights from interviews with five educators across a range of specializations, including general education, interventional support, and multilingual learning. Using inductive thematic analysis and descriptive coding, the study identified key themes that reflected shifts in academic achievement, student behavior, attendance, and school priorities post-pandemic. These findings illuminate critical areas where students require support and outline the structural, instructional, and relational strategies educators use to bridge learning gaps. The conclusions contribute to broader conversations around educational policy and offer insight into how schools can more effectively support recovery and reimagine academic success in a post-pandemic era.

Keywords: COVID-19, Elementary Education, Learning Loss, Literacy, Teacher Interviews

Chapter I - Introduction

A Young Student Navigating Kindergarten Online

Being born into a household with three older siblings, Rose grew up with many examples of how education should look. Beginning kindergarten was something she had been looking forward to her whole life. For seven months, Rose worked on her sprinting skills each day in PE and picked out the most colorful books in the school library to read. The apple tree she sprouted in science class in February was given the special name "Selia". Selia only grew six inches before Rose had to leave her classroom for two weeks. It never

had the chance to be repotted. Like the rest of the kindergarteners' trees, which had once been so lovingly cared for, Selia was left alone in her halted state, eventually forgotten.

Eventually, Rose was given a laptop to take home, meaning she was able to start learning once again. All three of Rose's siblings took their laptops to their rooms and attended school behind closed doors. Soon their beds became their desks. With five computers running at the same time, the Wi-Fi was dependably undependable. It regularly short-circuited, disconnecting the kids from their schoolwork. Rose's teacher, Ms. Henderson, attempted in vain to teach her students how to write their b's and d's in the correct direction through a pixelated screen with lagging Wi-Fi.

The story above is a glimpse into the experiences of a kindergartener whose first interactions with academics took place in 2020. Every student was impacted in a distinct way, but it's safe to say that no students came out of the pandemic unscathed. While the long-term effects of this disruption cannot be known, some more immediate impacts are coming to light as time after COVID continues to pass.

The education of young students took a major hit. Teachers and students tried their best to supplement these crucial years of learning with whatever resources they had. Children who were kindergarteners at the beginning of the pandemic are now entering the next levels of their education and are still battling to gain stable footing with a crippling lack of foundational literacy skills (Strickland et al., 2004; Sucena et al., 2022). Student academic achievement has declined in many subject areas including reading, math, and science (Hammerstein et al., 2021). Attendance rates are erratic at best following mandated social distancing during the pandemic, which only works to set students further behind (Kaloustian, 2023). While recovery from such a catastrophic event will inevitably stretch into the future, it is imperative to focus on the present and address the current needs of students. These students require immediate support and have limited means to advocate for themselves. They require dedicated assistance in regaining their

footing, and this support begins with close examination of the educational systems across the country and identification of areas that demand changes.

Research Questions

The following research questions drove this study, which aimed to uncover trends in academics following the pandemic, specifically regarding literacy levels.

1. How has the pandemic affected schooling at an elementary level?
 - a. How has it affected student literacy levels?
2. If there has been an effect, what can be done to mitigate these effects in future years?

Significance of Study

Given the influence of elementary school years on young students' development, specifically with literacy, swift and informed action is essential to prevent long-term effects (Strickland et al., 2004). Mitigating the effects of COVID is an ongoing issue that is still at ground zero as far as research and data with new research surfacing each day. Likewise, this project aims to contribute to the ongoing discourse and propose new solutions for lessening detrimental impacts. The results of this study bring a new perspective to the struggles that current elementary students are going through, and highlight struggles that teachers are now facing in their classrooms post-pandemic. With reading scores that have dropped significantly and a widening educational gap between advantaged and disadvantaged students, teachers now face an enhanced set of challenges (Jacob & Stanojevich, 2024).

This study uncovered evolving educational struggles specific to literacy and reading comprehension, looking at personal accounts from educators who witness these challenges firsthand daily. The findings provide a comprehensive context for these challenges and present compelling evidence in favor of prioritizing innovative solutions. Novel methods of instruction and new resources that allow for one-on-one learning are just the beginning for elementary education's transition into effective post-pandemic methods (Catolico, 2023; Jacob & Stanojevich, 2024). By centering around educator perspectives, this qualitative research

captured the realities of teaching and offers a compelling case for interventions that are grounded in professional insight. The project may serve as a tool for school administrators, especially in underperforming institutions, to establish clear goals and actionable strategies that will address the educational disruptions caused by the pandemic.

Chapter II - Literature Review

The COVID-19 pandemic deeply impacted students, educators, and families across the United States. As schools transitioned to remote learning, students in elementary grades faced significant interruptions to their academic, social, and emotional development (Lester & Michelson, 2024; Pinto, 2023). Literacy and foundational learning became a primary point of concern, as young students missed out on crucial early instruction during these formative years, (Strickland et al., 2004). As schools work to recover from these disruptions, researchers, educators, and policymakers are now challenged with assessing the full scope of the pandemic's impact and using those insights to support students moving forward.

This literature review establishes how one can measure educational success in a post-pandemic context and examines the interconnected factors that influence student outcomes today. It begins by reviewing how academic success is commonly defined and measured, including both standardized test performance and student engagement (Hammerstein et al., 2021; Lester & Michelson, 2024). The review then introduces factors that affect student learning—such as attendance, parental expectations, and socioeconomic inequality—to the larger conversation (Pinto, 2023; Rapaport & Polikoff, 2024). Finally, it considers the ways in which the field of education has already begun to transform with the integration of new technology and expanded academic and emotional support systems (Catolico, 2023; Rodriguez, 2023).

These areas of research lay the foundation for understanding the conditions under which post-pandemic academic success is achieved. They also highlight the need for additional

research centered around the voices of educators who are directly navigating these changes and establishing new solutions.

Measuring Educational Success

To determine the impacts of covid on schooling, it's crucial to define academic success and see if post-pandemic students are meeting that mark. One straightforward way to measure academic success is by looking at the average state testing scores of students. Recent data clearly shows a higher percentage of failing state test grades than in pre-pandemic years (Hammerstein et al., 2021; Rosensweig, 2022). Several studies synthesized data from other studies on student's test scores post-pandemic and saw a negative impact resulting from time spent online. (Hammerstein et al., 2021; Molnár & Hermann, 2023; Pinto, 2023; Rosensweig, 2022).

Another method for measuring academic success is looking at student engagement and attitudes towards learning. Studies show that students being invested and engaged in their learning is a major contributor to their scholastic achievement (Konold et al., 2018; Schnitzler et al., 2021). Engagement is defined as a student's willingness to be emotionally, behaviorally, and cognitively involved in their learning (Schnitzler et al., 2021). While there is no clear-cut way to define educational success, firsthand accounts can help us figure out the emotions involved in a successful schooling experience. Some students notice a difference in their education after the pandemic and reminisce on how they enjoyed learning in previous years (Callimachi & Kalifa, 2021).

Aspects That Impact Success

With methods for measuring academic success identified, it becomes crucial to examine the factors that influence it. One major contributor to changes in post-pandemic success rates is attendance. During the pandemic, attendance rates dropped dramatically, and they are far from returning to pre-pandemic numbers (Kaloustian, 2023; Lester & Michelson, 2024). Chronic absenteeism—the number of students who miss about a month of the school year—has drastically increased post-pandemic (Kaloustian, 2023). Studies show that higher numbers of

absences result in an overall decrease in school performance (Kaloustian, 2023). As attendance rates continue to fluctuate, academic success of students continually suffers.

So, why are attendance rates fluctuating? Studies point to a shift in parental expectations that has decimated the urgency to keep kids in school that was once standard. During the pandemic, many parents had negative feelings toward the ineffectiveness of learning from home (Pratama & Firmansyah, 2021; Rapaport & Polikoff, 2024). These negative feelings toward online schooling have caused some parents to believe the curriculum has decreased in rigor, and pushed them to lower their own expectations to match (Rapaport & Polikoff, 2024).

In addition to a general decrease in commitment, there are certain post pandemic challenges that disproportionately harm certain demographics of families. The pandemic did not affect all students equally and low-income families were hit especially hard. These heightened disadvantages are likely directly linked to worse outcomes for low-income students.(Chen et al., 2022; Pinto, 2023). Many minority groups fear for their students' academic success in the future (Rapaport & Polikoff, 2024). Additionally, many low-income families could not successfully attend remote learning, and are still struggling to make up for these years that were completely lost (Callimachi & Kalifa, 2021; Chen et al., 2022; Pinto, 2023).

Education Transformed

Education has already had to change in many ways in the years since schooling returned to in-person instruction post-pandemic. Online learning paved the way for many technological advancements and virtual programs like Prodigy, Kahoot, and learning simulations to be increasingly used in post-pandemic classrooms (Zhang & Wasie, 2023). Chromebooks and other digital learning tools are being distributed to classrooms across the country to utilize learning programs in lessons (Rodriguez, 2023). Artificial intelligence is being increasingly used by teachers to create pieces of text to support learning, and design tutoring robots that can provide a space for students to ask questions and increase engagement (Rodriguez, 2023; Zhang & Wasie, 2023).

Afterschool programs developed post-pandemic have been used to provide academic assistance and social-emotional connection for students who need additional support (Catolico, 2023). These outside-of-school resources have been used for many years, with clear benefits. Students who consistently can attend high-quality afterschool programs will often see academic growth in the form of higher standardized test scores and healthier work habits (Vandell et al., 2007). Deficits in social health and educational well-being post-pandemic call for programs that allow students to socialize with their peers and get one-on-one learning time (Lester & Michelson, 2024). Pandemic funding has been utilized to create new resources for students post-pandemic, but more investment in high-quality after-school programs will be needed to counteract the effects (Catolico, 2023).

Conclusion

Across the literature, it is clear that academic success cannot be fully understood through test scores alone. While standardized assessments remain a central metric, researchers increasingly point to student engagement, attendance, and social-emotional wellness as critical components of long-term achievement (Schnitzler et al., 2021). Studies show that student success is heavily influenced by family support, school attendance, and structural inequalities—factors that became even more pronounced during the pandemic (Chen et al., 2022; Lester & Michelson, 2024; Pratama & Firmansyah, 2021). However, the literature has not yet fully captured how educators themselves interpret and respond to these complex shifts in their daily practice. This study addresses those gaps by centering on the voices of five educators with diverse roles. The findings help define academic success, identify the pandemic's effects, and identify strategies for bridging learning gaps in a rapidly evolving educational landscape.

Chapter III - Design and Methodology

Research Design

Although quantitative data reveals the pandemic's significant impact on schooling, it offers a limited perspective. Phenomena like behavior towards schooling, a mindset or attitude

shift amongst educators, and other factors can be difficult to capture through quantitative data (Tenny et al., 2022). Five educators with specialized roles in pre- and post-pandemic education were interviewed for this study. This study aligns with applied qualitative research, as it contributes both to knowledge and practical intervention (Patton, 2002, pp. 215–217). Specifically, it examines the question, “How has the pandemic affected elementary-level schooling?” with the goal of informing problem-solving strategies (Patton, 2002, p. 224). The interview questions were designed to generate relevant data that contributes to discourse.

The research aimed to prioritize a comprehensive understanding of each interviewee’s individual experiences. Given that the study sought to compare personal experiences, case studies were intentionally incorporated as an appropriate method for organizing and analyzing data (Patton, 2002, p. 438). For each participant, a case study was developed using all available data, allowing for systematic cross-examination during analysis. This approach allowed for the identification of common themes and differences across participants’ experiences (Patton, 2002, p. 438).

Participants

To be eligible for participation, individuals needed to be current educators within the rural Washington community and have teaching experience both before and after the onset of the pandemic. Preference was given to educators with backgrounds in literacy or reading intervention, as these perspectives were especially relevant to the study’s focus on reading and academic recovery. This selection criterion ensured that participants could meaningfully reflect on how their students’ learning needs and their own instructional practices have changed over time, while keeping the study grounded in a specific regional context without attempting to represent the entire state.

Table 1*Participant Information*

Participant	Specialization / Background	Gender	Years Teaching	School Context
Participant 1	Reading Intervention Specialist	Female	19	Rural elementary school, small community
Participant 2	MTSS Coordinator; background in general and special education	Female	23	Rural elementary school, small community
Participant 3	4th Grade General Education Teacher	Female	8	Rural elementary school; previously worked in a different district pre-COVID
Participant 4	Higher Education Psychology Faculty; Reading Intervention Lead	Male	20+	Rural higher education institution; coordinates programs with local elementary schools
Participant 5	MLL Educator; background in MTSS coordination	Female	15+	Rural elementary school, small community

Data Collection

Once participants agreed to an interview, they were asked to sign an electronic informed consent form. They were given the interview questions to review ahead of time to ensure their comfort during the interview. The researcher completed all of the interviews, utilizing Zoom's transcription software to assist in transcription. Only the audio recordings of these interviews were saved and were destroyed upon the study's completion. The interviews were conducted online. The semi-structured interviews had a set interview protocol (see Appendix A) with questions each interviewee would be asked, allowing for follow-up questions to be asked if necessary, and for questions to be altered if needed (McGrath et al., 2019).

In qualitative work, reflexivity is essential to acknowledge the subjectivity and interpersonal motivators of the researcher that helped bring the research to fruition (Olmos-Vega et al., 2023; Russell & Kelly, 2002). One of the unique qualities of qualitative research is the researcher's influence on every step of the research process, which, as a result, enriches the product put forth (Olmos-Vega et al., 2023). This interpersonal bias needs to be acknowledged throughout every step of the research process (Russell & Kelly, 2002). During analysis, it was

essential that the researcher examined their personal beliefs and kept this in mind to properly differentiate the collected data (Russell & Kelly, 2002).

Analytical Methods

Coding is a fundamental technique in qualitative research that helps organize large volumes of data by categorizing and labeling key concepts, making the information easier to navigate and analyze (Patton, 2002, p. 440; Saldana, 2009). While codes can take various forms, their primary function is to capture the essence of the data (Saldana, 2009, p. 15). In this study, descriptive coding, assigning a single word or short phrase to summarize the core topic of a passage, was used for analysis to break data into distinct topics, which were later examined for broader themes (Saldana, 2009, p. 76).

Inductive thematic analysis was used by continuously refining and grouping codes into larger conceptual categories until themes and patterns emerged (Patton, 2002, p. 453; Tenny et al., 2022). The researcher became familiar with the data, generating initial codes based on recurring ideas and participant language. The codes were then grouped into larger categories representing shared patterns across the interviews (Patton, 2002, p. 452). These codes and categories were continually refined through comparison across participants. The final themes reflected both areas of agreement and role-specific implications, and were supported with direct participant quotes to highlight the voices and perspectives central to the study.

Limitations

A study's limitations are factors that can influence the outcomes of the research, like conscious and unconscious choices by the researcher, which must be acknowledged (Ross & Bibler Zaidi, 2019). In this study, the researcher looked at a specific population through purposive sampling to get rich information from interviewees with a variety of backgrounds. As a result, the generalizability of this research must be taken into consideration when applying the results to larger populations. Another aspect that challenges the generalizability of this research is the sample size being five educators. This is a mere fraction of the educators in the target rural

county, so assuming that all educators fall under the same conclusions drawn from this data is impossible. The researcher's personal assumptions may inevitably influence the study, making it impossible to ensure that the findings are entirely free from bias.

Chapter IV - Results

Interview Profiles

Participant 5 – MLL Educator with MTSS Coordination Experience

Participant 5, an MLL (Multilingual Learner) educator with over 15 years of experience, has also served in general education and as an MTSS (Multi-Tiered System of Supports) coordinator supporting academic and behavioral interventions. She now works primarily with MLLs, helping them acquire conversational English.

To define academic success, she emphasized closing learning gaps for marginalized populations. While proficiency percentages are used for data, she stressed that success is better measured by growth: "Academic success is closing the gap." For multilingual learners, this means progressing toward grade-level standards even if they don't reach them within the usual timeframe.

Participant 3 – Fourth Grade Teacher

Participant 3, a fourth-grade teacher with nine years of experience, brought deep enthusiasm and a student-centered approach to her work, calling it "the best job in the world." She has taught in multiple districts and now works in a community with very different demographics than her pre-pandemic district, particularly in income and test performance.

When asked to define academic success, Participant 3 emphasized student mindset and personal growth over numerical outcomes. "The numbers can only tell you so much," she said, explaining that success means students take pride in progress and develop a desire to keep learning: "If we can instill this desire... and be proud of how we've gotten better, to me, that feels like academic success."

To address learning gaps, she prioritizes relationships and flexibility: “If they don’t have a relationship with their teacher, they’re not going to want to learn.” Her approach includes student voice and choice, offering multiple entry and exit points for mastering concepts and engaging students in ongoing conversations about progress. For her, collaboration, adaptability, and a sense of belonging are essential components of academic growth.

Participant 2 – MTSS Coordinator

Participant 2, an MTSS coordinator with over 23 years of experience in general education, special education, reading intervention, and behavior support, now works at an elementary school focusing on data, interventions, and behavior systems. Her broad background has shaped a flexible view of student growth.

To close learning gaps, Participant 2 prioritizes student engagement and parent involvement. She explained that students can recover from educational deficits much more easily if their parents are willing to pick them up from an after-school activity. She also stressed the need for interest-driven lessons and creative strategies, from books on favorite topics to fidget tools and flexible seating. “Can I be flashy enough for you to learn today?” she joked. Her school also uses individualized attendance plans and “Attendance Works” strategies to rebuild habits, emphasizing that “kindergarten attendance equals high school graduation.” For her, bridging gaps means more than academics—it requires more than academic recovery, it requires rebuilding structure across school communities.

Participant 1 – Reading Intervention Specialist

Participant 1, a reading intervention specialist with 19 years of experience, works with K–5 students in small groups to provide targeted reading support. She has also taught across grade levels, including special education and highly capable programs, and held district-level roles focused on school improvement.

While acknowledging pandemic challenges like reduced reading at home and inconsistent attendance, Participant 1 focused on positive shifts—specifically, her school’s

increased focus on direct family outreach. “COVID has actually helped us... be better about outreach with our parents,” she reflected. Her school moved from one-way communication to more personal engagement, using conferences and events to uncover family needs. For example, chronic absenteeism in one student was resolved when the school helped the family enroll a younger sibling in a TK program, allowing the older child to attend regularly.

Participant 4 – Head of a Higher Education Reading Intervention Program

Participant 4, a university professor of psychology with over 20 years of experience, oversees a reading intervention center that partners with local elementary schools to provide one-on-one, evidence-based tutoring. His work focuses on training graduate and undergraduate students in early intervention and academic support, serving 40–50 elementary students annually. “Interventionists and teachers only can do so much... this has been helpful for those particular kids they refer to us that need that extra attention,” he noted.

To close gaps, he advocates for individualized intervention. “There’s nothing like one-on-one where you can really address the unique kids’ needs,” he stated. His center supplements tutoring with progress monitoring and collaboration with MTSS teams. While transportation and cost often limit access, he has explored online tutoring as a free alternative, though participation remains low. Despite challenges, he believes that “with volunteers and a good evidence-based plan... you can have a really effective program,” underscoring the importance of community-based supports beyond the classroom.

Results

The themes in this research fall into three categories: how academic success is defined, the effects of COVID on schooling, and structural supports to bridge learning gaps.

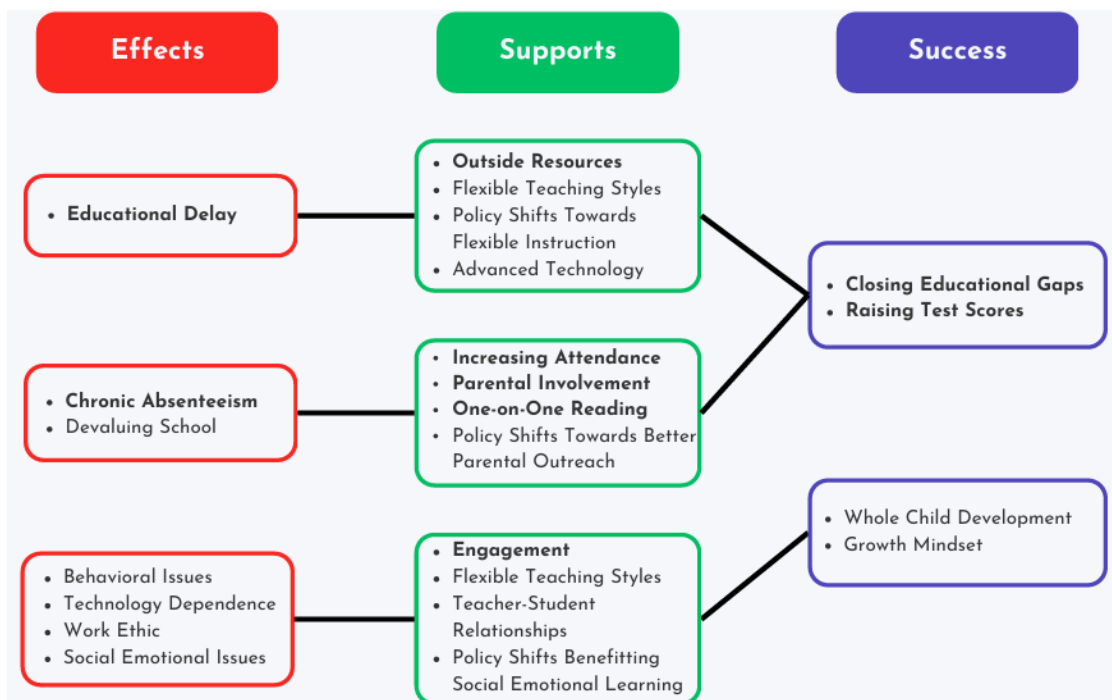
Defining Academic Success

The most common way educators defined academic success was through progress monitoring and test scores. While all participants referenced scores, four out of five emphasized that true success is better understood through a “whole-child” perspective—preparing students

to thrive both inside and outside the classroom. As Participant 1 explained, academic success means preparing a child “to be a successful adult... and to be intellectually, behaviorally, and mentally ready,” noting that if this one piece is missing, it is difficult to develop the other pieces. From the perspective of these educators, test data offers only a limited picture. Success is about ensuring students move forward prepared to appreciate their growth, collaborate with others, behave appropriately, and mentally thrive. Through improvement in these areas, the numerical growth will come naturally.

Figure 1

Pathways to Success



Note. Bolded factors were mentioned by all five interviewees.

This study uncovered multiple pathways leading to the two primary areas of academic success: whole child development and the closing of educational gaps (see Figure 1). The effects of the pandemic were categorized into areas that need similar intervention. Interviews

conducted allowed for supports to come to light that uniquely remedy these effects and bring the desired successful results. Figure 1 presents a visual synthesis of the recommended supports, organized by their frequency of mention across interviews. Items appearing at the top of each grouping were cited most often, highlighting their importance and relevance in bridging the identified gaps toward student success.

Effects of the Pandemic on Students

Educational Delays and Widening Gaps. All five participants noted academic delays, especially among students who were in early elementary grades during the height of the pandemic. Participant 1 reflected, "the kids that were in kinder and first grade at COVID time... their scores raised, but we're not seeing them be where we'd like them to be." Despite years of intervention, many students are still lagging behind.

Participant 5 expressed concern about progress: "If we're talking about academic success as students growing—as students closing that gap: Yeah, the gap is getting wider. It's not closing." Similarly, Participant 1 shared that out of 86 students in her intervention program, only two met the already lowered benchmark goals: "Like we were doing all sorts of things to try to get kids to read. I had two kids out of our entire program meet what we thought was very successful—like we set the bar low." Even foundational skills like phonological awareness were significantly impacted, as Participant 4 noted: "there's still a pocket of kids that haven't" made progress despite intensive efforts.

Participant 3 offered a contrasting note: while test scores may be lower, the inherent motivation among students remains. "The numbers were lower, but what they show me in class day in and day out is the same, like, drive to work hard and be the best I can, as I saw before." This contrast shows that while academic outcomes have dipped, the human elements of learning persist. However, these positive attributes alone are not enough to close the gap without consistent attendance and family support.

Declining Attendance and the Devaluing of School. Another near-universal observation was the decline in student attendance. Educators were clear that absenteeism is more widespread and normalized than it was pre-pandemic. Participant 2 stated plainly that “attendance is worse everywhere,” while Participant 1 described a dramatic increase in chronic absenteeism, where the number of chronically absent students rose from 15 to 20 in a group of 250, to about 35 to 40 requiring interventions post-pandemic.

Educators consistently linked these attendance issues to a broader trend of parents devaluing the importance of daily school attendance. Participant 5 shared an example of a kindergarten student who had just 59% attendance for the year. She stressed that early grades are critical for developing phonemic awareness, phonics, social skills, and fine motor skills—yet there seemed to be an assumption that “it did not matter because he was just in kindergarten.” Participant 3 described this shift as systemic, calling it “the biggest problem post-COVID” and noting that many parents now think “it’s just okay not to send their kids to school.”

This devaluation was reflected in the attitudes and actions of parents and caregivers. Participant 2 observed that more families are taking a hands-off approach, explaining that parents often drop their children off, insinuating, “You take care of it.” Participant 1 noted a similar mindset: “The viewpoint has been more, home is for home and school is [for school].” The availability of remote learning during the pandemic also contributed to this mindset. As Participant 2 put it, families developed the belief that if a child misses school, “it’s fine—we’ll just do the assignment on Schoology.” Participants agreed that this normalization of missing school has created a cycle: students are absent, fall behind, and then struggle to re-engage when trying to catch up from a disadvantaged position.

Behavior, Work Ethic, and Social-Emotional Struggles. In addition to attendance and academics, participants discussed rising behavioral challenges and a decline in social-emotional well-being. Participant 2 noted, “For elementary school, behavior challenges have gotten harder... it’s even more important to think about the whole child.” She linked these

issues to increased mental health concerns, while Participant 5 shared that "so much of our day is focused on the behavior piece," suggesting instruction often takes a backseat to emotional regulation and classroom management.

Many interviewees tied these challenges to increased technology dependence, which has affected attention spans and reading habits. Participant 1 observed, "More are dependent on devices and gaming and phones and iPads," adding that "electronics are so stimulating... if a kid has that as their choice, they might choose that over a book." Participant 4 questioned how a "phone-based culture" impacts literacy, noting that "reading is not linear anymore" because of constant clicking and scrolling.

This reliance on technology appears to correlate with declining intrinsic motivation. Participant 5 connected these trends, explaining that students "were getting everything spoon-fed to them during the pandemic... and if somebody wasn't with them, they were on a screen," creating "a learned helplessness." She suggested that constant engagement with devices diminished interest in reading and other academic tasks. Participant 1 lamented, "We used to have so many kids taking AR tests... And now... there's a complete decline in that." Fewer students read outside school, and according to Participant 4, teachers are "trying to make up for some trends in the broader culture that are inhibiting reading interests." These behavioral and motivational shifts, combined with weakened social-emotional development, underscore the need for a teaching approach that balances academic rigor with emotional support and behavioral structure.

Structural Supports to Bridge the Gaps

Engagement, Whole Child Focus, and Relationships. Educators described a clear shift toward flexible, student-centered strategies to better support the whole child. Many moved away from rigid expectations to practices that value choice, interests, and creativity. Participant 1 explained that passive instruction no longer resonates: "So really for us, the days of 'sit and get'—that's over... in order to keep their interest, it's got to be engaging." Participant 5 echoed

this: "Engagement is the only way we're going to encourage students to take control of their learning and not be so passive about it."

Teachers also adapted to diverse needs by allowing more flexibility. Participant 2 illustrated this with a hypothetical student perspective: "I'm fidgeting with something over here and I'm kind of doodling over here, but I'm also doing my math because I'm engaging with the lesson." She noted this shift as uniquely post-pandemic: "Before COVID, honestly, there'd be some teachers who'd probably be like, 'Oh my gosh. That's too much happening at the same time.' But... very highly engaged!"

This flexibility reflects a deeper mindset shift among teachers. As Participant 1 put it, "We, as teachers, had to adapt... and I think it's helped us reach some of our learners that weren't maybe as motivated." Participant 3 described this growth: "I think there was a mindset shift that happened among teachers. I have all these new tools. I have all these new skills." The challenges of COVID required teachers to grow and left them feeling more prepared to meet students' needs.

These changes also underscore the role of relationships in fostering engagement. Participant 3 stressed consistency and trust: "Stability, it's non-negotiable... being a person who keeps her promises." She added that belonging remains a core human need: "That hasn't changed, pre-post." Participant 2 agreed that relationships form the foundation of effective teaching: "If the adult doesn't really have that like, 'I'm with you, friend. We're doing this together'... that instantly will stop progress." Ultimately, emotional safety and connection remain essential precursors to academic growth.

Attendance, Family Engagement, and One-on-One Support. Improving attendance emerged as one of the most widely discussed and strongly agreed-upon themes. Every participant who addressed it reported worsening trends post-COVID and emphasized its role in learning recovery. Participant 2 framed the stakes clearly: "Kindergarten attendance does equal high school graduation... it's not about one grade, it's about every grade." Participant 1

explained the logistical challenges, noting that it is difficult to provide supplemental services “if they aren’t here.”

To address these challenges, schools have implemented new policies and outreach strategies aimed at families. Efforts now range from sharing data to individualized family attendance plans. Participant 5 described weekly newsletters with detailed attendance breakdowns, while Participant 2 mentioned using resources to create individualized family attendance plans. Reinforcing these new policies, Participant 1 reflected that, “COVID taught us a lot of different ways to be proactive about situations that could rise—things like kids being gone.”

These strategies connect directly to broader themes of parental involvement. As Participant 5 noted, “We’ve called parents in and set up attendance plans. Because we know it’s not the students usually who aren’t getting here... it’s your parents.” Several participants emphasized that family habits shape not just attendance but also home learning. Participant 1 linked engagement to skill-building: “Do they have practice times or routines for reading?” This aligns with Participant 4’s observation that “one-on-one is something [young students] can soak up,” fostering interest in books. Together, these supports work to rebuild the home-school connection, reinforce consistent learning routines, and reinstate the value of school in families’ lives.

Rethinking Instruction, Tech Integration, and Community Supports.

Participants described broader structural changes that reflect a reimagining of how learning is delivered. Several educators spoke about the need to redesign school itself. Participant 5 stated, “I think that also we have to do school differently... school is not working the way it is being done.”

One approach is through UDL and flexible instructional strategies. Participant 3 explained how allowing different problem-solving methods can increase success: “If you’re assessing two by two digit multiplication... Can a student show you how to solve that problem

any way they want? Then success increases.” This flexibility does not lower expectations, as Participant 5 clarified: “It’s rigorous expectations and here are the different routes to get there.”

Technology is another area of transformation in schools. Participant 3 described using AI tools to create customized reading passages: “I have AI create me a reading passage about Minecraft... converted into a second grade reading level, a comic strip... whatever reading level I need.” Initially skeptical, many educators now see technology as a tool that improves engagement and eases workload. As Participant 3 reflected, “All of these technological resources came out that actually improved student engagement in a big way, and they make my job easier too.”

Outside-school supports also emerged as critical. Nearly all participants described the success of their district's partnership with a local university that provides tutoring and reading intervention. Participant 1 noted, “Our interim principal saw a real need for something for kids outside of the school day,” leading to after-school and summer programs focused on collaboration and hands-on tasks. However, socioeconomic barriers like transportation can limit access to these supports. Participant 3 shared, “His mom wants that, but she doesn’t have a car. So there’s no way for her to get him there.” Online tutoring has shown promise as an alternative, with Participant 4 mentioning expanded access to reading intervention through virtual options.

Together, these innovations reflect a willingness to rethink schooling, from how curriculum is delivered to how students are supported inside and beyond the classroom. The key is creating a classroom focused on helping students achieve success on every front, while removing barriers for students. When these academic supports are made equally accessible, these shifts have the potential to fundamentally reshape learning in a post-pandemic world.

Chapter V - Conclusion

Key Findings

Impact on Schooling and Literacy

The pandemic caused widespread academic disruptions, notably in early literacy development (Rosensweig, 2022). Participants observed that foundational skills such as phonological awareness and decoding were significantly delayed, with students in early elementary years experiencing the most difficulty. Research shows that when students fall behind in early literacy learning, they are likely to see continuous lags in achievement with their future classes (Strickland et al., 2004). These delays have proven persistent despite years of intervention efforts, highlighting the long-term nature of COVID-related academic regression.

In addition to academic delays, all five educators observed significant drops in student attendance and shifts in parental attitudes toward the value of school (Lester & Michelson, 2024). Chronic absenteeism, especially in early grades, has severely hindered students' ability to retain at-level foundational skills across subjects, especially in literacy (Lester & Michelson, 2024). Several participants noted a growing disconnect between home and school, where some families appear to view education as optional or unworthy of consistent investment. This mindset not only damages the likelihood of students practicing literacy skills at home but makes it difficult to reestablish the importance of daily attendance (Kaloustian, 2023). As absenteeism becomes normalized, learning gaps widen, and students access to consistent instruction and support is sporadically disrupted.

Educators also reported increased emotional and behavioral challenges, often linked to greater dependence on technology and reduced social development (Chau et al., 2022). Educators described a rise in attention difficulties and behavioral outbursts. These issues can be attributed to reliance on screens during remote learning. When a student acts in a way that prevents them from learning, it also disrupts their peers who are trying to learn. These

behavioral shifts post pandemic not only disrupted instruction but placed additional demands on teachers who must balance classroom management with teaching.

Mitigation Through Structural Supports

To address these challenges, participants emphasized a range of instructional strategies aimed at recovery meant to last. These included flexible, engagement-centered instruction, supported by UDL principles, and intentional relationship-building between students and teachers (Schnitzler et al., 2021). Attendance emerged as a critical focus that should be at the forefront of policymaking, prioritizing proactive communication with families about attendance expectations (Kaloustian, 2023). New technological resources that emerged post-pandemic offer creative, customizable ways to engage students (Zhang & Wasie, 2023). Schools are also exploring tutoring programs that are technology-supported to provide one-on-one intervention outside regular school hours (Catolico, 2023). These resources are only effective, however, if families are aware of them and able to access them. While these efforts are promising, barriers to access, particularly related to socioeconomic status and efficient communication, can limit their effectiveness for many students.

Defining Academic Success

The participants in this study identified academic success not as a fixed benchmark, but as an evolving outcome shaped by students' academic, behavioral, and emotional development. While many referenced test scores and grade-level expectations as one way to track progress, they emphasized that true success involves more. From a whole-child perspective, academic success is defined by student growth, engagement, collaboration, and a readiness to advance to the next grade.

These definitions of success offer a critical lens through which to view the supports identified in this study. The effects of the pandemic, such as educational delays, poor attendance, and behavioral challenges, have required schools to implement adaptive strategies. These supports, including relationship-building, flexible instruction, targeted interventions, and

community resources, are ultimately designed to move students toward that more holistic vision of success (Vandell et al., 2007). In this way, the flow from effect to support to outcome becomes clear: supports are not ends in themselves, but pathways that help students reach a fuller version of academic success.

Implications for Practice

Classroom-Level Supports

At the classroom level, educators described the need for flexible, engagement-driven instruction that meets students where they are: academically, behaviorally, and emotionally (Schnitzler et al., 2021). UDL strategies, student voice and choice, and strong teacher-student relationships were all referenced as vital tools for increasing motivation and engaging students in literacy and other subjects. These practices were often paired with social-emotional learning approaches to support behavioral regulation and to create safe learning environments.

School and Family-Level Supports

At the school level, participants highlighted the importance of consistent attendance policies and strengthened family outreach. Schools have introduced attendance plans, public data-sharing tools, and individualized family meetings to reestablish the value of school in the home (Kaloustian, 2023). Parental involvement was seen not only as essential to improving attendance but also to encouraging learning beyond the classroom, particularly through home reading routines and shared academic goals (Pratama & Firmansyah, 2021).

Community and System-Level Supports

Finally, participants identified a need for broader community and system-level supports. These include partnerships with universities, after-school reading programs, and accessible tutoring. While these resources have strong potential to address learning gaps, educators also noted that logistical challenges like transportation and funding continue to prevent equitable access (Chen et al., 2022). Transportation policies and funding strategies must be prioritized

moving forward to address these barriers and fully realize the potential of community-based intervention (Catolico, 2023).

For educators and administration, this translates to investing in policy development centered on whole-child support, flexible instruction, and strategies that account for unique barriers to learning. For legislators, the findings highlight the necessity of allocating resources to support low-income and multilingual learner populations, to ensure that effective post-pandemic education is available to every learner.

Recommendations for Future Research

Future research should examine the long-term outcomes of the interventions described by participants while exploring the outlooks of students and caregivers. While comprehensive data is still emerging, as we remain in the early post-pandemic period, longitudinal studies will be especially valuable (Vandell et al., 2007). These studies could help determine whether the educational innovations developed in response to the pandemic are truly effective in closing learning gaps by looking at the data over time and gaining insight from new perspectives.

Additionally, future research would benefit from comparative studies examining the effectiveness of these supports across different geographic and demographic contexts. The educators interviewed in this project all work in rural, small community settings in Washington state, where student populations, resources, and school structures may differ significantly from those in suburban or urban areas. Expanding this research to include educators from more diverse communities could reveal important variations in how post-pandemic challenges manifest in different areas, and which supports prove most effective in addressing them.

Final Reflection

The COVID-19 pandemic has fundamentally transformed education at the elementary level. The information unearthed by this study is not just a portrait of loss, but of transformation. Beyond the challenges that continue to impact students, new developments have changed schooling for the better. Educators and their districts have adapted and must

continue to adapt to assist students in dire need of support. Students will always have barriers in the way of their learning; participant 3 emphasized this, “There's a lot! A lot in their way. And so, like I feel like I can only make the most of my six hours a day with them.” The crucial part of post-pandemic teaching is taking advantage of what resources and time are made available.

Schools are going in the right direction, with new inclusive policies that foster a community across districts and their families. Focusing on and raising up students, the ones who are most affected by the pandemic day to day, will take an environment that encourages a growth mindset and a more holistic view of education. The lessons of the pandemic have ultimately led to a more resilient and responsive educational system, one capable of, not only closing learning gaps, but rethinking how we define and pursue success for every learner.

References

- Callimachi, R., & Kalifa, T. (2021, May 5). 'I Used to Like School': An 11-Year-Old's Struggle With Pandemic Learning. *The New York Times*.
<https://www.nytimes.com/2021/05/05/us/remote-learning-education-pandemic.html>
- Catolico, E. (2023, April 10). *Can After-School Programs Help Children Recover From the Pandemic? - EdSurge News*. EdSurge. <https://www.edsurge.com/news/2023-04-10-can-after-school-programs-help-children-recover-from-the-pandemic>
- Chau, K., Bhattacharjee, A., Senapati, A., Guillemin, F., & Chau, N. (2022). Association between screen time and cumulating school, behavior, and mental health difficulties in early adolescents: A population-based study. *Psychiatry Research*, 310, 114467.
<https://doi.org/10.1016/j.psychres.2022.114467>
- Chen, C. Y.-C., Byrne, E., & Vélez, T. (2022). Impact of the 2020 pandemic of COVID-19 on Families with School-aged Children in the United States: Roles of Income Level and Race. *Journal of Family Issues*, 43(3), 719–740.
<https://doi.org/10.1177/0192513X21994153>
- Hammerstein, S., König, C., Dreisörner, T., & Frey, A. (2021). Effects of COVID-19-Related School Closures on Student Achievement-A Systematic Review. *Frontiers in Psychology*, 12. <https://doi.org/10.3389/fpsyg.2021.746289>
- Jacob, B. A., & Stanojevich, C. (2024, August 26). *Rewiring the classroom: How the COVID-19 pandemic transformed K-12 education*. Brookings.
<https://www.brookings.edu/articles/rewiring-the-classroom-how-the-covid-19-pandemic-transformed-k-12-education/>
- Kaloustian, S. (2023). *The Effects of COVID-19 on School Attendance: Examining Explanations for Chronically Absent Students* [Ed.D., The University of North Dakota].
<https://www.proquest.com/docview/2917767597/abstract/F961608A0D5D4519PQ/1>

- Konold, T., Cornell, D., Jia, Y., & Malone, M. (2018). School Climate, Student Engagement, and Academic Achievement: A Latent Variable, Multilevel Multi-Informant Examination. *AERA Open*. <https://doi.org/10.1177/2332858418815661>
- Lester, K. J., & Michelson, D. (2024). Perfect storm: Emotionally based school avoidance in the post-COVID-19 pandemic context. *BMJ Ment Health*, 27(1). <https://doi.org/10.1136/bmjment-2023-300944>
- McGrath, C., Palmgren, P. J., & Liljedahl, M. (2019). Twelve tips for conducting qualitative research interviews. *Medical Teacher*, 41(9), 1002–1006. <https://doi.org/10.1080/0142159X.2018.1497149>
- Molnár, G., & Hermann, Z. (2023). Short- and long-term effects of COVID-related kindergarten and school closures on first- to eighth-grade students' school readiness skills and mathematics, reading and science learning. *Learning and Instruction*, 83, 101706. <https://doi.org/10.1016/j.learninstruc.2022.101706>
- Olmos-Vega, F. M., Stalmeijer, R. E., Varpio, L., & Kahlke, R. (2023). A practical guide to reflexivity in qualitative research: AMEE Guide No. 149. *Medical Teacher*, 45(3), 241–251. <https://doi.org/10.1080/0142159X.2022.2057287>
- Patton, M. Q. (2002). *Qualitative Research & Evaluation Methods* (3rd ed.). SAGE.
- Pinto, S. (2023, August). *The Pandemic's Effects on Children's Education*. Federal Reserve Bank of Richmond. https://www.richmondfed.org/publications/research/economic_brief/2023/eb_23-29
- Pratama, A. R., & Firmansyah, F. M. (2021). Disengaged, Positive, or Negative: Parents' Attitudes Toward Learning From Home Amid COVID-19 Pandemic. *Journal of Child and Family Studies*, 30(7), 1803–1812. <https://doi.org/10.1007/s10826-021-01982-8>
- Rapaport, A., & Polikoff, M. (2024, January 17). The “Un-Average”: Not Every Child Bounced Back After COVID. *USC Schaeffer*. <https://healthpolicy.usc.edu/evidence-base/every-child-bounced-back-covid/>

- Rodriguez, V. (2023). *Impact of Technology on K-8 Students' Learning Post-COVID-19*.
- Rosensweig, S. (2022). "Kids are 100% Behind": *The Impact of the Covid-19 Pandemic on Elementary and Secondary School Students in Massachusetts* [Honors, Union College].
<https://digitalworks.union.edu/theses/2626>
- Ross, P. T., & Bibler Zaidi, N. L. (2019). Limited by our limitations. *Perspectives on Medical Education*, 8(4), 261–264. <https://doi.org/10.1007/s40037-019-00530-x>
- Russell, G. M., & Kelly, N. H. (2002). Research as Interacting Dialogic Processes: Implications for Reflexivity. *Forum Qualitative Sozialforschung / Forum: Qualitative Social Research*, 3(3), Article 3. <https://doi.org/10.17169/fqs-3.3.831>
- Saldana, J. (2009). *Coding Manual for Qualitative Researchers*. SAGE Publications.
<http://ebookcentral.proquest.com/lib/cwu/detail.action?docID=585421>
- Schnitzler, K., Holzberger, D., & Seidel, T. (2021). All better than being disengaged: Student engagement patterns and their relations to academic self-concept and achievement. *European Journal of Psychology of Education*, 36(3), 627–652.
<https://doi.org/10.1007/s10212-020-00500-6>
- Strickland, D. S., Morrow, L. M., Neuman, S. B., Roskos, K., Schickedanz, J. A., & Vukelich, C. (2004). The role of literacy in early childhood education. *Reading Teacher*, 58(1), 86–100. <https://doi.org/10.1598/RT.58.1.9>
- Sucena, A., Silva, A. F., & Marques, C. (2022). Reading skills intervention during the Covid-19 pandemic. *Humanities and Social Sciences Communications*, 9(1), 1–6.
<https://doi.org/10.1057/s41599-022-01059-x>
- Tenny, S., Brannan, J. M., & Brannan, G. D. (2022). Qualitative Study. In *StatPearls*. StatPearls Publishing. <http://www.ncbi.nlm.nih.gov/books/NBK470395/>
- Vandell, D. L., Reisner, E. R., & Pierce, K. M. (2007). Outcomes Linked to High-Quality Afterschool Programs: Longitudinal Findings from the Study of Promising Afterschool

Programs. In *Policy Studies Associates, Inc.* Policy Studies Associates, Inc.

<https://eric.ed.gov/?id=ED499113>

Zhang, Z., & Wasie, S. (2023). Educational Technology in the Post-Pandemic Era: Current Progress, Potential, and Challenges. *The 15th International Conference on Education Technology and Computers*, 40–46. <https://doi.org/10.1145/3629296.3629303>

Appendix A

Interview Protocol

Interview Protocol

Introduction/Warm-up (5 minutes)

Begin with introductions and describe the goals of this study.

Get some basic information from the interviewee: *How long have you been an educator and what grades have you taught? Do you enjoy what you do? Tell me about your students.*

Acknowledge specific role and explain why reading center educators were the focus group of choice for this study.

Ask for mailing address to mail compensatory gift card.

Questions (30 minutes - 1 hour)

Questions
Perception of Student Academic Success (Comprehension/Reading Levels)
Q.1 What would you define as academic success in schooling?
Q.2 Have you noticed a shift in your student's academic success in recent years? Tell a story about a student who exemplifies this change. Follow-up: What about reading levels or achievement, are there shifts that have occurred recently?
Q.3 What are some trends you see with students who are able to bridge academic gaps and meet standards compared to students who have a harder time meeting standards? Follow-up: What about reading levels or achievement, do you see similar patterns with students?
Perception of Student Motivation/Interest in School
Q.4 Have you noticed changes in the attendance patterns of your students in recent years? Why do you think that exists?
Q.5 Have your students, in the past 3 years of teaching, shown high interest in learning and how does this compare to years prior to COVID? If there have been differences, what are some examples of these differences? Follow-up: Tell a story about a student who exemplifies this change. Does interest in reading follow similar patterns?
COVID's Impacts
Q.6 If you feel like there were differences in student success before and after COVID, what do you believe is the best way for students to find academic success? Follow-up: Tell a story about a student who exemplifies this success [for each strategy mentioned]. Any specific to reading?
Q.7 Post-pandemic, have you had to change your methods of teaching to account for these changes? Follow-up: How is what you're doing as a teacher helping your students find success? What have you seen be successful for other teachers? Do you have any strategies specific to reading?
Q.8 Are there any resources or programs you believe help students see growth in a more successful/efficient way? What are some examples?

Journal of SOURCE Vol. 1, Iss. 1 (September 2025)
ISSN 2997-0059 (online)
Central Washington University