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Forbidden Love

Brooke E. Ranney

(Featured on the cover and to the right)

FACULTY MENTOR: Jinchul Kim

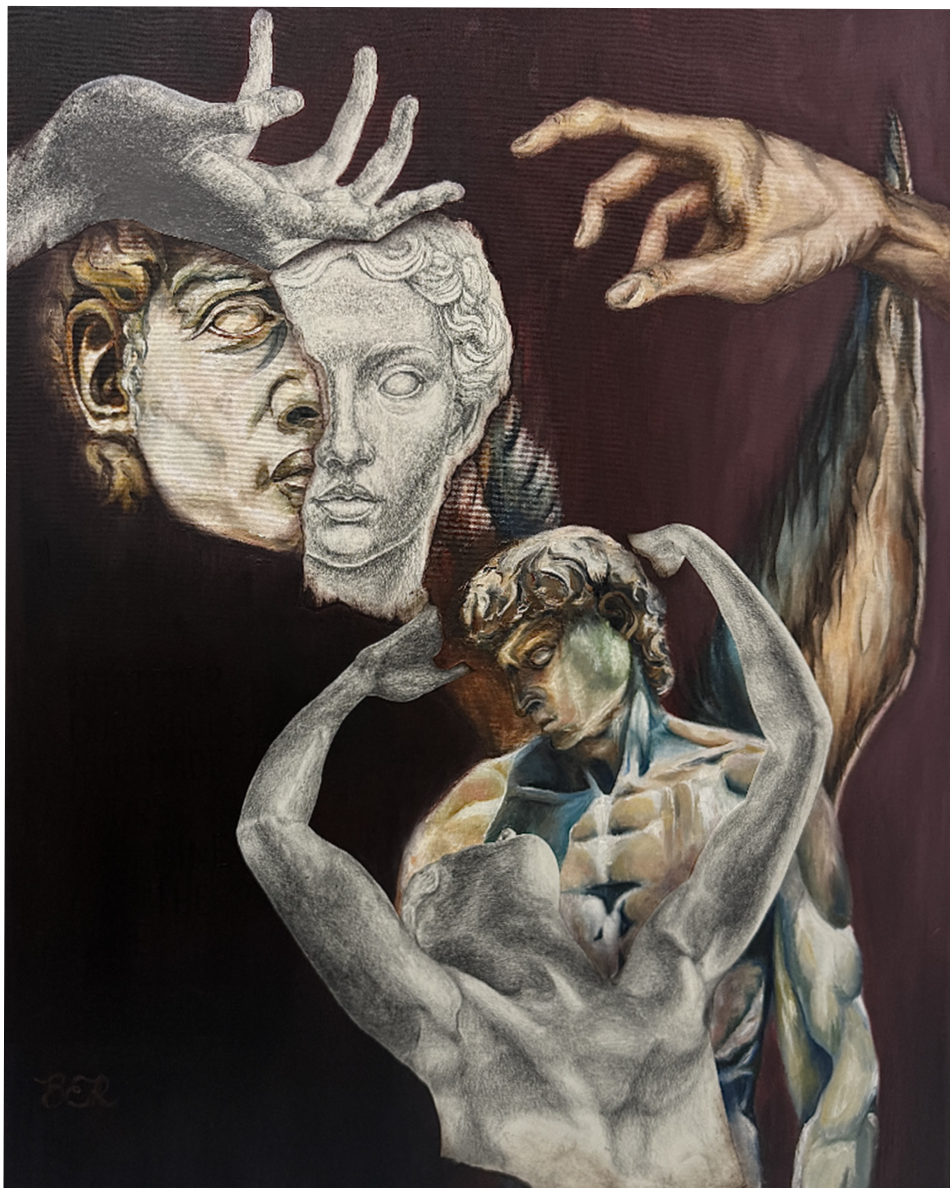
ABSTRACT

Forbidden Love is a 30" x 24" mixed-media composition on canvas that tells the story of a secret, intimate relationship between two individuals. It uses both oil paint and graphite to show the contrast in their love—deep and emotional, yet marked by distance, uncertainty, and the need to hide. Their relationship exists in a quiet, in-between space, making their connection both powerful and delicate, filled with longing and tension.

Their meeting place is set in a dark space, filled with deep shadows that reflect the secrecy and emotion of their relationship. In the darkest part of the painting, on the left side, presents an empty void, containing a secret message tucked away. Etched softly into the abyss are the words of Emily Brontë in her novel *Wuthering Heights*: "Whatever our souls are made of [yours] and mine are the same" (Brontë, 1847, p. 5). This quote, originally spoken by Catherine Earnshaw in *Wuthering Heights*, is often seen as a declaration of two souls being intertwined and inseparable. By placing the quote nearly out of sight, it invites viewers to look deeper for hidden meaning.

The figures in the painting are modeled after Roman-style marble sculptures. Inspired by Antonio Canova's famous sculpture *Cupid and Psyche*, this style shows a gentle and emotional moment between two lovers. Like that piece, *Forbidden Love* captures a quiet interaction – one full of emotion and unspoken words. Their outstretched hands nearly touch, a gesture inspired by Michelangelo's *The Creation of Adam* on the ceiling of the Sistine Chapel. This connection to both classical sculpture and Renaissance painting places the couple's story within a long history of love and human connection shaped by outside forces and fate.

A key part of the painting is the way the two figures are created using different materials. The masculine figure is painted in oil, which is bold and full of depth. On the other hand, the feminine figure is drawn in graphite, which is lighter, softer, and more fragile. The difference in materials adds emotional tension to the painting. One figure feels more present and grounded, while the other seems to fade into the background. Still, both are equally important and connected.



This contrast reflects the emotional experience of loving someone you cannot be fully with. *Forbidden Love* is about wanting to be close to someone while having to keep that closeness a secret. It explores themes of desire, silence, and restraint with the use of different art materials to help tell this story.

In the end, the painting asks the viewer to think about what it feels like to love someone in secret. It shows the strength and beauty of that kind of love, even if it cannot be lived out fully. Through its materials, classical and Renaissance influences, and emotional tone, *Forbidden Love* becomes a portrait of a relationship that is as beautiful as it is impossible.

Keywords: forbidden love, relationship, secret, desire, distance, mixed media, classical art influence, sculptures, emotion, beauty

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Contents

Letter from the Editor-in-Chief | **Ben Cooper** 1

ARTICLES

(ARTICLES APPEAR IN THE STYLE OF THEIR DISCIPLINE)

Be Our Guest (or Not!): The Role of Public Opinion in Providing Services to Same-Sex Couples | **Lian Peach** 2

The Significance of Purpose and Where We Can Find It: *Ikiru* (1952) | **Jeremy Heilmeier** 15

Review of Formaldehyde-Releasing Cosmetic Preservatives:
Mechanisms of Action and Resistance, Toxicity, Clinical Manifestations, and Relevant Legislation | **Molly Sahler** 18

Influence of Immunity Gene Mosaicism on Intraspecific Competition in *Vibrio fischeri* | **Alyson Schulze** 22

Teaching with All Five Senses: Multimodal Strategies for Deeper Learning in Early Childhood and Elementary Education | **Emily Saul** 28

The Data Adds Up: U.S. Students' Struggles in Math and the Call for Pedagogical Reform | **Albi Freda** 33

The Interdependence of Power and Profit: State, Corporate, and Criminal Convergence
in the Mexican Drug Trade | **Theo Rafael Marroquín-Gómez** 41

The Harsh Reality Hidden Within the Yoshiwara of Japan | **Reece Berry** 48

Women in Motorsports: The Uphill Battle for Safety and Equality | **Paige M. Beetler** 52

ART

Forbidden Love | **Brooke E. Ranney** Cover

Chalk Lines and Memory Threads | **Sarah Milbow** 17

Festival Hearts and Tranquil Lanterns // Glowing Together | **Daniel Etherton** 27

No One Leaves | **Kara J. Jordan** 39

Letter from the Editor-in-Chief



As we celebrate Salisbury University's Centennial here at *Laridae*, we find ourselves deeply honored to have been able to contribute to even a fraction of this school's rich history. During this time, I've been fortunate enough to see this journal grow into a truly remarkable publication that not only provides a deeply enriching experience for its editors, but also a much-needed platform for our undergraduate researchers as they discover and use their burgeoning voices.

This year's selection of articles was far more diverse than any of the other years I've worked on this journal, covering topics ranging from the significance of purpose in Akira Kurosawa's masterpiece *Ikiru*, to the impact of formaldehyde-releasing cosmetic preservatives, all the way to the fight for gender equality in motorsports. Suffice to say, we editors were truly spoiled for choice when it came to thought-provoking, impactful research to choose from.

Of course, *Laridae* is only possible through the continued support of the lovely people in the Office of Undergraduate Research and Creative Activity, especially Dr. Sherry Maykrantz, Dr. Tim Werner, and Dr. Rhyannon Bemis. On top of their support, our Managing Editors Albi Freda, AJ Fontaine, Logan Lankford, and Sophia Smith and the rest of our editorial staff helped form this edition into something truly worthy of Salisbury's Centennial. I'm humbled to have been able to work with such a lovely group of people this year, and I hope you enjoy your time with these pieces.

Beyond everything, in a time where research journals like *Laridae* are being defunded across the country, I find it important to note – to our editors, contributors, and readers alike – how necessary the support of undergraduate research is to the development of free-thinking and intellectually honest students. Be it through the use of the scientific method, the close observation of students in the classroom, or something so seemingly simple as picking up a paintbrush, the student researchers found within our pages have used their voices to inspire positive change. In these difficult times, that might be the most important thing we can do.

Thank you for your continued support,

BEN COOPER
Editor-in-Chief



Be Our Guest (or Not!): The Role of Public Opinion in Providing Services to Same-Sex Couples

Lian Peach

FACULTY MENTOR: Dr. Adam Hoffman

ABSTRACT

Despite major steps forward, in today's world, same sex couples are still not afforded the same rights and acceptance as heterosexual couples. This is exacerbated when considering whether or not private businesses should be allowed to refuse services to same sex couples for any reason, including the most prominently argued: for religious reasons. Even more interesting is how public opinion around this controversial topic is shaped, discussed, and influenced. Using data from the 2020 American National Election Studies (ANES) Time Series Study, this paper analyzes which factors have the strongest relationship to opposing the requirement that services be provided to same sex couples. The results conclude that an individual's ideology – whether they lean liberal or conservative or rather identify as moderate – is the strongest factor analyzed, with whether or not the respondent consumes conservative media as the next strongest factor. This finding is quite unsurprising, as individuals who identify as liberal are typically more supportive of progressive policies for same-sex couples and believe that government regulation is an effective and efficient method of expanding these rights, with the opposite often being true of more conservative individuals. Public opinion seems to differ widely when it comes to rights for different segments of the LGBTQIA+ community and even for different types of rights for individuals in one segment. Many individuals are affected by these legal rights, or the lack thereof, and as one can clearly see, all they want – and all they deserve – is equality.

Keywords: public opinion, same sex couples, public accommodation law, antidiscrimination law

INTRODUCTION

"All we want is equality." These are the cries and pleas of minoritized and marginalized communities all across America. In the past couple of decades, immense focus and spotlight have especially been on the LGBTQIA+ community, with examples such as same-sex marriage, same-sex couples' rights, transgender rights. This community, much more than other historically marginalized communities, seems to face intense and even hateful opposition, often from individuals in a 'traditional' culture, context, and community, who go on to cite morals and personal beliefs as valid reasons for discrimination and hate. Recently, same-sex couples have been facing challenges from businesses that refuse to provide services to them – usually small, self-owned businesses who work in the wedding industry – with the 2018 U.S. Supreme Court case *Masterpiece Cakeshop, Ltd. v. Colorado Civil Rights Commission* as primary evidence for the growing intolerance in society for LGBTQIA+ individuals.

From a public opinion standpoint, standpoint, some Americans support this refusal to provide services to same-sex couples due to a combination of deeply rooted cultural, religious, and personal beliefs. For some, traditional views on marriage, often influenced by religious teachings, see marriage as a union solely between a man and a woman. They may perceive accommodating same-sex couples as conflicting

with their values and beliefs about family and morality. Additionally, there is a fear that societal norms are shifting too quickly, leading to concerns about the erosion of what they consider to be time-honored traditions. While these perspectives are part of the broader societal debate, they are often at odds with growing calls for equal rights and anti-discrimination policies, which seek to ensure fairness and inclusion for all citizens, regardless of sexual orientation.

This paper aims to explore the factors behind why some Americans are against businesses providing their services to same-sex couples. Though it is a little explored factor, the author assumes that if Americans have more confidence in the Republican Party to better handle the national economy, the less likely they will favor regulations requiring businesses to service same-sex couples. The author predicts that this phenomenon is due to the fact that those who believe that the Republican Party is better at handling economic policy do not often have an accurate understanding of fiscal and monetary policies, and they either willingly or unwittingly listen to misinformation and disinformation, since the idea that the economy thrives much better under a Republican administration has been proven false. Because of this, these individuals seem more likely to support discriminatory policies that would allow businesses to refuse to serve same-sex couples than others.

LITERATURE REVIEW

Same-sex couples and marriage has been an extremely controversial topic over the past decade or so. Even before the ruling in *Obergefell v. Hodges* was decreed, legalizing same-sex marriage, there was strong, vocal opposition to marriages that were viewed as 'non-traditional,' those that were not one cisgender man and one cisgender woman of the same race, from a multitude of standpoints. One of the most commonly cited reasons for opposing non-traditional marriages was due to conflict with an individual's religious beliefs (Thomas, 2018). Even with increasingly favorable attitudes toward same-sex couples, there is still a large amount of the population against supporting these couples' rights (Lee & Mutz, 2019). Research shows that the main factors for a rise in public support include a decline in religiosity, increasing education levels, and polarization in cultural and morality policy viewpoints (Gaines & Garand, 2010; Lee & Mutz, 2019).

In the same vein, since the legalization of same-sex marriage, requirements for providing services to same-sex couples, often for weddings or similar celebrations, have been greatly debated. A study found that a surprising 53% of respondents support a refusal of service by businesses to gay couples (Powell et al., 2017). Perhaps even more surprising, about 50% of same-sex marriage supporters favor service

refusal by self-employed business owners, regardless of the owners' reasons for refusing service (Powell et al., 2017).

Clearly, whether or not an individual supports same-sex marriage is neither an accurate or trustworthy factor alone to determine if they will support refusal of service to same-sex couples by corporate and self-employed businesses.

While there is substantial research and evidence exploring public opinion and attitudes toward same-sex marriage as a whole, and even then, public opinion and elite discourse around the LGBTQIA+ community seems to continuously teeter and change, few studies have discussed the implications of businesses refusing services to same-sex couples. In 2017, the U.S. Supreme Court heard arguments for *Masterpiece Cakeshop, Ltd. v. Colorado Civil Rights Commission*, which sparked this recent division between antidiscrimination laws and religious freedoms. The case focused on whether Colorado's public accommodations and antidiscrimination law can require a baker to make a cake for a same-sex couple when same-sex marriage conflicted with his religious beliefs. The next year, with a 7-2 decision, the Supreme Court Justices sided with *Masterpiece Cakeshop* in favor of religious freedom (*Masterpiece Cakeshop, Ltd. v. Colorado Civil Rights Commission*, 2018; Thomas, 2018).

In fact, through this elite discourse from the Supreme Court of the United States ruling and from conservative news media that covered this case, public attitudes shifted toward favoring religious liberty at the expense of the rights of same-sex couples. Proponents for staunch freedoms of religion often argue that exemptions should be granted for business owners who do not recognize same-sex marriages as legal and moral (Thomas, 2018). However, opponents to this, who believe such exemptions would go too far and infringe on the rights of the same-sex couples, argue that businesses that are open to the public must comply with anti-discrimination laws. Much like racial discrimination would be illegal and consequences for the business would be upheld, the same protections should extend to individuals regardless of their sexual orientation or gender identity (Thomas, 2018).

Interestingly enough, a study found that when religious individuals heard religious elites speaking favorably on same-sex marriage, they, themselves, were more likely to support same-sex marriage (Harrison & Michelson, 2015). These findings highlight several, illuminating key factors. The first being that individuals with high religiosity also have diverse ideas, opinions, and perspectives, so that religiosity is

not always a reliable factor for predicting public opinion. Then, the second being that belief in religious freedom and support for same-sex marriage and antidiscrimination policies are not mutually exclusive and do not have to be viewed that way either. Lastly, the third being that religious elites and elite discourse overall has an immense impact on public opinion and public attitudes (Harrison & Michelson, 2015). Going even further, in-group elites in general are often responsible for shifting public attitudes, even for highly controversial and divisive issues. Elites in all groups seem to showcase this ability to reliably and efficiently control the public opinion of their communities.

A theory that encompasses this sentiment at its heart is the theory of elite mobilization. The theory of elite mobilization posits that backlash and policy adoption attempts originate from organized elite interests instead of through natural challenges due to the changing public opinion (Bishin et al., 2020). All in all, the elite groups tend to control and maneuver public opinion on gay rights, advancing their own specific agendas under the guise of mass public support. Elites are specially situated to have an immense impact on mobilizing and swaying the public to join their crusade. This is especially true when they are from an involved and polarizing group, such as the religious right. For example, conservative religious organizations will use mail, media, and even sermons to mobilize advocates against gay rights within the evangelical churches. These elites have policy adoption on the top of their minds, usually their directed public opinion as means to push policy through (Bishin et al., 2020). Elite mobilization theory at its core questions the actuality of organic grassroots public mobilization and instead argues that mobilization is rather the result of careful, strategic action and planning taken by the in-group elites.

In recent years, as this controversy increases in intensity, anti-LGBTQIA+ elites have been successful in their attempts to introduce and adopt anti-gay policies and legislation, especially at the local and state levels. The factors that determine support for these policies vary greatly across the different aspects of anti-gay rights laws (Taylor et al., 2012). The research shows that not one factor, such as ideology or education, will determine whether individuals support or oppose anti-gay policies. There is immense variation among these different internal factors, which made support for same-sex couples and the LGBTQIA+ community complex and uncertain (Taylor et al., 2012). More research is needed to truly assess the many aspects and factors that can determine

public acceptance and policy adoption for nondiscrimination laws.

To make the LGBTQIA+ rights issue even more complex, there are often varying viewpoints and acceptance rates for different groups under the LGBTQIA+ umbrella. Studies show that public opinions toward transgender individuals and related policies are often more negative than those of differing sexual orientations (Lewis et al., 2017). Some of the factors that may explain these differences in acceptance for nondiscrimination laws include interpersonal contact, ideology, and religious affiliation (Lewis et al., 2017). If respondents are close to several members of both the transgender community and those of differing sexual orientation, then they are more likely to support public accommodation nondiscrimination laws that aim to protect the rights of those with differing sexual orientations due to more knowledge, education, and familiarity surrounding gay rights issues.

Ideology is a large determinant, with those who are conservative or right-leaning often opposing nondiscrimination laws, especially those dealing with transgender rights, while those who are liberal or left-leaning are in support of nondiscrimination laws consistently across all groups in the LGBTQIA+ community. Interestingly, religious attendance is not a determinant of differences in support for transgender and gay rights policies, but religious affiliation is, with Christian respondents – Evangelical/Protestant and other denominations – reporting a larger difference in acceptance rates than their nonreligious counterparts (Lewis et al. 2017). Obtaining and supporting rights for the LGBTQIA+ community are often a fraught and uphill battle with a multitude of complexities, specific aspects, and differing factors to determine acceptance rates. In keeping with such complexity, it has been difficult in the past to assess the factors that would determine support or opposition for public accommodation laws in favor of same-sex marriage rights.

DATA AND METHODS

The data set used by the author for analysis is the American National Election Studies (ANES) 2020 Time Series Study. The ANES study conducts pre- and post-election surveys and interviews with participants spanning topics surrounding voting, public opinion, political efficacy, political participation, media, and more in order to provide prevalent research data to the political science field. For the ANES 2020 Time Series Study, data collection began in August 2020 and continued through the end of December 2020 (ANES 2020, 2021). According to the website, the

ANES 2020 Time Series Study features "a fresh cross-sectional sample, with respondents randomly assigned to one of three sequential mode groups: web only, mixed web, and mixed video" and additionally features "re-interviews with 2016 ANES respondents, and post-election surveys with respondents from the General Social Survey (GSS)" (ANES 2020, 2021).

The dependent variable used in this research is public opinion on the ability of businesses to choose to provide services to same-sex couples or not, with variable title being "V201406." This dependent variable is a dichotomous variable with one category being "1. Should be allowed to refuse" and the other being "2. Should be required to provide services." The dependent variable will be cross tabulated with eight different independent variables in order to determine which is the strongest factor affecting the dependent variable.

The first independent variable is five categories of generations, titled "AGE." The categories are Gen Z, Millennials, Gen X, Boomers, and Greatest generations. The second independent variable is education levels in three categories, titled "ED3." The categories are no college, bachelor's degree, and graduate degree. The third independent variable is public opinion on which party handles the economy better, titled "V201239." The categories for this variable are "1. Democrats would do a much better job, 2. Democrats would do a somewhat better job, 3. Not much difference between them, 4. Republicans would do a somewhat better job, and 5. Republicans would do a much better job." The fourth independent variable is three levels of political knowledge, titled "KNOW3." The categories are low knowledge, medium knowledge, and high knowledge. The fifth independent variable is an individual's identified party identification, titled "V201231x." The categories are "1. Strong Democrat, 2. Not very strong Democrat, 3. Independent-Democrat, 4. Independent, 5. Independent-Republican, 6. Not very strong Republican, and

7. Strong Republican." The sixth independent variable is ideologies among respondents in three categories, titled "IDEOLOGY." The three ideological categories are liberal, moderate, and conservative. The seventh independent variable is respondent self-identified race and ethnicity, titled "V201549x." The six categories for this variable are "1. White, non-Hispanic, 2. Black, non-Hispanic, 3. Hispanic, 4. Asian or Native Hawaiian/other Pacific Island, non-Hispanic alone, 5. Native American/Alaska Native or other race, non-Hispanic alone, and 6. Multiple races, non-Hispanic." The final and eighth independent variable is a dichotomous variable on whether or not the respondent typically follows conservative media sources, titled "RTMEDIA." The one category is "does not follow conservative media" with the other category being "follows conservative media." This research chose to exclude type of religion or religiosity as a dependent variable, as it has been shown to be a major influential factor in public opinion of the gay community already. The research aims to explore additional factors that seem to contribute to the support or opposition of requiring businesses to provide services to same-sex couples.

FINDINGS

There are some statistically and substantively significant findings when analyzing cross tabulations of the eight independent variables individually to the dependent variable for bivariate regression analysis. Each of the cross tabulations were found to be statistically significant to a p-value of 0.01, with the absolute value of gamma scores ranging from 0.057, a very weak relationship, to 0.671, a strong relationship.

As seen in **Table 1**, public opinion about providing services to same sex couples is clearly a very divided and controversial topic, with 49.31% of respondents believing that businesses should be allowed to refuse services and an incredibly close 49.34% of respondents

believing that businesses should be required to provide services. There is a difference of only two respondents between the opposing, polarized opinions on this topic, demonstrating just how controversial public opinions are surrounding this topic.

The first independent variable of age divides respondents into five generations. In **Table 2**, one can see that Boomers are the largest generation represented in this survey at 33.26% of total respondents, with Millennials (27.32%) and Gen X (24.92%) trailing behind. As seen in the cross tabulation (**Table 2**), the younger the respondent, the more likely they are to believe that businesses should be required to provide services to same-sex couples and vice versa, though there is not a huge difference. The data is statistically significant with a negative weak gamma score of -0.161, proving the previous statement that there may be some negative relationship between the variables, but it is not very strong at all. This result, most especially the low gamma strength score, is surprising as typically one would assume that the younger an individual, the much more likely they are to support same-sex couple rights in many or all aspects, including public accommodations. As mentioned above, while this is slightly true, there is not much of a difference in public opinion across the generations, at least, much less than one might assume there would be.

The second independent variable is education, divided into three categories. In **Table 3**, one can see that "No College" is the largest level represented by far at 55.25% of total respondents. As seen in the cross tabulation (**Table 3**), education does not seem to have much of an effect on the dependent variable. The data is statistically significant but has a positive very weak gamma score of 0.100, proving little to no relationship between the variables. This result is unexpected as studies have typically shown that the more education an individual receives, the more likely they

TABLE 1. Summary Statistics of the Dependent Variable – Service to Same Sex Couples

PRE: Services to same sex couples	N	% of Total
-9. Refused	99	1.20%
-8. Don't know	13	0.16%
1. Should be allowed to refuse	4083	49.31%
2. Should be required to provide services	4085	49.34%

TABLE 2.**Frequency Table and Cross Tabulation of 5 Generations Variable**

5 GENERATIONS	N	% of Total
GEN Z	99	1.20%
MILLENNIALS	2167	27.32%
GEN X	1977	24.92%
BOOMERS	2638	33.26%
GREATEST	530	6.68%

PRE: Services to same sex couples * 5 GENERATIONS Cross Tabulation

		GEN Z	MILLENNIALS	GEN X	BOOMERS	GREATEST	Total	
PRE: Services to same sex couples	-9. Refused	Count	0	9	14	40	9	72
		% within 5 GENERATIONS	0.0%	0.4%	0.7%	1.5%	1.7%	0.9%
	-8. Don't know	Count	0	3	1	6	1	11
		% within 5 GENERATIONS	0.0%	0.1%	0.1%	0.2%	0.2%	0.1%
	1. Should be allowed to refuse	Count	241	964	992	1393	302	3892
		% within 5 GENERATIONS	38.9%	44.5%	50.2%	52.8%	57.0%	49.1%
	2. Should be required to provide services	Count	379	1191	970	1199	218	3957
		% within 5 GENERATIONS	61.1%	55.0%	49.1%	45.5%	41.1%	49.9%
	Total	Count	620	2167	1977	2638	530	7932
		% within 5 GENERATIONS	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	113.143 ^a	12	<.001

Symmetric Measures

		Value	Asymptotic Standard Error	Approximate T	Approximate Significance
Ordinal by Ordinal	Gamma	-.161	.016	-9.856	<.001

are to have progressive ideals and support the LGBTQIA+ community. While there is a greater difference for those who have obtained graduate degrees, favoring the requirement of businesses to provide services, the other categories – no college and bachelors – are much closer in percentage, especially among those with bachelor's degrees.

The third independent variable is public opinion on which political party is better at handling the nation's economy. The largest group of respondents believe that the Republican party would do a much better job handling the nation's economy, at 28.20%, with not much difference between them following behind in second at 22.20%. The data is

statistically significant with a negative relatively strong gamma score of -0.554, meaning that the more confident an individual is that Republicans are better at handling the economy, the more likely they believe that businesses should be allowed to refuse services. This can be seen in the cross tabulation (**Table 4**), where 78.9% of respondents who said that the Republican

TABLE 3.**Frequency Table and Cross Tabulation of Education Variable**

Educ 3	N	% of Total
No College	4502	1.20%
Bachelors	2055	25.22%
Graduate	1592	19.54%

PRE: Services to same sex couples * Educ 3 Cross Tabulation

		Educ 3				
		No College	Bachelors	Graduate	Total	
PRE: Services to same sex couples	-9. Refused	Count	48	21	17	86
		% within Educ 3	1.1%	1.0%	1.1%	1.1%
	-8. Don't know	Count	7	3	3	13
		% within Educ 3	0.2%	0.1%	0.2%	0.2%
	1. Should be allowed to refuse	Count	2322	1023	681	4026
		% within Educ 3	51.6%	49.8%	42.8%	49.4%
2. Should be required to provide services	Count	2125	1008	891	4024	
	% within Educ 3	47.2%	49.1%	56.0%	49.4%	
Total		Count	4502	2055	1592	8149
		% within Educ 3	100.0%	100.0%	100.0%	100.0%

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	37.020 ^a	6	<.001

Symmetric Measures

		Value	Asymptotic Standard Error	Approximate T	Approximate Significance
Ordinal by Ordinal	Gamma	.100	.019	5.279	<.001

party would do a much better job handling the nation's economy believe that businesses should be allowed to refuse services, while 77.7% of respondents who said that the Democratic party would do a much better job handling the nation's economy believe that businesses should be required to provide services. This finding is more expected and predicted, as those who believe that the Republican Party is better at handling the nation's economy are more likely to be Republican or right-leaning themselves and may also be less politically knowledgeable as it has been proven that across history, the economy is not, in fact, much better under a Republican

administration. These individuals are then also more likely to not be in favor for government regulations, nondiscrimination laws over freedom of religion arguments, and supporting the gay community.

The fourth independent variable is three levels of political knowledge. In the frequency table (Table 5), one can see that the medium knowledge category is the largest group with 54.89% of total respondents. In the cross tabulation (Table 5), one can see that knowledge is another factor that does not really affect the public opinion on providing services to same-sex couples, even though the data is statistically

significant, as the percentages are pretty even across the board. This is also shown in the gamma score which is very weak and negative at -0.057. This result was initially surprising, but upon further reflection, it is not as surprising as it might seem at first glance. Those are who are more politically knowledgeable are likely to be attuned to the 2018 Masterpiece Cakeshop Supreme Court case, and as the court sided with Masterpiece, may be basing their public opinion on the overall decision of that Supreme Court case ruling.

The fifth independent variable is self-determined party identification, and the largest number of respondents are considered Strong

TABLE 4.

Frequency Table and Cross Tabulation of Economy Handling Perception Variable

PRE: Which party better: handling nation's economy	N	% of Total
-9. Refused	36	0.43%
-8. Don't know	5	0.06%
1. Democrats would do a much better job	1474	17.80%
2. Democrats would do a somewhat better job	1389	16.78%
3. Not much difference between them	1838	22.20%
4. Republicans would do a somewhat better job	4083	14.53%
5. Republicans would do a much better job	4085	28.20%

PRE: Services to same sex couples * Which party better: handling nation's economy Cross Tabulation

			-9. Refused	-8. Don't know	1. Democrats would do a much better job	2. Democrats would do a somewhat better job	3. Not much difference between them	4. Republicans would do a somewhat better job	5. Republicans would do a much better job	Total
PRE: Services to same sex couples	-9. Refused	Count	21	2	8	18	26	6	18	99
		% within PRE: Which party better: handling nation's economy	58.3%	40.0%	0.5%	1.3%	1.4%	0.5%	0.8%	1.2%
	-8. Don't know	Count	0	1	1	3	3	3	2	13
		% within PRE: Which party better: handling nation's economy	0.0%	20.0%	0.1%	0.2%	0.2%	0.2%	0.1%	0.2%
	1. Should be allowed to refuse	Count	8	0	319	392	763	758	1843	4083
		% within PRE: Which party better: handling nation's economy	22.2%	0.0%	21.6%	28.2%	41.5%	63.0%	78.9%	49.3%
	2. Should be required to provide services	Count	7	2	1146	976	1046	436	472	4085
		% within PRE: Which party better: handling nation's economy	19.4%	40.0%	77.7%	70.3%	56.9%	36.2%	20.2%	49.3%
	Total	Count	36	5	1474	1389	1838	1203	2335	8280
		% within PRE: Which party better: handling nation's economy	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	2869.843 ^a	18	<.001

Symmetric Measures

		Value	Asymptotic Standard Error	Approximate T	Approximate Significance
Ordinal by Ordinal	Gamma	-.554	.012	-43.364	<.001

TABLE 5.

Frequency Table and Cross Tabulation of Knowledge Level Variable

3 LEVELS OF KNOWLEDGE	N	% of Total
LOW KNOWLEDGE	2411	29.12%
MEDIUM KNOWLEDGE	4545	54.89%
HIGH KNOWLEDGE	1324	15.99%

PRE: Services to same sex couples * 3 LEVELS OF KNOWLEDGE Cross Tabulation

		LOW KNOWLEDGE	MEDIUM KNOWLEDGE	HIGH KNOWLEDGE	Total	
PRE: Services to same sex couples	-9. Refused	Count	46	37	16	99
		% within 3 LEVELS OF KNOWLEDGE	1.9%	0.8%	1.2%	1.2%
	-8. Don't know	Count	5	4	4	13
		% within 3 LEVELS OF KNOWLEDGE	0.2%	0.1%	0.3%	0.2%
	1. Should be allowed to refuse	Count	1100	2303	680	4083
		% within 3 LEVELS OF KNOWLEDGE	45.6%	50.7%	51.4%	49.3%
	2. Should be required to provide services	Count	1260	2201	624	4085
		% within 3 LEVELS OF KNOWLEDGE	52.3%	48.4%	47.1%	49.3%
	Total	Count	2411	4545	1324	8280
		% within 3 LEVELS OF KNOWLEDGE	100.0%	100.0%	100.0%	100.0%

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	35.034 ^a	6	<.001

Symmetric Measures

		Value	Asymptotic Standard Error	Approximate T	Approximate Significance
Ordinal by Ordinal	Gamma	-.057	.019	-3.003	.003

Democrats at 23.68%, and the next biggest group is Strong Republicans at 20.89%. The cross tabulation (Table 6) shows that there is a strong correlation between party ID and opinions on providing services. Respondents who are Democrats or Democrat-leaning are much more likely to support the requirement of businesses to provide service to same-sex couples while Republican or Republican-leaning are much more likely to favor the ability of businesses to refuse

services to same-sex couples. This can also be shown through the statistically significant data and negative relatively strong gamma score of -0.523. This result is not surprising and appeared as expected. Those who are a Democratic are often much more in support of the gay community and the expansion of the community's rights, while Republicans are often less supportive of the gay community and are less likely to favor government regulation of businesses.

The sixth independent variable is about the respondent's overall ideologies - liberal, moderate, or conservative. About 39% of the respondents are conservative, whereas 35% of respondents are liberal, leaving the remaining 26% as moderate, which can be seen in the frequency table (Table 7). Similar to the last independent variable, liberal respondents are extremely likely (75%) to support businesses being required to provide service to same-sex

TABLE 6.

Frequency Table and Cross Tabulation of Party Identification Variable

PRE: SUMMARY: Party ID	N	% of Total
-9. Refused	31	0.37%
-8. Don't know	4	0.05%
1. Strong Democrat	1961	23.68%
2. Not very strong Democrat	900	10.87%
3. Independent-Democrat	975	11.78%
4. Independent	968	11.69%
5. Independent-Republican	879	10.62%
6. Not very strong Republican	832	10.05%
7. Strong Republican	1730	20.89%

PRE: Services to same sex couples * PRE: SUMMARY: Party ID Cross Tabulation

		-9. Refused	-8. Don't know	1. Strong Democrat	2. Not very strong Democrat	3. Independent-Democrat	4. Independent	5. Independent-Republican	6. Not very strong Republican	7. Strong Republican	Total	
PRE: Services to same sex couples	-9. Refused	Count	18	0	10	10	13	24	6	6	12	99
		% within PRE: SUMMARY: Party ID	58.1%	0.0%	0.5%	1.1%	1.3%	2.5%	0.7%	0.7%	0.7%	1.2%
	-8. Don't know	Count	0	0	2	1	5	0	4	1	0	13
		% within PRE: SUMMARY: Party ID	0.0%	0.0%	0.1%	0.1%	0.5%	0.0%	0.5%	0.1%	0.0%	0.2%
	1. Should be allowed to refuse	Count	6	2	464	295	309	452	647	512	1396	4083
		% within PRE: SUMMARY: Party ID	19.4%	50.0%	23.7%	32.8%	31.7%	46.7%	73.6%	61.5%	80.7%	49.3%
	2. Should be required to provide services	Count	7	2	1485	594	648	492	222	313	322	4085
		% within PRE: SUMMARY: Party ID	22.6%	50.0%	75.7%	66.0%	66.5%	50.8%	25.3%	37.6%	18.6%	49.3%
Total	Count	31	4	1961	900	975	968	879	832	1730	8280	
	% within PRE: SUMMARY: Party ID	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	2588.344 ^a	24	<.001

Symmetric Measures

		Value	Asymptotic Standard Error	Approximate T	Approximate Significance
Ordinal by Ordinal	Gamma	-.523	.012	-42.872	<.001

TABLE 7.**Frequency Table and Cross Tabulation of 3 Ideologies Variable**

3 IDEOLOGIES	N	% of Total
LIBERAL	2497	35.39%
MODERATE	1818	25.77%
CONSERVATIVE	2741	38.85%

PRE: Services to same sex couples * 3 LEVELS OF KNOWLEDGE Cross Tabulation

		LIBERAL	MODERATE	CONSERVATIVE	Total	
PRE: Services to same sex couples	-9. Refused	Count	15	25	19	59
		% within 3 IDEOLOGIES	0.6%	1.4%	0.7%	0.8%
	-8. Don't know	Count	3	4	1	8
		% within 3 IDEOLOGIES	0.1%	0.2%	0.0%	0.1%
	1. Should be allowed to refuse	Count	608	813	2165	3586
		% within 3 IDEOLOGIES	24.3%	44.7%	79.0%	50.8%
	2. Should be required to provide services	Count	1871	976	556	3403
		% within 3 IDEOLOGIES	74.9%	53.7%	20.3%	48.2%
Total	Count	2497	1818	2741	7056	
	% within 3 IDEOLOGIES	100.0%	100.0%	100.0%	100.0%	

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	1621.499 ^a	6	<.001

Symmetric Measures

		Value	Asymptotic Standard Error	Approximate T	Approximate Significance
Ordinal by Ordinal	Gamma	-.671	.012	-46.089	<.001

couples while conservative respondents are much more likely (79%) to favor businesses refusing services to same-sex couples. Moderate respondents are considerably split down the middle – 54% vs. 45%. This relationship is statistically significant and has a negative strong correlation, shown through the gamma score of -0.671. This finding is also unsurprising, as individuals who identify as liberal are typically supportive of progressive policies for same-sex couples and believe that government regulation is an effective and efficient method of expanding

these rights, with the opposite often being true of conservative individuals. Moderates are unsurprisingly fairly evenly split down the middle, with a slight preference toward requiring businesses to provide services.

The seventh independent variable is the respondent's self-identified race and ethnicity. The overwhelming majority of respondents is White non-Hispanic, at 72.02% of the total respondents; whereas, the next largest group is Hispanic at only 9.20%. This reveals an immense gap in the data set (Table 8), as

these percentages are not nearly reflective of the current racial and ethnic demographics of America, meaning race could be a more salient factor, given more data. There is no clear relationship shown in the cross tabulation or through the positive weak gamma score of 0.179, though the relationship is statistically significant. This result, though does not have an overall strong gamma score, still indicates some interesting implications and findings. Those who identify as White non-Hispanic are pretty evenly split down the middle with a slight preference

TABLE 8.

Frequency Table and Cross Tabulation of Race and Ethnicity Variable

PRE: SUMMARY: R self-identified race/ethnicity	N	% of Total
-9. Refused	96	1.16%
-8. Don't know	6	0.07%
1. White, non-Hispanic	5963	72.02%
2. Black, non-Hispanic	726	8.77%
3. Hispanic	762	9.20%
4. Asian or Native Hawaiian/other Pacific Islander, non-Hispanic alone	284	3.43%
5. Native American/Alaska Native or other race, non-Hispanic alone	172	2.08%
6. Multiple races, non-Hispanic	271	3.27%

PRE: Services to same sex couples * PRE: SUMMARY: R self-identified race/ethnicity Cross Tabulation

			-9. Refused	-8. Don't know	1. White, non-Hispanic	2. Black, non-Hispanic	3. Hispanic	4. Asian or Native Hawaiian/other Pacific Islander, non-Hispanic alone	5. Native American/Alaska Native or other race, non-Hispanic alone	6. Multiple races, non-Hispanic	Total
PRE: Services to same sex couples	-9. Refused	Count	18	0	50	12	8	5	4	2	99
		% within PRE: SUMMARY: R self-identified race/ethnicity	18.8%	0.0%	0.8%	1.7%	1.0%	1.8%	2.3%	0.7%	1.2%
	-8. Don't know	Count	0	1	7	2	2	0	0	1	13
		% within PRE: SUMMARY: R self-identified race/ethnicity	0.0%	16.7%	0.1%	0.3%	0.3%	0.0%	0.0%	0.4%	0.2%
	1. Should be allowed to refuse	Count	48	3	3117	292	298	115	82	128	4083
		% within PRE: SUMMARY: R self-identified race/ethnicity	50.0%	50.0%	52.3%	40.2%	39.1%	40.5%	47.7%	47.2%	49.3%
	2. Should be required to provide services	Count	30	2	2789	420	454	164	86	140	4085
		% within PRE: SUMMARY: R self-identified race/ethnicity	31.3%	33.3%	46.8%	57.9%	59.6%	57.7%	50.0%	51.7%	49.3%
Total	Count	96	6	5963	726	762	284	172	271	8280	
	% within PRE: SUMMARY: R self-identified race/ethnicity	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	455.483 ^a	21	<.001

Symmetric Measures

		Value	Asymptotic Standard Error	Approximate T	Approximate Significance
Ordinal by Ordinal	Gamma	.179	.021	8.394	<.001

TABLE 9.**Frequency Table and Cross Tabulation of Conservative Media Variable**

Follows Conservative Media Sources	N	% of Total
Does not Follow Conservative Media	6897	83.30%
Follows Conservative media	1383	16.70%

PRE: Services to same sex couples * Follows Conservative Media Sources Cross Tabulation

			Does not Follow Conservative Media	Follows Conservative media	Total
PRE: Services to same sex couples	-9. Refused	Count	91	8	99
		% within Follows Conservative Media Sources	1.3%	0.6%	1.2%
	-8. Don't know	Count	13	0	13
		% within Follows Conservative Media Sources	0.2%	0.0%	0.2%
	1. Should be allowed to refuse	Count	2965	1118	4083
		% within Follows Conservative Media Sources	43.0%	80.8%	49.3%
	2. Should be required to provide services	Count	3828	257	4085
		% within Follows Conservative Media Sources	55.5%	18.6%	49.3%
Total	Count	6897	1383	8280	
	% within Follows Conservative Media Sources	100.0%	100.0%	100.0%	

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	660.840 ^a	3	<.001

Symmetric Measures

		Value	Asymptotic Standard Error	Approximate T	Approximate Significance
Ordinal by Ordinal	Gamma	-.655	.019	-25.667	<.001

to allowing businesses to refuse services, which is not a surprising result, but those who identify as Black non-Hispanic, Hispanic, and Asian or Native Hawaiian/Pacific Islander non-Hispanic alone are fairly overwhelmingly more in support of requiring businesses to provide services. This is likely due to the phenomenon of solidarity and advocacy of other minoritized and historically marginalized communities with each other. Native American/Alaska Native or other non-Hispanic alone and respondents of Multiple races non-Hispanic are both also evenly split down the middle with a slight lean towards

requiring services to be provided.

The eighth and final independent variable is whether or not the respondents follow conservative media sources. The large majority, at 83.30%, of respondents do not regularly follow conservative media, while only 16.70% of total respondents do follow conservative media. In this cross tabulation (**Table 9**), one can see there is certainly a relationship between these variables. While opinions on providing services are more split among the respondents who do not follow conservative media, there is clear correlation for those who do follow

conservative media to then support business in refusing services to same-sex couples (80.8%). This relationship is statistically significant and is confirmed by the strong but negative gamma score of -0.655. This finding was not surprising, as those who frequently follow conservative media sources, such as Fox News, often have an alternative outlook on issues surrounding the gay community and are, of course, incredibly likely to identify as Republican and conservative themselves, the same effect on public opinion which we have seen in the previous cross tabulations. Those who do not follow

conservative media sources may still identify as conservative or Republican and instead follow more reputable and unbiased news sources, so their public opinion may not be as misconstrued, which may explain the more even split.

CONCLUSION

Taking in the above results and findings, some stick out and need to be highlighted for their statistical significance or their gamma strength. One of the most surprising findings from this research is that age does not have a larger effect on individuals' public opinion on providing services to same-sex couples. Typically, it is assumed that those who are younger are more tolerant and accepting of progressive and anti-discriminatory laws, especially for members of the LGBTQIA+ community; however, there appears to be an incredibly weak relationship between these variables. Another interesting finding is the low gamma score for racial and ethnic identity; however, a disproportionate number of respondents self-identify as White non-Hispanic, far among the other groups,

and this discrepancy warrants further study and exploration.

All in all, from this research, ideology (liberal, moderate, and conservative) appears to be the strongest and most prominent factor in determining public opinion surrounding whether or not businesses should be required to provide services to same-sex couples, as it has the largest gamma strength score of -0.671, which somewhat contradicts the earlier hypothesis. Though there does appear to be a strong, negative relationship between the feelings on the ability to choose to provide services to same-sex couples or not and the perception of which political party is better with handling national economic policies, it was not found to be the strongest factor among the data. Additionally, instead of the initial reasoning that this relationship is due to a lack of political, historical, and economic knowledge, the reasoning seems to be more closely linked to the party identification or ideology aspects of the perception of which political party handles the economy better.

The implications of this research are far-reaching and stand as a strong jumping-off point for future research of the rights and discrimination that same-sex couples face in society, and especially in public accommodation settings. Public opinion seems to differ widely when it comes to rights for different segments of the LGBTQIA+ community and even for different types of rights for individuals in one segment, such as marriage rights, child service rights, education and employment rights, and public accommodation rights. Especially in light of the current second term of the Trump administration, many from the LGBTQIA+ community are fearful and pessimistic what this means for the expansion of future legal rights and what restrictions may be placed on current legal rights for the community, and these fears have already been proven to have substance. Many individuals are affected by these legal rights, or the lack thereof, and as one can clearly see, all they want – and all they deserve – is equality.

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The Significance of Purpose and Where We Can Find It: *Ikiru* (1952)

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ABSTRACT

This research analyzes the protagonist of Akira Kurosawa's film *Ikiru*, Kanji Watanabe, and his journey from a highly dissociated man to an inspiring figure of life and purpose. Firstly, this paper gives an introduction to who Watanabe is presented as at the start of the film and how his physical illness is representative of a broader sense of brokenness in Japanese culture after World War II. Second, it provides an analysis of a scene that embodies his rebirth into a new mindset. Previous scholarship has explored themes of bureaucracy and cultural brokenness in post-war Japan, which this analysis further investigates through the lens of Watanabe's journey. In the case of a film such as *Ikiru*, audiences can embark on a journey of self-discovery and find a new meaning of life simply through engagement with its subject matter. As the film constructively criticizes the normalized society of post-World War II Japan, it asks the audience to avoid living the kind of life its protagonist led before his rebirth—one that is consumed by work and devoid of personal connections. Ultimately, the film is inspirational in demonstrating that it is never too late to have a shift in mindset, regardless of your age or physical condition.

Keywords: environmental education, policy, Maryland, race, gender, ability, socioeconomic status, equity, environmental literacy, pro-environmental behavior, climate education

INTRODUCTION TO KANJI WATANABE

The protagonist of *Ikiru* (1952) eventually says: "I can't afford to hate anyone. I don't have that kind of time." This might lead the audience to assume that this character has a nuanced definition of the meaning behind life and legacy. While Kanji Watanabe may *reach* a state of such understanding before delivering this line, his statement stands as a stark contrast to how he is initially presented at the beginning of Akira Kurosawa's film. Within the opening minutes of *Ikiru*, the narrator informs us that Watanabe has terminal stomach cancer, and an X-ray image of his stomach is shown. When placed in a cultural context – that is, the significant meaning that the stomach (or the *hara*) holds in Japanese culture – this enhances our understanding of why this type of cancer is especially grim for Watanabe: "Translated from Japanese, the literal meaning of *hara* is 'belly,' but its true meaning is much deeper. In a spiritual sense, the word *hara* refers to your true self – who you truly are as a human being. It's seen as the unification of your physical, spiritual, and psychological dimensions" (Riffle, 2024).

As Dallas Riffle illustrates, the stomach is parallel to what the heart or soul represents within American culture; as such, if this spiritual place within the body is disrupted or distorted, a person is unlikely to reach their highest potential. Upon learning that Watanabe's *hara* has been disrupted by his terminal illness, the audience is being led to a conclusion before he even appears on screen: this is a character who is spiritually broken from the start. When Watanabe

finally does appear in the film, both his behavior and the film's narration reinforce this conclusion. We learn that Watanabe is the Chief of Public Affairs, but he's placed in the scene distantly and away from any interaction at a lone desk. He initially refuses to help a group of women who wish to drain a nearby sewage break and build a playground for children, despite the overwhelming bureaucratic processes involved. Watanabe's mannerisms in the first act (or lack thereof) are also an embodiment of his character; he's hunched over with a strained walk and has an incredibly apathetic voice and facial expression. The narrator encapsulates this character in just one phrase: "He might as well be a corpse. In fact, he's been dead for some twenty years now." (Kurosawa, 1952).

A FIGURATIVE REBIRTH

By the time *Ikiru*'s concludes, Watanabe's character has completely shifted from how he is presented in the exposition, and it's important to first consider just *when* this change happens and *why*. When Watanabe learns of his impending death, he immediately withdraws from his work and resents the life he's led over the past twenty years. He also befriends a young coworker named Toyo, who he seems to live vicariously through. Her spirit and optimism for life are traits that Watanabe seeks to have, but he doesn't know how to achieve. So much so, he begs Toyo to answer how she has been living this way: "Watanabe desperately seeks to overcome his sense of isolation through interactions with Toyo. His deep desire to mimic her 'aliveness' results

in his honest, naïve question: 'How can I be like you?' But Toyo's aliveness seems accidental – neither self-conscious nor self-chosen" (Kaufman, 2009).

Watanabe believes Toyo has some sort of secret; however, their only difference is the way each views life. While Watanabe views life as a stagnant plain, Toyo views it as a mountain of possibilities. After Watanabe asks her how she lives so freely, he undergoes a moment of enlightenment: Toyo describes her job making toy rabbits for children as fulfilling, saying it makes her feel as if she has an impact in *every one* of their lives. This inspires Watanabe to search his mind for his own version of toy rabbits. Within moments, Watanabe's expression changes from a blank stare to a joyful smile as he finally has the idea of building the playground that was asked of him. For the first time, Watanabe discovers the purpose he had previously been lacking. As he leaves the restaurant, a crowd sings "Happy Birthday" in the background, signifying his birth of a new mindset in life.

Watanabe's rebirth allows for him to connect with people in his mission, and within the short time he spends building the playground, he leaves a lasting impact on many; we see evidence of this after Watanabe passes, at his wake. While the group of women who pleaded with him for the playground openly cry and mourn this man they never personally knew, Watanabe's son and daughter-in-law seem indifferent. This contrast shows that what we choose to do with our lives is what defines how

we are truly remembered, over-and-above our simple proximity to those around us. We also see evidence of this in how the film concludes. A coworker who Watanabe has inspired to break this cycle of a senseless existence stands over the park, admiring it from a distance. The image of this coworker becoming a dark silhouette before the end credits begin leaves a lasting impact on the audience: anyone can break this cycle as Watanabe did.

CULTURAL CONTEXT OF JAPAN AND THE FUTURE

A final significant point to note is what Watanabe's journey references about Japanese culture at the time *Ikiru* was released. In the opening minutes of the film, we witness the group of women seeking help being given the runaround by various bureaucratic offices. This process is actually started by Watanabe, who at this early point in the film, is merely a contribution to this painstaking bureaucratic system. Author Hanmo Cong (2012) provides context to this time period being reflected: "*Ikiru* was produced in the year 1952, one year after the end of the American occupation

[in Japan] ... During the occupation period (briefly before the story takes place), SCAP (Supreme Commander of the Allied Powers) was dedicated to the breakup of large business trusts, or *zaibatsu*, and reform of the civil service bureaucracy ... The Allied occupation administration failed to efficiently restructure the government by implementing the reform indirectly, through many of the same agencies [were] in power during wartime" (pp. 9-10).

As Cong explains, these bureaucracies failed to be efficient in helping the citizens with issues, even outside of an environmental scope, and these first scenes of *Ikiru* reflect this. Watanabe and the heads of other offices are depicted in a darkly satirical manner, as corpses who only exist to hold a position. As Watanabe can be considered a representation of these office heads, we can also consider his rebirth as a message from Kurosawa: time will run out on everyone, and it would be best for individuals to find meaning in their work in any way they can.

Toyo is a crucial character in the development of Watanabe and for the audience, as she is the embodiment of what Kurosawa wishes these office heads would become. As miniscule as

her job may seem on the outside, she feels great purpose in her work and the impact that it leaves; none of these office heads in *Ikiru* could say the same. Additionally, Kurosawa recognizes the ease of reverting to one's old form and not implementing change – change that he seems to argue is necessary. Toward the ending of the film, we see all of Watanabe's coworkers begin to return to old form after claiming they would change previously – besides one man. This man, the same one who looks over the playground at the end, confronts their behavior and almost admonishes them; he represents the living continuation of Watanabe's journey.

Through these three key characters, Kurosawa is both telling of a story of the significance of finding purpose and pleading with those in power to uplift those beneath them. While the first half of Watanabe's journey in *Ikiru* shows how easily one can take life for granted, his reawakening reveals the fulfillment that comes with leaving a lasting impact on those around us. As an audience, we can honor Kurosawa's film through heeding this message and refusing to allow ourselves to become what Watanabe is at the beginning of this story.

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Chalk Lines and Memory Threads

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ABSTRACT

"Chalk Lines and Memory Threads," oil on canvas (16" × 20"), explores the emotional, mental, and internal landscape of the self through a nostalgic lens. The central image portrays the artist's self-portrait with her head lying down, surrounded by expressive and symbolic miniature versions of herself. As an early childhood education major, the artist has continuously learned how our early interactions and experiences influence our development. Through showcasing our childhood memories and emotions once experienced, this work highlights the often-overlooked aspects of adult identity that significantly shape who we are today.

Digging into her current self, the artist found deep connections to her childhood, reflected in miniature versions of herself engaged in activities from that time. In one version, she is playing with her family dog, running

sporadically, showcasing the freedom she wore so proudly. A version of the artist tangled in her hair, toddling with her feet, depicts the impatience of children's minds as they are tangled in their thoughts of wonder. Another version of the artist shows herself painting the sun, depicting what bright futures of hopes and expressions of creativity children grasp with such small hands. Lastly, there is a version of herself picking a flower, immersing herself back into nature, curious about opportunities, and exploring the natural world.

As our experiences and memories are presented through play as children, it goes back to child development by displaying how play is important for fostering emotional resilience and social competence. The rain cloud symbolizes this emotional resilience as it passes through the artist and creates a lake to which a version of her young self can play next to and admire. The clothing line ties symbolic expression to the childhood staple outfits that carry the stains of memories and identities. The ruffly pink dress hanging on the line recalls afternoons spent playing dress-up and having tea parties with stuffed animals, creating an emotional shelter. Hidden in the back is a playground that ties in play as the foundation for emotional and mental growth. Playgrounds become home to many

children, creating relationships and holding the loudness of laughs, shaping our childhood.

From a psychological viewpoint, the artist's design is grounded in the idea that our adult identity is not separate from our childhood, but a continuation of it. The painting visualizes how emotional patterns, dreams, and creative energy from childhood remain active forces in our lives, tied to us by threads. Through the combination of realism in the self-portrait and whimsicalness in the background, the composition symbolizes the need for teachers to hold space for both adult understanding and children's perspectives, fostering an environment where learning and growth happens through play and exploration. These moments of connection, such as playing hide and seek in the backyard or drawing at the kitchen table, become the invisible threads that anchor our adult sense of identity. This invites the viewer to consider which memories have quietly shaped their beliefs and continue to shape who they are becoming.

Keywords: self-portrait, childhood, development, identity, education, nostalgia, symbolism

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Review of Formaldehyde-Releasing Cosmetic Preservatives: Mechanisms of Action and Resistance, Toxicity, Clinical Manifestations, and Relevant Legislation

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ABSTRACT

Cosmetic products commonly incorporate preservatives to maintain product stability, extend shelf life, and prevent microbial contamination. Among chemical preservation strategies, synthetic preservatives, particularly formaldehyde releasers, are frequently used despite concerns regarding their potential health risks. This literature review examines the roles, mechanisms of antimicrobial action and microbial resistance, toxicological assessments, and regulatory oversight surrounding these compounds. Toxicological assessments link formaldehyde exposure to allergic contact dermatitis (ACD), irritant contact dermatitis (ICD), and carcinogenicity. Formaldehyde is a known human allergen and a classified Group 1 carcinogen, with sensitized individuals at risk of persistent reactions even at concentration levels below regulatory thresholds. While jurisdictions like the US, EU, and UAE limit formaldehyde concentration to 0.2% weight/weight (w/w) – meaning the total mass of this solute cannot exceed 0.2% of the total solution weight – discrepancies in labeling requirements and regulatory enforcement have allowed products to exceed safe limits without consumer awareness. In addition to this, the US does not mandate labeling for formaldehyde content below 0.05% w/w, in contrast to stricter EU and UAE policies, increasing the risk posed to sensitized consumers. Studies report unlabeled formaldehyde in products distributed internationally, highlighting regulatory gaps. This review emphasizes the need for stricter compliance measures, transparent labeling, and enhanced toxicological monitoring to mitigate the health risks associated with formaldehyde-releasing preservatives used in cosmetics.

Keywords: cosmetic preservatives, formaldehyde releasers, toxicological assessment, ACD, ICD, regulatory compliance, labeling transparency

INTRODUCTION

Cosmetic products intend to serve a variety of purposes to the consumer, including cleansing, beautifying, or altering appearance. However, several components of cosmetic products are specifically intended to maintain composition, delivery, and efficacy of the product itself. Preservatives are a common component of these products, intended to slow or inhibit microbial growth and product degradation. The use of certain synthetic preservatives, particularly formaldehyde releasers, has been linked to various adverse health effects including allergic contact dermatitis (ACD), irritant contact dermatitis (ICD), and carcinogenicity. ACD and ICD are two forms of contact dermatitis that manifest in distinct ways. ACD is an inflammatory condition that is caused by contact with allergens, characterized by a delayed type IV hypersensitivity reaction and mediated by an immune T-cell response. ICD is understood to be a nonspecific response of the skin to direct chemical damage, triggered by a wide variety of chemical substances, that causes the release of inflammatory mediators and confer skin irritation. Carcinogenicity refers to the ability of a substance or agent to cause cancer.

In order to assess and ensure consumer safety, this review covers the mechanisms of action, microbial resistance mechanisms,

toxicological assessment, legislation, and compliance surrounding the use of both general synthetic and formaldehyde-releasing preservatives in cosmetic products.

COSMETICS OVERVIEW

Cosmetics are defined as any product applied to the human body for cleansing, beautifying, promoting attractiveness, or altering appearance without affecting the body structure or functions. According to Halla et al. (2018), these products can be broken down further into subcategories, including cosmetics for personal cleaning (soaps, deodorants, shampoos); skin, hair, or integument care (toothpastes, products for external intimate care); embellishment (perfumes, lip colors); protection (solar products, anti-wrinkle products); correction (beauty masks, hair dyes); maintenance (shaving cream, moisturizers); or active cosmetics (fluoridated toothpastes, antiseptics).

Cosmetics, in addition to their individual primary ingredients and their intended functions, often contain other chemical substances that assist in their composition and/or delivery. These substances may include pigments, emulsifiers, preservatives, thickeners, emollients, humectants, surfactants, and fillers. Each type of chemical has a different intended function.

PRESERVATION STRATEGIES

Preservatives are used in a variety of food, cosmetic, and pharmaceutical products and are intended to slow or prevent bacterial growth and prevent product degradation. In addition to chemical preservatives, there are a variety of other strategies intended to reduce microbial growth in cosmetic products. Halla et al. (2018) describe the primary and secondary preservation strategies commonly used for cosmetic preservation. Primary preservation strategies include water treatment, microbial control of raw materials, equipment disinfection, and qualification of personnel. Secondary preservation strategies incorporate physical, chemical, and physiochemical aspects to reduce microbial growth and preserve product efficacy. Physical preservation strategies target materials used in and the configuration of product packaging. Chemical preservation strategies incorporate one or a combination of synthetic preservatives, natural preservatives, and multifunctional ingredients. Synthetic preservatives include organic acids, alcohols, phenols, aldehydes, formaldehyde releasers, isothiazolinones, biguanides, quaternary ammonium compounds, nitrogen compounds, heavy metal derivatives, and inorganic compounds. One class of promising natural preservatives includes plant-derived phenolic compounds such as plant extracts

and essential oils (Rathee et al., 2023). Multifunctional ingredients include, but are not limited to, chelating compounds, surfactants, humectants, and phenolic compounds. Physicochemical preservation strategies aim to reduce water activity, assess emulsion form, and control the pH of the cosmetic product (Halla et al., 2018).

MECHANISMS OF ACTION

Synthetic preservatives act through several different mechanisms of action and typically act on multiple cellular targets. Morente et al. (2013) describe three levels of interaction that may work alone or in tandem: (i) interaction with outer cellular components; (ii) interaction with the cytoplasmic membrane; and (iii) interaction with cytoplasmic constituents.

Some preservatives, such as phenols and organomercurials, disrupt the integrity of the cytoplasmic membrane, leading to dissipation of the electrochemical membrane gradient, cellular contents leakage, energy depletion, and cell death (Morente et al., 2013). Another mechanism that impairs bacterial cytoplasmic membranes, exhibited by preservatives like EDTA and quaternary ammonium compounds, involves interference with cell membrane integrity and maintenance of homeostasis that leads to cell death. These mechanisms confer leakage of integral cellular components including K^+ ions, inorganic phosphates, amino acids, nucleic acids, and proteins that are essential for the vitality of microbial species (Lambert & Hammond, 1973). Preservatives may interact with cytoplasmic constituents by cross-linking cellular components, such as proteins and nucleic acids, and interfering with cellular processes (Gorman et al., 1980); glutaraldehyde, as one example, works in this fashion. Preservatives may also inhibit crucial metabolic processes, like the inhibition of folic acid synthesis by parabens and benzoic acid, that also lead to cell death (Rathee et al., 2023). Multiple preservatives are typically used in a mixture to increase antimicrobial activity, the spectrum of activity, reduce the development of microbial resistance, and reduce risk of toxicity (Strilets et al., 2017).

FORMALDEHYDE RELEASERS AND RESISTANCE MECHANISMS

Focusing on the aldehydes and formaldehyde releasers class of synthetic preservatives, these are substances that release formaldehyde due to decomposition or chemicals synthesized from formaldehyde that may still contain residues of free formaldehyde. The source of formaldehyde releasers in cosmetic products may come from a variety of places during the manufacturing process. The product may contain formaldehyde

releasers due to their use as an active ingredient, release from preservatives in the product, use in preserving raw materials for the product, presence in raw materials, excess formaldehyde from releaser synthesis, use in product packaging sterilization, release by packaging materials (e.g. formaldehyde resins), or formation by degradation of non-formaldehyde-containing components (Groot et al., 2009).

Formaldehyde releasers are commonly used in cosmetic products, such as shampoo, shower gel, and liquid soap. Examples of formaldehyde-releasing preservatives include the following: formaldehyde, paraformaldehyde, glutaraldehyde, formalin, formic aldehyde, methanal, methyl aldehyde, methylene oxide, oxomethane, paraform, imidazolidinyl urea, diazolidinyl urea, quaternium-15, DMDM hydantoin, bronopol, bronidox, hexetidine, and methenamine, among others. As mentioned previously, these preservatives inhibit microbial activity in products by cross-linking proteins with formaldehyde, leading to protein aggregation and resulting in irreversible chemical modification that inhibits metabolism and cell division (Gorman et al., 1980).

Several antimicrobial mechanisms of resistance to formaldehyde releasers exist. Halla et al. (2018) highlight resistance mechanisms particularly in mycobacteria and gram-negative bacteria. Microbes, including *Pseudomonas putida*, *Pseudomonas aeruginosa*, and *Burkholderia fungorum*, may enzymatically degrade formaldehyde via formaldehyde dehydrogenases (FDHs (Chen et al., 2016). FDHs are zinc-dependent enzymes that utilize NAD^+ as an electron acceptor during the direct oxidation of formaldehyde to formate. Microbes may also resist cross-linking through reduction of cell permeability by changing monosaccharides of the arabinogalactan and arabinomannan fractions or by lipopolysaccharides of gram-negative bacteria (Manzoor et al., 1999).

TOXICOLOGICAL ASSESSMENT AND CLINICAL MANIFESTATIONS

Toxicological assessment of cosmetic products is essential for protecting consumer health, regulatory compliance, and product development and selection. Assessment includes risk characterization of the product through hazard identification, dose-response assessment, and characteristics of exposure including extent, duration, frequency, and route of administration (Heid et al., 2006). This process is especially important for products containing preservatives, as preservatives are the second leading group of allergens implicated in cosmetic allergy, second only to fragrances (Halla et al., 2018).

Current legislation deems the maximum

permissible limit (MPL) of formaldehyde in personal care products as 0.2% w/w (2000 ppm) in the United Arab Emirates (UAE), United States (US), European Union (EU), and other manufacturing countries. Toxicological assessments of formaldehyde-releasing preservatives in cosmetics reveal a connection to irritant (ICD) (Groot et al., 2009; Halla et al., 2018; Patel & Nixon, 2022) and allergic (ACD) contact dermatitis (Groot et al., 2009), carcinogenicity (Groot et al., 2009; Jairoun et al., 2020; Rathee et al., 2023), and facial dermatitis (Groot et al., 2009).

Formaldehyde is understood to be a well-established skin allergen. There is a high prevalence of positive patch test reactions in subjects suspected of having contact dermatitis in the US, at 8-9%, compared to 2-3% in Europe; Groot et al. (2009) found levels of 200-300 ppm free formaldehyde in cosmetic products were sufficient to induce dermatitis from short-term use on normal skin. ACD caused by formaldehyde exposure is often chronic due to its use in such a vast range of cosmetics, foods, and textile finishes. Furthermore, once a person has become sensitized to formaldehyde, they are likely to react to all formaldehyde releasers even at levels below the MPL (Groot et al., 2009). The widespread use of formaldehyde releasers in various products makes complete avoidance difficult and contributes to the persistence of ACD in sensitized individuals (Groot et al., 2009; Jairoun et al., 2020).

No direct link between formaldehyde exposure and ICD exists currently; however, it is suggested that it may contribute to the development or exacerbation of ICD. Formaldehyde is described as a potent irritant that can damage the skin barrier and increase its permeability (Chen et al., 2016). Disruption of the skin barrier makes the skin more vulnerable to irritation by formaldehyde and susceptible to further irritation from other substances; exposure to multiple irritants may have an additive or synergistic effect, amplifying the skin's inflammatory response and potentially leading to ICD (Patel & Nixon, 2022). Research by Hauksson et al. (2016) suggests that even levels of formaldehyde below the MPL, at a mere 10-40 ppm, can aggravate pre-existing ICD in allergic individuals, especially with repeated or prolonged exposure. This is especially relevant to formaldehyde releasers, which release small amounts of formaldehyde over time and have the potential to produce cumulative irritation.

Formaldehyde is classified as a Group 1 human carcinogen by the International Agency for Research on Cancer (IARC). It is linked to an increased risk of nasopharyngeal cancer and

leukemia in embalming, woodworking, and textile industry workers that are exposed to high levels of formaldehyde (Bachand et al., 2010). Due to carcinogenic speculation, formaldehyde use in cosmetics has been abandoned for formaldehyde donors (Groot et al., 2009).

LEGISLATION AND COMPLIANCE

Legislation and compliance in the US are governed by the Food & Drug Administration's (FDA) Federal Food, Drug, and Cosmetic Act (FD&C Act), and independently by the Cosmetic Ingredient Review (CIR) expert panel, as funded by the Personal Care Products Council (Halla et al., 2018). As previously stated, the MPL of formaldehyde in personal care products is 0.2% w/w (2000 ppm). In both the UAE and EU, products that contain formaldehyde or formaldehyde releasers in concentration above 0.05% w/w (500 ppm) are required to display a label stating 'contains formaldehyde' on the product, but no such requirement exists in the US.

In the US, manufacturers are independently responsible for ensuring the safety of their products and complying with the FD&C Act. CIR safety assessments of cosmetic ingredients generate reports that manufacturers may use for guidance, however the ultimate responsibility for product safety remains with the manufacturer (Halla et al., 2018). By December 2025, according to the Modernization of Cosmetics Regulation Act of 2022, cosmetic manufacturers will be mandatorily required by the FDA to follow Good Manufacturing Practices (GMPs) to ensure product safety and quality. Increasing manufacturer oversight is essential to ensure compliance with current legislation.

Jairoun et al. (2020) examined 69 personal

care products manufactured in the UAE, EU, and US that did not indicate any presence of formaldehyde on the product label and found nine of the samples to contain formaldehyde concentrations that exceed the MPL. Product samples manufactured in the UAE had an average formaldehyde content of 0.23% w/w (2300 ppm) and were distributed to and sold in the EU and US. The researchers advise updating current regulations to enforce accurate product labelling, product testing through standardized laboratory testing, and an urgent need to monitor skin sensitivity incidences that result from the use of cosmetics containing formaldehyde releasers as preservatives. Groot et al. (2009) also recommended updates of current regulations to include accurate details of product ingredients on labels, implementation of a system to inspect and license manufacturing plants, and the implementation of laboratory-based analysis and testing procedures through an accredited laboratory applying standard methodology within a predetermined tolerance framework. There is an apparent need for accurate product labeling, increased research and reporting of adverse effects, and adopting and ensuring compliance with formaldehyde-use regulations in cosmetic products.

CONCLUSION

This paper provides a comprehensive review, through evaluation of current scientific literature and case studies, of formaldehyde-releasing preservatives in cosmetic products, covering their roles in formulation, antimicrobial mechanisms, microbial resistance, toxicological profiles, and current legislative frameworks. While preservatives are essential for the safety,

stability, and shelf-life of cosmetic products, the potential for adverse health effects, especially those in relation to synthetic formaldehyde releasers, emphasize an apparent need for reform. The prevalence of ACD and ICD in response to products that contain formaldehyde releasers and the link between formaldehyde and carcinogenicity encourage improved oversight, updated legislation, and increased risk awareness surrounding their use in cosmetic products.

New standards in cosmetic preservation should focus on transparency and accountability. To address these concerns, regulatory bodies should implement stricter thresholds for permissible formaldehyde levels based on the most current toxicological evidence instead of legacy standards. Uniform global policies should be adopted to ensure consistency across manufacturing and exporting countries, reducing the risk of high-formaldehyde products entering less-regulated markets. Mandatory labeling of all cosmetic products containing formaldehyde or formaldehyde-releasing agents at any concentration would allow consumers, particularly individuals with known sensitivities, to make informed choices. Manufacturers should also be incentivized to adopt safer alternatives, such as natural preservatives or multifunctional ingredients with antimicrobial properties, through grants or labeling certifications. Periodic third-party testing and certification of preservative content may also enhance compliance and product integrity. Ultimately, meaningful reform will require collaboration between regulatory agencies, industry stakeholders, researchers, and consumer advocacy groups.

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Influence of Immunity Gene Mosaicism on Intraspecific Competition in *Vibrio fischeri*

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ABSTRACT

Bacteria engage in diverse forms of interaction through both direct and indirect means. The type VI secretion system (T6SS) is a means of direct competition where one bacterial cell physically injects another and releases toxic effectors. With these toxic effectors, there must be a way to neutralize them, and that task is completed by immunity factors. One such effector immunity (EI) pair that current literature has identified in *Vibrio cholerae* is VasX and TsiV2. The number and sequence identity of the *tsiv2* genes differ between and even within strains of *V. cholerae* giving rise to an immunity gene mosaic. These gene mosaics are theorized to increase cell survival through allowing them to neutralize many variations of the toxin. While possibly acting as a record of evolutionary progress within the bacterial genome due to the suggested method of acquiring the orphan immunity genes. A means of studying these interactions is through the symbiosis of marine bacterium, *Vibrio fischeri*, and the Hawaiian bobtail squid, *Euprymna scolopes*. Within this symbiosis, *V. fischeri* is the only bacterial species present, allowing for a controlled environment. This review aims to describe the current understanding of immunity gene mosaicism in T6SS containing microbes and its impact on bacterial competition. Consequently, this will increase the ability to understand intraspecific competition in a related species, *V. fischeri*.

Keywords: type VI secretion system, bacterial competition, *Vibrio fischeri*, effector immunity pair, gene mosaic

INTRODUCTION

Bacteria exist in diverse environments where they must interact with varying other species to survive (Dong et. al., 2012). These interactions can exist through direct competition facilitated by the type VI secretion system (T6SS) (Russell et. al., 2011). The T6SS is a microneedle possessed by many gram-negative bacterial species, that can inject toxic effectors into opposing cells (Smith et. al., 2015). Within the genome of a T6SS containing bacterium, there are immunity genes found directly downstream of the effectors (Whitney et. al., 2013). The proteins synthesized from those genes have been found to neutralize the effector located directly upstream (Whitney et. al., 2013). Variation exists in the number and identity of the immunity genes that follow those effectors between strains of the same species. This review will focus on the variation found in immunity genes between strains and how that could impact intraspecific competition in *Vibrio fischeri*.

BACTERIAL INTERACTIONS

Bacteria are ubiquitous. They can be found within complex environments, both outside in nature and even within humans (The Human Microbiome Project Consortium, 2012). In those environments, microbes encounter a wide variety of different species with which they must form relationships to survive (Dong et. al., 2012). Microbial relationships can take many forms, be antagonistic, mutualistic, competitive, or commensal (Simões et. al., 2007). These different interactions can affect the diversity and composition of areas with many bacterial

species (Holdridge et. al., 2016). Within humans, external and internal surfaces such as the skin and gastrointestinal tract lining, can benefit from coexisting with certain microbes (The Human Microbiome Project Consortium, 2012). If these microbial interactions are disrupted and the communities enter a state of dysbiosis or imbalance, infection and illnesses may occur (Gilbert et. al., 2018).

This review will focus on the competitive form of microbial interactions. Competitive interactions between microbes can take place through indirect or direct means (Holdridge et. al., 2016). Indirect competition is one of the main driving evolutionary forces in microbes (Simões et. al., 2007). It takes the form of exploitation through one microbe being able to more efficiently utilize or hoard the available nutrients (Holdridge et. al., 2016). Exploitation can also include simply taking up more surface area and not allowing other species to establish themselves (Holdridge et. al., 2016). Direct competition can take the form of interference, where cells release antimicrobial chemicals or use some other means to purposely cause neighboring cells to lyse, causing death due to pores in their membrane. (Guckes & Miyashiro, 2023). This allows the instigating microbe to decrease resource use in their area without needing to hoard or use it all themselves (Holdridge et. al., 2016). These types of competitive interactions can be studied in the actions of different strains of the marine bacterium *V. fischeri* as it establishes itself in the symbiosis with the Hawaiian bobtail squid.

THE SQUID-VIBRIO SYMBIOSIS

Studying bacterial competition can be difficult, as many natural platforms contain a wide variety of microbes in the same space. The human microbiome can contain 500-1000 different species of bacteria at any one point in time (Gilbert et. al., 2018). Studying just one interaction between two strains would be difficult in a symbiosis swarming with diverse species. This is where the mutualistic symbiosis between the marine bacterium, *V. fischeri*, and the Hawaiian bobtail squid, *Euprymna scolopes*, enters the picture (Visick et. al., 2021). *V. fischeri* resides in a specialized crypt, termed the light organ, within the squid, where they can conduct bioluminescence (Bongrand et. al., 2022). This bioluminescence allows the squid to evade predation in the darkness of night as the glow from *V. fischeri* mimics the light from the moon (Miyashiro & Ruby, 2012). *V. fischeri* is one of the only bacterial species that have been found inhabiting the light organ, with less than 2% of cells belonging to unclassified *Vibrio* species (Bongrand et. al., 2022). This symbiosis provides a model platform where host-colonization and bacterial competition can be studied within a symbiosis with only one species of bacteria present (Guckes & Miyashiro, 2023).

The various strains of *V. fischeri* inhabiting one squid conduct interference competition using a T6SS to successfully colonize *E. scolopes* (Speare et. al., 2018). A juvenile squid will be surrounded by *V. fischeri* cells when it hatches into the seawater (Visick et. al., 2021). Consequently, it will be inoculated with those strains of *V. fischeri* for the rest of its life.

The *V. fischeri* cells form an aggregate on the exterior of the squid and slowly make their way into the light organ through a small pore to settle in a crypt (Visick et al., 2021). Once inside the squid, the strains will compete through the means of the T6SS to segregate into different crypts of the light organ (Speare et al., 2018). This eliminates the existence of two different strains in the same crypt in the natural symbiosis (Speare et al., 2018). Each morning at dawn, *E. scolopes* will eject around 95% of the *Vibrio* population that resided within it (Bongrand et al., 2022). This mass disruption in the *V. fischeri* population identity yields great genomic diversity within the symbiont population (Bongrand et al., 2022). The 5% of *V. fischeri* remaining post-expulsion are tasked with re-populating the crypt to ensure bioluminescence can be conducted the following evening (Speare et al., 2018). This creates a divergence in strains that can acquire or evolve various genes for the T6SS to yield an advantage against opposing strains attempting to colonize the same area (Smith et al., 2025).

TYPE VI SECRETION SYSTEM

Many gram-negative bacteria, such as *Vibrio fischeri* and *Vibrio cholerae*, possess a T6SS and utilize it as a means of conducting direct, interference competition (Dong et al., 2012). The T6SS is a small, contact-dependent, needle-like structure with a hollow tube to allow for the piercing and injection of toxins into opposing cells (Figure 1) (Dong et al., 2012). The T6SS comprises hexameric rings to make the Hcp tube and a VgrG spike at the top (Leiman et al., 2009).

The T6SS is anchored in the cell membrane by a baseplate composed of TssE, TssF, TssG, and TssK proteins (Guckes & Miyashiro, 2023). This lancet-like apparatus allows one cell to pierce the peptidoglycan layer of another during cell-to-cell contact (Russell et al., 2011). The T6SS can then contract and expel toxic effectors into the victim cell (Smith et al., 2025). Along with those toxic effectors, the VgrG tip may also have putative effects to ensure the victim cell is intoxicated enough to lyse and no longer serve as competition to the victor (Brooks et al., 2013).

The structural and effector components of the T6SS are encoded by a T6SS gene cluster. Although the structures and effectors are encoded together, the effectors need not be present for the T6SS to form (Russell et al., 2011). The formation of the structure without effectors present may be a poor choice, as there is a proposed fitness cost associated with creating and arranging a functional T6SS while in the stationary growth phase in *V. fischeri* (Septer et al., 2023). Forming a functional T6SS without the effectors would provide the cell with a needle, but no toxins to eject through it making it less efficient at killing opposing cells (Russell et al., 2011). The energy used to form the T6SS may be better used for other methods of survival for the bacterial cell.

EFFECTOR-IMMUNITY PAIRS

The translocated effectors associated with the T6SS can be found within the T6SS gene clusters inside the bacterial genome. The genes for the effectors are organized in an operon with effectors and cognate immunity genes directly

following them (Whitney et al., 2013). They are organized as a sort of effector-immunity (EI) pair (Figure 2). This organization may have evolved from more commonly found toxin-antitoxin (TA) pairs that are present in bacteria that do not possess a T6SS (Yadav et al., 2021). The effectors that are secreted during T6SS-mediated competition can function as phospholipases, glycosaminidases, nucleases, and in many other ways to elicit damage upon competing cells (Yadav et al., 2021).

The immunity genes that follow the EI pair encode proteins that can neutralize the effectors located upstream (Whitney et al., 2013). For example, in *Pseudomonas aeruginosa* (another T6SS possessing microbe), there is an EI pair containing an effector that can damage the peptidoglycan layer of a competing cell (Whitney et al., 2013). The immunity genes that follow it encode a co-expressed protein that was found to neutralize the effector (Whitney et al., 2013). In *V. cholerae*, the toxic consequences of the TseH effector have been observed to be suppressed by the expression of a gene encoding the TsiH immunity factor, located directly downstream (Altindis et al., 2015). Another EI pair in *V. cholerae* encodes VgrG as an effector and TsaB as the cognate immunity factor (Brooks et al., 2013). The TsaB immunity factor was observed directly binding to the effector and was able to neutralize its lytic activity and render the toxin ineffective (Brooks et al., 2013).

The EI pairs present within the genome of opposing strains can determine their compatibility and who will survive the duel. Strains belonging to the same species can

FIGURE 1.

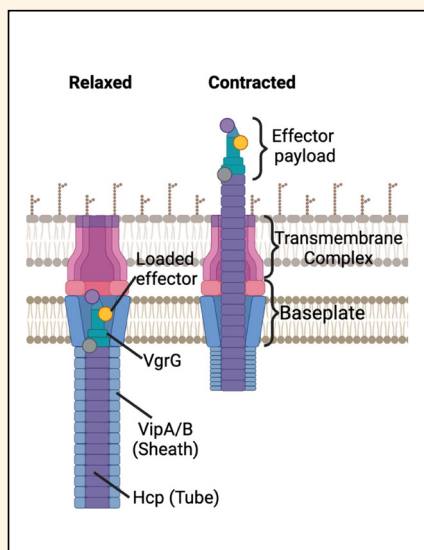
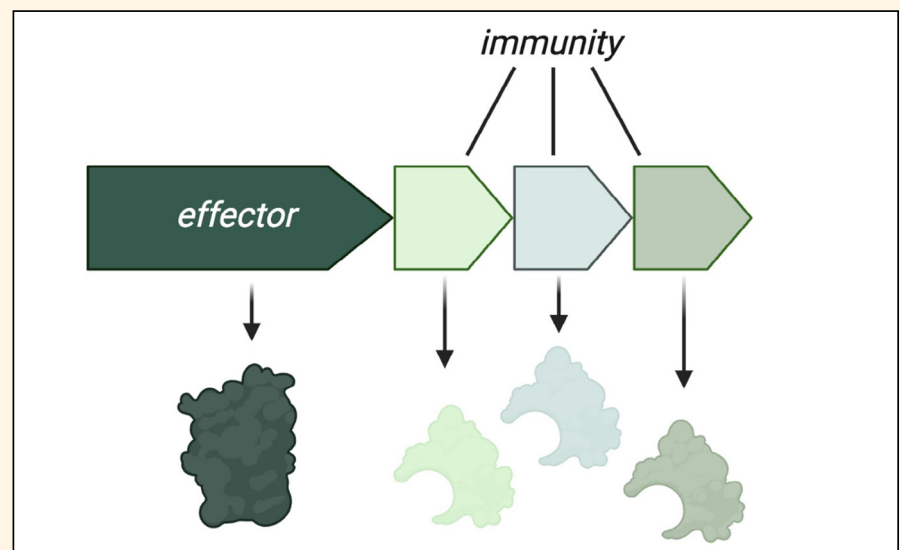


FIGURE 2.



possess subtle variations in EI pairs, along with possessing different sets of EI pairs (Alteri et al., 2017). The presence of the same EI pair and variation can assist cells in recognizing kin, while possession of distinct EI pairs can elicit a duel and result in one cell dying (Alteri et al., 2017).

To identify and characterize these EI pairs within T6SS possessing bacterial genomes, many techniques have been proposed. Mass spectrometry of secretome samples from cells with active T6SSs can be conducted to determine which proteins are being actively ejected (Altindis et al., 2015). The proteins found in the secretome can then be compared to those of a wild-type strain to observe the impacts of any mutations (Russell et al., 2011). The wild-type strain is utilized as a control in bacterial research and is meant to exemplify the species how it was found in nature; with no laboratory made alterations to the genotype or phenotype. This allows for observation of a baseline observation of the secretome as it occurs naturally. The proteins can then be identified based on many characteristics such as size and sequence. Once the proteins are known to be expressed, a bioinformatic approach can be adopted through predicting conserved domains within the sequences (Altindis et al., 2015). Finally, those proteins deemed as effectors or immunity factors can be compared to other strains or species to search for homologous or orthologous genes to better establish their function (Altindis et al., 2015). Homologous genes would be those found to be similar between separate species, while orthologous genes are those that have been found similar in the same species. Based on the identification of those EI pairs, various strains of the same species can be compared and competed based on the presence of differing EI pairs (Hussain et al., 2021). In *V. fischeri*, strain compatibility can be partially predicted by the possession of T6SS toxin genotypes (Speare et al., 2018). Although some strains appear to be able to diversify their toxins rapidly during their interactions with other strains (Speare et al., 2018).

EFFECTOR - IMMUNITY GENE EXPRESSION

The possession of EI pairs does not necessarily require expression of either or both of the proteins encoded. In *V. cholerae*, TsaB immunity factor is encoded in a gene downstream of the VgrG effector, which was expressed at the same time and was able to neutralize the toxin's activity within the cell, preventing self-intoxication (Brooks et al., 2013). The EI pair was likely co-expressed, so that when the effector is expressed, the immunity protein immediately

follows and is expressed along with the functional structures of the T6SS (Altindis et al., 2015). Although the EI pairs are expressed with the T6SS functional proteins, the T6SS is not a requirement for EI proteins to be expressed. Immunity factors can also be expressed separately from their effector and the possession of the T6SS apparatus. The immunity gene of the EI pair can still be expressed in strains that cannot assemble the T6SS to act as a sort of immune defense against attacking cells (Miyata et al., 2013). An internal promoter has been located within the gene encoding some effectors to initiate transcription of immunity genes without transcribing the effector (Miyata et al., 2013).

The EI pair of interest for this paper is the VasX-TsiV2 pair. VasX is an effector that targets the cell membrane of victim cells, and it has been found in *V. cholerae* (Altindis et al., 2015). Encoded directly downstream of *vasX*, the *tsiV2* gene can be found (Dong et al., 2012). In *V. cholerae*, when the *tsiV2* gene was lacking, the strain became susceptible to killing by a wild-type strain due to the presence of the VasX toxin (Miyata et al., 2013). The TsiV2 immunity factor can neutralize the activity of VasX in *V. cholerae*, impacting the outcome of a T6SS duel (Miyata et al., 2013). A homolog to *vasX* and *tsiV2* has been identified in *V. fischeri* (Guckes et al., in prep).

IMMUNITY GENE MOSAIC AND PREVALENCE

Within this EI pair of interest, preliminary searches of various *V. fischeri* strain genomes have shown the presence of two to five *tsiV2* immunity genes following the *vasX* gene (Guckes et al., in prep). Each of those immunity genes has varying amino acid identities within and between the strains (Guckes et al., in prep). The presence of up to seven additional immunity genes has been observed in other bacterial species, such as *V. cholerae* EI pairs as well (Hussain et al., 2021). The EI pair is organized as an effector with several immunity genes located directly downstream (Hussain et al., 2021). Due to the lack of understanding of their purpose and origin, they have been termed orphan immunity genes (Kirchberger et al., 2017). This pattern has been observed in many strains of *V. cholerae*, with each strain possessing a different mosaic of immunity genes for a single effector (Kirchberger et al., 2017).

IMMUNITY GENE MOSAIC: ORIGIN AND PURPOSE

The origin of the orphan immunity genes has not yet been established. Novel immunity gene types may occur through an intermediate gene that

differs in identity but could still confer protection to an unchanged effector (Alteri et al., 2017). This would introduce a new gene sequence for the immunity factor, adding to the diversity and selective pressure of other variations (Alteri et al., 2017). Although, novel immunity gene variations may be selected against due to the nature of the T6SS and its numerous effectors. The expulsion of many different toxins by some more competitive strains may limit the evolution of those novel immunity genes (Smith et al., 2025). If many toxins are released, those without all the matching immunity genes may not survive as they are unable to neutralize the toxins (Smith et al., 2025). This suggests novel immunity genes are slower to evolve due to the multi-faceted toxin attack, while the immunity gene mosaic is selected for as the victim would possess many neutralizing proteins to allow survival.

Conversely, immunity genes are also hypothesized to be acquired through horizontal gene transfer (HGT). HGT allows one bacterial cell to pick up new EI pairs and integrate them into its genome (Hussain et al., 2021). The EI pair would be integrated into the bacteria's genome, replacing the original effector with a novel effector and immunity gene, while retaining the original immunity genes through sequential displacement (Kirchberger et al., 2017). This results in the cell containing a new effector, a new immunity gene, and the original immunity genes are simply pushed downstream (Kirchberger et al., 2017). This would create the mosaic of one effector with many different immunity genes downstream in the EI pair, resulting in an evolutionary record of when certain strains encountered others.

The purpose of possessing an immunity gene mosaic has been theorized for many different reasons in T6SS competition survival. In most cases, strains with more immunity genes present can survive better than those with fewer (Hussain et al., 2021). This provides evolutionary selection for possessing many diverse immunity genes, as those that do contain the mosaic will survive better (Smith et al., 2025). The compatibility of competitors and victims can be determined through the possession of a certain set of immunity genes. If the correct type and number of immunity genes are present, each cell will survive, and they will be deemed compatible (Alteri et al., 2017). This can allow for recognition of kin, as those that are more related should possess the same immunity genes and be equipped to neutralize effectors from their sister cells (Alteri et al., 2017).

As the *V. fischeri* cells enter the crypt of the bobtail squid and establish, they must duel with

other strains to claim their shelter (Speare et al., 2018). The type of immunity gene mosaic in which each strain possesses may determine the victor and which strain gets to colonize and dominate that specific crypt. The mosaic presence within strains could impact the strain distribution, allowing those with a stronger mosaic to dominate and become more prevalent within the squid. When acquiring new immunity genes, *V. fischeri* could have picked up an entire new EI pair or slowly evolved a new immunity gene. If the bacterium were to utilize HGT, the cell would take a gamble as it could acquire an even more lethal EI pair or it could encounter a weaker effector, decreasing its killing ability (Kirchberger et al., 2017). This would provide an immediate shift in the identity of the effectors the cell can form, possibly creating an advantage. The slower method of acquiring a new EI pair would be through duplication and evolution of a current EI pair. This may take longer time for the bacterium,

but it could yield a novel immunity gene fit to protect against commonly encountered foe.

SELF VS NON-SELF-IMMUNITY GENES

Comparison of the immunity genes within the mosaic can yield some insight into the purpose of each gene. Some immunity genes within the EI pair that are less conserved over strains have been found to neutralize only one form of their complementary effector (Alteri et al., 2017). This mosaic may be present as a sort of immune system which allows one immunity gene to neutralize the self-version of the effector and prevent self-intoxication, while the rest correspond to foreign effectors to protect the cell from potential attacks (Kirchberger et al., 2017).

CONCLUSION AND UNANSWERED QUESTIONS

The T6SS is a biological microneedle that allows for lethal competition between microbes (Smith et al., 2015). Variation in the effectors

released by the instigator and the immunity genes possessed by the victim can determine the outcome of a T6SS-mediated battle. The immunity gene mosaics have previously been studied in *V. cholerae* (Kirchberger et al., 2017). Similar patterns have been identified in *V. fischeri* and the purpose of the possession of the many immunity genes is of current interest (Guckes et al., in prep).

While this review aims to consolidate our understanding of immunity gene mosaics, it highlights what remains to be explored. The purpose of possessing the mosaic of immunity genes has yet to be agreed upon in the literature. In addition, the mechanism of VasX neutralization by TsiV2 has yet to be explored in *V. fischeri*. The ability of the immune proteins within most EI pairs to effectively neutralize their cognate toxin and the purpose of possessing each orphan immunity gene has not been established within T6SS possessing microbes.

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Festival Hearts and Tranquil Lanterns // Glowing Together

Daniel Etherton

FACULTY MENTOR: Jeanne Anderton

ABSTRACT

"Festival Hearts and Tranquil Lanterns // Glowing Together" (2025) is a photograph taken during the artist's study abroad trip to Japan using a Sony A7III camera paired with a 28-70mm lens. The artist spent a month deeply immersed in Japanese culture, mythology, poetry, and folklore before finally finding the courage to capture the image with authenticity and respect. This process involved dozens of solemn reflections and experiences aimed at discovering what makes the Japanese heart beat, and through this, what defines the concept of the Japanese spirit, called *Yamato-Damashii* (大和魂). The artist's pursuit of this sacred spirit led him from Buddhist temples nestled within Tokyo's neon-drenched metropolis to quiet, nearly forgotten Shinto shrines hidden deep in the mountains – often miles from any trace of civilization.

This duality of experiences—praying while surrounded by millions, and praying in complete solitude—granted the artist a deeply personal understanding of the Japanese spirit. This unprecedented discovery manifested boldly in the artist's work and soul. The sacred ideas of Shinto, Japan's native religion, offered the artist guidance in appreciating everything. In Shinto, there is no line drawn between the alive and the inanimate. The energy and the *Kami* (Japanese spirits or gods) imbue without reserve and can be felt universally. The artist felt the fullest culmination of these ideas while engaging in traditional *Ohanami* (Japanese Cherry blossom viewing) with thousands of other passionate, present, and spirited Japanese park-goers scattered in groups under miles of seemingly endless blossoms. As the sun set, the fusion of excited festival goers paired brilliantly with the tranquility of the lanterns, and the artist felt the same duality he studied while praying at dozens of shrines. Only this time, as in Shinto belief, the elements of the scene did not stand apart – they converged in quiet harmony. Much like the warm lanterns lining the park, the crowds only became more beautiful as the sun fell – they began to glow and radiate from within. The lanterns themselves began to



take on the vibrancy of emotions and feelings the artist once believed were reserved only for people. Now, the lines were blurred, and this articulation of Japanese Spirit unlocked tremendous creative inspiration. When the artist passed the lantern, he felt less that he found the composition, and felt more like it found him. The sounds of *Taiko* (Traditional Japanese drum) and *Fuke Shakuhachi* (Traditional Japanese bamboo flute) filled the air, and the work revealed itself: an elegant lantern, cradled by Sakura blooms, ignited the space and petals around it. Structurally, the background features a diagonal composition divided into five distinct zones, echoing the five notes of the pentatonic scale – blue, green, black, pink, and black once more. The focal point is the central lantern, warming the viewer and the cherry tree which holds it.

The cascading descent of more lanterns invites the viewer into the festival and into the moment. This delicate yet powerful moment resonated with the artist. Its natural poetry and sensitivity to its surroundings became a subject and scene worthy of perpetuity.

Keywords: Japan, spirit, culture, Shinto, photography, lantern, cherry blossoms

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Teaching with All Five Senses: Multimodal Strategies for Deeper Learning in Early Childhood and Elementary Education

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ABSTRACT

Teaching strategies that incorporate visual, auditory, and kinesthetic methods are supported by research to enhance U.S. student learning and retention, particularly in early childhood and elementary education. By engaging multiple modalities, these approaches foster deeper cognitive processing, support emotional development, and create an inclusive learning environment that caters to diverse student needs. Research indicates that multimodal strategies benefit students with learning disabilities and improve overall academic performance by offering varied ways to engage with content for all learners with different abilities. These methods support social-emotional learning, boost retention through active engagement, and promote long-term cognitive benefits. While challenges such as financial constraints and post-pandemic implementation issues exist, the advantages of multimodal teaching far outweigh these concerns. To optimize early childhood and elementary student outcomes, educators must integrate multimodal approaches into their classrooms, ensuring that all students have access to the resources they need for success regardless of their abilities.

Keywords: Multimodal teaching, early childhood education, student retention, differentiated instruction, inclusive classrooms, social-emotional learning, learning styles

INTRODUCTION

In a world where the demands of education continue to evolve, one thing remains clear: traditional teaching methods no longer suffice to meet the needs of diverse learners. Research supports the use of multimodal and inclusive strategies, effectively addressing the wide range of abilities and backgrounds in modern classrooms (Goldstein & Williams, 2022; Goa, 2023). As classrooms become more varied, educators face the challenge of engaging students with different learning styles, home lives, and needs. The concept of multimodal teaching emerges here, a dynamic approach that integrates multiple modes of learning, such as visual, auditory, and kinesthetic methods, to create a more inclusive and effective educational experience (Fleming & Mills, 1992; Mayer & Fiorella, 2021). Thoughtful implementation of these strategies enhances academic outcomes and fosters student motivation and engagement by aligning with individual learning preferences (Immordino-Yang & Damasio, 2007).

Rooted in cognitive science and inspired by historical educational frameworks and modern educational research, multimodal teaching provides a way to cater to the varied needs of students (Mayer & Fiorella, 2021; Immordino-Yang & Damasio, 2007). Whether in inclusive classrooms, those serving students with special education needs, or in culturally diverse settings, multimodal strategies help bridge learning gaps, ensuring that no student is left behind (Carter & Hughes, 2019; Goa, 2023;

Moll et al., 1992). Through practices such as cooperative learning, hands-on activities, and integrating digital tools with physical engagement, multimodal instruction maximizes students' ability to learn and retain information (Moats & Farrell, 2005; Fleming & Mills, 1992; Birsh, 2006). While the benefits of this approach are evident, it also raises important questions about implementation, resource allocation, and overcoming the challenges posed by limited funding and infrastructure (Goldstein & Williams, 2022; Fisher & Hall, 2021). By leveraging the power of multimodal strategies, we can enhance academic performance, promote emotional well-being, and support social-emotional learning (SEL), equipping students with the tools they need to succeed academically and personally (Jennings & Greenberg, 2009; Dixon, 2016).

THE ROOTS OF MULTIMODAL EDUCATION

The historical roots of multimodal instruction can be traced back to the educational reforms of the 19th century, which emphasized sensory-rich, interactive learning. One early example is *McGuffey's Readers*, a widely used series of graded textbooks in 19th-century America that employed repetition, phonics, moral lessons, and dialogic questioning to promote literacy and critical thinking. These texts supported active engagement with language and created the foundation for structured, scaffolded instruction that acknowledged varying developmental levels among learners (Birsh, 2006). Simultaneously, the Montessori Method, developed in the

early 20th century, advanced these ideas by emphasizing student agency, independence, and multisensory engagement. Through tactile learning materials and a prepared environment, Montessori education positioned children as active participants in their learning where exploration, choice, and movement were integral to cognitive and emotional development (Carter & Hughes, 2019). This approach recognized that learning is not a passive reception of information but a dynamic, experiential process that engages multiple senses and modes of expression. These foundational philosophies continue to inform modern educational practices, particularly those focused on differentiated and inclusive instruction that accommodate diverse learning needs and preferences (Fleming & Mills, 1992; Goa, 2023).

Building on these historical foundations, the Orton-Gillingham (OG) approach, originally developed to support students with dyslexia, employs visual, auditory, and kinesthetic (VAK) modalities to reinforce comprehension and retention in literacy instruction. It has since become one of the most widely recognized multimodal methods. Students engage in tactile and movement-based activities such as tracing letters in sand, clapping syllables, and using color-coded vocabulary cards, all activating multiple sensory pathways to support literacy development (Birsh, 2006; Gillingham & Stillman, 1997). This multisensory approach has been shown to be effective amongst diverse learners with a spectrum of needs. Research

by Ritchey and Goeke (2006) highlights OG's success in general education classrooms, emphasizing its adaptability and impact across varied learner profiles.

As multimodal instruction evolves to meet the diverse needs of today's learners, differentiated instruction has emerged as a key approach for personalizing teaching methods. This approach aligns closely with the principles outlined by Klingner and Vaughn (2000), who emphasize the importance of adapting instructional strategies to the cognitive profiles of students with learning disabilities to promote academic success. Their research reinforces the value of evidence-based methods like OG, which are intentionally designed to meet diverse learner needs, thereby supporting more inclusive and equitable learning environments. By incorporating strategies such as OG, educators can enhance retention and comprehension across a spectrum of learners, effectively bridging the gap between theory and practice in inclusive education (Birsh, 2006; Ritchey & Goeke, 2006).

The theoretical underpinnings of multimodal instruction draw from psychological frameworks such as Maslow's Hierarchy of Needs. According to Maslow (1943), students must first have their physiological and emotional needs met before they can fully engage in cognitive tasks. In the educational context, this principle translates into the importance of creating emotionally safe and inclusive environments (Jennings & Greenberg, 2009). Kinesthetic and collaborative learning experiences can fulfill needs for physical engagement and social belonging, while multimodal success boosts self-esteem by validating students' unique ways of learning (Immordino-Yang & Damasio, 2007; Fleming & Mills, 1992). At the highest level, self-actualization is fostered through creative, inquiry-based tasks that allow students to explore and express their full potential (McLeod, 2007).

Multimodal instruction also plays a crucial role in creating culturally responsive and equity-centered classrooms. The Funds of Knowledge theory, introduced by Moll et al. (1992), emphasizes that students bring a wealth of experiential and cultural knowledge from their home environments, resources that traditional pedagogy often overlooks. By incorporating multimodal strategies such as storytelling, community-based projects, and visual or performance-based expression, educators can validate these diverse backgrounds and bridge the gap between home and school literacies (Moll et al., 1992; Carter & Hughes, 2019). This approach promotes deeper engagement and aligns with Maslow's (1943) emphasis on belonging and esteem, particularly for

marginalized or under-resourced communities (Jennings & Greenberg, 2009).

Despite the logistical challenges that underfunded schools may face in implementing multimodal instruction such as limited materials, time constraints, or larger class sizes, research indicates that many effective strategies require minimal resources. Collaborative group work, oral storytelling, peer mentoring, and art-based reflections are examples of low-cost yet high-impact practices that foster inclusive participation and holistic development (Carter & Hughes, 2019; Moll et al., 1992). These strategies mirror the informal learning contexts found in students' homes and communities, supporting a culturally sustaining pedagogy in which students are viewed as recipients of knowledge and as co-constructors of meaning and understanding (Moll et al., 1992; Jennings & Greenberg, 2009).

MULTIMODAL STIMULI AND COGNITIVE ENGAGEMENT

Multimodal instruction involves integrating multiple modes of communication and instructional strategies within the classroom. While the VARK model (Visual, Auditory, Reading/Writing, and Kinesthetic; Fleming and Mills, 1992) has often been cited as a framework for accommodating learner preferences, the concept of fixed "learning styles" remains controversial in educational and psychological research. Studies have found that while students may express preferences for certain modes of learning, there is limited evidence that matching instruction to these preferences improves learning outcomes (Pashler et al., 2009). What is supported, however, is that students benefit most from instruction that integrates multiple modalities simultaneously.

This multimodal approach aligns with how the brain processes information. Research in cognitive science shows that students develop more robust memory traces when modalities are used synergistically, such as pairing images with narration, because engaging multiple sensory pathways enhances encoding and retrieval (Mayer & Fiorella, 2021). Goa (2023) found that incorporating multiple modalities in English language classrooms significantly improved both engagement and retention. These findings are especially relevant in early childhood education where visual aids, movement, and storytelling help young learners grasp abstract concepts (Zhao, Chen, & Ma, 2021). Additionally, active engagement through multiple senses reinforces neural connections, leading to improved recall and application of knowledge (Immordino-Yang & Damasio, 2007).

These early innovations are grounded in

principles of cognitive load theory and dual coding theory. Mayer and Fiorella (2021) assert that when learners receive information through multiple sensory channels, their cognitive processing is enhanced, leading to deeper memory encoding and improved retention. Swanson and Deshler (2003) support this by noting that instructional generalization is more effective when teaching methods are aligned with learners' cognitive profiles. The brain's working memory, which is responsible for temporarily holding and processing new information, benefits from multimodal delivery by reducing overload in any single channel and distributing the cognitive load across both visual and auditory pathways (Mayer & Fiorella, 2021).

NURTURING HEARTS TO SHAPE MINDS

Multimodal teaching strategies foster support for emotional engagement in the classroom. Emotional support is a critical yet often overlooked aspect of effective teaching. Dixon (2016) illustrates how tools such as peace corners, puppets, and role-play activities help young children process emotions while simultaneously reinforcing academic concepts. Safe environments enhance students' ability to engage, persevere, and collaborate with peers (Jennings & Greenberg, 2009). By acknowledging and supporting emotional needs, multimodal classrooms promote a sense of safety that encourages risk-taking and curiosity, both of which are essential for meaningful learning (Immordino-Yang & Damasio, 2007).

Tharp and Gallimore (1988) reinforce this by suggesting that learning is most effective when situated in social contexts. Social-Emotional Learning (SEL)-oriented multimodal strategies enable students to learn through interaction, reflection, and collaboration, stimulating deeper understanding. These strategies align with the growing recognition of the "whole child" approach in education, where emotional well-being and academic learning are treated as intertwined goals (Jennings & Greenberg, 2009). The ability to self-regulate, express feelings, and work effectively with others is as crucial for academic success as mastering content (Immordino-Yang & Damasio, 2007).

Research emphasizes that emotional engagement, particularly in early childhood education, strengthens the cognitive-emotional connection necessary for sustained academic growth. According to Immordino-Yang and Damasio (2007), emotions play a fundamental role in cognitive processes such as memory, attention, and decision-making. Multimodal activities – such as cooperative games, musical storytelling, and expressive arts – offer students

opportunities to connect emotionally with content, making learning more meaningful and personally relevant (Jennings & Greenberg, 2009). When students are emotionally invested, they are more likely to internalize information and develop intrinsic motivation, fostering a love for learning that transcends academic requirements (Zhao, Chen, & Ma, 2021).

Emotionally responsive classrooms created through multimodal methods can help mitigate the adverse effects of trauma and stress, particularly in under-resourced or high-needs environments. Jennings and Greenberg (2009) argue that emotionally supportive classrooms contribute to stronger teacher-student relationships and improved behavioral outcomes. Through the consistent use of multimodal strategies such as journaling, mindfulness exercises, and structured group discussions, teachers can provide students with accessible emotional outlets (Dixon, 2016). These approaches build students' resilience and coping mechanisms, thereby reinforcing emotional stability, enhancing executive functioning, and reducing disruptive behaviors that may impede learning (Jennings & Greenberg, 2009). Integrating emotional literacy into daily instruction equips students with the tools to understand and manage their emotions, laying the groundwork for academic success and personal growth (Maslow, 1943).

MULTIMODAL INSTRUCTION AS A BRIDGE TO EQUITY

Multimodal strategies are valuable in promoting inclusivity. The adaptability of the OG method makes it highly effective in both special education and mainstream classrooms. Moats and Farrell (2005) emphasize that multisensory instruction enables teachers to tailor lessons to meet individual learner needs. This flexibility is essential for accommodating students with disabilities, language barriers, or cultural differences. In inclusive classrooms, students may face a range of challenges. For instance, some students may require speech-language interventions, while others might benefit from tactile reinforcement. In practice, this might lead to a teacher guiding students through writing letters in shaving cream, simultaneously saying the letter sounds aloud with the letter depicted on a large poster. This approach helps all students engage through touch, sight, and sound, providing multiple sensory pathways for accessing learning (Birsh, 2006; Gillingham & Stillman, 1997). These multimodal strategies bridge differences in learning needs by making content accessible to diverse learners.

Moreover, multimodal strategies foster

equity in education by supporting differentiated instruction. Carter and Hughes (2019) advocate for differentiated instruction as a key method for ensuring equity. By employing varied strategies such as visual timelines, tactile learning stations, and group storytelling, teachers create inclusive learning experiences that reach all students. This improves academic outcomes and cultivates a classroom culture where all learners feel valued and supported (Goldstein & Williams, 2022). For example, during a unit on community helpers, students might choose to role-play as a firefighter, draw a picture of a nurse, or build a post office with blocks to demonstrate their understanding. Such activities allow each child to express their learning in a way that fits their interests and abilities while aligning with the same academic content. By offering these differentiated approaches, teachers ensure that all students can succeed and participate fully, regardless of background or ability.

In inclusive classrooms, multimodal strategies also reduce the stigma for students receiving accommodations, creating a shared learning space where all students can thrive.

Differentiation, when implemented effectively, ensures that no student is marginalized based on ability, language, or background. For example, visual aids and tactile materials are particularly beneficial for students with learning disabilities or English Language Learners, providing multiple avenues for understanding the content. These strategies support academic achievement and encourage social inclusion, as students with varying needs engage with their peers in meaningful ways (Swanson & Deshler, 2003; Zhao, Chen, & Ma, 2021).

CONFRONTING THE LIMITS OF MULTIMODAL IMPLEMENTATION

Despite its promise, multimodal instruction faces several challenges. One major concern is the financial and logistical burden it places on schools. Goldstein and Williams (2022) argue that implementing multimodal strategies requires significant investment in teacher training, materials, and sometimes technology. This is problematic for underfunded districts where teachers already face high workloads and limited resources. Schools with limited access to manipulatives (such as base ten blocks), interactive whiteboards, or adaptive software may find it difficult to implement these strategies on a wide scale (Fisher & Hall, 2021). Additionally, larger class sizes and time constraints can make delivering individualized instruction in a multimodal framework more difficult, further complicating efforts to provide equitable

learning experiences (Zhao, Chen, & Ma, 2021).

The COVID-19 pandemic further disrupted consistent multimodal implementation. Fisher and Hall (2021) found that many school districts struggled with fragmented adoption of multimodal strategies, leading to unequal learning outcomes. Some educators became overly reliant on technology, which diminished the hands-on and social aspects that are central to multimodal learning (Zhao, Chen, & Ma, 2021). In large classrooms with limited adult support, sustaining differentiated instruction also proves difficult, as teachers must balance a variety of learning needs with limited time and resources (Birsh, 2006). Moreover, students with limited access to stable internet or learning devices often fell behind, despite the best efforts of educators to provide equitable learning experiences (Goldstein & Williams, 2022).

Another concern is the overuse of technology in early education environments. While educational technology can supplement instruction, its excessive application can hinder student growth – particularly when used as a replacement for tactile, multimodal methods. Children in preschool and kindergarten specifically require physical interactions with their learning materials to build fine motor skills, spatial awareness, and conceptual understanding (Jennings & Greenberg, 2009). When technology replaces traditional hands-on learning, it may reduce the sensory engagement essential for memory formation and cognitive development (Mayer & Fiorella, 2021). Additionally, extended screen time has been linked to reduced attention span and lower self-regulation in young learners, further emphasizing the importance of balanced technology integration (Zhao, Chen, & Ma, 2021). This highlights the need for a balance in integrating technology, ensuring it supports rather than substitutes the tactile and social dimensions of learning (Dixon, 2016).

If not carefully planned, the implementation of multimodal instruction may exacerbate educational inequalities. Bennett and Johnson (2022) caution that students in wealthier districts are more likely to benefit from such implementation, leaving those in underfunded schools further behind. Furthermore, Goa (2023) notes that excessive sensory input can overwhelm or distract some learners, particularly those with sensory processing disorders or ADHD. Teachers must assess the needs of individual students to avoid overstimulation and ensure that multimodal strategies are implemented effectively. Carefully balanced implementation with input from specialists and families is essential for supporting an inclusive and equitable learning environment (Carter &

Hughes, 2019).

SOLUTIONS WITH MULTIMODAL IMPLEMENTATION

In the wake of the COVID-19 pandemic, education systems have heavily relied on digital tools like iPads and laptops to maintain continuity. While technology provided vital support during remote instruction, the return to in-person learning requires a recalibration of strategies – one that emphasizes physical, hands-on experiences over screen time. Multimodal instruction should prioritize tactile engagement, especially in early childhood and elementary classrooms during the critical development of cognitive and motor skills.

Rather than counting bears on an iPad screen, students benefit more from physically manipulating objects – by grouping bear manipulatives, sorting blocks, or measuring ingredients in a mock kitchen. These sensory experiences solidify abstract concepts, reinforce motor coordination, and make learning more memorable (Moats & Farrell, 2005). Approaches such as "see one, do one, teach one" allow students to visually observe a skill, perform it themselves, and reinforce their understanding by teaching it to peers, promoting mastery through action.

Technology can support learning as a complement, not a substitute, for real-world interaction. When used intentionally, digital tools can enhance hands-on lessons by allowing students to document their work, access supplemental information, or reflect on their

learning processes. In a science unit, students might build terrariums and use tablets to photograph plant growth or record observations, combining physical engagement with digital reinforcement. This approach maintains sensory-rich experiences while leveraging technology to deepen understanding. Educators can support engagement and equity by integrating tech thoughtfully and without allowing screen-based instruction to dominate or displace more impactful, tactile learning.

Schools can foster this shift by providing professional development focused on low-tech, high-impact teaching methods – many of which are cost-effective and accessible for underfunded districts. Investing in expensive digital tools for every student is not always feasible, and overreliance on technology can unintentionally exacerbate educational disparities. Instead, reinstating manipulatives, art materials, and cooperative learning centers promotes active participation and social interaction without requiring large financial investments. Even in resource-constrained schools, recycled materials, outdoor exploration, and peer teaching groups can bring rich, multimodal learning to life. These strategies ensure that all students benefit from engaging, hands-on learning experiences, regardless of their school's budget. Returning to tactile instruction honors how young children naturally learn – through touch, movement, and interaction – and fosters holistic and developmentally appropriate growth as we move beyond the digital dependencies of the

pandemic era.

CONCLUSION

Multimodal teaching strategies offer a powerful framework for improving academic performance, memory retention, and emotional well-being among early childhood and elementary students (Moats & Farrell, 2005; Jennings & Greenberg, 2009; Mayer & Fiorella, 2021). Rooted in both historical pedagogies and contemporary cognitive science, this multimodal approach accommodates diverse learners and cultivates inclusive, equitable classrooms (Gillingham & Stillman, 1997; Immordino-Yang & Damasio, 2007; Carter & Hughes, 2019). However, the successful implementation of these strategies requires thoughtful planning, resourcefulness, and professional support (Swanson & Deshler, 2003). While challenges such as financial constraints, overreliance on technology, and the potential for widening inequalities persist, these barriers can be addressed through scalable, creative solutions (Goldstein & Williams, 2022; Zhao et al., 2021). By integrating teacher collaboration, family engagement, and low-cost resources, multimodal teaching can create adaptive, resilient, and deeply engaged learners (Moll et al., 1992; Tharp & Gallimore, 1988). In a rapidly changing world, multimodal instruction stands as a critical strategy for shaping students who are equipped with academic knowledge and empowered by the confidence and social-emotional tools to succeed (Dixon, 2016; Goa, 2023).

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The Data Adds Up: U.S. Students' Struggles in Math and the Call for Pedagogical Reform

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ABSTRACT

Mathematical acuity controls for occupational and financial success long after formal schooling, yet math literacy and performance in children and adults in the U.S. have been steadily declining, even before the pandemic. Past and current scholarly research have identified that the various causes behind low math achievement are mostly formed in early childhood through a combination of cognitive abilities, affective dispositions, and facets of the educational system. Similarly, interventions and alternative educational structures have been recently proposed and researched. However, little research has sought to combine both areas of study and field test a unified solution. Therefore, this paper argues that elementary schools across the nation, including those in Wicomico County, should develop a multivariable approach to combat the domestic and systemic factors behind insufficient math development as well as relieve the negative effects COVID-19 had on both educational structure and children's conceptual understanding of math. This structure will facilitate math learning and improvement in children, ensuring the opportunistic, intellectual, and economic future of the U.S.

Keywords: math education, educational reform, low math achievement, elementary pedagogy

INTRODUCTION

In 2023, the National Center for Education Statistics (NCES) found that math literacy and performance in children in the U.S. have been on a steady decline, even before the pandemic. Kids are actively struggling in math and have been for years. This is particularly detrimental to children as Ritchie and Bates (2013) found that mathematical acuity in young age controls for occupational and financial success, long after formal schooling. The NCES (2020) also found that over one in four adults in the U.S. are innumerate, meaning that they cannot accurately understand nor calculate numbers, directly impacting their long-term employment opportunities (Koedel & Tyhurst, 2012, pp. 138-139). Derived from this data is the fact that a strong mathematical foundation needs to be established in childhood and maintained in order for these skills to transfer into adulthood.

Additionally, low performance scores in math in both children and adults are not a minor issue compared to the rest of the world. On a global scale, the Organization for Economic Cooperation and Development (OECD) triennially administers a test via the Program for International Student Assessment (PISA) to measure 15-year-olds' literacy in three main subjects: reading, mathematics, and science. The most recent PISA (OECD, 2023) found that the U.S. is seven points below the OECD average in math (OECD average: 472; U.S. average: 465) and ranks 34th out of 80 other countries in that subject, despite being a top performer in reading and science. This places the U.S. at an international disadvantage, not

only in prominent and rising fields of research but also economically. These deficiencies in knowledge are a direct result of the ways math has been taught for decades.

As such, elementary schools across the nation, including those in Wicomico County, Maryland, should develop a multivariable approach to combat the domestic and systemic factors behind insufficient math development as well as relieve the negative effects COVID-19 had on both educational structure and children's conceptual understanding of math. With proper and detailed planning, a varied curriculum would not add on to elementary teachers' existing workload and would potentially even alleviate some of their stress and responsibilities.

DOMAINS OF LEARNING

Two distinct learning domains outline educational attainment goals and are used to develop true conceptual understanding of a topic. Using these frameworks within schools can be effective in substantially developing school and career readiness for young students (Blair, 2002). The first domain is the cognitive domain, which concerns the evolution of mental abilities and intellectual skills (Armstrong, 2010; Bloom et al., 1956; University of North Carolina at Charlotte [UNCC], n.d.). As the originators of the taxonomy, Bloom et al. (1956) listed six objectives in order from the most basic cognitive understanding to the most complex: knowledge, comprehension, application, analysis, synthesis, and evaluation. In more simple terms, knowledge involves simple fact

recall, comprehension involves understanding material without making further relevant connections, application involves abstracting the information to probe extrapolated questions, analysis involves creating a hierarchy of or relationship between the concepts within each learned concept, synthesis involves taking the inquiries and revelations made from the previous steps along with knowledge and ideas from many different areas to form a complete understanding of the subject, and evaluation involves critical thinking and questioning of ideas (Armstrong, 2010; UNCC, n.d.). However, in 2001, Anderson and Krathwohl made a revision to these objectives by changing their titles and order to better reflect updated standards and the active cognitive processes learners use in content mastery. The new objectives consisted of remembering, understanding, applying, analyzing, evaluating, and creating, with four dimensions of knowledge acting as the basis for all (Anderson & Krathwohl, 2001; Armstrong, 2010; Emporia State University [ESU], n.d.). Both classifications offer a useful guide for teaching and assessing learning.

Although, the cognitive domain only plays one part in one's ultimate understanding of a subject. The second impactful learning domain is the affective domain, which deals with emotions and interests in learning (ESU, n.d.; Krathwohl et al., 1964; UNCC, n.d.). Formatted in a similarly basic-to-complex hierarchy, Krathwohl et al.'s (1964) five objectives for the affective domain are receiving, responding, valuing, organization, and characterization. The processes

associated with these levels respectively are open-mindedness, being an engaged learner, assigning internal worth to the information being imparted, comparing these values and updating one's internal value system, and a final orderly assimilation of ideas and values (ESU, n.d.; UNCC, n.d.). This domain along with the cognitive domain work together to increase engagement and conceptual understanding.

As for how mathematics would fit within these domains, there is little research. For mathematics within the cognitive domain specifically, Shorser (n.d.) used Bloom et al.'s (1956) cognitive taxonomy to create a developmental outline for calculus, proving that mathematics is compatible with the frameworks. The effectiveness of this design and creation of mathematical taxonomies outside of calculus, though, are different issues. Manual guidelines for math classes that follow the objectives of the frameworks would have to be created, which is complicated by the fact that no other references or examples for how a math subject, especially a lower level one, might incorporate knowledge of the domains within coursework exist. However, by their design, the frameworks provide enough flexibility to be applicable to every subject or field, providing general action verbs, examples, and ideas to build off (Armstrong, 2010; ESU, n.d.).

THE HEAD AND THE HEART IN MATH

Various factors behind math development have been proposed and studied. As named and defined in this paper, domestic factors relate to individual and internal effects as well as parental effects. These factors can either facilitate or impede learning under cognitive and affective domains depending on how these factors develop. Domestic factors that impact the cognitive domain include impulse and concentration control and the formation of approximate and exact number systems. Impulse and concentration control, otherwise called inhibitory control, relates to one's ability to regulate compulsions and maintain attention in the face of stimulus (Bari & Robbins, 2013, p. 48), whereas approximate and exact number systems describe one's ability to mentally map numerals, recognize the relations between the numerals, and manipulate them for the purpose of problem solving (Mazzocco et al., 2011). Early deficits in these areas directly correspond with long-lasting lowered math performance and understanding and can exacerbate or even underly math learning disabilities (Geary, 2013; Mazzocco et al., 2011). As such, the poor mathematical performance by the U.S. indicates a lack of properly developing inhibitory control and acute

number systems within young students.

On the other hand, there are many factors that impede the affective domain that also tie in with math achievement, the most notable of which is math anxiety. Math anxiety has been found to have significant negative effects on math performance in students (Hoorfar & Taleb, 2015). In order to improve rates of math achievement, math anxiety must be addressed as well. However, the ways of lessening math anxiety are complicated due to the transferable nature of the affliction. In 2015, Maloney et al. discovered a direct negative link between math anxiety in parents and math anxiety in children, which led to lower math scores in the children as well. The unintentional harm being caused to children's mathematical prowess by parents' math anxiety indicates a need for addressing affective issues across all age groups and as a family unit.

While there is little research analyzing the effects of both impaired domains simultaneously on math achievement, Silver et al. (2022) found that math anxiety was more predictive of lower math scores in college students than either concentration control or approximate number-system mapping, indicating that domestic factors influencing the cognitive domain may be more important in determining math outcomes in children before becoming "disengaged" from future mathematical learning (Geary, 2013). Therefore, math intervention efforts should be tailored for each level of education, with elementary schools placing special emphasis on improving both cognitively and affectively impacted abilities and emotions in children.

THE INSTITUTION IN MATH

Alternatively, alongside domestic factors, there is another equally important category of factors behind math achievement. Systemic factors concern the role the educational system plays in developing students' mathematical abilities. Teachers, as part of this system, play a similar role to parents in children's attainment of math achievement, but they are much more involved with the process and can sometimes be directly responsible for one's comprehension of math. While the U.S. ranks slightly above average in the amount of support students receive from their teachers compared to other countries (OECD, 2023, pp. 349, 351), math scores are still lacking, showing that teacher support is not the only determiner of a valuable education.

Another possible determiner of student success is how stressed their teachers are. Teacher stress levels have been found to correlate inversely with student outcomes, such that high teacher stress levels lead to

poorer student academic performance, and the lower the teacher's ability to cope with their stress, the lesser students conceptually grasped mathematical content (Herman et al., 2018). Additionally, Herman et al. (2018) found that 93% of elementary school teachers experienced high amounts of stress, which means that in most elementary classrooms both teachers and students are struggling mentally and emotionally. Steiner et al. (2023) similarly report teachers being overworked more than seven hours compared to other working U.S. adults and their own teaching contracts. All of these interact to place teachers in an already vulnerable position, for which concerns over changing pedagogy might be raised to keep from adding onto teachers' stress.

However, one pedagogical change could be beneficial for students' learning and alleviating teacher stress. Facilitating stronger student-teacher relationships has been shown to be effective in increasing student motivation and achievement (Wu et al., 2010) while also having noticeable positive effects on teacher's mental wellbeing (Cui, 2022). Similarly, Kraft and Dougherty (2013) found that parent-teacher correspondence also increased student engagement, parental involvement, and trust between families and educators. So long as educational interventions are incorporating more opportunities for families and faculty to interact and bond in healthy ways, concerns over educational reform should be minimal. After all, the blame is not to be placed on teachers; instead, the roots of their stress should be identified and alleviated.

COVID-19 AND A LACK OF ADEQUATE SUPPORT, RESOURCES, AND MATH RESILIENCE

Despite declining math scores having been a years-long trend, the effects COVID-19 had on math education and development were significantly detrimental (Curriculum Associates, 2020, p. 7; NCES, 2023). For instance, on long-term trend assessments for mathematics, elementary-school students on average scored seven points lower between 2020 and 2022 and middle-school students scored nine points lower between 2020 and 2023 (NCES, 2023). The closure of schools delayed learning for most students by months, many of whom still have not recovered from this loss in learning (Goldhaber et al., 2022). As natural aspects of social and occupational life shut down, much of the world became reliant on online substitutions and the Internet. Schools were no exception to this as they eventually turned to online instruction as the gaps in learning, especially

between financially stable and unstable students, increased (Fahle et al., 2022; Goldhaber et al., 2022). However, many parents reported that their children had inadequate access to remote learning due to technological restrictions (The Education TrustWest, 2020, p. 5). As such, core areas of students' learning, especially for low-income students, were drastically affected.

Not only was there insufficient access to technology and education, but mental health in children plummeted (Ng & Ng, 2022; O'Sullivan et al., 2021). Many students were deprived of key elements of their education, such as sufficient interaction with their teachers and fellow students, which led to extreme feelings of isolation, depression, and anxiety (Almeida et al., 2021). To make matters worse, deteriorating mental health in childhood is associated with decreased cognitive skills (Almeida et al., 2021) and performance in math even over a decade later (Agnafors et al., 2021). As seen by research portraying both intellectual and mental decline, addressing and remedying COVID-specific instructional and mental health issues is critical to raising students' math achievement.

PROPOSALS OF REFORM

To address both domestic and systemic factors, some researchers have proposed and tested different teaching methods to varying degrees of success. Despite most of these studies being conducted on secondary or university level students, these methods could still potentially be used in younger groups, if only with some slight adjustments. One such proposed method is active teaching and learning, which utilizes challenging and creative problems as well as student interactions with each other to grasp material instead of merely relying on lecture-based instruction or memorization (Bonwell & Eison, 1991). In addition, Bonwell and Eison (1991) refer back to the higher-ordered cognitive processes of Bloom et al. (1956) – analysis, synthesis, and evaluation – as key components of active teaching and learning (p. iii). This method has been shown to be effective in increasing math scores and mathematical understanding (Nurbavliyev, 2022, p. 709; Theobald et al., 2020). However, Deslauriers et al. (2019) noted that this method is often received negatively by older students due to their conceptualizations of their learning, which can be flawed or uninformed. Methods like these, if introduced while students are younger, though, could possibly effectively eliminate future student bias against useful instructional practices.

There are a few more specific types of active learning that have garnered support and evidential credibility. One of these, called

project-based learning (PBL; Barrows & Neufeld, 1974), uses a real-world problem to drive the teaching units of the math class in hopes of better connecting information in students' minds and emphasizes development of "5 C's": critical thinking, creativity, communication, collaboration, and citizenship. In a study that sought to uncover the efficacy of PBL in different classrooms and grade levels, Lee and Galindo (2021) reported that results varied incredibly. PBL was noted by some participants as being difficult to sustain, especially in an environment where other teachers and/or the institution still followed traditional guidelines, implying that an entire systemic reform might be required for such teaching methods to thrive.

However, an analysis by Espinas and Fuchs (2022) on how language affects mathematical development implies a solution could potentially be reached without a total educational reform. Their research found that most facets of language and language education had a profound effect on children's mathematical abilities, especially when stories included terminology related to math or quantity. While not explicitly researched, reading to young elementary or preschool children with simplistic quantities involved seems to address the more fundamental cognitive domain of building an approximate number system than affective domains or systemic factors.

Non-empirically tested solutions have been discussed and put in place in some schools as well. One such method is a flexible and neutral ability grouping, first written about by *New York Times* writer Vivian Yee (2013). This model of ability grouping was introduced by elementary school teacher Jill Sears and does not follow the standard practice of ability grouping where those who are ahead move further ahead and those who are behind stay behind. The model splits students into any number of desired groups still based on initial mathematical proficiency while using neutral terminology, like "Blue Group" or "A Team," instead of "High Math Group" or "Low Math Group" so that students do not internalize feelings of inadequacy. The students are then given a problem, and they work in their teams to solve it. The separate groups have varying levels of tasks associated with completing the problem that correspond to their current level of math understanding. The groups with students who understand the material could also occasionally assist in helping the groups who struggle more in those areas. An important aspect of this model would be the flexibility with which students could move to different groups depending on how they are performing. This method of ability grouping would eliminate the long-standing practice of "teaching to the middle," which, to quote Jill

Sears, leaves out "approximately two-thirds of the classroom" (Yee, 2013).

A MULTIVARIABLE APPROACH

Despite many tested and non-tested solutions having been theorized and administered, most are still unknown and unpracticed. In addition, most of these methods are narrowly focused and do not consider the other determiners behind math development and achievement in their framework. As such, a separate approach to change math instruction should be taken. Utilizing knowledge of cognitive and affective domains, domestic and systemic factors of math development, COVID-19 impacts, currently proposed solutions, teacher and student mental health struggles, and lack of teacher-student and teacher-family relationships and correspondence, a multifaceted implementation addressing each of these core areas and blending aspects of current solutions will allow for a comprehensive shift in pedagogical methodology such that greater and longevous positive effects may be observed.

While seeing schools nationwide adopt such new practices is the ultimate goal, starting with such a demand is unrealistic and will most likely lead to no change. Therefore, elementary schools within a particular county should be used as a case study that schools across the U.S. may later look to as an example of reform. This paper recommends Wicomico County, Maryland, for this purpose as the county has not met their annual target for students' proficiency in math across all student groups and grade levels since 2019 (Maryland State Department of Education, 2019, 2022, 2023). The data indicate issues that need to be addressed in order for the children and later adults within the county to have equal opportunities to succeed.

This paper suggests a few main methods that elementary schools can implement to increase math achievement. The first suggestion states that elementary schools within Wicomico County develop new teaching methods. Methods tackling the more cognitive domains of learning should be implemented given that developing a fundamental number sense is crucial for students to continue learning math at an acceptable level and speed. Simple changes like reading books that contain numbers or relative quantities and introducing creative math-based activities as part of active learning would be both easy to implement and beneficial for both teachers and students. Meanwhile, using an ability grouping model similar to the one discussed by Yee (2013) would have the potential for students to interact and learn from each other across the affective domain, in turn decreasing teachers' workload.

The second suggestion is introducing parent-teacher workshops. These workshops could be used to target a number of issues. For example, workshops could occur at the beginning of the school year to inform parents about what their kids are learning and how, increasing both teacher-family correspondence and helping parents be more involved in their children's schooling. In addition, workshops should also attempt to combat parent math anxiety that could be imparted into the children.

And finally, general interventions, stress-management services, and more opportunities for students and teachers to connect should be implemented. Interventions should identify students at risk of innumeracy and create tailored solutions to improve student academic performance in math. Assessments of student performance on homework and tests could be used to first locate who needs additional assistance, for which after-school or weekend tutoring could be offered. In addition, professional mental health services should be installed within schools and should be versed

in handling student stress as well as relieving teacher stress and mental fatigue (for which similar interventions as the ones above could be established to identify teachers with noticeably high stress levels). To this effect, students and teachers should be given more opportunities to connect with each other outside of classroom settings to better the mental health, motivation, and engagement of both parties once back in the classroom.

CONCLUSION

Negative domestic and systemic factors have been found to impede development along both cognitive and affective domains within young students, whose math abilities directly relate to their future outcomes. Current research and solutions that have sought to overcome these issues have been narrow in scope and have not addressed concurring comorbidities in math learning development. To address the many coinciding factors behind low math achievement, a multivariable approach is suggested. Further research should focus on testing and measuring

the effectiveness of multidimensional solutions and if such approaches are difficult to maintain or if student achievement is met under such practices. In addition, future studies should be conducted into counties, states, and countries that have high rates of math achievement and especially those that maintained math scores in spite of COVID-19, such as Canada, one of the U.S.'s closest neighbors that made up ninth place on PISA with a score of 497 (OECD, 2023), and the viability of implementing those methods in the U.S. The path to high math achievement has been long debated, studied, and tested to mixed results, and there is little that is universally agreed upon within the math education community except that current instructional practices, for a number of known and some unknown reasons, are ineffective in providing children with a necessary background in and comprehension of math. Further research and action are imperative to ensure that all children are given the proper math education to succeed financially and opportunistically in the future.

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No One Leaves

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ABSTRACT

"No One Leaves" is an oil painting measured at 18"x12" that is the first in an upcoming series of works intended to question and criticize the current government establishment in the United States. The text within the work, "No one leaves, but they always have room. You know why. Do something," is about the wrongful deportation of Kilmar Abrega Garcia on March 15, 2025, to El Salvador's "mega-prison" CECOT (Finley, 2025). This is just one case out of many, most of which never reach the public eye as Garcia's has. The current presidential administration sends these people to a "kill shelter" without reason, refusing them of their rights in an effort to "clean up" America (Alemán, 2025).

In this painting, a mass of wolves sit, peering out from a cramped, uninhabitable cage. The hand of a boy reaches out from the mass of wolves, grasping for freedom. As the days move on, more individuals are kidnapped from their homes and placed in prisons such as these. Government sources, including various news networks, continuously train us to fear immigrants, regardless of their intentions (Otero et al., 2025). We are trained to fear others based on the color of their skin, and what ethnicity they belong to. By putting aside our differences, we can push past the dramatics and see what's truly happening – innocent lives are being derailed, upended after decades of living in the United States without issue. Families are being torn apart and separated, leaving children alone. Countless lives are being lost to this system of genocide.

This painting was made with a variety of inspirations. The intense red, white, and black color scheme is borrowed from Shepard Fairey's version of George Orwell's 1984 book cover (Fairey, 2008). Retaining the symbolism of



1984, the colors black, white and grey represent oppression and monotony, with how normalized it has become to see violent headlines in the media. The wolves are colored black, marking them in a negative light, similar to the way news networks criminalize those who are deported. Bolded, red tones symbolize the needless violence, though also as a warning that continuing down this road of violence will

have consequences. The artist's inspiration also stems from the politically motivated artwork of Leon Golub, and the visceral ways he portrayed the raw brutality of the human-made atrocities committed during wartime and protest.

Keywords: political art, human rights, immigration, dystopian

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The Interdependence of Power and Profit: State, Corporate, and Criminal Convergence in the Mexican Drug Trade

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ABSTRACT

Mexico has been plagued with violence and corruption by several drug cartels since the late 1980s, with prominent cartels like the Sinaloa Cartel, Jalisco New Generation Cartel, and the Gulf Cartel. Criminologists can claim that they know the true causes of these cartels as they aim to seek profit in an easier way. But how can these drug traffickers operate at such high volumes of product, violence, and power without the government at least knowing about their operations? Since the 1982 Mexican Debt Crisis, Mexico saw neoliberal "reforms" as a turning point in Mexico, as it sent the country on a trajectory of corruption, and the lack of state capacity, and blindness to the role that multinational corporations play in transnational criminal organizations. Without the three actors, the Mexican Drug Trade would not be even close to the Mexican drug trade known today.

INTRODUCTION

"Si eres pobre te humilla la gente. Si eres rico te tratan muy bien. Un amigo se metió a la mafia. Porque pobre ya no quiso ser. Ahora tiene dinero de sobra. Por costales le pagan al mes (If you are poor, people humiliate you. If you are rich, they treat you very well. A friend of mine joined the mafia. Because he did not want to be poor anymore, he now has plenty of money. They pay him monthly in sacks) (Los Tucanes de Tijuana, 1997). This is the opening verse to the Regional Mexican band Los Tucanes de Tijuana's popular song "El Centenario," which sheds light on one of Mexico's most significant problems – the fact that drug trafficking organizations (DTOs) provide too much of an incentive for people to join and the power these DTOs possess. This paper aims to explain the Mexican drug trade, subsequent corruption, violence, income inequality, and migration produced as a byproduct of a neoliberalism push from the United States. This push from the United States ultimately created these conditions and the complex interdependent nature of the three leading social actors involved: the criminal organizations, the private sector, and the government that created the Mexican Drug Trade.

NEOLIBERALISM AND DRUG TRAFFICKING: A SHARED POLITICAL HISTORY

From the 1980s to today, corruption in Mexico has become more prominent in both Mexican culture and politics. However, the start of the new era of Mexican corruption can be traced back to a single year: 1982. In the 1970s and 1980s, the President of the United States, Ronald Reagan, and the United Kingdom's Prime Minister, Margaret Thatcher, were champions of neoliberal economic reforms. David Harvey

defines neoliberalism as "a theory of political, economic practices that proposes that human well-being can best be advanced by liberating entrepreneurial freedoms and skills within an institutional framework characterized by strong private property rights, free markets, and free trade" (Harvey, 2011, p. 9). In essence, neoliberalism stands to *liberate* the market as much as possible by the deregulation of the state in the free market. This economic model was built on the fundamentals of core-periphery relations in which the periphery was dependent on the core's economy. The periphery depended on loans from the core for capital and only exported once they had to pay off the loans. Mexico was no different. Mexico's economic growth was tied to the richness of its oil reserves, so it could take on massive debt and pay it off with its oil capital. However, in 1982, the world saw a global recession in the price of oil, which destroyed the Mexican debt model and economy in a single blow.

After the implementation of neoliberal policy in the United States, "the ratio of the median compensation of the worker to the salaries of the CEO increased from just over 30 to 1 in 1970 to nearly 500 to 1 by 2000" (Harvey, 2011, p. 21). This concentration of wealth among the 1% in a society is not just correlated with neoliberalism; instead, it is directly structured within it. Around half the working force of Mexico earned less than the minimum wage by 1989 (Reding, 1989). Many promoters of neoliberalism would argue that "attempts to offset inequality through state interference will inevitably lead to the erosion of human freedom" (Faulks, 1999, p. 74). However, it is proven that this is not the case. All it does is create inequality with no actual benefit. These structural inequalities left conflicts unresolved by

the Mexican government, which led to a context that promoted the rise of DTOs as the Mexican economy favored capital over labor.

The history of drug trafficking in Mexico has mainly been traced back to the low economic prosperity given to the lower classes. This opportunity for many was seen as an attractive offer as selling around 700 grams of marijuana, 18 grams of heroin, or 66 grams of cocaine into the United States market would be equivalent to the median salary in Mexico. (Smith, 2021). The Mexicans might have produced, transported, and sold all these drugs, but the real consumers were in the United States. Operation Condor (1964-1982) was a joint military effort from the U.S. and Mexican governments to destroy drug crops within the Mexican drug Golden Triangle (Sinaloa, Durango, and Chihuahua, as seen in **Figure 1**).

This violent effort entailed by the binational military operation can be tied to the Mexican government's interest in keeping the United States government and economy satisfied with Mexico, as explained by Zavala and Savinar, "that apparent subordination alone does not explain the power dynamics with which both countries operate concerning the *narco*" (2022, p. 64). Although Operation Condor itself predates the 1982 Mexican economic crisis, the violence left many peasants from the mountainous region displaced and dead. It is also important to note that the nature of Operation Condor in Mexico is directly linked to Mexico's Dirty War, in which the Mexican government wanted to attack leftist radicals hidden in the same Golden Triangle, again intertwined with the United States' efforts in all of Latin America during the Cold War.

Corruption, as explained, was nothing new to Mexicans, but its level was unprecedented.

Figure 1.
The Mexican
Golden Triangle
(Mexican States
of Sinaloa,
Durango, and
Chihuahua)



“Over 58% agreed that there has been ‘widespread’ fraud in Mexican elections, while another 26.3% conceded that there has been ‘some’ fraud” (von Sauer, 1992, p. 268). The most prominent level of corruption was seen at the regional and municipal levels, as the Mexican government spent less to pay for public services like law enforcement. Several DTOs stepped up to pay the police’s wages in exchange for their services. The National Conference of Secretaries of Public Security stated that “93.6% of municipal police depend on corruption to supplement their low salaries” (Morris, 2012, p. 31). This is where the basis of many DTO operations lay, as controlling their state’s police force was crucial for protection from both the government and rival cartels and preventing any real action from being taken against their high bidders. The protection racketeering for several DTOs served functions like allowing certain people and items to pass undetected in airports, warning of potential raids and stings by law enforcement, and aiding in protecting and transporting both leaders and merchandise (Morris, 2012).

When corruption reached a higher level, it sometimes took the form of inaction or controlled action against the bidder’s rival. Such cases can be seen with General Jesus Rebello, the head of the Mexican National Counternarcotics Institute (INCD), who was tasked to bring down these violent cartels. Well respected in both the United States and in Mexico for his efforts against the Sinaloense and Tijuana Cartels, by 1997, General Rebello found himself behind bars as he was discovered to be on the payroll of the Juarez Cartel, led by Amado Carrillo Fuentes (Office of the Press Secretary, 1997). However, this is not a unique case, but a pattern, as in 2020, Mexican Defense Minister General Salvador Cienfuegos Zepeda was arrested on allegations of conspiring

with drug cartels.

Mexico is not the only country engaged in drug corruption, as the United States has been tied to both the illegal drug and arms trade, apart from famous cases like the Iran-Contra Scandal or even Pinochet’s coup d’état on Salvador Allende in Chile with help from the U.S. Central Intelligence Agency (CIA). Less-known scandals involve the CIA, which was involved in selling cocaine produced by Pablo Escobar’s Medellín Cartel to pay for weapons for Contras in Nicaragua (Simon, 2012). The United States was even influential in the fall of the *Dirección Federal de Seguridad* (DFS) and the Guadalajara Cartel after the death of Kiki Camarena, who would go on to become a Jesus-like figure for the U.S. DEA.

After the closures of the Caribbean routes by the South Florida Task Force (Smith, 2021), the U.S. demand for and the Colombian supply of cocaine remained. Juan Matta-Ballesteros, a Honduran businessman and socialite, also connected the Mexicans and the Colombians (Smith, 2021). As the United States used Medellín cocaine to fund the Contras, they, too, got involved with the Mexicans, like Miguel Ángel Félix Gallardo, the head of the Guadalajara Cartel, as they allegedly shipped both drugs and guns *through* Mexico (Smith, 2021). This Colombian cocaine then flew into the streets of Black neighborhoods in Los Angeles and the San Francisco Bay Area (Simon, 2012). Rick Donnel Ross, also known as Freeway Ricky, would purchase Colombian cocaine, transform it into crack, and sell it. All the money used to buy cocaine, as proven by court records, was then used to buy weapons for a guerilla army in Nicaragua called the *Fuerza Democrática Nicaraguense* (FDN), or more commonly known as the *contras* (Simon, 2012).

As sociologist Robert K. Merton would argue, crime is not biological but instead sparked by the social structure of a common goal and the lack of cultural means to achieve this cultural goal (Merton, 1938). This statement could not better describe the corruption and violence seen in Mexico later in the 20th century. The creation of these DTOs all stemmed from Mexico’s inability to provide adequate wages to its people, as it took a more significant interest in supporting foreign businesses. Mexico has been compelled by the U.S. government to act this way, helping the U.S. economy more than Mexico.

THE ROLE OF THE GLOBALIZED FINANCIAL SECTOR

It is highly generalized that the Mexican drug trade is a glorified tale of cops and bandits. The cops, DEA agents, go on a hunt for the Sinaloense robbers, who are the *sole* arbiters of the drug trade. However, this generalization misses a massive sector of the Mexican DTOs and organized crime as a whole. Legal, multinational corporations (MNCs), and international financial institutions play one of, if not the most crucial, roles in these operations. As drug money cannot be used without having a trace of it due to its origin, money laundering is used to disguise “financial assets so they can be used without detection of the illegal activity that produced them” (Financial Crimes Enforcement Network, n.d.). However, money laundering has one unique characteristic – the intentional lack of accountability. The core of this interdependence is found in the fact that all three of these social actors benefit immensely from their cooperation: the DTOs, who produce these illicit funds: the MNCs, who then launder and move the funds for profit, and the states, who are lobbied by these MNCs for their inaction. As this compliance by the MNCs can severely hurt not just the states’ domestic economy, but the world’s economy especially after the massive globalization efforts brought forth by neoliberal reforms in the latter half of the 20th century (Sjoberg, 2009), perfectly exemplified by the 2008 financial crisis and the United States ‘Too Big to Jail’ stance on punishment to these MNCs.

Money laundering has played an enormous part in DTO operations. From 2010 to 2016, Mexico had 707 money laundering prosecutions, in which only 103 cases had convictions (Martínez-Fernández, 2021), a 14.57% conviction rate. This number has become even smaller, as in 2016 alone, 7,414 accounts were suspended for suspicion of money laundering, making the percentage of convictions for 2016 alone around 0.13%, showing that the government is aware yet takes little. Nevertheless, under the analysis of constructivism in international relations, defined

as politics that are determined by perceptions (D'Anieri, 2017), it makes sense why many states in the global community award this impunity as street-level crime takes more precedence.

Since the development of neoliberal reforms in Mexico after the 1982 financial crisis, Mexico's economy has only continued to globalize. This perfectly sets up several financial MNCs to have a stake in the Mexican economy. Industries like agriculture, oil, and telecommunications sold during these reforms were given to international companies as a form of privatization from the state. Businesses are looking to maximize profits, and when a country's biggest economic sector is illicit, MNCs are willing to turn a blind eye to capitalize on those markets. With this blindness, MNCs can build wealth, which can be converted into power or capacity to realize any goal without any substantial opposition (Simon, 2012). Wealth plays a role in power as a resource that only builds one's or an MNC's capacity to employ its power.

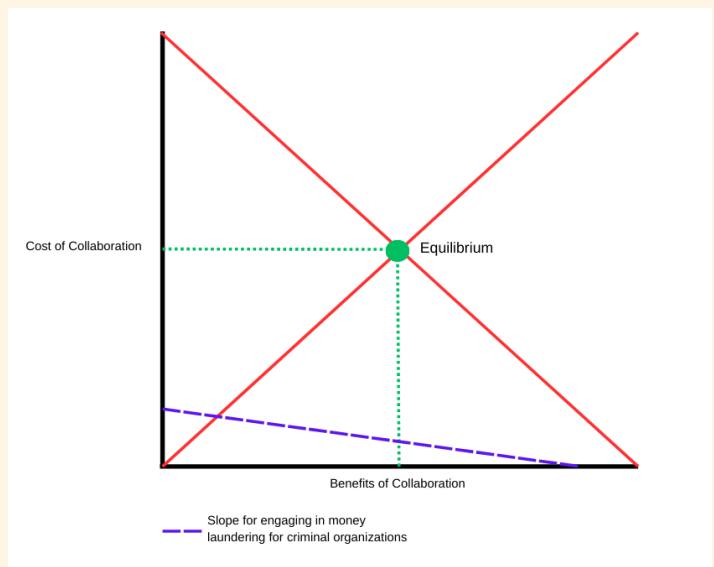
An example of this power is intellectual property rights. A standard concept in the United States but taboo in other parts of the world. Adding charges and claiming monetary ownership of an idea, concept, name, word, or photo is a very Western idea. However, in 1994, the Uruguay Round of the World Trade Organization, which discussed new trade policies with its member states, created the Agreement on Trade-Related Aspects of Intellectual Property Rights. The foundation of this agreement was laid by lobbyists from twelve powerful MNCs based in the United States, making 'public law for the world' (Sjoberg, 2009). This quintessential example shows us that wealth directly provides the capacity for the MNCs to exercise their power in influencing politics. Although this is a very explicit example, it does not negate the fact that many similar instances are not public knowledge, identical to the role of financial MNCs in money laundering and the international inaction against these activities.

Because of their power in the world economy, these MNCs are awarded impunity, committing fraud for criminal organizations. Their marginal utility or benefits (the funds acquired for engaging in business with criminal organizations) gained are incomparable to their marginal cost (accountability) because there is no cost proportional to these benefits as shown in **Figure 2**.

As for money laundering offenses, there are no substantial consequences. As exemplified by the purple slope in Figure 2, money laundering for criminal organizations is rational in an organizational sense because it yields the same benefit for very little to zero cost. Standard

Figure 2.
Cost-Benefit
Analysis of MNCs'
Cooperation with
DTOs.

Note. A cost-benefit diagram shows the benefits of cooperation with DTOs and low costs.



Chartered Bank (SCB), one of the biggest banks in the UK, was connected with helping launder and transfer funds to terrorist groups in the Middle East (Verity & Oliver, 2024). SCB achieved this by falsifying transaction statements to move billions all around the world to the Central Bank of Iran, which is used to finance terrorist groups like Hamas, al-Qaeda, and the Taliban. Despite this connection going public, the consequences only amounted to a \$340 million fine, despite SCB *claiming* in the report that 14 billion out of the initially reported \$250 billion were transferred illegally (Stricker, 2012). SCB admitted to having illicit transfers of \$14 billion, yet was only fined \$340 million, a 0.02% fine – a tax.

To further eliminate any cost, much of the blame that the MNC is found accountable for is usually placed on the organization, not the organization's leaders. The only group that MNCs should care about is their shareholders, even in bankruptcy and significant losses. Their responsibility is not to people but rather to their shareholders, who are only bound by corporate laws. Many organizations that have indirectly or directly caused economic and physical harm to a large group of people, like 3M with the Flint, Michigan water crisis, Purdue Pharma, their role in the United States' opioid epidemic, and Citibank with its ties to several cartels and Raul Salinas, the brother of former President Carlos Salinas. If CEOs or leadership of organizations that employ these practices had been held accountable, not only would the cost of money laundering and fraud go up for the organization, but it would be irrational in terms of cost-benefit

because of the potential to be convicted of a crime for one's participation.

In addition, one of the key things that makes the MNCs work perfectly in organizational crime is their use of secrecy. It is very common within bureaucracies for managers to have secrets from those under them. For example, trade secrets that higher-ups at Apple would know but Apple Store workers don't know. Those in the chain of the U.S. bureaucracy have access to certain information, but not all federal employees have permission to know many of these secrets. However, the opposite is also true, as many lower positions hold secrets to protect themselves from their superiors (Sjoberg, 2001). There is secrecy on both sides of the bureaucracy, and accountability for wrongdoing becomes complicated in any complex organization. When superiors delegate responsibilities within a bureaucracy, they also delegate blame (Sjoberg, 2009).

Therefore, when those in a lower position see any wrongdoings or fallacies within the organization, they tend not to mention it to avoid accountability, and loyalty gets created, as each level fears for their survival, creating a well-respected and crafted hierarchy. Because of this division and hierarchy created, many organization leaders tend to see the whole as more important and valued than the entities that make it up. Secrecy is the glue that combines their rational thinking with the practical application of their crimes. As this secrecy and delegation of tasks and blame gets passed around, underlings do not know what the managers know yet keep quiet because of their interest in survival within the bureaucracy.

Consequently, these patterns are consistent in Mexico, most notably witnessed in the Raul Salinas-Citibank case. One of the most notorious cases of drug money laundering, Raul Salinas, was arrested in Mexico in February 1995 for murder and in November 1995 in Switzerland for drug trafficking and money laundering. Although this seems like a massive win for anti-drug trafficking efforts, Salinas was not convicted of money laundering but of murder. Salinas allegedly laundered \$100 million of illegally earned funds with Citibank Mexico, relaying the money to offshore accounts in the Cayman Islands under Citibank Cayman and to Citibank London and Citibank Switzerland, which helped to hide the course and destination of these funds and break their 'paper trail' (GAO, 1999).

Citibank's Know Your Customer (KYC) policy, which Citibank claims is its internal anti-money laundering measure (AML), requires references and other documentation to prevent fraud. Salinas's name was absent from his application (GAO, 1999), and many parts of his application were left blank (Malkin & Elizur, 2001). His background was not investigated, which violated Citibank's KYC policy. Although these allegations never went anywhere, it is clear that this financial fiasco was not as clean as both Salinas and Citibank claimed. Citibank's actions are consistent with similar MNCs' actions in turning a blind eye to more capital.

In an organizational sense, it is a necessary sacrifice. Citibank was not fined for its involvement in money laundering for Salinas, only for similar offenses in 2019, 2020, and 2024 for a combined total of \$605.6 million, yet it laundered \$100 billion for Salinas. The consistency of the levels of impunity for the most crucial sector of criminal organizations enables DTOs to operate. This may be the most famous case, but it is nowhere near the only case of Citibank or any bank laundering these amounts of money for DTOs. The ignorance of fraud by MNCs is perforated even further under the constructivist theory. This explains why so many countries forgo any action despite the glaring statistics they face. There is no pressure on these issues, and MNCs lobby for state blindness. During the 2008 financial crisis and the Obama administration's 'Too Big to Jail' phenomenon, this was perfectly shown. These globalized MNCs are too powerful to bolster the international economy. As a result, this is why we see United States-Mexican street-level enforcement but not investigating the banks that handle and process the money made by the DTOs. The state benefits from their inaction, the financial MNCs benefit from their cooperation in the business, and the DTOs benefit from the newfound ability to use

their illegally earned income without a trace. Had the banks of the 2008 financial crisis or Citibank leadership been punished, there is a chance that the cost would be drastically higher. But because there is nothing but impunity, why would they not?

INEQUALITY AND VIOLENCE

A COSTLY BYPRODUCT

Compared to the rest of Latin America (LATAM) in 2018, 41.5% of the Mexican population lived in poverty, with 10.6% in extreme poverty, fourth in the LATAM region (Alemán, 2021). Corruption has long been associated with inequality, violence, and migration. Many countries deemed corrupt are also considered some of the most dangerous. This is not because corruption brings about violent state repression but because corruption becomes the state's system (United Nations, 2004), which redirects resources to the state's elites. This corruption creates an immense lack of welfare, danger for the citizens, and an incentive for deviance. Inequality is rampant in Mexico, driven by corruption, a lack of state interest in the people, and neoliberal reforms (Buenrostro, 2011). This inequality not only distorts the opportunities poor and rural Mexicans have for success but also creates social problems. When people are given no other option for survival through legal means, they have to find alternatives. In Mexico, joining criminal organizations to fulfill basic human needs is an alternative for many people. DTOs provide Mexicans with an opportunity that the legitimate economy cannot. For those who do not deviate, if all legitimate resources are

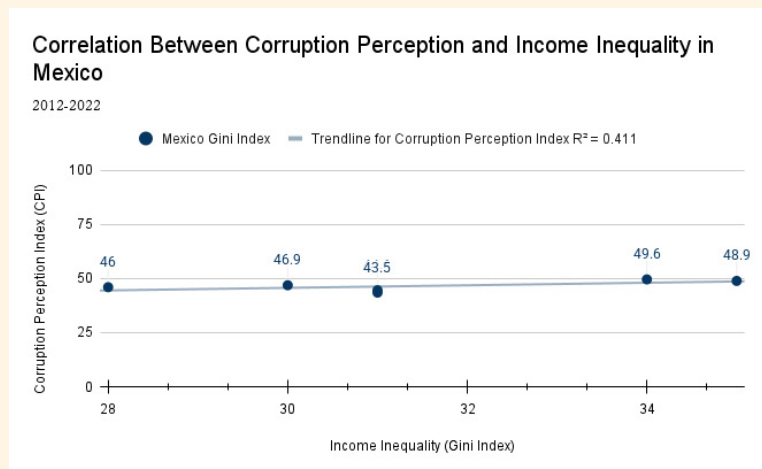
exhausted, the last option is to leave. However, these migrations are *constructed* (Shah, 2025) with inequality as they are easily exploitable and beneficial to the U.S. economy. All of this stems from one crucial moment in recent Mexican history – the neoliberal reforms that privatized much of the state-sponsored programs and expedited the growth of the wealth gap.

MEXICAN INEQUALITY

Mexico is one of the world's leading societies in terms of inequality. It almost doubles Denmark's Gini coefficient, which has one of the lowest Gini coefficient index scores. At the same time, Mexico ranks 140 out of 180 on the Corruption Perception Index (CPI) with a score of 26, while Denmark has a score of 90 (Corruption Perception Index, 2024). These two indices show not only the state that Mexico is in but also a strong statistical correlation between corruption and income inequality, with a correlation coefficient of 0.64 as shown in **Figure 3**. Income inequality is only so rampant in Mexico because of the corruption that the Mexican government employs, putting corporate and DTO needs over the people.

As pointed out earlier, Merton's *Social Structure and Anomie* (1938) explains that when institutional means (legal means) do not meet cultural goals (success and wealth), rebellion or rejection of institutional means to obtain the cultural means becomes a viable option. Because of these lowered wages and decentralization of the states, one of the *most* affected areas is law enforcement. Local and municipal police could not make ends meet. Therefore, they turned to

Figure 3. Correlation Between Corruption Perception and Income Inequality in Mexico



Note. Calculated using the Gini Coefficient Index (2024) and the Corruption Perception Index (2024).

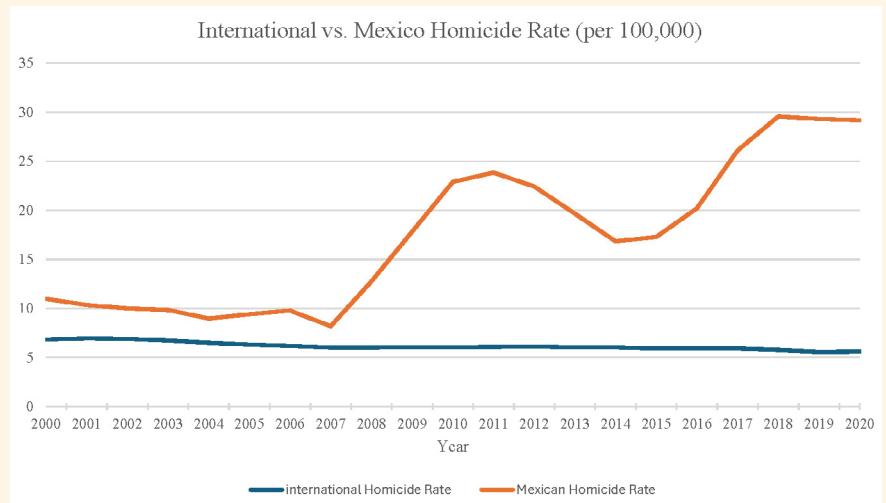
a method that could – bribes and aid DTOs. In Mexico, the opportunities, education, and wages cannot offer a poor person the resources for social mobility, forcing two crimes most traditionally seen in this strain in Mexico: migration to the United States or deviance to a DTO.

Migration is a key aspect of current Mexican-United States relations. As drug corruption and neoliberalism raise violence and inequality, they create a nation in which thousands, if not millions, do not have access to adequate infrastructure, education, support for agricultural sectors, and security. For many, they are left without any other option but to move to the United States; however, these migrations are not just a byproduct of DTO operation, violence, or inequality but rather a part of why the state benefits so much from drug corruption and neoliberal reforms.

The United States played a massive role in Mexico's adoption of neoliberal reforms (Harvey, 2011), which made Mexico a desirable state for the elites while inhospitable for the working class. These economic reforms benefited the United States immensely, as it needed worker's unskilled labor. Many businesses are unwilling to pay United States citizens due to how costly their salaries and benefits are, and many United States citizens do not want these jobs. With the influx of undocumented immigrants rising in the United States, these businesses are provided with a golden opportunity—a highly exploitable, expendable workforce. The fleeing Mexicans are seen as nothing but sought-after, cheap human capital (Shah, 2025). The Mexican and other Latin American migrants do not necessarily feel exploited as they are accustomed to not earning as much as they do in their home countries (Shah, 2025), despite their salaries being uncompetitive compared to the wages given to United States citizens.

The corrupt nature of the Mexican government, which allows for these economic and violent conditions, and the adoption of neoliberal reforms, mixed with the fact that DTO money laundering is ignored, explains why migration is so high in Mexico. Although migration and drug trafficking may seem highly unrelated, they stem from the same branch of neoliberal reforms sparked by the 1982 Mexican Debt Crisis. Ever since, they have remained highly interconnected, leading to workforce exploitation of the poor working class in private markets in the United States. The Mexican people are born into a state with limited options: suffer, leave, or become part of the issue, in which a job that degrades them and alienates them is a better option for life than living in a corrupt, violent, drug and neoliberal-endorsed Mexico.

Figure 4. International vs. Mexico Homicide Rates 2000-2020 (per 100,000)



Consequently, the drug-related violence in Mexico is unprecedented. Compared to the rest of the world, Mexico witnesses a staggering five times more homicides per 100,000 compared to the global average. As demonstrated in **Figure 4**, by 2020, Mexico had a score of 29.185 per 100,000 in homicide rates (United Nations Office on Drugs and Crime, 2024), ranking it third, only behind Venezuela (29.427) and South Africa (33.965). However, this violence is not just criminal violence but rather an extension of state violence, as argued by Oswaldo Zavala and William Savinar (2022).

Not only are DTOs allowed to operate under the state, but they *cannot* operate without the state. DTOs, by nature, are violent, as much of their business requires control, control that is not given to them by any legitimate means. After the arrest of El Mayo in July 2024, the leader of the Sinaloa Cartel, a spike in violence resulted from the power vacuum. DTOs are violent as their operations require them to be, but state interference does not create safety; rather, it intensifies the levels of violence. Had both the Mexicans taken more action against money laundering schemes, it is possible that DTO operations would be limited and may be eliminated.

However, it is not to deny the crucial role that governments play in raising the violence seen in Mexico. Operation Condor was linked to the Mexican Dirty War (1964-1982), which saw a “brutal but effective bipartisan program carried out by army intelligence work and the DFS [which] came the mass exodus of peasants to the major cities of Sinaloa, in particular to Culiacán”

(Zavala & Savinar, 2022, p. 64), and the 1997 U.S. killing of a teenage goat herder in Redford, Texas (Dunn, 2001). Both the U.S. and Mexican counterdrug efforts have worked hand in hand in raising the drug-related violence in Mexico.

An explanation can be seen from the constructivist approach in international relations, which places a bigger emphasis on street crime as more of a threat than any form of white-collar crime. Explaining why Mexican and U.S. authorities haven't taken action against the MNCs aiding DTOs in transferring and laundering money, as on the street, crime and violence take more precedence. Media reinforces these perceptions, as they help convince the public that street violence is more prevalent, dangerous, and costly compared to White collar crime (Barkan, 2023).

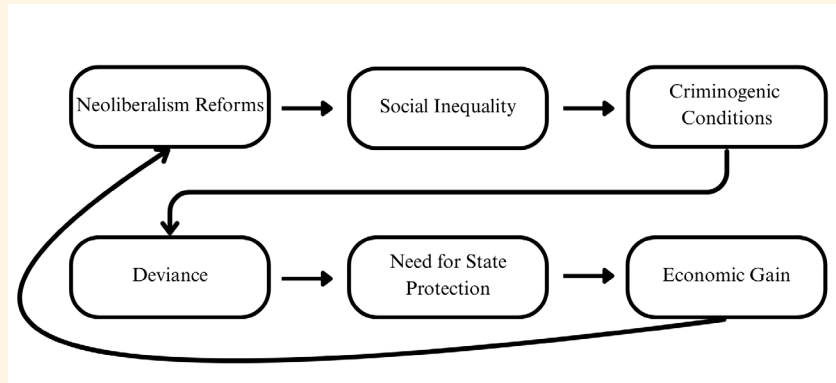
However, this street-driven approach is ineffective. By 2011, over 100,000 soldiers were ordered to fight in counterdrug operations in Mexico. The capture or death of 25 key DTO leaders created violent and dangerous power vacuums that the people of those areas had to deal with, or at times, revenge violence. One of the most famous cases of this revenge violence was the capture of one of El Chapo's sons, Ovidio Guzmán López, in 2019. Guzmán was arrested during a raid on one of his houses. (Villarreal & Orsi, 2021). However, hours after his arrest, his release was ordered by the Mexican President, Andrés Manuel López Obrador, as violence in Sinaloa erupted. The violence “paralyzed the capital of Mexico's Sinaloa state, Culiacan, and left the streets littered with burning vehicles” (Villarreal & Orsi, 2021). The Mexican government can no longer compete with DTOs

when they approach DTO crime with military force, creating a “rule of law deficit” or a situation where the law cannot be enforced (Morris, 2012).

The Mexican government is not the only government to militarize its counterdrug efforts. The U.S. has taken drastic measures to aid in international counterdrug efforts, concentrating these efforts on the Southern border. The U.S.-Mexico border is considered the *most* dangerous land border (Pérez Damasco et al., 2023); however, the creation of Joint Task Force 6 (JTF-6) created a hazardous environment for migrants, who are usually considered “nonthreatening immigrants” (Dunn, 2001). The DEA estimates that 85% of *all* illegal drug entries occur at legal points of entry, like ports (Dunn, 2001). This statistic only puts into question more why the United States government fixates on the militarization of its southern border. This decision by the U.S. government did nothing but create a hostile environment at the border for both locals and migrants. The turning point for JTF-6 came in 1997 when Clemente Banuelos, a U.S. Marine Corporal, killed Esequiel Hernandez, an 18-year-old Mexican American who was herding goats near the border during a JTF-6 mission searching for drug traffickers (Dunn, 2001).

Although, after the incident, direct military action was halted around the border for counterdrug measures, the question of why targeting the border in the first place is left lingering. It is an entry that only an estimated 15% of drugs come into. It shows nothing but failed military action against the DTOs, as the U.S. government has rarely effectively attacked their operations at the border, instead creating a cesspool of human rights violations (Dunn, 2001) under the pretext of counterdrug efforts. DTOs do not play as much of a role in the violence at the border as the U.S. and Mexican governments do. They cite these DTOs as prime opponents for both the War on Drugs and the War on Crime, yet they ignore the true causes of these drug empires: inequality, neoliberal reforms, and MNCs laundering money keep DTOs. Until these

Figure 5. Neoliberalism and DTO Deviance Feedback Loop



governments take real action on addressing any of these key roots of DTO operations, they will continue to wreak havoc on the Mexican state.

As Merton explains, social strain can lead to deviance (Merton, 1938). In Mexico’s case, this social strain not only creates the incentive to join DTOs but also works together to promote neoliberalism further. This works when neoliberal policies are implemented, which creates social inequality for the working class. This inequality then creates criminogenic conditions, which can be seen as the strain that forces deviance to DTOs. However, once these DTOs are operational, because of the strain created, they cannot operate without the aid of the state in both protection racketeering (Morris, 2012) and protecting their finances, which then leads to economic gain. They all benefit, while no real costs are associated with these practices at the expense of millions of working-class Mexicans. As demonstrated in **Figure 5**, violence and inequality are not the causation of any of these issues; they are consequences stemming from the Mexican state’s dive into neoliberalism and the rise of opportunity for corruption.

CONCLUSION

Given these points, the Mexican drug trade is nothing but an interdependent relationship between the DTO, the corporations, and the Mexican and U.S. states. All the violence, corruption, and inequality associated with the drug trade have their roots in the Mexican adoption of neoliberal reforms in the 1980s. In the same vein, it is evident throughout the literature and analysis of the operations of DTOs that they cannot operate without permission from the Mexican state. Implying that, to a certain extent, Mexico is a *Narco Democracy*, or at the very least, a plutocracy ran by narcos.

In addition to their interdependence, the conditions in Mexico, mixed with the neoliberal reforms and the DTO power over the state, create an unbreakable chain of neoliberalism that feeds into DTO power. If the Mexican government or the international community truly wanted to fix Mexico, emphasizing the MNCs that laundered the money would be the best place to start and the key to stopping this chain. Without this money, these cartels are nothing.

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The Harsh Reality Hidden Within the Yoshiwara of Japan

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ABSTRACT

Although its hidden social injustices offer a much darker understanding, the Yoshiwara district of Edo-period Japan is often celebrated as a center of entertainment, culture, and artistic breakthroughs of its time. The dual nature of the Yoshiwara as a symbol of culture and a representation of institutionalized exploitation is critically analyzed in this essay. Edo-Japan supported censorship within its system, gender discrimination, and human rights abuses while also promoting *kabuki* theater, *ukiyo-e* art, and other economic opportunities. Female courtesans suffered cruel treatment, physical punishment, and sometimes even death from illness or abuse, with many being sold into brothels as children. Similarly, despite their high recognition within their society, *kabuki* performers were subject to severe government censorship and limitations based on their class. This essay questions the stature of the Yoshiwara by closely analyzing historical documents and cultural artifacts.

Keywords: Yoshiwara, Edo-period Japan, culture, kabuki, ukiyo-e, gender discrimination, death, limitations, censorship

INTRODUCTION

During the period of 1600 to 1868 in Japan, known as the Edo Period, the Yoshiwara was a district set up by the Tokugawa government directly in Edo, now formally known as the city of Tokyo, to establish a specific sector for entertainment. This district was first set up in 1618 as a method by Japanese authorities to attempt to control the widely scattered gangs of prostitution (Garon, 1997). Originally, this district was located close to the Shogun's castle, but it did not have the best reputation among authorities. In 1657, the Yoshiwara faced a large-scale fire destroying most of the district, and the Japanese authorities saw this as an opportunity. They chose to create a new Yoshiwara but instead moved it to the outskirts of Edo (Gordon, 2019). The idea of the Yoshiwara being located on the outskirts of Edo was very symbolic, as it was a representation of the Japanese social caste system. Overall, the Japanese caste system had four main social classes that were based on Chinese Confucianism by the Tokugawa government; however, there was even a social group determined that fell below these classes. This class of people were considered outcasts, or *pariahs*, and the people of the Yoshiwara, such as prostitutes and entertainers, belonged to this group (Hickman, 1978). Being outcasts, and then eventually being placed on the outskirts of the city of Edo, the people of the Yoshiwara and its overall purpose played right into the idea of its marginal existence, that being "The Floating World."

The Floating World was another name for the Yoshiwara and came from the word *ukiyo*. Within the word *ukiyo*, the word "uki" means floating, and the word "yo" means world, and together they created the title of "The Floating

World" (Hickman, 1978). The main idea was that the entertainment district was somewhere that citizens could escape to go drink, enjoy themselves, and essentially detach from society. To the people of Japan, it was an otherworldly place (Hix, 2015). The Yoshiwara mainly consisted of two areas: the *kabuki* theater district and the Yoshiwara pleasure quarters. Within the *kabuki* district, one could indulge in *kabuki*, which was a live action play with actors, or *bunraku*, which was a form of puppeteering and storytelling. For the pleasure quarters, this was seen as a place where many brothels holding legal prostitution were found, as well as smaller teahouses and restaurants (Stalker, 2018). While all of these aspects put together at first glance seem to portray an area that was filled with liveliness and promotion of entertainment in Edo, a deeper look into the Yoshiwara reveals this is not entirely the case. The Yoshiwara held many dark and inhumane aspects that were largely ignored by the Tokugawa government and society as a whole, and together these aspects have been somewhat ignored and even forgotten in modern times. Although the Yoshiwara was considered to be a progressive place for entertainment and creativity through many art styles, the unethical practices that took place throughout pleasure districts, the *kabuki*, and even art must be recognized when examining Japanese history.

HISTORICAL FRAMING OF THE FLOATING WORLD

It is important to first examine why the Yoshiwara has been viewed as a positive historical symbol in Japanese culture since its existence. Many viewed the entertainment district as an escape from debt or from personal problems at home. By the 1900s, about half of all the women in

the Yoshiwara district came from households destroyed by natural disasters and agricultural failure (Husiman, 2020). The Yoshiwara served as a gateway from the countryside and allowed outsiders to integrate into Edo society quite easily. The Yoshiwara made the most sense for these women to head to, as it was one of the main sources of economy during its time. Many men came from the district ready to spend large sums of money, which created numerous opportunities for the women there. Another positive aspect of the Yoshiwara was the art and culture that emerged from it. Woodblock print was an incredible phenomenon that occurred from the Tokugawa period, mainly coming from the Yoshiwara. A woodblock was used to print images and text upon paper, and this was effective as it allowed these producers to mass market their work and attract a larger audience (Stalker, 2018). This was beneficial, as it served as something similar to the modern-day internet, where citizens could access news and gossip much more quickly. Along with this, art became very prominent, among things like *ukiyo* prints that came from the Yoshiwara, which could be represented by a variety of images, portraying artwork full of color that depicted similar images of women with unreadable facial expressions (Hix, 2015). These prints were also boosted and popularly known due to the new technology of woodblock printing that allowed the Yoshiwara culture to flourish in historical Japan.

CELEBRITY AND PERFORMANCE IN KABUKI

The *kabuki* theater was also an aspect of The Floating World that could have been seen as a positive part of the Yoshiwara. The *kabuki* was composed of many actors who were seen as celebrities across Japan during their time.

Different actors had varying levels of status and could rise to prominent fame. An Edo period samurai reported that, from the *kabuki* he saw, their "residences too are magnificent; their wives, concubines, and even their children have male and female servants; they live in exceptional splendor, toy with rare Japanese and Chinese objects, and satiate themselves on exotic foods from mountain and sea; their extravagance in everything is beyond compare" (Miyazaki et al., 2017, p. 214). From the food they ate to their families, these actors were able to live their lives like royalty because of the fame they acquired. Many actors became so famous that they attracted fan clubs, with followers who showed tremendous amounts of support towards them. These actors would receive money, clothes, curtains, and other decorations from their fan clubs simply because their fans enjoyed seeing their performances (Miyazaki et al., 2017). Their income did not stop there, either. Some of the actor managers in *kabuki* could earn up to 1,000 gold coins, which at the time amounted to an incredible sum of money (Leiter, 2010). From all of this information, at first glance, it may seem obvious why the Yoshiwara was seen as a positive part of Japan's history. There was great economic opportunity, and new culture bloomed from the Yoshiwara. However, taking a further look into this history, the number of negatives associated with the Yoshiwara completely outnumber these upsides.

CENSORSHIP AND CONTROL

One of the main issues of the Yoshiwara that is not commonly talked about can be seen with the censorship that took place. As mentioned before, woodblock prints and art pioneered Japanese culture when first gaining popularity during the Tokugawa period of Japan. However, these works were surrounded by very strict laws and censorship, imposed by the Japanese government with the intent to preserve social order and prevent dissent from the public. The Tokugawa government prevented the publication of anything that "depicted current events, unorthodox theories, rumors, scandals, erotica, government officials, or anything directly related to the Tokugawa rulers or the Imperial family" (Stalker, 2018, p. 182). Although the Yoshiwara was supposed to be a place where citizens could detach themselves from the struggles of society, their speech and actions were still being strictly dictated by the government. If one was to disobey these laws, they could face harsh punishments. For example, a writer by the name of Kyoden wrote about social status and politics, and ended up facing 50 days in handcuffs, while his publisher, Tsutaya Juzaburo, had to pay

half of his entire net worth (Stalker, 2018). One could face strict punishment and lose all of their money simply for expressing an opinion in the Yoshiwara.

There were some writers who did manage to expose the true issues affiliated with the Yoshiwara, however. One of these was Ihara Saikoku, a famous writer and poet from the Tokugawa period. In one of his stories, he described how his character desired to feel "that this boy's beauty might never tarnish, that he might forever wear the forelock of a lad," when talking about another person (Saikaku, 1686, p. 102). This sentiment reflects the idea that the Floating World represented eternal beauty and youth, which the character desired to see in the person he was admiring. This idea was also very common across the Yoshiwara, as the *ukiyo* prints gave inaccurate depictions of beauty as well, manipulating common people for the purpose of money. Artists created images of unrealistic women in order to seduce men and draw them towards the Yoshiwara (Huisman, 2020). This contributed to a distorted perception of women, and led men to draw unrealistic expectations towards them, believing they could keep some sort of everlasting beauty and youth, when in reality, that could never happen with age.

CENSORSHIP AND SEXISM IN KABUKI

As mentioned earlier, the *kabuki* was seen as prominent and luxurious among Yoshiwara society; however, beyond all these great qualities lay hardships as well. Although the actors within the *kabuki* were paid extremely well, they faced censorship and backlash from the government. The first attempt at this was with the Kensei Reforms during the Tokugawa period, which attempted to cap actors' salaries at 500 gold coins. This initially failed; however, this cap was later put in place once again, and the actors were also prohibited from traveling outside of Edo (Leiter, 2010). This was done to prevent the actors from avoiding the salary cap and traveling to other districts where the Edo laws did not apply. Along with this, *kabuki* actors also saw censorship upon what they wore on stage during their performances. Anti-luxury laws were put in place by the government to prevent actors from wearing certain fabrics and outfits on stage. Punishments were given if this rule wasn't followed, such as in the case of the actor Ichikawa Danjuro, who was banned from *kabuki* for seven years after wearing a suit of armor gifted to him by a samurai (Leiter, 2010). Ultimately, one can conclude that these punishments to prevent outcasts like the actors of *kabuki* from rising to the same prestigious levels as other social castes were unjust and unethical actions by the

Japanese government.

Along with this, the *kabuki* also had significant internal sexism that played a large part in its system. In 1629, the Tokugawa Government chose to completely ban women actors from the stage, replacing them with attractive men who played their parts instead (Stalker, 2018). These men were referred to as *onnagata*, and their introduction caused a chain reaction of additional problems. Women previously involved in the *kabuki* were forced to take their entertainment to the pleasure districts, where even more problems concerning mortality and disempowerment lay (Hickman, 1978). The *onnagata* themselves faced problems from the Japanese government due to their involvement in homosexuality and homosexual prostitution. The government saw this as a problem and a social disruption, and completely banned *kabuki* as a whole in 1652 (Hickman, 1978). Eventually the *kabuki* was reopened, but on the agreement that the *onnagata* had to shave their heads to remove erotic elements like long hair from their shows. From the outside, the *kabuki* seemed to offer the most luxuries and to represent the Yoshiwara as an area of culture and development. However, beneath the surface, it faced a great amount of systematic prejudice and government discrimination, including sexism and homophobia.

LIFE IN THE PLEASURE DISTRICTS

Arguably, the most horrific side of the Yoshiwara was hidden within the pleasure districts and the brothels that comprised them. Many of the female workers were bought from families at a very young age to try and help with that family's hardships and debts. Some girls were even as young as 12 or 13 years old when they first went to the Yoshiwara (Huisman, 2020). The idea of a family selling away their own daughter so easily for financial issues is extremely disturbing in itself, along with the young age at which it was done. Following this initial offer was a lifetime of hardships and traumatic experiences. The young girls would begin training at a young age and occasionally would experience their virginity being sold at a high price to a client at the start of their courtesan training (Hix, 2015). The overall harsh reality was that, although this was all being done for the benefit of the girl's family, that was rarely the case. The debts they had to repay would only grow over time due to many expenses that the courtesans had to pay themselves. Many scholars view this as a "near slave system" where women would be forced to work for no pay until they died (Huisman, 2020). These girls had to pay for items like kimonos and bedding all by themselves in order to continue

to provide good service for customers, and these prices accumulated to large amounts over time.

MORTALITY AND MARGINALIZATION

Because the courtesans' debts rose so much over time, as well as an increase in clients, women in the pleasure districts would commonly see a decline in the quality of service they were able to provide, which led to punishment. The punishments within brothels would typically come from the wife of the owner, who was in charge the majority of the time. A samurai from the Edo period reported that some of these punishments included being "denied food for several days or put to work cleaning the toilets or some other dirty place, or stripped naked, bound with hemp rope, and doused with water. When moistened with water the rope shrinks, causing her to shriek in pain" (Miyazaki et al., 2017, p. 198). These punishments were so inhumane and cruel that, in some cases, the courtesan would be tortured to death. Inhumane punishments were quite common throughout the pleasure district of the Yoshiwara in a variety of ways. Courtesans who chose to try and run away faced severe consequences if caught. These included being "beaten with a bamboo stick until she faints, or be stripped naked, gagged with a hand towel stuffed in her mouth, her four limbs tied together behind her back, and suspended from a crossbeam to be beaten" (Miyazaki et al., 2017, p. 200). These punishments were incredibly severe and showed no justification for their reasoning. With aspects like these being so common within the Yoshiwara, this evidence only further strengthens the point about the inhumane underlying nature that the Floating World held.

Not only did women in pleasure districts face death from punishments, but also frequently died from other factors within the Yoshiwara.

During the Meiji period of Japan, "syphilis was a major killer of women in Yoshiwara" (Huisman, 2020). Many women died due to hiding the disease often out of fear that it would take away from their beauty and service, possibly resulting in them being sold to a brothel of lower status and condition. Along with this, women in the pleasure districts commonly died from failed abortions (Huisman, 2020). These women did not have access to proper medical resources, but knew they had to keep working, so they attempted to abort the babies themselves, which often led to death.

It is also important to look at how the courtesans were treated after death. The majority of courtesans did not have any money due to being entrapped in the slave system of the brothels and were unable to afford their own funerals. The courtesans that died were brought to the Jooganji Temple in Edo where they were given unnamed burials and simply thrown into a grave, as if their lives had no importance (Huisman, 2020). It was said that the Jooganji temple contained "the remains of 21,056 muen ('without connection') prostitutes - many of them in their twenties - who had no one to cover the cost of their funerals" (Hix, 2015). It is unsettling to think that thousands of once-loved women were given no recognition or compassion in death and were reduced to mere statistics by the people of the Yoshiwara. From all of these inhumane actions within the pleasure districts alone, it is clear to see the true nature that surrounded the Yoshiwara.

CONCLUSION

Overall, the general idea of the Yoshiwara, when examined on a deeper level, does not seem normal and is unsettling to some extent. It should be seen as extremely alarming from the start, since "the legal system appeared to

encourage selling daughters into prostitution as a legitimate response to poverty" (Garon, 1997, pp. 90-91). When a government resorts to using unethical measures to solve economic problems instead of looking for other solutions, that alone should indicate that the Yoshiwara was a dark idea to begin with. A fenced-off entertainment district where people could go to disconnect from the world was ultimately created as a pure financial decision without regards to human rights and value. As seen in the account of Edo Samurai Katsu Kokichi, he went to the Yoshiwara with 200 gold coins, and "spent it all in the Yoshiwara in less than a month and a half" (Kokichi & Teruko, 1988, p. 45). The Yoshiwara was created by the Japanese government with the sole purpose of manipulating its own people and getting them to spend money in ways they normally would not.

Although the Yoshiwara has sometimes been regarded as a progressive location for innovation and enjoyment through a variety of art forms, when examining Japanese history, it is important to acknowledge the unethical acts that occurred in pleasure districts, the *kabuki*, and even in the field of art. Within art and mass production of prints, censorship was commonly found, and extreme punishments were handed out by the government for simply expressing opinions. Within the *kabuki*, both integrated sexism and an unjust attempt to control actors' earned money stemmed from government regulation. The pleasure districts proved to be the most inhumane aspect of the Yoshiwara, with children being placed in prostitution at extremely young ages, severe punishments including death, and a lack of quality of life all commonly seen. Overall, evidence has consistently proven to show that when taking a deeper look into the Yoshiwara of Japan, the Floating World strongly represents a place of inhumanity and cruelty.

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Women in Motorsports: The Uphill Battle for Safety and Equality

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ABSTRACT

Motorsports are a male-dominated field with very few women either competing as drivers or serving as crew. While attempts have been made to increase female participation within the sport, barriers such as stereotypes, sponsorship struggles, and insufficient safety research persist. This paper argues that women's involvement in motorsports is dependent on an increase in research focusing on the physiological impacts of racing on the female body. Existing studies have only focused on male drivers; this gap compromises the potential safety of the sport, as this research is key for developing training programs and safety equipment to mitigate any physiological impacts on the body. Additionally, the gaps in the literature act as reinforcements for the harmful stereotypes surrounding women in motorsports that create the perception of being unworthy or incapable competitors. The findings of this paper emphasize that in order to increase female participation within the sport, improvement of safety standards, and an expanse of research focusing on female drivers are crucial. For motorsports to truly be an equal playing field for both men and women, all targeted efforts towards safety development and inclusivity must be prioritized.

Keywords: motorsports, gender, equality, safety, physiology, women

INTRODUCTION

"Drivers! Start your engines!"

Historically, this call does not include every driver. The world of motorsports has long been a male-dominated sport, with women representing only a small fraction of participants in various racing disciplines. While motorsports require a unique blend of physical endurance, technical skills, and mental sharpness – traits that are not inherently tied to gender – historical, cultural, and social barriers have often limited women's access and participation (Kochanek et al., 2020, p. 6; Matthews & Pike, 2016, p. 2). Over the past few decades, however, there has been a notable shift as more women have entered motorsports, from karting to Formula One. This uptick in the number of female drivers is supported by changing attitudes, targeted initiatives, and the rise of high-profile female drivers who inspire future generations (Kochanek et al., 2020, p. 1). In recent years, however, the only notable increase in female participation was in American-based championship circuits (Matthews & Pike, 2016, p. 2; Pflugfelder, 2009, p. 412). Female drivers and fans around the globe have questioned how motorsports can increase female participation within the sport. Younger girls who tune in may find themselves asking: "Where are the girl drivers?" "Could that be me one day?" This paper argues that despite prior research being done on the physical demands of the sport and how the human body is affected, female participation in motorsports is dependent on the increase and focus of research exploring the physiological impacts of racing on the female body. The lack of gender-specific research not

only slows the progress of gender equalization in the sport but it also actively places women at risk. Training protocols, safety equipment, and vehicle design optimized for male physiology can fail female drivers and aid in the exclusion from top-tier competition. A gap that, if left unaddressed, risks reinforcement of unsafe equipment design, ineffective training protocols, and preventable injuries for women in motorsports. Without filling this gap, motorsports remain structurally unequal, no matter how inclusive its rhetoric becomes. This research will aid constructors and motorsports officials in designing vehicles that are safe for the female body, along with implementing training strategies and programs to prevent injury.

DRIVERS! START YOUR ENGINES!

Motorsports is a term encompassing the various forms of competitive motor-vehicle racing, primarily involving the racing of motorcars and motorcycles (Matthews & Pike, 2016, pp. 3-4). Additionally, this discipline of racing is the art of mechanical engineering and pure athleticism combined into a competitive atmosphere. This competition tests not only the speed and velocity of the vehicles but also the skill and precision of the drivers behind the wheel as they aim to be the first to cross the finish line or to set the fastest time around a circuit. Auto racing is increasingly becoming one of the most popular sports in the world, especially in America (Ferguson et al., 2019; Ebben & Suchomel, 2012). Reid and Lightfoot (2019) noted that motorsports include a wide variety of championship circuits, each of which is distinguished by the different

configurations of the vehicles. They explain that the cars can range from single-seater and open-wheeled to closed-wheeled, dual-seater, and even motorcycles (p. 2549). The most renowned championship circuits include Formula One (F1), IndyCar, NASCAR (National Association for Stock Car Automobile Racing), and MotoGP.

Motorsports have been considered a "masculine" activity since its increase in popularity within the 1960s (Kochanek et al., 2020, p. 1). More Than Equal (MTE), an organization dedicated to increasing the participation of female drivers within motorsports, conducted a study released in June 2023 in which they explored the gender participation gap within motorsports. The organization found that female participation percentages within different championship circuits range from as low as 7% to 13% (MTE, 2023). These figures highlight the significant gender participation gap in motorsports, where women remain a minority despite growing interest and initiatives aimed at fostering inclusivity (MTE, 2023). While karting, the racing of go-karts by children and adolescents, and the most commonly considered entry point for professional racing, shows slightly higher female engagement rates in some areas, systemic challenges such as limited funding, less media coverage, fewer opportunities, and gender stereotypes hinder the attempt at a greater gender balance (MTE, 2023).

PHYSIOLOGY OF RACING

Contrary to popular belief, motorsports do not fully rely on the cars but rather on a partnership

between the vehicle and the driver. For example, Potkanowicz and Mendel (2013) described the ongoing battle for drivers to be recognized as athletes. They noted that the public view of racing drivers sees the sport as only turning left (p. 565). Despite typical assumptions of racing drivers, Lavsi noted that motorsports demand the highest level of physical and mental fitness (2023, p. 31). Racing can be detrimental to the body with stressors such as high gravitational forces, elevated temperatures, fire risk, and even accidents, which have resulted in fatalities (Reid & Lightfoot, 2019, p. 2549). This level of danger has led researchers to study the physiological effects of racing on the human body. However, very few publications have explored the medical science behind racing. Ferguson et al. (2019) noted that there were fewer than thirty peer-reviewed studies on the physical demands of the sport; in addition, drivers were not considered athletes until around the early 2000s (p. 2570). Potkanowicz and Mendel (2013) found that after monitoring heart rates, blood oxygen levels, sweat production, and even metabolic rates, driver athletes exhibit physiological responses to stimuli comparable to, if not exceeding, those of athletes in other sports such as basketball, football, or soccer (p. 572). This research supports the conclusion that driver athletes are no different from athletes of other sports regarding levels of athleticism and what is considered to be an "actual sport."

Emphasized by Reid and Lightfoot, the usual output of carbon monoxide from the vehicles often exceeds the occupational safety limit, and with long-term exposure to the body, the large amounts of exhaust emissions have been proven to cause potentially fatal health effects (2019, p. 2549). Reid & Lightfoot also note the high temperatures of closed-wheeled cars as the drivers are enclosed in the cockpit. The drivers are constantly subjected to temperatures well beyond the occupational safety limit and pose the risk of heat stroke (2019, pp. 2549-2550). In addition to these temperatures, the gravitational forces of turning alone can act as a detriment to the body, not to mention the gravitational forces produced by impacts from accidents. Gravitational forces (g-forces or "g") are measured whenever a driver experiences a change in speed or direction (Lavsi, 2023, p. 34). Within races, drivers can be exposed to downforces that surpass 5 g during braking and cornering zones; for reference, the average commercial plane generates about 1.5 g during takeoff (Lavsi, 2023, p. 34; Reid & Lightfoot, 2019, p. 2552). Reid and Lightfoot reported that exposure to gravitational forces alone can cause dizziness, loss of consciousness, loss of peripheral vision,

vertigo, and disorientation, increasing the risk for accidents (2019, p. 2552).

Motorsports are a dangerous pastime enjoyed by those who seek excitement and thrill through the inherent risk of death. In order to counteract these potentially fatal effects on the body, researchers have used this data in order to design training programs to help offset these environmental stressors. As explored by Ebben and Suchomel (2012), the data surrounding the body's reactions to environmental stressors can be used to guide motorsports physicians and conditioning coaches in creating training programs to help the driver athletes become more ready to handle the physical demands of the sport (p. 1196). However, a limitation of this study and similar reports is that the subjects were all male. This omission doesn't just affect data quality; it translates into training regimens and safety standards that may unintentionally endanger or disadvantage female drivers. Reid and Lightfoot clarify that the driver-athlete demographic is generally men, but in recent years, there has been an uptick in the number of female drivers (2019, p. 2550). An increase in research on the female body would aid these drivers in becoming more competitive by allowing their bodies the proper training in order to mitigate these effects, which, in turn, would aid in creating a safer environment for women to race in.

SAFETY IN MOTORSPORTS

Throughout its lifetime as a sport, motorsports have gone through various evolutions in safety. Driven by technological advancements, regulatory changes, and an emphasized focus on driver health, motorsports today are comparatively safe considering the physical demands the drivers face to compete. However, this has not always been the case. From the early days of racing, safety standards were considered rudimentary at best. In the 1950s and 1960s, drivers faced extreme risks due to inadequate vehicle structures and minimal safety gear (Stuart, 2020). The vehicles were extremely fragile and flammable, offering little to protect the driver in cases of roll-overs (Hylton et al., 2012). As stated by Watkins (2006), the fuel tanks within the cars were incredibly fragile and it took up until 1970 for the correct safety bladder fuel tanks to be added into the cars, along with safety foam in 1972, and self-sealing coupling to immediately stop gasoline flow to the engine in the event of a crash in 1974 (p. 148). As for personal protective equipment, drivers only wore leather helmets and goggles, which did very little to aid in protection. After constant advocacy from drivers, medical and safety advancements

have been and continue to be implemented as a form of intervention for potentially fatal accidents (Stuart, 2020). The reconstruction of the vehicles shifted to a focus on a carbon fiber chassis, which significantly reduced the amount of severe leg fractures as well as reinforcement to the survival cell surrounding the feet (Watkins, 2006, p. 149). While existing research on the skeletal structure of male drivers has significantly contributed to the development of safer vehicle designs, there is still a relatively large gap in the literature surrounding musculoskeletal characteristics of female drivers, such as bone density, skeletal proportions, and injury risk. This oversight means that crash safety devices and gear may not be optimized for women, leaving them more vulnerable in high-impact scenarios and possibly discouraging female participation due to perceived danger. Without this data, current safety designs may fail to protect all drivers equally, leaving women more susceptible to injury or disqualification due to ineffective design of racing cars attempting to meet safety standards while failing to comply with regulations within the league.

This research has been groundbreaking in creating a safer environment for the drivers to compete in. Kempema (2024) explained that the introduction of safety devices, protective fireproof overalls, and rules implemented can ensure the drivers are safe to participate (p. 3). The most notable safety improvements include the introduction of the HANS device (Head and Neck Safety), which acts as an impact absorption and stabilization surrounding the driver's head and neck to reduce movement in accidents (Watkins, 2006, p. 151). In addition to this, the introduction of the HALO device within F1 cars in 2018 which encapsulates the drivers head in a protective rim that can withstand forces up to five times the vehicle's weight, the inclusion of fireproof overalls, as well as improved circuit barriers and increased medical staff present at the races (Watkins, 2006, p. 152; Kempema, 2023, p. 3; Franchini et al., 2007).

With the improved safety innovations, the last fatality within Formula One was in 2014, IndyCar in 2015, NASCAR in 2001, and MotoGP in 2011. This improved safety, while performing miracles in keeping the drivers alive, still has a major gap within its literature: research on the female body. This sport cannot be truly safe for all of its drivers until every aspect of safety has been thoroughly observed, including any possible differences in female bone structure that may make female drivers more or less prone to fractures. The research on the physical demands of motorsports has aided motorsports physicians in creating training programs designed to help

the drivers mitigate any potential physiological impacts their bodies might face. As revealed by MTE's 2023 study, there is little to no research exploring the possible gender biases in the design of safety equipment or if requirements around mechanical aspects of the cars, such as power steering, are acting as barriers for these female drivers (2023, p. 9). In order for motorsports to truly be considered a "safe thrill," research focusing on the female body is required, so every racer, no matter their gender, is safe.

ENGINES AND EQUALITY

Motorsports have been a historically male-dominated sport with very few women either competing within the sport or serving as crew members or officials. There are no rules or regulatory barriers inhibiting the participation of women within motorsports (Howe, 2022, p. 454); however, very few women have managed to compete in top tiers of motorsports such as F1, IndyCar, and NASCAR (Pflugfelder, 2009, p. 413). As reported by the UK Motorsport Association (2015), motorsports are considered to be one of the very few sports where men and women are, on a competition level, "equal." While this is reported to be true in regulatory terms, Matthews and Pike (2016) revealed that statistically, men represent the majority of drivers, pit crew, managers, and officials, leaving only a small percentage of women being actively involved within the sport. Specifically, Matthews and Pike also reported that women only make up about 8% of registered license holders in motorsports (p. 6). Emphasizing the lack of female participation, they noted the fact that the last woman to compete in Formula One was Lella Lombardi in 1976 (p. 6). While there has been an increase in women participating within North American championship circuits such as NASCAR and IndyCar, they remain remarkably underrepresented within the sport (Kochanek et al., 2020, p. 9)

This lack of female participation has created a significant barrier to improving safety measures for all drivers, specifically female drivers. As of 2024, there is extraordinarily little research on the physiological impacts of racing on the female body (Reid & Lightfoot, 2019, p. 2548). In a common misconception among male drivers and fans, women are seen as genetically inferior within the sport due to the menstrual cycle (Ferguson et al., 2019, p. 2570). In contradiction with this claim, Ferguson et al. (2019), states that there were no major differences between the physiological responses to motor-racing in males and females, citing results that state conclusions cannot be made to prove that the menstrual cycle affects skeletal muscle strength which, therefore,

would not impact physiological responses in female racing drivers (p. 2576). Furthermore, Ferguson et al. (2020) noted that every claim surrounding the menstrual cycle impacting the performance of women in motorsports is not based on any scientific evidence or research (p. 2571). These false claims have created this slanderous trope that women's bodies are inferior, which deters women from pursuing a career in motorsports out of fear of being labeled a burden or a diversity hire. Increased research on the female body regarding the effects of racing is crucial to not only improve performance, but also to counteract damaging stereotypes and to ensure that physiological misconceptions do not justify systemic exclusion. Without this research, women remain locked out of elite levels of the sport; not because of a lack of ability, but because the science fails to acknowledge them.

Further complicating the road for women in motorsports is the threat of being seen as objects or decorations for the male drivers rather than actual human beings. Matthews and Pike (2016) noted that in the sport today, the only girls usually seen are models or the significant others of the drivers. In addition to this, Kochanek et al. (2020) explained how the sexualization has gotten out of hand as the main occupations typically for women in motorsports are 'grid girls' (p. 6). As defined by the Austin Grand Prix website, 'grid girls' are models who act as advertisements for sponsors. The idea behind it is to engage male fans by having attractive female models pose with the vehicles, interact with fans, and act as essentially decorations for the podium ceremonies at the end of the races (Wong, n.d.). This creates a harmful stereotype surrounding potential female drivers, as they are forced to balance being seen as feminine and attractive while also trying to prove themselves as worthy competitors (Kochanek et al., 2020, p. 6).

In addition to the aspect of keeping a feminine image for sponsors, female drivers also face the problem of not being taken seriously. Pflugfelder (2009) explains that female drivers are often seen as 'exceptions' to competitions with many media outlets placing an emphasis on their gender rather than their performance (p. 413). Kochanek et al. (2020) revealed that female drivers have stated they receive harsher criticism than their male counterparts. Kochanek follows this statement with an example of how the public tends to be more forgiving when a male driver crashes out of a race or makes what is considered to be a "dirty move," they are seen as just trying to do their best (2020). When a woman makes the same mistake, they are labeled as uncompetitive or not good enough to even compete within motorsports in the first place.

Female drivers also face the problem of being perceived as 'token hires' rather than serious competitors. Along with the criticism surrounding their performances, women also face skepticism for their sponsorship and media attention. Matthews and Pike (2016) noted that female drivers often receive more sponsorships due to their gender as opposed to their skill, leaving those who disapprove of women in motorsports to diminish their legacies on account of their gender. This goes hand in hand with the perception of female drivers being "token hires." Within an interview conducted by Matthews and Pike, two female drivers emphasized that sponsors tend to be more willing to offer a contract for female drivers due to the amount of "good press" they receive (Matthews & Pike, 2016). This relative 'ease' of gaining sponsorships has the tendency to give off the impression that the women are simply 'diversity hires', there to make the sport more money in terms of sponsorships. This harmful assumption is what essentially kills the motivations for younger generations of female racers to enter the sport out of fear of being perceived as a 'token hire.'

SEPARATION OF COMPETITION

Opposition to the increased research on the physiological responses of the female body claims that there is no current need for the increased research due to the creation of women's racing leagues. Common examples of this would be Formula One Academy, a championship circuit attempting to mock the competition style of F1, but only for women. Additionally, its predecessor, the failed W-series, was another attempt at an open-wheeled women-only championship, which went bankrupt after only two competitive seasons (MTE, 2023). These two racing leagues shared the common goal of creating an atmosphere where women could showcase their talents in an attempt to improve the incorporation of women into the sport. However, the implementation of women-focused championships has done very little to aid in the inclusion of women in motorsport. In other sports such as basketball, soccer, and even tennis, women's leagues are created with the idea that women would be competing against other women. The reasoning behind this is to eliminate any unfair physical advantages male athletes may have over female athletes, such as weight, height, or physical strength. In contrast, unlike other sports, motor racing does not rely on physical competition between athletes; the competition is wheel-to-wheel.

On the track, the winner is not determined by who is behind the wheel; it is a matter of skill, intelligence, and pure competitiveness. The

separation of men and women in motorsports hurts the performance of female drivers. Matthews & Pike (2016) argue that since the women-only championships have different rules and regulations regarding the cars, women are not competing on the same level as the men, leaving them, realistically, with no real competition experience. Emphasized by Pflugfelder (2009), the competitions are less intense, which in turn enforces the stereotype that women are simply worse drivers due to slower track times and worse results. Matthews and Pike concurred with this statement through the acknowledgement that the gender-based structure did not offer much in terms of challenging the stereotypes that plague these female drivers (Matthews & Pike, 2016). While the intention was to create an environment to further the inclusivity of motorsports, the creation of women's leagues unintentionally reinforces the idea that women need a separate competition. Instead of creating a separate championship circuit, the focus should be more on integrating these women into the main events, which cannot happen safely or equitably without physiological research that ensures equal

standards in safety, training, and car control. Ignoring this research means continuing to force women into second-tier competition due to an unverified assumption of difference.

CONCLUSION

The landscape of motorsports is gradually evolving, but true inclusivity and safety for women in racing still require substantial advancements, most urgently in the area of scientific research. The cost of inaction includes not just missed talent, but higher injury risk, alienation of young female drivers, and the stagnation of one of the most technologically sophisticated sports in the world. The persistence of cultural, physiological, and societal barriers has historically limited female participation in motorsports. An increase in research dedicated to understanding the unique physiological impacts of racing on the female body could lead to essential improvements in training programs, safety standards, and possible vehicle design to prevent injury in the event of a collision. Additionally, this research will aid in dismantling the harmful stereotypes surrounding female drivers. Acknowledging their skill and athleticism

on equal terms with male drivers is crucial for fostering a more supportive environment in motorsports. Targeted research is crucial to the improvement of safety for female drivers as well as the increase in female participation within the sport. Multiple scholars within the field of research have acknowledged the gap within the literature surrounding female drivers (Pflugfelder, 2009; Kochanek et al., 2020). With continued advocacy, targeted research, and the commitment of motorsport organizations to inclusivity, a future where motorsports genuinely welcome and support all drivers, regardless of gender, is within reach. But without urgent attention to the physiological research gap, the sport risks repeating a history of exclusion under a moderate, safety-first façade. More than just inclusion, this is about protective lives, advancing science, and fully unlocking human potential in one of the most technologically and physically demanding sports in the world. This reframes the question of "Where are the girl drivers?" into a definitive assertion: "Here they are, they are competing, and they are winning."

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