Cal Poly Humboldt
McNair Scholars Program

Cal Poly Humboldt McNair Scholars Program Research Journal

Volume 1 - Summer 2023

Research reported by the Cal Poly Humboldt McNair Summer Research Fellows

Foreword

The *Cal Poly Humboldt McNair Scholars Research Journal* is an annual publication of the Cal Poly Humboldt McNair Scholars Program. Funding was received for this work from the Cal Poly Humboldt McNair Program, grant number P217A220345.

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Research Reports

Max Cartagena

California LGBTQ+ College Student's Perceptions of Political, Media, and Campus Climate

Abstract

This study is investigating California LGBTQ+ college students' perceptions of the current political, media, and campus climate as it pertains to LGBTQ+ rights, and how it relates to their well-being. It also investigates whether these perceptions differ between transgender and gender-diverse students and those who only identify as sexual minorities.

Introduction

On June 6th, 2023 the Human Rights Campaign (HRC), the largest LGBTQ+ civil rights organization in the United States, declared a state of emergency for LGBTQ+ people living in the United States for the first time since its inception. According to the organization, in the 2023 legislative session, they tracked over 525 anti-LGBTQ+ bills in the United States. According to the American Civil Liberties Union (ACLU) many of these bills particularly target trans and gender diverse (TGD) individuals and their ability to engage in public life and access healthcare (ACLU, 2023), and at least 220 target transgender youth (HRC, 2023). The majority of these bills have been introduced in states with predominantly Republican-leaning legislatures (ACLU, 2023).

According to a press release from California state representative, Scott Weiner, in response to the wave of anti-LGBTQ+ legislation, on September 30th, 2022 California became the first transgender sanctuary state which codifies protections for individuals seeking gender-affirming care and crucially will prevent the extradition of families to other states who wish to prosecute them for providing their child with gender-affirming healthcare (2022). Since then 11 other states have passed similar sanctuary state legislation (Reed, 2023). This protection is vital as gender-affirming care has been shown to significantly reduce symptoms of depression and suicidality in TGD populations (Tordoff et al., 2022).

This presents a challenge to sexual and gender minority (SGM) California students who benefit from California's robust legal protections as they consider their prospects for

the future. In addition, the resulting media climate includes increasing stories of anti-LGBTQ+ rhetoric and legislation. In a poll conducted by The Trevor Project and Morning Consult looking at LGBTQ+ people aged 13-18, when asked how the recent debates about state laws restricting the rights of transgender individuals have impacted their mental health, 85% of transgender and/or non-binary youth and 66% of LGBTQ+ youth reported a negative impact on their mental health (2023).

In a longitudinal study conducted during a Massachusetts referendum on transgender individuals' right to go to the appropriate restroom, they found that the referendum accounted for 40% of the variance in symptoms related to depression for TGD people (Horne et al., 2022). Other studies illustrating the importance of legal protections for the mental well-being of LGBTQ+ individuals have shown how nondiscrimination policies lead to lower rates of internalized homophobia and lower rates of reported negative messaging in LGBTQ+ people's everyday lives (Riggle et al., 2010).

These studies point to the negative effects the current wave of legislation may have on SGM college students though not all of the effects are direct. Structural stigma theory posits that institutions such as governments, colleges, and others that individuals live under play a pivotal role in the well-being of different groups existing within the systems—especially marginalized groups. This power comes from the institutions' ability not only to implement harmful or helpful policies but to set the tone for the cultural norms people are expected to abide by (Pachankis & Bränström). Living in high-stigma areas as a result of the sociopolitical environment has been associated with adverse health effects in SGM individuals such as increases in substance use and chronic HPA-axis dysregulation (Drabble et al., 2022, Hatzenbuehler & McLaughlin, 2014).

Within the context of institutions of higher education, several studies have demonstrated the importance of structural inclusivity. In one study, transgender students were 45% more likely to report a suicide attempt within the last year when denied access to facilities such as bathrooms on campus, and 65% more likely if denied gender-appropriate housing (Seelman, 2016). Another study demonstrated how proactive policies such as anti-discrimination policies, access to LGBTQ+ community resources, and offering LGBTQ+-related courses are associated with less distress and higher rates of self-acceptance.

Gap

While research has been conducted on how anti-LGBTQ+ rhetoric and legislation have impacted young people, the research has largely focused on people aged 13-18 and has done so at the national level. This study would build on the prior research by specifically looking at college students in California. By looking at college students in California, a better understanding will be gained on the effects of anti-LGBTQ+ legislation on LGBTQ+ individuals in states that have more protections. Furthermore, this study will build on prior research by investigating the differences in needs and perceptions between those belonging to gender minority groups and those who only belong to sexual minority groups.

Hypotheses/Question

Q1: With the rise of anti-LGBTQ+ legislation and rhetoric in the media, what are their effects on sexual and gender minority (SGM) college students in California?

Null Hypothesis Testing

H1: Participant reports of negative impact on mental health as a result of the current political and media focus on anti-LGBTQ+ legislation and rhetoric will be worse for transgender and gender diverse students than those who only belong to a sexual minority identity.

H2:: Participant reports of being deterred from moving out of state as a result of the current political and media focus on anti-LGBTQ+ legislation and rhetoric will be greater for transgender and gender diverse students than those who only belong to a sexual minority identity.

Methods

A survey built on Qualtrics will be filled out by participants. Participants will be considered eligible if they are attending a public college/university in California and identify as a sexual and/or gender minority. Participants will be recruited via convenience and snowball sampling. Faculty/Staff in LGBTQ+ centers and who advise LGBTQ+ clubs will be contacted. Additionally, outreach will be done via social media. The survey will take approximately 10-15 minutes to complete.

Questions

The survey consisted of 56 items. The questions were mostly on a 5-point Likert scale with a couple of dichotomous questions and fill-in-the-blanks. Additionally, there were some demographic questions where participants were instructed to select all that apply.

The survey was split into several blocks which were as follows: the consent form, demographic section, questions about campus experience, questions about their feelings living in California, questions about their media consumption and its effect on well-being, questions asking for their opinion on visibility in society, questions relating to survivor's guilt, questions about the future, their mental health, and a final block that allowed participants to write in suggestions for improvements campuses and classrooms could make.

Results

As of July 27, 2023, there have been 30 total participants. Three participants had to be thrown out—two because they stated they are not currently enrolled at a college in California and another who selected "other" but noted they are currently attending a college out of state. After excluding those participants, the following statistics are with N=27

Currently, neither hypothesis has been tested and statistical analysis has yet to be run in order to determine whether TGD and non-TGD participants differ in their responses as it pertains to mental health and willingness to move out of state.

Pertaining to the research question, there have been some interesting preliminary results. Notable statistics include 15% of respondents agreeing with the statement " I moved to California because I felt it was safer than the state I previously lived in". Also with the exception of one respondent, all said they agree with the statement "I feel safer living in California than I would living in another state as it relates to LGBTQ+ legal rights".

52% of participants responded often and 24% neither rarely nor often to the question, "To what extent are you exposed to media that you believe presents falsehoods surrounding LGBTQ+ identities?". 56% of participants strongly agreed and 16% somewhat agreed with the statement "I feel guilty for feeling safe while others are living in states where more anti-LGBTQ+ legislation is being passed".

Discussion

At the present moment, more participants are needed to increase the statistical power of the study. Nevertheless, some interesting trends are beginning to emerge from the data. 14% of participants at the moment stated that they moved to California from another state for reasons pertaining to safety. In comparison, in a national survey, 8% of TGD respondents stated that they have already moved out of state for their safety (Phares, 2023). As more individuals participate in the study it will be interesting if these numbers become more similar. If the difference is maintained, it is possibly due to the act of going to college serving as a catalyst for this migration pattern given that among all students 30% moved out of state for college (Kupriyanov 2021).

Limitations

The extent to which this research is generalizable to the total population of SGM college students is uncertain. A major limitation of the sample is the self-selection bias due to the use of convenience and snowball sampling. Given that students were reached out to from an email list of students who attended an LGBTQ+ summit and from having LGBTQ+ center advisors share the study with their students, it is likely that participants are more impassioned than SGM students who are less engaged. Nevertheless, if a larger sample size is gained and trends in data remain the same, this study will still illustrate the needs of an underserved population even if it is a smaller proportion of the total body of LGBTQ+ students.

Future Research

This study will highlight the need for additional resources on college campuses for LGBTQ+ students, and guide further research on how to best serve this population. With students reporting that they have already moved to California for their safety, it is essential that colleges and universities have the resources needed to service these students.

Further research must be conducted as to how our colleges and the state as a whole can best serve LGBTQ+ refugees. If my hypothesis is correct and TGD participants are experiencing more pronounced distress due to the current rhetoric it is vital that institutions of higher education work to dismantle structural stigma. Owen-Smith found that transgender participants living in an environment rated as high in tolerance had a third of the rate of depression compared to those in low-tolerance environments (2016).

Another interesting avenue of inquiry to be explored in future research should look at the prevalence of survivor's guilt and the extent to which it is distressing for marginalized communities living in areas with more or less structural stigma. No previous literature was found discussing survivor's guilt among SGM individuals living in different states.

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Matías Chapman

Evaluating Monomer Candidates for Active Layer Insertion in Organic Photovoltaic Applications

Abstract

Traditional photovoltaic (PV) substrates are primarily based on crystals of inorganic compounds (e.g., silicon). The inorganic PV substrates have proven to be reliable and efficient and are used in a wide variety of applications from providing power to street signs to powering the International Space Station. However, they are relatively expensive to manufacture (although costs are declining) and are too rigid for most energy applications. Solar cells manufactured using organic photovoltaic (OPV) compounds are less expensive to produce and can be made on a flexible plastic sheet. The goal of this project is to use computational chemistry to identify new possible OPV substrates. DFT calculations were carried out using Spartan and Gaussian computational packages locally and at the San Diego Supercomputer Center. The calculated HOMO-LUMO gaps revealed which compounds are best suited to pursue for synthesis.

Introduction

Traditional solar farms are excessively stressing infrastructure and ecologies, and are increasing pressure on silica mining, which is of great environmental concern (Rahman, 2022). The overall cost of OPV substrate manufacturing is still being evaluated, while its relatively wide range of low-footprint applications potentially offsets its environmental impact to a greater degree than do traditional PV systems (Mayer, 2007; Hu, 2022). As they stand, OPVs are half as efficient as their counterpart, due to a relatively underdeveloped body of discovered organic substrates appropriate for the task (NREL, 2023). In this work, a variety of new OPV substrate structures are proposed, and their competences are evaluated computationally and against benchmarks of existing work. Synthesis pathways are to be proposed for new candidates with reasonable computed theoretical performance.

Method

One pathway to discovering new, efficient OPV compounds is to start with computational chemistry. This allows one to survey a large number of possible compounds, including looking at a variety of minor changes for each compound, in a relatively short amount of time (Hachmann,

2014). Through researching known OPV compounds, new OPV compounds were determined, either through changing or functional groups and/or combining different parts of known OPV compounds. The novel OPV substrates were then modeled on Windows PCs at Cal Poly Humboldt using the computational packages Spartan'20 and GaussView. Geometry optimizations and HOMO and LUMO energy levels were calculated via a DFT method (B3LYP/6-311G**) using Gaussian 16 (Frisch, 2016) on the Expanse supercomputer system housed at the San Diego Supercomputer Center (SDSC), which was accessed remotely. The calculated LUMO energy levels and the HOMO/LUMO gap were graphically correlated to experimental data as can be seen in Figures 3 and 4, whose best-fit lines were used to predict experimental values for the new OPV compounds. The corrected data was then fitted to contour plot Figure 7 that correlates the LUMO levels and the HOMO/LUMO gap to an estimate of the efficiency of the OPV substrate (Blouin, 2008).

Results

DFT calculations with method and basis sets B3LYP and 6-311G** were performed on the six structures in Figure 1, each of which was inserted into the structure in Figure 2 for said calculations. These structures, from the work of Blouin et al, were useful for the purpose of creating an eV benchmark that accounts for variance in DFT calculation results. The LUMO energy level and band gap data of these were collected, and their correlations with published experimental data are reflected in Figures 3 and 4, respectively.

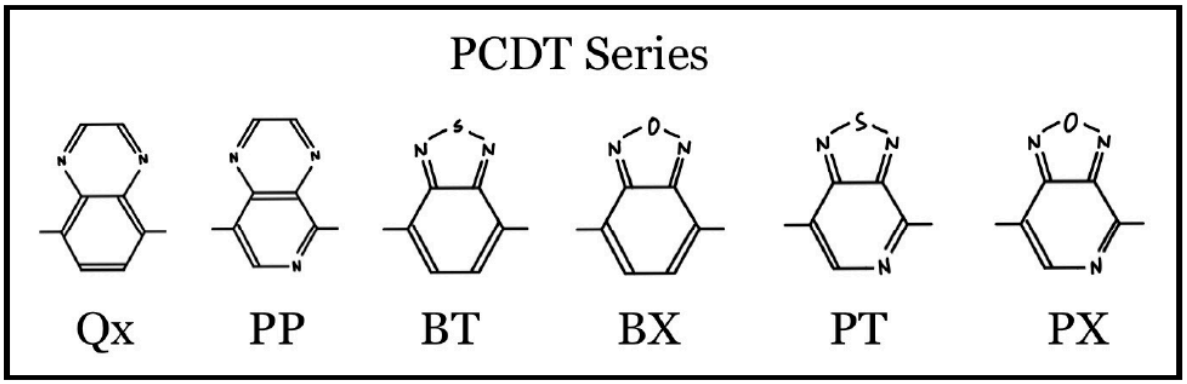

Figure 1: Six structures tested by Blouin et al, inserted into the structure in Figure 2 for DFT calculations.

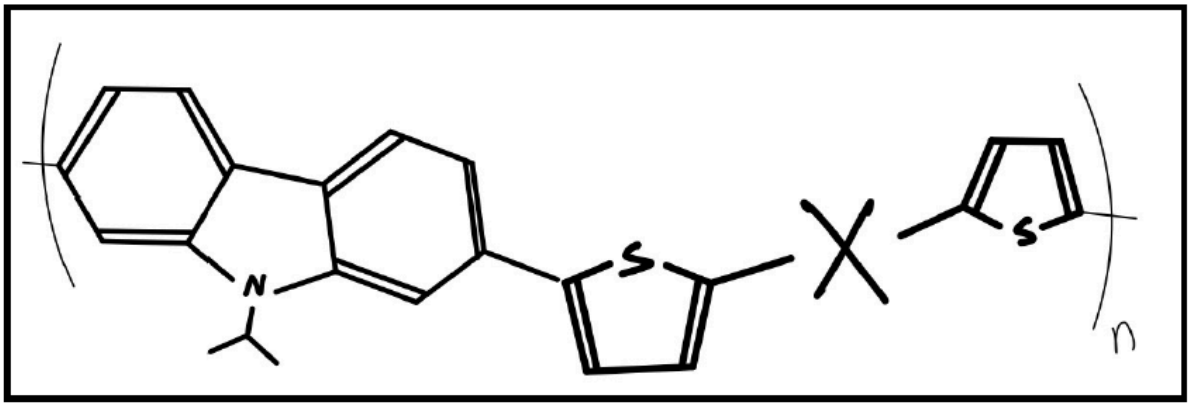

Figure 2: The carbazole derivative from the same publication as Figure 1. This structure was included in DFT calculations in order to achieve theoretical LUMO and band gap energy levels resembling the work of Blouin et al.

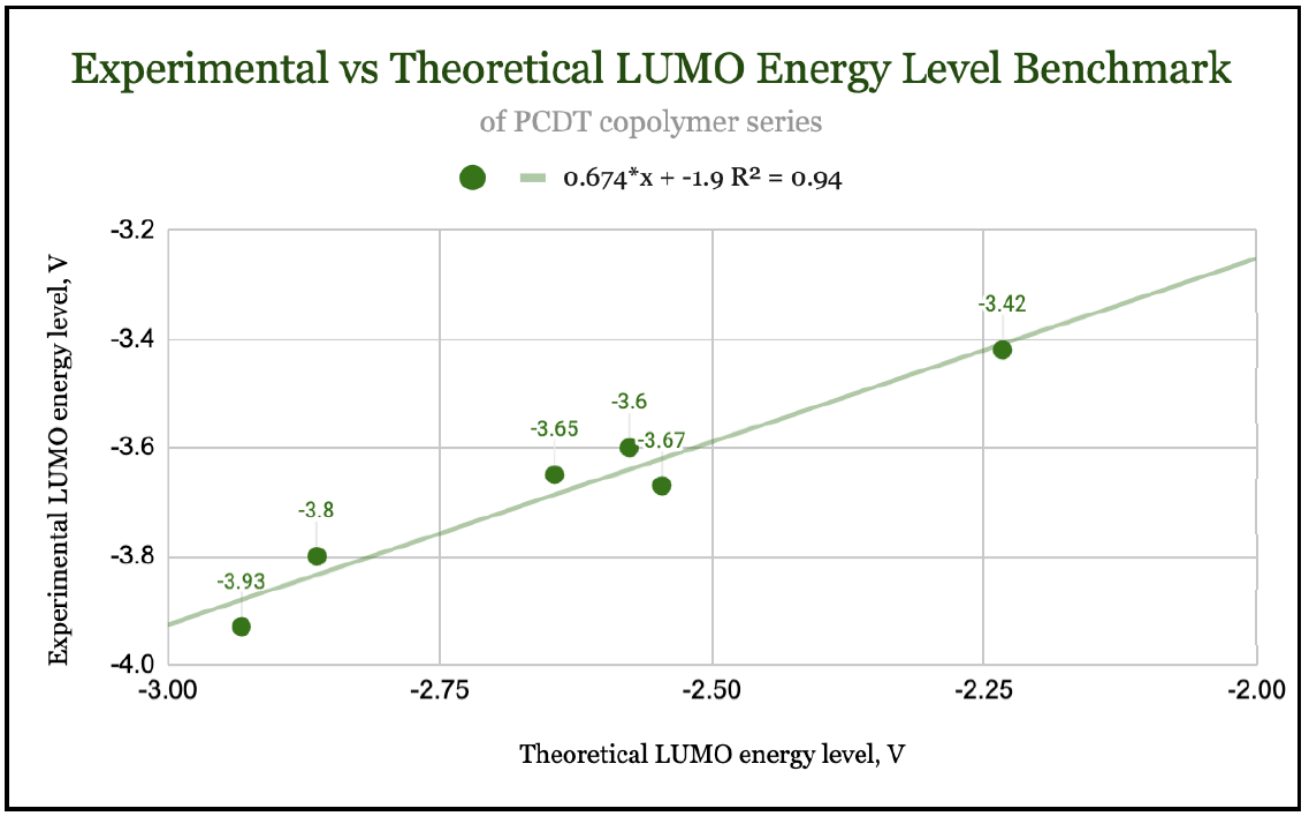

Figure 3: A scatter plot that correlates experimental data of the compounds in Figure 1. Its trendline was used to forecast the experimental LUMO energy levels of the newly proposed compounds in Figure 5.

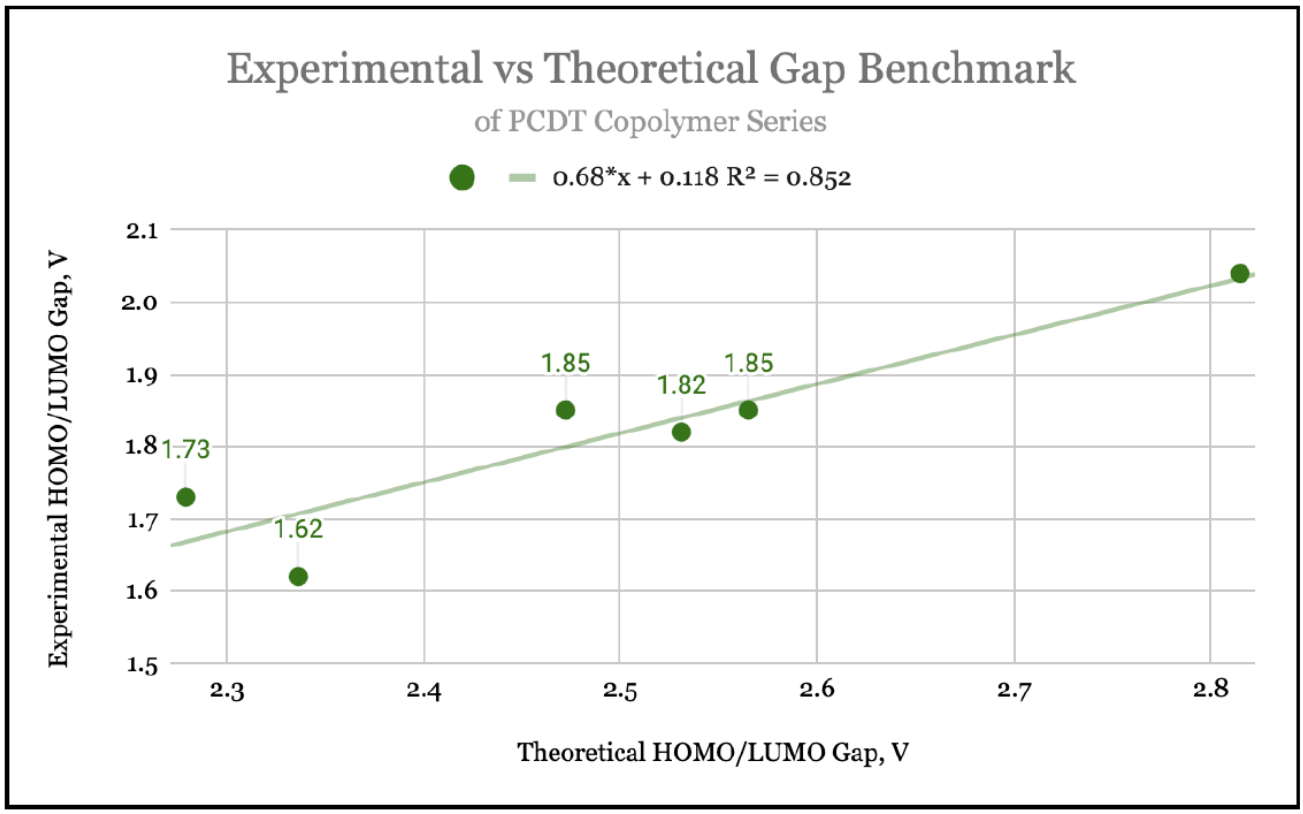

Figure 4: A scatter plot that correlates experimental data of the compounds in Figure 1. Its trendline was used to forecast the experimental band gaps of the newly proposed compounds in Figure 5.

Identical DFT calculations were performed on the fourteen proposed compounds in Figure 5, several of which were inserted into the structure in Figure 2 in an effort to improve their alignment with benchmarks. Of the fourteen, the ten shown in Figure 6 had LUMO energy levels at or below -3 eV, the purpose of this benchmark being to allow power conversion efficiency forecasting.

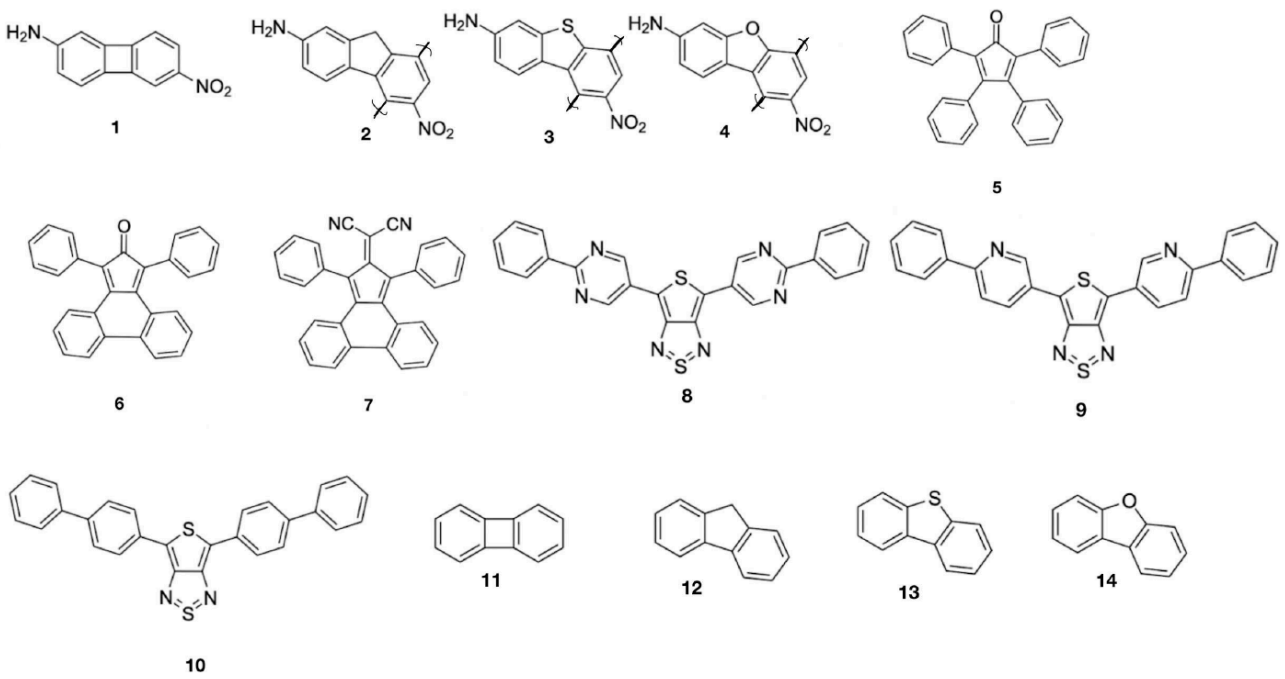

Figure 5: Fourteen structures analyzed for applicability as copolymer insertions in PCBM-based bulk heterojunction solar cells. Note the connectivity indicators on compounds **2**, **3**, and **4** for their insertion into the carbazole derivative in Figure 2.

Of the fourteen, **1-10** came within the benchmark for analysis via Figure 7. Compounds **6-10** were expected to have power conversion efficiencies at or above the ideal 10% according to the contour plot in Figure 7, making them candidates for which synthesis pathways will be proposed. Please refer to Table 1.

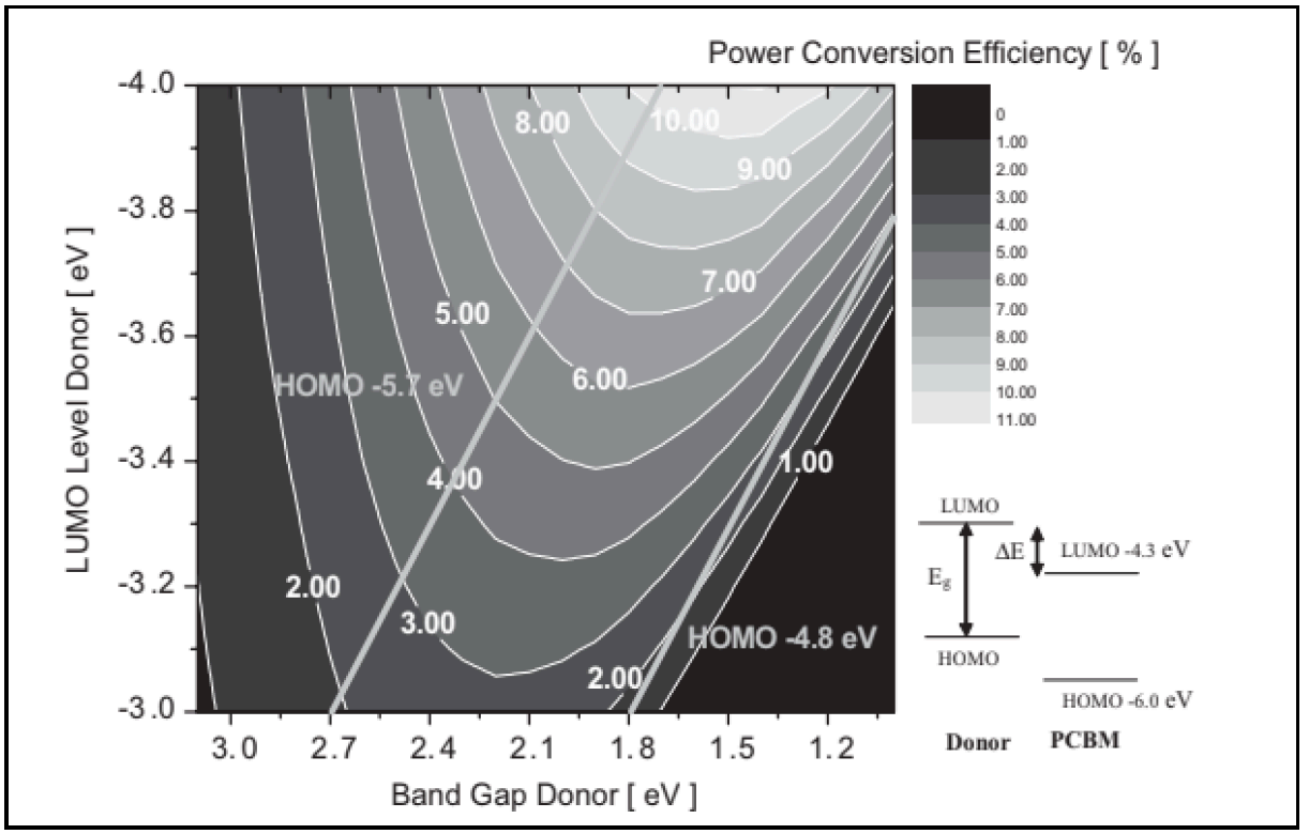

Figure 7: Contour graph from Scharber et al. contextualizes power conversion efficiency based on benchmarked LUMO and band gap energy levels. These are corroborated by Hachmann et al (2014).

Table 1

Structure	LUMO level Donor	Band Gap Donor	Power Conversion Efficiency, %
1	-3.64	2.17	6
2	-3.33	2.14	4.5
3	-3.38	2.16	4.3
4	-3.36	2.06	4.2
5	-3.86	2.00	7.5
6	-4.02	1.70	10.2
7	-4.40	1.61	>10
8	-4.36	1.53	>10
9	-4.20	1.51	>10
10	-4.04	1.52	10.8

Summary and conclusions

We have successfully identified six compounds (5-10) that meet our criteria to move forward to the process of proposing syntheses. Compound 5, tetraphenylcyclopentadienone, is readily available and has an established and highly feasible synthesis pathway. Others are more challenging to produce in appropriate quantities, or their synthetic pathways are still being developed. Additionally, we will continue to propose and test new structures against the benchmarks set herein.

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Nathaniel Evans

Understanding the Geography of Cannabis License Types in California and the Impacts of Cannabis Regulation on Humboldt Communities

Author Note

We have no conflict of interest to disclose. Thank you to Dr. Dominic Corva for his guidance and expertise and to the McNair program staff for their support. Grant #P217A320345

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Abstract

Cannabis cultivation has until recently dealt with state and federal prohibition regulations that forced cultivators to act outside both state and federal law. California has slowly eased into allowing medicinal and recreational use and cultivation, though a majority of cannabis cultivators still participate in the shadow economy. Smaller cannabis cultivators that participate in the legal market, following the regulations stated in 2018, have fallen victim to social and financial barriers. Legalization has favored larger industries with policy rewritten to exclude advantages originally promised to smaller cannabis cultivators. The issues present with cannabis cultivation in California call into question the short-term effect that regulations are having on smaller cannabis cultivators in Humboldt County and the possibility that cannabis cultivators are leaving the legal market in favor of the shadow economy. The current regulations and barriers to entry for smaller cultivators encompass issues that relate to community support, environmental sustainability, and encouragement to maximize the production of cannabis products.

Keywords: cannabis, cannabis cultivation, geography, cultivation permits, sustainability, environment, decolonize, sociology, public policy, California, Yurok, small cultivators, shadow economy, Industrialization, prohibition, legalization, illicit cannabis cultivation

Introduction

Recent policy changes during the legalization of cannabis have encouraged larger cultivation sites while limiting access to smaller cultivators (Bodwitch et al., 2021; Dillis et al., 2021; Polson, 2022; Sayre et al., 2021; Silvaggio, 2021; Zender, 2021). Regulations paired with the previous stigma of cannabis cultivation have driven most counties in California to ban cannabis cultivation, while financial institutions are advised to avoid conducting any business with cannabis cultivators due to the risk of losing federal benefits (Polson and Peterson, 2019; Polson, 2021). There is hope that some of California county's prohibition policies can be changed if there is a large enough shock to an economy, creating space for legal cannabis cultivation (Polson, 2020). Cannabis cultivation in the shadow economy of Humboldt County was previously driven by the back-to-the-landers movement of the 1960s and grew with time as the War on Drugs increased the price of cannabis, eventually leading to the green rush in the 1990s (Polson, 2020; Polson, 2021; Sayre et al., 2021; Silvaggio, 2021). The increase in price and steps to cannabis legalization encouraged the growth and industrialization of cannabis cultivation, though at the cost of the environment due to the lack of regulations (Dillis et al., 2023; Sayre et al., 2021; Silvaggio 2021). The issues of pollution related to unsustainable cultivation regulations have affected tribal sovereignty, as the Yurok tribe is left questioning the damage caused by industrialized cannabis cultivation (Reed 2021). The Yurok tribe also cannot participate in the state cannabis cultivation market without deferring regulation to the state and waiving sovereign immunity (Formosa and Kelly, 2021; Reed, 2021). The process of regulation also brings other innovations, utilizing pharmacology to recommend certain cannabis strains to consumers based on genetic inheritance, and utilizing social media to recommend rehabilitation to cannabis users (Baumgartner and Piper, 2017; Papastergiou et al., 2020).

Research Question

RQ 1: If regulations for smaller cannabis cultivators are too limiting, then cannabis cultivators may leave the legal market in favor of profits in the shadow economy.

RQ 2: If there has been a significant change in permits acquired over the last 3 months of available data, then to what extent and what policy changes have occurred?

Hypothesis Questions

My research questions were somewhat covered by the literature review, but only time and more data collection are necessary to properly answer them. The first research question proved a bit difficult to answer as the data I analyzed for Humboldt County suggested a high number of provisional permit holders had allowed their permits to expire, though that may be due to some factors such as no longer wanting to participate in cannabis cultivation, barriers to the continuing operation of their business and possible issues with regulations that may delay the process of reapplying for a cultivation permit (**Figure 1**); There would also be no real way to ascertain whether cultivators chose to return to the shadow economy just for profit, at least not without interviewing previous cultivation permit holders.

My second research question was also difficult to answer due to time constraints. Santa Barbara County's permit data is required to make a proper comparison and analysis of significant changes caused by policy changes within the last three months of permit acquisition. Further data analysis is required to verify how many permits were issued in the last three months and what cultivation permit types were issued. I have found that half of all adult-use provisional cultivation permits in Humboldt County's data are expired, but the dates need to be pulled to verify if the high number of cultivation permits expired over the past three months and if the same businesses sought to reapply (**Figure 1**).

Methodology

The design of my project utilized public data on cannabis cultivation licenses. I accessed the Department of Cannabis Control's database and used the Cannabis Unified License search. Selecting the advanced search function, I filtered the results to include all cultivation license types and include all license status types (**Figure 2**). I then exported all available data to Excel and began processing the data (**Figure 3**). After simplifying and removing any identifiable information, I exported the Excel data to Tableau. Tableau is a data analyzing software that aids in graph making. Next, descriptive statistics were used to define the information in **Figure 1**. The data was secured in an encrypted folder; any devices used were not left unattended and required a password for access.

Results

Cleaning the data left me with more questions as the specifics of each permit type were somewhat obscured due to the current system's encouragement of larger cultivation. The smallest of the permit types is specialty cottage and the largest is considered large, allowing for 4 choices, including Outdoor, Indoor, and Mixed-Light Tier 1 and 2 (**Table 1**). I utilized Tableau, an analytics software that assisted in graph making, to create simple bar graphs and histograms. I settled with **Figure 1** as I had run out of time for the project. Adult-Use designated permits had a higher number of permit holders than medicinal, while half of all Provisional, Adult-Use permits expired (**Figure 1**). The next steps of my project include the cleaning of Santa Barbara County's permit data, descriptive analysis and simplification of the data, and a comparison to Humboldt County's permit data.

Limitations

The outcome of my project is still yet to be determined, as the start of my project was delayed. The literature review assisted in framing my perspective, an interdisciplinary approach to the issues and solutions of legalization. I had little to no knowledge of the intricate process of participating in the legalized cannabis industry, while also understanding little about the path to the legalization of cannabis within California, requiring an adequate study and understanding of the requirements. The field of Cannabis Studies is new with little to no previous research regarding the recent legalization of cannabis cultivation and public information provided by the Department of Cannabis Control. Cultivation permit information is available to the public, however, the data is rather difficult to access for the layperson. Each cultivation permit type has 4 choices available, further complicating the process of attaining a cannabis cultivation permit and miring the data further (**Table 1**).

Future Recommendations

Future research could survey and interview permit holders that surrendered, canceled, allowed the expiration of their permit, filed for non-operation, or had their permit revoked; other projects could investigate permit holders leaving the legal market in favor of the shadow economy, interview cannabis dispensaries, compare future permit data to the data collected in this project to further measure the process of cannabis legalization, comparison to other states that have legalized cannabis cultivation, and study the progression of cannabis cultivation policy concerning small cultivators and the retail bottleneck.

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Tables and Graphs

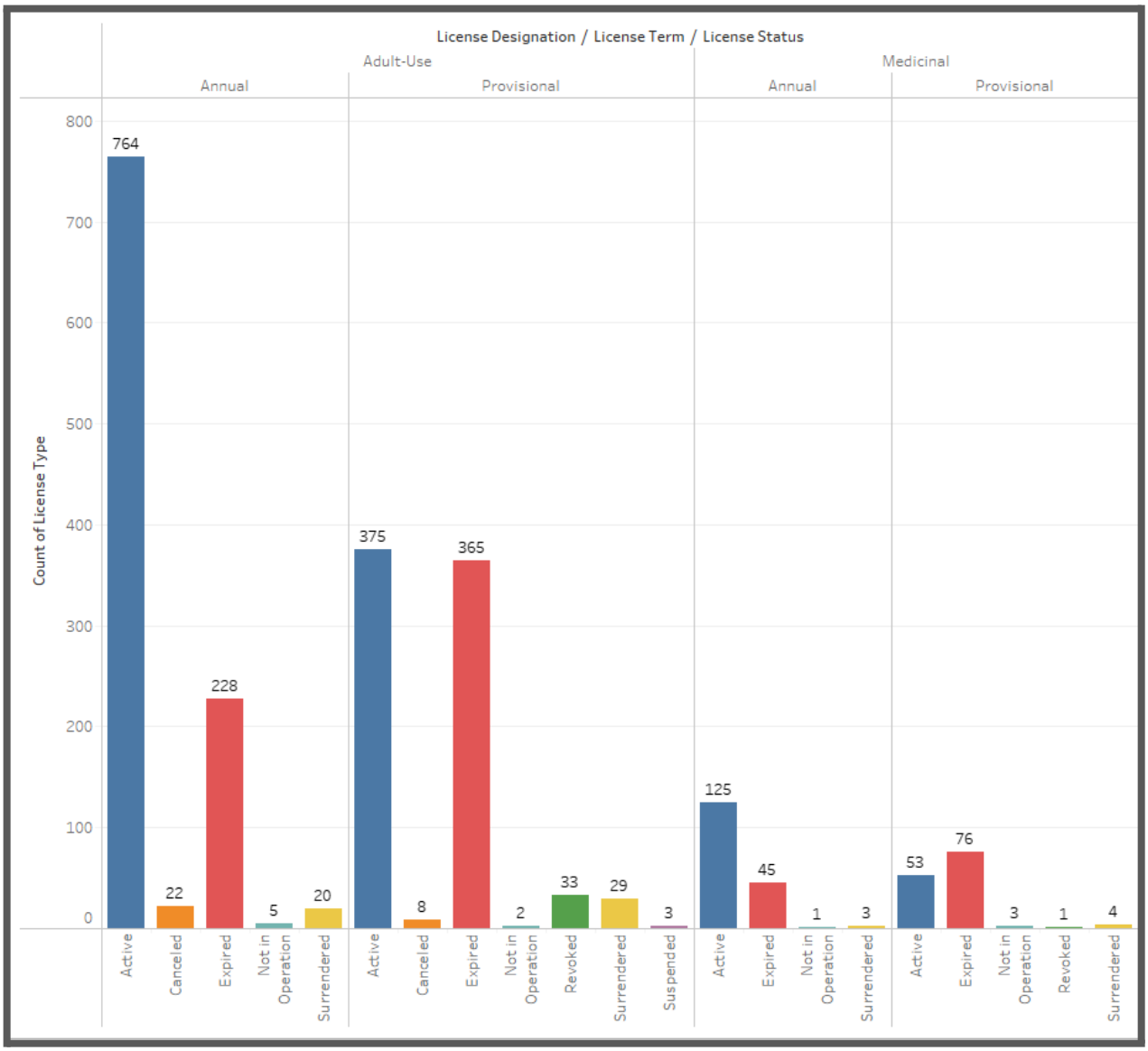


Figure 1: A bar graph representing the number of License Type statuses, comparing Adult-use Annual and Provisional to Medicinal Annual and Provisional.

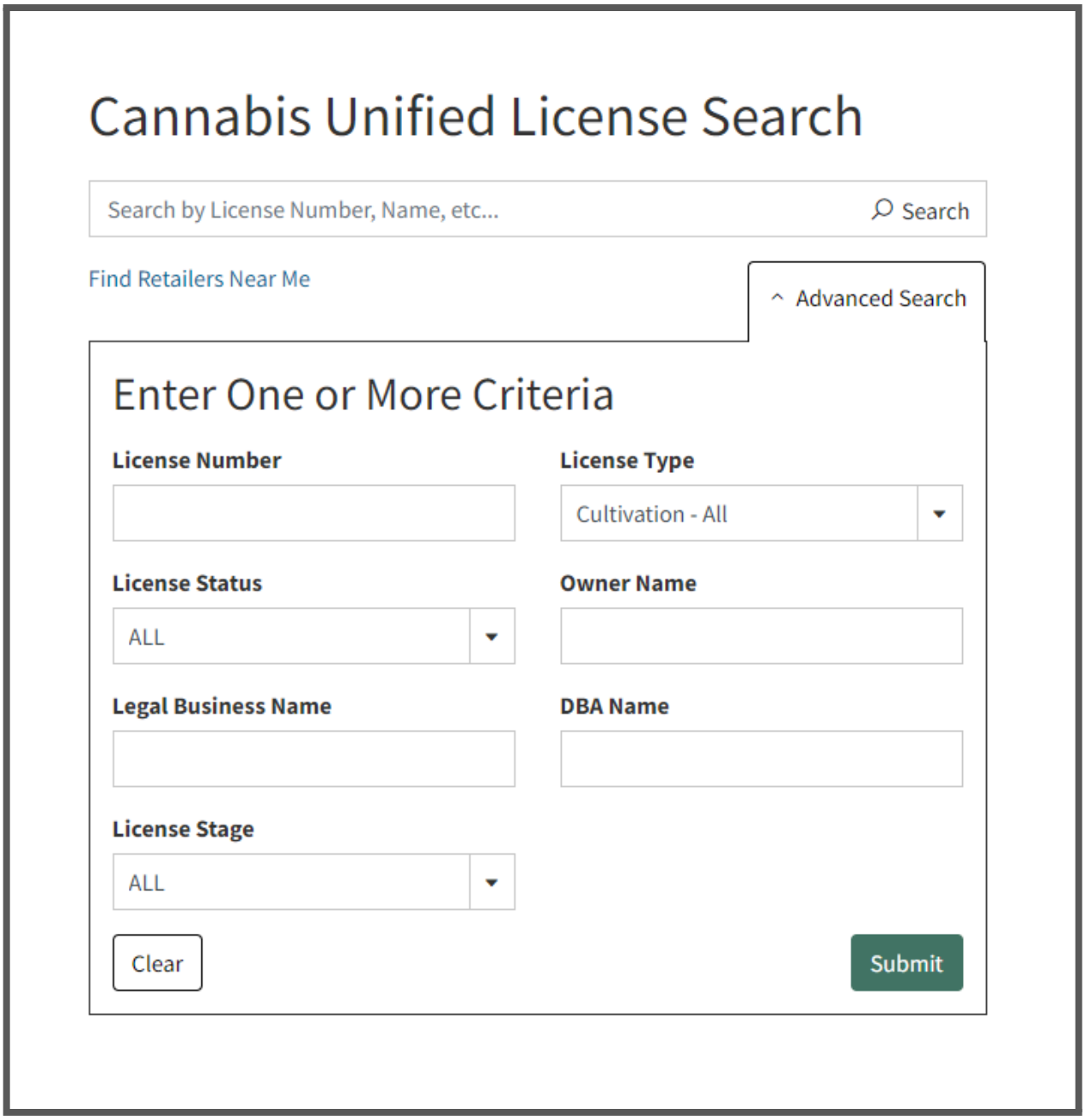
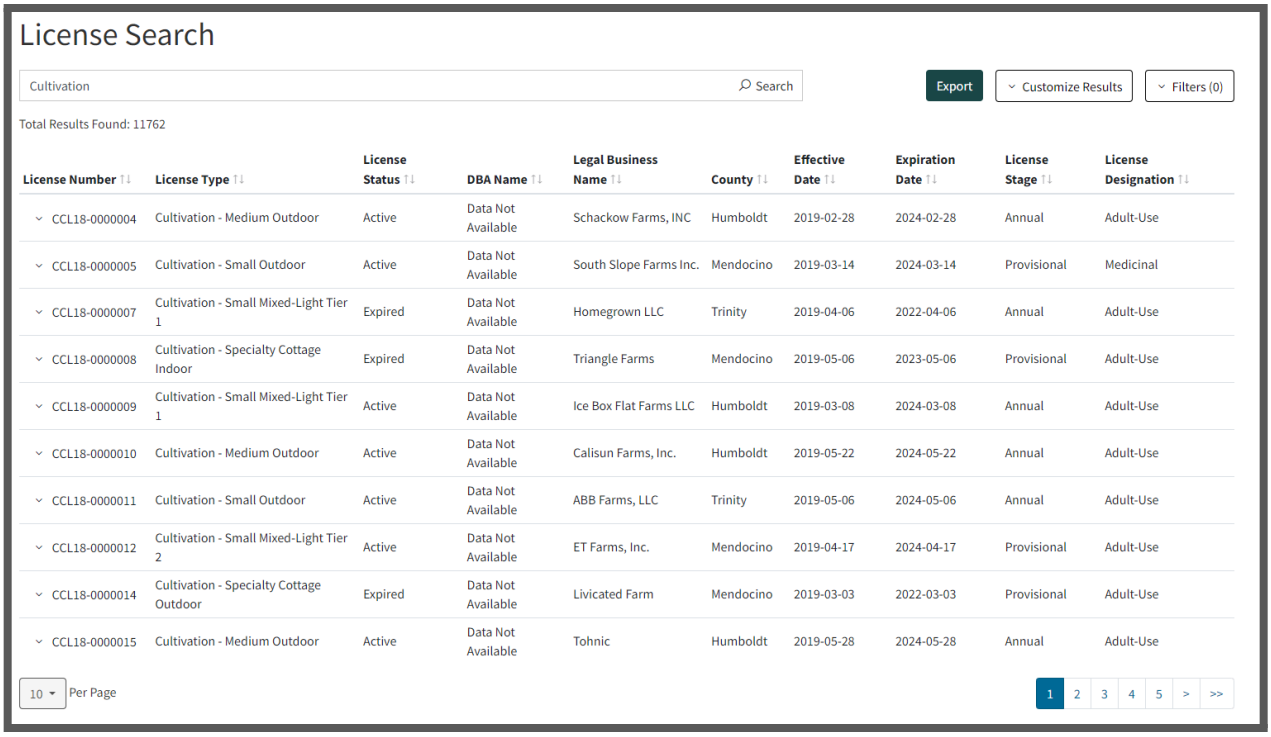


Figure 2: A screenshot of the Department of Cannabis Control's License Search Tool



License Search

Cultivation

Search

Export

Customize Results

Filters (0)

Total Results Found: 11762

License Number	License Type	License Status	DBA Name	Legal Business Name	County	Effective Date	Expiration Date	License Stage	License Designation
CCL18-0000004	Cultivation - Medium Outdoor	Active	Data Not Available	Schackow Farms, INC	Humboldt	2019-02-28	2024-02-28	Annual	Adult-Use
CCL18-0000005	Cultivation - Small Outdoor	Active	Data Not Available	South Slope Farms Inc.	Mendocino	2019-03-14	2024-03-14	Provisional	Medicinal
CCL18-0000007	Cultivation - Small Mixed-Light Tier 1	Expired	Data Not Available	Homegrown LLC	Trinity	2019-04-06	2022-04-06	Annual	Adult-Use
CCL18-0000008	Cultivation - Specialty Cottage Indoor	Expired	Data Not Available	Triangle Farms	Mendocino	2019-05-06	2023-05-06	Provisional	Adult-Use
CCL18-0000009	Cultivation - Small Mixed-Light Tier 1	Active	Data Not Available	Ice Box Flat Farms LLC	Humboldt	2019-03-08	2024-03-08	Annual	Adult-Use
CCL18-0000010	Cultivation - Medium Outdoor	Active	Data Not Available	Calisun Farms, Inc.	Humboldt	2019-05-22	2024-05-22	Annual	Adult-Use
CCL18-0000011	Cultivation - Small Outdoor	Active	Data Not Available	ABB Farms, LLC	Trinity	2019-05-06	2024-05-06	Annual	Adult-Use
CCL18-0000012	Cultivation - Small Mixed-Light Tier 2	Active	Data Not Available	ET Farms, Inc.	Mendocino	2019-04-17	2024-04-17	Provisional	Adult-Use
CCL18-0000014	Cultivation - Specialty Cottage Outdoor	Expired	Data Not Available	Livicated Farm	Mendocino	2019-03-03	2022-03-03	Provisional	Adult-Use
CCL18-0000015	Cultivation - Medium Outdoor	Active	Data Not Available	Tohnic	Humboldt	2019-05-28	2024-05-28	Annual	Adult-Use

10 Per Page

1 2 3 4 5 > >>

Figure 3: A screenshot of the Department of Cannabis Control's License Search Page

Legend		Max Plants/Canopy Allowed
Cultivation - Specialty Cottage Outdoor	SCO	≤25 /≤2500 ft^2
Cultivation - Specialty Cottage Indoor	SCI	≤500 ft^2
Cultivation - Specialty Cottage Mixed-Light Tier 1	SCMLT 1	≤2500 ft^2
Cultivation - Specialty Cottage Mixed-Light Tier 2	SCMLT 2	≤2500 ft^2
Cultivation - Specialty Outdoor	SPO	≤50/≤5000 ft^2
Cultivation - Specialty Indoor	SPI	501-5000 ft^2
Cultivation - Specialty Mixed-Light Tier 1	SPMLT 1	2501-5000 ft^2
Cultivation - Specialty Mixed-Light Tier 2	SPMLT 2	2501-5000 ft^2
Cultivation - Small Outdoor	SO	5001-10000 ft^2
Cultivation - Small Indoor	SI	5001-10000 ft^2
Cultivation - Small Mixed-Light Tier 1	SMLT 1	5001-10000 ft^2
Cultivation - Small Mixed-Light Tier 2	SMLT 2	5001-10000 ft^2
Cultivation - Medium Outdoor	MO	10001 ft^2 - 1 acre
Cultivation - Medium Indoor	MI	10001-22000 ft^2 (≤0.50 acres)
Cultivation - Medium Mixed-Light Tier 1	MMLT 1	10001-22000 ft^2
Cultivation - Medium Mixed-Light Tier 2	MMLT 2	10001-22000 ft^2
Cultivation - Large Outdoor	LO	≥1 acre
Cultivation - Large Indoor	LI	≥22000 ft^2
Cultivation - Large Mixed-Light Tier 1	LMLT 1	≥22000 ft^2 (≥ 0.50 acres)
Cultivation - Large Mixed-Light Tier 2	LMLT 2	≥22000 ft^2 (≥ 0.50 acres)
Cultivation - Processor	PR	for cultivators that only trim, sift, cure, dry

Table 1: A legend of all cultivation types used in this study with codified labels and max allowable plants.

Sofia Gutierrez Johnson

The Impacts of Covid-19 on the Family Unit of Kindergarten Students

Abstract

The COVID-19 pandemic was an extremely chaotic and precarious time for many individuals, especially families with children. While considerable research has demonstrated how adults have been negatively impacted by anxiety and social isolation, little research has focused on adolescents and teenagers, leaving a significant gap in understanding how young children manage stress and disorder during this time. This research will focus on the emotions of parents whose children are integrating into the school system for the first time, having missed out on some significant developmental milestones associated with peer engagement. Questions will be associated with their child's academic and social preparedness and emotional levels associated with this transition. The Qualtrics survey will be distributed to parents whose children entered kindergarten and transitional kindergarten during the 2021 and 2022 school years.

Keywords: *Covid-19, anxiety, social isolation, kindergarten, social development, cognition, peer learning*

Introduction

The Covid-19 pandemic has profoundly impacted various aspects of society, including the early childhood education system and the social-emotional well-being of young children. As the pandemic unfolded, families, schools, and early childhood centers faced unprecedented challenges in providing quality education and support for young children. The pandemic has raised concerns about the readiness of children entering kindergarten after experiencing significant disruptions to their early education (Fyffe et al., 2022). Understanding the implications of the pandemic on young children's school readiness is crucial for developing effective strategies to support their smooth transition into formal schooling.

One of the key factors affecting young children's school readiness is the play-based education they receive during their early years (Fyffe et al., 2022). Play-based education fosters cognitive, social, and emotional development, equipping children with the necessary skills and foundations for future academic success. However, the pandemic has disrupted this critical aspect of early childhood education, with restrictions and lockdowns limiting children's opportunities for play and peer interactions (Fox et al., 2021). This disruption raises concerns about the potential impacts on young children's school readiness and overall well-being.

Furthermore, the increased reliance on screen time during the pandemic has concerned young children's developmental health (Kerai et al., 2022). Excessive screen time may affect children's physical, emotional, cognitive, and social skills. Understanding the effects of screen time on young children's developmental outcomes during the pandemic is crucial for designing appropriate guidelines and interventions to support their healthy development.

The emotional well-being of young children is also a critical aspect to consider in their school readiness and overall development. Emotional regulation skills are vital in children's ability to navigate social interactions, engage in learning, and adapt to new environments (Hen et al., 2022). However, the emotional well-being of young children may have been affected by the pandemic, as evidenced by changes in emotional and behavioral patterns (Landman et al., 2023). The potential impacts of maternal depression and early parenting practices on young children's emotion recognition and regulation further highlight the interconnectedness of emotional development and school readiness (Kujawa et al., 2014).

To effectively address the challenges young children face and support their optimal development during and beyond the pandemic, it is essential to examine the implications of Covid-19 on early childhood education and care. This includes understanding the emotional and behavioral changes experienced by children (Landman et al., 2023), exploring the impact of Covid-19 restrictions on the social-emotional well-being of preschool children and their families (Linnavalli & Kalland, 2021), and considering the broader implications for early childhood education (La Valle et al., 2022; Raver, 2002).

By synthesizing the findings from these studies and addressing the gaps in our understanding, we can gain insights into the challenges and needs of young children affected by the

pandemic. This knowledge will inform evidence-based strategies, interventions, and policies that promote their social-emotional well-being, school readiness, and overall development.

Statement of the Problem

The Covid-19 pandemic has significantly impacted individuals of all age groups, particularly children and adolescents. While research has extensively examined the mental health effects of the pandemic on high school students (Anderson et al., 2022), there is limited understanding of the specific challenges and consequences experienced by very young children, particularly those aged 0-5. This knowledge gap hinders our ability to support and address this vulnerable population's needs effectively.

The disruptions caused by the pandemic, such as social isolation, lack of community engagement, and fear, have resulted in adverse consequences for young children and their families. Research has shown that these challenges can contribute to poor mental health, including an increased risk of suicidal behaviors, among high school students (Anderson et al., 2022). However, the effects of the pandemic on the emotional well-being and developmental outcomes of children aged 0-5 remain largely unexplored.

Furthermore, the pandemic has disrupted early childhood education and play-based learning, which is crucial for promoting school readiness and social-emotional development (Fyffe et al., 2022; Raver, 2002). The shift to remote learning and limited opportunities for peer engagement have raised concerns about the social-emotional well-being of young children (Linnavalli & Kalland, 2021). Additionally, the dependence on screen time in the form of television and video games during the pandemic has potentially harmful implications for children's developmental health and well-being (Kerai et al., 2022).

Literature Review

The COVID-19 pandemic has profoundly impacted individuals, families, and communities worldwide, bringing about significant disruptions in various aspects of life. Particularly vulnerable during this unprecedented crisis are young children, whose development and well-being will be significantly influenced by the challenges and changes brought on by the pandemic. Understanding the specific effects of COVID-19 on young children is crucial for developing effective strategies to support their growth and mitigate potential adverse outcomes. Research studies have shown that

the pandemic adversely affects adolescents' mental health and well-being. Anderson et al. (2022) found a substantial increase in suicidal thoughts and poor mental health among high school students during lockdown periods. This research highlights the pressing need to investigate the impacts of the pandemic on younger children, especially those in the critical age range of zero to five years old.

Furthermore, the disruption to early education and socialization opportunities caused by the pandemic has raised concerns about the school readiness of young children. Fyffe et al. (2022) conducted a cross-case analysis and demonstrated the positive impact of play-based education on school readiness in kindergarten students. This highlights the importance of exploring the effects of COVID-19 on young children's social and academic readiness as they transition into formal schooling.

In addition, the restrictions imposed during the pandemic have led to increased screen time for young children, which may have implications for their developmental health. Kerai et al. (2022) found a negative association between extended screen time and children's physical, emotional, cognitive, language, communication, and social skills. Understanding the effects of increased screen time during the pandemic is crucial for developing appropriate guidelines and interventions to support healthy development in young children.

The role of school readiness in predicting future academic success is highlighted in the study by Duncan et al. (2007). Using longitudinal data from six studies, the authors examined the predictive value of entry-level math, attention, and reading on later achievement. The findings indicated that entry-level math was the strongest predictor of future success, while socioemotional skills showed no significant predictive power across socioeconomic levels and gender. Understanding the implications of school readiness after two years of lockdown is essential for establishing and supporting interventions for young children who entered school at a vulnerable time.

During the COVID-19 pandemic, the roles of preschool administrators, teachers, and parents in early childhood education underwent significant changes. Yildiz et al. (2023) conducted interviews with administrators, teachers, and parents using Moustakas' phenomenological research method. The study identified three main factors: challenges in integrating effective online education with student engagement, difficulties in teachers' ability to lead as educators in an online teaching platform, and shifts in roles to support children through online education. Considering educators'

thoughts and feelings, we can see how the pandemic negatively disrupted the family unit and the education system.

The pandemic also impacted parent-teacher relationships in early childhood education programs. Keengwe and Onchwari (2022) explored the assessment of these relationships during the COVID-19 pandemic. Due to the pandemic's changing role, the study revealed that parents assumed the responsibility of both primary caregivers and teachers. This shift posed challenges for parents and children as family dynamics adapted to new expectations and restrictions during lockdown. The study highlighted that demographic factors such as income, education level, child's age, and location influenced parents' connection with their child's teacher.

Furthermore, the pandemic has disrupted early childhood education and play-based learning, which is crucial for promoting school readiness and social-emotional development (Fyffe et al., 2022; Raver, 2002). The shift to remote learning and limited opportunities for peer engagement have raised concerns about the social-emotional well-being of young children (Linnavalli & Kalland, 2021). Additionally, the dependence on screen time in the form of television and video games during the pandemic has potentially harmful implications for children's developmental health and well-being (Kerai et al., 2022).

Moreover, the emotional well-being of young children is influenced by various factors, including maternal depression and early parenting practices (Kujawa et al., 2014).
These studies contribute to our understanding of the impacts of the COVID-19 pandemic on early childhood education. They emphasize the importance of school readiness as a predictor of future academic success, educators' and administrators' challenges in transitioning to online education, and the evolving dynamics of parent-teacher relationships during the pandemic. Understanding these complexities is crucial for supporting families and educational institutions navigating the post-pandemic world.

Gap in research

While research has extensively examined the impact of the pandemic on adolescents and teenagers, there is a significant gap in understanding the specific effects on children aged 0-5. The limited research on this age group during the pandemic primarily focuses on mental health and emotional regulation difficulties (Hen et al., 2022). To address this gap, it is essential to explore the

emotional experiences, social readiness, and academic preparedness of young children transitioning back into the education system after experiencing social isolation and disruptions caused by the pandemic. This study aims to fill the knowledge gap by investigating the emotions and experiences of parents whose children entered kindergarten or transitional kindergarten during the 2021 and 2022 school years. By understanding these children and their families specific challenges, policymakers, educators, and parents can develop targeted interventions and support systems to ensure their successful transition into formal schooling.

Parenting and family dynamics during the global COVID-19 pandemic have been the subject of research examining the impact of stress and mental health on parents and children. Brown et al. (2020) investigated the effects of stress on parenting practices during the pandemic, highlighting the need for support and intervention to mitigate the negative consequences. Similarly, Danese et al. (2020) emphasized the importance of addressing the mental health needs of children and adolescents in emergency and disaster situations. These studies underscore the significant impact of the pandemic on families and the necessity of understanding and addressing their unique challenges.

Through a comprehensive exploration of the emotional, social, and academic aspects of young children's experiences during the pandemic, this study seeks to contribute to the broader understanding of the impacts of Covid-19 on early childhood development. The findings will inform evidence-based strategies and interventions to support young children and their families in navigating the challenges posed by the pandemic, fostering their well-being and optimal development.

Research Results:

Anderson et al. (2022) found a substantial increase in suicidal thoughts and poor mental health among high school students during the COVID-19 lockdown period. Adverse childhood experiences (ACEs) were identified as significant factors exacerbating these issues. Fyffe et al. (2022) highlighted the positive impact of play-based education on school readiness, as reported by primary caregivers and teachers. Fox et al. (2021) emphasized the importance of peer engagement and interaction in early childhood education, particularly during the pandemic. Hen et al. (2022) emphasized the limited research on the emotional regulation difficulties children aged 0-3 face

during lockdown. Kerai et al. (2022) revealed the negative association between extended screen time and children's developmental health. Kujawa et al. (2014) demonstrated the impact of parental depression and anxiety on the emotional well-being of young children. Landman et al. (2023) highlighted the emotional and behavioral changes observed in French children during the pandemic, emphasizing the impact of social isolation and anxiety. Linnavalli and Kalland (2021) explored the social-emotional well-being of preschool children and their families during COVID-19 restrictions, revealing the profound effects of social isolation. Finally, La Valle et al. (2022) examined the implications of COVID-19 for early childhood education and care in England, emphasizing the challenges faced by families and the importance of support services.

Potential contributions of the current study

This study hopes to make several significant contributions to the existing literature on the impacts of the Covid-19 pandemic on young children. By focusing specifically on children aged 0-5 who entered kindergarten or transitional kindergarten during the pandemic, this research fills a critical knowledge gap regarding the experiences and challenges faced by this age group during this unprecedented time. This research provides valuable insights into this age group's unique challenges and needs by exploring the emotions associated with transitioning into formal schooling after social isolation.

This study investigates parents' assessments of their children's social and academic readiness as they enter kindergarten or transitional kindergarten during the pandemic. By gathering data on these children's social interactions, peer engagement, and cognitive development preparedness, this research examines the impacts of disrupted early education experiences and the potential consequences for children's overall school readiness. The findings will contribute to developing strategies and interventions to support these children in their transition into formal schooling.

Furthermore, this study contributes to the growing body of literature on increased screen time's effects on young children's developmental health during the pandemic. By examining the relationship between extended screen time and parents' judgments of their children's physical, emotional, cognitive, language, communication, and social skills, this research adds to our understanding of the potential consequences of excessive screen use on early childhood

development. The findings will inform guidelines and interventions to promote healthy screen habits for young children.

Lastly, this study intends to extend our knowledge of the impacts of the Covid-19 pandemic on early childhood development by focusing on parents' experiences. By surveying parents of young children, this research captures the perspectives of those directly involved in supporting and nurturing their children during this challenging time. Understanding parents' experiences, concerns, and needs provides valuable insights for policymakers, educators, and practitioners in designing effective support systems and interventions for families.

Overall, this study's contributions lie in its comprehensive exploration of the emotional, social, and academic aspects of young children's experiences during the Covid-19 pandemic. By filling the gaps in knowledge regarding this age group and its unique challenges, this research informs evidence-based strategies and interventions to promote the well-being and optimal development of young children and their families during and beyond the pandemic.

Research conclusions:

The synthesis of these studies reveals the multifaceted impact of the COVID-19 pandemic on child development and mental health. The findings underscore the need for targeted interventions to address the increased rates of poor mental health, suicidal thoughts, and ACEs among high school students. Furthermore, the positive effects of play-based education, social interaction, and limited screen time on child development are highlighted. The influence of parental depression and anxiety on children's emotional well-being and the necessity of support services for families is emphasized. The emotional and behavioral changes observed in children during the pandemic call for attention to their social and emotional needs. Overall, this synthesis provides valuable insights into children and adolescents' challenges during the COVID-19 pandemic and highlights the importance of prioritizing their well-being.

Moreover, the emotional well-being of young children is influenced by various factors, including maternal depression and early parenting practices (Kujawa et al., 2014). The pandemic has undoubtedly impacted parents' mental health, potentially exacerbating their young children's challenges (Hen et al., 2022).

Overall, there is a critical need to understand the deep and lasting impacts of the Covid-19 pandemic on young children's emotional well-being, social development, and school readiness. We can develop targeted interventions and support systems that promote resilience and optimal outcomes for young children and their families by addressing this knowledge gap.

Research Questions

The study aims to investigate the emotions and experiences of parents whose children are entering the school system for the first time during the Covid-19 pandemic. The following research questions will be examined:

- How do parents perceive their child's academic preparedness for kindergarten or transitional kindergarten after experiencing the disruptions caused by the Covid-19 pandemic?
- What are parents' perceptions of their child's social preparedness for kindergarten or transitional kindergarten after missing out on significant developmental milestones associated with peer engagement during the pandemic?
- How do parents describe their own emotions and levels of stress/anxiety related to their child's transition into the school system during the pandemic?
- What factors or challenges do parents identify as influencing their child's emotional well-being during the transition to kindergarten or transitional kindergarten?
- How do parents perceive the impact of social isolation and limited social interactions on their child's cognitive and social development as they enter the school system?
- What strategies and support systems do parents perceive helpful in facilitating their child's successful integration into the school system after experiencing social isolation and disruptions caused by the pandemic?

By addressing these research questions, the study aims to provide insights into the emotional experiences of parents and the preparedness of young children entering the school system during the Covid-19 pandemic. The findings will contribute to a better understanding of the challenges faced by families and inform the development of interventions and support systems to ensure a smooth transition and positive outcomes for children during this critical period.

Hypothesis

H1: Parents of children transitioning back into the school system after two years of social isolation will experience higher levels of stress and anxiety than their peers who did not experience social isolation before entering the education system.

H2: Children who transition back into the school system after two years of social isolation will be less adept socially, emotionally, and academically compared to their older peers who did not experience social isolation and lockdown.

H3: Children transitioning back into the school system after two years of social isolation will experience elevated levels of stress and anxiety than those children who did not experience lockdown.

Methods

Survey research was conducted online via Qualtrics. No sensitive or potentially illegal data will be collected. An online survey, based and modeled after the Finnish study of Linnavalli & Kalland, 2021 has been created via Qualtrics and will be distributed to first-grade parents at Fieldbrook Elementary in Fieldbrook, CA, Dows Prairie Elementary in Mckinleyville, Grant Elementary in Eureka and Arcata Elementary in Arcata. The survey is anonymous. The survey has 53 questions with Likert-style questions: strongly agree-strongly disagree, true/false questions, and one open-ended question. The survey has six blocks: emotions, social readiness, academic readiness, future, personal thoughts, and demographics. The survey takes approximately 8.5 minutes to complete and will be offered online. A drawing for a National Geographic Terrarium kit will be used to enhance the potential for participation in the survey.

Preliminary Results

The Qualtrics survey opened on June 2, 2023, and will run until September 30, 2023. The data from five families have been collected. This is not enough for a reliable and valid results section.

However, the current data imply that parents and children were impacted in vastly different ways depending on familial and community structures, socioeconomic status, and education level.

Discussion

The Covid-19 pandemic has presented unprecedented challenges for early childhood education and the social-emotional well-being of young children. This section discusses the findings from relevant studies and explores the implications of these findings for understanding the impact of the pandemic on young children's school readiness and overall development. The cited studies shed light on the effects of disrupted play-based education, increased screen time, emotional regulation difficulties, and changes in social-emotional well-being. By considering these factors, we can gain a comprehensive understanding of the challenges faced by young children during the pandemic.

The study by Fyffe et al. (2022) emphasizes the importance of play-based education in fostering school readiness. However, the pandemic has disrupted this critical aspect of early childhood education, limiting children's opportunities for play and peer interactions (Fox et al., 2021). This disruption may affect young children's school readiness and overall development. As such, interventions and strategies should promote play-based learning experiences to support young children's cognitive, social, and emotional development, especially during the pandemic.

Another significant concern during the pandemic is increased reliance on screen time among young children. Kerai et al. (2022) highlight the potential negative association between extended screen time and developmental health. Excessive screen time may impact young children's developmental domains, including their physical, emotional, cognitive, language, communication, and social skills. Therefore, balancing screen time and other developmentally appropriate activities is crucial, emphasizing the importance of outdoor play and hands-on learning experiences.

Emotional well-being is vital to young children's overall development and school readiness. The study by Hen et al. (2022) emphasizes the possible difficulty in emotional regulation among children and adolescents during the pandemic. Emotional regulation skills are essential for children to navigate social interactions, engage in learning, and adapt to new environments. This suggests that disruptions caused by the pandemic may affect young children's emotional well-being and ability to regulate their social emotions effectively. Addressing the emotional needs of young children, supporting their regulation skills, and providing opportunities for social-emotional learning is crucial in promoting their overall well-being and school readiness.

Previous studies also highlight the changes in young children's emotional and behavioral patterns during the pandemic. Landman et al. (2023) conducted a retrospective study that observed emotional and behavioral changes in French children. These findings reinforce the notion that the pandemic has significantly impacted the social-emotional well-being of young children. Changes in routines, limited social interactions, and increased stress and uncertainty may have contributed to these emotional and behavioral changes. Understanding these changes and addressing the associated needs of young children are crucial for providing appropriate support and intervention.

Moreover, the implications of maternal depression and early parenting practices on young children's emotional development are noteworthy (Kujawa et al., 2014). Maternal depression can impact the well-being of young children and may further contribute to difficulties in self-regulation. Early parenting practices are crucial in shaping young children's social development and academic readiness for school. Recognizing the influence of these factors during the pandemic is essential in providing targeted support and resources to parents and young children.

Overall, the findings discussed in this section underscore the complex and multi-faceted impact of the Covid-19 pandemic on young children's school readiness and overall development. Disrupted play-based education, increased screen time, emotional regulation difficulties, and changes in social-emotional well-being are among the significant challenges young children face during this time. Addressing these challenges requires a holistic approach that promotes play-based learning, effectively managing screen time, supporting emotional well-being, and providing resources and support to parents.

Limitations

While this research aims to provide valuable insights into the emotions and experiences of parents and their children during the transition into the school system during the Covid-19 pandemic, there are certain limitations to consider:

- Sample Size and Generalizability: The study will survey parents whose children entered kindergarten and transitional kindergarten during the 2021 and 2022 school years. The sample size may be limited, potentially affecting the generalizability of the findings to a larger population. The results may primarily reflect parents' experiences from specific geographic

locations or socio-demographic backgrounds, limiting the broader applicability of the findings.

- Self-Report Bias: The data collection will rely on self-reported responses from parents through an online survey. This method is subject to self-report biases, including social desirability or recall bias, which may influence the accuracy and reliability of the data. Parents' perceptions and interpretations of their child's emotions and experiences may also vary, leading to subjective responses.
- Lack of Objective Measures: The study will primarily rely on parents' perceptions and subjective assessments of their child's academic and social preparedness, as well as their own emotions and stress levels. While subjective measures provide valuable insights, they may only partially capture the objective reality of the situation. Objective measures, such as standardized assessments or observational data, could provide a more comprehensive understanding of children's readiness and emotional well-being.
- Timing and Context: The study will focus on children who entered the school system during the Covid-19 pandemic. The unique circumstances and challenges associated with the pandemic, including lockdowns, remote learning, and social distancing measures, may have influenced the experiences and emotions of parents and children in ways that differ from non-pandemic times. The findings may not be directly applicable to other periods or situations.
- Parental Bias and Subjectivity: Parents' responses may be influenced by their own biases, expectations, and subjective interpretations of their child's experiences. Factors such as parental stress, anxiety, or personal beliefs about education may shape their perceptions and responses, potentially introducing bias into the data.
- Limited Longitudinal Perspective: The study focuses on the immediate experiences and perceptions of parents and children during the transition into the school system. Long-term effects or changes over time may be partially captured. A more extended longitudinal study would be needed to understand the longer-term impacts of the pandemic on children's academic, social, and emotional development.

Despite these limitations, this research aims to contribute to the existing knowledge base by exploring the unique experiences of parents and their children during the Covid-19 pandemic. The findings will provide valuable insights and serve as a foundation for further research and developing targeted interventions and support systems for families and children during and after the pandemic.

Future Recommendations

Based on the findings and limitations of this study, several recommendations can be made for future research:

- More Extensive and Diverse Sample: Conducting studies with more extensive and diverse samples would enhance the generalizability of the findings. Including parents from different geographical locations, socio-economic backgrounds, and cultural contexts would provide a more comprehensive understanding of the experiences and emotions of families during the transition into the school system.
- Longitudinal Studies: Longitudinal studies that follow children over an extended period would be beneficial in capturing the long-term effects of the pandemic on their academic, social, and emotional development. Tracking their progress and well-being beyond the immediate transition period would provide insights into their resilience and the potential challenges they may face in subsequent academic years.
- Objective Measures: Incorporating objective measures, such as standardized assessments, behavioral observations, or teacher evaluations, would complement the subjective reports of parents. Objective measures can provide a more comprehensive and reliable assessment of children's academic readiness, social skills, and emotional well-being, reducing the reliance on self-report biases.
- Comparative Studies: Conducting comparative studies between pre-pandemic and pandemic cohorts would allow for a better understanding of the unique effects of the Covid-19 pandemic on children's school readiness and emotional experiences. Comparing children who experienced typical early childhood education with those who experienced disruptions during the pandemic would highlight the specific challenges and potential gaps in their development.

- Intervention and Support Programs: Designing and implementing targeted interventions and support programs for children and families affected by the pandemic is crucial. Evaluating the effectiveness of these programs in promoting children's resilience, social-emotional well-being, and successful transition into formal schooling would provide valuable insights for future interventions and policy development.
- Focus on Specific Subgroups: Exploring the experiences of specific subgroups, such as children from low-income families, diverse cultural backgrounds, or those with special educational needs, would help identify unique challenges and tailor interventions to address their specific needs. Understanding how the pandemic has impacted different subgroups of children and families can inform equitable and inclusive support strategies.
- Multi-method Approaches: Employing qualitative and quantitative methods, such as interviews, observations, and surveys, would provide a more comprehensive understanding of the complexities of children's experiences and emotional responses during the transition into the school system. Mixed-method approaches can offer a richer and more nuanced understanding of the multifaceted impacts of the pandemic.
- Collaboration and Knowledge Sharing: Encouraging collaboration among researchers, educators, policymakers, and practitioners is crucial for sharing knowledge, best practices, and interventions. Collaborative efforts can facilitate a multidisciplinary approach to addressing the challenges children and families face during and after the pandemic, leading to more effective support systems and interventions.

By addressing these recommendations, future research can build upon the current knowledge base and contribute to a deeper understanding of the effects of the Covid-19 pandemic on children's school readiness, emotional well-being, and overall development.

Conclusion:

The Covid-19 pandemic has brought profound challenges and disruptions to individuals, families, and communities worldwide. This has particularly impacted young children, who may face significant emotional and developmental consequences due to the unprecedented circumstances. While there has been extensive research on the impact of the pandemic on adults and adolescents, there still needs to be a notable gap in understanding the specific effects on children aged zero to

five. This study aimed to address this gap by examining the emotions of parents whose children entered the school system for the first time during the pandemic, focusing on their academic and social preparedness and the associated emotional levels.

The findings from the literature review provide valuable insights into the impacts of the Covid-19 pandemic on early childhood development. Anderson et al. (2022) highlighted the substantial increase in suicidal thoughts and poor mental health among high school students during lockdown periods. Brown et al. (2020) emphasized the impact of stress and parenting during the pandemic, underscoring the need to explore the experiences of young children. Duncan et al. (2007) demonstrated the significance of school readiness in predicting future academic success, with entry-level math being the strongest predictor. Yildiz et al. (2023) and Keengwe and Onchwari (2022) shed light on the changing roles of preschool administrators, teachers, and parents and the challenges faced in transitioning to online education and maintaining parent-teacher relationships.

The study's limitations should be acknowledged, including the small sample size and the use of self-reported measures. The survey methodology may introduce response biases, and the study's findings may only be generalizable to some populations. Additionally, the study focused on parents' perspectives, and it is essential to consider the child's viewpoint and experiences in future research.

Several recommendations can be made based on the research. Firstly, there is a need for further studies to explore the long-term effects of the pandemic on children's emotional well-being, social development, and academic preparedness. Understanding the interplay between these factors can inform the development of targeted interventions and support systems to mitigate potential adverse outcomes. Secondly, policymakers, educators, and parents should collaborate to develop guidelines and interventions that address the challenges of online education, promote healthy screen habits, and enhance parent-teacher relationships. Thirdly, it is crucial to prioritize early childhood education and provide resources and support for families to ensure children's successful transition into formal schooling.

In conclusion, the Covid-19 pandemic has had far-reaching effects on early childhood development. By understanding the specific challenges young children and their families face during this time, policymakers and practitioners can develop evidence-based strategies and interventions to support their well-being and optimal development. By considering the emotions, academic and

social preparedness, and the changing roles of parents, teachers, and administrators, we can navigate the post-pandemic world with a deeper understanding of the unique needs of young children and foster their success in the face of adversity.

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Isamar Lopez-Argueta

How does Water Quality and Salinity Affect Coastal Amphibian Occupancy in Humboldt County, California?

Abstract

The basic biology of amphibians includes their highly permeable skin, which makes them sensitive to their environments. It has been shown for decades that amphibians are restricted to specific habitats that do not harm them while they are developing or when they are grown adults. In previous studies, high salinity deterred amphibians from inhabiting particular coastal habitats. Not only does saline water deter most amphibians from occupying otherwise suitable habitats, but other water quality parameters affect amphibian occupancy. The goal of this study was to assess the salinity and amphibian occupancy among aquatic habitats in Humboldt County, California. This study conducted visual surveys of amphibians in freshwater to saline waters within local wetlands and coastal areas. After recording visual observations, ponds and creeks were tested for salinity, pH, turbidity, and dissolved oxygen content. Data collected from seven sites did not reveal a clear relationship between amphibian occupancy and water quality variables, but average turbidity was lower at sites with amphibians present. It is expected that a larger dataset would show that coastal amphibians will occur in greater abundance within areas of low salinity levels and decreased abundance within areas of high salinity levels.

Introduction

Amphibians are known for their unique body plan that inhibits them from occupying highly saline habitats that prevent them from performing their normal physiological functions (Calderon et al., 2019; Hopkins & Brodie, 2015; Peluso et al., 2021). Unlike reptiles, amphibians are more prone to water loss and salt exposure due to their sensitive, permeable skin and the inability to excrete excess salts (Albecker & McCoy, 2017; Bounas et al., 2020; Calderon et al., 2019; Hopkins & Brodie, 2015; Vegso et al., 2022). With the increase of urbanization, natural wetland habitats are decreasing and the water quality of the remaining natural wetlands is often altered by human activity (Bounas et al., 2020; Calderon et al., 2019; Peluso et al., 2021; Sendak, 2008). Assessing water quality can determine where amphibians occupy wetland habitats and what their relationship with salinity says about their increasing adaptation to saline habitats (Hopkins & Brodie, 2015).

Other water quality parameters in association with larval amphibian occupancy can also influence their chemosensory functions (Troyer & Turner, 2015). Although amphibians prefer to inhabit freshwater aquatic environments, it is unclear why amphibians choose to inhabit brackish and saline aquatic environments. Dating back to the late 1950s and early 1960s, there have been studies that recorded anecdotal notes of amphibians occupying aquatic saline habitats, but no experiments were conducted to test the salinity tolerance of these recorded amphibian species (Hopkins & Brodie, 2015). Since there is a lack of water quality testing in amphibian-occupied habitats in Humboldt County, California, this research project will provide the data to assess the aquatic health of these saline environments. Aside from determining the overall health of saline environments where amphibians may potentially occupy, there could be new insights regarding salinity tolerance in amphibians.

Research Questions

1. How does salinity, pH, turbidity, temperature, and dissolved oxygen affect and determine where coastal amphibians inhabit?
2. What are the impacts that water quality has on amphibian occupancy?
3. Does seasonality affect water quality, which in turn affects amphibian occupancy?

Hypothesis

Amphibians will occur in greater abundance in pools with lower salinity levels and in lower abundance in pools with higher salinity levels. It is also expected that amphibians will occur in greater abundance in cooler water temperatures, low turbidity, basic pH values, and normal freshwater dissolved oxygen levels.

Methods

The field sites were located in various wetland and terrestrial habitats in Humboldt County, California, USA ranging from freshwater to saline (Fig. 1): the Arcata Marsh, Mad River Slough Wildlife Area (MRSWA Sullivan, 2017), Manila Community Park, Arcata Community Forest, Clam Beach, and Hiller Park. Field data collection and visual surveys took place from May to July 2023, when there is less known information about amphibian movement in terrestrial habitats (Hayes et al., 2008). Visual surveys were conducted at all of the sites to assess amphibian occupancy (Albecker & McCoy, 2017; Bounas et al., 2020; Calderon et al., 2019), however, the sites that have no visual confirmation of amphibians were also included in the data collection

process as potential candidates for amphibian occupancy sites. Measurements of the pond size were recorded in square feet (Bounas et al., 2020) along with photographs of each site where the water quality data was collected. The map of the study sites was created in ArcMap along with the NAIP file that was used to generate the image of Humboldt County via the Humboldt Planning & Building website.

The five water quality parameters that were tested were salinity, pH, turbidity, dissolved oxygen (DO), and surface and internal water temperature (Dodd Jr., 2009; Heyer et al., 1994; Olson et al., 1997). Gerlanc and Kaufman (2005), Troyer and Turner (2015), Albecker and McCoy (2017), Calderon *et al.* (2019), and Bounas *et al.* (2020) used a combination of these parameters in their studies to determine how water quality impacts amphibian growth, development, chemosensory functions, and spatial distribution. The data for salinity was retrieved from a salt optical refractometer and the data for pH, dissolved oxygen, and turbidity was retrieved from portable digital meters of their respective parameters. The surface water temperature was recorded with an infrared thermometer gun and the internal water temperature was recorded with a digital pocket thermometer with calibration. Once the water quality parameters were collected, they were analyzed for variability and compared to see which parameters were the most variable.

Results

In total, two out of the seven sites had amphibian presence at the time of data collection. Both of these sites are permanent freshwater habitats. Out of the seven sites, only one site is saline while the rest of the sites are freshwater. The site with saline water was at MRSWA, where the salinity reached 43 parts per thousand (ppt), and with a turbidity value at 75.65 nephelometric turbidity units (NTU). The salinity and turbidity values at MRSWA proved to have promising results considering how there were recently metamorphosed Sierran Treefrogs (*Pseudacris sierrae*) in the vicinity of where the data was collected a few weeks later. The average salinity at sites with amphibian absence is 8.69 ppt while amphibians' presence at sites had an average salinity of 0 ppt (Fig. 2). The average turbidity value of amphibian absence at the sites is 26.3075 NTU and amphibian presence at the sites is 6.33125 NTU (Fig. 3). Turbidity was the most variable parameter compared to the other measured parameters that remained in close range. For example, the measured DO across all seven sites ranged from 10.52 mg/L to 11.84 mg/L while turbidity values ranged from 1.53 NTU to 78.7 NTU.

Discussion

The water quality data collected at MRSWA is promising for future data collection and monitoring of the area considering how the salinity value of the water is well above the norm for brackish water (~30-35 ppt). Collecting water quality data during the winter and spring seasons when amphibians are actively breeding would be the next phase of this study. If this study were to include data on amphibian occupancy in brackish or saline habitats, this suggests that they are a lot more adaptable to these types of habitats than previously thought by researchers (Hopkins & Brodie, 2015). To seek that possibility, the study sites must include most, if not all brackish and saline habitats that have amphibian presence or evidence of amphibian presence. The sites that were used in this study so far have been freshwater habitats with predictable results that show habitat suitability for amphibians.

Limitations

The two limitations of this study were seasonality and lack of transportation to the sites. A lot of the pools where amphibian breeding activity takes place during the winter and spring seasons dried up leaving behind a limited selection of habitats to include in this study by mid-May. Because of the limited selection of sites, most of the sites are permanent freshwater ponds or creeks, which decreases the diversity of the necessary data to test water quality and answer the questions this study is investigating. Aside from the timing of the project, transportation to the sites has limited the range of sites to include the study due to the unavailability of public transportation to many of the sites.

Future Recommendations

If salinity plays an important role in amphibian occupancy in wetland habitats, this could mean that coastal amphibians are slowly evolving to adapt to saline environments which was not previously thought to be possible (Albecker & McCoy, 2017; Gerlanc & Kaufman, 2005; Hopkins & Brodie, 2015). Amphibians, like frogs who are restricted to depositing their eggs in water, are more vulnerable to poor water quality (Albecker & McCoy, 2017). If adult frogs have limited habitat choices to deposit their eggs in a pond that has inadequate water quality, then their young will run the risk of improper development or physical deformities (Peluso et al., 2021). Water quality can contribute to amphibian breeding behavior and could cause detrimental impacts on the vulnerable species of amphibians that are not as resilient to salt exposure. It is important to consider performing water quality assessments for amphibians in all wetland habitats to determine how water quality impacts local populations of amphibians (Calderon et al., 2019), and to also raise awareness of the scarcity of remaining natural wetland habitats (Knutson et al., 2004).

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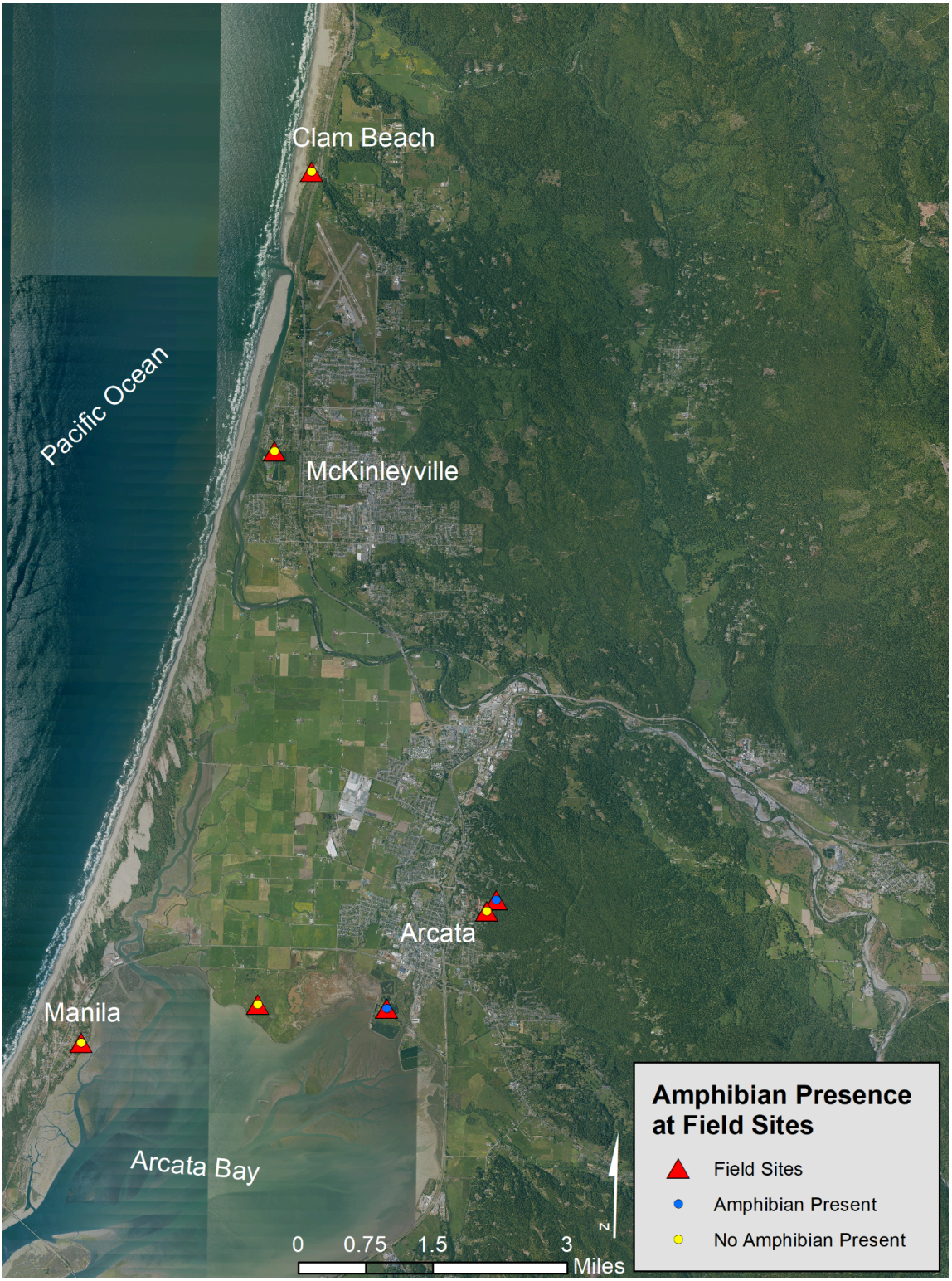

Figure 1. Map of the study sites in Humboldt County, California.

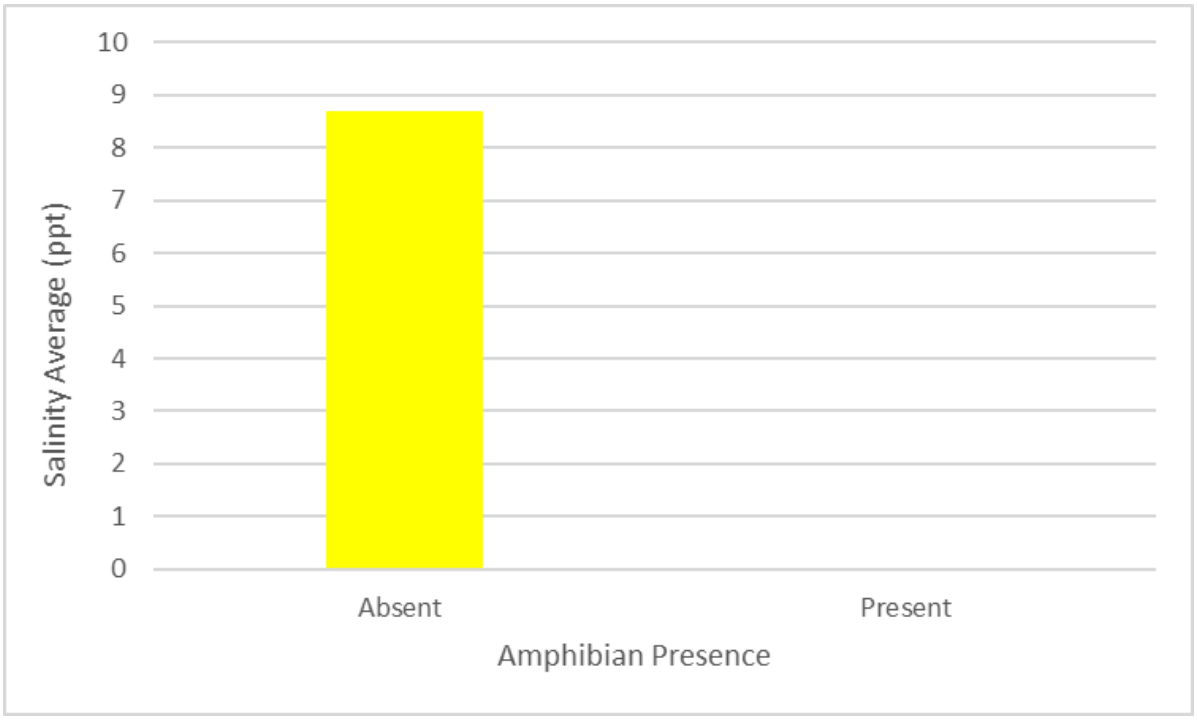

Figure 2. Average salinity at field sites where amphibians were absent (yellow bar) or present (blue bar) at the time of data collection.

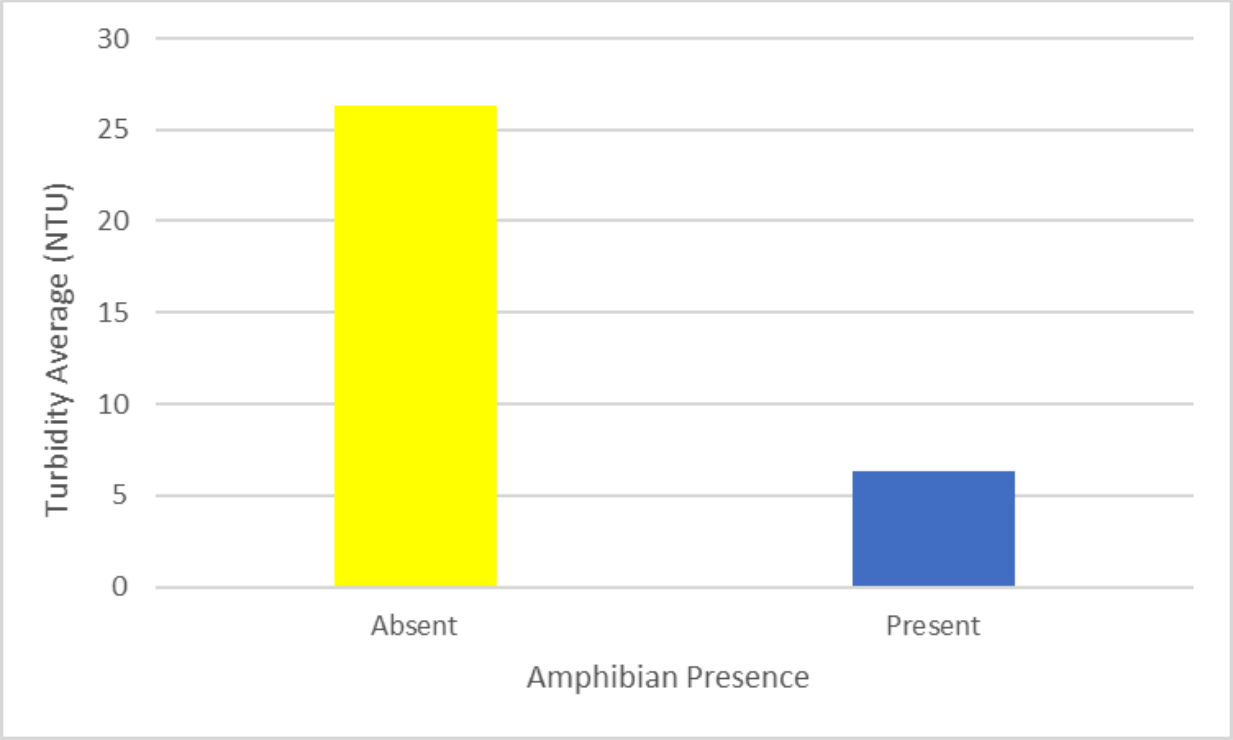

Figure 3. Average turbidity at field sites where amphibians were absent (yellow bar) or present (blue bar) at the time of data collection.

Athens Marrón

¡Aquí Estamos!: Latinx/a/o Students in Rural California

Abstract

This is a qualitative study that centers on the schooling experience of Latinx/a/o high school students in predominantly white rural schools. The research questions center around how the racial climate of the school affects the sense of belonging of Latinx/a/o students. We explore how school climate arises from traditional values, limited exposure to diverse perspectives, and a lack of awareness regarding the experiences and needs of Latinx/a/o students. To shed light on these experiences, this study focuses on the stories and experiences of Latinx/a/o students and how they perceive their school climate. Existing literature on Latinx/a/o students who attend predominantly white rural schools states that they often face challenges like racialization, lack of confidence in academic success, pressure to assimilate into the dominant culture, hostility, and a lack of acceptance (Marx, 2008; Fergus, 2016; Han, et al., 2016; Yeo, 1999; Smith, 2021). The early results align with the themes found in the literature, confirming the similar challenges Latinx/a/o students in Humboldt County face. Our study in particular highlights the role of a culturally relevant environment and curriculum in fostering students' sense of belonging and affirmation of their ethnic identities.

Keywords*:* predominantly white schools, rural, Latinx students, sense of belonging, campus climate, Decolonial education, culturally relevant education, dominant schooling

Introduction

High schools in California must prepare to meet the various needs of underrepresented students, as the state has now passed AB 101 (Assembly Bill No. 101, 2021; Bell, et al. 2022). AB 101 mandates high schools to implement Ethnic Studies as a graduation requirement by the year 2025. This educational policy is significant because it offers an opportunity for high schools to acknowledge the cultural and social histories of various ethnic communities, fostering representation and empowerment among historically marginalized students. The implementation becomes complex due to the influence of local educational policy and the agency school boards are granted to make the

final decisions (Assembly Bill No. 101, 2021; Bell, et al. 2022).

A community's political climate can influence the decisions the school board will make and if they will follow a lack of cultural responsiveness for students of color or design a curriculum that follows the Liberated Ethnic Studies Model, affirming and empowering underrepresented students (Bell, et al. 2022). This is what motivated us to uncover the educational experiences of Latinx/a/o students residing in rural, predominantly white settings. We hope our research will shed light on the importance of designing a curriculum that fosters the various assets they have and contribute to the knowledge of research on the effects of campus climate, Latinx/a/o students in this specific context, and the transformative effects of culturally responsive curriculum and school environments.

Latinx/a/o students

The National Center for Educational Statistics has reported that Hispanic students are the fastest-growing school population in the United States. In fact, between 1995 and 2017, the enrollment of Hispanic students skyrocketed from 6.0 million to 13.6 million (Wang, et al. 2020). However, in this study, we intend to not use the term "Hispanic" to describe our focus group. Instead, we will adopt the term "Latinx/a/o" to counteract the historical oppression associated with the term "Hispanic" (Villanueva, et al. 2022).

Despite the rapid growth in Latinx/a/o students, research reveals they are facing challenges such as underperforming academically and attending the most racially segregated and underfunded schools in the United States (American Psychological Association, 2012; Rodríguez, et al., 2015; Pizarro, 2005, Donato, 1997). Noteworthy, most of the research conducted on these issues has focused on central cities with high numbers of Latinx/a/o students. Thus, our research project holds significant value as it addresses a gap in the existing literature concerning Latinx/a/o students enrolled in rural, predominantly white schools. We intend to extend research on the impacts of a campus's racial climate on students' connectedness and overall sense of belonging to the secondary education level. Research on this topic has predominantly focused on the experiences of Latinx/a/o students in higher education institutions. As a result, there is a lack of studies regarding the experiences of secondary school students in rural settings. Given the distinct cultural, social, and geographical characteristics of rural communities, it is important to understand how these factors impact students' educational experiences.

Setting and Land Acknowledgement

This study takes place in Humboldt County, a rural region on the north coast of California. We also acknowledge that we are situated on the present and ancestral homeland and unceded territory of the Wiyot Tribe. Tribes and Nations in Humboldt County include Hupa, Karuk, Mattole, Tolowa, Wailaki, Wiyot, and Yurok.

Latinx/a/o students in Humboldt County caught our attention, because there are notable disparities in the racial demographics between the state of California and Humboldt County. According to the U.S. Census Bureau (2022), the white population accounts for 72.6% of Humboldt County's population, while the Hispanic population makes up the second largest racial group. On the contrary, the state reveals a different trend where Hispanics are the largest racial group. The school demographics display the same findings, indicating Latinx/a/o students in Humboldt County are enrolled in predominantly white schools. They account for 19.8% of the school population, while in California, they represent 55.9% of the student population (Source: 2021-22 eddata.org). It is critical to recognize these disparities and explore how this impacts the schooling experiences of Latinx/a/o students.

Statement of Problem

Existing literature on students of color who attend predominantly white rural schools states they often face challenges like racialization, lack of confidence in academic success, pressure to assimilate into the dominant culture, experiences of hostility, and a lack of acceptance (Marx, 2008; Fergus, 2016; Han, et al., 2016; Yeo, 1999; Smith, 2021). In a student listening session report, BIPOC (Black, Indigenous, People of Color) students expressed their shared experiences of racism in local schools and the absence of a culturally responsive curriculum. As Smith (2021) notes, BIPOC students reported that "most curriculum taught in the local schools is Eurocentric and not reflective of other cultures or races." This is a prevalent theme in rural contexts with predominantly white populations, as there is often a notable lack of acceptance and even hostility toward people of color and social justice education (Han, et al., 2016; Yeo, 1999).

Literature Review on Campus Climate

Researchers have contributed to extensive studies on campus climate: a multifaceted concept that incorporates the "current perceptions, attitudes, and expectations that define the institution and its members" (Hurtado et al., 1999, p.5). Hurtado et al. (1999) highlight the importance of understanding campus environments from the eyes of various people with different racial/ethnic backgrounds. They add how it is often viewed differently by non-white students. For example, a study conducted by Rankin et al. (2005) explored the differences in the campus climate experiences amongst students from diverse racial groups. Results from their study revealed that students of color reported higher rates of harassment compared to white students.

Furthermore, students of color viewed the campus climate as more racist and less accepting than white students, making it more challenging for them to detach their experiences and perspectives from their overall feelings about the campus climate. Students of color may encounter hostility, microaggression or racist remarks, which all have real and strong impacts that are difficult to dismiss or shrug off (Sanchez, 2019; Hurtado et al., 2015; Yosso, et al., 2009; Rankin et al., 2005). They are denied that ability due to the pervasive impact of whiteness. Rankin et. al states, "the different experiences and perceptions of white students reinforce the concept of White privilege on college campuses" (Rankin et al., 2005, p. 58).

White students are less likely to experience similar encounters with racism and are more likely to benefit from epistemic privilege. Epistemic privilege "refers to the ability to remain unaware of benefits and barriers associated with race" (Rankin et al., 2005, p. 55) . This form of White privilege can be perpetuated by social structures in an institution, as educational institutions are not exempt from these systems of oppression. Racism is deeply ingrained throughout US society, and has been found to be intricately connected to the institutional aspect of the campus climate (Mwangi et al. 2018).

Given the concerning findings that students of color are more likely to experience negative campus climates than white students, it becomes crucial to understand the potential effects on their educational outcomes. Researchers have explored the link between campus climate and student outcomes, revealing negative campus climate has been found to "contribute to isolation and diminish sense of belonging and institutional commitment" (Mwangi et al., 2018. P. 457). As a result, the level of dedication and motivation amongst students of color may decrease when they feel unsupported and disconnected from their college campuses.

To address these critical issues, various higher education institutions have begun developing programs aimed at enhancing positive environments for students (Hurtado et al., 1999). However, it is important to acknowledge that while significant efforts have been made in the higher education settings, the majority of research and action plans have been predominantly focused on college students. This has led to a gap in knowledge on how campus climate is perceived by secondary school students, especially students in rural settings.

Rural School Settings

Rural settings in the United States grabbed our attention because of their distinct sociopolitical and racial climates. For this study, we reviewed literature pertaining to diversity education in rural predominantly white settings. However, it was a challenge to find scholarly studies focusing specifically on this subject. The lack of substantial research motivated us to delve further into this context and conduct our own investigation.

The studies we found uncover the increasing need for diverse education in rural school settings. In their study, Han et al. (2016) explore the importance of diversity within rural contexts, highlighting the demographic divide prevalent in these areas. They state, “in rural regions, schools consist of overwhelmingly White citizens in all educational settings” (p. 131). This prevailing racial landscape is similar to the environment in Humboldt County, where the white population constitutes 72.6% of the population (U.S. Census Bureau, 2022). Han et al. (2016) elaborate on how this type of environment produces a lack of experience and exposure to people from diverse backgrounds and reinforces Euro-American epistemology (p. 131). As a consequence, the attitudes found in these racial environments pose a risk for students of color. They report feeling isolated and instances where they have endured racism (p.119). How are white teachers being prepared and trained to address these issues of race and racism for their students of color? Smith et al. (2023) examine the existing gap in scholarly literature concerning the training teachers receive to effectively engage in conversations about subjects such as race. This matter is concerning, particularly for students who encounter feelings of isolation due to their ethnic identities, and/or racialization within school. The absence of such affirmative spaces or culturally responsive trained teachers could have far-reaching consequences, not only for the emotional and psychological well-being of these students but also their overall engagement in learning. These findings motivate us to understand how Latinx/a/o students in Humboldt County schools perceive their school racial climate and if they experience similar challenges like racialization, hostility, lack of acceptance,

and isolation. Additionally, how do they resist these issues and rise above them?

Culturally Relevant Teaching and Practices

Ladson-Billings (1995) defines culturally relevant teaching as a form of pedagogy that opposes established norms. She names three essential principles that lay the foundation for culturally relevant pedagogy: "(a) Students must experience academic success; (b) students must develop and/or maintain cultural competence; and (c) students must develop a critical consciousness through which they challenge the status quo of the current social order" (Ladson-Billings, 1995, p. 160).

Critical Race Theory

Critical Race Theory (CRT) has been utilized by scholars and researchers to examine school climate, it has been used to identify instances of racism within K-12 settings (Ledesma et al., 2015). It brings attention to the presence of racism throughout the realm of education, which challenges the notion that schools are neutral environments where racial inequalities are absent. To truly address the ongoing racism in education, recognizing racial inequalities within education is crucial. This is why we turn to CRT to critically assess the racial climate in predominantly white schools.

Critical Race studies in education involve analyzing racism as a system of oppression and exploitation. This approach deeply explores both historical and current ideas surrounding race in our society, particularly within schools (Ledesma et al., 2015). Furthermore, many researchers of Critical Race studies in education are examining teaching techniques and pedagogy that can empower students of color. Effective teaching is closely linked to culturally relevant teaching practices.

Research Questions

R1: How have the practices and culture of Humboldt County schools influenced the schooling experience of Latinx/a/o students?

R2: How do Latinx/a/o students in Humboldt County navigate and find a sense of space, community, belonging, and validation within predominantly white educational environments?

Sub Questions

1. What is the social climate and institutional culture of the high schools attended by Latinx/a/o students in Humboldt County?

2. Do these schools welcome and embrace the cultural and linguistic assets of Latinx/a/o students?
3. To what extent do these schools support and promote a sense of belonging for Latinx/a/o students?
4. Do Latinx/a/o students feel pressured to assimilate into the dominant culture within these school settings, or are they able to express and embrace their own cultural identities?

Hypothesis

H1: The schools attended by Latinx/a/o students in Humboldt County are predominantly white and characterized by a dominant school culture that often leads to feelings of isolation and invisibility among Latinx/a/o students.

H2: Despite the challenges they face, Latinx/a/o students have managed to find spaces where they can create a sense of community, belonging, and validation. They often find support and inspiration from each other, as well as from their families. Additionally, some teachers play a crucial role by actively including Latinx/a/o culture in the curriculum, which helps validate the students' identities and experiences.

Methodology/Methods

CRT and Counternarratives as Decolonial Methodologies

We are using decolonial methodologies (including CRT) to examine the racial climate in predominantly white schools and explore how Latinx/a/o students perceive it. Zavala's work was fundamental in guiding our methodology. He breaks down decolonial research in education and provides many helpful approaches to help us better understand it. Zavala describes decolonial education as "a process for community self-determination" (Zavala, 2016, p. 1).

He names three major interlocking strategies in decolonial projects: counter/storytelling, healing, and reclaiming. Engaging in dialogue with the students and giving them a safe space to reflect on their schooling experiences was part of this method. Zavala describes this dialogue and reflection as an aspect of counter-storytelling. He shares how in the field of CRT, testimonio (testimony) and collective voicing has been used as counter-storytelling methods. Centuring the

voices and experiences of students who are historically marginalized and silenced is apart of the goal to decolonize research, because academia has been and is a place of power struggle (Zavala, 2016). Eurocentric and colonial logics tell us this myth that research is neutral and education is neutral, but this is not always the truth. Therefore, we sit down with students and listen to their lived experiences of racism in school to highlight how this neutral myth silences their struggles and resilience.

Participants/Subjects

The primary focus of this study is to highlight the educational experiences of Latinx/a/o high school students residing in Humboldt County, which is a rural and predominantly white setting. We aim to explore how they perceive their school's racial climate and the effects it has on their sense of belonging. In addition, subjects covered in the interviews included the students ' experiences with the curriculum in school, the impact of the Ethnic Studies curriculum, their motivation in school, and how their teachers influence their school engagement.

Data Collection/Analysis

In this study, we use qualitative methods to collect data that uncovers the educational experiences of Latinx/a/o students in Humboldt County. Specifically, the study involves conducting oral interviews with Latinx/a/o high school students. The interviews include open-ended questions, designed to gather information about students' experiences in school and in classes. Additionally, the questions help us understand how the students describe the level of support they feel at school by teachers and peers, thus revealing the school's social climate.

We invited students to participate in our research from two groups: those who voluntarily enrolled in the Ethnic Studies summer course offered by Cal Poly Humboldt and those who participated in the Ethnic Studies curriculum provided by the Promotorx Transformative Educators program in their high schools. Prior to conducting the interviews, we obtained consent and assent forms from all selected participants, ensuring they were aware of the purpose of the interviews. Additionally, ensuring their parents were aware of the nature of their involvement in the study. To protect the privacy of the students, they and their parents decided if they wanted their school or name to remain anonymous in the interviews. If so, pseudonyms were used to replace identifying factors.

The interviews were conducted face-to-face to create an open and comfortable environment. They were captured using a digital voice recorder and were stored securely in password-protected Google Drive. Upon conducting the interviews, the data was carefully and

manually transcribed. For interviews conducted in Spanish, we took great care to accurately translate the responses into English. After, we carefully analyzed the information we collected from students and identified common themes within their responses.

Preliminary Findings

"Yo senti como que ya me había liberado de unas cadenas... Y ahi pude expresar como me sentia" (translated as "I felt like I had been freed from some chains... And there, I could express how I felt") - **Student 1**.

The transformative impact of Ethnic Studies is evident in this student quote because **Student 1** is sharing how they broke free from chains by expressing their feelings. This transformation aligns with the curriculum's focus on providing a space for historically underrepresented students to explore and understand their own identities, histories, and experiences. This is especially important in the schools these students attend, because they are predominantly white environments that might not allow students of color to feel represented and seen.

Additionally, we asked the two students a series of questions to learn more about their school experiences and the impact the Ethnic Studies curriculum had on them. Through these interviews, certain recurring themes emerged in the students answers concerning their schooling. These themes included a lack of culture responsiveness, limited chances to express themselves, the pervasive influence of a dominant curriculum and norms, and the importance of familismo/family strength.

Spanish is the primary language for both students, and they both feel the most comfortable communicating in Spanish. When questioned about their favorite subject in school, they both said Spanish is. **Student 1** elaborated, stating "Spanish, because we can communicate in spanish". **Student 2** said "they make me feel comfortable, it's the class where I can be free to be me and talk to everyone, without being afraid that they won't understand me".

The fear of being misunderstood was a recurrent theme in both of the students' responses. Their fear was closely linked to the language barrier. For instance, when asked if they feel safe in their classes, **Student 1** answered "I don't, because I am afraid that they will discriminate against me or that they will speak badly to me and I won't understand them". While neither students shared specific instances, the fear of something like that happening caused notable stress and anxiety.

They shared that they felt safer in classes where they were able to speak Spanish, practice their English skills, and when asked about desired changes within the school, **Student 2 e**mphasized the need for increased assistance for non-English speakers. **Student 1** said "I would add more classes with bilingual teachers to help us deal with the dominant language"

It is evident to us that both students encountered challenges stemming from the language barrier. However, they found support in settings that acknowledged their linguistic capital and identities. Which fostered an environment where they were able to thrive academically and personally because they felt engaged, seen, and supported.

Limitations

During the initial stages of our research, we encountered a limitation concerning the attainment of consent and assent forms from participants within the desired timeframe. This challenge affected the number of participants we were able to include in our study. However, we are addressing this limitation by implementing improved consent procedures for future interviews.

Furthermore, due to the limited time available with the students, we could only conduct oral interviews with two students from a single high school. As our study progresses, we hope to strengthen our comprehensive analysis of their experiences, by conducting additional interviews with students from various high schools across the county.

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Olivia Ortiz

College Students' Mindfulness and Resilience in Relation to Academic and Psychological Outcomes

Abstract

Many college students experience chronic or overwhelming stressors. Students who develop resilience, an individual's capacity to persevere in the context of adversity, may be more equipped to mitigate the harmful effects of stress. Mindfulness, a non-judgmental present-moment awareness, can also reduce stress. Previous research indicates that mindfulness and resilience are positively correlated and are predictors of college students' psychological well-being. Academic motivation also influences students' stress and well-being, yet the relationships between mindfulness, resilience, and academic motivation are largely unknown. This study investigated dispositional mindfulness, an individual's innate propensity to be mindful, and resilience in relation to both academic outcomes (i.e., test anxiety, academic performance, and academic motivation) and psychological outcomes (i.e., perceived stress and psychological well-being). We hypothesized that dispositional mindfulness and resilience would positively correlate with academic motivation and psychological well-being and negatively correlate with test anxiety and perceived stress, respectively. Regression models analyzed mindfulness and resilience as predictor variables and psychological and academic outcomes as criterion variables. Approximately 50 college students completed a cross-sectional online survey. Preliminary Pearson's correlational analyses indicated that mindfulness and resilience were positively correlated, and both were positively correlated with psychological well-being. Mindfulness, but not resilience, was negatively correlated with cognitive test anxiety. Preliminary analyses found insufficient support for the relationship between mindfulness, resilience, and academic motivation. A larger sample size is needed to be more confident in the results. Future research can examine the constructs in this study before and after the implementation of mindfulness interventions.

College Students' Mindfulness and Resilience in Relation to

Academic and Psychological Outcomes

College students encounter an unprecedented range of mental, emotional, social, and financial stressors in addition to the academic demands (e.g., coursework, enrollment, and exams) that coincide with obtaining a degree (Barbayannis et al., 2022; Beiter et al., 2015; Freire et al., 2020; Liu et al., 2019; Weber et al., 2019). These stressors, considered by some to be critical to personal and intellectual development, may disproportionately burden vulnerable student populations (e.g., racial, ethnic, and gender minorities) with significant barriers to higher education (Liu et al., 2019; Smith et al., 2014). Educational inequities must be addressed; however, institutional change is slow, and students in the post-COVID-19 era are experiencing more academic-related stress than ever before (American Psychological Association [APA], 2020, 2022). Despite the precipitous rise in stress, the utilization of on-campus mental health services remains low (Nestor et al., 2016), particularly for ethnic/racial minorities who experience stigmatization and culturally insensitive care (Augsberger et al., 2015; Cheng et al., 2013; Liu et al., 2019). There is a need for practical and accessible stress-reducing resources that students can implement independently or complementary to traditional mental health services.

Mindfulness, a present-moment awareness without judgment or editorialization (Kabat-Zinn, 2003), may help reduce stress during periods of considerable social change. Mindfulness interventions have been studied extensively in the last several decades and have been shown to benefit various dimensions of cognitive performance and psychological well-being (Eberth & Sedlmeier, 2012). Resilience, an individual's capacity to persevere in the context of adversity (Luthar et al., 2000), was initially conceptualized as a fixed trait. However, recent findings suggest that resilience can be developed through mindfulness interventions (Joyce et al., 2018). Similar to mindfulness, resilience has been associated with improvements in college students' academic performance (Reynolds & Weigand, 2010) and general well-being (Brewer et al., 2019). While there has been considerable research on mindfulness and resilience as independent constructs, only a few well-constructed studies have investigated the relationship between mindfulness and resilience in college students.

Considering the putative benefits of mindfulness and resilience, it is necessary to document how these constructs interact with other variables related to college student success and well-being. This study will focus on the relationship between dispositional mindfulness (i.e., trait mindfulness), an individual's innate mindful behavior in daily life (Brown & Ryan, 2003), and resilience in college students. In particular, this study will investigate dispositional mindfulness and resilience in relation to both academic outcomes (i.e., test anxiety, academic motivation, and academic performance) and personal outcomes (i.e., perceived stress and psychological well-being). Although studies have examined dispositional mindfulness in relation to psychological well-being, perceived stress, academic performance, and test anxiety, to our knowledge, no studies have examined mindfulness or resilience in relation to the sub-domains of academic motivation: intrinsic, extrinsic, and amotivation.

Mindfulness and Resilience

Denkova et al. (2020) and Jha et al. (2017) evaluated mindfulness interventions designed to enhance cognitive resilience (i.e., the ability to maintain cognitive performance during stressful situations) using quasi-experimental designs in high-stress populations. Jha et al. (2017) examined if mindfulness training (MT) bolstered cognitive resilience by protecting attentional control from deterioration. Jha et al. (2017) hypothesized that attentional performance would decline in the low-practice MT and control group, and attentional performance would be protected in the high-practice MT group through a reduction in mind-wandering. U.S. Marine Corps reservists (N=56; 100% Male) were recruited during their pre-deployment period and split into the MT and military control (MC) groups. Results suggest that MT may promote cognitive resilience by protecting attentional performance from degradation in pre-deployment military cohorts that completed a significant amount of home practice. These findings suggest that MT strengthens and protects attentional control by attenuating mind-wandering during stressful conditions; however, the benefits observed appear to be dependent on the amount of time the participant dedicates to mindfulness practice (Jha et al., 2010; Morrison et al., 2014). Additional studies will need to demonstrate that MT is applicable in different contexts and in diverse populations who also experience significant stressors while needing to maintain optimal cognitive performance.

Similarly, Denkova et al. (2020) studied mindfulness as a mode of enhancing cognitive resilience. This study improved upon Jha et al. (2017) by including a direct measure of resilience comprised of multiple aspects vs. focusing solely on indirectly measured cognitive resilience. Denkova et al. (2020) investigated two questions regarding the effectiveness of a four-week mindfulness training (MT) program offered to high-stress professionals; first, would MT improve psychological resilience, affect, and sustained attention; second, is the frequency of MT practice related to the magnitude of observed differences in psychological resilience, affect, and sustained attention performance? Firefighters (*N*=121; 19% Female) were assigned to three groups based on their pre-determined work shifts: mindfulness training, relaxation training (RT), and no-training control (NTC) in a nonequivalent control group pretest/posttest design. Additional home-trainings were included in this study for the MT and RT groups and involved 10-15 mins of independent, daily practice. Participants were measured on psychological resilience, affect, sustained attention, and adherence to daily home practice. Denkova et al. (2020) demonstrated that MT increased self-reported resilience and expanded on previous findings by demonstrating an increase in resilience compared to a matched active-control (RT) and an NTC group. However, the observed change in psychological resilience was not sensitive to the amount of home practice, which was inconsistent with Jha et al.'s (2017) findings. Conversely, changes in sustained attention and positive affect were sensitive to the amount of home practice but were not significant as a function of group change over time. A possible explanation for these results was that MT may only benefit sustained attention and affect during periods of high stress.

Findings from Denkova et al. (2020) and Jha et al. (2017) suggest that mindfulness interventions may increase resilience; however, they provide conflicting results in regard to the amount of home practice, a foundational aspect of most mindfulness interventions. These findings offer potential pathways for future research where conflicting findings need to be clarified. Both of these studies do not include measures of mindfulness, which brings into question if increased mindfulness was actually responsible for the observed changes in resilience. Future research should include objective and subjective measures of mindfulness and resilience before and after the introduction of mindfulness interventions.

Mindfulness and Resilience in College Students

Pidgeon and Keye (2014) and Galante et al. (2018) examine similar questions regarding college students' mindfulness, resilience, and psychological well-being using different methodological approaches. Pidgeon and Keye (2014) hypothesized that mindfulness and resilience would positively predict psychological well-being, and individuals who practice meditation would score higher on measures of mindfulness. Australian college students (*N*=141, majority female but percentage not specified) completed self-report measures of psychological well-being and mindfulness and answered questions regarding their meditation experience. Pearson's correlations indicated that students' mindfulness and resilience positively correlated with their psychological well-being. Hierarchical regression analysis suggested that mindfulness and resilience are significant positive predictors of psychological well-being. However, due to the cross-sectional and correlational design, the author cannot rule out possible alternative explanations. This study was the first to examine the relationship between mindfulness and resilience as predictors of Australian college students' psychological well-being.

Expanding upon the relationship posited by Pidgeon and Keye (2014), Galante et al. (2018) provides experimental evidence of the efficacy and feasibility of mindfulness training in a randomized controlled trial of college students. Galante et al. (2018) investigated whether mindfulness courses (MC) would improve students' resilience and psychological well-being throughout stressful intervals. Researchers hypothesized that MC would decrease distress and increase well-being during examinations when compared to traditional mental health support offered at most universities. The authors operationalized resilience as decreased stress during a recognized stressor (i.e., exams). United Kingdom undergraduate and postgraduate students (*N*=616) were randomly assigned to a mental health support group (i.e., treatment as usual) or the mindful student study (MSS) group in an independent group pretest/posttest design with follow-up. Participants completed self-report measures on psychological distress and mental well-being; additional questions assessed academic performance and perceived academic issues. Results indicated that the MSS enhanced well-being and reduced psychological distress during college examinations. The findings likely indicate a curvilinear relationship between mindfulness and academic performance. Furthermore, the MSS group indicated that they had fewer difficulties affecting their coursework. The findings from this study provide evidence that mindfulness bolsters resilience to stress in educational

contexts. This study lacked an active control and thus is limited in ruling out placebo effects. Significantly, this study implies that mindfulness may be more effective at preventing the deleterious effects of stress than the current treatment services available at most universities. Galante et al. (2018) is the first study to suggest a more nuanced relationship between mindfulness and academic performance; further research should investigate the nature of this relationship.

Mindfulness and Academic Performance

Mindfulness may enhance academic performance in student populations; however, some inconsistencies have been found regarding the nature of the relationship. For example, Mrazek et al.'s (2013) findings do not support the curvilinear relationship reported by Galante's et al. (2018). Mrazek et al. (2013) investigated if mindfulness training (MT) improved college student performance on objective measures of reading comprehension and working memory capacity (WMC) by reducing mind-wandering (i.e., task-unrelated thoughts). The authors hypothesized that improvements across all measures would be mediated by attenuating task-unrelated thoughts (TUTs). Mrazek et al. (2013) used a two-by-two mixed-factorial pretest/posttest design and randomly assigned undergraduate students (N=48; 71% Female) to a nutrition or mindfulness class. WMC and reading comprehension was assessed with the operation span task (OSPAN) and verbal-reasoning questions extrapolated from the GRE, respectively. Mind-wandering was assessed using self-report, retrospective self-report, and intermittent probe questions. Results indicated that mindfulness training improved WMC and led to a 16-point increase in GRE accuracy when compared to the nutrition program. Mind-wandering mediation analysis confirmed the hypothesis that reduced TUT mediates the effect of MT on performance.

Results from this study suggest that short-from MT can enhance WMC and verbal reasoning. For people who are easily distracted, these findings suggest that improvements in performance post-MT can be attributed to a diminished TUT. This study has broad implications and relevance for the field of education; if MT enhances WMC and reading comprehension, benefits may be observed across other measures of cognitive ability (e.g., quantitative reasoning). However, no direct measure of mindfulness was used in this study, making it difficult to link these benefits to increased mindfulness.

Caballero et al. (2019) noted the lack of direct measures in mindfulness studies and argued that if mindfulness is not explicitly tested (e.g., through self-report), then researchers cannot causally link mindfulness and academic performance. Caballero et al. (2019) investigated the relationship between dispositional mindfulness and academic performance in U.S. middle school students. Although mindfulness-based interventions can augment cognitive performance in students (Mrazrek, 2013), there is a lack of evidence supporting that mindfulness is directly responsible for enhanced academic performance. Caballero et al. (2019) hypothesized that dispositional mindfulness is associated with enhanced grade point average (GPA), attendance, standardized test scores, and decreased suspension rates. U.S. fifth through eighth-grade students (N=2,311, 51% female) from minority and low-income families completed the short-form Mindfulness Attention Awareness Scale (MAAS; Black et al., 2012; Brown & Ryan, 2003). Additional academic data, including GPA, Partnership for Assessment of Readiness for College and Careers (PARCC) standardized mathematics and English language arts (ELA) test scores, attendance, and suspension rates were collected from the school district.

Correlational analysis suggested that higher dispositional mindfulness was associated with higher GPA and standardized test scores and negatively associated with absenteeism and suspension rates. Regression analysis results indicated that mindfulness scores predicted higher GPA, PRCC Math and ELA scores, and previous school year performance. In addition, mindfulness predicted all measures of academic performance when all demographics were statistically controlled for. The results supported the hypothesis that mindfulness is associated with measures of academic performance in this population. However, due to the correlational nature of this study, additional studies are needed to provide causal evidence for these findings. These findings provide novel evidence for the correlation between mindfulness and academic outcomes in U.S. middle school students using explicit measures of mindfulness.

The following study by Bellinger et al. (2015) expands on the relationship between dispositional mindfulness and academic performance by examining college students in a two-study design. In the first study, the authors utilize experimental measures to establish a mediation model that is then applied in the second, more ecologically-valid study. Herein, researchers investigated the relationship between college students' dispositional mindfulness, academic performance, and anxiety during examinations. Researchers in the first study hypothesized that higher levels of dispositional

mindfulness would be related to reduced state anxiety and increased academic performance in a simulated high-stakes testing environment. Study 2 hypothesized that test anxiety would mediate the relationship between dispositional mindfulness and performance for quizzes and exams (i.e., high-pressure environment) but not for homework (i.e., low-pressure environment). Undergraduate students (*N*=112, 69.6% female) in Study 1 completed an arithmetic assessment in a simulated high-pressure testing environment. Participants were tested using self-report measures of single-factor dispositional mindfulness trait anxiety and state anxiety. Undergraduate students in Study 2 (*N*=248; 24% female) were tested in their calculus course and completed measures of cognitive test anxiety, mindfulness, and academic performance (i.e., exam performance).

Bellinger's et al. (2015) hypotheses were supported; mindfulness enhanced performance across both studies by reducing anxiety. Dispositional mindfulness and academic performance were significantly mediated by state anxiety, and mindfulness significantly predicted greater accuracy on exams and lower anxiety. Study 2 regression analysis suggested that students' mindfulness scores significantly predicted higher exam performance and lower cognitive test anxiety. The findings supported the mediation model; cognitive test anxiety mediated the relationship between dispositional mindfulness and exam performance. This study provides experimental and ecologically valid data regarding dispositional mindfulness, state anxiety, cognitive test anxiety, and academic performance in a sample of college students. Importantly, this study highlighted a potential mechanism underlying the effect of dispositional mindfulness and academic performance, suggesting that mindfulness reduces anxious thoughts during high-pressure situations, allowing the student to concentrate on the material at hand.

Mindfulness, Academic Performance, and Psychopathological Symptoms

Further support for the relationship between dispositional mindfulness and academic performance comes from Vorontsova-Wenger et al. (2020). In contrast to the aforementioned studies, Vorontsova-Wenger et al. (2020) utilized a five-factor measure of dispositional mindfulness (i.e., Non-judging, *Acting with Awareness* (*Acting*), *Non-reactivity*, *Describing* and *Observing*) and assessed additional measures of depression, anxiety, and stress in college students. Recent findings diverge on the relationship between mindfulness facets and stress, depression, and anxiety, and it is not clear which facets consistently predict decreased psychopathological symptoms. The authors

mention a paucity of empirical evidence regarding the relationship between college students' mindfulness, psychopathological symptoms, and academic performance. Swiss college students (*N*=150; 76.35% Female) completed self-report measures of depression, anxiety, perceived stress, academic performance, and the five facets of mindfulness.

Multiple linear regression analyses suggested that facet *Non-reactivity* negatively predicted depression symptoms and *Non-judging* negatively predicted anxiety. Inconsistent with previous research (Mayer et al., 2019), the facets of mindfulness were not related to stress. Further regression analyses identified that students' total mindfulness scores significantly negatively predicted all psychopathological outcome variables. Pearson's correlations identified a significant relationship between students' total mindfulness and recent exam scores. The findings are promising, however, more research is needed to understand the relationship between mindfulness facets and psychopathological symptoms as well as academic performance.

Mindfulness and Psychopathological Symptoms

In another study examining dispositional mindfulness in relation to psychopathological symptoms, Medvedev et al. (2018) compared results between two different populations to examine if each facet of mindfulness contributed similarly. Medvedev et al. (2018) investigated the relationship between different facets of mindfulness (i.e., Non-judging, Acting with Awareness, Non-reactivity, Describing and Observing) and depression, anxiety, stress, and distress in non-clinical populations. New Zealand college students and the general population (*N*=400; 50% college students, 50% general population; 75% female) completed the Five Facet Mindfulness Questionnaire (FFMQ; Baer et al., 2006) and the Depression, Anxiety, and Stress Scale-21 (DASS-21; Lovibond & Lovibond, 1995). Pearson's correlations identified mindfulness facets *Non-Judging* and *Acting* to be significantly negatively correlated with all subscales of the DASS-21 (i.e., depression, anxiety, stress, and distress), with *Non-judging* having the most impact across both populations. *Non-reactivity* correlated with all subscales except for anxiety in the student population. *Describing* was negatively associated with anxiety, depression, and stress in students but was only related to depression in the general population. Stepwise multiple regression found *Non-judging* to most strongly predict psychopathological symptoms in both populations Additional interaction analysis found differences

between students and the general population and different mindfulness facets for *Non-judging* and stress, depression, and distress as well as *Acting* and anxiety.

This study supports previous findings, which indicated that the facet *Non-judging* most significantly negatively predicted psychopathological symptoms measured by the DASS-21. Medvedev et al. (2018) suggested that to reduce depression, anxiety, and stress in non-clinical populations, one must develop a non-judgmental perspective. *Non-judging* and *Acting* most significantly predicted reductions in anxiety for college students but not for the general population. These findings suggest that developing facets of *Non-judging* and *Acting* may be particularly helpful in reducing anxiety and possibly test anxiety in college students; however, more direct research is needed to understand the relationship between these facets and test anxiety. This study implies that mindfulness interventions should be adapted depending on the relevant mindfulness skill that needs to be developed. This study provided preliminary evidence of the role of mindfulness facets in relation to anxiety, stress, and depression in the general population vs. college students. These findings support Peocchi and Ottaviani (2016) by suggesting that the positive influence of each mindfulness facet may differ depending on the outcome variables and the population, such that some facets may be more impactful than others.

Academic Motivation, Psychological Well-being, and Academic Performance

Baker (2004) addresses academic performance from a motivational lens; this study moves away from an explicit discussion of mindfulness and resilience and focuses on the relationships between academic motivation, psychological well-being, and perceived stress. The dual objectives of this study were: (1) to examine the role of each motivational domain (i.e., intrinsic, extrinsic, and amotivation) in predicting second-year college students' adjustment, stress, and well-being, and (2), to investigate each motivational domains' ability to predict students' second and third-year academic performance. Consistent with Self-Determination Theory (SDT; Deci & Ryan 1985; Deci et al., 1991) and research by Vallerand et al. (1989, 1992), Baker (2004) hypothesized that the relationship between extrinsic and intrinsic motivation and academic outcomes would be associated with the placement of an individual's intrinsically and extrinsically motivated behavior on the self-determination continuum (i.e., the degree to which an individual's behavior is autonomous). Second-year psychology undergraduates in the UK (N=91; 78% Female) completed a self-report

questionnaire on academic motivation, psychological well-being, college adjustment, stress, and academic performance. Entry qualifications were also collected from the university. Hierarchical regression results indicated that amotivation was a predictor of impaired college adjustment and higher psychological distress. Stepwise regression analysis revealed that intrinsic motivation was a predictor of reduced perceived stress. Amotivated behaviors had the most influence on the outcome measures in this sample of college students compared to the intrinsic and extrinsic motivational domains. Data from this study did not support research from Deci and Ryan (1985), Deci et al. (1991), or Vallerand et al. (1989, 1992) and suggested that only one form of self-determined intrinsic motivation, intrinsic motivation *to know*, was associated with an outcome variable, perceived stress. In contrast to these authors' theories, the motivational domains in this study did not predict academic performance; this finding is likely due to the restricted scope of analysis, which focused solely on investigating direct effects. Restricting the scope of analysis was a limitation in this study; however, the absence of direct effects alludes to possible mediating paths between motivational domains and academic performance.

The Current Study

College students' stress increased precipitously during the pandemic (American Psychological Association, 2020) and continues to present challenges for students returning to in-person instruction. Given that post-pandemic stress levels in college students remain dangerously high and mental health service utilization across all students, but especially for vulnerable student populations, remains low (Liu et al., 2019), research on alternative stress-reduction strategies is necessary. Increasing college student mindfulness to enhance resilience may be a sufficient and highly accessible technique to reduce distress in this population. Recent research supports this claim and suggests that mindfulness interventions can increase resilience by mitigating the deleterious effects of stress for college students (Galante et al., 2018). Several studies indicate that higher dispositional mindfulness is associated with increased resilience in college students (Zhang et al., 2023), yet some of these findings were inconsistent, which warrants further research. Much less is known about how dispositional mindfulness relates to psychosocial measures of resilience and constructs influential to academic success in U.S. college students. Furthermore, academic motivation has not been evaluated in relation to college students' dispositional mindfulness and resilience. These gaps prompted several questions, which will be addressed in the current study.

The purpose of this study is to understand mindfulness and resilience in relation to academic motivation, psychological well-being, perceived stress, and test anxiety in a unique sample of rural college students. Examining dispositional mindfulness will allow us to understand the natural conscious state of mindfulness in students with little to no prior mindfulness training. This study will enable us to visualize the relationship between these constructs and determine the potential mechanisms (e.g., mediation) that increase mindfulness and/or resilience in higher education. If mindfulness is related to resilience, and both constructs are positively and negatively associated with the hypothesized outcome variables, this would justify further investigation into interventions specifically designed to target resilience through mindfulness practice. Through a cross-sectional online survey, students will respond to questions regarding their subjective experience of mindfulness, resilience, and the hypothesized outcome variables.

Hypotheses

This study has two main hypotheses, divided into two sub-hypotheses. First, we examined correlations with academic outcomes; and hypothesized that dispositional mindfulness and resilience would be positively associated with academic motivation and negatively associated with test anxiety ($H1_A$). For psychological outcomes, we hypothesized that dispositional mindfulness and resilience would be positively associated with psychological well-being and negatively associated with perceived stress ($H1_B$). Next, we will investigate prediction models using multivariate multiple regression; we hypothesized that dispositional mindfulness and resilience will positively predict psychological well-being, academic motivation, and academic performance ($H2_A$) and that dispositional mindfulness and resilience will negatively predict perceived stress and test anxiety ($H2_B$).

Method

Participants

Forty-two college students at California Polytechnic State University Humboldt, a rural public university in Arcata, CA, completed an online survey on the Qualtrics platform. Students were required to be at least 18 years old and enrolled in summer courses or active at the university through a program or club in the summer to participate in the study. Table 1 contains a summary of the preliminary demographic variables.

Measures

Demographics

Demographic information collected included students': gender, age, race/ethnicity, class standing, student type (e.g., transfer), student status (e.g., full-time, part-time), major, household size, household composition (e.g., family, alone), parent's education level, socioeconomic status (e.g., Pell Grant qualification), first-generation college student status, and disability status (e.g*., have you ever received accommodations for a disability at Cal Poly Humboldt?*).

Previous Meditation Experience

Prior meditation experience was assessed by asking participants if they practiced mindfulness with a discrete yes or no question; if they selected yes, we asked them to specify the type of practice. Another question assesses the frequency of practice (e.g., *How often do you practice mindfulness?*).

Dispositional Mindfulness

Dispositional mindfulness was measured using the Five Facet Mindfulness Questionnaire (FFMQ; Bauer et al., 2006), a 39-item, 5-point Likert-type scale (1= *never or very rarely true*, 5= *very often or always true*) with five subscales that assess an individual's inherent capacity to be mindful. The scale explicitly examines five related facets of dispositional mindfulness: observing, describing, acting with awareness, nonjudging, and nonreactivity rate (e.g., *In difficult situations, I can pause without immediately reacting*). The scores from each subscale will be considered individually and as a combined total mindfulness score. A higher score is indicative of higher

dispositional mindfulness. The FFMQ has good construct validity in both meditating and non-meditating samples (Baer et al., 2008). The scale had high internal consistency (α = .90).

Resilience

The Resilience Scale for Adults (RSA; Friborg et al., 2005) evaluates intra and interpersonal protective factors associated with resilience to psychosocial adversity in adult populations. The instrument contains 33 items scored on a 7-point semantic differential scale designed to measure six resilience factors: perception of the self, planned future, social competence, family cohesion, social resources, and structured style (Friborg et al., 2005). Resilience is reported as a total resilience score, with higher scores representing more psychosocial resilience. The RSA has stable test-retest reliability and good construct validity across various clinical and non-clinical populations (Windle et al., 2011). The scale had high internal consistency (α = .89).

Academic Motivation

Academic motivation was assessed using the Academic Motivation Scale (AMS-C 28; Vallerand et al., 1995), an instrument developed to measure seven motivational constructs in the context of education (e.g., *I go to school because I think that a college education will help me better prepare for the career I have chosen*). The scale contains 28 items and seven subscales, scored using a seven-point Likert-type scale (1 = *does not correspond at all*, 7 = *corresponds exactly*). This study will combine subscales and report scores based on motivation type (e.g., extrinsic, intrinsic, and amotivation). Total and mean scores will be computed, with higher scores representing higher levels of each motivational domain. The AMS-C 28 shows strong discriminant, convergent, and construct validity in college students (Fairchild et al., 2005). The scale had high internal consistency (α = .90).

Cognitive Test Anxiety

The Cognitive Test Anxiety Scale - Short Form (CTAS; Cassaday & Finch, 2002, 2014) measures the cognitive components of test anxiety through the test preparation, performance, and reflection stages of the learning cycle (e.g., *When I take a test, my nervousness causes me to make careless errors*). The measure is comprised of 17 items and utilizes a four-point Likert-type response scale (1= *not at all typical of me*, 4= *very typical of me*). Responses are summed and reported as a total score; higher scores indicate higher levels of test anxiety. The 17-item CTAS is the shortened

version of the original 27-item scale. In the short version, all reverse-coded questions have been removed. This scale shows good criterion and construct validity (Cassady & Finch, 2014). The scale had high internal consistency (α = .95).

Psychological Well-Being

The Psychological-Well Being Scale (PWB; Ryff, 1989) was developed to examine psychological well-being using a multidimensional framework of six aspects of eudaimonic mental well-being: self-acceptance, environmental mastery, purpose in life, positive relations with others, autonomy, and personal growth (e.g., *I enjoy making plans for the future and working to make them a reality*). The scale consists of 42 times assessed using a six-point Likert scale (1= *strongly disagree, 6 = strongly agree*). Results are reported as an overall psychological well-being score by summing all the scores in the scale. The PWB scale shows good criterion validity (Ryff, 1989). The scale had high internal consistency (α = .92).

Perceived Stress

The Perceived Stress Scale (PSS - 10; Cohen et al., 1983) is a 10-item measure scored on a five-point Likert-type scale (0= *never*, 4= *very often*) designed to measure the degree to which an individual appraises recent situations in life as stressful or unpredictable (e.g., *In the last month, how often have you felt that you were unable to control the important things in your life?*). The 10-item scale was found to be psychometrically superior to the 14-item scale from which the measure was derived. Results from the PSS-10 are reported as a mean score from 0-40, with higher scores indicating more perceived stress. The scale had high internal consistency (α = .88).

Academic Performance

Student GPA was self-reported on a 4-point scale ranging from 0.00-4.00 (i.e., *What is your current cumulative college GPA?)*. Self-reported GPA is reliably accurate among college students (e.g., Crockett et al., 1987).

Procedure

Informed consent was obtained before students could access the survey. Participants were compensated for completing the self-report measures with course credit if enrolled in a participating course. The study protocol was approved by the Institutional Review Board for the Protection of Human Subjects at California Polytechnic State University on June 6th, 2023 (IRB #: IRB 22-134). College students were recruited for this online cross-sectional study through convenience sampling. Data was collected for four weeks. Instructors teaching summer courses and program or club leaders at Cal Poly Humboldt were contacted via email and asked to post the recruitment script and flyer on their course website or forward the recruitment message directly to students. The instructors were asked to consider offering course credit as compensation for students who completed the survey. Students taking a Psychology course could access the online survey through the Psychology Department's research participation pool, SONA systems. All other students were provided a direct link to the Qualtrics survey. In order to begin the questionnaire, students were required to provide informed consent by checking the box stating, "I have read and understood the consent information and agree to participate in this study" to proceed. Students were redirected out of the survey if they did not agree to participate. The survey was approximately 30 minutes long. Question order was taken into consideration and controlled for. After completing the survey, participants were thanked for their participation and provided a debriefing document with information about mental health services at Cal Poly Humboldt.

Data Analysis

The data was analyzed using SPSS Statistics. First, we ran Pearson's bivariate correlational analysis to assess hypotheses $H1_A$ and $H1_B$. In the first matrix, we ran total mindfulness (i.e., the sum of all the sub-scales), resilience, and all the hypothesized outcome variables. In the second matrix, we ran each mindfulness facet separately, along with resilience and the hypothesized outcome variables. Next, we ran separate linear regression models to assess hypotheses $H2_A$ and $H2_B$ with mindfulness and resilience as the predictor variables and psychological well-being, perceived stress, cognitive test anxiety, intrinsic motivation, extrinsic motivation, and amotivation as outcome variables.

Results

Hypothesis 1_A

There was partial support for Hypothesis 1_A; total dispositional mindfulness and resilience were not correlated with any of the sub-domains of motivation (i.e., intrinsic, extrinsic, and amotivation) or academic performance. Total dispositional mindfulness (r = -.56, p = <.001) and resilience (r = -.36, p = 0.019) were significantly negatively correlated with cognitive test anxiety. Further analysis included the five facets of mindfulness entered into the model as separate variables. The findings suggested that facet *Non-judging* was significantly negatively correlated with academic amotivation; see Table 2 for further detail and a complete correlation matrix. Furthermore, cognitive test anxiety was significantly negatively correlated with resilience and mindfulness facets *Non-judging* and *Acting* (See Table 2). Mindfulness Facet *Non-judging* but not resilience was significantly positively correlated with academic performance.

Hypothesis 1_B

The findings supported the hypothesis; total dispositional mindfulness (r = .79, p = <.001) and resilience (r = .68, p = <.001) were significantly positively correlated with psychological well-being. Similarly, total mindfulness (r = -.70, p = <.001). and resilience (r = -.66, p = <.001) were negatively correlated with perceived stress. Resilience and all mindfulness facets, except the facet *Observing*, strongly positively correlated with psychological well-being. Facets *Non-judging*, *Non-reacting*, *Acting,* and resilience were negatively associated with perceived stress (See Table 2).

Hypothesis 2_A

Separate linear regression models were used to assess the relationship between the predictor variables, total mindfulness and resilience, and the outcome variables, psychological well-being, academic motivation, and academic performance. There was partial support for the hypothesis; the regression model assessing psychological well-being was statistically significant, Adjusted R^2 = .63, F (2, 39), p = < .001. The only significant predictor variable in the model was total mindfulness (β = .612, p = <.001). Total mindfulness and resilience were not predictors of academic motivation or academic performance. Further analysis of the five facets of mindfulness indicated that the model assessing GPA with facet *Non-judging* and resilience as predictor variables was significant Adjusted

R^2 = .26, F (2, 37), p = .005. Both predictor variables were statistically significant; however, *Non-judging* (β = .575, p = .002) positively predicted GPA, whereas resilience negatively predicted GPA (β = -.414, p = .02). In another significant model, Adjusted R^2 = .14, F (2, 37), p = < .026, facet *Acting* positively predicted GPA (β = .484, p = .009), and resilience (β = -.360, p = .05), negatively predicted GPA. The model assessing academic amotivation with *Non-judging* and resilience as predictor variables was weakly significant, Adjusted R^2 = .14, F (2, 39), p = .048, and facet *Non-judging* was the only significant predictor variable (β = -.448, p = .016).

Hypothesis 2_B

There was partial support for the hypothesis, and both models assessing perceived stress and cognitive test anxiety were significant. The first model assessed cognitive test anxiety, with total mindfulness and resilience as predictor variables, Adjusted R^2 = .284, F (2, 39), p = < .001. Mindfulness was the only significant predictor variable (β = -.625, p = .002). For perceived stress, Adjusted R^2 = .516, F (2, 39), p = < .001, mindfulness (β = -.466, p = .005). and resilience (β = -.325, p = .044) were both significant negative predictors. Analysis of cognitive test anxiety with resilience and the five facets as predictor variables produced two significant models. First, we assessed the outcome variable, cognitive test anxiety, with facet *Non-judging* and resilience as predictor variables, R^2 = .268, F (2, 39), p = <.001, *Non-judging* was the only significant predictor variable, (β = -.502, p = .003). Next, we removed facet *Non-judging* and entered *Acting* into the model, R^2 = .399, F (2, 39), p = <.001, *Acting* was the only significant predictor variable, (β = -.641, p = <.001).

Discussion

Mindfulness-based interventions have been identified in previous studies as a possible method of reducing stress (Bergin & Pakenham, 2016) and improving academic outcomes for college students (Bellinger et al., 2015; Mrazek et al., 2013). The underutilization of on-campus mental health resources despite college student stress persisting at dangerously high levels underscores the need for alternative prevention and treatment options. Mindfulness-based programs designed to enhance resilience may be an effective alternative or complementary treatment, particularly for student populations in need of practical and affordable stress-reducing resources who are resistant to traditional mental health services due to stigmatization or culturally insensitive care (Liu et al., 2019).

Although these results are in the preliminary stages, this study makes a significant contribution by examining the extent of the effects of mindfulness and resilience on distal constructs significant for college students' success and well-being. The present study examined dispositional mindfulness and resilience in relation to measures of academic performance, academic motivation, cognitive test anxiety, psychological well-being, and perceived stress in a sample of 42 rural college students. We posited two main hypotheses and divided them into two sub-hypotheses based on the constructs being examined and the type of analysis that was conducted.

Total mindfulness and all its facets were strongly correlated with resilience, which suggests that mindfulness practices may enhance resilience in this population. There was partial support for $H1_A$ when we analyzed dispositional mindfulness through the five-facet framework. Mindfulness facet *Non-judging* was positively correlated with academic performance, as measured by cumulative college GPA, but was not positively correlated with intrinsic or extrinsic motivation as hypothesized. However, *Non-judging* was negatively correlated with academic amotivation. The mindfulness facets *Non-judging* and *Acting* were negatively correlated with cognitive test anxiety. This implies that some mindfulness facets may act as a protective factor against the negative effects of amotivation and cognitive test anxiety rather than strengthening the positive aspects of motivation.

There was full support for hypothesis $H1_B$, total mindfulness and resilience, and both were positively correlated with psychological well-being and negatively correlated with perceived stress, which is consistent with previous findings by Pidgeon and Keye (2014). Correlational analysis, including the five mindfulness facets, suggested that resilience and all mindfulness facets, except facet *Observing*, positively correlated with psychological well-being and negatively correlated with perceived stress. This is consistent with Bränström et al. (2011), who suggested that facet *Observing* was the least impactful of the facets in relation to measures of perceived stress. Although observing one's experience is considered to be an integral aspect of mindfulness (Baer et al., 2006), expanding one's capacity to observe thoughts, sensations, or experiences through mindfulness practice is insufficient in reducing stress or improving psychological well-being.

Furthermore, we ran separate multivariate multiple-regression models for mindfulness, resilience, and the hypothesized outcome variables. There was partial support for $H2_A$; total mindfulness, not resilience, significantly predicted psychological well-being. Neither total

mindfulness nor resilience predicted any sub-domain of academic motivation. Analysis of the five facets indicated that facet *Non-judging* significantly negatively predicted academic amotivation. In regard to academic performance, total mindfulness and resilience did not significantly predict GPA, but when analyzing the facets separately, *Non-Judging,* and *Acting* significantly positively predicted cumulative college GPA. These results suggest that mindfulness practice may reduce academic amotivation and improve academic performance when one focuses on developing a non-judgmental attitude and acts with awareness throughout their daily life.

There was also partial support for $H2_B$; dispositional mindfulness negatively predicted perceived stress and cognitive test anxiety. Total mindfulness and resilience strongly negatively predicted perceived stress. In addition, total mindfulness, but not resilience, negatively predicted cognitive test anxiety. Further analysis of the five facets suggested that both facets, *Non-judging* and *Acting,* negatively predicted cognitive test anxiety. This finding expands upon research by Medvedev et al. (2018), who suggested that only facet *Acting* was a negative predictor of anxiety and stress in college students. This study expands upon Medvedev's et al. (2018) study by suggesting that there is a predictive relationship between the facets *Acting*, *Non-judging* and test anxiety.

Overall, these preliminary findings highlight the relationship between mindfulness, resilience and several constructs that are integral to college student success and well-being. The results from this study provide support for the incorporation of mindfulness-based programs in university curricula. Furthermore, these findings suggest that targeted mindfulness-based interventions for college students should reflect facets *Non-Judging* and *Acting*.

Limitations and Future Directions

To our knowledge, this is the first study to examine mindfulness and resilience in relation to academic motivation in this unique sample of rural college students. As such, it is important to recognize several limitations which warrant careful interpretation of these results and necessitate further research. First, this study was cross-sectional and, by nature, cannot establish directionality or causation. Due to our small sample size and limited statistical power, we ran several separate linear regression models, inflating the likelihood of a Type Ⅰ error. Because students took the survey during the summer and are typically enrolled in two courses at most, students likely experienced reduced academic stressors. Future research should utilize longitudinal designs and repeatedly

observe the effects of mindfulness and resilience across periods of high and low stress over the academic year. In addition, academic outcomes were assessed using only two measures of academic ability, GPA and academic motivation. GPA is not a comprehensive measure of academic ability. Furthermore, academic motivation inconsistently predicts academic performance (Baker, 2004). Future studies focusing on mindfulness and resilience should employ more comprehensive and reliable assessments of academic achievement.

This study relied on self-report measures. The validity of self-report measures is often criticized, yet the assessment of an individual's subjective experience of events often directly relates to one's appraisal of a situation and subsequent response. Subjective assessments are necessary to assess how students perceive the impact of the constructs in this study on their education and psychological health. Self-report measures are useful in establishing initial covariance; future studies should build upon the findings in this study by using alternative research methodologies and/or measures, such as objective measures of mindfulness and resilience.

Another limitation of this study is convenience sampling, which limits the generalizability of these results. However, this study examines a population of rural college students at a small-teaching institution. Most mindfulness studies are produced in large research institutions, where the students may be significantly demographically different from those at smaller institutions. Conducting research at universities with different student demographics is essential to address the needs of diverse student populations. Future research could compare mindfulness and resilience at large and small universities and examine the differences between the student populations. Many students in the study were taking summer courses. Students who elect to take summer courses may systematically differ from those who only take courses during the academic year. For example, students who take summer courses may be more driven, motivated, and less susceptible to academic-related stressors. Thus, they may be able to adapt quickly to an accelerated summer curriculum without experiencing excessive stress.

Findings from this study can be used to design and inform future research on mindfulness interventions. The results supported Hypothesis $H1_B$ and partially supported the other hypotheses; mindfulness and resilience may act as a buffer against the harmful effects of test anxiety and perceived stress, increasing psychological well-being. However, this claim is beyond the scope of this

analysis, and the mechanisms behind the results in this study will need to be studied in further detail. Future research could examine the constructs in this study before and after the implementation of mindfulness interventions. If future studies corroborate these findings, it will justify the widespread implementation of mindfulness practices to enhance college students' academic abilities and psychological well-being.

Implications

Findings from this study can inform resource center options for college students. Considering the underutilization of on-campus resources by underrepresented students, this study supports the claim that mindfulness programs to enhance resilience may be a possible complementary or alternative treatment option to increase students' psychological well-being and protect students from the negative effects of stress and cognitive test anxiety. Mindfulness-based programs may be helpful for subsyndromal students, students who are exhibiting symptoms of psychopathology that do not meet the diagnostic threshold (Pibernik-Okanović et al., 2015). These programs could be incorporated into the university curriculum for students during intervals of excessive stress or transition, such as offering mandatory stress management courses for university credit for incoming freshman and transfer students.

Conclusion

Student stress in the post-pandemic age excessively burdens vulnerable student populations, underscoring the need for practical and accessible alternative mental health resources. Through this study, we found that mindfulness and resilience have a positive and predictive relationship with psychological well-being. Both constructs, particularly mindfulness, can potentially reduce student stress, test anxiety, and amotivated behaviors. One of the key findings in this study was that facet *Non-Judging* significantly affects both psychological and academic outcomes; this can inform the design of future mindfulness interventions and suggests that students have better outcomes when they approach academic and life situations with a non-judgmental attitude. These findings support offering or incorporating mindfulness-based programs into the university curriculum during stressful intervals when students are particularly susceptible to the adverse effects of stress.

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Table 1

Demographic Variables (N = 42)

Variables	*M*	*SD*	*Range*
Age	22.95	5.33	18-45
Ethnicity		Percent	
Asian American or Pacific Islander American		2.4	
Black, African American or African		4.8	
Latinx/a/o		16.7	
White		42.9	
Two or More Races		33.3	
Gender			
Male		21.4	
Female		66.7	
Non-binary		4.8	
Two or More		7.1	

Table 2

Intercorrelations and Descriptive Statistics between the Five Facets of Mindfulness, Resilience and Outcome Variables

Variables	*N*	*M*	*SD*	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Resilience	42	4.63	0.79	--												
2. M - Observing	42	3.76	0.56	.33*	--											
3. M - Acting	42	2.81	0.82	.52**	-0.01	--										
4. M - Describe	42	3.11	0.80	.43**	0.23	.42**	--									
5. M - Non-Judge	42	2.78	0.97	.56**	-0.07	.70**	.30*	--								
6. M- Non-React	42	2.96	0.68	.55**	0.23	.39*	0.24	.48**	--							
7. Psych WB[a]	42	4.22	0.68	.68**	0.26	.61**	.54**	.68**	.47**	--						
8. Intrinsic Mot.	42	5.14	1.42	0.14	0.29	-0.18	0.15	0.10	0.01	.33*	--					
9. Extrinsic Mot	42	5.35	1.07	0.21	0.02	-0.09	0.29	0.01	-0.08	0.24	.42**	--				
10. Amotivation	42	1.82	1.19	-0.07	0.04	-0.29	-0.16	-.35*	0.08	-.52**	-0.27	-0.12	--			
11. Test Anxiety	42	2.46	0.80	-.36*	-0.06	-.65**	-0.25	-.55**	-0.25	-.39*	0.05	.31*	.34*	--		
12. Perceived Stress	42	2.01	0.72	-.66**	-0.05	-.57**	-0.30	-.72**	-.58**	-.72**	-0.04	-0.05	0.24	.51**	--	
13. GPA	40	3.31	0.66	-0.10	-0.14	0.29	-0.07	.35*	0.02	0.19	0.12	-0.29	-.49**	-.31*	-0.22	--

[a] Psychological Well-Being
*$p < .05$. **$p < .01$.

Edith M. Solorio-Rodriguez

Barnacle Facilitation of an Invasive Bryozoan (*Watersipora spp.*)

ABSTRACT

Potential Barnacle Facilitation of Bryozoan
(*Watersipora sp.)* Larval Settlement and Invasion

Many non-indigenous species have been transported globally through anthropogenic vectors such as hull-fouling via commercial shipping vessels (Ruiz et al., 2000). Efforts have been made to prevent non-indigenous species from being able to travel on these ships, like the use of antifoulants (Piola et al., 2009). However, some species of the genus *Watersipora* have been documented to have a tolerance to copper which is commonly found in antifoulants (Dafforn et al., 2008). Thus, this marine-encrusting bryozoan has been able to invade estuaries and bays worldwide (Kelso & Wyse Jackson, 2012; Kuhlenkamp & Kind, 2013; Duncan et al., 2022). The Eureka Public Marina (EPM) within Humboldt Bay is one of the numerous locations that *Watersipora spp.* have invaded. It was previously observed that *Watersipora spp.* had higher success when settling in the presence of the barnacle *Balanus crenatus* (Roscoe, 2005)*,* a barnacle that is highly abundant at the EPM. Our research aims to see if this barnacle plays a facilitating role in the larval settlement of *Watersipora spp.* Research has been previously done on the role *Watersipora spp.* play in facilitating the transport of other non-indigenous marine species (Floerl et al., 2004; Stachowicz & Byrnes, 2006). However, little to no research has been done on what species facilitate *Watersipora spp.* success, especially research that allows for natural settlement of larvae outside of the lab.

INTRODUCTION

The invasion of non-indigenous species has had a profound impact on the community dynamics of estuaries and bays globally (Cohen and Carlton, 1998). The introduction of these non-indigenous species (NIS) has been facilitated by anthropogenic vectors such as commercial shipping vessels (Ruiz et al. 2000). Within these vectors, hull-fouling, the settling and accumulation of biota along the hull, propeller, and any other submerged portions of a ship (Ruiz et al., 2000; Hewitt et al., 2009), is a sub-vector that has significantly contributed to the transportation of NIS (Piola et al. 2009). Many efforts have been made to prevent the settlement of fouling organisms on shipping hulls. For instance, Copper (Cu)-based antifouling coatings are routinely used as a biocide

on the hull of ships (Piola et al. 2009). However, there is a great amount of scrutiny associated with antifouling coatings, as there are rising concerns regarding the release of metal pollutants into the water (Valkirs et al. 2003). Additionally, the use of Cu-based antifoulants inadvertently leads to the transportation of Cu-tolerant organisms and, post-introduction, may give these organisms an advantage in areas that are already polluted with heavy metals (Piola & Johnston, 2006).

Many species within the genus *Watersipora,* a marine encrusting bryozoan, have been reported to have a high tolerance to Cu-based antifoulants (Dafforn et al. 2008). In a previous study with the species *Watersipora subtorquata,* brief exposure to copper accelerated larval attachment to an adequate substrate, however, metamorphosis was consequently delayed or completely inhibited (Ng & Keough, 2003). It is plausible that *Watersipora spp.* are responding to copper as an environmental settlement cue and have a profound preference for settling on copper (McKenzie et al., 2012). Nevertheless, this tolerance/preference to Cu has allowed this genus to invade estuaries and bays globally via hull-fouling (Kelso & Wyse Jackson, 2012; Kuhlenkamp & Kind, 2013; Duncan et al., 2022). Humboldt Bay is one of the numerous locations in California infiltrated by *Watersipora spp.*, most likely as a result of the in- and outflux of boat traffic.

Cryptic species are defined as more than two species that are morphologically indistinguishable, however, differ genetically. They are often classified as the same species (Bickford et al., 2007) and their individual invasion to non-native lands often goes unnoticed due to their misidentification (Geller et al., 2010). Recent studies have shown that there is cryptic diversity within the "species" *Watersipora subtorquata,* comprising of three clades (A and B) and one "new species", which has now been coined the *W. subtorquata*-complex (Mackie et al., 2012). In addition to genetic analysis, species differentiation usually requires microscopy work for measurement of zooid size, operculum size, and lophophore tentacle count (Ryland et al., 2009). All three clades (A, B, and "new species) have documented appearances within Humboldt Bay (Lopiccolo 2022). As a result of the need for genetic analysis and microscopy for species differentiation, in the field species identification is not feasible and later identification will need to be done.

The settlement choices of marine invertebrate larvae are an ongoing area of intensive investigation (Botello & Krug, 2006). The timing and location of larval settlement is dependent on endogenous factors such as energy reserves and size (Ward, 1987; Marshall & Keough, 2003) as well as other exogenous factors such as light and substrate habitability (Yamada et al., 2009). The larvae of *Watersipora spp.* are lecithotrophic (they do not consume food during their larval period) and have a

finite energy reserve (Allen & Pernet, 2007). Consequently, the larval lifespan of *Watersipora spp.* is short lived with a planktonic life duration of approximately 24 hours (Ng & Keough, 2003). Finding adequate substrate to settle on in a timely manner becomes imperative when the duration you can spend in the water column is short.

Beneath the Eureka Public Marina of Humboldt Bay, the barnacle *Balanus crenatus* is highly abundant and a previous graduate student (Catherine M. Roscoe) observed that *Watersipora* had a higher success rate when settling in the presence of *Balanus crenatus* (Roscoe 2005). This raises the question of whether *Balanus crenatus* facilitates larval settlement (and therefore invasion) of *Watersipora spp.* The crevices, pits, and grooves on this barnacle's outer shell plates are likely to provide an ideal settlement substrate as well as potential protection against predation for *Watersipora spp.* larvae. Consequently, we hypothesize that *Balanus crenatus* indeed plays a facilitating role in *Watersipora spp.* larval settlement.

Understanding the preferential settlement choices of *Watersipora spp.* larvae is imperative as this invasive species impacts indigenous communities in Humboldt Bay both negatively, through competition of primary substrate (Fine & Loya, 2003; Duncan et al., 2022; Needles 2007), and positively through its ability to act as a foundation species (Floerl et al., 2004). If we can better understand the species that facilitate invasion, we may be able to predict the location and rate of future dispersion to non-colonized locations dependent on the presence of these facilitator species.

RESEARCH QUESTION

Research Question:

- Does the barnacle *Balanus crenatus* play a facilitating role in the larval settlement of *Watersipora spp.*

Hypothesis:

- We predict that *Balanus crenatus* facilitates *Watersipora spp.* larval settlement on its outer shell plates AND provides potential protection against predation for the larvae.

If our hypothesis is supported, then we should see more settlement on the panels with barnacle shells. Additionally, within the panels with barnacles, we should see more settlement on the barnacle shells than on the panel itself.

METHODS AND MATERIALS

Study Species:

Watersipora is the primary genus of concern for this experiment. Found in the Phylum Bryozoa, Class Gymnolaemata, Order Cheilostomatida, and family Watersiporidae, this genus comprises approximately 12 extant species. It is a marine colonial animal made up of individuals called zooids. It is orange/red in coloration and has a crust-like morphology.

Site Location:

The Eureka Public Marina (EPM) in Northern Humboldt Bay was chosen for our site location (**Fig. 1**). We selected the EPM based on its previous success with *Watersipora sp.* recruitment (Roscoe, 2005; Wilson, 2011) and collection (Lopiccolo, 2022). Furthermore, since the EPM is a public space, no permit was required for deploying the experiment, and pallets could easily be checked on a weekly basis. We deployed the pallets with the panels along the first dock on either side of the 5th piling at the EPM. This location at the EPM was chosen to prevent disturbance by boat traffic and to always ensure full submersion of the panels during low tide. The constant in- and outflux of boat traffic likely contributes to the high level of NIS invasion within the EPM, making it an ideal site for this experiment.

Experimental Design and Treatments:

In order to test our hypothesis, we deployed two pallets with attached settlement panels at the EPM. These pallets were constructed by previous grad students using 1" polyvinyl chloride (PVC). The pallets were designed in an L-shape so they could easily slide underneath the dock. Each settlement panel measured 10 cm X 15 cm X 0.65 cm and was made of acrylonitrile butadiene styrene (ABS). The use of ABS panels allowed natural settlement of larvae. A ¼" hole was drilled in the center of each panel so that a ¼" X 2" stainless steel bolt could fasten the panels to the pallets. Each pallet consisted of a mixture of panels categorized as either (1) control (with no barnacles) or (2) barnacle shells. We included 14 control panels and 12 barnacle shell panels for a total of 26 panels. In order to attach the pallets to the dock, two zinc coated pipe hangers were used per pallet. They were screwed in using 2" stainless steel screws. The initial deployment of the panels took place on June 21, 2023.

After initial deployment of the pallets, check ins began occurring at 1-week intervals. These check ins were used to monitor and take photographs of settlement and succession. Originally, photographs were taken using phones, however, after poor picture quality a Nikon D5600 was used. This swap occurred on week 4. Additionally, on week 4 a small 6 of the panels were transported to Humboldt State University Telonicher Marine Laboratory (TML) in Trinidad, CA for species identification and to determine if *Watersipora spp.* settlement had begun. These panels were returned the following morning. [In Progress]

Analysis of Data:

[In Progress]

RESULTS

[In Progress]

DISCUSSION

[In Progress]

LIMITATIONS

The overall progression of this research has gone rather smoothly. However, there have been a few setbacks. When first starting the experiment, we had the intention of deploying the pallets with three treatments instead of two. In addition to the (1) control panels and (2) barnacle shell panels, we also wanted to deploy (3) live barnacle panels. This was so that we could see if there was a reason separate from the shells offering adequate substrate and protection that the larvae would have been settling near or on the barnacles. What caused the loss of this treatment was the collection of live barnacles. First, when collecting these barnacles, I needed the presence of Grant Eberle who is an equipment technician and aquarist at the Telonicher Marine Lab in Trinidad, CA. He also has the invertebrate collection permit. While he was not opposed to coming out into the field with me to collect, the time needed for collection far exceeded the time I felt comfortable asking him to be out there. It would have most likely taken more than a few days and other pressing matters need his attention.

Additionally, collection of viable living barnacles proved to be more difficult than expected. The issue was keeping the barnacles back plate intact during and after they were removed from whatever substrate they were on. Removing the barnacles almost always resulted in shattering of the shell or at least the exposure of the animal due to the back plate not remaining intact. Some of these barnacles did remain viable, however, the ratio of barnacles killed to viable barnacles was not one I felt comfortable with. Thus, with the amount of time needed to collect these barnacles and the number of barnacles that would be killed in the process of collection, we decided not to proceed with the third treatment. A choice that was made reluctantly, but one that I do not regret as it did not mean we could not proceed with the experiment.

On top of the loss of a treatment, there was a lack of presence from *Watersipora spp.* this summer. Compared to the last, as I have been told, there is a stark contrast between the amount of *Watersipora spp.* found at the EPM. It was previously extremely abundant, covering the bottom of the docks and boats. However, this summer, I have been lucky to catch even a glimpse of it. The first spotting of *Watersipora spp.* was on the fourth week of deployment (07/19/23) and colonies on average were only about 2-4 zooids in size. There are possible explanations for this lack of presence, however, all are speculative at this point. Firstly, it could be that the storms we had this previous winter flushed a large amount of the *Watersipora spp.* that settled last summer out. Additionally, it could be due to the unusually foggy summer. *Watersipora spp.* disperse their larvae under direct light, and with the lack of natural light we have had, it is possible that they have not yet had the opportunity to disperse. It could also be a combination of these factors, or another that we are not yet aware of.

FUTURE RECOMMENDATIONS

If this experiment were to be replicated my first recommendation would be to do both in/ex situ experiments and in lab experiments. This way there is more than one set of data you can rely on. I would also recommend that the live barnacle treatment be reintroduced into the experiment. In hindsight, instead of trying to collect the barnacles off of the substrate they were attached to, I would have allowed for the natural settlement of the barnacles on the panels first. This would require much more foreplaning but would keep the barnacles alive and intact.

If our hypothesis proves to be true, then further research into why *Balanus crenatus* facilitates *Watersipora spp.* larvae can be done. We predict the crevices, pits, and grooves on the outer shell

plates likely provide an ideal settlement substrate as well as potential protection against predation. However, other potential variables could also be true. Perhaps it is the active feeding (when barnacles swirl their cirri actively to create a current to bring in suspended food particles) that brings the larvae into proximity to the barnacle. An example of an experiment that could be done in the future to determine whether it is the crevices, that act as protection, or the active feeding of the barnacle that facilitates larvae settlement is as follows:

- A similar method to our current would be used with pallets and panels deployed beneath the Eureka Docks. However, the variables could be (1) live barnacles with intact shells, (2) live barnacles with sanded-down shells, (3) intact barnacle shells, (4) sanded-down barnacle shells, and (5) a control with no barnacles.

LITERATURE CITED

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TABLES, PICTURES, AND GRAPHS

Figure 1. Site location at the Eureka Public Marina (EPM) in Northern Humboldt Bay, CA. Pallet 1 and 2 coordinates: 40°48’09°N 124°10’44” W.

Figure 2. This image shows the placement of pallets 1 and 2 at the Eureka Public Marina (EPM). The pallets were placed on either side of the 5th piling. They were fastened to the docks using pipe holders and 2” stainless steel screws.

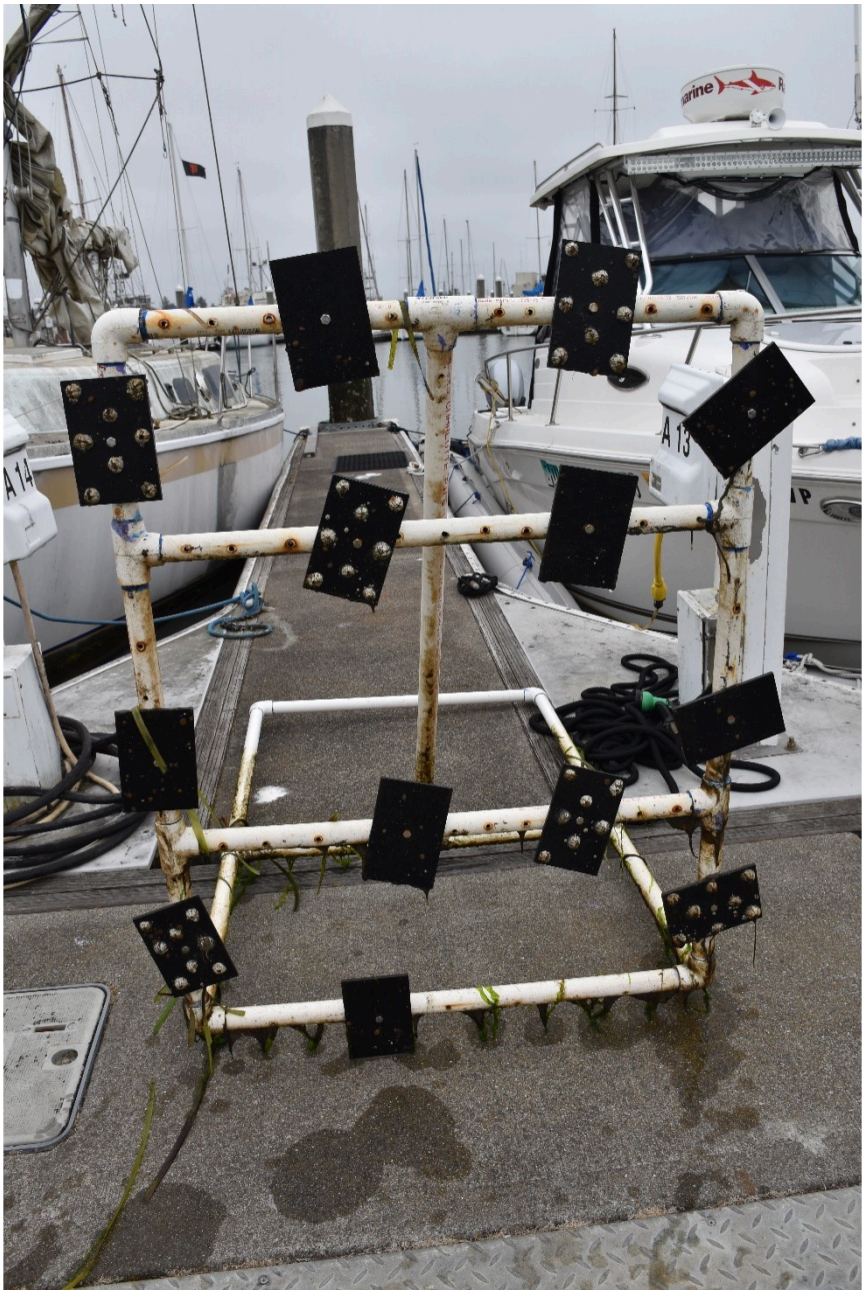

Figure 3. Image of pallet 2. The pallet was constructed in an L-shape so that it could easily be placed beneath the dock. A mixture of control panels and barnacle panels were bolted to the pallets using 2” stainless steel bolts, washers, and nuts.

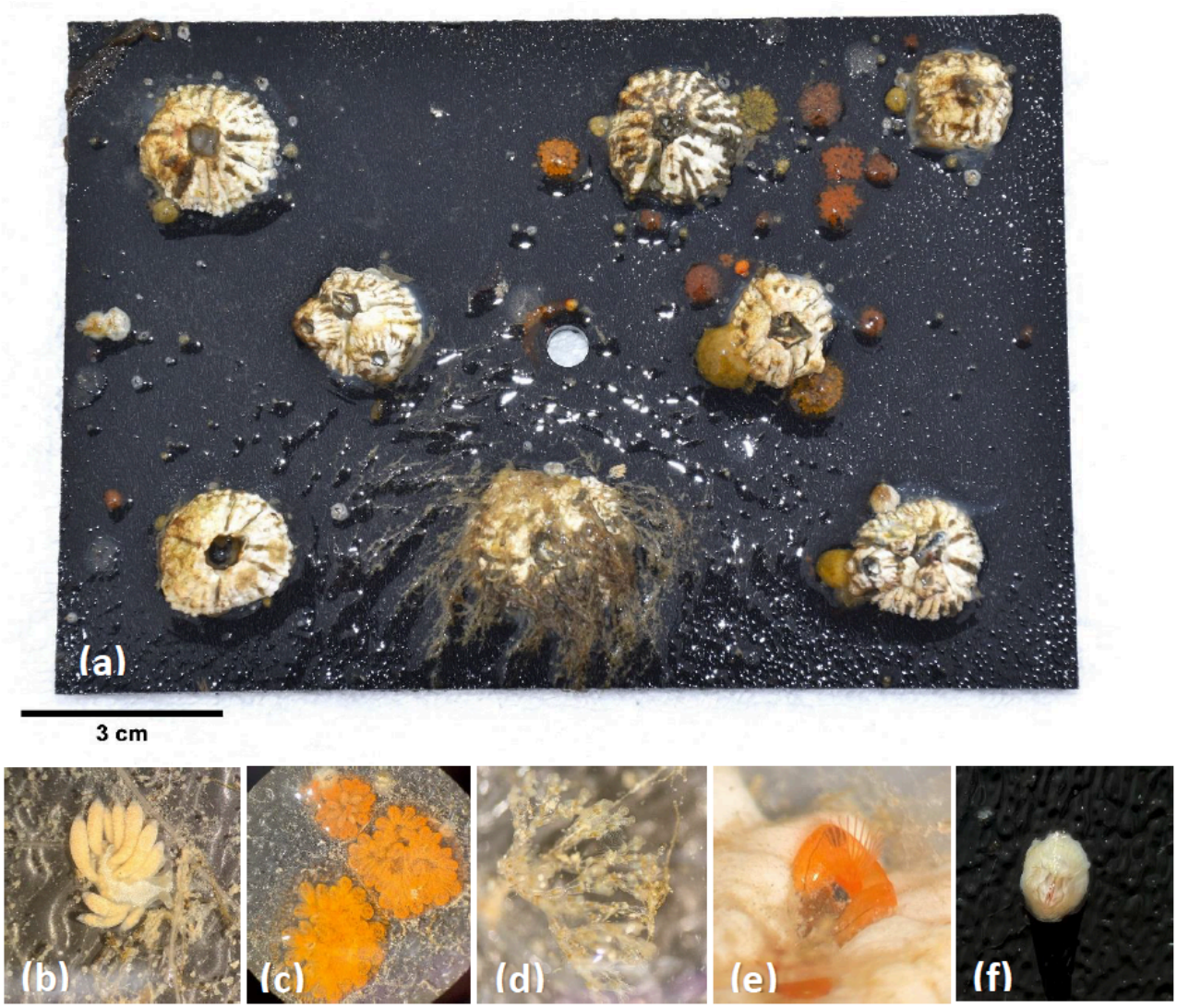

Figure 4. Image (a) shows panel 1 with barnacle shells at week 4 (07/19/23) with the following invertebrates (zoomed in through a dissecting scope): (b) Nudibranch *Trinchesia albocrusta, (c)* Tunicate *Botrylloides sp.,* (d) Bryozoan *Bugula sp.,* (e) Bryozoan *Watersipora sp.* on a barnacle shell, and (f) Unknown barnacle species.