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The St. Mary's University
McNair Scholars Program

RESEARCH JOURNAL

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After yet another year of complexities, concerns, and adaptations to many changes, our Scholars have once more completed a strong summer research program! We believe Dr. Ronald McNair would be extremely proud of how students benefiting from the McNair Scholars Program at St. Mary's University have responded to unprecendented challenges.

In spite of local and global challenges, these students keep their eyes set on a future which only a short time ago was unimaginable. Now, they are taking steps into a world they will lead, form, strengthen, and inspire. Please enjoy the latest work of the McNair Scholars, and keep an eye out for them in the future! It will be here before we know it.

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Assistant Director

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Director

TO GRADUATE SCHOOL AND BEYOND

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Splitting Hairs: The (non) Effects of Demographics on Student Selection of Graduate Schools

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As society has evolved over the decades, so has higher education, specifically in the realm of post-baccalaureate education. Enrollment patterns have mirrored that evolutionary process. In this paper, I investigate different factors that have been theorized to have an impact on where students choose to attend graduate school. The previous literature has posited that certain demographic factors, such as race/ethnicity, age, gender, and enrollment status, influence the graduate school decision process. Other studies have investigated factors such as financial aid, location, housing availability, program reputation, etc. to determine their effects on one's choice of graduate schools. The purpose of this study was to explore the relationships between those sets of factors. In other words, how does the emphasis placed on any given factor vary across an array of demographic characteristics. Results indicate that there is no clear pattern linking demographic characteristics to factors involved in the decision-making process. Recommendations for graduate school program directors are provided.
Keywords: graduate school, post-baccalaureate education, demographics, graduate education

More than 1.8 million students were in enrolled in graduate certificate, master's, or doctoral programs in Fall 2016 (Okahana & Zhou, 2017). To better understand this population, the Council of Graduate Schools and the Graduate Record Examination Board conducted a survey entitled the *CGS/GRE Survey of Graduate Enrollment and Degrees* that explored trends in graduate school education (Okahana & Zhou, 2017). Information regarding master's

and doctoral program applications, enrollment, and degrees in the United States is outlined within the report.

Overall, graduate education continues to diversify demographically, with more underrepresented minority students contributing to the first-time graduate enrollment (Okahana & Zhou, 2017). Diversity within graduate education is not only seen through race/ethnicity aspects, but also in gender. Women represent a significant number of graduate students enrolled in all graduate degree levels, with 58.9 percent in master's programs and 52.8 percent in doctoral programs (Okahana & Zhou, 2017).

These patterns have remained stable over time. During the 1970s, the United States began seeing "shifting patterns of enrollment, student financial aid, and resource allocation" due to effects of larger social, economic, and political forces (Kallio, 1995). As a result of these new conditions, the competition for students intensified (Kallio, 1995). This has created a difficulty for institutions, specifically graduate programs, "to manage both the quantity and quality of their graduate student populations" (Kallio, 1995). Therefore, there is a need for deeper understanding regarding why students choose to attend graduate school, and how they go about the decision process (Kallio, 1995). In this study, I examine the various factors that prospective students view as the most important in choosing a graduate school.

Complexity of the Issue

The existing literature suggest that the process of selecting a college is "lengthy and complex" (Bersola et al., 2014). Many applicants who choose to pursue graduate education find the graduate school decision process to be both stressful and time-consuming (Poock & Love, 2001). According to Thresher (1966), "the decisions that determine the sorting among colleges are guided by a certain substratum of factual knowledge about higher education, supplemented by a vast, amorphous, and confused body of beliefs, rumors, folklore, and gossip. This situation is true both of students in choosing colleges and of colleges in choosing students." In other words, the graduate school decision process is tailored uniquely to the individual, and such a process is heavily influenced by various factors (Bersola et al., 2014). The student process of selecting a graduate school is similarly nuanced.

While much research has explored how students select undergraduate colleges and universities, much less is known about how they select graduate schools. What is known is that individuals who

choose to pursue graduate degrees vary significantly in backgrounds. Demographic characteristics are important in understanding where students choose to attend graduate school hence why "graduate students with different demographic characteristics need to think about which ones [factors] matter most to them and tailor their investigation accordingly" (Lei & Chaung, 2010). Some demographic factors that were specifically identified within the research include: age and/or enrollment status, gender, and race/ethnicity (Lei & Chuang, 2010; Kallio, 1995). Olson (1992) found that the most important factors to graduate school applicants included location, cost, academic reputation, personal contact with faculty, and recommendations from family and friends.

Demographic Factors

Age/Enrollment Status

Regardless of academic discipline, there are significant differences amongst older and younger students (Lei & Chuang, 2010). For example, Kallio (1995) reported that older students are more likely to be employed and to attend graduate school part-time. Therefore, they are primarily influenced by factors that allow for them to study around their schedules, such as location, availability of classes, flexible program requirements, and ability to continue working full-time (Kallio, 1995). For the younger students, who compose over half of full-time students in graduate school, the main factors are financial aid, availability of graduate assistantships and fellowships, amount of graduate stipend, as well as department reputation and quality (Kallio, 1995).

The effects of life stage development also influence an individual's behavior in the graduate school decision process (Kallio, 1995). Examples include the importance of spouse and work-related considerations reflective of early adulthood tasks that have been identified in the life stage and adult development literature (Kallio, 1995). The influence of family, particularly parents, is especially profound in the early stage of life when students are undergoing the graduate school decision process (Kallio, 1995).

Gender

The factors that influence the decision of an individual to attend graduate school vary across genders (Lei & Chaung, 2010). Ethington and Smart (1986) conducted a study that identified academic and social

integration as factors that are significant to both men and women, but academic factors were more of an influence for men and social factors were substantially more important to women. Malaney (1987) stated that men in various academic disciplines were only slightly more concerned about departmental reputation and knowledge of faculty whereas women were much more attentive to graduate institution location (Malaney, 1987). Poock and Love (2001) found that women place greater emphasis on the importance of academic accreditation and rigor when choosing a doctoral program.

Race/Ethnicity

Previous research has shown that the different factors involved in the graduate school decision process also vary among ethnic groups (e.g., African American, Native American/American Indian, Chicano/Mexican American, Latino, Filipino; Lei & Chuang, 2010; Bersola et al., 2014). Some factors are directly related to academics (e.g., academic accreditation, opportunity for graduate assistantship, diversity of course offerings), while others are non-academic (e.g., institutional sensitivity to minorities, campus environment, input from alumni, family, and friends; Lei & Chuang, 2010; Poock & Love, 2001). Ethnic minority students, excluding African Americans, are more influenced by location, opportunity for financial assistance, input from alumni, cost of living and/or housing affordability (Poock & Love, 2001) than Caucasian students are. African American students are more influenced by the academic reputation and opportunity for internships, as well as sensitivity to the needs and interests of minorities and women (Poock & Love, 2001). Two other studies (Webb, 1993; Webb & Allen, 1994) found that Caucasians, Hispanics, and American Indians/Alaskan Natives, and female students are more likely to choose a graduate school based on location.

Theoretical Frameworks

There are three theories that have driven research in the area: Hossler and Gallagher's (1987) three-step college choice model, person-environment (P-E) fit theory, and Ajzen's (1985) theory of planned behavior.

Hossler & Gallagher's 3-step College Choice Model

Initially, Hossler and Gallagher's (1987) three-step college choice model was developed to better understand the major transition

from high school to college (Bersola et al., 2014). However, the model can also be applied toward understanding the various factors related to the graduate school decision process (Bersola et al., 2014). It is composed of three different stages. The first stage is predisposition, where students "develop educational aspirations and decide where to seek a degree" (Bersola et al., 2014). The second stage is search, and this occurs when students seek out information regarding potential graduate institutions (Bersola et al., 2014). The final stage is choice and begins when a student has made the final decision on which institution to attend (Bersola et al., 2014).

Person-Environment (P-E) Fit Theory

Bersola et al (2014) introduced the P-E fit theory to explain "how potential doctoral students decide which institution to attend and how institutions select students for admission." The foundation of the theory is that it predicts that students will seek out and "select academic environments that match their distinctive patterns of abilities, interests, and personality profiles" (Feldman et al, 2001). Furthermore, the P-E fit theory asserts that students will select a graduate institution that will meet their academic, financial, social, and structural needs (Bersola et al., 2014). Any fit theory appropriates the assumption of individuals having "an innate need to fit their environments and to seek out environments that match their own characteristics" (van Vianen, 2018).

Overall, fit theories are based on three basic principles. The first principle states that "fit is a more powerful predictor of individual outcomes (e.g., job satisfaction) than either of its components (the person and the environment) alone" (van Vianen, 2018). In other words, where an individual feels he or she most belongs, the higher the likelihood of achieving success in the present and in the future. The second principle proposes that outcomes are "most optimal when personal attributes (e.g., needs, abilities, values) and environmental attributes (e.g., supplies, demands, values) are compatible regardless of the level of these attributes (van Vianen, 2018). This means that individuals are expected to succeed in their areas of "fit" (van Vianen, 2018). The final principle suggests that differences between one's personal and environmental attributes, or misfits, "reduce positive outcomes irrespective of the direction of the discrepancies" (van Vianen, 2018).

Person-environment (P-E) fit theory is best understood as individuals striving to fit in a particular environment that matches their

preferences of consistency, allows for fulfillment of their desire to exert control over their life and to decrease any uncertainty, to experience the need to belong, and to have happiness and life satisfaction (van Vianen, 2018).

Theory of Planned Behavior

The theory of planned of behavior can be summarized as "one's intention to perform a behavior is a function of three determinants: the individual's attitude toward the behavior, subjective norms about the behavior, and perceived behavioral control over the behavior" (Ingram et al., 2000). The theory is comprised of four steps, and involves attitudes, subjective norms, intentions, and target behavior. During the first step, an individual will form an intention to engage in a certain behavior. In this situation, that would mean deciding to apply to graduate school to continue one's education (Ingram et al., 2000). The second step involves the attitudes driving the intentions and reflecting the extent to which the individual will have a positive or negative evaluation of the behavior (Ingram et al., 2000). In other words, the individual believing that "going to graduate school is more important to my future success than getting a job" (Ingram et al., 2000). The third step is primarily the subjective norms acting as a link to "the perception of social pressure to perform a behavior" (Ingram et al., 2000). Subjective norms, which are defined as the "beliefs that other individuals or groups think he or she should perform the behavior" (Fishbein & Ajzen, 1975; Ajzen, 1985; Ingram et al., 2000). This can be understood as the thoughts and feelings of the individual's family and/or friends as to whether he or she should go forward with applying and later attending graduate school. The final step is the idea of perceived behavior control, which is defined as a "non-motivational factor and represents the degree to which a person believes that the required opportunities and/or resources are accessible for performing the behavior" (Ajzen, 1988). According to Madden, Ellen, and Ajzen (1992), perceived behavior control can be viewed as the more resources and opportunities an individual believes they possess, the greater level their perceived behavior control over the target behavior (Ingram et al., 2000). A statement portraying this concept is: "I have confidence that my level of persistence will eventually cause me to get into graduate school" (Ingram et al., 2000).

The study conducted by Ingram et al (2000) utilized the theory of planned behavior to predict college students' intentions and behaviors pertaining to graduate school admissions based on their attitudes, subjective norms, and perceived behavior control. The findings revealed that students who had a positive outlook towards graduate school were more inclined to attend graduate school (Ingram et al., 2000). Overall, the model was predictive of student behavior, thus showing that there are strong influencing factors involved in the graduate school decision process (Ingram et al., 2000).

Methodology

Sampling Procedure

The sample consisted of 857 participants, specifically graduates from St. Mary's University. Men (*n*=225), women (*n*=626), and non-binary (*n*=6) participants, ranging in age from 20 to 67 and in enrollment status (e.g., full-time vs. part-time student), participated in this study. Participants were sent the survey link via email and were encouraged to recruit others who may have also qualified for the study, thus beginning a snowball selection method. Participation in the study was completely voluntary, but a request to provide informed consent prior to completing the survey was included. Participants had the option to refuse to participate, or later decide to cease participation in the study without penalty. A drawing for a $25 Visa gift card was held to incentivize participation.

Design

The study was correlational, with groups (e.g., genders) that were pre-existing and not formed via random assignment. The independent variables were gender, race/ethnicity, enrollment status, and age. The dependent variables were financial aid, school accreditation, student: teacher ratio, location, faculty, housing availability, program reputation, and feedback from alumni and/or current students.

Instruments

A survey was created by a professor from the St. Mary's psychology department for the purpose of investigating how individuals selected the graduate/professional school they currently attend. The instrument, entitled *Graduate Student Survey*, is composed of different sections. The first section asks participants for demographic

information, such as one's race/ethnicity, gender, and age. The second section asks for one's area of professional study, enrollment status, and Carnegie classification of their chosen program. The third section asks for further identification of one's area of graduate/professional study. Participants are given the following options and asked to select the one that best describes their major field of study: business, communication, computer and information sciences, education, engineering, humanities, life sciences, mathematics, physical sciences, psychology, social sciences, or other fields. The fourth section specifically asks participants about their decision on which graduate institution they chose to attend in terms of how the different factors played a role in the graduate school decision process. Responses were measured on a Likert scale ranging from *strongly agree* to *strongly disagree*. The final section of the survey asked participants to rank the top five most important factors influencing their decision from least influential to most influential.

Results

The primary analyses involved regressing each of the eight dependent variables one by one on a model containing all four of the independent variables. Results of these analyses indicated that race/ethnicity was only related to one dependent variable: student: teacher ratio (t= 2.264, p= 0.0239). Age was a statistically significant predictor of the importance placed on financial aid (t= -2.857, p= 0.0044) and housing availability (t= -3.503, p=0.0005). Gender had no significant impact on any of the eight observed factors. Enrollment status exerted an impact on financial aid (t= -4.151, p= 0.00004), student: teacher ratio (t= -2.607, p=0.00932), location (t= 3.026, p=0.0026), faculty (t= -4.489, p= 0.000008), and housing availability (t= -4.777, p= 0.000022).

Table 1: The Effects of Demographic Characteristics on Influential Factors

	Age	Gender	Enrollment Status	Race/Ethnicity
Financial Aid	-0.11* *p*= 0.0044	< .01 *p*= 0.9993	-0.16* *p*= 0.00004	-0.03 *p*= 0.3952
School Accreditation	0.03 *p*= 0.385	0.04 *p*= 0.232	0.04 *p*= 0.363	0.05 *p*= 0.219
Student: Teacher Ratio	0.03 *p*= 0.4355	-0.03 *p*= 0.4225	-0.10* *p*= 0.0093	0.08* *p*= 0.0239
Location	-0.02 *p*= 0.6727	0.06 *p*= 0.0975	0.12* *p*= 0.0026	0.05 *p*= 0.1441
Faculty	-0.02 *p*= 0.582	-0.04 *p*= 0.264	-0.18* *p*= 0.000008	0.04 *p*= 0.262
Housing Availability	-0.13* *p*= 0.0005	-0.04 *p*= 0.3010	-0.18* *p*= 0.0000022	-0.01 *p*= 0.8426
Program Reputation	0.05 *p*= 0.2346	0.06 *p*= 0.1219	0.01 *p*= 0.7261	0.06 *p*= 0.1197
Feedback from Alum/Current Students	-0.07 *p*= 0.0635	-0.07 *p*= 0.0700	-0.02 *p*= 0.6440	-0.02 *p*= 0.5923

*Note: The first row of numbers represents standardized regression coefficient*s.

Discussion

Although there has been much research examining how students select their undergraduate institution, relatively little attention has been paid to how students select graduate programs. The purpose of this research study was to fill that gap in the existing literature. By drawing on responses from graduates of one HSI in Texas, this study found that despite being able to identify one statistically significant predictor for five of the dependent variables, the models overall account for so little variance as to warrant the results practically meaningless.

Furthermore, the findings offer limited support to one of the three theories mentioned. The Person-Environment (P-E) Fit Theory states that students are more likely to select an institution that meets their needs and desires in the following ways: academically, financially, socially, and structurally. Regardless of an individual's demographic characteristics, the research study revealed that students had specific requirements that must be met to attend graduate school. Financial aid and housing availability were the two influencing factors that showed strong significance, meaning whichever graduate institution one chose to attend, it was imperative that their financial and structural needs be met before anything else. Therefore, the evidence supports the foundational idea behind the person-environment (P-E) fit theory to an extent.

Limitations and Future Directions

There were several limitations that should be taken into consideration when reviewing the results of this study. First, there was a high proportion of missing data that could have affected the statistical conclusions. Depending on the nature of the missingness (e.g., missing completely at random as opposed to missing not at random), estimates could have been affected.

A second limitation was the exclusion of socioeconomic status (SES) as a demographic characteristic. Previous research has shown that SES is one of the more influential factors involved in the graduate school decision process (Baird, 1976).

In terms of future research, it would be beneficial to conduct similar studies, but specifically with underrepresented minorities. The numbers of African Americans, Hispanic/Latinxs, Native Americans, and others in graduate education have grown drastically over the years. As society continues to evolve, so does higher education. It is important that graduate programs continue to learn how to adapt to such changes in enrollment patterns and with respect to the needs of current and future graduate students.

Recommendations that should be directed towards the many graduate program directors would be to, first, create survey instruments that solely focus on gathering student feedback regarding their graduate institution and/or program. Knowing and ensuring students' satisfaction is a key aspect towards adaptation of present and future conditions.

The transition from undergraduate to graduate education is and can be very challenging for any student, whether a student is part-time or full-time. Therefore, the second suggestion would be for graduate programs to have the appropriate mental health resources available for all their students. While this was not elaborated on within this research study, well-being of college students is an important area that needs to be further investigated. Because the transition of environments described previously can be difficult for most, for graduate programs to ensure that such necessary tools are accessible would even create more desirability for future students to attend.

The third suggestion would be for graduate programs to be held responsible for creating environments that allow for their graduate students to thrive. It was understood through the person-environment (P-E) fit theory that students will select academic environments that satisfies their needs, meaning graduate programs must strive to make themselves more desirable if they have not already.

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Superfund sites, ICE, and Non-ICE Detention Centers: Proximity Analysis in Texas

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Superfund sites are hazardous areas that require a long-term response to clean up unsafe material contaminations. Today, there are thousands of contaminated sites in the United States of the direct result of hazardous waste being dumped or improperly managed. During the last decade, immigrant detainees have made headlines after protesting the harsh and inhumane conditions at detention centers. Such is the case of the Northwest Detention Center in Tacoma, Washington, which first made headlines in 2014 and more recently in 2017 when immigrant detainees protested against conditions inside the for-profit immigration jail. This sparked the interest of environmental justice activists and researchers who worries about the effects on detainees, including those of women and children. For example, in the Northwest Washington area, detainees have protested against cruel treatment and abuse from guards, maggoty food, lack of medical care, as well as adverse health effects caused by the pollution in the area[1] More recently, researchers have studied the issue of immigration and non-immigration detention centers being built at or near large superfund sites in the Northwest Washington area, also called the industrial "Tideflats" area. These areas tend to be heavily polluted and have been identified as unfit for residents, but still, immigrant detainees are housed here.

Studies have analyzed this issue in several western states with the goal of identifying if a pattern of toxic industrial sites are in close spatial proximity of juvenile detention centers. This study analyzes the relationship between US Immigration and Customs Enforcement (ICE) and Non-ICE detention facilities hosting women

[1] Bernd, "US Is Locking Immigrants"

and families and Superfund sites in the state of Texas through an Environmental Racism Theory lens. A map was created using the Aeronautical Reconnaissance Coverage Geographic Information System (ArcGIS) to determine the proximity between ICE and Non-Immigration centers and Superfund sites. The important contribution to recent literature on environmental justice is that at least eight out of 26 official ICE and non-ICE detention facilities in Texas are placed near at least one active, deleted or proposed Superfund site in Texas. We include a section on the potential adverse health effects to vulnerable populations of our findings.

Introduction

Environmental pollution, unfortunately, is not a novel issue. Human caused pollution and its impact on the environment has been widespread throughout history and more so in recent times with urban development and industrial activity. The ever-increasing rise of pollution has brought about a number of issues related to climate change, such as harm to living resources and ecosystems, hazard to human health, increase of global temperatures, rise of environmental hazards, etc. Recent research has shown the many ways that pollution affects global populations, with greater effects on low income and marginalized communities.[2] Unequal distribution of resources, inadequate access to healthy foods, increased risk to extreme weather events, and exposures hazardous chemical exposures, are just a few examples of how the poor and people of color around the world are being affected from pollution. In the United States, this issue is reflected among what can be considered as one of the lowest groups of the societal hierarchy: immigration detainees seeking for asylum.

Literature Review

Environmental Injustice as a Theoretical Framework

In this paper, I put forth the notion that the environmental issues faced by women in immigration detention centers can be described through and Environmental Racism theory lens. The problems that marginalized people tend to encounter in relation with the

[2] Abeygunawardena et al. “Poverty and Climate Change", 5-6.

environment fall under the field of environmental justice research, which focuses on the problems associated with the disproportionated societal distribution of environmental risks and hazards and the impacts on low-income groups, racial minorities, and other vulnerable groups.[3] The problem with environmental justice is that it is not well defined nor conceptualized. According to Bryant, environmental justice refers to the "cultural norms and values, rules, regulations, behaviors, policies, and decisions to support sustainable communities where people can interact with confidence that the environment is safe, nurturing, and productive".[4] There are many ways in which environmental justice is attained, including but not limited to, decent paying jobs, adequate health care, descent housing, communities free of drugs and violence, etc. Overall, this field focuses on ameliorating potentially life-threatening conditions, as well as improve the overall quality of life for the poor and people of color.[5]

Environmental injustice, a term that is not frequently used in research, focuses on wider dimensions of the intersection between environmental quality and social hierarchies. It addresses more structural questions that focus on social inequality and environmental burdens that affect a particular social group.[6] Under this term falls environmental racism, a term that is often interchanged with environmental justice but is in reality an extension of racism. According to Bryant, the term refers to the disproportionate impact of environmental hazards on communities of color.[7] Together, these ideas allow for a more holistic approach to environmental research that not only identifies and attempts to solve a problem but seeks to understand the players and contributors of these issues as well.

Climate Change as a Factor of Immigration

The yearly increase of pollution affects communities around the world in several ways, reducing their ability to live in a safe environment. In 2020, the United States alone emitted about 68 million

[3] Grineski et al. "Criteria Air Pollution", 536.
[4] Bryant, "Environmental justice", 6.
[5] Pellow, "Environmental Inequality Formation", 582
[6] Pellow, "Environmental Inequality Formation", 582
[7] Bryant, "Environmental justice", 6.

tons of air pollutants alone into the atmosphere.[8] One of the social problems associated with the rise of pollution and its detrimental effects on the environment is the increase of migration from less developed nations. A rising number of immigrants coming from central american countries (including Honduras, Guatemala and El Salvador) identify various reasons of migration, including the plummeting of their country's economies, increase of poverty and violence rates, the rise of environmental catastrophes, as well as the rise of COVID-19 cases.[9] These immigrants come to the United States escaping the deadly effects of pollution only to to be put in heavily contaminated detention centers.

As the theory of environmental racism focuses on the unequal distribution of pollution and environmental risks, during the last decade, researchers have identified trends that extend to Superfund sites and immigration and non-detention centers. In 1980, Congress passed the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) to address the dangers of abandoned or uncontrolled hazardous waste dumps in the United States. The nationwide program does so through the gathering and analysis of information, requesting liability from responsible parties, and site cleanup. As of June 2019, there were 1344 superfund sites on the National Priorities List (those that are eligible to receive funding through the superfund) in the United States.[10] While the Superfund program is intended to help the environment through site cleanup, there are some problematic areas. For example, the Superfund was supposed to be a short program to cleanse the nation of dangerous, hazardous waste sites, but cleanup has been slow due to high costs and litigation problems. Living near these sites can be very detrimental to humans, with the risk of losing nearly 15 months of their life spans.[11]

Research also shows that there is a significant association between living near Superfund sites and cancer rates. Recent studies in Houston, Texas examined a cancer cluster around a former railroad creosote treatment facility, showing the number of lymphoblastic

[8] U.S. EPA, "Air Quality".
[9] Sheridan, "What's causing the migrant surge at the U.S. border?"
[10] U.S. EPA, "Superfund History".
[11] Kiaghadi and Dawson, "The Presence of Superfund Sites as a Determinant of Life Expectancy in the U.S.", 3

leukemia cases in children was greater compared to cancer rates in the state.[12] Additionally, superfund sites cause property values to fall, which can have several outcomes: on one hand, it forces residents to move away and on the other hand, forces minorities and low-income populations to live near Superfund sites since it is an affordable option. Recent studies have found that the area within 3 miles of Superfund includes only 16% of the U.S. population, but it disproportionately includes 19% of Black Americans and 23% of Hispanic/Latino population. Out of the 38% of minorities living in the United States, 49.3% of people living within 1 mile and 49.7% of people living within 3 miles of Superfund sites are minorities.[13] Overall, the majority of people living near Superfund sites are minorities and low-income populations typically belonging to underserved communities which lack the resources to efficiently express their health concerns regarding nearby pollutants.

During the last decade, immigration detainees have made headlines for being placed at detention centers and because of the harsh and inhumane conditions they experience. These complains have sparked the interest of environmental justice activists and researchers who have shed light on the environmental injustices behind detention centers, with many of these near Superfund sites. In support of this claim, research has shown that the prison systems in the United States are a space where incarcerated persons and their allies struggle for environmental justice.[14] In 2016, the Prison Ecology Project studied the relations and proximity of adult detention facilities to Superfund sites and found that at least 589 federal and state prisons are located within three miles of a Superfund site on the national priorities list (NPL), also known as the priority list of hazardous waste sites eligible for remedial action. Out of the 598 prisons, 134 are located within one mile of an active superfund site.[15] In 2020, researchers from California conducted a study on the relationship between juvenile detention centers and Superfund sites in nine western states in the United States. The results

[12] Preidt, “Live Near a Superfund Site?”
[13] Pellow, Ashby, and Vazin, “Superfund Sites and Juvenile Detention”, 65
[14] Perdue, “Linking Environmental and Criminal Injustice”, 182.
[15] Bernd, Mitra, and Farren, “America’s Toxic Prisons.”

showed that out of 167 juvenile detention centers, 49 are within five miles and four are within one mile of at least one Superfund site.[16] While these studies seek to identify a trend between detention centers and Superfund sites, there is a lack of studies that focus on immigration detention facilities in relation to hazardous waste sites.

In the state of Texas, for-profit and ICE detention centers have been greenlit without consideration to environmental impacts of detainees. The Department of U.S. of Immigration and Customs Enforcement (ICE) is required by a 1994 executive order to consider their human and environmental impacts of their actions on low-income communities and communities of color that have been disproportionately impacted by environmental pollution. With this plan, they are to create a strategy that implements environmental justice in the development of the detention center. However, there are times that ICE does not follow the executive order in the way that it requires. For example, in 2016, a new immigration jail was built in Conroe, Texas, and even though ICE wrote a project-level environmental assessment, the outcome was in reality an economic impact assessment. which only analyzed the benefits of the local economy of the area but not about potential environmental impacts.[17] Because of concerns of this nature, this paper seeks to understand the relationship between immigration detention facilities hosting women and families to the locations of Superfund sites in the state of Texas.

Research Methods

The state of Texas is the geographical focus for this study. ICE and Non-ICE detention facilities hosting females and families from 2018 to 2020 were tracked, totaling to 26 facilities. Temporary immigration facilities were not considered in this study because reliable data such as exact location and number of detainees was not available at the time of writing but are discussed in Discussion section. The choice of this state is based on its closeness to the border between Mexico and the United States. Addresses for the detention centers were retrieved from the U.S. Immigration and Customs Enforcement website provided

[16] Pellow, Ashby, and Vazin, “Superfund Sites and Juvenile Detention”, 67
[17] Candice Bernd, “US is Locking Immigrants”.

from the ICE Integration Decision Support (IIDS). Through the Aeronautical Reconnaissance Coverage Geographic Information System (ArcGIS) software, 69 Superfund sites were located, including those currently in the National Priorities List proposed sites, as well as the sites deleted from the list after 2018. The status of the sites as well as the contaminants were gathered from the United States Environmental Protection Agency website.

The proximity of detention facilities to the Superfund sites were measured through the creation of distance buffers of 5, 15, and 30 miles. While there is not an agreed distance used to study proximity to hazardous sites, a reasonable approach was to use these distances to include some of the common distances used in Superfund proximity analysis studies (0.5, 1, 2, and 5 miles)[18] as well as include distances of potential adverse effects (<5 miles). Because of the proximity of some detention facilities, exposure to some Superfund sites might be repeated since detention facilities are considered as independent from each other. After creating the buffers, it was determined which immigration detention centers were within 5, 15, and 30 miles of at least one Superfund site. This allowed to then determine the potential risks that the women and children are exposed to from these hazardous waste sites.

Results

As seen in Figure 1, the study revealed that nine out of 26 official ICE and Non-ICE detention facilities (represented with black dots) in Texas are within 30 miles of at least one active (red dots), deleted (green dots) or proposed (blue dots) Superfund site. In total, there are 35 instances of Superfund sites proximity to the 9 detention centers. Results yield 19 Superfund sites within 15 and 30 miles of the nine detention facilities, 10 superfund sites are within 5 and 15 miles, and 6 superfund sites are within zero and 5 miles. Only one of the detention centers is in close proximity of just one superfund site, while the rest of the detention facilities are in close proximity to two, three and even fifteen superfund sites. Tabulated results including present contanimants in Superfund sites are reported in Appendix Tables A1-A4

[18] Beth, “Fetal Deaths and Proximity to Hazardous Waste Sites in Washington State”, 776.

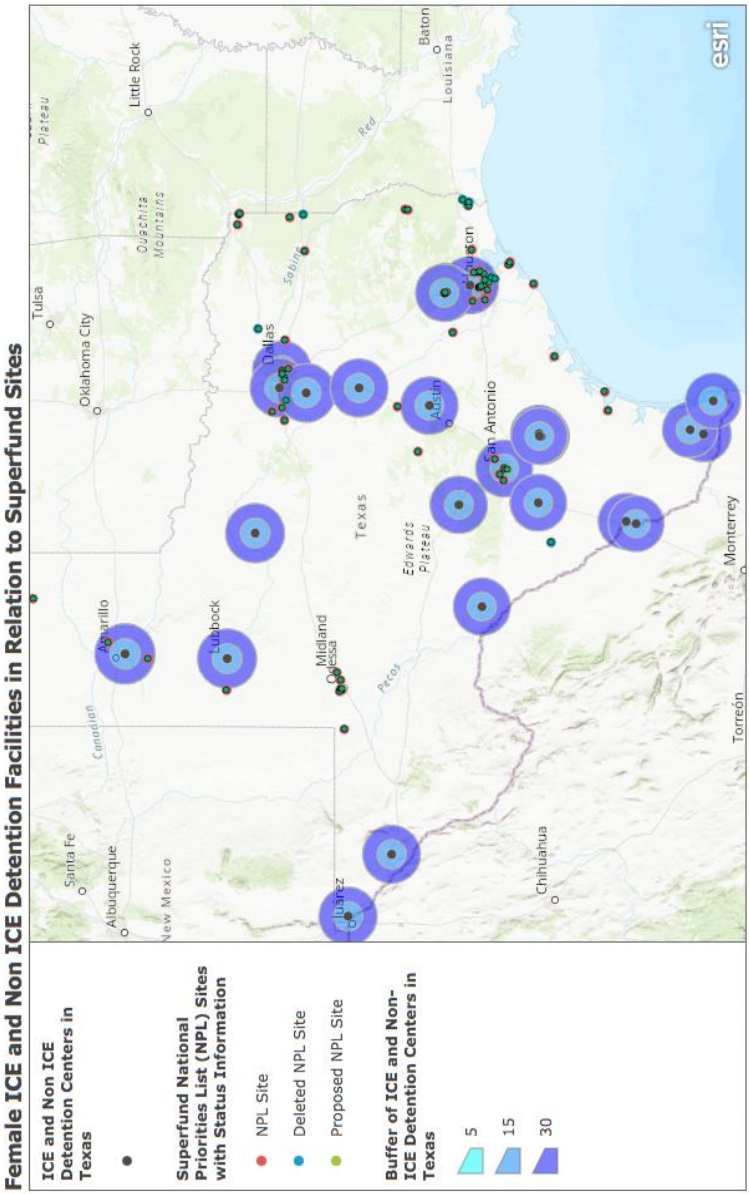

Figure 1. Map of ICE and Non-ICE Detention facilities in Texas in relation to Superfund sites. The detention facilities in this map are only those who host females and families. The buffer zones around each detention facility are of 5, 15 and 30 miles.

Esri, USGS | Texas Parks & Wildlife, Esri, HERE, Garmin, FAO, NOAA, USGS, EPA, NPS

Discussion

The results of this study reveal how many Texan ICE and Non-ICE detention facilities are within distances of Superfund sites. From the total ICE and Non-ICE detention facilities, 34% are near at least one active or non-active superfund site. As seen in Appendix Table A4, about half of the total Superfund sites near a detention center fall are within zero-to-15-mile category while the other half fall under the 15-to-30-mile buffer zone. This is problematic because long-term exposure of the various contaminants found at the detention facilities can bring about adverse and even fatal effects to human health. There's a wide range of contaminants of concern at the superfunds near Texas ICE and Non-ICE detention facilities.

In the data collected, metals (including semi-metal and heavy metal) are identified 32 times. Metals, such as lead, cadmium, and arsenic, are problematic because they can result in chronic toxicity manifestations such as hypertension, kidney impairment, and cognitive disturbance.[19] Volatile Organic Compounds (VOCs) appear 25 times in the data. These gases emitted from certain solids or liquids can cause a number of effects on health, including eye, nose, and throat irritation, difficulty breathing, nausea, and can damage central nervous system as well as other organs. Additionally, VOCs can cause different types of cancer.[20]

In the data, there are 20 mentions of dioxins and chemical compounds including chlorinated compounds. Dioxins are produced as a by-product of chemical production and combustion. While not all dioxins are toxic, 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD), the most toxic of the dioxins, appears in at least 10 superfund sites. Research shows that dioxins can cause a wide range of health problems, including, but not limited to, metabolic disorders (porphyria), chloracne as well as the possibility of cancer.[21]

Based on the evidence shown throughout this study, I find that environmental racism happening at immigration detention facilities in

[19] Howard, "Exposure to Metals", 983
[20] U.S. EPA, "Volatile Organic Compounds"
[21] J. Donald Millar, "Current Intelligence Bulletin 40 – Dioxins"

relation to Superfund sites. Because the majority of detainees being housed here are people seeking asylum, their ability to voice their concerns about potential threats to their health is limited, giving these detention facilities the opportunity to ignore these threats.

The detention facilities studied here are guilty of being environmentally racist toward detainees at the facilities because of unsuccessful and incomplete analysis they perform on the detention facility and the potential threats to the detainees' health. Because these documents or plans are not successfully performed, no remedial action or effort to protect these communities is implemented, putting hundreds of lives at risk. As part of the Environmental Justice, ideally, ICE detention facilities should work on efforts to protect the rights of those who fall victim to environmental injustices, such as climate change immigrants. Yet, the detention facilities are intentionally neglecting this by housing vulnerable women and children at hazardous facilities without interest in providing them with a safe space. The pollutants at nearby Superfund sites and their potential effects to women and children are too great to be ignored and it's time for detention centers to address this.

Conclusion

The impact of pollution has reached people of every socioeconomic level, but research shows that marginalized communities are more affected by it. A group identified to be greatly and continuously affected by this are asylum seekers who migrate to the United States in hopes of finding better living conditions. Yet, upon entry, the majority are placed in immigration detention camps that are built near or at Superfund sites with pollutants capable of causing a number of health problems, including cancer and potential death. ICE and Non-ICE detention facilities do not plan nor adequately protect their detainees, pursuing in what is known as environmental racism.

In order to get a bigger picture of the problem shown here, there are several things that can be studied. Future research can include the temporary facilities built in Texas specifically designed to house unaccompanied immigrant minors. Reliable data such as exact location and number of detainees was not available at the time of writing, but there's proof that there are many of these facilities being built near or at

Superfund sites. These temporary facilities around the southern U.S. border continue making headlines for their proximity to hazardous sites and with children being housed there. By including this in the research, a better analysis and understanding of environmental injustices happening at detention centers. Additionally, future research should include a more robust examination of the threats that these pollutants pose and how recent detainees have been affected by these. The pollutants at nearby Superfund sites and their potential effects to women and children are too great to be ignored and it's time for detention centers to address this.

Appendix

Appendix Table A1. Zero to Five Mile Data

Figure 1 Location	*Detention Center*	*Detention Type*	*Superfund site*	*Contaminants (location)*
1	Central Texas Detention Facility (San Antonio, TX)	ICE Detention Facility	R&H Oil Company (NPL site)	Metals, heavy metals, and VOCs. (air, soil)
2	Dallas County Jail – Lew Sterrett Justice Center (Dallas, TX)	ICE Detention Facility	RSR Corporation (NPL site)	Semi-metals, metals and heavy metals, VOCs. (Soil, surface water, groundwater)
5	Joe Corley Processing Center (Conroe, TX)	ICE Detention Facility	Conroe Creosoting Company (NPL site)	Semi-VOCs and organic solvents (groundwater)

			United Creosoting Co. (NPL site)	Dioxins, PCP, PAHS, Chlorinated Dioxins (Soil, groundwater)
7	Montgomery ICE Processing Center (Conroe, TX)	Non-ICE Facility	Conroe Creosoting Company United Creosoting Co.	Semi-VOCs and organic solvents (groundwater) Dioxins, PCP, PAHS, Chlorinated Dioxins (Soil, groundwater)

Appendix Table A2. Five to 15 Mile Data

Figure 1 location	***Detention Center***	***Detention Type***	***Superfund site***	***Contaminants (location)***
1	Central Texas Detention Facility (San Antonio, TX)	ICE Detention	Bandera Road Ground Water Plume (Proposed site) River City Metal Finishing (NPL site)	VOCs, PCP, hydrocarbons, (Groundwater, air, soil) Heavy metals, cyanide, hexavalent chromium. (groundwater, soil) Chlorinated solvents (soil and groundwater)

			Eldorado Chemical Co., Inc. (NPL site)	
2	Dallas County Jail – Lew Sterrett Justice Center (Dallas, TX)	ICE Detention Facility	Lane Planting Works, Inc. (NPL site) Bio-Ecology Systems, Inc. Delfasco Forge (NPL site)	Heavy metals, VOCs, and chemical compounds (soils and groundwater) Heavy metals, cyanide, hexavalent chromium. (groundwater, soil) VOCs, TCE, chemical compounds (soil, groundwater, and indoor air)
3	Eules City Jail (Eules, TX)	ICE Detention Facility	Bio-Ecology Systems, Inc. Delfasco Forge (NPL site)	Heavy metals, cyanide, hexavalent chromium. (groundwater, soil) VOCs, TCE, chemical compounds

			RSR Corp (NPL site)	(soil, groundwater, and indoor air)
			Pesses Chemical Co. (Deleted site)	Semi-metals, metals and heavy metals, VOCs. (Soil, surface water, groundwater)
			North Cavalcade Street (NPL site)	VOCs, heavy metals, metals, chemical compounds (groundwater, soil)
			South Cavalcade Street (NPL site)	VOCs, heavy metals, chemical compounds (groundwater, soil)
	Houston Contract Detention Facility (Houston, TX)	Non-ICE Detention Facility	Many Diversified Interests, Inc. (NPL site)	Dioxins, heavy metals, hydrocarbons (groundwater, soil)
			Sikes Disposal Pits (NPL site)	VOCs, dioxins, heavy metals, hydrocarbons (soil, groundwater, sludge, surface water)

	French, Ltd. (NPL site)	VOCs, dioxins, heavy metals (groundwater, sludge, soil)

Appendix Table A3. 15 to 30 Mile Data				
Figure 1 location	***Detention Center***	***Detention Type***	***Superfund site***	***Contaminants*** *(location)*
3	Eules City Jail (Eules, TX)	ICE Detention Facility	Air Force Plant #4 (General Dynamics) (NPL site)	Heavy metals, VOCs, arsenic, chromium, (Sediments, surface water, and ground water)
			Sandy Beach Road Ground Water Plume (NPL site)	VOCs (groundwater)
			Lane Planting Works, Inc. (NPL site)	Heavy metals, VOCs, and chemical compounds (soils and groundwater)
4	Houston Contract Detention Facility (Houston, TX)	Non-ICE Detention Facility	United Creosoting Co. (NPL site)	Dioxins, PCP, PAHS, Chlorinated Dioxins (Soil, groundwater)
			Conroe Creosoting Company (NPL site)	Semi-VOCs and organic solvents (groundwater)
			Jones Road Ground Water Plume (NPL site)	VOCs, chemical compounds and organic solvents (groundwater)
			Crystal Chemical Co. (NPL site)	

	Sol Lynn/Industrial Transformers (NPL site)	Arsenic (groundwater, soil)
	Geneva Industries/ Fuhrmann Energy (NPL site)	VOCs, chemical and organic compounds, PCBs (air, groundwater, soil, structures)
	US Oil Recovery (NPL site)	VOCs, chemical and organic compounds, PeCDFs, PCBs, TCDFs, etc. (soil, groundwater)
	Patrick Bayou (NPL site)	"Arsenic and other substances" "results are inconclusive" (groundwater, soil)
	Highlands Acid Pit (NPL site)	Chemical compounds, heavy metals, PAHs, PCBs, HCBs. (sediments)
	San Jacinto River Waste Pits (NPL site)	Arsenic, heavy metals, VOCs (groundwater, solid waste)

				Dioxin and dioxin containing material (not specified)
6	Lubbock County Detention Center (Lubbock, TX)	ICE Detention Facility	State Road 114 Ground Water Plume (NPL site)	DCAs, benzene, vanadium (groundwater)
8	Prairieland Detention Facility (Alvarado, TX)	Non-ICE Detention Facility	Air Force Plant #4 (General Dynamics) (NPL site)	Heavy metals, VOCs, arsenic, chromium, (Sediments, surface water, and ground water)
			Delfasco Forge (NPL site)	VOCs, TCE, chemical compounds (soil, groundwater, and indoor air)
			Bio-Ecology Systems, Inc. (Deleted site)	Heavy metals, cyanide, hexavalent chromium. (groundwater, soil)
			Pesses Chemical Co. (Deleted site)	Semi-metals, metals and heavy metals, VOCs.

				(Soil, surface water, groundwater)
9	Randall County Jail (Amarillo, TX)	ICE Detention Facility	Pantex Plant – USDOE (NPL site) North East 2nd Street (Formerly Attebury Grain Storage Facility) (NPL site)	Uranium,VOCs, chromium, chemical compounds, etc. (Groundwater, soil) CTCs, EDBs, DCAs, and TCEs (groundwater)

Appendix Table A4. Percentage of Sites Within Select Distances (miles) of the Nearest Superfund Site

Distances of Detention Centers	Percentage of Superfund Sites Near Detention Facilities
Within 5 miles	18%
Within 15 miles	28%
Within 30 miles	54%

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San Antonio Pecan Shellers' Strike: How the Media Portrayed the Mexican American's Struggle for Change

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On January 31, 1938, about 12,000 pecan shellers walked out from the pecan shelling facilities in San Antonio, Texas (Croxdale, n.d.). The three-month strike garnered much attention and was recognized as the biggest strike of its kind during the Great Depression era. While previous research describes the predicament of pecan shellers and the role activists played in the strikes, few studies explore how the media portrayed the pecan shellers in their plight. In this study, I examine how the newspapers portrayed the plight of workers on strike. This study also considers historical and social factors that augmented the struggle of the pecan shellers who were mostly Mexican American women (Randolph, 2003). Using a content analysis, I analyzed data from English and Spanish newspapers drawn from 1938 and 1939. I use a Marxist social movement theory to categorize my findings. I find newspapers were sympathetic to the pecan shellers. Results identify two recurring themes: social justice and fear of communism. Pecan shellers as a collective unit were desirous of change due to income and racial inequalities in their community. The decision to strike was in response to exploitation experienced at the hands of the Southern Pecan Shelling Company and oppression of their Mexican American community. Although the pecan shellers had a short-lived monetary victory, the strike demonstrated the power of organizing, community solidarity, and labor rights among Mexican Americans.

Introduction

The Pecan Shellers' strike of 1938 is a significant part of the history of San Antonio, Texas. Previous research describes the pecan

shellers strike and their working conditions. The purpose of this study is to analyze and identify reoccurring themes in the portrayal of the pecan shellers. More specifically, this study analyzed how the predicament of the pecan shellers was portrayed in the newspaper in years 1938 and 1939. 1938 is a significant year because that is when the three-month strike occurred. 1939 is significant because after an agreement was reached in 1938, the pecan industry re-mechanized, leaving pecan shellers unemployed. Aside from analyzing the portrayal of the plight of pecan shellers, this study also considers historical factors in the story of the pecan shellers. The lives of Mexican American men and women during the Great Depression era are taken into consideration. The Class and Race relations in San Antonio are also considered in this study as the pecan shellers belonged to a marginalized community. A Marxist Social Movement theory lens is used to view the pecan shellers. The theoretical framework allows for a certain perspective of the pecan shellers on strike as a logical response to exploitation.

Literature Review

Historical Background

Social Movement Theory

This study utilized a Marxist social movement theory as a lens to view the pecan shellers and their portrayal in the media. Researchers study why social movements occur, who participates, and their efficacy. In the encyclopedia article titled, *Four Stages of Social Movements* by Johnathan Christiansen it is suggested that social movements vary in different ways. Social movements have occurred throughout history in many different times and places. Some have been successful in galvanizing change in big and small ways. Sometimes they have even failed at creating change. The author states that social movements can vary in their ideology, and scope. Christiansen says that a social movement can have a revolutionary or reformist ideology and they can also have a local or international scope. While social movements may differ, Christiansen claims they have similarities in their life cycles and why they occur. It is important to this study to understand that social movements, even local ones like that of the Pecan Shellers' Strike (1938) do not occur randomly or for solely one reason. Because this

study uses a Marxist social movement theory as a lens, it is important to understand what constitutes a social movement and how it is defined. Christiansen defines a social movement as, "organized yet informal social entities that are engaged in extra-institutional conflict that is oriented towards a goal. These goals can be either aimed at a specific and narrow policy or be more broadly aimed at cultural change" (para. 3). This definition provided by Christiansen verifies the pecan shellers strike as a collective action of the people that sought to bring about change. In the book, *Social Movements: The Key Concepts* by Graeme Chesters and Ian Welsh the term social movement is also defined. The authors recognize a difference between "new social movements" and "old social movements." However, social movement is broadly defined by Chesters and Welsh as, "historically and spatially located expressions of social and cultural responses to prevailing political and economic dynamics" (p. 2). Chesters and Welsh also identify the many different concepts that exist within social movement theory. More importantly to this study, the authors define and describe the Marxist social movement theory. The Marxist concept views the relationship between the owners of means of production and the workers as inherently unfair. They claim that the importance of this concept is the way that it proposes self-organization of workers a logical response to exploitative systems. Chesters and Welsh suggest that the Marxist social movement theory places an emphasis on the exploitation of the working-class and how they create change for themselves. The pecan shellers were a working-class community subject to oppression and exploitation at work. Their collective decision to strike and create change makes the Marxist social movement theory adequate for this study.

Mexican American lives during 1930's

Understanding the lives of Mexican Americans during the 1930's is vital to this study. The pecan shellers of San Antonio and those who went on strike consisted of mainly Mexican American women. According to author of *Labor Rights Are Civil Rights: Mexican American Workers in Twentieth Century America* Zaragosa Vargas, there was a significant population of Mexican Americans in the United States. She claims that roughly 1,422,533 Mexican Americans lived in the U.S. in the year 1930 with three-fourths of that population being in

the southwestern states (Texas, Colorado, New Mexico, Arizona, and California). Mexican American families during the 1930's unfortunately depended on exploitative employers (Vargas, 2008). We see this was at least true for pecan sheller families who earned "starvable wages". Vargas even states that "Mexicans in the Southwest had been systematically incorporated into an emergent working class, and many found themselves increasingly serving in the agricultural sector and subjected to an extreme form of economic exploitation" (Vargas, 2008, pg.16). Vargas focuses on exposing the horrible working conditions of Mexican Americans during The Great Depression. This is relevant because the Texas economy during the 1930's was agriculture reliant and the pecan industry in San Antonio played an important part. Vargas' research is relevant to this study because the majority of pecan shellers were Mexican American workers that were exploited and perpetuated the pattern of Mexican American workers experiencing exploitation during the Great Depression era. Her studies also add an understanding that the Pecan Shellers' Strike was only one of many Mexican American labor movements across the nation. Another important aspect of Mexican American lives during the 1930's was immigration. The document titled, *Immigration and Relocation in U.S. History* from the Library of Congress fills in the gaps that exist in general studies (regarding Mexican Americans) of the 1930s. This document reveals a struggle for survival within the Mexican American community. It emphasized that Mexicans and Mexican Americans felt the same negative impact of the Great Depression such as job crisis and food insecurity during the 1930's. However, they also had to deal with the risk of deportation which their white counterparts were not likely to face. Both pieces show what was typical of Mexican American lives during The Great Depression era. Vargas (2008) suggests that it was typical for Mexican Americans to enter exploitative work. The (LOC) document suggests that a more exclusive struggle to the Mexican American community during the great depression era was deportation. Both sources mentioned lack a female perspective to their studies, resulting in treating the experiences as a monolith. Doing so could be potentially harmful, especially to this study of pecan shellers who were mostly Mexican American women.

So, the next discussion will focus on Mexican American women during the 1930's.

Mexican American Women during 1930's

Throughout history it has been proven that women and men are not treated equally. This study cannot analyze workers who were mostly Mexican American women and amalgamate their experience to that of the Mexican American men. Recent studies demonstrate that Latinas experience multiple oppressions and poor mental health due to their triple minority status as poor, female, and women of color (Diaz & Ngoc, 2017). Diaz and Ngoc explain the significance of strict gender roles and pressure to conform to them within the Latino community, especially the Mexican American community in the southwest of the U.S. It is important to understand the strict gender roles and the pressures that Mexican American women like pecan shellers would have felt. This is applicable because the strike consisted of mostly Mexican American women pecan shellers that faced resistance. It could even be said that Mexican American women in the 1930's possibly felt even more pressure of gender roles than the women of Diaz' and Ngocs' study. The strike was initially led by a young Mexican American woman, Emma Tenayuca. As a Mexican American woman Tenayuca drew opposition to the movement of the pecan shellers. Of course, men, both Hispanic and Anglo, the Catholic church, and the KKK did not want to see a woman create change. More notably, the Catholic church did not like that a woman, especially a communist affiliated woman was creating change in San Antonio. It is important to note as Vargas (1997) points out that Tenayuca only turned to communism because no other institution would provide aid to the Mexican population in San Antonio. Furthermore, Gabriela González, author of *Carolina Munguía and Emma Tenayuca,* gives insight to Mexican American women from San Antonio. González describes San Antonio during the 1930's as, "a diversity of ideas and strategies." González' study reveals that Tenayuca's approach to community activism was quite radical for its time. Through Carolina Munguía she reveals how strict gender roles were during the time period. Although Munguía was an activist, she called for bringing about change for La Raza in their already placed societal expectations as women, wives, and Mexicans (González, 2003). This is important because various Mexican

American women of all ages collectively worked together and successfully created change for their community in the Pecan Shellers' Strike of 1938 despite the patriarchy. The above-mentioned sources contribute to this study by highlighting some odds that Mexican American women face and faced. The resistance that pecan shellers faced as women only prove that their decision to strike was due to a buildup of various oppressive systems. Researchers reveal Mexican American women in the early twentieth century were at the forefront of movements (Herrera & Lizcano, 1974). For example, Mexican American women in the 1930's heavily pursued social justice and took on very public roles (Ruiz, 2008). That typical characteristic of the 1930's can be seen with the Pecan Shellers' Strike of 1938 when leaders like Tenayuca and the women shellers kept the movement going. Herrera and Lizcano (1974) say that the Chicano community should be proud of the feminists within their history because of a "rich legacy of heroines and activists in social movements." These two works showcase Mexican American women and their importance to history. This information is fitting because despite the uphill battle as Mexican American women in this world, the pecan shellers on strike were part of a social movement that created change and hope for their community

Class relations (San Antonio)

Recognizing the differences between the social classes is important for setting the scene in San Antonio during the 1930's. The Marxist social movement theory requires that this study understands the social classes. More specifically, it is important because this study takes focus on the exploitation of the working-class. In this discussion of classes, the term Mexicanos will refer to anyone of Mexican origin like Mexican Americans, Mexicans, or Tejanos. Author Arlene Sánchez-Walsh of chapter six in *The Pew and the Picket Line: Christianity and the American Working Class* describes both the working and middle classes of San Antonio during the 1930's. She suggests that working-class Mexicanos had harsh lives compared to Mexicanos of the immigrant class or middle-class. The immigrant class Mexicanos that arrived in San Antonio were middle class citizens of Mexico that had enough of their own resources to fare better. Not all Mexicano immigrants were middle class, some were of the working-class. Sánchez-Walsh (2016) suggests that Mexican workers and working-

class Tejanos were treated as a replaceable workforce in various areas. Working-class citizens of San Antonio were pushed to the bottom of the hierarchy leaving them victim to horrendous living and working conditions. Garcia (1991) suggests the laboring sector of the Mexicanos was poor. He suggests that majority of Mexicanos in san Antonio at the time were immigrants from rural areas of Mexico. Most Mexicanos who arrived in San Antonio, immigrants or not, were illiterate and turned to the agriculture sector for labor. Garcia (1991) also suggests that the American born Mexicanos typically worked in different areas than Mexico born Mexicanos. Immigrant Mexicanos (who were mostly working-class) worked in jobs like pecan shelling, construction, sugar, garment, or cigar industries. More important to this study, Garcia claims that the 1938 strike sort of widened the economic gap between the working-class and the middle and upper class Mexicanos. “In essence, the strikes increased the cultural and ideological differences in the Mexican community; the ricos deplored the strikes and the middle class avoided them” (Garcia, 1991, p.64). The information provided by Sánchez-Walsh and Garcia is valuable to this study because the pecan shellers were from the working-class. Understanding the differences between the working and middle-class is important because it exposes the opposition pecan shellers faced as working-class people. Sánchez-Walsh and Garcia allow for this study to truly understand/analyze the struggles that pecan shellers and their community faced. This reveals what the workers were fighting for, which was better lives and working conditions for their Mexican working-class community of San Antonio.

Race Relations (San Antonio)

In the 1930’s many Mexican Americans faced anti-Mexican racism. It is important to identify this issue that people of Mexican origin (Mexican, Mexican American, Tejano) faced. Although there was a prominent Mexican community that had a booming population, they still faced oppression based on their skin color and Mexican identities (Dominguez-Karimi, 2018). Jim Crow laws did not legally apply to Mexicans but, there was still a “de facto form” of the law that applied. She said, “Segregation of Mexican Americans from White society crept into all sectors: banks, restaurants, parks, government offices, movie theaters, swimming pools, beaches, some areas of cities and schools” (Dominguez-Karimi, 2018, p.51). Research by

Dominguez-Karimi proves that racism in Texas was not just on the mere surface, instead it has deep roots that impact many areas of our lives. Dominguez-Karimi provides adequate information regarding anti-Mexican racism. Recognizing this racism is important to this study because it shows just how harsh life, and the systems were to Mexican Americans during The Great Depression. This proves that pecan shellers were under much more stress than just unfair wages. The pecan shellers were of multi-minority status due to them being Mexican American, women, and of the working class. This source proves that racism was just one of many oppositions that pecan shellers faced before, during and after the strike. This information is applicable because it validates the pecan shellers' strike as a logical response to exploitation and oppression.

Mexican American workers of San Antonio

To further set the setting in San Antonio during the 1930's for the pecan shellers, it is important to understand the Mexican American workers of San Antonio. Robert Landbolt, author of the book, *The Mexican American Workers of San Antonio, Texas* gives insight into the history of organized labor in San Antonio. He claims that San Antonio has a history of an abundance of labor from Mexico. This has made it easy throughout history in San Antonio to replace workers on strike or even replace any workers who were unhappy with working conditions. He suggests that big companies having a constant supply of labor also served as a deterrent to labor organizing. This is relevant to this study because pecan shellers were considered easily replaceable. Close distance to the border and constant immigration meant pecan shellers could be replaced by anyone looking for work and, in most cases, by someone willing to accept the low wages. Landbolt also explains why San Antonio became the hub for all-things pecans. He states that more than half of the pecans in the U.S. are yielded from within a 250-mile radius of the city. Since the pecans weighed less when shelled, it created the need for a pecan shelling job to maximize the profits of The Southern Pecan Shelling Company. This is useful because it explains why there were so many Mexican Americans in pecan labor, it was abundant in the city of San Antonio and companies were able to exploit them for cheap labor. In the journal article, *The Labor Movement in San Antonio, 1865-1915* by Harold Shapiro, the lack of unions in San

Antonio history is shown. Shapiro claims that unionizing in San Antonio was rare and had not been successful. He claims that only until after the first world war, the number of unions began to rise. His work reveals to this study that the odds were not in favor of the pecan shellers on strike yet, they were one of the biggest strikes and labor organizing movements throughout The Great Depression era. Another interesting and relevant detail from Shapiro is that public sentiment typically lied with the workers in early strikes in San Antonio. This is important because the purpose of this study is to examine how the pecan shellers were portrayed in the media. Zaragosa Vargas, author of the journal article, *Tejana Radical: Emma Tenayuca and the San Antonio Labor Movement during the Great Depression,* describes Mexican American workers in San Antonio. She suggests that grass-roots activism brought Mexican and Mexican American women to the forefront. She suggests that these minority women made up a lot of the local unions. Vargas (1997) identifies Emma Tenayuca (the initial strike leader) and other Mexican American women such as Juana Sanchez and Minnie Rendon as leaders of the union-effort in San Antonio during the 1930's. This is relevant because it reveals the pecan shellers as part of the ongoing challenge to fight for workers' rights in San Antonio which authors Shapiro and Landbolt have proven to be a long fight.

Pecan Shellers' Strike 1938

Now that historical context has been given, the story of the Pecan Sheller's Strike can be described. It is important to take all the factors that have been discussed into account. Richard Croxdale author of *Pecan Shellers' Strike* entry in the online Handbook of Texas gives a detailed run down of the strike that occurred in 1938. Amanda Randolph, author of the journal article, *In a Nutshell: The Pecan Shellers' Strike of 1938* from The Texas State Historical Association also describes the plight of the pecan shellers. Both authors Croxdale and Randolph state that the strike consisted of more than 8,000 pecan shellers who were mostly Mexican American women. Croxdale identifies Julius Seligmann, the owner of the Southern Pecan Shelling Company, as the antagonist. Although it is easy to place blame on one person, this study recognizes that it was more than just policy and wages that set the workers off. The work of author Randolph can support this study because it takes into consideration other

factors/systems that also contributed to the workers' frustrations. This study aims to identify and recognize systems of oppression that contributed to stress of pecan shellers making their decision to strike reasonable. Randolph (2003) explains that the workers already lived in horrible conditions in the West side of San Antonio. She also suggests that low wages had negative implications like poor nutrition which left workers more susceptible to illnesses like tuberculosis. Chapter six in *The Pew and the Picket Line: Christianity and the American Working Class* by Arlene Sánchez-Walsh identifies other antagonizing people or institutions involved in the Pecan Shellers' Strike. Not only does she identify Julius Seligmann as part of the problem but, she also identifies the Archdiocese of San Antonio as an opponent of protesters and initial strike leader Tenayuca. This is relevant to this study because as we look at the portrayal of the workers on strike, it is important to consider the resistance they faced. Selden Menefee and Orin Crossmore, authors of the book, *Pecan Shellers of San Antonio: The Problem of Underpaid and Unemployed Mexican Labor* also describe the strike. Menefee and Crossmore (1940) identify the workers as part of the West side Mexican community that was in a state of penury. They explain the struggle to stay afloat financially for Mexican families as they were disproportionately affected by unemployment, especially when pecan shelling was mechanized in San Antonio. All the sources mentioned give a detailed account of the strike that occurred in 1938 and provide more as to why the workers were driven to create change.

Methods

Data Collection

This study utilized content analysis (a qualitative research method) to collect and assess data on the portrayal of pecan shellers in San Antonio. I searched on databases JSTOR, Texas Portal, Readex, and Discover. I searched for the following terms and their variants: "Pecan Shellers", "San Antonio 1938", "1938 Pecan Shellers", "Pecan Shellers Strike", "Nueceros", "Nueceros Huelga 1938". I filtered my results to only include newspapers from the years 1938 and 1939. Data on the portrayal of pecan shellers was only collected from 1938 and 1939 newspapers for various reasons. 1938 is the year the actual Pecan Shellers' strike occurred and resulted in an agreement of both sides.

Congress also passed the Labor Standards Act in 1938. I also used 1939 because the mechanization of pecan shelling left pecan shellers displaced. The department of Wage and Hour administration declined a request from both pecan shellers and companies to be exempt from a minimum wage that contributed to the displacement of pecan shellers. My sample of newspapers came down to eight newspapers. Four of them from 1938, two in Spanish and the other two in English. I also used four newspapers from 1939 with two of them in Spanish and the other two in English. The newspapers were from newspaper publications like, “The Rattler”, “La Prensa: San Antonio”, “The Daily Sun”, and “Lampasas Daily Reader.”

Data Analysis

Utilizing a content analysis of the newspapers in my sample I was able to identify reoccurring themes. After an initial read of the newspapers, I concluded whether the newspaper portrayed the plight of the pecan shellers in a sympathetic manner or not. After further reading and coding of the newspapers I created categories. For this study I used a Marxist social movement theory to categorize my findings. The newspapers fit into at least one of the following recurring themes: social justice and fear of communism. The Marxist social movement lens places emphasis on the exploitation of the working-class and collective action for change. So, fear of communism and social justice were identified as important themes.

Results

This study focuses on how the media portrayed the struggle of the pecan shellers. The newspapers analyzed were sympathetic and supported the workers on strike in several ways. Using a Marxist social movement lens, the results identified social justice and fear of communism as recurring themes regarding the portrayal of the pecan shellers. Granted with a strike, conflict existed between the pecan shellers and the Southern Pecan Shelling Company. Because the newspapers depicted the dispute in such a manner where the actions of the Southern Pecan Shelling company are unjust, social justice is a theme. Fear of communism is a theme because of the way newspapers were very wary of communist ties to the pecan shellers unionizing. Aside from the recurring themes as key findings, results also reveal

other problems that existed within the Mexican American community of the pecan shellers.

Social Justice

Social Justice as a theme refers to the way the media displayed a call to action in different ways. Some newspapers called on the community to help those on strike by donating food to the Guadalupe commissary dedicated to aid pecan shellers out of work. Some exposed the pecan shelling industry by publishing or informing the public of the horrendous wages and working conditions they created. Others also showed solicitude for those on strike by exposing policies enforced by local authorities that allowed jailing, and tear gassing of picketers. For example, in The Daily Sun (1938), "While strike negotiations remained at a standstill, police continued their policy of dispersing picket lines in the strike area by making arrests and spraying occasional groups with tear gas." The Lampasas Daily Reader published an article where they inform of the denunciation of working conditions by the Wage and Hour Administration. The newspaper reported, "For years they have been employed under shocking living and working conditions… WPA relief, church aid and private charity have had to bridge the gap between their slender earnings and starvation." I also found in La Prensa (January 1939) that they informed of a local function for the benefit of the pecan shellers that have found themselves unemployed. They said, "*Distribuirá diez guajolotes, que han sido cedidos por distintas casas comerciales…también serán repartidos varios grandes pasteles que han ofrecido diversas panaderías de la localidad*." This translates to, "Ten turkeys that were given from different houses will be distributed…and various big cakes that have been offered by local bakeries will also be distributed." The Rattler (1939) calls on the people to once-again come to the aid of pecan shellers since their arbitration was short-lived when machines replaced workers. The Rattler said, "Today, when newspapers have ceased printing articles on the crisis and public interest begins to wane, the problem of the pecan-sheller is more complex than ever before."

Fear of Communism

In this study, the media displayed a fear of communism or concern with pecan shellers affiliating themselves with communism. Some of the newspapers were afraid that the pecan shellers in their vulnerability were perfect targets for communism to spread. For example, in The Rattler (1938) it said, "Offering, in their utter poverty, a fertile field for sowing the bitter seeds of Communism, the pecan shellers have been subjected to much pressure from the Communists." La Prensa (February 1, 1938) reported that the chief of police said, "*no permitiria que los rojos tomaran parte en la huelga.*" Which translates to "he would not allow the reds to take part in the strike." Trepidation is also shown in The Rattler (1939) when they explain that pecan shellers have been displaced by machinery. However, the newspaper is also concerned with preventing the spread of communism to the pecan shellers. They said, "The problem of the pecan-sheller must be solved, lest he be driven to Communism."

Poverty in the Mexican American Community

I found that the community faced other problems outside of the workplace like unemployment, poverty, and starvation. Results also show that the pecan shellers lived mostly on the West Side of San Antonio in penury. From La Prensa (February 2, 1938), "…*las malas condiciones de salud y cultura que existen en el West Side se deben directamente a las agobiantes condiciones del trabajo y el bajo nivel de los salaries que reciben los obreros*…" This translates to, "…the bad health and cultural conditions that exist in the West Side are due to the overwhelming working conditions and low wages of the workers…" Starvation as a serious issue of the pecan shelling community is depicted in The Daily Sun (1938). They reported the words of Austin Beasley, "We'll let the police arrest the pickets, if they will. And if they take them to jail, we'll leave them there. The city can feed hem and take care of them." Using the sample of newspapers, four pecan shelling locations were found in the West Side of San Antonio. The first two locations derived from La Prensa (1938) Spanish newspaper article: 2419 W. Commerce St and 519 Guadalupe St. The second two locations found derived from La Prensa (1939) Spanish newspaper article: the corner of Veracruz St. and Pinto St. and the corner of Tampico St and San Jacinto St. Acknowledging the West Side is

important because the pecan shellers belonged to the Mexican American population that was concentrated in that area of San Antonio.

Discussion

The Mexican American community was subject to racism, classism, and the women, subject to a patriarchal society (Dominguez-Karimi, 2018; Garcia, 1991; Ruiz, 2008). It was very interesting to see the pecan shellers who were mostly women and belonged to the Mexican American community, lead a strike and hold the line. The pecan shellers were able to show The Southern Pecan Shelling company and other corporations that they are not an expendable workforce. The pecan shellers created a movement that allowed not only companies but, also the community itself to realize they deserved better. The two themes fear of communism and social justice are reflective of society during the time period.

Fear of communism as a theme in the media had implications for society at the time. Fear of communism meant people were concerned with who was aiding the pecan shellers. Inherently, that meant fear was a driving force for the aid of pecan shellers. Fear of communism in the media displayed how United States capitalist society was very cautious about left leaning ideologies like communism and socialism.

The media also portrayed social justice as an important theme regarding the pecan shellers. The media essentially served as a call to action for the community. As the media reported on commissaries and food drives meant to aid the shellers, it showed how working together was essential to their survival. In doing so, the newspapers also served as an example of how others in the community could do their part. The people all came together to strike, to feed each other, to hold the picket line, and to survive. This is important because it showed that the community recognized a problem and worked collectively to solve it. The medias portrayal of the pecan shellers (working-class) shows that collective action was possible and effective in creating change.

The findings of this study demonstrated that the pecan shellers desired change as a result of their community facing oppression and exploitation at work. Their reaction was not the sole result of one change in policy that cut their wages. Instead, it was also a reaction to

oppressions like racism, classism, and sexism that the community faced. Revealed through the literature and the newspapers, unemployment, starvation, and poverty were also serious issues of the West Side community. It is important to recognize that despite a short-lived monetary victory, the strike demonstrated the power of organizing, community solidarity, and labor rights among Mexican Americans. This is important because the Mexican American population was seen as an expendable workforce. During this time period companies did not expect their workers to react to low wages or bad working conditions. The pecan shellers portrayal in the media served as an eyeopener for labor rights to the workers of San Antonio.

Conclusion

Overall, the topic of the San Antonio pecan shellers is not well known and has not been extensively researched. This work is an attempt to work against the perpetuation of a consensus history that dismisses the experiences and voices of marginalized groups. The purpose of this study was to identify how the media portrayed the pecan shellers and provide historical context. This study focuses on social justice and fear of communism as recurring themes in the media. Using a Marxist social movement theory allowed this study to identify the pecan shellers as a community collectively fighting for change. Perhaps further research and a larger sample could identify more recurring themes regarding the portrayal of the strike. Future research could also focus on the leading activists or persons who helped galvanize the strike and analyze the role that local government played.

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Rhetoric & Reality: Reviewing Vice President Harris's Rhetoric and the Causes of Immigration

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The rate of immigration from the Northern Triangle countries (El Salvador, Guatemala, and Honduras) to the United States has varied significantly since the 1990s. During the years 2000-2017, the US received roughly 650,000 immigrants per year (Camarota, 2020). Immigration decreased in the first two years of the Trump Administration by about 200,000 immigrants per year. However, immigration has increased dramatically during the Biden Administration. According to the U.S. Customs and Border Protection, agents encountered more than 172,000 immigrants in just the first few months of Biden's Presidency. To address this increase of immigrants from the Northern Triangle and Mexico, President Biden placed Vice President Harris in charge of the White House task force on immigration. This paper will analyze how Harris is addressing the increase in immigration in the past few months. In particular, it will review the scholarly literature on the main reasons why immigrants leave their home countries to come to the U.S. The causes that will be examined will be push-and-pull factors, such as governance, poverty, climate change, and violence, among others. Using political discourse analysis, it will then review how Harris is addressing the causes noted in the literature. This paper will contribute to the literature by providing a comprehensive review of existing literature and the causes of immigration. It will also determine how the causes identified by existing literature are being incorporated into the policy response from the Biden/Harris administration.
Keywords: Push and Pull, The Northern Triangle, Immigration, Violence, Corruption, Education, Climate Change, Kamala Harris, Joe Biden

Rates of Immigration to the United States

Rates of immigration from Central America, and in particular the Northern Triangle, to the United States have varied significantly over time. This variation has a variety of causes, including the economic opportunities that exist in the United States, the civil wars that ravaged the region in the latter parts of the 20th century, and the perception of how easy it is to emigrate into the United States, among others. Many immigrants have moved to the United States to escape those causes and other immigrants are waiting for those causes to improve in their country so they can return home. In the past, the dominant group that migrated to the United States was young males looking for labor in order to provide for their families by sending them money once they obtained a paycheck (remittances). However, recent trends in immigration have seen an increase in families risking their lives to escape their country, instead of single males arriving for labor work. The countries from where migrants are fleeing have also changed. In the 1990s and early 2000s, Mexican migrants were one of the larger blocks to migrate to the United States (O'Neil, 2020). However, a focus on economic development in Mexico during the 1990s and 2000s, based on a bilateral partnership between the United States and Mexico, led to the dual phenomenon of reduced levels of migration from Mexico to the US, and the return of many Mexicans back to their native homes to benefit from the economic prosperity Mexico was witnessing. Despite the decrease in the number of migrants from Mexico, the number of migrants from Central America rose, and has continued to grow over the years.

From 2007-2015 the rate of immigrants from the Northern Triangle (Honduras, El Salvador, and Guatemala) to the United States rose by 25 percent (Pew Research Center, 2017). That number continues to rise, even as the number of migrants from Mexico has decreased by six percent (Pew, 2017). This rise was tempered briefly during the Trump Administration. During the Trump administration (2016-2020), many restrictions were placed on the immigration system to discourage migration into the United States. In terms of reducing the total number of migrants coming into the United States, the Trump Administration achieved its goal. In Trump's first two years in office,

legal and illegal migration overall was about 200,000 a year compared to the numbers from 2010-2017, which were roughly 650,000 a year (Camarota,2020). Also, between 2017 and 2019, out-migration (people leaving the United States to go back to their home country) was 975,000 immigrants on average for each year, double the amount between 2010 and 2017 (470,000 immigrants). However, the number of immigrants coming to the United States would slowly increase as conditions became worse in Northern Triangle countries due to the SARS-CoV-2virus, rising levels of violence, and other factors. After Joe Biden's inauguration in 2021, the United States experienced many problems on the southern border. There number of in-migrant encounters at the border has increased by 71% since February 2021. Many of the new migrants were unaccompanied children. In March 2021, the border encountered more than 172,000 migrants compared to February, with 100,441. Additionally, the number of unaccompanied children encountered on the border from February 2021 was 9,297, which doubled to 18,890 by March (Morin and Brown, 2021).

In response to the dramatic increase in migrants at the southern border over the course of just a few months, President Biden announced in a March 2021 press conference the creation of a task force to address the issue of immigration, with a focus on the root causes of immigration. He named Vice President Kamala Harris as the head of this task force.

The current literature on the causes of immigration is vast, and points to a variety of root causes of immigration. This paper seeks to determine how the Harris task force has incorporated the root causes identified in the literature into her policy dealing with the Northern Triangle countries. These root causes include economic factors, social factors, violence in the origin country, climate change and environmental disaster, inept or corrupt government/regime, and more. The paper will then look at the rhetoric used by the Biden-Harris task force, using public speeches, press releases, and interviews, to answer the question of how the Biden Administration is incorporating the root causes identified in the literature and whether solutions are matching the root causes identified in the literature. This project will help us understand more clearly the dominant root causes identified by Harris

and determine whether the task force is creating solutions that address these root causes.

Why Do People Emigrate? Root Causes of Immigration

Much of the recent literature on the causes of immigration is grounded in the Push-Pull theory developed by Lee (1966). Lee argues that there are both positive and negative factors in both the origin country (push factors) and the destination country (pull factors) that cause people to migrate. In particular, these factors are the diversity of the destination country, levels of development/infrastructure in both origin and destination country, education levels. He discusses that if there is a high degree of diversity among the territory it would result in high levels of migration. In addition, Lee does say if there is a sameness among people like in terms of their race, ethnic origin, education, income, or tradition it will cause lower rate of migration. He explains that when migrants have higher levels of education, they are more likely to emigrate when there are more opportunities for educated individuals in the destination country than in their origin country. When the destination country needs low-paid labor, migrants are more likely to have lower levels of education.

O'Neil (2020) and Burke (2017) focused on similar issues of the causes of immigration to the United States, which is the primary destination country for migrants from Mexico. O'Neil argues that the variation in the ease of entry to the United States based on different domestic US policies on immigration (pull), the coronavirus pandemic (push), economic progress (push/pull), education (push/pull), familial ties (push/pull), and changing demographics (pull/push) are factors that impact immigration. In addition, O'Neil mentions that another group of individuals from Central America is emigrating because of poverty, violence, and devastating droughts due to climate change (push factors). The majority of the most recent wave of immigration have been women and children looking for family, friends, and economic ties in the U.S. The migration flow in 2020 decreased because of restrictions related to the pull factors of President Trump's aggressive implementation of strict border policies, changes in asylum rules, particularly those disqualifying asylum seekers fleeing gang and domestic violence, limiting asylum processing to official border

crossing zones, and challenging to seek protection, as well as changes in push factors, such as the improvement of the Mexican education systems and the response to COVID-19. However, O'Neil mentions that many of the push factors that discouraged emigration have changed due to Mexican President Andres Manuel Lopez Obrador's misguided economic policies. Lastly, O'Neil mentions that the rising violence from Mexico is driving hundreds of thousands of migrants to the U.S. In 2019 homicides topped 34,000 compared to the first half of 2020, where that number is even higher.

On the other hand, Burke discusses why undocumented immigration from Latin America to the U.S. will slow. Burke's causes of immigration include changing demographics in Mexico and Latin America where there are fewer young people immigrating in the United States because there are more opportunities at home due to a shrinking labor force. Burke also mentions education as an essential factor- in between 1970 and 1990 migrants with a high school degree or less rose from 11.6 percent to 34.0 percent in Mexico and 13.2 percent to 23.7 percent from the Caribbean and Latin America, which led to a huge wave of low-skilled immigrants.

Burke also mentioned the stability of the Mexican economy as a factor that leads migrants to stay in their origin country by comparing income from a middle-income earner in Mexico to a low-income earner in the U.S. Burke shows that in the 1990s and early 2000s, people who moved from Mexico to the United States increased earnings by 2.3 percent, but post-2007 the earning fell to 1.75. It also mentions that the increase in border security and immigration enforcement slows immigration. For example, the number of U.S. Border Patrol agents policing the U.S.-Mexico border doubled from 8,600 officers to 17,500 officers between 2000 and 2010, and the numbers are still historically high. The United States has also increased the number of deportations of non-criminal undocumented immigrants. The number of border agents and deportations affect the pull factors for immigration.

Mirivolic (2010) argues that a state's immigration patterns are driven by regime type, economic development, and interstate threats. Migrants tend to use cost-benefit analyses when looking at destination countries. Mirivolic explains that economic development increases both the supply of (push) and demand for immigrants (pull). Migrants

choose destination countries that produce significant wages because migration is economically, physically, and mentally taxing. Developing countries have increased demand for immigrants because of the need for unskilled laborers. Mirivolic also explains that "moving from a democracy to a dictatorship decreases the supply of immigrants while increasing the demand for them." The logic to this reasoning is that people prefer living in democracies because of democratic values, such as their political rights and fair treatment. However, democratic countries tend to restrict immigration, while dictatorships tend to use permissive admission policies because of their desire for immigrants. Lastly, Mirivolic explains that immigration is vital when a destination country faces a security threat. Immigration increases security in three ways. It raises the number of goods and services an economy can produce by increasing labor which in turn increases the GDP. If the military's share of the budget is higher than zero, immigration also leads to an increase in military power. The country's ability to recruit military personnel is boosted. Immigration also makes destination countries less vulnerable to seizure through increased population.

Kanayo et al. (2019) and Van Dalen et al. (2005) discuss root causes of immigration from Africa. While Africa is obviously a separate region from North America, it has a similar history of corruption and violence. The authors grouped push and full factors of immigration into categories—economic, political, social, and demographic. Political factors include violent conflicts, underdevelopment, poverty, political instability, poor governance, extensive human rights violations, malnutrition, and corruption. Economic factors include limited job opportunities, income, and unemployment. Social factors include welfare benefits. If the welfare benefits and average income are higher in the destination country than in the origin country, the migration rate will increase. For example, in some countries, children of refugees receive social grants, and if an adult has four or more children, they are able to afford rent and other expenses.

The American Enterprise Institute (2017), the Association for a More Just Society (2020a), and Kirby (2019) mention that violence and crime, especially gang violence, is a root cause of migration. Gang violence has reached epidemic levels in Northern Triangle countries.

The American Enterprise Institute stated that gang violence is present in the Northern Triangle countries is due to weak institutions, corruption, scarce rule of law, and a paucity of economic opportunity. The Association for a More Just Society (2020b) explains that gangs threaten and rob people in public transportation systems, extort business owners and bus drivers, assault others, and commit domestic violence. Urban neighborhoods are often caught in the crossfire of rival gang activity. The cycle of violence is created and supported by continual gang activity, drug trafficking, impunity, and corruption. Guatemalan indigenous populations suffer from high rates of malnutrition and insufficient access to health care and education. Kirby and O'Neil briefly mentioned that droughts and erratic weather linked to climate also affect the Northern Triangle.

Poor governance and instability fuel both poverty and insecurity. The murder rates in El Salvador and Honduras have decreased, but criminal gangs still operate with impunity since the government and police cannot or will not stop their crimes. On the other hand, Call (2020), focuses more governance and corruption as root causes of migration. Call focuses on what the Biden administration plans on addressing in the Northern Triangle, such as democracy and human rights, trade and investment, and drug trafficking. Call blames nefarious nonstate actors and corrupt exclusionary states for worsening conditions in the past years. The coronavirus has also contributed to economic problems, and ongoing violence, worsening corruption, and challenges to democracy continue to push individuals to flee their homes. In December, the International Monetary Fund predicted that Central American economies would shrink in 2020 due to a decline in remittances and decreased tourism. Call explains that Covid-19 related issues will continue in Guatemala, El Salvador, and Honduras. Honduras is already one of the poorest countries in Latin America due to continual natural disasters and has become the largest source of migration into the United States. The situation in Honduras is worsened by corrupt officials who give themselves immunity. Guatemala's government terminated an anti-corruption mission from the Organization of American States (OAS) because they did not agree with their investigative authority. Guatemala suffered a 2% economic decline caused by issues with its current government run by President

Alejandro Giammattei. The Guatemalan government also shut down a U.N.-backed anti-impunity commission that had success in the past 12 years, indicting over 400 politicians, businesspeople, and ex-military officers implicated in illicit networks. This scandal associated with shutting down the U.N commission suggests a challenge to growing accountability of government officials.

In El Salvador, the country faces serious issues with gang violence in many neighborhoods and towns. Nayib Bukele, the populist president elected in 2019, made a pact with the gangs and instructed them to help him enforce curfews for covid-19. Interestingly, after this pact, homicides in El Salvador dropped 69 percent from 2019 to 2020. However, an important question regarding justice is raised when leaders make secret pacts with drug cartels. This scandal further emphasizes the issues of weak democracy and corruption, which further shift El Salvador towards authoritarianism (Call, 2020).

Angelo (2021) argues that economic precariousness, government corruption, crime, violence, and climate change are all factors that drive immigration. Most people in Guatemala and Honduras live below the poverty line and are employed in the informal sector, thus they lack access to benefits (i.e., social protection and insurance). The populist politicians and corrupt officials erode democratic checks and balances, which caused frustration among residents. Many migrants are families or unaccompanied children which contributes to domestic violence and gang recruitment of minors.

Northern Triangle countries have been unstable for more than a decade because civil wars and poor leadership have led to many of the root causes previously mentioned. Authors such as Bedolla (2014), Planas (2015), and Dias (2021) discuss how the United States' political and economic interests, directly and indirectly, have caused corruption, violence, and economic downfall in Northern Triangle countries. The United States has made life in Latin America harder by overthrowing elected governments, financing atrocities, and pushing trade policies that undermine Latin American industries, and local economies. Planas (2015) mentions 19 scenarios in which the United States interfered. One was when the Mexican-American War (1846-1848), which resulted in the United States gaining a significant portion of Mexican territory, which now has 33.5 million people of Mexican origin. The

United States overthrew elected governments, indirectly or directly, in Guatemala in 1954, Brazil in 1964, and Chile in 1973. The United States funded dictatorships, such as the military junta in Argentina from 1976-1983 and financed a rebel army in Nicaragua, the "Contras," which committed atrocities and smuggled drugs in the late 1970s and 80s. The United States also financed the El Salvador civil war in the 1980s and the Guatemalan dictatorship during the 1960s- 80s, by providing guns and equipment that led to rape, assassinations, and death. The United States has also found it difficult to control the flow of weapons into Mexico. From 2007 to 2011, Mexican authorities have seized almost 70,000 weapons that came from the United States. Also, in 2004, the United States Congress declined to renew a 10-year ban on the sale of assault weapons, which later became the gun of choice for Mexican drug cartels. Dias focuses on the contribution of the United States to poverty and violence in Central America, drivers of migration. Dias mentions the work of Cecilia Menjivar, a professor of sociology at UCLA that says, "you can't leave that part out," which means that you cannot mention the root causes of immigration without acknowledging the foreign policy of the United States. Dias interviews Dr. Menjivar, who explains how historical inequalities and economic development were created in Guatemala, El Salvador, and Honduras. He notes that the ruling elites had economic development models and modernization strategies that only had two agricultural products and exploitative labor conditions. They only had one or two products to export because it was influenced by the United States government and corporations that impacted very small economies. When the Great Depression of the 1930s came, it heavily impacted these three countries. These led to labor exploitation and more dispossession of land. Depression caused many small farmers to take out loans, lose land, and work for large landowners. Eventually, farmers protested for a better working conditions and the United States helped to silence the uprisings. This decision led to military aid and the escalation of the dictatorships. These conditions are still present today because of local ruling elites, land, and business owners.

The influence of US foreign policy has not been solely coups d'état and chaos. The United States has given the El Salvadorian government $1.5 million in the past 12 years. Through the Merida

Initiative, the U.S. government has appropriated more than $1.5 billion to Mexico and Central America to fight the war on drugs by increasing interdiction capabilities, improving the rule of law, strengthening communities, and modernizing the border (Seelke, 2021).
Other authors such as Gomez (2021), Chadbourn (2021), Kocherga (2021) have looked more at the current causes of migration to the United States. These root causes mentioned involved the security condition on the U.S-Mexican Border, governance from the origin country, climate change/natural disaster, economy, and the idea of there being no more options left if one is to remain. Other authors such as Estevadeordal (2019) focus on how the origin and destination culture of integration affects immigration decisions. Gomez notes how the apprehensions have increased and the poor conditions and treatment of the immigration facilities, thus creating a disincentive to emigrate.

Restrepo, Sutton, and Martinez (2019) say that "fear and desperation have led millions of people to uproot themselves and seek safety and security far from home." Their primary drivers are crime and violence, extreme poverty and economic collapse, environmental degradation, loss of traditional lifestyle, and impunity. For crime, they note that from 2018, Latin America and the Caribbean have become the most violent region on the planet, which counts about 40 percent of the global homicides despite containing only 8 percent of the world's population. This crime is mostly coming from the Northern Triangle countries, Mexico, and Venezuela. Extortion, kidnappings, violence against women are also a problem in these countries. This insecurity has led to large-scale displacement. Doctors Without Borders reports that "40 percent of Northern Triangle asylum-seekers mentioned direct attacks on them or their families as the main reason for their emigration."

Malnutrition, disease, and other effects of climate change are also affecting migration levels (Azpuru and Hernandez, 2015 and Sigelmann, 2019). The region has experienced droughts, hurricanes, and crop diseases that have created a hunger epidemic in communities, especially in Guatemala and Honduras, which have affected women and children from indigenous in particular (Restrepo et al, 2019). The agricultural sector has also been affected, and since this sector provides a quarter of employment in the Northern Triangle, the loss of

agricultural jobs has an outsized impact on the population. Weather patterns such as drought and irregular rainfall have increased food insecurity and devasted many lives work. This weather especially affects indigenous communities since they focus on traditional farming methods. Lastly, the authors say, “a combination of democratic backsliding, deepening corruption and state capture, and weak institutions has meant that national and regional elites in Central America and Mexico are uninterested in and unwilling to invest in social programs, undertake much-needed law and justice reforms, and help communities battered by climate change manage erratic weather patterns and crop failure.” Because of this impunity and indifference, the Northern Triangle is struggling with violence and high unemployment. Even when levels of violence seem to improve in the short-term, the extreme levels of violence in the recent past means high levels of migration continue. In particular Sigelmann (2019) argues that as climate change worsens, it will be intensify food insecurity. She says up to 10.6 million people in Latin America could become internal 'climate migrants' by 2050. People from impoverished rural areas will be the hardest hit. Most of the remittances are sent to rural households such as in Guatemala. Nearly two-thirds of unaccompanied minors from El Salvador leave from rural areas. The poverty rate for 2019 in Guatemala is 59.3 percent, Honduras - 61.9 percent, and El Salvador-29.2 percent. There is chronic malnutrition in children under five because of the dry corridor and climate change.

Although climate change and its related effects are more recent additions to the literature, there appears to be largely a consensus on a number of other factors as root causes of migration. The categorization of these reasons into “push-pull” factors helps us understand more clearly that the literature sees a wide variety of reasons that individuals might choose to leave their homes to emigrate to another country. In the next section, I will use the factors identified by the literature to perform a text analysis of documents from the Biden/Harris Administration to determine how often they are acknowledging the root causes identified in the literature.

Discursive Analysis as a Methodological Approach

The methodological approach that I will be using is a qualitative method known as discursive analysis, or rhetoric analysis. Discursive analysis is a method that analyzes texts to identify patterns of word usage to illustrate the cohesion, dominance, and repetitiveness of certain keywords in political speeches (Klebanov et al, 2008). Political discourse analysis rests on the argument that "discourse is a form of social action and interaction" and a review of discourse should help us highlight priorities in the political sphere (van Dijk, 2004). In order to analyze the documents in this study, I use QDA miner. QDA miner is a Computer Assisted Qualitative Data Analysis (CAQDAS) package, which is a tool that supports the range of qualitative analytic techniques. QDA miner is primarily for textual and image analysis, but it can also conduct text mining, and has broad boundaries because of its ability to conduct both methods qualitative and quantitative (Silver, 2014). Using QDA miner, I will find and count key words selected from the literature of root causes of migration.

The documents analyzed are those published by the Biden-Harris Administration from the White House, Department of Homeland Security, and the Department of State websites. That has led to a total of 54 documents that mention or involves the Northern Triangle countries, Mexico, and the discussion of root causes of migration and proposed solutions. These documents consist of six factsheets, ten remarks, six statements, one proclamation, three readout of calls, one executive order, 26 press briefings, the 2021 Presidential Address to Congress, and a bill supported by President Biden. One message that the President tells his cabinet and others about Kamala Harris responsibility on immigration is that both of them are working together but Harris is taking the lead was "So it's not her full responsibility and job, but she's leading the effort because I think the best thing to do is to put someone who, when he or she speaks, they don't have to wonder about is that where the President is. When she speaks, she speaks for me. Doesn't have to check with me. She knows what she's doing, and I hope we can move this along."

From the literature, I identified keywords related to root causes of immigration. The 35 keywords are democratic, corruption, governance, security, homicides, domestic, violence, cartels, gang

violence, cartel violence, trafficking, rural, urban, climate change, agriculture, disaster, farmer, hurricanes, drought, injustice, justice, check & balances, rule of law, women, girls, men, boy, malnutrition, food insecurity, reunification, poverty, investment, remittances, education, and local. These words are then organized into six categories, based on the broader theme each key word falls under. I used QDA miner to identify not only the 35 keywords, but also the themed groupings of each keyword. The six categories are: regime, safety, environment, order, family, and economy. The following table illustrates the organization of the keywords and group themes.

Table One: Root Causes Identified by the Literature, by Category

Group Name	Root Cause Keyword
Regime	*Democratic, corruption, governance*
Safety	*Security, homicides, domestic violence, cartels, gang violence, trafficking, violence*
Environment	*Rural, urban, hurricanes, climate change, agriculture, disaster, farmer, drought*
Order	*Injustice, justice, checks & balances, rule of law*
Family	*Women, girl, man, boy, food insecurity, malnutrition, reunification*
Economy	*Poverty, investment, remittance, education, local*

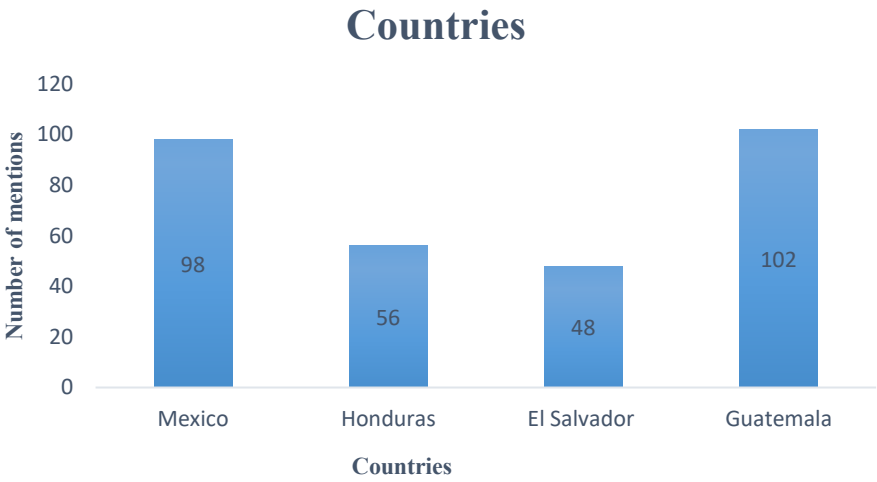
In the first category "regime," I include democratic, corruption, and governance. The reason for those three keywords added in the category regime is that, in the most fundamental definition, regimes are either democracies or not, so democracy is used as a dichotomous word (a country might be described as "not democratic," but Harris is mentioning the regime type, thus it is coded as a mention of the regime type). Good governance and low levels of corruption are also indicator of democratic quality, therefore they are included in regime type. The second category, "safety," includes nine key words: violence, security, homicides, domestic violence, cartels, gang violence, cartel violence and trafficking. The reason for adding these eight keywords to the category safety was cause migrants from these countries tend to stay if they are safe to remain there. So that is why violence and some categories such as cartel, domestic, and gang violence were added, along with homicides and trafficking since that are some of the actions

that occurred in these countries because of violence. The third category "environment" will contain eight key words, which are rural, urban, climate change, agriculture, disaster, farmer, hurricanes, and drought. The reason for adding these eight keywords was because of how the environment is being affected due to climate change. Also, hurricanes and drought were added because these have been the primary climate factors involved with disaster. Rural, urban, agriculture, and farmer were added because the literature identifies rural habitants as more insecure due to climate change. The fourth category, "order" contains four key words- injustice, justice, checks and balances, and the rule of law. The reason for adding these keywords is that justice is required for order. Justice can also become injustice if the rule of law and checks and balances are not implemented. The fifth category, "family" contains seven key words- reunification, food insecurity, malnutrition, men, boy, women, and girls. The reason for adding these eight keywords to the category "family" was to see what group was being mentioned more often. Also added to the category "family" were malnutrition, food insecurity, and reunification because these are other factors that cause families to migrate since they are either trying to save their family or reunite with them. The sixth category "economy" contains five keywords- poverty, investment, remittances, education and local. The reason for adding these five keywords to the category economy was because these five keywords affect these countries economy such as education, remittances, investment affect poverty, and local was added to the keywords cause to see if the United States focuses on the economy in the local level, then at the national/federal level. There will also be an analysis for solutions offered by the task force to see what approach she is first taking and if it corresponds with the most mentioned category.

In addition to the root causes identified by the literature, I also separate out the countries of the Northern Triangle to determine how often Harris is mentioning the individual countries in her speeches. The reason for this is to determine whether a specific country is receiving more of a focus. The four countries that this research will focus on will be the Northern Triangle countries that are Guatemala, El Salvador, and Honduras and Mexico.

Root Causes and Rhetoric: Results

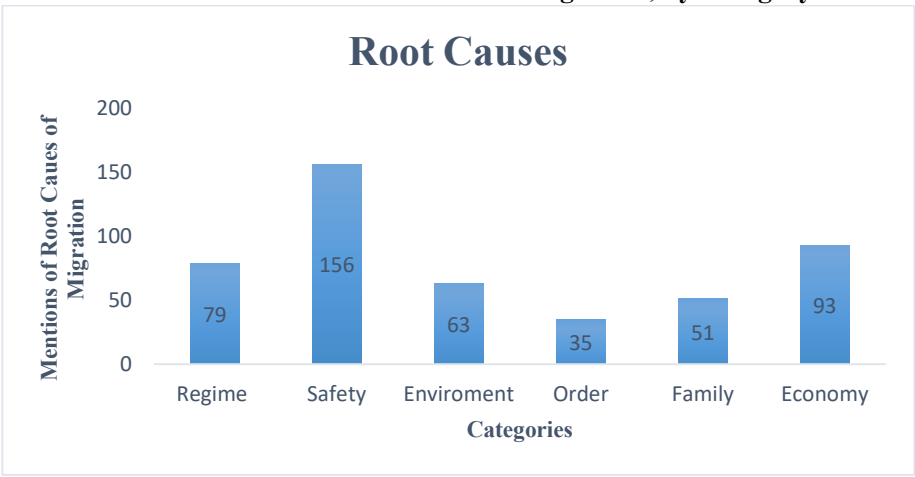
Table One: Number of Mentions- Countries



Although the Northern Triangle is grouped together as a region, these are separate, sovereign states with independent governments and the opportunity to create unique, separate domestic and foreign policies. As a result, Harris will need to work with the countries both individually and as a region. The analysis shows that Guatemala and Mexico have been mentioned the most. Guatemala was mentioned the most with 102 mentions in the documents, Mexico had 98 mentions, Honduras came in third with 56 mentions, and El Salvador came in fourth with 48 mentions. Vice-President Harris has met with the President of Guatemala, Alejandro Giammattei, and the Mexican President, Andres Manuel Lopez Obrador (AMLO), in bilateral meetings where they have discussed future plans and policies on resolving the root causes of migration. Kamala Harris has also met with the Guatemalan Supreme Court Justices to discuss the importance of democracy and its need of protecting it. Kamala Harris has also conducted a meeting with Latin American experts so they could learn

from each other and understand the Northern Triangle countries in depth.

Table Three: Mentions of Root Causes of Migration, by Category



The results show that the categories "safety" and "economy" are the two broad categories of root causes that the Harris task force is focusing on the most. In ranking all the categories, safety came first with 156 mentions, economy came second with 93 words, regime came third with 79 words, environment came fourth with 63, family came fifth with 46 words, and order came sixth with 35 words. As expected, safety is a major concern in the Northern Triangle and Mexico.

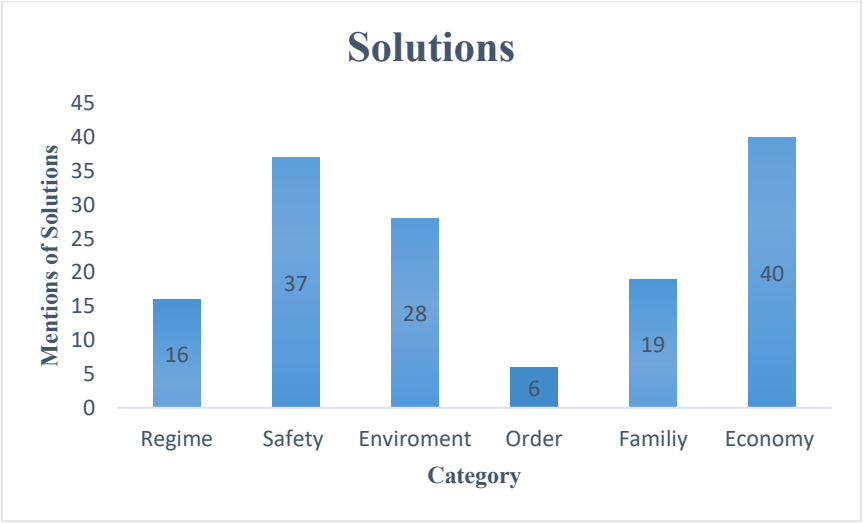
As noted in the literature review, violence appears to be a dominate root cause of migration. There are 58 mentions in all the documents of the root causes identified as "violence" issues. The types of violence mentioned in the documents included gang, domestic, sexual, and gender-based violence. The two most mentioned was gang and domestic violence with gender-based violence just involving women and girls which will be explained when discussing the category of family. Gang violence was mentioned 20 times whereas domestic violence was mentioned 13 times. The other keywords for safety were security (51 mentions), homicide (1), trafficking (10), and cartel and cartel violence (3) each.

The word grouping for economy came in second with 93 mentions and the keyword “local” had the most mentions (50). Investment was mentioned 19 times, poverty- 15, education- nine, and remittances- two. The third category, “regime” had democratic mentioned 10 times, corruption had 54, and governance with 15. The fourth category which is “environment,” received 63 mentions, with rural mentioned seven times, urban- zero, climate change- ten, agriculture - 11, disaster - six, farmer- seven, hurricanes- 16, and drought- eight. The fifth category which is “family” had women with 27 mentions, girls with five, men with zero, boy with two, malnutrition with one, food security with four, and reunification with seven. The sixth category which is “order” had injustice with two mentions, justice with 19, check and balances with zero, and rule of law with 14. Of the six categories, the dominant word in each was corruption, violence, hurricanes, justice, women and girl(s), and local, respectively.

Overall, Kamala Harris has identified the importance of combating violence, has also shown the importance of climate change and how natural disasters can have on these four countries, the importance of maintaining democracy and reducing corruption from devasting the political system and the lives of their citizens and how investment in the economy will help these countries to maintain its population instead of migrating. Kamala Harris also mentions solutions and actions that the United States government and these four countries have done to address the root causes of migration.

Now that we have determined the primary foci of the root causes, we now turn to an analysis of the rhetoric related to solutions. I use the same words identified in root causes, but using QDA analysis, also review the surrounding words (roughly three sentences surrounding the identified word) to determine if the mention of the root cause is directly tied to a solution offered.

Table Four: Mentions of Solutions, by Category



Kamala Harris and her task force has mentioned possible solutions to these six categories. Each category mention certain solutions. The category for safety had 37 mentions involving solutions, regime had 16 mentions, environment had 28 mentions, order had six mentions, family had 17, and economy had 40. In the category safety, it had democratic with two solutions, corruption with nine solutions, governance with five solutions. In the category for regime, it had eleven solutions for violence, 14 solutions for security, one for homicides, two for domestic violence, zero for cartel, seven for gang violence, two for trafficking. In the category environment, it had seven solutions for rural, zero for urban, four for hurricanes, four for climate change, four for agriculture, two for disaster, four for farmer, and three for drought. In the category for order, it had zero solutions for injustice, six for justice, zero for check and balances, and zero for rule of law. In the category for family, it had 16 solutions for women and girls, zero for men and boy, zero for malnutrition, one for food security, and zero for reunification. In the category for economy, it had three solutions for

poverty, 13 for investment, one for remittances, six for education, and 17 for local. It is shown that the Kamala Harris task force are offering more solutions for the economy category. The ranking for the category from the most offered solutions to the least offered solutions is: economy, safety, environment, regime, family, and order. Solutions that Kamala Harris offered for the environment category was when she set up a call with 12 companies and organizations that have committed to support inclusive economic development in the Northern Triangle. The 12 companies and organizations consist of "Accion, Bancolombia, Chobani, Davivienda, Duolingo, the Harvard T.H. Chan School of Public Health, Mastercard, Microsoft, Nespresso, Pro Mujer, the Tent Partnership for Refugees, and the World Economic Forum" (White House, 2021a). The overarching strategy appears to be the commitment of regional public-private sector partnerships to support long-term development of the region. A quote mentioned in a briefing that discusses how this economic cooperation from the private sector could help was by "including efforts to foster economic opportunity, strengthen governance, combat corruption, and improve security. This approach will leverage commitments and resources from the governments in the Northern Triangle, as well as partnerships with multilateral development banks and international financial institutions" (White House, 2021a). The commitments from the corporations involve a proposed reform agenda in business practices, digital and financial inclusion, food security and climate-smart agriculture, climate change adaptation and clean energy, education and workforce development, and public health access. Kamala Harris also has provided substantial solutions on improving safety especially in the areas of security and violence. Some solutions that Kamala Harris has mentioned was on security, especially border security, was the increase in security personnel by the Mexican government (by 12,000 security personnel) to the Southern Mexico border and increased border checkpoints (White House, 2021b). Another solution offered for security is training USAID police officers on domestic violence procedures, as well as training investigators and analysts on the prosecution of human smuggling cases (White House, 2021b).

Does The Rhetoric Meet Reality?

An analysis of Vice President Harris's rhetoric on the root causes of immigration from the Northern Triangle and Mexico reveals a strong connection between her rhetoric and the root causes identified in the literature. She mentions security and the economy as the top categories of root causes, which are listed as dominant causes in the literature.

In terms of solutions, the Biden-Harris administration focuses primarily on the safety category, especially violence, which makes sense because of the many authors that incorporate violence as one of the key drivers in migration. It is shown multiple times in the literature review that gang violence is affecting the lives of many migrants from the Northern Triangle countries and Mexico. However, the task force is also focusing on economic causes and, the documents provide more details regarding economic solutions that the others. The administration must not forget that the other factors are also important to improve the situation, as the causes of migration are multi-dimensional. There must be an improvement in the levels of corruption in the region, climate change should be addressed, and solutions provided, and the United States and other countries should invest in these countries so that their economies can improve.

Future research will continue to analyze the statements and actions by the Biden-Harris administration as the task force continues its work. As further documents become available, I will add them to the database to see if the focus remains on security and economy, or if the administration broadens its response. Another future research project I plan on is to conduct a survey to interview Northern Triangle migrants and ask them what caused them to leave their country. Much needs to be done for the Biden-Harris administration to succeed and truly understand the root causes. Overall, migration from the Northern Triangle will not be fixed if the root causes remain unaddressed in these countries. This project demonstrates that at least in her rhetoric, Vice President Harris recognizes the root causes of immigration and is working to address them to solve the immigration crisis from the Northern Triangle.

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All documents reviewed by QDA miner can be found at the dropbox link here:
https://www.dropbox.com/sh/aqkj1krgeexuhqw/AABIoGFnqKqHO9sLT2V9

Object Play in Bottlenose Dolphins (*Tursiops truncatus)*

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Bottlenose dolphins (Tursiops truncatus) engage in various types of play, such as locomotor, social, and object play. Systematic study of object play, a cognitively complex behavior, across sex and age groups in dolphins is limited. The current study focused on the duration of object play in a group of 18-19 dolphins in managed care. Using an underwater video recording system and a standardized recording protocol, seven sessions of data were collected and coded between 2018 and 2019. Bouts of object play involving inorganic (underwater fins) and organic (seaweed, seagrass, and leaves) objects were coded for individual dolphin, sex, age class, and duration. The preliminary results indicated that on average, the dolphins played with the objects for roughly 6-8 seconds for both years. Males and females, as well as the different age classes, had similar durations in object play. Additionally, there was no difference in duration for sex or for age when the type of object (organic or inorganic) was considered. These findings were consistent across both years, despite large individual variation. More data are needed to better understand the relationship between age, sex, and duration for object play in bottlenose dolphins. This knowledge is critical as it may provide insight into their cognitive abilities.
Keywords: bottlenose dolphins, play, object play, sex, age

Object Play in Bottlenose Dolphins (*Tursiops truncatus*)

Play can be complex and may be characterized by an optimistic mood and associated internal motivation, usually occurring in secure and minimal-stress settings (Bateson, 2014). Hill, Dietrich, and Cappiello (2017) state that play behaviors should also seem to be pleasurable and spontaneous to the one engaging in play, as well as of

their own free will. Held and Špinka (2011) found that play is often an indicator of an animal's current welfare state; they mention how the benefits of play can be instantaneous, stalled, and/or long-term, which positively contributes to the animal's welfare.

There are various types of play, including solitary, observer, social, parallel, pretend, rough-and-tumble, object, and locomotor (Bateson, 2014; Cappiello et al., 2018). However, due to the strict criteria for recognizing animal play, certain types of play are usually only considered for humans, such as pretend and rough-and-tumble play (Bateson, 2014). Despite the differences in types of play across species, the act of playing is a common activity seen in most species. In fact, a large number of bird and mammal species have been observed engaging in play behaviors (Paulos et al., 2010); for example, both dogs and cats exhibit locomotor play. Dogs get into a low position on their forelegs and wag their tails to initiate play, while cats crouch with their heads down low and "paddle" their back legs (Bateson, 2014). A more common type of play to occur across species is social play, which can be seen in belugas (*Delphinaptera leucas*), bottlenose dolphins (*Tursiops truncatus*), and many mammals (Hill et al., 2011; Hill et al., 2017; Greene et al., 2011).

Bottlenose dolphins engage in play for a variety of reasons, including to hone their locomotor skills, social skills, and critical thinking skills (Kuczaj & Eskelinen, 2014). The skills are practiced and improved once play becomes more complex, which occurs in situations where older dolphins are involved or when a group adds another member, which is prevalent in social play (Cappiello et al., 2018). Play is a crucial component to the development of bottlenose dolphins. Hill et al. (2017) mention that play is social learning for calves, and use "Groos's play as practice" and "Parten's social hierarchy of play development" as theories to support their findings. Although dolphins do engage in social play, researchers stress that each dolphin brings their own behavioral differences to the group. Still, more research is needed in order to better understand each dolphin's contributions to the group's behaviors (Highfill & Kuczaj II, 2010).

Object play occurs when objects are manipulated or have captured the attention of an animal. Objects may be organic or inorganic. The former includes leaves, sticks, seaweed, and more. The

latter consists of items such as plastic bags, plastic balls, and more (Paulos et al., 2010). Bouts of object play are usually recorded when there is a contact between the dolphin and an object, or when the dolphin investigates an object in a close proximity ~one meter (Greene et al., 2011). The objects can be manipulated by any body part on the dolphin, such as their rostrum, flukes, and dorsal and pectoral fins. By engaging in object play, dolphins are developing and demonstrating their higher cognitive processes (Kuczaj et al., 2006). Object play is considered a "cognitively demanding process," due to the novel experiences that transpire during the play (Greene et al., 2011; Kuczaj & Makecha, 2008). Recording and analyzing object play by bottlenose dolphins is a research topic that has been examined in only a few studies (Delfour et al., 2017; Greene et al., 2011; Hill et al., 2017; Ikeda et al., 2018).

Present Study

We considered multiple questions in this study: 1) With what objects do dolphins play? 2) Which individuals (young or older, male or female) play with objects the most? 3) Which dolphins play more solo and which play more mutually? To summarize, the overall goal of this research is to examine how dolphins play with objects. I hypothesize that both sexes and the different age groups would play differently with a variety of objects. I predict that young dolphins play more with a variety of objects than do adult dolphins, males play more with a variety of objects than do females, young dolphins exhibit more object play than older dolphins, males show more object play than females, older dolphins exhibit more solo play while younger dolphins exhibit more mutual play, and that females exhibit more solo play while males exhibit more mutual play.

Method

Study Animals

Bottlenose dolphins (*Tursiops truncatus*) in managed care at the Roatan Institute for Marine Sciences (RIMS), Roatan, Honduras, were observed and their behavior recorded on video underwater. Dolphins were observed during two separate, one-week sessions: October 2018 and October 2019. In 2018, there were 19 dolphins, while

in 2019 there were 18 dolphins. During both sessions, ages ranged from one month to ~35 years. In 2018, there were 7 adult females, 3 subadult females, 1 calf female, 4 adult males, 2 subadult males, and 2 calf males. In 2019, there were 9 adult females, 1 juvenile female, 1 calf female, 3 adult males, 2 subadult males, 1 juvenile male, and 1 calf male. However, in 2019, the males were kept separate so they were not available for object play in our data. We only included data from animals that were available for observation.

The dolphins lived in a natural lagoon, with the main enclosure encompassing about 8,000 m^2 in surface area (Dudzinski et al., 2010). This lagoon is comprised of natural coral, seagrass beds, and sand with depths ranging from 8 m to the shore (Dudzinski et al., 2010).

Data Collection

Underwater video with synchronous stereo audio data were gathered with a mobile video/acoustic system (Dudzinski et al., 1995) following a focal animal/small group protocol. Data were collected in 30- or 60- minute sessions in the early morning in October 2019, and October 2018, with session length restricted by underwater visibility, current strength, and weather conditions. For this study, two morning sessions were event sampled from 2019, and five morning sessions were included from 2018.

Events of object play were sampled from these video data (collected K.M. Dudzinski, pers. comm., June 2021). From video data, object play (OP) bouts were event sampled using BORIS, a behavioral analysis software tool (Friard & Gamba, 2016). A bout of OP started when a dolphin's attention focused on an object. Each object play bout began with the initial contact a dolphin made with an object, or when a dolphin approached an object within one meter and inspected it, and ended when the dolphin left or dropped the object. A single bout included instances where a dolphin would interact with an object despite having intermittent physical contact, as long as the dolphin continued to show interest in the object (Greene et al., 2011).

Every OP bout documented involved a dolphin interacting with an object, whether it was organic or inorganic. Objects included seagrass, KD fins, KD, seaweed, fish, leaf, stick, rock, shell, trash, and other. Other associated information that was recorded included the

dolphin identification, age, and sex, "real" time of engagement, each dolphin's posture, the body part(s) used in object play, object type, whether the OP bout was solo or mutual, any vocal cues, and the departing dolphin. For the departing dolphin, this variable pertained to whether the focal dolphin engaged in OP stopped playing, went out of view, or was interrupted by another dolphin. The variables of interest that were analyzed for this research included the subject, age, sex, object, duration of OP bout, and whether the OP bout was solo or mutual (Table 1).

Definitions

Table 1

Operational Definitions of Variables of Interest

Variables of Interest	Operational Definition
Object	Object(s) (organic or inorganic) involved in an OP bout
Solo/Mutual	OP done solo or mutual with other dolphins. If mutual, check other individuals involved and comment who is joining.
Departing dolphin	**Outview** when the OP or contact ends out of view of the observer, **neither** when another dolphin swims in between object and dolphin interacting with object, or lose interest

Statistical Analyses

All statistical analyses used bouts of object play. A bout of object play began when a dolphin first showed interest in an object that was ~1 meter away, or when the contact was initiated between a dolphin and an object. A bout's end was recorded when the dolphin stopped interacting with the object for at least 10 seconds. If a dolphin exhibited intermittent physical contact with an object, but continued to show interest in the object, this was documented as a single bout of play.

A 4 (age class) x 2 (sex) x 2 (object type) x 2 (play type) ANOVA was performed to investigate all the hypotheses of interest.

Main effects were evaluated to address specific variables, which examined if there was a difference between sexes, ages, and play types. Significant interactions were followed-up with a 1-way ANOVA and post hocs to determine significant group differences. Two-way interactions were assessed to determine the additional hypotheses of interest. The data for 2018 and 2019 were assessed separately.

Results

To summarize the results briefly, the results of the two 4-way ANOVAs did not produce many significant effects. As will be discussed below, variability across the subjects and a limited sample size in some conditions affected many of the results. The data are organized per year for each hypothesis examined. Descriptive statistics for all variables and conditions of interest are summarized in Tables 3, 5, and 6.

Influence of Age and Sex on Object Play Duration

In 2018, 258 total bouts of object play were recorded (Table 2). The results of the 4-way ANOVA indicated no main effects for age or sex. Descriptively, adults played for slightly longer durations than the other age classes, but several of the age classes overlapped in their variability (Figure 1), which likely impacted the analysis. Likewise, although males had a slightly longer average duration for object play than females, females had greater variability in durations and overlapped with the males (Figure 2). These results indicated that the four age classes had similar object play durations and males and females had similar object play durations. Table 3 summarizes the descriptive statistics for 2018.

Table 2

2018 Bouts of Object Play Recorded

Variable	OP Bouts Recorded
Age	
Calves	59
Subadults	131
Adults	68
Sex	
Females	138
Males	120

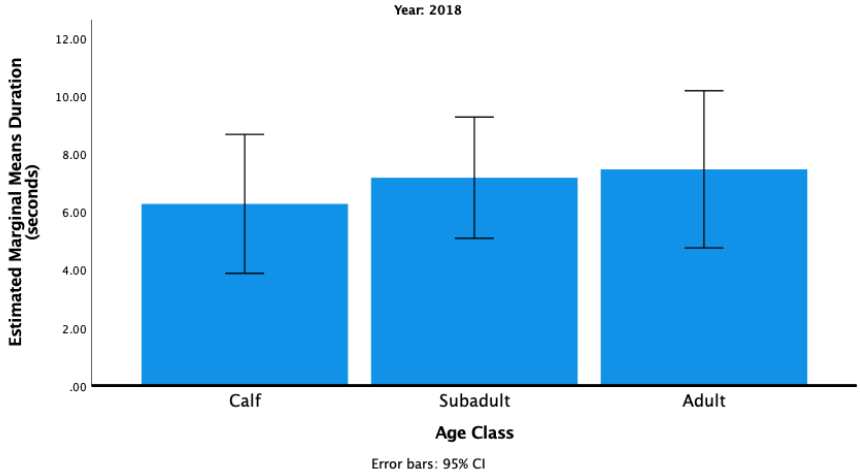

Figure 1
2018 Age versus Duration for Object Play Bouts

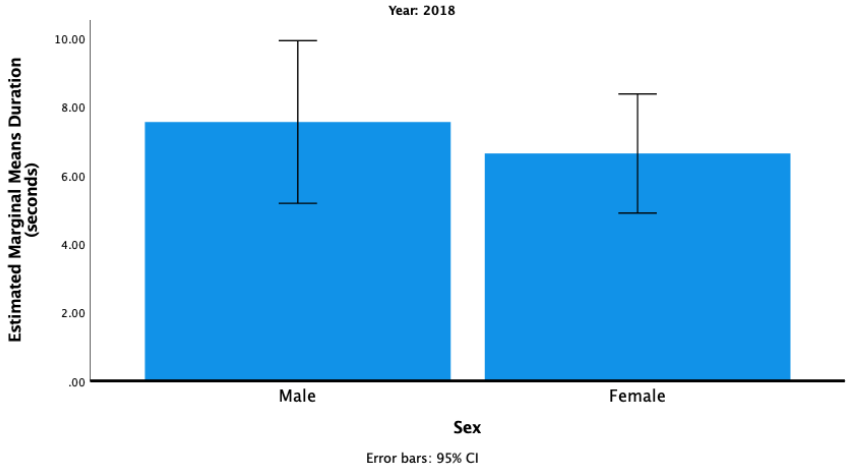

Figure 2
2018 Sex versus Duration

Table 3
2018 Descriptive Statistics

Variables	Mean	Standard Deviation	Sample Size
Age			
Calf	6.48	7.03	59
Subadult	7.68	7.84	131
Adult	7.84	8.05	68
Sex			
Male	8.24	7.55	120
Female	6.76	7.80	138
Object			
Inorganic	7.80	7.64	213
Organic	5.77	7.87	45
Play Type			
Solo	6.44	7.02	152
Mutual	8.90	8.42	106

In 2019, there were 83 total bouts of object play recorded (Table 4). The results of the 4-way ANOVA indicated no main effects for age or sex. Descriptively, calves played for longer durations than the other age classes, but several of the age classes overlapped in their variability (Figure 3), which likely impacted the analysis. Likewise, although males had a slightly longer average duration for mutual play than females, males had greater variability in durations and overlapped with the females (Figure 4). These results indicated that the four age classes had similar play durations and males and females had similar play durations. Table 5 summarizes the descriptive statistics for 2019.

Table 4

2019 Bouts of Object Play Recorded

Variable	OP Bouts Recorded
Age	
Calves	7
Juveniles	47
Adults	29
Sex	
Females	49
Males	34

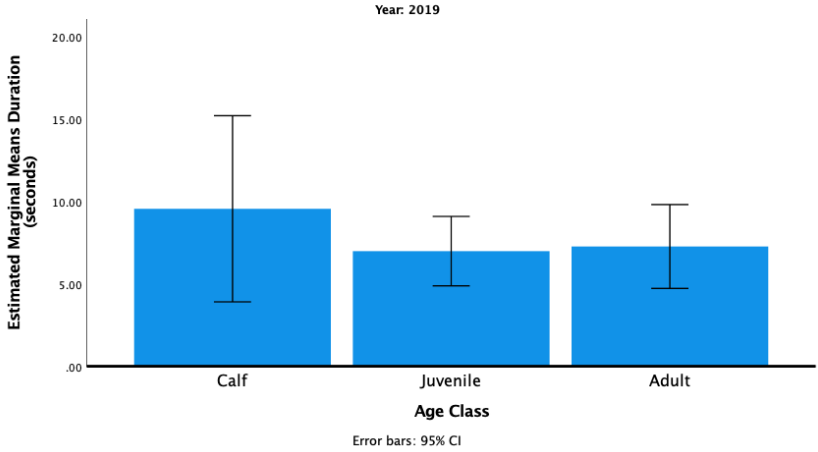

Figure 3

2019 Age versus Duration for Object Play Bouts

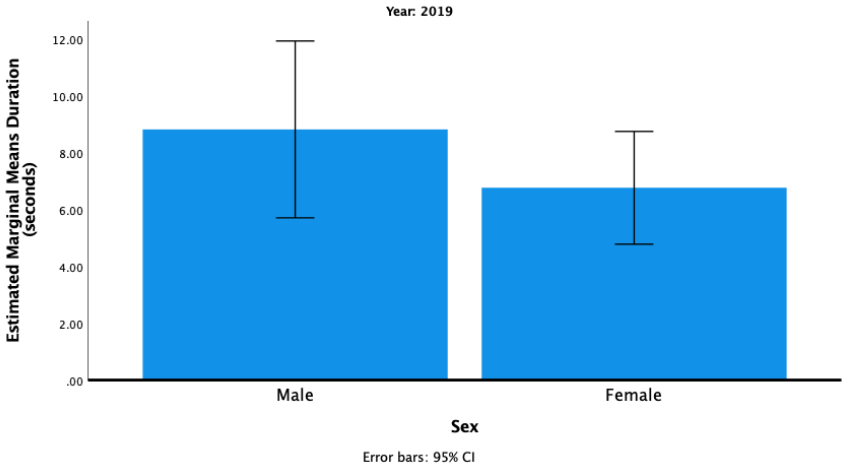

Figure 4
2019 Sex versus Duration

Table 5
2019 Descriptive Statistics

Variables	Mean	Standard Deviation	Sample Size
Age			
Calf	7.97	6.43	7
Juvenile	7.26	7.50	47
Adult	7.20	6.88	29
Sex			
Male	7.70	7.08	34
Female	7.02	7.22	49
Object			
Inorganic	7.64	7.54	65
Organic	6.06	5.38	18
Object Play Type			
Solo	5.71	5.89	50
Mutual	9.71	8.19	33

Object Play Type with Age and Sex

In 2018, there were no significant differences between age with object play type, sex with object play type, or object type with object play type. Overall, dolphins engaged in more mutual play rather than solo play, but this finding was not significant (Figure 5). Though not statistically different, there did seem to be an interaction between object play type and object type. The interaction showed that these dolphins played with the inorganic materials for longer durations when they played mutually versus when they played solo, $F(1, 240) = 3.24$, $p = 0.07$, $\eta_p^2 = 0.01$ (Figure 6).

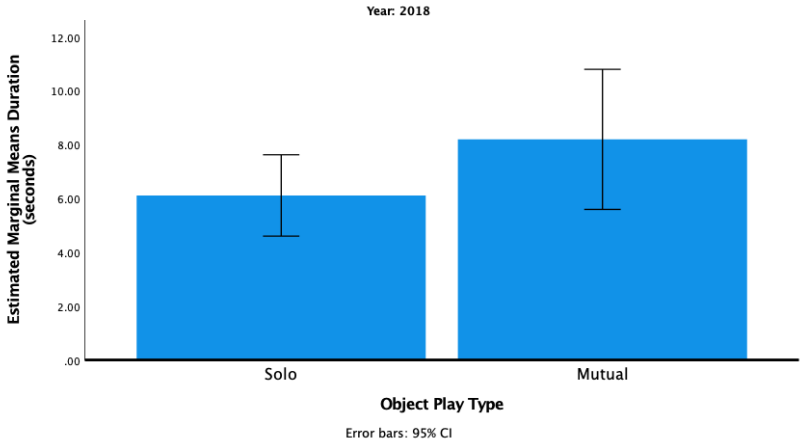

Figure 5
2018 Object Play Type versus Duration

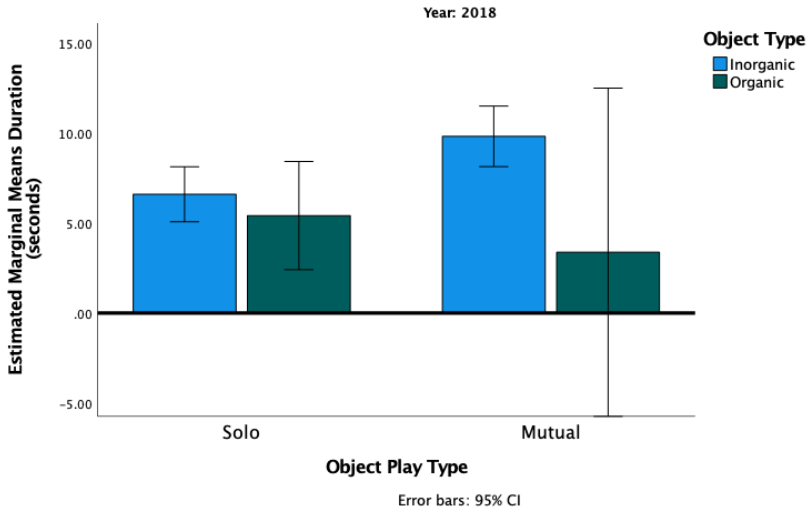

Figure 6
2018 Object Play Type versus Object Type

In 2019, there were no significant differences between object type with play type. Overall, dolphins participated in more mutual play than they did solo play, but this finding was not significant (Figure 7). Juveniles engaged in mutual play for a significantly longer duration of time than they did in solo play, $F(2, 73) = 5.13$, $p = .01$, $\eta_p^2 = 0.12$ (Figure 8). After conducting a one-way ANOVA, the juvenile solo play and juvenile mutual play were still significantly different ($p = .01$). No other differences were found to be statistically significant. Table 6 summarizes the descriptive statistics for age by play type.

Table 6

2019 Descriptive Statistics for Age by Play Type

Age by Play Type	Mean	Standard Deviation	Sample Size
Calf Solo	13.25	7.77	2
Juvenile Solo	3.95	2.92	27
Adult Solo	7.25	7.64	21
Calf Mutual	5.86	5.24	5
Juvenile Mutual	11.73	9.37	20
Adult Mutual	7.05	4.74	8
Total	7.30	7.13	83

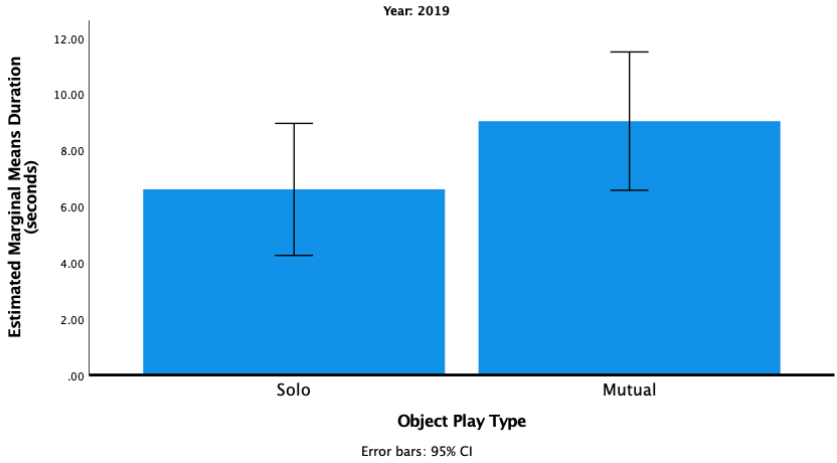

Figure 7

2019 Object Play Type versus Duration

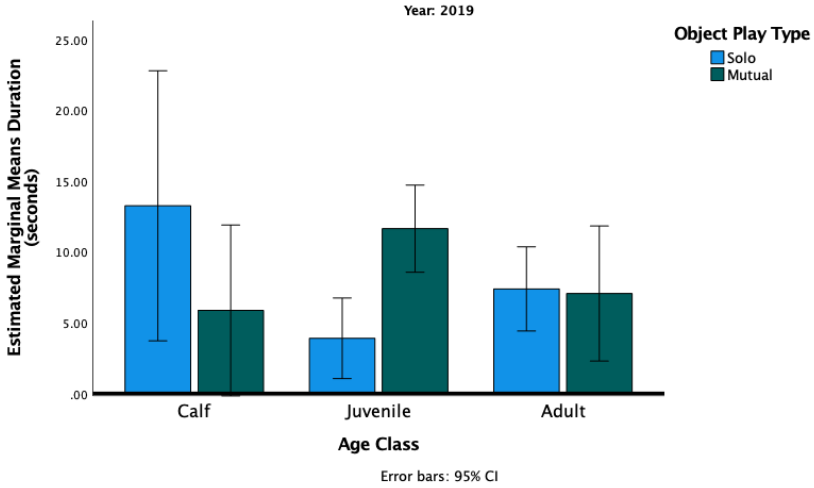

Figure 8
2019 Age versus Object Play Type

Object Type with Age and Sex

In 2018, there were 213 bouts of inorganic objects and 45 bouts of organic objects. No main effect emerged for length of time with each type of object was played (Figure 9). Likewise, there were no significant differences within the 2-way interactions between age or sex with object type. Although not statistically significant, the durations for inorganic materials and organic materials, respectively, were about the same for males and females (Figure 10). Figure 11 shows that all three age classes played with inorganic materials and organic materials, respectively, for similar durations. Similarly, no statistical significance emerged for the results showed inorganic materials were played with for longer durations than organic materials, $F(1, 240) = 3.34$, $p = 0.07$, $\eta_p^2 = 0.01$ (Figure 9).

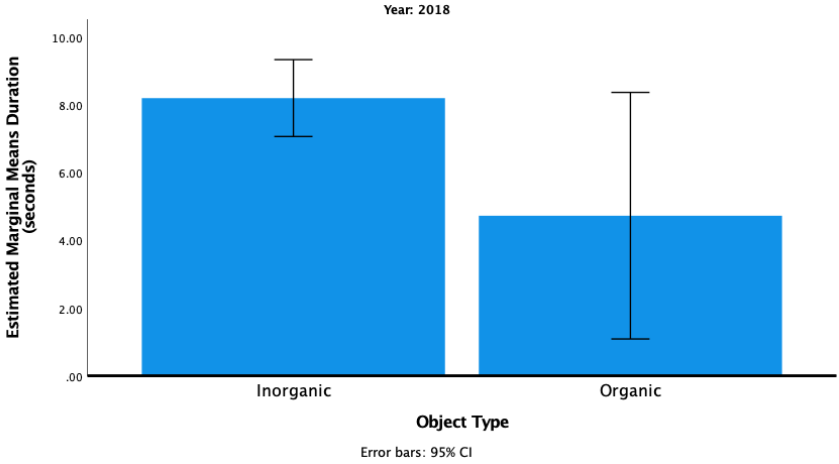

Figure 9
2018 Object Type versus Duration

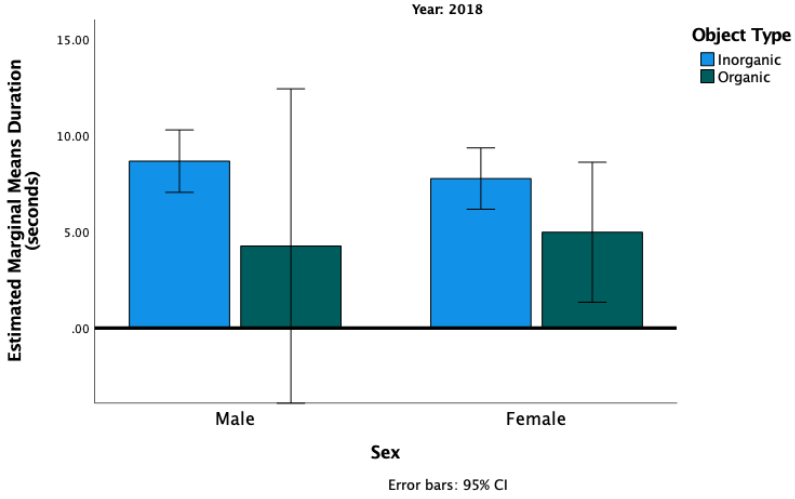

Figure 10
2018 Object Type versus Sex

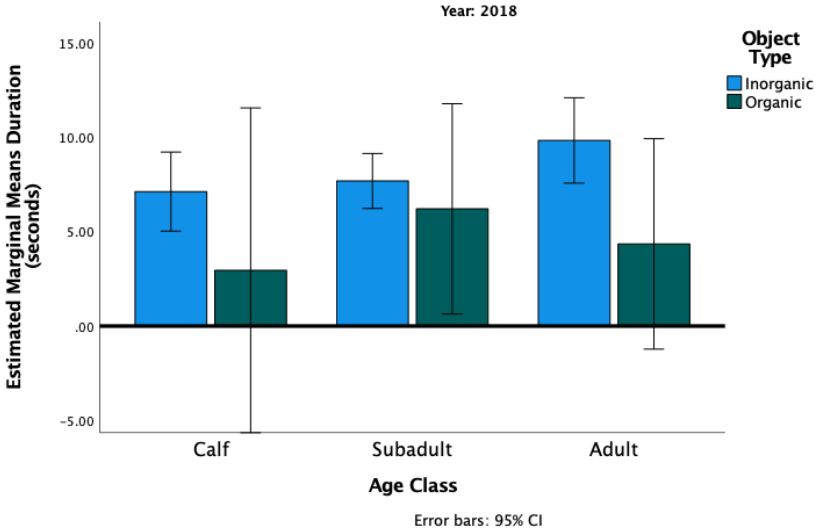

Figure 11
2018 Object Type versus Age

In 2019, there were 65 bouts of inorganic objects and 18 bouts of organic objects. There was no significant difference between age or sex with object type. Calves were not observed to play with organic material at all (Figure 12). There were no males that played with organic materials, but this lack of observation(s) was due to the absence of males in the recorded data for this year (Figure 13). Inorganic materials were played with for about the same durations across all age classes and both sexes, but this finding was not significant.

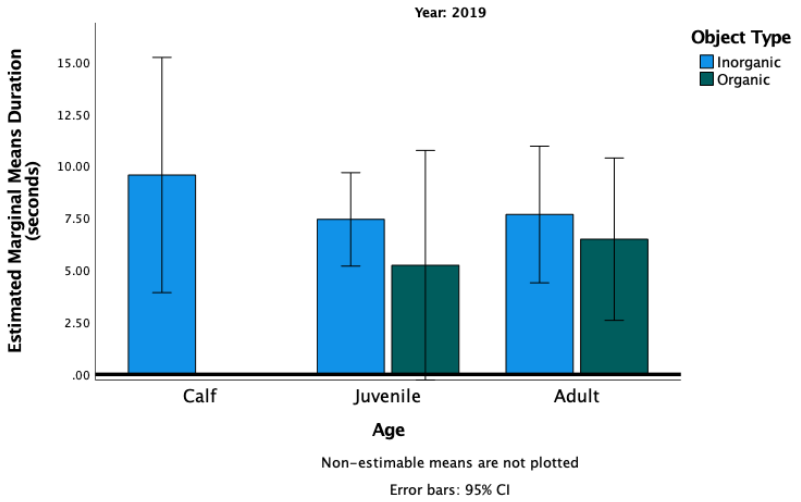

Figure 12
2019 Object Type versus Age

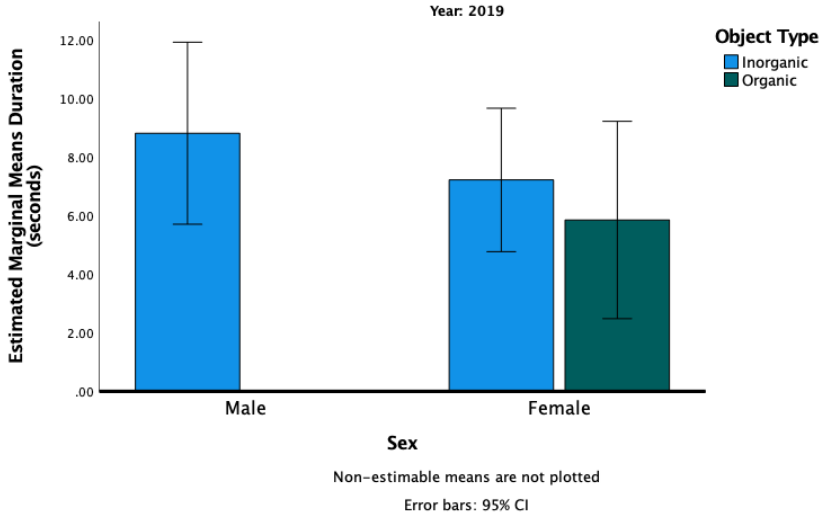

Figure 13
2019 Object Type versus Sex

Discussion

The results produced from this research did not support my hypotheses. From previous studies, the expected outcomes involved younger dolphins engaging in object and social play for longer durations of time rather than older dolphins (Delfour et al., 2017; Paulos et al., 2010; Kuczaj & Makecha, 2008). In addition, some previous studies included males engaging in object play for longer durations of time rather than females (Greene et al., 2017). The findings from this study were similar since the juveniles did significantly engage in social object play for longer durations than they did for solo object play. However, due to the limited sample size, the results cannot be generalized. More research would need to be conducted with larger sample sizes in order to generalize the findings. Juveniles playing for longer durations in mutual play versus solo play could continue to be tested with larger samples as well.

In 2018's play type data, the inorganic materials were played with for longer durations but due to the wide variability for organic materials in mutual play, statistical significance was not. There was some partial support in the direction of object type influencing object play durations. Dolphins played with the inorganic materials for longer durations when they played mutually versus when they played solo. This interaction could potentially suggest that when there are more animals around, the dolphins play longer with the inorganic materials than when there are fewer animals around. However, this result could be inaccurate due to the large amount of variability shown in organic material with mutual play. More research would need to be done to support this.

Limitations

There were limited sample sizes for certain individuals. Not all age groups were available for observation in 2018. All age groups were available for observation, but not for both sexes, in 2019. Despite the observations with all the age groups in 2019, the males were all kept separate. This means the males weren't available in the data to engage in object play. There were no adult males in 2019, which is why the data collected from 2018 could not be compared to the data collected from 2019.

There were only two video sessions coded for 2019, while there were five video sessions coded for 2018. The difference in the number of sessions was another contributing factor as to why I couldn't compare 2018 data to 2019 data. Therefore, the sample size of object play bouts for 2019 was smaller than the bouts recorded and coded for 2018.

Future Research

Future research could compare the two years if there are enough sample points recorded and coded to analyze. Ideally, all age groups would be available for all years in order to more precisely compare the years. By comparing observations of object play between the years, it would be possible to examine if there is a pattern in how individual dolphins in this group engage in object play.

It is also crucial for researchers to look into individual differences among dolphins when they engage in play, keeping in mind variables such as sex and age with respect to how play evolves in a group. My research looked into how a variety of variables might affect duration of object play bouts. Other research has shown that there are differences in dolphin behavior; for example, Kuczaj and Makecha (2008) take a closer look when they examine vocal ontogeny in their study, while mentioning McCowan and Reiss's (1995) study as well. Although McCowan and Reiss (1995) recognize that mature dolphins were able to "produce unique whistles," Kuczaj and Makecha (2008) conclude that it there are still questions to be raised about how the development milestone "benefits communication." However, this finding does suggest that dolphins are capable of flexibilities within communication (Kuczaj & Makecha, 2008). If researchers continue to explore individual variables, we could better understand each dolphin's contributions and behavioral differences to the group.

More types of play can be used for research, like locomotor, social, parallel, and more. Since there are more skills that are honed during various types of play rather than one, we could grasp a better idea of the dolphins' cognitive skills improving with all types of play.

Conclusion

Despite having a limited sample size, the data still showed one statistically significant result: juveniles played for longer durations when engaged in mutual play rather than solo play. Additional research with an expanded sample size would potentially facilitate determining if these results would change with more data. By examining multiple variables, we could better understand the individual contributions that dolphins provide to their groups when engaged in play. By further exploring those individual differences, we could also get a clearer insight into their unique cognitive abilities and developmental markers.

Researching object play does not directly provide a better understanding of the cognitive abilities or development milestones of dolphins, but it is a small and significant step in that process. All factors must be considered with the long-term goal of understanding dolphins' cognitive abilities and developmental milestones.

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The History of the School Finance System in San Antonio, Texas and the Implication on Minorities

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This study examines the relationships of the history of school finance and graduation rates through a comparative case study of four independent school districts (ISD) in San Antonio, Texas. Historically how Texas finances public education, despite numerous lawsuits and attempted revisions, has yet to display equity in educational outcome. Because local property tax and other state revenue have historically funded public education in Texas, a disparity between districts in neighborhoods with high and varying property values has developed over time. Many researchers have specifically focused on Alamo Heights ISD, which has been known for being a more affluent district, and Edgewood ISD, which has a reputation for high poverty levels, because the disparity between these two school districts has been apparent since school districts were introduced. This disparity is mostly caused by segregation, property tax values, and minimal state effort to close the gap. This paper is a comparative case study of the graduation rates and total operating expenditures at four independent school districts in the San Antonio area—Alamo Heights, Edgewood, Northside, and Southwest over a span of four years to examine the impact of the amount of resources allotted to each school district to provide a quality education. Graduate rates and operating expenditures are derived from the Texas Education Agency and difference in means test are utilized. Results show that districts, like Edgewood, that spend less and tax at a higher rate, have lower graduate rates than schools that spend more and tax less.

San Antonio, Texas and its surrounding areas is home to twenty public school districts. However, when viewing these schools on a

spectrum of wealth, it is apparent that even though these schools may only a few miles apart from each other, the students attending are living in two completely different worlds. Public education in Texas has historically disadvantaged students in poor districts. Many researchers have speculated that school finance system for public education in Texas is the leading cause of the obvious disparity in resources. More often this disparity of the funds is seen between more affluent school districts and less affluent school districts. San Antonio school districts face great funding disparities. So much so that the state of Texas recognizes this discrepancy, however, the government has not actively sought a resolution. Historically, these minority communities fare worse regarding educational attainment compared to their white counterparts.

This study is a comparative case study of four independent school districts (ISDs) in the San Antonio are—Alamo Heights, Edgewood, Northside, and Southwest. It considers how historical factors like residential and economic segregation, state government failing to establish equity among school districts, and local funding of public education in the city of San Antonio impacts graduation rates. Previous research has focused on identifying existing issues within the San Antonio school system and the impact they have on quality of education. This study examined whether there is a relationship between graduation rates and allocation of resources for four existing school districts in San Antonio. Preliminary analyses will be run to determine if the unequal allocation of resources affects graduation rates in the four districts being compared.

Literature Review

The History of School Finance

The literature of school finance affirms that economic segregation became apparent when school districts were established. Historically, the city of San Antonio has always struggled with funding public school education. Economic segregation began when Spain ruled Texas because they refused to assume responsibility for funding education (Gambitta, et al., 1983). This led to San Antonio locals funding their own public schools. In chapter 6 of “The Politics of San Antonio”, Richard Gambitta (1983) describes, at length, the process for

creating the school finance system. In his writings, Gambitta makes it clear that establishing a system of education that serves more than one type of demographic is challenging especially in a city as diverse as San Antonio. He strongly demonstrates how much thought and detail went into formatting a system to educate students in public schools which would explain the fact that even present day government officials have yet to rectify the inequity established at the genesis of this system. Gambitta (1983) also adequately iterates that although every amount of progress towards equitable funding in public schools is a victory, there are still a myriad of boundaries to overcome. He also goes on to illustrate just how unfair the system can be. In his book, he writes about the legal power more affluent districts were given with the ability to veto propositions that would equalize school funding. Researchers of this topic have agreed that because wealthier families have been able to give their children a better education, a disparity in funds was created which continues to cause implications on public education. Eventually, *ad valorem* taxes led to the establishment of the school finance system that created an even greater disparity in allocation of resources to public schools (Gambitta, et al., 1983). Funding for public education through the school finance system is provided by collecting local property taxes from the district's corresponding neighborhoods and then receiving state revenue based on remaining balances (Swaby, 2019).

In 2019, Marialena Rivera picks up where Gambitta (1983) left off. She describes the programs that were established in the late 1990s that proposed more assistance to schools in impoverished areas. Rivera (2019) also strongly makes point of how the state has lacked to provide suitable funding for schools. This information will be used as a base for the claim that the state government has yet to assume the full responsibility of funding public schools. The fact that property wealth is the deciding factor of which school districts receive better textbooks, teachers, and/or technology, displays just how inequitable the school finance system can be. The Edgewood cases, among other landmark court cases, exemplified that it is a complex situation due to economic segregation seen throughout San Antonio (Rivera, Lopez, 2019). Property values in San Antonio vary and are often reported to be lower in areas where poverty levels are higher (Rivera and Lopez, 2019). For example, Southwest can generate 43 cents of tax effort which

approximates to about $1,489 of spending per student. On the other hand, Alamo Heights can tax only 15 cents, but along with state aid can generate $1,732 of spending per students (Rivera, Lopez, 2019). "Interestingly, the school district with the greatest property wealth per student show the lowest school district tax effort" (Rivera, Lopez, 2019, pp. 14). This affirms the claim made by Glenn Hegar (2019), the Texas Comptroller of Public Accounts, that property-poor districts were forced to set a tax rate that was nearly double the tax rates for richer districts and despite this, those richer districts who tax less are able to spend more to provide a quality education (Hegar, 2019).
In his article, Hegar (2019) agrees with Gambitta (1983) and Rivera (2019) about how the state has struggled to "produce a system offering efficient, equitable public education (Hegar, 2019)." In his writing, Hegar (2019) coins terms like "a general diffusion of knowledge being essential to the preservation of liberties and rights of the people (Hegar, 2019)" and how it is "the duty of legislature of the state to establish and make a suitable provision for the support and maintenance of an efficient system of free public schools (Hegar, 2019)". These terms address the roles of the state government in public education seen in Texas legislation. This information continues to pave the paths sought out by previous researchers.

Landmark Cases Regarding School Finance

Texas state legislature has been, for the most part, responsible for creating a school finance structure that is both efficient and free (Gambitta, et al., 1983). While many lawsuits across various states were filed due to the inequities the public education system displayed, some like the *Edgewood Cases*, *Edgewood v. Kirby,* and *San Antonio Independent School District (SAISD) v. Rodriguez*, are further proof that a suitable school finance structure for public education has been difficult for state legislators to define. In *SAISD v. Rodriguez*, for example, plaintiffs including Demetrio Rodriguez argued that relying on local tax to fund public education was one of the main causes for the disparity in funds seen amongst the school districts in San Antonio. The court found that this was indeed in violation of the Equal Protection Clause of the 14th Amendment (Kozol, 1991). In chapter 6 of his book, "Savage Inequalities," Jonathan Kozol provides clarity about the harsh

process of reform. He does this by reminding the reader that even after more than twenty years since *SAISD v. Rodriguez*, the range of funds allotted to each student still obviously shows the disparity seen between in the resources allocated to each district. Unfortunately, even though cases like these were often taken to the U.S. Supreme Court, the disparity would be acknowledged, but would rule that the disparity was not great enough for reform at the federal level. Plaintiffs in the *SAISD v. Rodriguez* case were turned to the Texas Supreme Court to seek a solution for the disparity. Similarly, The Edgewood Cases consists of over 65 school districts filing a lawsuit with the primary complaint being the "unacceptable disparity in resources among Texas' public schools" (Hegar, 2019). Another subject addressed in Hegar's (2019) writings include The Edgewood Cases. He uses strong language to make it apparent that The Edgewood Cases are yet another example of how lengthy and complicated to process of achieving equity in public schools can be

Another landmark case would be *Edgewood Independent School District et al. v. Kirby et al*. The Mexican American Defense League and Educational Fund sued the commissioner of education, William Kirby, for arguing that the State public school finance system discriminated against students who lived in poor districts. The plaintiffs, again, believed that the gap in funds was simply unfair and ineffective and, thus, the school finance system needed reform. This widening gap affected poor school districts' ability to provide an overall equitable education for its students. Despite numerous attempts, plans, and revisions, flaws were pointed out by the court deeming both the plan and financial disparity among school districts, illegal. The State Legislature, in response to these court cases, have attempted various plans such as the "Robin-Hood" plan, that would offer options to schools in order to equalize school funding (Acosta, 1993). Despite these proposed solutions, researchers have concluded that inequality in school funding continues to be a problem. They have concluded this by addressing historical events, legislature, and landmark court cases that although they may seem substantial enough to have already achieved reform, the state of Texas is still far from it.

Residential Segregation

Residential segregation has historically housed minorities in the impoverished sides of town (Cotrell, 1975), which is yet another cause for the inequalities seen in public education. In his study, Charles Cotrell, Ph.D.,(1975) contributes to this research by addressing the quality of overall municipal services to different areas of San Antonio. Cotrell (1975) writes how municipal services, including education, are limited in neighborhoods with high poverty levels. He strongly elaborates on the on the notion of the containment of Latinos to one side of town and how it has led to an inequity in allocation of resources throughout the city. For example, San Antonio, due to its housing restrictions, did not allow minorities to purchase property in areas such as Alamo Heights, Olmos Basin, and Terrel Hills which are known to be the more affluent areas of the city (Gambitta, et al., 1983). This led to immigrants being left with no choice but to buy property in neighborhoods they could afford, which led to ISDs like the infamous Edgewood ISD neighborhood. Unfortunately, poor families historically being restricted in a certain area of town was no coincidence. When San Antonio finally opened up the first primary schools, there was a total of four schools; one for boys and one for girls on the West side, where majority of the population was Mexican, and one for boy and one for girls on the East side which is where the Anglos and Germans resided. This was one of the first racially based divisions seen in San Antonio (Gambitta, et al., 1983) Therefore, because minorities have been confined to a certain area of town with scarce opportunities for work and education, high poverty levels have continued to be reported which inevitably leads to low property values, higher tax rates, and still, poor quality education (Nathan and Adams, 1989). In their article, Richard Nathan and Charles Adam offer four perspectives on the hardships endured by those living in urban areas. The Metropolitan Area-Wise Perspective, the Central City Perspective, the Poverty Impaction Perspective, and the Central Business Perspective really captivate how urban areas, which are usually majority impoverished neighborhoods, are not appropriated the necessary resources to achieve equity. Further research also shows that property in suburban areas, compared to urban areas, have much higher property wealth allowing school districts assigned to those communities to collect more taxes than school

districts in urban areas with lower property wealth. In the case of this study, district lines often serve as barriers between students that are economically disadvantaged and students that come from more affluent families. Therefore, education has been a better experience for the Anglo population that reside away from Latino populations. Mexican Americans have been historically excluded from quality city services, such as education, due to a lack of representation (Cotrell, 1975). Frankly, there has not been enough people with positions of power than can advocate for equality within public schools. Housing restrictions as well as overall racism has contained the Latinx communities to one side of town and have made it difficult for them to purchase property in areas where property values are higher, and education is better, like suburban areas (Cotrell, 1975). More specific studies done from 1970-1980 show that the disparity seen between inner cities and the corresponding suburban areas steadily grew. Unfortunately, it is common to see higher poverty rates in areas that are more racially segregated than others (Santiago and Wilder, 1991). Anne Santiago and Margaret C. Wilder (1991) have boldly proposed that growth in levels of poverty in urban areas of the city would not have occurred had it not been for segregation. The conclusions in their journal confirm the inequities seen in the system by explaining how segregation contributes to poverty among minorities due to their lack of opportunities. Additionally, as property values have increased over the years, state funding, as a result, has decreased and, thus, widening the gap seen between more affluent and less affluent districts (Swaby, 2019). It then becomes more apparent that school funding relies on the property value of the surrounding neighborhoods and leads to an unequitable distribution of resources (Swaby, 2019). In her article, Aliyya Swaby (2019) provides an objective view on how the Texas school finance system works. Her clear and strong explanations allow for the system to be explained in a way that is not biased, but still speaks for itself how economically racist the system can be. This study hypothesizes that based on past studies and recent data collections from the four districts being compared, the inequity seen in the allocation of resources impacts the district's graduation rates.

Methods

This study analyzes four Independent School Districts (ISD) in San Antonio that include Alamo Heights, Edgewood, Northside, and Southwest. Alamo Heights and Northside were chosen for this study because of their reputation for having more affluent families within their district lines. Edgewood was chosen because it has historically been known to have higher poverty levels than other districts and Southwest was chosen because although it is fairly new, there is a majority Hispanic population with varying wealth. Data for these school districts were collected from the Texas Education Agency (TEA) and from the 2015-16 school year to the 2018-19 school year. These years were chosen for this study in order to analyze the most recent implications the school finance system has had on the public education system. The TEA provided graduation summaries which contained the average graduation rates as well as budget reports that contained the total amounts of local tax revenue and state revenue that each school district received.

This comparative case study uses graduation rate averages from each school district are compared both among each other and to the graduation rate average for all districts in Bexar County. A bivariate correlation analysis is also used to determine a correlation between graduation rates, local tax revenue, state revenue, and percent of the population that is considered economically disadvantaged. The one-way ANOVA test is utilized to find the difference in means, however, in this case, it is used only to compare graduation rates by district and by percent economically disadvantaged. The variable of percent economically disadvantaged, in this case, serves as a surrogate measure for property tax values.

Results

The results of the bivariate correlation show moderate to moderately strong negative correlations between graduation rates, the dependent variable, and local tax rates, state revenue, and percent economically disadvantaged for all four school years that were examined. Data for the 2015-16 school year shows that the strongest negative correlation occurred between graduation rates and percent economically disadvantaged with a Pearson correlation of –.788 (See

Table 1). Between graduation rates and state revenue the Pearson correlation was -.495 and between graduation rates and local tax revenue it was -.251. Alamo Heights ISD reported a graduation rate of 87.17% and 20.5% of students were economically disadvantaged. Edgewood ISD reported a 72.09% graduation rate with 50.9% of students were economically disadvantaged. Northside ISD reported a 76% graduation rate and 81.9% of students were economically disadvantaged. Southwest ISD reported an 80.06% graduation rate and 92.2% of students were economically disadvantaged. A visual representation of this data can also be found in Figures 1 and 2.

For 2016-17 school year, data shows a moderately strong correlation showed between graduation rates and local tax revenues with a -.648, as well as graduation rates and state revenues with a -.824 (See Table 1). For graduation rates and percent economically disadvantaged, the Pearson correlation was –.538. In Appendix A, table 3, Alamo Heights ISD reported a graduation rate of 87.94% and 20.7% of students were economically disadvantaged. Edgewood ISD reported a 75.24% graduation rate with 49.9% of students were economically disadvantaged. Northside ISD reported a 71.68% graduation rate and 81.6% of students were economically disadvantaged. Southwest ISD reported an 80.35% graduation rate and 91.1% of students were economically disadvantaged. A visual representation of this data can also be found in Figures 3 and 4.

Data for the 2017-18 school year shows that the strongest negative correlation was between graduation rates and percent economically disadvantaged with a -.759 (See Table 1). Between graduation rates and local tax revenue, the correlation was -.366 and between graduation rates and state revenue, it was -.621. In Appendix A, Table 4, Alamo Heights ISD reported a graduation rate of 86.44% and 20.7% of students were economically disadvantaged. Edgewood ISD reported a 75.91% graduation rate with 48.1% of students were economically disadvantaged. Northside ISD reported a 79.05% graduation rate and 82.4% of students were economically disadvantaged. Southwest ISD reported an 74.69% graduation rate and 93.2% of students were economically disadvantaged. A visual representation of this data can also be found in Figures 5 and 6.

Lastly, data for the 2018-19 school year showed the strongest negative correlation between graduation rates and percent economically disadvantaged with a correlation of -.820 (See Table 1). Between graduation rates and local tax revenues, the correlation was -.195 and between graduation rates and state revenue, it was -.466. In Appendix A, Table 5, Alamo Heights ISD reported a graduation rate of 87.94% and 19.7% of students were economically disadvantaged. Edgewood ISD reported a 71.68% graduation rate with 49.5% of students were economically disadvantaged. Northside ISD reported an 80.35% graduation rate and 85.1% of students were economically disadvantaged. Southwest ISD reported an 75.24% graduation rate and 94.7% of students were economically disadvantaged. A visual representation of this data can also be found in Figures 7 and 8.

Table 1. Correlation Matrix of Graduation Rates and Local Tax Revenue, State Revenue, and Percent Economically Disadvantaged

		Local Tax Revenue	State Revenue	% Economically Disadvantaged
Graduation Rates (based on the 2015-16 school year)	Pearson Correlation	-.251	-.495	-.788
Graduation Rates (based on the 2016-17 school year)	Pearson Correlation	-.648	-.824	-.538
Graduation Rates (based on the 2017-18 school year)	Pearson Correlation	-.366	-.621	-.759

Graduation Rates based on the (2018-19 school year)	Pearson Correlation	-.195	-.466	-.820

*Correlation is significant at the 0.05 level (2-tailed).

Table 1 shows a bivariate correlation matrix that displays the Pearson correlation for graduation rates, local tax revenue, state revenue, and percent economically disadvantaged.

Appendix A

Table 2

2015-16	N	Graduation Rate Average	% Economically Disadvantaged
AHISD	1	87.17	20.5
EISD	1	72.09	50.9
NISD	1	76	81.9
SWISD	1	80.06	92.2
Total	4	78.83	

Table 2 shows the average graduation rate for each district as well as the corresponding percent economically disadvantaged for the 2015-16 school year.

Table 3

2016-17	N	Graduation Rate Average	% Economically Disadvantaged
AHISD	1	87.94	20.7
EISD	1	75.24	49.9
NISD	1	71.68	81.6
SWISD	1	80.35	91.1
Total	4	78.80	

Table 3 shows the average graduation rate for each district as well as the corresponding percent economically disadvantaged for the 2016-17 school year

Table 4

2017-18	N	Graduation Rate Average	% Economically Disadvantaged
AHISD	1	86.44	20.7
EISD	1	75.91	48.1
NISD	1	79.05	82.4
SWISD	1	74.69	93.2
Total	4	79.02	

Table 4 shows the average graduation rate for each district as well as the corresponding percent economically disadvantaged for the 2017-18 school year

Table 5

2018-19	N	Graduation Rate Average	% Economically Disadvantaged
AHISD	1	87.94	19.7
EISD	1	71.68	49.5
NISD	1	80.35	85.1
SWISD	1	75.24	94.7
Total	4	78.80	

Table 5 shows the average graduation rate for each district as well as the corresponding percent economically disadvantaged for the 2018-19 school year

Figure 1

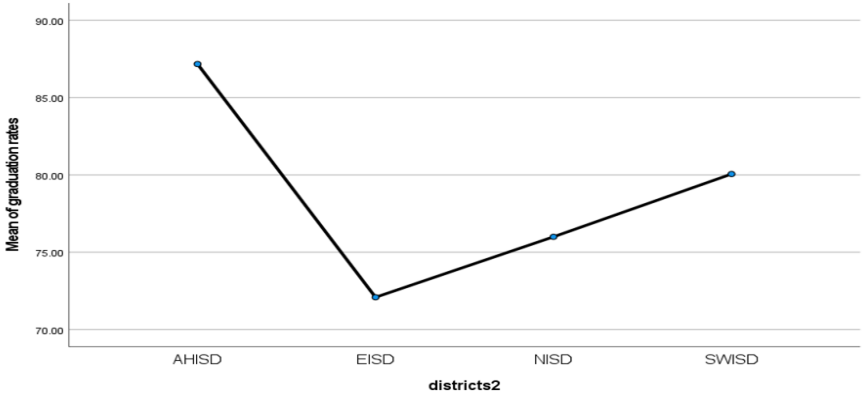

Figure 1 shows the average graduation rates for each district for the 2015-16 school year.

Figure 2

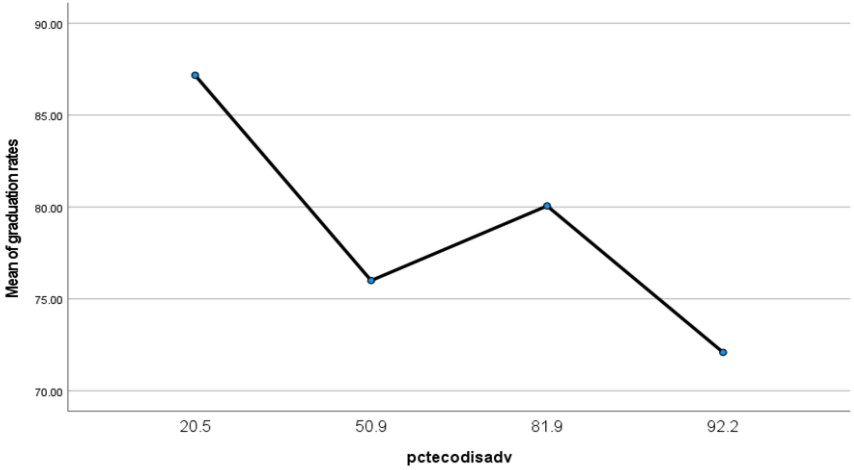

Figure 2 shows the average graduation rates compared to percent economically disadvantaged for the 2015-16 school year.

Figure 3

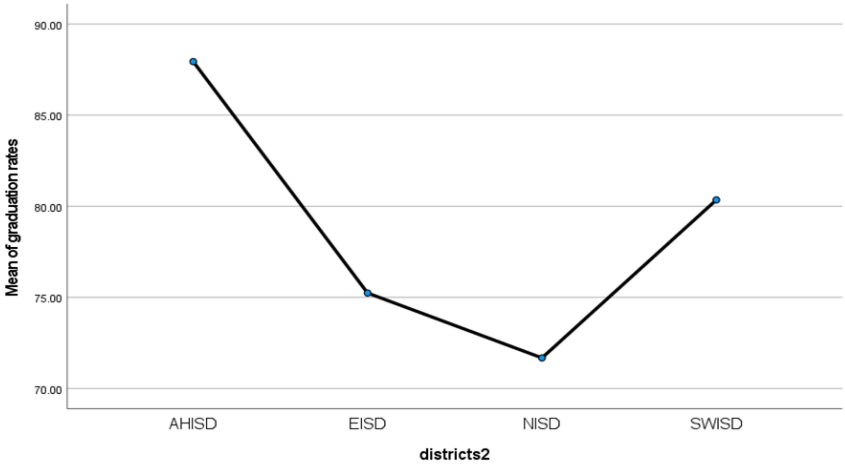

Figure 3 shows the average graduation rates for each district for the 2016-17 school year.

Figure 4

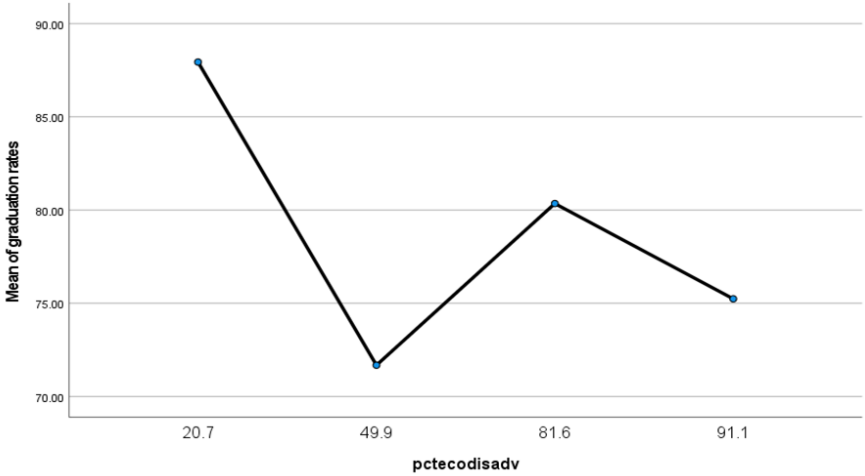

Figure 4 shows the average graduation rates compared to percent economically disadvantaged for the 2016-17 school year.

Figure 5

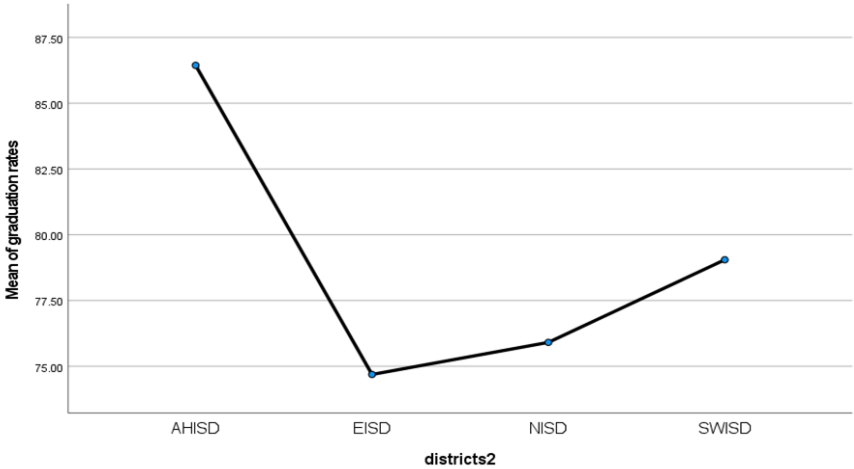

Figure 5 shows the average graduation rates for each district for the 2017-18 school year.

Figure 6

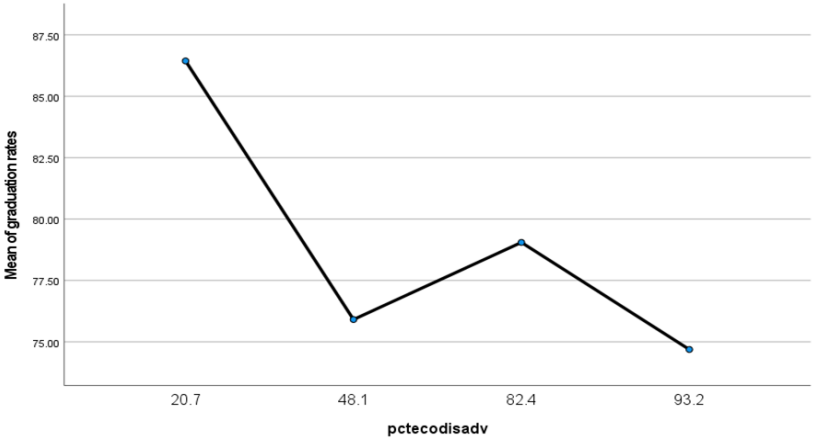

Figure 6 shows the average graduation rates compared to percent economically disadvantaged for the 2017-18 school year.

Figure 7

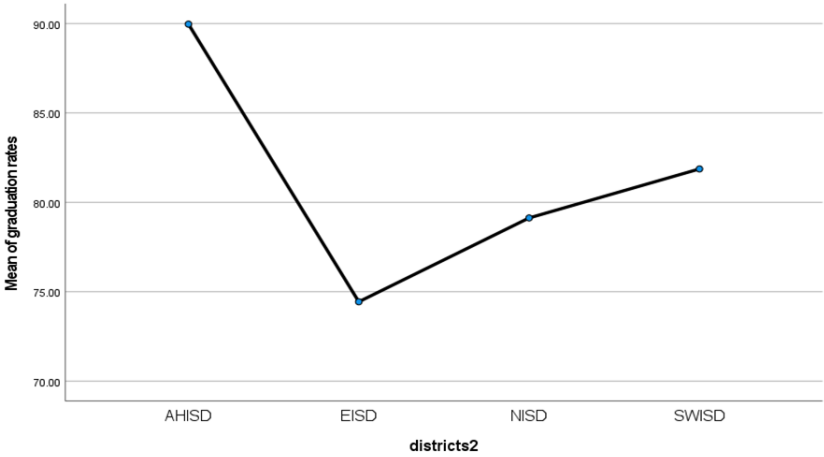

Figure 7 shows the average graduation rates for each district for the 2018-19 school year.

Figure 8

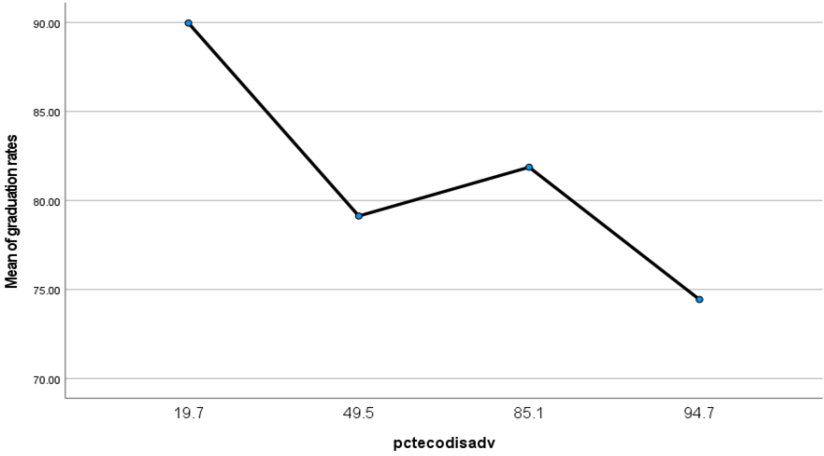

Figure 8 shows the average graduation rates compared to percent economically disadvantaged for the 2018-19 school year.

The results of the analyses show consistency in that graduation rates are negatively correlated to local tax, state revenue, and percent economically disadvantaged. For all years except 2016-17, the negative

correlation between graduation rates and percent economically disadvantaged has been the strongest. When looking at the comparison of means between district graduation rates and percent economically disadvantaged, it is apparent that graduation rates are higher in areas where a lower percent of the student population is economically disadvantaged and vice versa. For example, data for Alamo Heights show to the highest graduation rate among the four districts being compared as well as the lowest percent of economically disadvantaged students. On the other hand, we see Edgewood, Northside, and Southwest with significantly higher percentage of economically disadvantaged students and lower graduation rates.

Discussion

From the data, we can infer that although local tax and state revenue can somewhat affect graduation rates, there was a stronger correlation with the percent of students more often with percent economically disadvantaged. However, as previous research has explained, it is common to see areas with lower property values and higher tax rates also report higher poverty levels. Therefore, the percent economically disadvantaged variable can also be considered in place of property values. From the 2016-17 to the 2017-18 school year, graduation rates for Southwest ISD dropped nearly 6% while the percent economically disadvantaged increased by 2.1%. The Pearson correlation also changed from -.538 in 2016-17 to -.759 in 2017-18. This shows that high poverty levels in an area is associated with graduation rates. In Edgewood, it shows that the slightest percent change in percent of students that are economically disadvantaged can have an impact on graduation rates. Districts with a higher percentage of economically disadvantaged students, are reporting lower graduation rates which affirms that the allocation of resources is affecting student performance. From the 2017-18 to the 2018-19 school year, the percent change for economically disadvantaged was only 1.4% higher than the year before, however, the graduation rate dropped 4.3%. Resources via tax revenue from local property tax and state funding are negatively associated with graduation rates in these four districts. However, the sample number being four districts is a limitation of this study which means it is not substantial enough for a sophisticated analysis. In future

research, the plan is to examine the school districts in Bexar County to get a more accurate representation of the different school districts as well as a more accurate conclusion. These findings suggest that a high percentage of economically disadvantaged students, which leads to insufficient resources because of local tax rates, results in lower graduation rates for the school districts compared in this study.

Conclusion

Although this is only a preliminary examination of data, these four cases somewhat confirm the literature that there is inequality in the allocation of resources seen between districts with higher property values and lower property values. Being the diverse city that it claims to be, San Antonio still faces the issue of segregation. Although it may not be as apparent as it used to be, residential and economic segregation still leads to issues that are seen in the unequal distribution of resources to the school districts in town. The school finance system is mainly at fault for this disparity, however, there has been no solution or plan that would be suitable and constitutional. Because San Antonio and surrounding areas house twenty school districts, future research will allow for a larger sample, which will result to confirm these preliminary findings. Future research will also include more variables that give a more accurate representation of property value to properly analyze if the school finance system relying on local tax revenue impacts student success rates measured by graduation rates.

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Investigating the Relationship Between Creativity and Personality in Bottlenose Dolphins (*Tursiops truncatus*) Measured With *Innovate* Task Performance

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Creativity and personality have been often studied together in humans, with a few repeated findings. Based on the Big Five model of personality, openness and extraversion correlate positively with creativity. Creativity has been tested in bottlenose dolphins (Tursiops truncatus) using the innovate task, in which dolphins are required to produce a novel, or creative, behavior under stimulus control. However, the relationship between creativity and personality has yet to be studied in bottlenose dolphins. The current study investigated the relationship between performance on the innovate task as a measure of creativity and trainer-rated creativity as a measure of personality for eight bottlenose dolphins housed at the Roatan Institute for Marine Sciences (RIMS) in Roatan, Honduras. The results indicated that there was a moderate positive correlation between two ratings of fluency (number of correct behaviors performed) and trainer ratings of creativity, suggesting that more creative dolphins produced more trials and different behaviors. These preliminary findings suggest that dolphin creativity and personality may be measurable like human creativity and can inform future use of the innovate task.

Investigating the Relationship Between Creativity and Personality in Bottlenose Dolphins (*Tursiops truncatus*) Measured With *Innovate* Task Performance

Creativity has long existed as a highly elusive and complex yet promising and fascinating subject for researchers. Although a single universal operational definition does not exist, creativity is most commonly characterized by "the generation of a new product, idea, or

original invention, re-elaboration, improve(ment on) products or ideas existents" (Alencar & Fleith, 2003, as cited by Almeida et al., 2008, p. 54). A growing consensus among researchers suggests that creativity is influenced by cognitive ability, personality factors, cognitive style, and motivation, which makes measuring with a single metric difficult and unlikely. (Furnham & Bachtiar, 2008).

The Torrance Tests of Creative Thinking (TTCT), first administered in the late 1950's, has been used in numerous studies on creativity and has remained a useful tool for measuring creativity and predicting personal creative achievement. The TTCT tests four components of creativity: Fluency, the number of ideas produced; Flexibility, the variety of the ideas produced; Originality, the uniqueness of the ideas produced; and Elaboration, how detailed the ideas produced are (Almeida et al., 2008). A 50-year longitudinal study demonstrated that the TTCT continue to correlate with various measures of creativity and creative achievement (Runco et al., 2020). Following a series of validation studies, the TTCT exhibited acceptable test-retest validity, high alpha coefficients, and a significant relationship between fluency and flexibility (e.g., in a group of Iranian high schoolers, Rad et al., 2010). DeCaroli and Sagone (2009) found significant correlations across all creativity factors except for flexibility, and in Runco and colleagues' longitudinal study (2010) the four factors remained moderately interrelated over 50 years.

However, the TTCT have also produced mixed results, given the difficulty in measuring such a flexible and abstract concept. Almeida et al. (2008) found inconsistency in the four components of the TTCT being used as the main factors to measure an individual's creativity in an analysis of the TTCT's construct validity across three empirical studies, with three of the four (fluency, flexibility, and originality) failing to explain the variance of the TTCT subtest's scores sufficiently. It was found that only elaboration was adequately measured with the subtests administered, which is ironic given the lack of emphasis of elaboration as an important dimension of creativity in earlier research. That is, many of the validation results for fluency, flexibility, and originality were influenced by the task being performed and thus not generalizable. Across the three studies analyzed, the data

for fluency, flexibility, and originality did not explain the variance on the scores of the TTCT subtests.

Like creativity, personality has the potential to offer much insight into cognitive abilities while also sharing the same difficulty with regard to to measurement or interpretation. Studies on creativity in humans must also include the consideration of personality as the two constructs seem to be intertwined and mutually dependent. The most common and accepted model of personality is the Five Factor model, which typically consists of the following traits: Openness to experience (a need for or preference of variety or novelty), Conscientiousness (achievement striving, strong sense of purpose), Extraversion (gregariousness, preference for companionship), Agreeableness (willingness to defer to others during interpersonal conflict), and Neuroticism (depression, tendency to experience negative emotions) (McCrae & Costa, 1999, as cited by DeCaroli & Sagone, 2009).

Research has demonstrated that Openness and Extraversion are two factors that correlate the strongest with components of creativity (Batey et al., 2010). Openness and Extraversion emerged as the main difference in personality between creative and uncreative scientists, and artists were found to score about half a standard deviation lower on conscientiousness and half a standard deviation higher on openness (Feist, 1998, as cited by Furnham & Bachtiar, 2008). Openness was correlated with scores of divergent thinking (DT) and extraversion correlated with all four creativity measures used by Furnham and Bachtiar's study. These studies illustrate that a consistent relationship exists between creativity and Openness and Extraversion for humans.

Although the TTCT were conceived exclusively to measure human thinking, a training method developed by Karen Pryor with dolphins allowed for the extension and adaptation of the TTCT to creative behavior exhibited by marine mammals (Kaufman & Kaufman, 2004). Exploration of animal creativity was suggested as a possible way to gain insight into both animal cognition and creativity itself (Kaufman & Kaufman, 2004). Utilizing this framework, the *innovate* task, in which dolphins and other marine mammals are trained to produce any novel behavior or behavior they have not produced in a previous trial (Pryor, 1975; Braslau-Schneck, 1994, as cited by Dudzinski et al., 2018), has been used to test creativity. Behaviors produced by animals

from this trained concept have been analyzed using the TTCT framework (Bradley et al., 2019; Courtemanche et al., 2017; Kuczaj & Eskelinen, 2014; Lawrence et al., 2016; McCabe et al., 2018). The results from these various studies have suggested that dolphins produce a higher mean score of creativity than human preschoolers, which may be driven by the dolphins' repeated exposure to the task throughout their training (McCabe et al., 2018). Similarly, all dolphins tested by Kuczaj and Eskelinen (2014) excelled at producing creative behaviors and utilized various strategies for successfully varying their behavior, indicating clear individual differences between dolphins. Some dolphins performed better on *innovate* trials when they are reinforced with a primary reinforcer, highlighting the importance of the primary reinforcer (Lawrence et al., 2016). Finally, Bradley et al. (2019) found that the dolphins were able to produce relatively stable scores of fluency over four trials, suggesting that *innovate* could be a consistent measure of creative fluency. The results of these studies indicate that creative behavior can be trained and measured using a human-adapted theoretical framework, but knowledge about how a trained, creative behavior relates to an animal's individual characteristics like personality is unknown.

Measuring personality in animals is possible and has generally been demonstrated using measures obtained from trainer-reported ratings. One series of studies in personality with dolphins (Highfill & Kuczaj, 2007) was able to demonstrate the stability of an instrument developed from the Big 5 Factor model of Costa and McRae (as cited by DeCaroli & Sagone, 2009). After hurricane Katrina, a group of dolphins was moved to a different facility and handled by different trainers. When the ratings between the original trainers and the new trainers were compared, the majority of dolphins had individually different, consistent, and steady personalities (Highfill & Kuczaj, 2007). This study suggests that dolphin personality can be measured reliably similarly to humans. Dolphins also have highly variable behaviors and behavioral repertoires, maternal care styles, clear individual differences in early social development, and individual differences in group movement (Highfill & Kuczaj, 2010), all of which provide evidence of personality. In fact, one might argue that the social structure of dolphins is dependent on personality, as bolder dolphins,

those less fearful of novelty, were found to be more sociable and played an important role in group cohesion, stability, communication within the group, and gaining greater access to resources and mating opportunities (Lopez, 2020).

Still, in depth research regarding the relationship between creativity and personality has yet to be conducted. The current study aims to preliminarily explore this gap by using performance of dolphins on the *innovate* task. Following the training of innovate with a group of captive bottlenose dolphins living at the Roatán Institute for Marine Sciences in Roatán, Honduras, eight dolphins were selected to test their performance of the *innovate* task. These sessions were videotaped and later coded for correct (i.e., behavior was different from previous trial and not repeated in the session) and incorrect behaviors (i.e., repeated behaviors). The same dolphins were also rated by their primary trainer for personality characteristics, including overall creative ability. To determine if there was a relationship between creativity and personality, the current study focused on the fluency of the dolphins' performance on the *innovate* task and the overall trainer rating of creativity. The following hypotheses were tested:

1. Trainer-rated creativity will correlate positively with all measures of creative fluency.
2. All measures of creative fluency will be intercorrelated.

Method

Subjects

Eight bottlenose dolphins (six male, two female) were the subjects of the current study. The dolphins were housed at the Roatán Institute for Marine Sciences (RIMS) in Roatán, Honduras where they live with 10-12 additional dolphins in a lagoon enclosure. The enclosure is approximately equal to three football fields in surface area and has depths ranging from the shore to eight meters. Ranging in age from birth to 30+, the majority of the 18-21 dolphins were born into managed care with the older animals being born in the wild. Of the 12 dolphins tested using *innovate***,** one male and three female dolphins were excluded due to too few training sessions and poor performance. The eight dolphins that were examined for the study ranged between 5 and 30+ years.

Sample

An archived set of video recordings collected by researchers affiliated with the Dolphin Communication Project were coded by two trained research assistants. Each assistant assessed reliability for 25% of the video recordings to ensure agreement on the reinforced behavior. These data were then coded by one research assistant for all factors of creativity examined. Again, a second coder assessed reliability for 25% of the available test sessions. Any disagreements were resolved with discussion between the two coders and the principal investigator of the study. All dolphins at RIMS tested on *innovate*, completed five to nine sessions over a two week period, January 8th through 12th, 2018, and January 13th through 17th, 2018. The *innovate* task was worked intermittently over the years which led to the dolphins having different degrees of training experience. The first test session completed was excluded as the dolphins were not familiar with the testing procedures and their responses were not likely representative of their abilities.

Measures

The current study used three measures of creative fluency to measure dolphin creativity. The total number of successful trials, those in which a novel behavior or number of novel behaviors were produced and reinforced with a primary reinforcer, were counted and represented fluency 1. The total number of successful trials divided by the total number of trials in a given session were calculated to evaluate the successful fluency percentage for each session. This percentage represented fluency 2. The total number of trials in a given session were counted and represented fluency 3.

Personality Assessment

A bottlenose dolphin personality measure was used based on the measure used by Highfill and Kuczaj (2007). This personality measure included 30 behavioral traits in line with a factor from the Big Five model of personality and a seven point Likert scale to rate how well or how poorly the described trait describes the animal. Of the 30 questions asked, the current study used only ratings from one question regarding creativity written as follows: Creative, imaginative: Approaches situations and addresses problems in novel, creative ways.

(E.g. finds various ways to play with a toy); very creative; somewhat creative; slightly creative; neutral; slightly uncreative; somewhat uncreative; very uncreative. The ratings were reverse scored, so that "very creative" resulted in a score of 7, "somewhat creative" resulted in a score of 6, "slightly creative" resulted in a score of 5, "neutral" resulted in a score of 4, "slightly uncreative" resulted in a score of 3, "somewhat uncreative" resulted in a score of 2, and "very uncreative" resulted in a score of 1. This score was used to represent creativity as an aspect of personality.

Two trainers who were considered the primary trainer for each dolphin completed a personality survey within a year of the testing sessions. Each trainer was asked to rate their confidence in their ratings on a 7-point Likert scale with the following options: very confident; somewhat confident; slightly confident; neutral; slightly unsure; somewhat unsure; very unsure. For the purpose of the current study, only the surveys completed by trainers who selected "very confident" completed by a primary trainer were used.

Procedure

Data Collection

Dolphins had been trained on *innovate* since 2007. The training process involved teaching the dolphins to perform a different behavior each time a discriminative stimulus (SD) was given by the trainer. When the correct behavior was performed the dolphins received a reinforcement. Once the dolphins had learned the concept to the trainer's criterion, approximately 80% of trials in a session correct, the dolphins were tested. Training sessions were performed intermittently since the conception of the study. Test sessions were conducted once a day for a period of four days across each test week. The test sessions lasted as long as the trainer determined, motivation was reduced, reinforcement was low, or the dolphin repeated the same behavior three times in a row.

Data Analysis

Six Spearman's rho correlations were run with rated creativity, fluency 1, fluency 2, and fluency 3. Spearman's rho was selected given the Likert scale of the creativity score and the small sample size.

Although statistical significance was determined using the standard criterion of an alpha at .05, the correlation coefficient and the variance accounted for were of greater interest when examining the relationships due to the small sample size.

Results

Spearman's rho correlations were conducted to test the relationship between the trainer-based personality ratings and the three fluency measures. Table 1 summarizes the correlations. Although not significant, modest positive correlations emerged between rated creativity and the number of correct trials (fluency 1) , $r_s(df = 8) = .484$, and rated creativity and the percentage of correct responses (fluency 2), $r_s(df = 8) = .440$. Dolphins rated as more creative by trainers also completed more trials and produced a greater percentage of correct behaviors per trial completed. Moderate positive correlations were also found between the number of correct trials (fluency 1) and the number of trials completed (fluency 3), $r_s(df = 8) = .611$, and the percentage of correct responses (fluency 2) and the number of trials completed (fluency 3), $r_s(df = 8) = .618$. More correct trials were associated with more trials completed and a greater percentage of correct behaviors per total trials completed. Finally, a strong significant positive correlation emerged between the number of correct trials (fluency 1) and the percentage of correct responses (fluency 2), $r_s(df = 8) = .994$, $p < .001$. Number of correct responses were associated with greater percentages of correct responses.

Table 1

Spearman's rho Correlations for trainer rated personality and three fluency measures

		RatedPers	Flu1	Flu2	Flu3
Rated Personality	Correlation Coefficient	1.000	.484	.440	.082
	Sig. (2 tailed)	.	.224	.275	.846
	N	8	8	8	8
Fluency 1	Correlation Coefficient	.484	1.000	.994	.611
	Sig. (2 tailed)	.224	.	.000	.108
	N	8	8	8	8
Fluency 2	Correlation Coefficient	.440	.994	1.000	.619
	Sig. (2 tailed)	.275	.000	.	.102
	N	8	8	8	8
Fluency 3	Correlation Coefficient	.082	.611	.619	1.000
	Sig. (2 tailed)	.846	.108	.102	.
	N	8	8	8	8

Discussion

The findings of the current study provide partial support of the expected relationship between trainer-rated creativity and dolphin behavior-based creativity on a trained task called *innovate*. The trainer-rated creativity measure was synonymous with self-rated creativity in studies of human creativity, with the exception that the trainers rate dolphin creativity instead of the dolphin. In human research, self-rated creativity does not correlate with creativity, but it does correlate positively with Openness and Extraversion and negatively with Neuroticism (Batey et al., 2008). As expected from these human-based patterns, some evidence emerged through moderately strong

correlations between the trainer ratings of creativity and dolphin creativity scores of fluency. Due to the small sample size, these correlations were not statistically significant despite accounting for approximately 18% of the variance between the different measures of fluency and personality ratings. The significant correlation between fluency 1 and fluency 2 has positive implications for the construct and criterion validity, although the correlation was likely inflated by the relationship between the two, as fluency 1 was included in the calculation of fluency 2.

The current study was affected by several limiting factors with the collection and analysis of data. The single measure of personality did not allow for a larger view of the dolphins' individual differences in personality, as the three measures of a single factor of creativity (i.e., fluency) did not sufficiently represent the dolphins' individual differences in creativity. Creativity is a multifaceted and complex subject, and to be assessed reliably, multiple measures are required (Furnham & Bachtiar, 2008). The dolphins only completed a maximum of nine sessions and a minimum of five sessions, making significant results more challenging.

Future research should include more dimensions of creativity, preferably multiple measures of other Torrance factors and at least one measure for each Torrance factor, as well as more dimensions of personality, especially openness and extraversion. Working more with the Big Five traits would allow the results to be directly compared to those found from human studies. A test with more factors and a larger sample of data would allow for reliable conclusions. Additional investigation of the correlations between trainer-rated creativity and measures of creativity would also provide insight into the ability of trainers to judge the creativity of the animals under their care, as well as potentially the judgment of creativity in general from an external observer. Finally, based on the measures used in this study, a dolphin could hypothetically learn a sequence of behaviors that satisfied the conditions of a successful session and repeat the sequence in future sessions. This proposed innovative strategy presents a potential limitation; in this case, the dolphin would score highly on the measures of creativity while engaging in behavior that, while clever, would be particularly uncreative. If evidence of this strategy was found, it would

call into question the validity of creativity as measured by fluency. Future studies should investigate the existence of this possible strategy.

An improved understanding of dolphin creativity and dolphin personality leads to better and more personalized training and husbandry practices. Due to *innovate* being used as an enrichment activity, a better understanding of a dolphin's creativity and ability to perform the *innovate* task can lead to a more efficacious use of the task as a form of enrichment. Just as educators are best able to direct more attention at students performing worse in school, trainers aware of dolphins performing worse on *innovate* could work from a more informed position to improve their performance and provide additional training. One primary purpose of dolphin creativity research and the *innovate* task itself is dolphin enrichment (Dudzinski et al., 2018). As knowledge of an individual human's personality informs efforts to improve their individual welfare, a trainer could more effectively improve the lives and welfare of dolphins with a better understanding of their individual personality. Wild dolphins are also benefited by a better knowledge of creativity and personality in dolphins. Creativity can influence individual differences in behavior (Highfill & Kuczaj, 2007) and personality can heavily affect social structure and fitness (Lopez, 2020). Finally, along with the applications in practice, every improvement to the current understanding of the relationship between creativity and personality in any species informs future research into cognition in general. In conclusion, expanding knowledge of dolphin creativity and personality has the potential to also improve the enrichment and welfare of dolphins, as well as conservation efforts.

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A Statistical Analysis of The Variables Influencing New York Home Ownership Rates

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The study aims to uncover variables that have strong correlations and influence on the home ownership rates in New York. This is achieved by examining historical data from three years, 2016 through 2018. Out of the nine variables collected from the housing markets, the empirical study finds that homeowner incomes, housing units, price of condominiums, and poverty rates have relatively strong correlations with home ownership. More specifically, the relationship between home ownership and homeowner incomes is a positive one, which indicates that if individuals have more income, they can purchase more homes. Next is housing units, where a positive correlation indicates that as housing units increase, so do the home ownership rates. Following is the price of condominiums where there is a negative correlation, meaning that when condominium prices rise, the home ownership rates fall. Compared with homeowner incomes, housing units, and price of condominiums, poverty rates show the lowest correlation with home ownership rates, inferring that the relationship between poverty rates and home ownership rates is weak. Hypothesis tests are then conducted using regression models. The results suggest that the homeowner income (demand side) is a statistically significant driver of home ownership rates in New York, whereas housing units (supply side) is not.
*Keywords**:** New York, housing, data mining, correlation, regression*

Introduction

Prior to discussing specific factors influencing home ownership rates in New York, there must be understanding of why homeownership rates are crucial to financial and social stability for individuals and

communities in New York (Di and Liu, 2005). In a study prepared for the Office of Policy Development & Research at the U.S. Department of Housing and Urban Development, Di and Liu state that in recent years, there has been an increasing challenge which influences the probability of individuals transitioning to homeownership. Their findings highlight the importance that income and wealth have on the importance of transitioning to become a homeowner. In addition to this, what can also be seen from this source is the influence home ownership has on an individual's financial stability. This study contributes to this line of research by focusing on major cities, specifically New York in this case, where it is a consistent challenge to become a homeowner. According to Clara H. Mulder, in her research article for the University of Amsterdam, "The relationship between population and housing", the notion is that in the long run, population growth leads to a growth in housing demand, and vice versa, population decline leads to a decrease in housing demand (Mulder, 2021). The same notion can be applied to New York which is one of the heaviest populated cities, thus causing a high housing demand.

The purpose of this study is to investigate how different variables affect home ownership, which is something that is beneficial for individuals, the community, and the economy. According to Discover Bank, which provides home loans to millions of Americans, studies show that while home ownership rates have gone down in recent years, "it is still an aspiration for 61% of Americans" (Discover). Additionally, as the housing industry continues to recover in the next few years, that percentage is likely to increase, leading to more people buying homes. Individuals can benefit from home ownership in the sense that it is a good investment "that offers wealth-building opportunities" (Discover), such as leasing or selling in the future.

Moreover, since the housing industry is tied to the economy, when house sales increase, so do the household wealth and spending activities. It also helps stimulate the economy by increasing the value of the land surrounding the houses, which in turn attracts businesses and recreational spaces such as parks or malls. According to "The Economic Benefits and Costs of Homeownership: A Critical Assessment of the Research" by George McCarthy, Shannon Van Zandt, and William Rohe for the Center for Urban and Regional Studies

at the University of North Carolina Chapel Hill, specialists such as policymakers, nonprofit leaders, and housing experts consider owning a house as a key investment to acquire or accumulate wealth for the average American family. Additionally, this investment improves families' financial prosperity as well as the state and health of neighborhoods and the overall markets for credit, labor, and finance. Funds from real estate taxes also ensure the community is benefitting by improving infrastructure and projects such as "road repair, construction of schools and libraries, increased police and fire protection, snow removal in areas where it is affected, parks and greenways, and other government social services" (Discover). Moreover, home ownership has even greater non-financial benefits, which include an increased sense of community and belonging and the opportunity for individuals to get involved as members of a city or town. According to research published by Habitat for Humanity titled "Beneficial impacts of homeownership: A research summary", homeownership leads to increased graduation rates, children's health, and net family wealth, as well as decreases in children's behavioral problems, reliance on government assistance, and even conditions such as asthma. Families with all levels of income can benefit from owning a house. According to Renée Glover, chair of Habitat for Humanity International's board of directors, owning a house provides individuals the opportunity to have financial and emotional stability, as well as more tangible effects such as decreased health problems and increased graduation rates within families.

Additionally, studies have shown that home owning leads to accumulated wealth stemming from this investment, improved living conditions, increased involvement within their communities, and children are more likely to stay out trouble and do well in school, as stated by the U.S. Department of Housing and Urban Development (Habitat for Humanity, 2016). Overall, owning a house can lead to many increased benefits for individuals and families, both financial and non-financial, as well as provide many benefits for the community and the economy.

Motivated by the significant influence of home ownership rate on the general economy, we investigate the variables that affect home ownership rates. Through analysis, it is found that homeowner incomes,

housing units, price of condominiums, and poverty rates are the variables with a relatively strong correlations with home ownership. Then, regression analysis was used to find the extent and significance of these relationships. Through this research study, one can derive inferences what affects home ownership rates in large cities, such as New York.

Methodology

Methodology Background

Throughout the entirety of this paper, the primary methods of research involve the usage of data mining and data analytics. These processes are used to find possible trends and relationships among a vast amount of data. In the digital age, there is an excess of information, both data mining and data analytics provide a means to supply a meaning to this surplus of data.

Data mining is the process of analyzing large groups of data to find patterns, relationships, and outliers in order to predict a certain outcome. This process is useful for many things, including sorting data despite repetitiveness or noise in the large data set, selecting relevant data and finding correlations among that data in order to assess likely trends, as well as helping decision-making be more informed, efficient and accelerated. Methods of data mining include association, classification, clustering analysis, prediction, sequential patterns, decision trees, outlier analysis, and neural network (EDUCBA). Data mining is currently used in many industries, some of which are media, education, insurance, manufacturing, banking, and retail (SAS).

Data analysis is a broader term, which according to the Office of Research Integrity, encompasses all “processes of systematically applying statistical and/or logical techniques to describe and illustrate, condense and recap, and evaluate data.” Some issues to be considered in relation to data analysis involve selecting appropriate data, drawing unbiased inferences, determining statistical significance, reliability and validity of data, and the extent and application of the analysis (ORI). Data analysis methods include descriptive analytics, predictive analytics, and prescriptive analytics. Through the use of statistics and logical reasoning, data analysis is able to describe a group of data, predict future outcomes, and prescribe a logical course of action.

Additionally, according to Joel Ashirwadan in his article, "Communication Research Methods: Methods of Data Analysis", "the purpose of data analysis is to identify, transform, support decision making and bring a conclusion to a research. Data analysis on its own varies its name based on the domain of the study ranging from business, science and social science" (Ashirwadan).

Correlation Matrix

The first step of this paper is to produce a correlation matrix with the ten variables derived from the data. Correlation matrices are used when there is more than one independent variable being examined. In that case, all pairs of variables are presented in a matrix form that evaluates the relationship between each other, particularly the strength and direction of that relationship (NCSS). Reasons for calculating a correlation matrix include, but are not limited to, summarizing a large group of data and finding patterns within the group, inputting the correlations found into other analyses, such as exploratory factor analysis, confirmatory factor analysis, structural equation models, and linear regression when excluding missing values pairwise, as well as serving as a diagnostic when checking other analyses (Displayr, 2020).

Regression Analysis

The next step is to produce a regression analysis. According to Data and Statistical Services at Princeton University, "regression analysis is used when one wants to predict a continuous dependent variable from a number of independent variables." The latter can be either continuous or dichotomous. Typically, regression analysis is conducted on naturally occurring data variables, rather than experimentally manipulated data, although it is still possible. However, it is important to note how causal relationships cannot be determined using regression; regression only determines if two variables are related, not if one causes the other (DSS). Moreover, a simple linear regression "is a statistical method that allows us to summarize and study relationships between two continuous (quantitative) variables: one variable, denoted x, is regarded as the predictor, explanatory, or independent variable, and the other variable, denoted y, is regarded as the response, outcome, or dependent variable." On the other hand,

multiple linear regression has two or more predictors (Penn State University, 2018).

Hypothesis Testing

When conducting research that involves hypothesis testing, regression analysis is a useful tool. It measures how an independent variable affects a dependent variable as well as how strong that relationship is. By plotting the data points in a scatter plot and running a linear regression with a program such as Excel, one can visualize the relationship between those two variables. Next, a regression analysis model provides much information on that relationship, with which one can form a formula for the regression line that describes the slope of the line. The steepness and the direction of the slope reflects the correlation between the two variables. Moreover, regression analysis also provides the p-value, which helps determine whether or not the relationship is statistically significant. Therefore, conducting a regression analysis on research is helpful because it is an effective way of testing whether or not the independent variable one hypothesizes to affect the dependent variable is relevant. Additionally, in determining what variables are relevant and which ones are not, regression analysis can also help sort through the vast amount of data when conducting research, similar to data mining (Alchemer, 2021).

Empirical Results

The first step following the collection of data is to examine years 2016 through 2018 for all of the variables. Once doing this, the average is taken of all three years and then the Excel function for correlation (“CORREL”) is applied where the selected data is compared to find correlation with home ownership rates. This ends with the following correlation rates in *Table 1.*

Correlation with Home Ownership Rates	**Correlation with Home Ownership Rates**
Homeowner Income	0.362
Renter Income	-0.014
Poverty Rate	0.151
Population	0.050
Price Single Family Home	-0.011
Price Condominium	-0.224
Housing Units	0.201
Rent Burden	-0.094
Serious Crime	-0.098

Table 1:

In *Table 1,* all correlations are relatively weak. However, it is important to note that Homeowner Income has the highest positive correlation. It is also seen that Price Single Family Home, Renter Income, and Population have the weakest correlations.

Table 2:

Correlation Ranges	*The closer to the end of the spectrum on either the negative or positive side, the stronger the correlation (e.g. 2.85 or – 2.9).*
1>CORREL > 0	Positive Correlation
CORREL = 0	No Correlation
-1 <CORREL < 0	Negative Correlation

Following the correlation process, another important factor to take into consideration was how the variables are correlated with one another. This is where the correlation matrix mentioned in the methodology comes into use. Consequently, there is the conduction of the full correlation matrix which can be seen in *Table 3*.

Table 3:
CORRELATION MATRIX

	Homeowner Income	Renter Income	Poverty Rate	Population	Price Single Family Home	Price Condominium	**Home Ownership Rate**	Housing Units	Rent Burden	Serious Crime
Homeowner Income	**1.000**	-0.021	0.090	0.222	-0.069	-0.155	0.362	0.214	0.048	0.164
Renter Income	-0.021	**1.000**	0.411	-0.042	0.129	-0.164	-0.014	-0.015	0.060	-0.158
Poverty Rate	0.090	0.411	**1.000**	0.042	-0.159	-0.173	0.151	0.143	-0.053	-0.012
Population	0.222	-0.042	0.042	**1.000**	0.104	-0.017	0.050	-0.034	-0.134	0.267
Price Single Family Home	-0.069	0.129	-0.159	0.104	**1.000**	-0.234	-0.011	-0.101	0.036	-0.041
Price Condominium	-0.155	-0.164	-0.173	-0.017	-0.234	**1.000**	-0.224	-0.005	-0.202	0.449
Home Ownership Rate	0.362	-0.014	0.151	0.050	-0.011	-0.224	**1.000**	0.201	-0.094	-0.098
Housing Units	0.214	-0.015	0.143	-0.034	-0.101	-0.005	0.201	**1.000**	-0.135	-0.197
Rent Burden	0.048	0.060	-0.053	-0.134	0.036	-0.202	-0.094	-0.135	**1.000**	0.075
Serious Crime	0.164	-0.158	-0.012	0.267	-0.041	0.449	-0.098	-0.197	0.075	**1.000**

Another point to note is that certain points repeat themselves which is coherent since two variables are being compared twice. In addition to this, it can be noted that from the top left of the matrix to the bottom right there is a 1.000 listed straight across diagonally. This is expected, considering a variable should have perfect positive correlation with itself.

It can be seen that the variable that is most correlated with other variables is home ownership rates. As for the variables that have the highest correlation with home ownership rates, homeowner incomes, housing units, price of condominiums, and poverty rates are the variables with the highest correlation coefficient. Due to this is why the

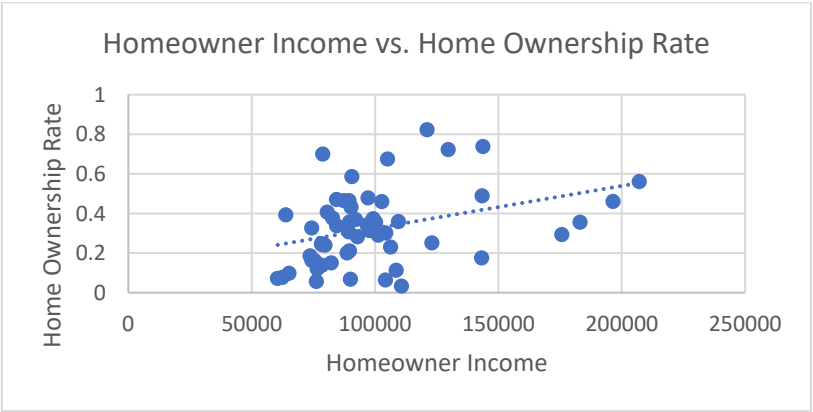
following four regression models are performed. Thus, the following factors compared to homeownership rates for this research are: Homeowner Incomes vs. Home Ownership Rates, Housing Units vs. Home Ownership Rates, Price of Condominiums vs. Home Ownership Rates, and Poverty Rate vs. Home Ownership Rates. These four comparisons are the ones chosen since they have the highest correlation coefficient among the rest of the variables.

When examining how other variables relate to Housing Units, we find that Homeowner Income, Home Ownership Rate, Rent Burden, and Serious Crime have the strongest correlation coefficients. Homeowner Income and Home Ownership Rate have a positive correlation with Housing Units, while Rent Burden and Serious Crime have a negative correlation. This means that when Homeowner Income and Home Ownership Rate increase, Housing Units increase as well. On the other hand, when the Rent Burden and Serious Crime increase, Housing Units decrease.

Homeowner Incomes vs. Home Ownership Rates

When examining the home ownership rate column, the strongest positive correlation can be seen with homeowner incomes. The correlation is of approximately 0.362, indicating a moderate positive relationship. This means that when homeowner income increases, so do home ownership rates. This relationship can be observed with the trendline found on *Graph 1*.

Graph 1:



In *Table 4*, the summary output can be seen. Throughout this study, there is a concentration on the coefficient and p-value cells. When looking at the correlation in a form of an equation, the equation Y = alpha + beta * X is utilized, alpha being the intercept coefficient and beta being the homeowner income coefficient. Thus, this makes the equation: Y = 0.111900046 + 2.13641E-06 * X. When graphed, this formula has a positive trendline which is what is illustrated in the previous graph. This indicates that for every unit increase in homeownership rate, the homeowner income increases by 2.13641E-06.

Additionally, this relationship is statistically significant as determined by the data presented. This is derived from the p-value of homeowner income, which is 0.006584. When this number is subtracted from 1.000, the outcome is approximately 0.993416 (≈ 99%). This means that, regarding this particular regression analysis, there is a confidence level of approximately 99%. The minimum confidence level for a statistically significant regression is 95%, which means that this regression is very reliable and appropriately demonstrates the relationship between these two variables.

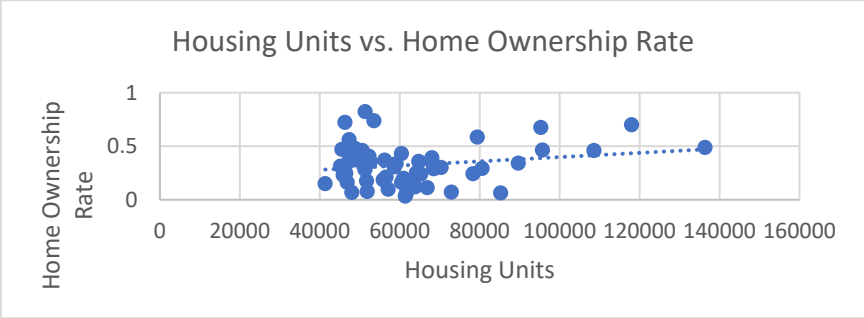
Table 4:
SUMMARY OUTPUT

	Coefficients	**Standard Error**	**t Stat**	**P-value**	**Lower 95%**	**Upper 95%**	**Lower 95.0%**	**Upper 95.0%**
Intercept	0.111900046	0.079416138	1.409034	0.164665	-0.047388555	0.271188647	-0.047388555	0.271188647
Homeowner Income	2.13641E-06	7.55256E-07	2.828722	0.006584	6.21558E-07	3.65126E-06	6.21558E-07	3.65126E-06

Housing Units vs. Home Ownership Rates

The second strongest correlation when comparing home ownership rates to the other nine variables is housing units. The correlation coefficient for this is 0.201, indicating a moderately weak positive correlation. This means when housing units increases, so do home ownership rates. This relationship can be visualized with the trendline found on *Graph 2*.

Graph 2:



In *Table 5*, the summary output for the regression model between housing units and home ownership rate can be seen. Once again, the concentration of the regression analysis is on examining the coefficient and p-value cells. The formula Y = alpha + beta * X is once again used. Therefore, when using the table to form this equation, it leads to the output of: Y = 0.200033646 + 1.98415E-06 * X. When this equation is graphed, it reinforces that the trendline for the relationship is a positive one. This indicates that for every unit increase in the home ownership rate, the housing units increase by 1.98415E-06.

Furthermore, this relationship is not statistically significant according to the data. This is derived from the p-value of homeowner income, 0.141344402. When this number is subtracted from 1.000, the outcome is approximately 0.858655598 (≈ 85%). This means that for this particular regression analysis, there is a confidence level of approximately 85%. Again, the traditional minimum confidence level for a statistically significant regression is 95%, which means that this regression is not statistically significant and does not appropriately demonstrate the relationship between these two variables. A possible explanation is that there might be other external factors influencing this relationship, such as the political systems in the surrounding area, location of the residence, and inflation rates.

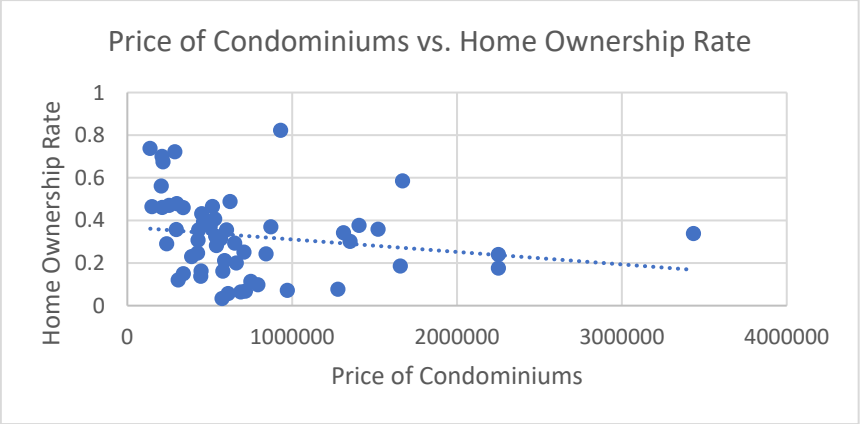
Table 5:
SUMMARY OUTPUT

	Coefficients	***Standard Error***	***t Stat***	***P-value***	***Lower 95%***	***Upper 95%***	***Lower 95.0%***	***Upper 95.0%***
Intercept	0.200033646	0.088090758	2.270767682	0.027250362	0.023345961	0.37672133	0.023345961	0.37672133
Housing Units	1.98415E-06	1.32889E-06	1.493085331	0.141344402	-6.81269E-07	4.64956E-06	-6.81269E-07	4.64956E-06

Price of Condominiums vs. Home Ownership Rates

When examining the negative correlations between the nine variables and home ownership rates, it is observed that the strongest negative correlation to home ownership rates is the price of condominiums. The correlation is -0.224, indicating a moderately weak negative relationship. This demonstrates that when home ownership rates decrease, the price of the condominiums increase. This can be tied to the fact that as the home ownership rates fall, there is an indication of less demand for houses and an increased demand for other types of housing, such as condominiums. Therefore, making the price of condominiums rise over time, possibly relating to the inverse relationship between these two factors.

Graph 3:



Within *Table 6*, there is the examination of the coefficient and P- value cells in the table. Similar to the two previous regressions, the equation Y = alpha + beta * X is utilized. As previously stated, alpha is the intercept coefficient and beta is the price of condominiums coefficient. This then makes the equation: Y = 0.369211351+ -5.86E-08 * X. Therefore, when the equation is graphed, it demonstrates a negative trendline which is what is shown previously in *Graph 3.* This illustrates that for every unit increase in the homeownership rate, the price of condominiums decreases by 5.86E-08.

To further examine the summary output, the p-value for the price of condominiums must be inspected. This value is approximately 0.164910049, according to the summary output of the regression analysis, as pictured in *Table 6*. When this number is subtracted from 1.000, the outcome is approximately 0.835089951 (≈ 83.5%). This indicates that the confidence level for this regression analysis is approximately 83.5%, which shows that this regression analysis is not reliable. Once again, this is because the traditional minimum confidence level for a statistically significant regression is 95%, indicating that this regression model does not appropriately demonstrate the relationship between these two variables, and that there can be external variables influencing this correlation. Such variables could include supply and demand of housing, consumer taste or preference, inflation rates, and the overall state of the economy.

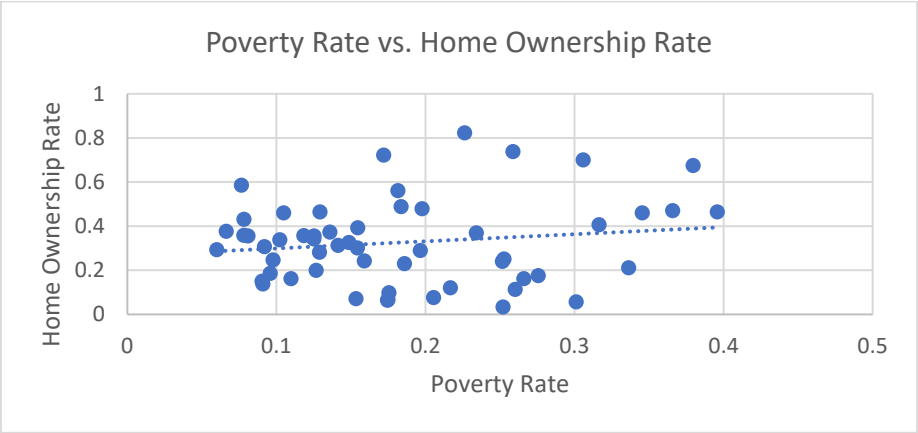
Table 6:
SUMMARY OUTPUT

	Coefficients	***Standard Error***	***t Stat***	***P-value***	***Lower 95%***	***Upper 95%***	***Lower 95.0%***	***Upper 95.0%***
Intercept	0.369211351	0.039703272	9.299267539	1.00203E-12	0.289576672	0.448844603	0.289576672	0.448844603
Price of Condominiums	-5.86E-08	4.1605E-08	-1.408203113	0.164910049	-1.42037E-07	2.48608E-08	-1.42037E-07	2.48608E-08

Poverty Rate vs. Home Ownership Rates

The last relationship examined is the correlation between poverty rates and home ownership rates. As per the correlation table and matrix shown above in *Table 1*, there is a correlation of 0.151. This is a weak positive correlation. As pictured in the scatter plot in *Graph 4*, there are many outliers in the data, which demonstrates that the relationship cannot accurately be described by a linear regression. Therefore, one can infer that poverty rates do not significantly affect home ownership rates.

Graph 4:



The summary output for this regression can be seen in *Table 7*. Moreover, an examination is conducted of the coefficient and P- value cells. For this, the equation Y = alpha + beta * X is used, alpha being the intercept coefficient and beta being the poverty rates coefficient. Therefore, the formula for this relationship is: Y = 0.266819546 + 0.322063309 * X. This formula, when graphed, highlights a flat positive trend line. This demonstrates that for every unit increase in homeownership rate, the poverty rate increases by 0.322063309.

Next, the statistical significance is examined. This is drawn from the p-value of poverty rates, 0.272739243. When this value is subtracted from 1.000, the result is approximately 0.727260757 (≈ 72.73%). This means that the confidence level regarding this regression analysis is approximately 72.73%, which is a lower amount than the

minimum confidence level for a statistically significant regression, 95%. The lower value for confidence level indicates that this regression is not reliable and does not appropriately demonstrate the relationship between these two variables.

Table 7:
SUMMARY OUTPUT

	Coefficients	***Standard Error***	***t Stat***	***P-value***	***Lower 95%***	***Upper 95%***	***Lower 95.0%***	***Upper 95.0%***
Intercept	0.266819546	0.059196467	4.507355909	3.65832E-05	0.148086469	0.385552623	0.148086469	0.385552623
Poverty Rate	0.322063309	0.290593864	1.108293561	0.272739243	-0.260794171	0.904920788	-0.260794171	0.904920788

Conclusion

The examination of different variables that influence home ownership rates in New York uncovers four important drivers: homeowner incomes, housing units, price of condominiums, and poverty rates. After conducting empirical studies on each of these variables' relationship to home ownership rates, it is found that homeowner incomes is the variable with the highest correlation with homeownership rate and the only one with statistically significance. This makes sense due to the fact that as an individual's income increases, so does the probability of that individual becoming a homeowner.

On the other hand, housing units, price of condominiums, and poverty rates also had a relatively high correlations with homeownership rates but were not statistically significant, according to the regression analyses. Overall, when attempting to solve the lack of homeownership in major cities, such as New York, this study shows that the focus should be placed on the demand side. Regardless of the housing units added to the city, an individual must first find the financial means to become a homeowner. If an individual does not have the financial means, that individual is less likely to purchase a home, which is one of the strongest financial assets a person can have.

This study opens up the opportunity for further research to be done on the implication of policies such as incorporating a higher minimum wage within large cities. The literature reveals that other variables that may lead to an individual not being able to buy a house include low income, unemployment, social class status, racial differences, lack of financial literacy, among others. Ideally, with more research and resources allocated to address such issues, new changes will allow for home ownership rates to increase, become more attainable, and more equal for all members of society.

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Autism Severity: Mean Differences of Social & Physical Activity Participation

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Children diagnosed with autism spectrum disorder (ASD) participate in lower rates of leisure activities (physical, social, recreational, skill, and jobs/chores) than children who do not have the condition, which predisposes them to various health concerns and a reduced quality of life. Levels of social and physical activity engagement are reciprocal—as participation in physical activity increases, so do levels of social activity and vice versa. Early intervention programs are dedicated to increasing participation in leisure activities and overall quality of life for children with autism. This study evaluates the impact of parent-rated autism severity on participation in physical and social activity. Based on previous literature, it was predicted children with moderate-to-severe autism would engage in less physical and social activity levels than children with mild-rated or without autism. Results suggest a significant difference in physical participation levels between children with moderate-to-severe autism and children not diagnosed with ASD, and a trend toward significance in the social activity of eating a meal with family between children rated with mild autism and children without autism. This implies that while intervention methods are important to promoting high rates of social and physical activity in children with ASD, these programs may not account for important differences between severity in diagnosis. Implications for future research will be discussed.
Keywords: autism, autism spectrum disorder, leisure activity, physical activity, social activity, autism severity, participation, children with autism, children with ASD, mild autism, moderate-to-severe autism

Autism Severity: Mean Differences of Social & Physical Activity Participation

Participation in leisure activities is vital for the health and development of individuals from childhood to adulthood (Potvin et. al., 2013; Ratcliff et. al., 2018). Children with autism are reported participating in fewer leisure activities than individuals without autism, which results in poor health outcomes and low quality of life (Ratcliff et. al, 2018; Simpson et al., 2019). Intervention programs are instituted at early ages for children with autism in order to decrease social exclusion as a result of deficiencies in communication, learning, and language processes (Brown et. al., 2020; Chiva-Bartoll et. al., 2021; Davidson & Orisini, 2013; Silverman, 2012). Although these intervention programs are *context-specific* and *user-centered,* the approach to increasing social and physical engagement in autistic children is generalized (Chiva-Bartoll et al. 2021; Colombo-Dougovito & Block, 2019; Howells et. al. 2019; Ruggeria et al., 2019). This study aims to evaluate whether key differences exist within participation rates of two leisure activities: (1) physical activity and (2) social activity based on their reciprocal nature. Based on the literature, it is predicted children with moderate-to-severe autism will engage in less physical and social activity levels than children with mild-rated autism or without the condition.

Autism

Autism as a condition derives from the concept of negative social affect or *autisic isolation* in patients with mental-health related illnesses (Silverman, 2012). Autism and autism- related conditions are categorized within the fifth edition of *Diagnostic and Statistical Manual of Disorders (DSM)* under the classification of autism spectrum disorder (ASD)—preceding versions having listed autism and other related disorders, such as Asperger Syndrome, separately until recent publication in May 2013 (American Psychiatric Association [APA], 2013; Silverman, 2012). The categorization of autism spectrum disorder (ASD) targets two areas of impairment: stereotyped (restricted or repetitive) patterns of behavior which present in onset early childhood and deficiencies in language, communication, and social relations

(APA, 2013; Brown et. al., 2020; Davidson & Orisini, 2013; Silverman, 2012). Furthermore, individuals diagnosed with autism have reduced engagement in creative play, processing stimulation, adjusting to noisy environments, and contact—especially maintaining eye contact—with others (Bowe, 2004; Chiva Bartoll et. al., 2021; Wilmshurst & Brue, 2010).

Children diagnosed with autism have increased at considerable rates with prevalence rising to one out of every fifty-four children at the age of eight (Chiva-Bartoll et al., 2021; Hamm & Yun, 2019; Maenner et al., 2020). Children with autism are resistant to change, have a limited range of interests, and show difficulties both in relating to others and following rules (Chiva-Bartoll et al., 2021; Habib et al., 2018). These challenges distort development in learning, communication, and attention processes (Chiva-Bartoll et al., 2021).

Although not universal to the experience of autism, children with the condition are commonly reported to show motor-related difficulties as well (Chiva-Bartoll et al., 2021; Dewey et al., 2007; Whyatt & Craig, 2012). Studies remain unclear whether the deficits in motor control stems from autism or other factors, such as decreased motivation or poor instruction (Chiva- Bartoll, et al. 2021; Fournier et al., 2010). Control of posture and gait, lateral alterations, and deficiencies in fine motor skills (manual dexterity, writing, visuomotor integration with object control) are a few examples that children with autism showcase in motor-related difficulties (Chiva-Bartoll et al., 2021). Studies report a range of 35-83% of individuals within ASD populations also have motor-control deficiencies, and suggest performance of motor skills worsens through adolescence and into adulthood (Chiva-Bartoll et al., 2021; Travers et al., 2017).

Leisure Activities

Ratcliff and colleagues (2018) define *leisure* as time that is time engaged for the purpose of pleasure without the demands of activities pertaining to survival. Engagement in leisure activities correlates with positive measurements in perception and participation of life events including health, education, independence, and both familial and social relationships (Billstedt et. al., 2011; Egilson et al., 2017; Ratcliff et al., 2018). These measurements detail whether an individual

has a high or low quality of life (Ratcliff et al., 2018). Individuals with autism commonly score a lower quality of life than individuals without autism, as a result of participating in few leisure activities (Ratcliff et al. 2018; Simpson et al., 2019).

Ratcliff and colleagues (2018) propose five categories of leisure activities as being *physical activity, recreational activity, social activity, skills,* and *jobs/chores*. What activities encompass each category varies. Engagement in sports (e.g., track, martial arts, soccer) or individual exercise (e.g., bicycling) for at least one hour is considered *physical* activity (Ratcliff et al., 2018). *Recreational* is more broad; activities do not require socialization and functional independence while providing pleasure or satisfaction, such as watching television (Ratcliff et al., 2018). Next, social activity pertains to the engagement of individuals to satisfy either social

or survival needs for social interaction (Ratcliff et al., 2018). Examples include eating meals with family or participating in afterschool clubs (Ratcliff et al., 2018). *Skills* refers to the utilizing of a new activity for the purpose of learning whilst *jobs/chores* require completion of a task (e.g., music and working for pay, respectively) (Ratcliff et al., 2018).

Children with autism are reported to participate in significantly lower rates of physical, social, skill, and jobs/chores activities when compared to non-autistic peers (Chiva-Bartoll et al., 2021; Lloyd et al., 2013; Ratcliff et al., 2018). Studies suggest the result of no significant differences between autistic and non-autistic groups in *recreational* activity is that the category requires only limited social interaction to acquire satisfaction (Ratcliff et al., 2018). Among the activities where significant differences between children with ASD and non-autistic children are reported, *physical* and *social* are correlative (Chiva-Bartoll et al., 2021; Colombo-Dougovito & Block, 2019; Howells et al., 2019; Ruggeria et al., 2019).

Social-Physical Engagement Relationship

A reciprocal relationship between engagement in social interaction and participation in motor functioning activities has been suggested in previous literature. For example, studies link social deficiency and impaired motor skills together—social deficits acting as

a barrier to development of motor skills, likewise motor-based difficulties hindering engagement in social outcomes (Chiva-Bartoll et. al., 2021; Lloyd et al., 2013; Ohara et al., 2020). Furthermore, organized physical activity programs that are *context-specific,* and *user-centered* are highlighted as reducing social exclusion in children with autism (Chiva-Bartoll et al. 2021; Colombo- Dougovito & Block, 2019; Howells et al., 2019; Ruggeria et al., 2019).

Insufficient physical activity is associated with higher risks of obesity, cardiovascular disease, diabetes, and overall poor mental health outcomes in children with autism (Brown et al., 2020; Dahlgren et al., 2021). These health risks are exacerbated as children with autism enter adulthood when compared to children of neurotypical development (Dahlgren et al., 2021). As such, researchers suggest it is vital to consider both physical and social activity patterns in children with autism in consideration of both physical and mental health risks (Brown et al., 2020, Chiva-Bartoll et al., 2021; Dahlgren et al., 2021; Dewey et al., 2007; Whyatt & Craig, 2012).

Aims of the Study

Researchers suggest that a reduction in a leisure activity affects outcomes on health risks and overall quality of life (Billstedt et al., 2011; Egilson et al., 2017; Ratcliff et al., 2018). Physical and social leisure activities are significant not only in terms of lower participation rates within autistic populations, but the given reciprocal nature of engagement between the two activity categories (Chiva-Bartoll et al., 2021; Colombo-Dougovito & Block, 2019; Howells et al. 2019; Ruggeria et al., 2019). As a result, early intervention methods were designed to decrease social isolation as physical participation rates increased (Chiva-Bartoll et al., 2021). While current studies have identified statistical differences in levels of participation within *social* and *physical* categories of activities between autistic and non-austitic children, the literature does not indicate research which studies the possibility of differences in participation between autistic children alone. Based on information provided by literature analyses, the study aims to evaluate mean score differences in social and physical activity between children with moderate-to-severe autism, mild autism, and

children without the condition in order to identify possible significant differences between each group.

Method

Participants

Descriptive composition of participants were gathered from The National Survey of Children's Health (NSCH; CAHMI, 2021), 2018-2019. The NSCH is a cross-sectional dataset conducted in the United States by the Health Resources Services Administration's Maternal and Child Health Bureau (HRSA MCHB). The national survey aggregates responses of parents or caregivers of children ages 0-17. Survey reports intersecting data on children's quality of life pertaining to physical and mental health, access to health care, and overall wellbeing in the context of social and physical engagement. Approximately 30,530 surveys were completed in2018, and 29,433 in 2019—which totals 59,963 interviews. Overall weighted response rates to the survey were reported at 43.1% (2018) and 42.4% (2019). The NSCH is available through the Data Resource Center for Child and Adolescent Health (DRC) website at http://www.childhealthdata.org.

Participants are heterogenous, varying in sex, range of age, and racial or ethnic identity. Data collected regarding these three descriptives were weighted proportional to the child population within the United States. Of the sample, 51.1% were reported as male and 48.9% as female (CAMHI, 2021). Race and ethnicity of subjects were classified under Hispanic (24.5%) and non-Hispanic groups: White (50.4%), Black (13.3%), Asian (4.6%), and other (6.2%) (CAMHI, 2021). The age of children was grouped into five categories with a range of three to four years: 0-3 years (21.3%), 4-7 years (21.5%), 8-11 years (23.0%), 12-14 (17.2%), and 15-17 years (17.0%) (CAMHI, 2021).

Autism prevalence within the sample collected by the NCHS was categorized into three categories: *does not have the condition*, e*ver told but does not currently have condition*, and *currently has condition*. Similarly to sex, age, and racial or ethnic background of subjects, the estimates of members in each group were weighted to represent the child population within the United States. A majority of the sample, a

total of 50,666 (96.9%) were categorized as not having the condition (CAMHI, 2021).. The second category, in which the subjects were informed they have autism spectrum disorder but not formally diagnosed, held the least members at 88 subjects (0.1%) (CAMHI, 2021). There were estimated 1,568 subjects (2.9%) within the sample who currently were diagnosed with autism (CAMHI, 2021). Parents reported within the survey that 798 children (3-17 years) presented mild symptoms of autism and 758 children were rated as having moderate or severe symptoms (CAMHI, 2021).

Children included in the analysis of the study are between 6-17 years old and do not have intellectual disability (as defined by health care provider or educator) (CAMHI, 2021) Similar to the methodology employed by Ratcliff et al. (2018), exclusion of intellectual disability eliminates impact of intelligence level in analyses on participation. Children under the age of six were excluded for two reasons: (1) the national survey collected data for physical activity between the ages of 6-17 years and (2) to focus on the developmental period of childhood and adolescence.

With exclusion of children under the age of six in our sample, the numbers of participants altered from the original data collected. Total subjects in the revised dataset totaled 43,213 (M =12.11, SD = 3.445). Subjects remained divided in three groups based on parent rated severity: (1) does not currently have autism (N = 41,646), mild autism (N = 728), and moderate-to-severe autism (N = 640). There were a total of 199 surveys excluded based on invalid responses.

Measures

Participants' physical activity and social activities were defined by questions asked within the National Survey of Children's Health (NSCH). Physical activity was defined by the question, "During the past week, on how many days did this child exercise, play a sport, or participate in physical activity for at least 60 minutes?"—PHYSACTIV (CAMHI, 2021). Responses were measured on a scale of 1-4; (1) indicating zero days of physical activity, (2) 1-3 days of activity, (3) 4-6 days of activity, and (4) reporting the child engaged in physical activity every day for at least sixty minutes (CAMHI, 2021). Social activity was defined by the questions: "During the past week, how many days did all

the family members who live in the household eat a meal together?" —K8Q11 (CAMHI, 2021). How many days a child ate a meal together with their family was reported on a scale of 1-4; (1) indicating the child did not eat with the family on any days, (2) 1-3 days eating a meal with the family, (3) 4-6 days eating a meal with the family, and (4) reporting the child ate at least one meal with the family every day (CAMHI, 2021).

Rates of participants with autism within the sample were identified by two questions: "Has a doctor or other health care provider EVER told you this child has Autism or Autism Spectrum Disorder (ASD)? Include diagnoses of Asperger's Disorder or Pervasive Developmental Disorder (PDD)"—K2Q35A, and "Does this child CURRENTLY have the condition?" —K2Q35B (CAMHI, 2021). Both questions were measured on a scale of 1-2 (CAMHI, 2021). Option one indicated *yes* the child was diagnosed by a doctor or health care provider and currently has the condition (CAMHI, 2021). Parents who selected option two as a response to both questions indicated the child was not diagnosed by a doctor or healthcare provider and does not currently have the condition (CAMHI, 2021). If the parent reported *yes* to the first two questions, caregivers were then prompted to rate the severity of autism their child presented. Autism severity was defined by the question: "Is it [autism] mild, moderate, or severe?"—K2Q35C (CAMHI, 2021). Responses were measured on a scale of 1-3; (1) mild, (2) moderate, and (3) severe (CAMHI, 2021).

Procedure

Households were selected via address-based sampling (ABS) from the Census Master Address File and invitations were distributed across all fifty states and the District of Columbia. The NCHS approached data collection in two phases: (1) an initial questionnaire was sent to screen for presence of children, basic demographic descriptives, and health care status; and (2) a detailed, age-specific topical survey to be completed by the parent or caregiver of a child selected as the subject (CAMHI, 2021). Parents or caregivers could complete the survey online or request a paper copy of the screener and topical questionnaire.

From June 2018 to January 2020, a sample of 176,000 households (2018) and 184,000 (2019) were selected (CAMHI, 2021). The sample was stratified by state and likelihood of children being present within the household. Invitations were sent requesting an adult familiar with the child—either a parent or caregiver—to complete a screening questionnaire. The initial screening survey consisted of two subsections asking: (1) how many children in the home, the primary spoken language spoken, and whether the home was rented or owned, and (2) demographics and specific health questions for up to four children in the household (CAMHI, 2021). A total of 71,000 (2018) and 68,500 (2019) screening questionnaires were completed (CAMHI, 2021). Between the years 2018-2019, 38,140 and 35,760 of those were eligible for follow-up respectively (CAMHI, 2021).

Within the surveys eligible for follow-up, one child was randomly selected from each household. Three different topical questionnaires were available, each tailored to specific age groups: NSCH-T1 for children 0-5 years, NSCH-T2 for 6-11 years, and NSCH-T3 for 12-17 years (CAMHI, 2021). There were eleven sections consistent between all three questionnaires, with only specific questions relevant to the subject's age group being key differences among the surveys. The eleven sections were alphabetized from A-K. Sections required the responding caregiver to provide information regarding whether the child has current or lifelong conditions (physical, mental, behavioral, learning, or developmental), the impact of health conditions on the child's ability to complete tasks, their source of health care within the last 12 months (including insurance coverage, costs, and satisfaction of care), activities the child completes within the home, school, or other organized activities, and more specific demographics of the household (CAMHI, 2021). Of the households, 30,530 (2018) and 29,433 (2019) surveys were completed (CAMHI, 2021).

The 2018 NSCH and 2019 NSCH were consolidated into a combined dataset. Only items that remained the same from both individual sets were included in the 2018-2019 NSCH dataset. The consolidated NSCH included an adjusted weight variable *fw_1819* to account for combining two years of data (CAMHI, 2021). Combining multiple years of data into one set allows the NSCH and other

researchers more opportunities to conduct variables and prevalence rates in a diverse range of specificity and complexity.

Results

A one-way between-groups analysis of variance was conducted to explore the impact of parent-rated severity of autism on levels of physical activity. Participants were divided into three groups based on rated severity of their diagnosis (Group 1: child does not have autism; Group 2: child has mild autism; Group 3: child has moderate-to-severe autism). Results suggested there was a significant difference at the $p <$ 0.5 level between the groups of severity, F (2, 358) =3.764, p = 0.23. Post-hoc comparison using the LSD test indicated that the mean score for Group 1 (M = 3.660, SD = 9.803) was significantly different from Group 3 (M = 2.890, SD = 7.690). However, Group 2 (M = 2.970, SD = 8.043) did not differ significantly from Group 1 or 3.

A second one-way between-groups analysis of variance was conducted to explore the impact of parent-rated severity of autism on levels in a social activity: *eating a meal with family*. Again, participants were divided into three groups based on rated severity of their diagnosis (Group 1: child does not have autism; Group 2: child has mild autism; Group 3: child has moderate-to-severe autism). Results are approaching significance at the $p < 0.05$ level, F (2, 2.105) = 2.757, p = 0.063. Despite not reaching statistical significance, post-hoc comparisons were conducted to further examine this finding due to the results approaching significance. Post- hoc comparisons using LSD indicated an approaching significant difference between Group 1 (M= 2.980, SD = 0.873) and Group 2 (M = 2.900, SD = 0.905). Mean scores in Group 3 (M = 2.990, SD = 0.922) showed no significant difference between Groups 1 and 2. Again, these findings should be viewed cautiously because the ANOVA test was not statistically significant at the $p < 0.05$ level.

Figure 1

Mean Levels of Physical Activity Based on Autism Severity

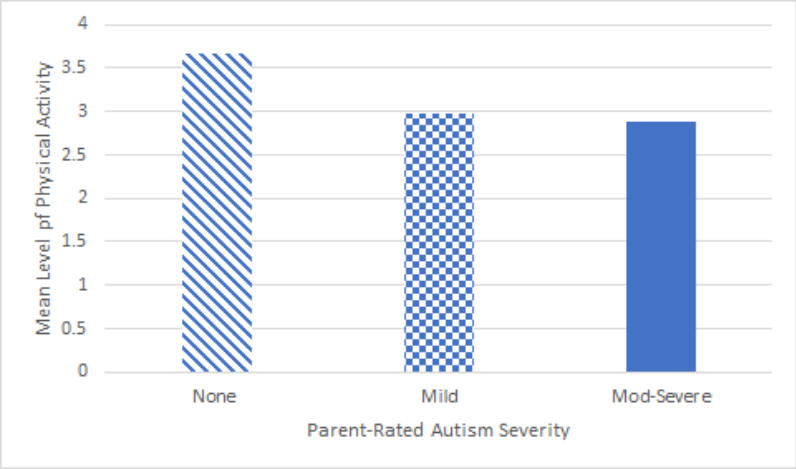
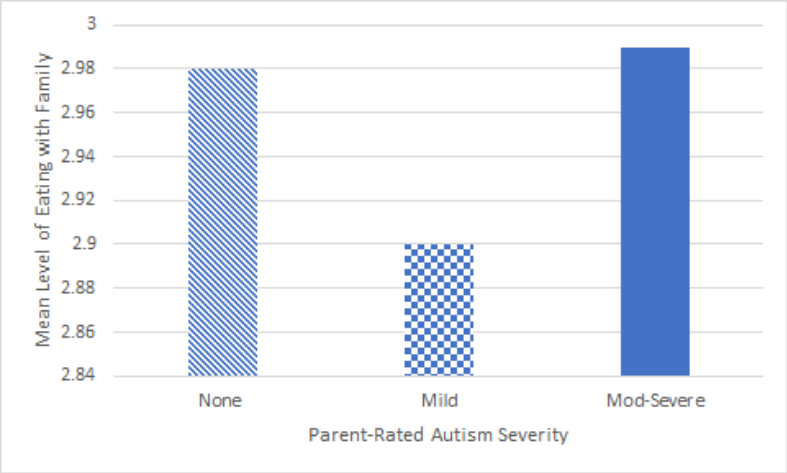


Figure 2

Mean Levels of Eating Meals with Family Based on Autism Severity



Discussion

This study found lower levels of participation in physical activity for children with moderate-to-severe autism than non-autistic children consistent with our first hypothesis, as well as previous findings in the literature (Chiva-Bartoll et al., 2021; Ratcliff et al., 2018; Simpson et al., 2019; Travers et al., 2017). Mean rates of participation in physical activity in children with mild autism were not significantly different compared to scores of children with moderate-to-severe autism or having no presence of the condition. Previous studies suggest the lack of differences are a result of participating in repetitive or self-stimulating behaviors (e.g., pacing or rocking back and forth), which can be considered as physical activities (Badia et al., 2013; Ratcliff et al., 2018).

Results between severity levels and mean difference rates in social activity did not support the second hypothesis, and is inconsistent with predictions informed by the literature (APA, 2013; Brown et al., 2020; Chiva-Bartoll et al., 2021; Davidson & Orisini, 2013; Habib et al., 2018; Silverman, 2012). The exception to this is the study by Ratcliff et al. (2018), which examined similar variables from the same dataset, which indicated no significant difference between austitic and non-autistic groups. Although there was no significant difference in mean rate of participation between all three groups in social activity, the data was trending towards significance.

Comparing a general physical activity variable with a singular social activity variable is a weakness of this study. Socialization encompasses a broad range of activities including but not limited to: going to parties, entertaining others, attending live events, community service, organization and club participation, or other activity involving engagement with others for satisfaction or survival (Ratcliff et al., 2018). No singular social activity encompasses the nuance of social interaction and interaction levels may be different among relationship types and settings that an individual with autism socializes in. With the scope of social activities in mind, further research evaluating participation in multiple social activities within autism groups to identify potential patterns is recommended.

Another weakness of this study was that autism severity was measured based on parent- rated responses within the NCHS 2018-2019

survey (CAHMI, 2021). This results in two issues: (1) a health professional did not legitimize the label associated with the diagnosis and (2) collapses a condition with a spectrum of symptoms into three nominal categories. It is recommended that future data relying on categorization of subjects based on severity of their autism diagnosis be collected based on the judgment of a medical professional in order to reduce bias. Instead of analyzing nominal categories such as *severity*, research may find more interest in studies which focus on the impact of specific symptoms occurring within autism populations and participation rates in social and physical activities.

The final weakness of the study was that the NSCH weighted its sample proportional to the United States population. As a result, the power of sample size was skewed in favor of the first group: *children without autism*. Different statistical analyses could be gathered in a replicate study where a more evenly distributed sample across all three groups can be examined.

Although these weaknesses are present, these results could inform early intervention programs geared towards increasing rates of social and physical activity in children with ASD. Future intervention programs may need to take into account important differences between severity in diagnosis. As indicated in the results, individuals with mild and moderate-to-severe rated autism responded differently between physical and social variables. This demonstrates the experiences of individuals with autism are not universal and important or unique differences need to be explored further in future research.

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Deliberately Separate and Unequal: How the HSI Designation Functions to Maintain Racial Stratification within Higher Education

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From the structural functionalist perspective, the purpose of the school system is to sort individuals according to societal needs. Admissions criteria for postsecondary institutions that reward White norms (Harris, 1993) and White-privileged access to quality K-12 education, ensure that most Black and Latinx students, including those who otherwise have demonstrated high aptitude in ways often unrecognized or even belittled by the school system, are deemed unqualified. The result is racial stratification across levels of institutional selectivity such that the lower the proportion of Black and Latinx students the more prestigious the institution tends to be. Within this context, Hispanic-serving institutions (HSIs) serve to "cool-out" Latinx students while facilitating prestige-driven segregation. That is, HSIs increase the access Latinx students have to some form of college without having to integrate the most prestigious universities. In this study, I consider whether the increased access provided by HSIs functions as an equalizing force or whether HSIs contribute to segregation across levels of institutional selectivity. Results indicate that Latinx students remain under-represented at the most prestigious institutions and over-represented at the least prestigious institutions. Because so few HSIs are among the more prestigious, and because such a high proportion of Latinx students enroll at these institutions, HSIs can only be seen as contributing to the problem. Recommendations for counseling high school students toward more prestigious PWIs are provided.
Keywords: Hispanic-serving institutions (HSIs), Latinx, higher education, Texas, Critical race theory (CRT)

Deliberately Separate and Unequal: How the HSI Designation Functions to Maintain Racial Stratification within Higher Education

From a merit-based perspective, education, socio-economic mobility, and success are all based on hard work alone. This implies that everyone has equal access to education and controls for extraneous factors such as: natural intelligence and inheritance (Alvarado, 2010). It would also include the assumption that every student has an equal chance at graduating high school and applying to a prestigious university. However, this would be unideal in a society that benefits from structural functionalism (Morrow, 1978). When applied to education, functionalism entails that every individual has a set position within society ensuring that jobs across all levels and sectors are filled. This is done through educational stratification. Each institution is given a level of selectivity based on standardized test scores and admission rates (Carnegie Classifications, n.d.). These levels of selectivity represent the status of an institution, with the most selective institutions being flagship schools or Ivy Leagues (Nichols, 2020). This justifies the institutions right to exclude, criteria that fall under the critical race concept of Whiteness as property (Harris, 1993). Thus, Latinx students are largely enrolled into HSIs while elite institutions keep their status by enrolling affluent White students. In this literature review, I will be exploring the creation of a separate and unequal environment that has affected the educational attainment and socioeconomic mobility of Latinx students attending higher education.

Latino Critical Race Theory (LatCrit)

Critical Race Theory (CRT) in education is a theoretical framework that centers the voices and experiences of marginalized groups within systems of education that have contributed to racial stratification. Latino Critical Race Theory (LatCrit) is an extension of CRT that focuses on the Chicanx and Latinx community (Yosso et al., 2001). LatCrit branched from CRT because "[i]t emphasizes the intersectionality of experience with oppression and resistance and the need to extend conversations about race and racism beyond the Black/White binary" (Yosso et al., 2001, p. 99). Thus, it has been used to address the intersection of race, gender, cultural identity, language,

and immigration and citizenship status in the United States (Trucios-Haynes, 2000). In using LatCrit, one can identify how the development of a racial hierarchy has translated into systemic racism and the educational inequities that continue to plague the Latinx community today (Trucios-Haynes, 2000).

Structural Functionalism

Structural Functionalism (Morrow, 1978) is a sociological theory that describes society as being separated into parts that contribute to its wholeness and functioning. The purpose of this theory is to fill job positions at every level and sector and keep high-paying and elitist jobs from being easily accessible. Within education, structural functionalism has influenced the separation of postsecondary institutions into three levels of selectivity (inclusive, selective, and more selective). Selectivity is evaluated by using the reported 25th percentile of test scores on the SAT verbal, SAT Math, and ACT Composite from each institution. The selectivity for institutions that did not indicate test scores were a requirement for admission, were based on the percentage of applicants admitted. Institutions that had open admissions were immediately designated as "inclusive" (Carnegie Classifications, n.d.). The 25th percentile ACT-equivalent scores for "inclusive" institutions were less than 18, and they accepted 80% or more applicants. "Selective" institutions scored between 18-21, and "more selective" institutions scored greater than 21 and accepted 55% or less of their applicants (Carnegie Classifications, n.d.).

Moreover, standardized testing has historically been used to racialize minority groups (Knoester & Au, 2017). Standardized testing was modeled after craniometry and other pseudo-science that determined group intelligence and is currently used to interpret the achievement of students. Today, test scores are attributed to an individual's competency, and such competency is then evaluated and used to determine the education and future employment opportunities of that individual. Like the stratification produced by a functionalist society, standardized testing is linked to the acceptance of students at postsecondary institutions and used to stratify those students between the categories of selectivity, with complete disregard to its connection to white supremacy.

Whiteness as Property

Structural functionalism coincides with the critical race concept Whiteness as property because institutional selectivity is based on Whiteness. As described by Harris, Whiteness is the "right to White identity" and the privileges associated with it (1993, p. 1714). In higher education, the status of an institution is based on admission policies that protect Whiteness. Instead of enrolling Black and Latinx students, elite institutions enroll affluent White students that contribute to their institutional prestige. This is because Black and Latinx students do not hold the property rights established by the White group. This dates to the colonial era when White people were the only group allowed to hold property and retain basic human rights (Harris, 1993). Thus, Whiteness is prioritized at the most selective institutions to maintain racial hegemony over the Black and Latinx community.

The racial stratification faced by Black and Latinx students within postsecondary education is apparent in a study conducted by Nichols (2020). The study examined how Black and Latinx access to selective public colleges and universities had changed over time. One-hundred and one of the most selective institutions across the United States were analyzed by assigning each institution an access score and letter grade. The public institutions were labeled as selective if they met one of these three criteria: 1) it was a flagship school (the best-known university or college in the state), 2) the institution had an average 2017 SAT score of 1150, and 3) the institution was classified as "more selective" and "highest research activity" in Carnegie's 2015 Classification scheme (Nichols, 2020). The study concluded that there was an increase in Latinx access from the year 2000, but 65% of these institutions did not correspond to the growing proportion of college eligible Latinxs in their respective states; furthermore, "[i]n the nine states that account for 75% of the nation's Latino population, nearly 75% of the selective public colleges and institutions earned D and F grades" (Nichols, p. 14). Thus, even amid a growing proportion of college eligible Latinxs, Latinx students continue to be underrepresented at more prestigious institutions.

Hispanic Serving Institutions (HSIs)

The Hispanic Association of Colleges and Universities (HACU) succeeded in getting the Higher Education Act of 1992 (HEA '92) to federally recognize Hispanic-serving institutions (HSIs) under Title III, defining HSIs as "[a]ccredited, degree-granting, public or private, nonprofit colleges or universities with 25% or more Hispanic enrollment" (Galdeon, 2012, p. 158). The HEA was reauthorized in 1998, which accredited HSIs under Title V, *Developing Hispanic-Serving Institutions*, which meets the 25% enrollment rate, and requires 50% or more students to be low-income (Galdeon, 2012). According to *Excelencia* in Education, 1.49 million Latinxs have met full-time equivalent (FTE) enrollment at HSIs, approximately 67% of Latinx undergraduate enrollment (2020). However, HSIs only make up 18% of all postsecondary institutions (*Excelencia* in Education, 2020). According to Laden (2001), HSIs have increased Latinx educational degree attainment. However, HSIs have also contributed to the racial stratification of Latinx students within postsecondary education (Laden, 2001). Approximately 60% of HSIs have open admissions, which would fall under the classification of an inclusive institution (*Excelencia* in Education, 2007; Carnegie Classification, n.d.). Therefore, a majority of Latinx students are attending inclusive institutions, and being disproportionately under-represented at selective and more selective institutions.

Moreover, HSIs were not originally built to serve the Latinx community. HSIs were established to "[s]upport [existing] colleges who enroll a large number of these [Hispanic] students" (Fletcher & Webster, 2010, p. 4). Thus, the HSI designation has created another way for institutions to receive federal grants for exploiting their students. Instead of integrating institutions, HSIs increase Latinx full-time enrollment and participate in Burton Clark's "cooling-out" function (1960). The "cooling-out" function is used to encourage students to embrace "[t]he realities of limited opportunity where "[f]ailure is structured and inevitable" (Clark, 1960, p. 569). HSIs afford Latinx students the opportunity to attend college and fulfill their ambitions but, are led to believe that they are not competent enough to earn a place in a prestigious university or attain a high-paying management position. Instead, they are directed towards a low-paying

position in the labor market with the belief that they have reached their fullest potential.

Separate and Unequal

From a functionalist perspective, the fulfillment of job positions at all levels and sectors is necessary for the betterment and functioning of society. Unfortunately, this has motivated educational stratification. Institutions are classified into categories relating to selectivity. The most selective institutions hold an elite status based on the proportion of affluent White students that attend. This is because Whiteness holds political and social status, and enrolling Black and Latinx students would diminish the prestige that a college or university has accumulated. Thus, instead of integrating institutions, the government has opted for schools that are "separate but equal" for Latinx students.

Hispanic-Serving institutions have facilitated prestige and race-based segregation to maintain the status quo. With a federal mission to enroll and graduate as many Latinx students as possible, HSIs have created a paradigm for Latinx education. While this could be seen as an accomplishment, an increase in Latinx enrollment at HSIs diminishes the Latinx representation at other institutions, creating a "separate but equal" school. Therefore, I would expect to find that HSIs are among the least elite universities, and that Latinx students are over-represented at them. I would also expect to find that Latinx students are under-represented at more prestigious institutions, partly because they are largely enrolled at HSIs. Furthermore, the objective of the current study is to examine and compare the distribution of Latinx and White students attending inclusive, selective, and more selective (public, four-year) institutions in Texas and how this relates to the high attendance of Latinx students at HSIs.

Method

Data Source

Data were extracted from the Integrated Postsecondary Education Data System (IPEDs) to determine Latinx and White undergraduate attendance at 40 Texas institutions and their level of selectivity. Data were also extracted from the National Center for

Education Statistics (NCES) regarding the number of Latinx and White high school graduates in Texas. The data were used to compare the institutional representation of Latinx and White students attending inclusive, selective, and more selective (public, four-year) universities in Texas from the years 2005-12 relative to the number in the graduating class for the same year.

Results

The institutional representation of Latinx and White undergraduate students attending inclusive, selective, and more selective institutions, were compared using two repeated measures analyses of variance (ANOVA). The between-groups factor was the Carnegie Classification of 2005, which categorized 40 Texas universities into inclusive, selective, and more selective institutions. Twelve out of the 40 institutions (30%) did not contain a classification. Of the institutions that did contain a classification, approximately 25% were inclusive, 37.5% were selective, and 7.5% were more selective. The within-groups factor was the undergraduate representation of Latinx and White students attending each level of selectivity over an eight-year span relative to the proportion of Latinx students in that year's graduating class. The within-groups factor was calculated by subtracting the proportion of Latinx graduating seniors from the proportion of undergraduate students attending each of the 40 universities.

Mauchly's Test of Sphericity indicated that the assumption of sphericity was violated, $\chi^2(27) = 181.07$, $p < .001$ and $\chi^2(27) = 395.84$, $p < .001$, respectively. Therefore, the Greenhouse-Geisser correction was reported for both groups. The results revealed that there was a significant interaction between the Carnegie classification as of 2005 and the representation of Latinx and White undergraduate students attending forty of the Texas universities over an eight-year span, $F(8.35, 100.27) = 1.02$, $p = .427$, $\eta^2_{partial} = 0.08$ and $F(5.39, 64.70) = 1.05$, $p = .402$, $\eta^2_{partial} = 0.08$, respectively.

Figure 1 shows that Latinx representation was higher than White representation among inclusive institutions; however, Latinx representation began to slightly decrease as White representation increased. In Figure 2, White representation was higher than Latinx

representation at selective institutions, and both decreased from 2006-07. Figure 3 shows the largest gap in representation among more selective institutions: White representation steadily increased from 2006-09 and began to decrease from 2009-11 as Latinx representation slightly increased.

Discussion

The purpose of the present study was to examine the distribution of Latinx and White students attending inclusive, selective, and more selective postsecondary institutions in Texas. The results reveal that Latinx students are underrepresented at selective and more selective institutions, overrepresented at inclusive institutions, and continue to be at a disadvantage across all levels of selectivity. These results coincide with those found by Nichols (2020), supporting the claim that Latinx students are segregated from selective and more selective institutions to institutions of less elite status, such as: HSIs. Two-year public HSIs contain the highest enrollment rate of Latinx students, and the lowest graduation rates' (UnidosUS, 2019). Therefore, HSIs may seem promising on the surface, due to their high Latinx student enrollment, but these institutions have not decreased the Latinx-White graduation gap at two-year institutions. In fact, HSIs have increased the Latinx-White graduation gap at four-year institutions (UnidosUS, 2019). HSI literature claims that these schools are intended to increase enrollment and degree attainment among Latinx students; instead, the HSI designation has created a convenient narrative used by the federal government in serving the Latinx community while still preserving Whiteness in elite higher education.

Directions for Future Research

A limitation of the current study is that I focused solely on public four-year institutions. Future research can include private four-year institutions. In addition, researchers can broaden the study to other states, particularly those with a high Latinx population. Another limitation of the current study is that eight years (2005-12) of data regarding undergraduate enrollment were extracted, and a single year (2005) was used to determine the Carnegie Classification. In future research, with the use of updated databases, the researcher will be able

to analyze a larger range of years and more recent data. Researchers can also observe the intersection between gender, class, and immigration status and how that affects undergraduate representation at each level of selectivity.

Finally, few HSI advocates have evaluated the representational gaps between HSIs and more elite institutions, and when these gaps are evaluated, they are hardly ever attributed to the inequities faced by Latinx students in K-12 education or inequitable admissions criteria. Instead, because public primary and secondary schooling is accessible to all children, it is assumed that all students have an equal chance of leveraging education in pursuit of a postsecondary degree. Thus, when Latinx students do not meet the standardized test scores required by prestigious institutions, or when Latinx students have completed little to no AP courses in high school, it is attributed to cultural factors. The abundant literature on familismo (Marin & Marin, 1991; Martinez, 2013) in the Latinx community, and how it affects their college-decision making has overshadowed the permeance of White supremacy within postsecondary education. Therefore, HSI advocates and researchers must reconsider the factors attributed to Latinx college enrollment and decision-making, through the evaluation of unequal funding and resourcing of K-12 schools and biased admissions criteria.

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Figure 1.
Latinx and White Representation at Inclusive Institutions

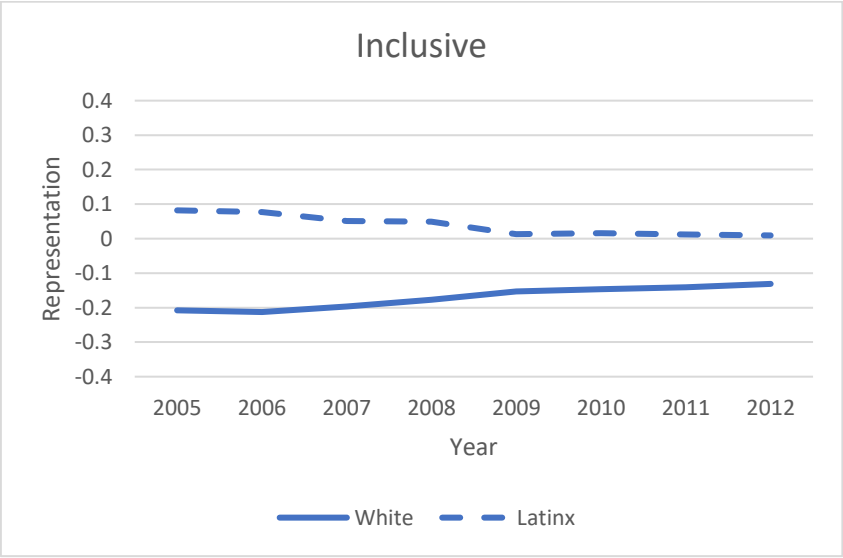


Figure 2.
Latinx and White Representation at Selective Institutions

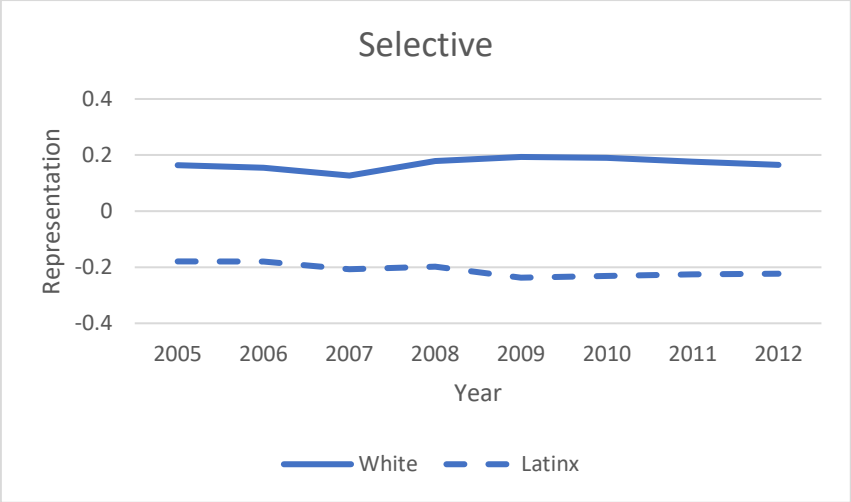
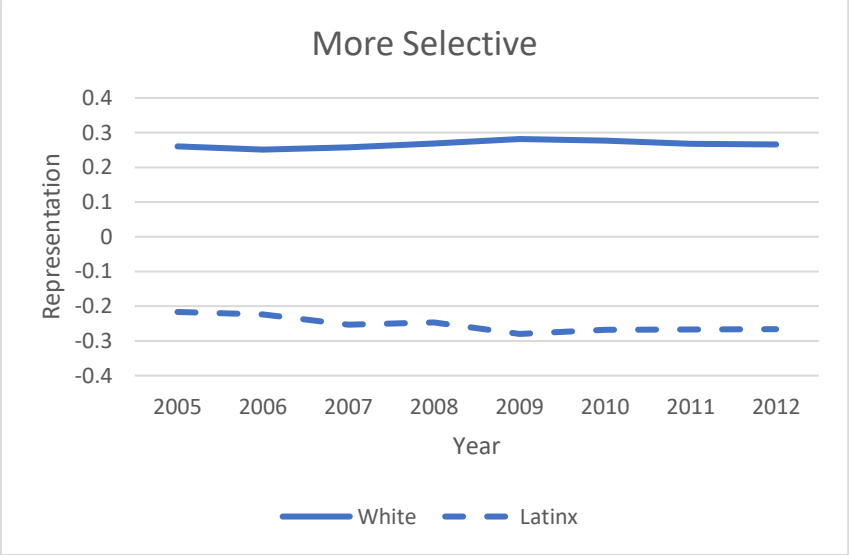


Figure 3.
Latinx and White Representation at More Selective Institutions



COVID-19 & Latinos: The Power of Misinformation on YouTube

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The COVID-19 pandemic proved especially violent for Latinos and other minorities. Crowding, lack of health insurance and access to healthcare, and segregation produced conditions that killed Latinos and blacks from three to six times more frequently than whites. In any such emergency, trusted information is essential; in this case did social media make it worse?

In this study, an initial survey found members of an extended family overrelying on unverified information from social media less likely to steady human decision making than to misinform and mislead. As people died in panic, the message service WhatsApp electrified the two-step flow of communication (Katz and Lazarsfeld), producing results as dependable as the game of telephone. In turn, social media that might produce an agenda setting effect also misinformed. For example, YouTube conveyed misinformation regarding the pandemic throughout 2020, information in turn shared in reverse by the two-step flow by Latinos across the United States.

To assess the dimensions of the problem, this study retrieved and content analyzed YouTube videos in 2020 that contained information about COVID-19, and split them for analysis into four categories. References from The Centers for Disease Control (CDC) and World Health Organization (WHO) were used to fact check the videos. The preliminary analysis provided evidence supporting the thrust of the study.

Keywords: COVID-19, Latinos, Agenda-Setting, YouTube, Two-Step Flow

COVID-19 & Latinos: The Power of Misinformation on YouTube

The use of social media and news played a massive part in how the COVID-19 pandemic was perceived by the general public especially minority communities. Minorities have been hit hard during the pandemic for many reasons; one unanswered question is: to what extent did social media, compound the tragedy? This content analysis seeks to frame a partial answer.

Literature Review

Misleading the Latino Community on the Effects of COVID-19

The COVID-19 pandemic has killed or compromised the health of millions and has had an enormous impact in minority communities (Nápoles et al., 2020, pg. 2466) raising questions not only about those communities' exposure to the virus, but to the media that inform them.

The populations of American counties with substantial COVID-19 infections are disproportionately "foreign-born, Latinx (including Puerto Rican), Black, or Asian" (Strully, Yang and Liu, 2021) -- and more likely to have higher numbers of COVID-19 cases than counties that do not. The disproportionality suggests a larger pattern in the U.S of minority populations facing greater exposure because of crowding, lack of health insurance, access to healthcare, and outright segregation. For example, many Latinos have become infected while working in essential jobs (Rodriguez-Diaz et al. 2020; Barry et al., 2020; Ramirez et al, 2021) – especially in meatpacking, an industry that's produced a large proportion of the dead (Dyal et al, 2020). According to Saenz (2021), "Blacks and Latinos are dying from COVID-19 at a rate that is more than three times higher than that of whites. The mortality gaps are even much worse — at rates of 6 to 1 — from ages 25 to 64." Such rates of infection and hospitalization suggest an undercounting of cases, often because Latinos fear of discovery and deportation. But if the demographic factors listed figure large in the casualty rate, might misinformation induced by social media have produced still greater numbers of infections and more deaths?

Community and Fear of COVID-19

In one study examining social media impact, researchers picked different groups from various regions and backgrounds in the United States and Italy to participate in Qualtrics surveys. After creating fake news inspired by online news and presenting them to participants, researchers found "COVID-19 fear positively correlates with willingness to share both COVID-19 and neutral news" (Salvi et al, 2020, pg. 8). The results affirmed a hypothesis that the presence of COVID-19 as a descriptive term predicted "a greater likelihood of believing fake news" (Salvi et al, 2020, pg. 2). Another study done with *Salud America!* found website traffic increased for an article headlining smoking's links to COVID-19 suggesting that the presence of word COVID in a headline amounted to clickbait (Depres et al, 2021).

Long before this pandemic, modern communication science has sought to differentiate what people find to be credible and not credible. For example, Katz and Lazarsfeld determined that information may be deemed more credible in a two-step flow, in which someone identified as an opinion leader passes a message to a second person, who then passes that message to someone else (*Two Step Flow Theory*, n.d.). Indeed, Katz argued "that all interpersonal relations are potential networks of communication" (Katz et al, 2017, pg. 33). That fact would seem to apply to WhatsApp, a social medium which Latino families commonly used as a resource for messaging, and for news. It's been among the most popular means to communicate news of the pandemic internationally between individuals and groups (Koch, 2019). Studying a messaging application as a news medium, however, may be troublesome in that different standards of validity and reliability are likely to apply. Nevertheless, just as Katz et al suggested, Bowles, Liu, and Larreguy (2020) in a study in Zimbabwe found trusted sources' use of WhatsApp spreading misinformation regarding COVID-19, with subsequent effects tantamount to agenda setting -- not only on individuals' knowledge, but on their health behaviors including believing in fake cures (Bowles et al., 2020).

Agenda-Setting

As a theoretical matter, agenda-setting is a well-tested hypotheical model which has proven that "[t]he mass media force

attention to certain issues" (McCombs & Shaw, 1972). The first and most basic element in the process, and the one most germane to this study, is "the impact of the media agenda on the public agenda regarding the salience of issues, political figures and other objects of attention" (McCombs et al, 2014). This is the process by which the media influence, if not directly what the public thinks, then what the public thinks about. In time, agenda-setting has been interpreted to have at least two more levels of influence: an impact of the media agenda on the public agenda, and a possibly more complex impact of a networked media agenda of objects or attributes on the networked public agenda (McCombs et al, 2014).

According to Bregman et al, the "agenda-setting process seeks to offer one explanation of how social change occurs in modern society" (Bregman et al, 1993). To that end, this study focuses on the first level, specifically, the extent to which a social media agenda acted less to inform, than to misinform Latinos on how seriously they should be taking COVID-19.

In a similar way, Feezell argues "that social media can serve an agenda-setting function by providing users with incidental political information as filtered through the process of two- step communication flow within their networks" (Feezell, 2017, pg. 483). Feezell's argument appears to apply, as in this instance, to agenda setting and the two-step flow process.

YouTube

This paper argues that the social media platform YouTube has itself become an agenda setting medium for its ubiquity in education and event documentation in permitting access to and widespread sharing of visual information (About YouTube, n.d., pg.1). Because of its scale and reach to over 100 countries and 80 languages, YouTube is regularly shared across a variety of other platforms (*YouTube for Press*, n.d.). For instance, a study about misinformation on YouTube "gathered 20 million shares and 71 million reactions and comments on Facebook, Twitter and Reddit" (Au et al, 2020, pg. 3). Moreover, Bailey et al found 62 million videos containing false information about COVID-19 (Bailey et al, 2020). An earlier content analysis regarding

vaccines on YouTube revealed that negative videos about vaccination exceeded the positives (Keelan et al, 2007).

Though not conclusive, counts of YouTube views may provide a gross measure of agenda-setting influence (Cooper, 2021). In other words, Latinos, among other populations, can go on YouTube, search information about COVID-19, and find videos that provide "Unsubstantiated or contradict[ing]" claims (Keelan et al., 2007, pg. 2483). In fact, YouTube adjusted its policies to discourage COVID-19 misinformation. Channels uploading such types of videos now are given three strikes before termination (COVID-19 Medical Misinformation Policy, n.d.).

In summary, partly for its ubiquity and its reach across various social media platforms, YouTube appears useful to consider as a potential agenda-setting medium, by which to study the phenomenon at hand.

Methodology

Table 1
Survey of Family Members

Name and Relation	Ages	Sex	How They Used Media
REDACTED	43	F	WhatsApp, Facebook (news accounts), YouTube (health videos), & Links from Friends
REDACTED	46	M	Radio (coverage of news), Facebook, & Links from Friends
REDACTED	35	F	Facebook, Spanish News Stations, and Links from Friends
REDACTED	41	F	Facebook and Links from Friends
REDACTED	41	M	Facebook (unverified accounts that share news) and Links from Friends

Data Collection, Sampling

This study began with a qualitative survey of family members (Table 1), who appeared to the researcher to be misinformed about the nature of the COVID-19 threat by the social media they used. The potential dangers of those behaviors inspired a closer look at their beliefs, and their discussion relating to social media use. From there, this research developed initial categories to classify misinformation, since refined as this study continued. While only one of the subjects specified using YouTube, all of them specified Facebook or links with friends – sources highly correlated with YouTube content, as discussed above.

Next, I searched Google Scholar and the Blume Library's Discover database for the terms misinformation, Latinx, YouTube, and COVID-19. After that, related videos were collected from YouTube, examined using the incognito mode, to reduce the impact of this study on the results. To look at what Latino Americans would also see, I searched YouTube for terms in Spanish like "informacion sobre covid 19" or information about COVID-19. n an effort to select a purposive sample as an initial target, a sample of videos (N= 30) were selected from a total of 533 that came up in a Google search with the "informacion sobre covid 19" and a YouTube filter. I then proceeded to a content analysis which consisted of carefully watching the videos, taking notes of the information they were sharing, and fact checking that information for accuracy with sites from the Centers for Disease Control and Prevention (CDC) and the World Health Organization (WHO). The thirty videos were selected in June 2021. However, in an effort to sensitize the sample selection. Through a process of elimination that considered the categories and time frame created twenty videos were cut and ten videos ended up being analyzed for this study. I narrowed the sample from thirty to ten produced in 2020, a period of greater knowledge uncertainty – but one in which, more certainty nevertheless appeared to be conveyed than may have been warranted by the state of knowledge at the time. Of the initial sample of thirty that appeared on the agenda-setting first page of YouTube listings. I reduced the sample number to ten, because the 20 videos remaining either didn't fit the four categories or 2020 time frame, the focal point of my initial sample.

Data Analysis

To analyze the data, I set up two binary categories: accurate information and inaccurate information. For better insight, I then created a scale ranging from one to five to label the degree of misinformation each of the ten videos purveyed. The number one signified low or no amounts of misinformation while five meant the video contained alarmingly dangerous amounts of misinformation. The Centers for Disease Control and Prevention (CDC) and the World Health Organization (WHO) were used as references to verify the accuracy of information provided. Using the data collected on each video, I created a chart to compare the videos and the implication of the information that was presented. Finally, I looked for patterns or significant themes in the sample.

Findings

The first video was *Información sobre el coronavirus (COVID-19)* which was uploaded by the channel Universidad Camilo José Cela and had 12,056 uses at the time of this analysis. The channel was not verified by YouTube and was put into the category of Universities/Colleges. The actual speaker in the video is a faculty member of the university. The video was given a four on the scale of misinformation because of the lack of acknowledgment of growing knowledge of COVID-19 and of statements that have since been proven wrong by the CDC.

The second video was uploaded by Luis Antonio Pacora Camargo MD, by a doctor who was categorized as unverified due to a lack of proof and beyond his channel name and claim. At the time it was analyzed it had 4,649,879 views. This video was received a five on the scale for the amount of misinformation being spread with false percentages.

The third video, *CORONAVIRUS: SARS-CoV-2. Síntomas, prevención, ¿tratamiento? y mitos del COVID-19 | Virología* was uploaded by the unverified channel, QuieroSerMédico. The video was categorized as a slideshow video and had 378,407 views. This video was given a two. There were similar instances of misinformation where statements made were true at the time of the upload like the previous

two videos, but this case also noted the need for more studies on COVID-19 to be sure about its claims.

The fourth video with 346,771 views was titled *Coronavirus Covid-19: Claves para entender la enfermedad y protegerse - Clínica Alemana*. It was uploaded by the unverified channel, Clínica Alemana and was categorized as a slideshow video. *Coronavirus Covid-19: Claves para entender la enfermedad y protegerse - Clínica Alemana* was given a four on the scale of misinformation because of the false statement about COVID-19's incubation period.

The fifth video was named *CUÁNTO DURA una Infección por CORONAVIRUS Covid 19 - Nos Cogió la Noche*. Nos cogió la noche Cosmovision, a verified channel, was categorized as unverified doctor. It had 4,323,631 at the time it was analyzed. It was given a four for its level of misinformation because of the medical specialist's lack of credentials.

The sixth video uploaded by BBC News Mundo channel is titled *Coronavirus: 6 buenas noticias sobre el nuevo virus covid-19 | BBC Mundo*. At the time of the analysis it had 10,795,316 views. This video fell into the category of international news, was a verified channel and was given the number one due to the positive approach and references to the World Health Organization.

The seventh video was from an unverified channel named Hartford HealthCare. The video with 929,613 views was categorized as verified due to a verified doctor presenting the information. The title was *¿Cuáles son los síntomas del Coronavirus (COVID-19) y cómo se diagnostica?* and it was given a one because of the speaker, a doctor, presented studies from other countries battling COVID-19.

The eighth video was named *Se da a conocer nueva información sobre el coronavirus | Noticias Telemundo* and was uploaded by Noticias Telemundo's verified channel under the same name. The video had 32,399 views and was categorized as international news. This video received a three on the scale of misinformation for continuing the pattern of sharing facts that have been proven wrong without acknowledging new information being found out.

The ninth video, *¿Qué es el Coronavirus? Causas y origen* was uploaded by Top Doctors LATAM. The video from the unverified channel had 2,751,992 views. It fell into the category of verified doctor.

However, after doing the analysis it was given a five on the scale because of the speaker's false and misleading statistic about one in three people dying from a previous form of COVID.

The last video was by UW Medicine, an unverified channel linked to a university which fell into the category of Universities/Colleges. *COVID-19: Lo que necesita saber* had 5,459 views when it was analyzed and received a one on the scale due to the doctor in the video acknowledging information about COVID-19 was still coming out and acknowledged corrections had already been made to known facts about COVID-19.

Discussion

One limitation of this study is that the shares of the videos were supposed to be retrieved for the first chart, however I was unable to get shares, as they aren't listed on the YouTube videos.

One reason for the assignment of the number four for the first video was that actual statements that appeared true at the time of the upload ended up being contradicted by the CDC after the video was uploaded. The presenter in the video fails to say the facts he's sharing are based on the limited knowledge at the time of the upload which makes him less credible. For example, he states, "[l]a mayoria de las personas se suele curar sin secuelas" (Universidad Camilo José Cela, 2020). This translates to the majority of people will be cured of COVID-19 without any after effects. The CDC has since verified a range of post-COVID-19 problems and acknowledges there is still new information coming through, something this video does address (Post-COVID Conditions, 2021). Failing to acknowledge the tentative nature of ever knowledge about COVID-19 is essential, in order to encourage Latinos to keep learning more.

The second video scored five for its concerning amounts of misinformation. At one point it is stated, "10 por ciento tendrá una forma severa" (Pacora Camargo, 2020). The speaker is saying there is a ten percent that will experience a severe form of COVID-19. The percent being referred to is never explicitly stated and there is no evidence of that ten percent existing on the CDC and WHO websites. Yet, this was a pattern throughout the entire video. Having a pattern of misinformation throughout the whole video renders it not credible.

Stating misleading statistics may ultimately induce fear and more misinformation – which is why this video merits a score of five.

While the third video had similar instances of misinformation like the previous two videos, it nevertheless noted the need for more studies on COVID-19 authenticate its findings. The video acknowledged there's no immediate cure, and that false news should be checked with the WHO. This added credibility, but lost some in the absence of a knowledgeable presenter. It received a four, however, because of misinformation: "no se recomienda la mascarilla en personas sanas excepto personal sanitario cuando atiende pacientes con el virus --" saying masks aren't recommended to healthy people unless they're attending to someone with COVID-19. The CDC declares this false because "masks work best when everyone wears them" (*Improve How Your Mask Protects You*, 2021). This is a concerning statement from the video that can cause confusion and potential exposure but its acknowledgement of the lack of information about COVID-19 is why it was given a two.

The fourth video was given a four on the scale of misinformation. The video states "el periodo de incubación es 14 días"- not true according to the CDC's site. The video is saying the incubation period is fourteen days when it is now known to be two to fourteen days (*Studying the Disease*, 2020). However, they did mention to viewers that they should contact their doctors for information at the end of the video.

The fifth video was rated a four on the misinformation scale because: a) The CDC warns of long COVID-19, a version that lasts a long time; b) because of the certainty the speaker who touted his credentials that did not authenticate as a medical specialist reducing credibility. Though the speaker does acknowledge a lack of information and encourages viewers safe behaviors, the misinformation warrants the score of four.

The sixth video, one of the most positive, received a score of one on the scale. The video from a reporter from BBC News Mundo shares positive news about COVID-19. She refers to the World Health Organization multiple times is part of BBC News Mundo, a verified channel and internationally known news site, adds to her credibility.

¿Cuáles son los síntomas del Coronavirus (COVID-19) y cómo se diagnostica? was the seventh video analyzed and it was given a score of 1. The video is from a doctor at a healthcare clinic supported with a verifying website and credit is given to studies from other countries being affected by COVID-19. The doctor spoke in a manner that was calming while sharing information as opposed to the other speakers who were more blunt.

Telemundo Noticias uploaded a video titled *Se da a conocer nueva información sobre el coronavirus | Noticias Telemundo* which was given a 3. The pattern of misinformation continues in this video with the anchor bluntly saying COVID-19 cannot be transmitted if people use social distancing only for the CDC to say "Transmission of SARS-CoV-2 from inhalation of virus in the air farther than six feet from an infectious source can occur" (*Scientific Brief: SARS-CoV-2 Transmission*, 2021). At the time of the video's upload there was uncertainty surrounding COVID-19 and sounding certain in cases like this is dangerous to viewers because they could end up exposing themselves to COVID-19 without realizing. However, it must be noted the anchor quotes the WHO which is one the source for information about COVID-19. The issue with misinformation here is that the WHO acknowledges more is being learned about the pandemic as time goes on and is not stating facts the way the anchor did (*Coronavirus Disease (COVID-19)*, 2020).

The video uploaded by Top Doctors LATAM, *¿Qué es el Coronavirus? Causas y origen*, received a score of 5. The category for this video was verified doctor and unverified channel. While this was in the verified doctor category, the speaker asserts that one in three people who with COVID will die, a statistic. WHO and CDC do not verify. He does make mention that not everyone is going to die but credibility is still taken away from the doctor and the video itself. This is worth noting because even though it's not about COVID-19, the name and number is enough to set off a Latino panic.

The last video I analyzed was *COVID-19: Lo que necesita saber*. This video is more credible than previous videos because it's from the University of Washington and has a doctor with qualifications answering questions about COVID-19. The doctor continues another pattern seen in credible sources where he acknowledges the information

on COVID-19 is still growing and coming in. He also consistently acknowledges there's been information that has been corrected. This is why *COVID-19: Lo que necesita saber* was given a 1 on the scale of misinformation.

Conclusion

The COVID-19 pandemic has opened up a lot of potential for research with its exposure of issues affecting populations like Latinos. Additionally, it has exposed issues that come with the access and impact of social media platforms like YouTube. Because Latinos have been Latinos were affected disproportionately by the COVID-19 pandemic, it is important to look at the factors that played a role in the illness that has so affected them. This study teaches me that in uncertain times, high quality information is essential to assess risk – and that those who fail to provide it may prove almost as dangerous to the public health as the illness itself.

Table 2

Analyzed Videos

Video Title	Channel Name	Views	Amount of Included Misinformation on a 1-5 Scale	Category	Channel Verification
Información sobre el coronavirus (COVID-19)	Universidad Camilo José Cela	12,056	4	University	Not Verified
COVID-19, ¿COMO IDENTIFICAR EL DÍA 1 DE LA ENFERMEDAD?	Luis Antonio Pacora Camargo MD	4,649,879	5	Unverified Doctor	Not verified
⚫ CORONAVIRUS ⚫: SARS-CoV-2. Síntomas, prevención, ¿tratamiento? y mitos del COVID-19 | Virología	QuieroSerMédico	378,407	4	Slide Show	Not Verified
Coronavirus Covid-19: Claves para entender la enfermedad y protegerse - Clínica Alemana	Clínica Alemana	968,509	4	Slide Show	Verified
CUÁNTO DURA una Infección por CORONAVIRUS Covid 19 - Nos Cogió la Noche	Nos cogió la noche	4,323,631	4	Unverified Doctor	Verified

Coronavirus: 6 buenas noticias sobre el nuevo	BBC News Mundo	10,795,316	1	International News	Verified
¿Cuáles son los síntomas del Coronavirus (COVID-19) y cómo se diagnostica?	Hartford HealthCare	929,613	1	Verified Doctor	Not Verified
Se da a conocer nueva información sobre el coronavirus | Noticias Telemundo	Noticias Telemundo	32,399	3	International News	Verified
¿Qué es el Coronavirus? Causas y origen	Top Doctors LATAM	2,751,992	5	Verified Doctor	Not verified
COVID-19: Lo que necesita saber	UW Medicine	5,459	1	University	Not Verified

Table 3

Rejected 20 Videos

Title of Video	Reason Why It Was Cut
Coronavirus (Origen, Síntomas, Tratamiento, Prevención, Vacuna) Explicado por Médico Real.	Not a Verified Channel, Hard to categorize as verified or not verified doctor because no names are mentioned
¿Qué es el coronavirus? – Prevención y consejos para niños - COVID-19	Video's audience is children and didn't fit any of the four categories
COVID 19 SPANISH - resumen visual de la nueva pandemia de coronavirus	Channel didn't fit any of the four categories

Covid-19: el virus que arrasó con todo	Channel didn't fit any of the four categories
Así ataca el #coronavirus al cuerpo humano	Channel didn't fit any of the four categories
COVID 19| ORIGEN del CORONAVIRUS: LA OMS ENCONTRÓ ESTO EN CHINA	Not from 2020
¿Qué tan peligrosa es la nueva variante del Covid-19 llamada Delta plus?	Not from 2020
VARIANTE DELTA, ¿CUÁLES SON LOS SÍNTOMAS Y POR QUÉ SE PROPAGA RÁPIDAMENTE?	Not from 2020
Variante Delta del covid es más contagiosa y se vincula con gangrena	Not from 2020. About a new variant.
¿Cuál es el peligro de la variante delta del COVID-19?	Not from 2020. About a new variant.
Lo que necesita saber sobre la vacuna Johnson & Johnson	Not from 2020 and is about vaccines
SÍNTOMAS DE PELIGRO DESPUÉS DE LA VACUNACIÓN POR COVID-19	Not from 2020 and is about vaccines
¿QUÉ ES EL CORONAVIRUS? Explicación para niños | Vídeos Educativos para Niños	Kids video and the second one to pop up from that channel
El "Hongo Negro" y COVID-19: lo que debes saber sobre esta peligrosa	Not from 2020

enfermedad	
Información Del Covid-19	Not from 2020
Informacion sobre COVID-19	Not from 2020
Variantes del coronavirus: ¿Cuál es la más peligrosa? | Contexto DW	Not from 2020. About a new variant.
Información sobre el nuevo coronavirus y la prevención de COVID-19 en Español	Radio Station. Does not fit categories.
ATENCIÓN | ¿INMUNIDAD DE POR VIDA CONTRA COVID? PROBABLEMENTE TENGAS ANTICUERPOS TODA LA VIDA	Not from 2020
Cinco cosas que debe saber sobre la vacuna COVID 19	Not from 2020
Vacuna contra la Covid: ¿todo bajo control?	About the Vaccine

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Do Differences in Creativity Exist Between Individual Killer Whales (*Orcinus orca*)?

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Cetaceans demonstrate unique and creative variations of common behaviors such as communication, foraging, socialization, and play. Few studies have tested cetaceans' ability to demonstrate creativity, especially in killer whales. This study examined the creative differences between individual killer whales from MarineLand France (MLF) when asked by a trainer to be creative. Researchers used two definitions of creativity from the Torrance Tests of Creative Thinking (TTCT), flexibility and fluency, to measure the creativity demonstrated by four killer whales from MLF. Results showed that killer whales demonstrated significantly unique behaviors from one another in regard to type and energy level of exhibited behaviors. All killer whales tended to use behaviors from their repertoire. There was some variation in the correct behaviors performed. Younger animals performed a greater number of behaviors. This study suggests that killer whales from MLF select to perform a variety of different behaviors when asked to be creative. This study contributes to research efforts that aim to explain and understand the cognitive functioning of non-human animals. Advancements in knowledge of the cognitive functioning of cetaceans under human care can be applied to free-ranging cetaceans, which can aid in species conservation efforts.
Keywords: killer whale (Orcinus orca), creativity, individual differences, Torrance Tests

Do Differences in Creativity Exist Between Individual Killer Whales (*Orcinus orca*)?

Many species demonstrate unique and creative variations of common behaviors such as communication, foraging, socialization, and play. For example, captive killer whales (*Orcinus orca*) have been

observed luring seagulls close enough to catch using fish (Kuczaj et al., 1998, as cited in Paulos et al., 2010). Similarly, bottlenose dolphins have been observed engaging in locomotor play such as surfing, where they ride pressure waves produced by boats, ships, or other cetaceans (Paulos et al., 2010). Dolphins under human care often play with balls and other toys similar to wild dolphins that engage in play behaviors with feathers, seaweed, sponges, and self-made bubble rings (Bateson, 2014). Other novel behaviors by cetaceans include sponge and bubble use during foraging by dolphins (Smolker et al., 1997; Fertl & Wilson, 1997), ice fishing techniques used to capture seals and penguins by groups of killer whales (Visser et al., 2007), and intentional beach stranding to catch prey by killer whales of Crozet Archipelago and bottlenose dolphins (*Tursiops truncatus*) of Western Australia (Guinet, 2011; Sargeant et al., 2005).

Each of the behaviors above demonstrate the ability of different cetaceans to produce new or novel behaviors in response to a changing environment. This flexibility in behavior indicates the presence of adaptive functioning and intelligence in non-human animals (Herman, 2006). Flexible complex cognitive functioning exhibited by non-human animals seems to be related to creativity. *Creativity,* although difficult to define, is a construct that can explain antecedent events that elicit specific observable responses. The antecedent event can be described as a creative act or behavior that is novel and functional. It has been argued that a non-human animal's ability to produce a creative behavior is dependent on the knowledge and cognitive abilities it possesses. Animals can only produce behaviors that stem from what they have already learned or are capable of learning (Bailey et al., 2007).

Among the tests available to test the theory of creativity, the Torrance Tests of Creative Thinking (TTCT) are most used (Torrance, 1990, as cited in Kaufman and Kaufman, 2004). The Torrance Tests developed from Guilford's approach to the theory of creativity (Guilford, 1950, as cited in Kaufman and Kaufman, 2004). Both Guilford and Torrance discussed four types of creativity: fluency, flexibility, originality, and elaboration. Fluency is defined as the number of ideas generated. Flexibility represents the ability to produce many different types of ideas, and how many categories the ideas fit

into. Originality is being able to produce unique ideas. Elaboration is the ability to produce details and examples about an idea.

The Torrance Tests of Creative Thinking were originally created to be a part of long-term research in children that emphasized classroom experiences that stimulated creativity. (Swartz, 1988, as cited in Kim, 2006). Torrance intended for the TTCT to serve as tools for understanding and enhancing creativity. The TTCT showed teachers different perspectives on student's abilities that were drastically different from common aptitude and achievement tests that were comprised of verbal and quantitative content (Torrance, 1977, as cited in Kim, 2006). Torrance strived to move away from conformity and standardization in the education system with the TTCT (Kim, 2006).

Overall, most researchers find that the TTCT appear to be valid and reliable (Treffinger, 1985; Cooper, 1991, as cited in Kim, 2006). The tests appear to be a good measure for identifying and educating gifted students and encouraging creativity in the general population. However, some potential issues with the tests have been discussed. For example, researchers believe that originality scores would change among various demographics over time. To control for the issue researchers have suggested the creation of independent criteria for different cultural groups, so that results for originality would no longer be misleading. Similarly, other researchers have concluded that environmental conditions, motivation, fatigue, testing conditions, and exposure to diverse information can influence TTCT scores (Kim, 2006).

The TTCT were not created for use on nonhuman animals. However, there is a training method developed by Karen Pryor (1999; as cited in Kaufman and Kaufman, 2004) that produced behaviors that could be coded for three of four creativity measures involved in Torrance Tests. The training method was originally created as a game to train marine mammals, but eventually turned into a training technique used for a variety of animals (reviewed by Dudzinski et al., 2018).

Past research has examined the intellectual abilities of non-human animals in several species. The idea that non-human animals can vary their behavior when asked to do so by humans was first investigated by Pryor et al. (1969), who trained rough-toothed dolphins

(*Steno bredanensis*) to respond to a discriminative stimulus, or SD, with a novel behavior. Pryor began training sessions by refraining from giving cues. Eventually, the dolphins offered random behaviors, perhaps due to frustration. If the dolphins offered a behavior that Pryor had never seen before, the behavior was reinforced. Similarly, Kuczaj and Eskelinen expanded upon Pryor's original study, using a discriminative stimulus to elicit creative responses (i.e., do something that you have not done before) from bottlenose dolphins (*Tursiops truncatus*). Each session in the study consisted of a trainer presenting a dolphin with a cue to produce an innovative behavior followed by the dolphin's response. The process was repeated until the dolphin failed to produce a new behavior or the trainer ended the session (Kuczaj & Eskelinen, 2014).

Sessions that test for innovative behaviors in animals tend to last for more than one behavior, which allows trainers and researchers to observe how many different ideas the subjects could produce. Kaufman and Kaufman (2004) suggested that the TTCT might be a good model for measuring creativity in non-human animals. The number of different behaviors produced could be considered a manifestation of fluency. Flexibility can also be observed when animals produce different types of behaviors that can be categorized. Finally, originality can be examined in animal innovate sessions as well. Trainers can examine the different behaviors produced by animals and determine how unique or rare specific behaviors are in comparison with behaviors in the animal's repertoire. Unfortunately, Kaufman and Kaufman (2004) also suggested that Torrance's fourth creativity measure, elaboration, could be difficult to examine in animals. Attempting to get an animal to elaborate on a behavior changes the object of innovate training sessions, which aim to elicit unique reinforceable behaviors. Changing the objective of innovate sessions to allow an animal to elaborate on a behavior is impossible to explain to the animal. Therefore, measuring elaboration would possibly end an innovate session and make the results of the measurement unreliable (Kaufman & Kaufman, 2004).

Individuality may play a role in the creative ability of killer whales. Individual differences have been discovered in many animals such as marine mammals, primates, and birds (reviewed by Gosling,

2001). It has been suggested that individual differences can be the result of various factors. In dolphin societies, dolphins engage in many types of relationships such as high-order alliances, long-term pair bonds, and cooperative associations (Conner et al., 2000, as cited by Highfill & Kuczaj, 2010). The different relationships may influence their individuality. For example, in both wild and captive dolphins societies, some dolphins are more dominant than others. When a dominant dolphin approaches a more submissive dolphin the submissive dolphin makes a choice about how to interact (Herman, 1980, as cited by Highfill & Kuczaj, 2010). The choice made by the dolphin, especially if it is consistent, may indicate the presence of consistent individual differences among dolphin societies (Highfill & Kuczaj, 2010).

Similarly, differences in feeding behaviors have been observed in various locations. In most cases, dolphins of the same pod utilize similar foraging techniques. However, individual differences have also been observed within groups. In Bull Creek, South Carolina bottlenose dolphins were observed strand-feeding, which involves dolphins stranding themselves onto mud banks in groups and driving fish onto shore. After feeding, dolphins return to the water in groups. Dolphins in Bull Creek were observed deviating from common group stand-feeding repertoire. Single dolphins were observed restranding themselves right after the group strand-feeding sessions to feed on the fish that the rest of the group missed. Also, some members of the group did not participate in the group strand-feeding sessions at all and remained offshore in the water (Duffy-Echevarria et al., 2008, as cited by Highfill & Kuczaj, 2010). These observations provide evidence of consistent and stable variations in individual dolphin behavior.

Similarly, Finn et al. (2009) observed a single bottlenose dolphin in the Upper Spencer Gulf in South Australia herd a cuttlefish, kill it, and wait to eat it. First, the dolphin beat it with its rostrum until all the ink was out. The dolphin then scraped the cuttlefish along the sea floor to remove the skin and the cuttlebone. The observers had never observed this behavior in another dolphin before. Although a single dolphin was observed that could be attributed to individual differences, the researcher suggested that the behavior may not have been restricted to a single dolphin, but rather whole pods in the area. Clean cuttlefish

bones were repeatedly observed bobbing to the surface in association with passing dolphin pods.

In captive settings, individual variation also exists in maternal care. A study from Hill et al. (2007) investigated the possibility of maternal styles in seven mother-calf dolphin pairs under human care. The mother-calf pairs were examined for target maternal behaviors and results showed that mothers significantly differed from one another in discipline, contact with calf, orient at environment, mother-calf swims. Two of the mothers specifically engaged in more controlling behaviors than the other mothers such as active herding and or following their calves. These experiences not only demonstrate individual variation among mothers but may also have a long-term influence on calf development, such as curiosity or play.

Like other dolphins, killer whales are influenced by their social relationships and structure. As a matrilineal society, killer whales social structure is shaped by maternal kinship and strong natal philopatry with hierarchically structured units. A matrilineal structure has been observed in many different killer whale pods and can be considered an intrinsic trait in the species (Esteban et al., 2015). Despite this consistent characteristic of the species, individual differences appear to exist among various kin-based pods. Nousek et al. (2006) found that vocal variations exist between free-ranging individual northern resident killer whales that were constantly associated with each other and engaged in group-specific vocalizations. This finding suggests not only the presence of individual differences in killer whale communication vocalization, but also that individuals can potentially distinguish between the highly similar shared calls of their matrilineal relatives (Nousek et al., 2006). Results from a similar study also showed distinct acoustical groupings by individual killer whales under human care at multiple facilities (Dahlheim & Awbrey, 1982). Along with individual differences in communication sounds, killer whale pods around the world also utilize different hunting strategies (Kuczaj et al., 1998, as cited in Paulos et al., 2010; Visser et al., 2007; Guinet, 2011), suggesting that individual variation exists as does flexibility in foraging strategies (Saulitis et al., 2000), which may reflect different characteristics of creativity.

However, much more systematic research is needed regarding the individual differences and creative abilities of cetaceans, but more specifically killer whales. The purpose of this study was to examine the creative abilities of killer whales and to determine whether creativity differed between individual killer whales from the same facility. Researchers examined archived video footage of innovate testing sessions of individual killer whales from MLF. Killer whales demonstrate uniquely innovative behaviors in the wild and examining their innovate sessions under trainer control may contribute to what is known about killer whale innovation and cognition.

The following questions were examined in this study of killer whales from MLF: (1) do individual killer whales produce similar types of behavior, (2) do individual killer whales produce behaviors using different energy levels, (3) do individual killer whales produce behaviors outside of their repertoire, (4) does individuality affect the ability of killer whales to produce reinforceable behaviors, (5) does individuality affect the number of total behaviors produced, (6) does individuality affect the amount of consecutively reinforced behaviors produced before a behavior is not reinforced, and (7) does individuality affect the percentage of reinforced behaviors produced out of the total number of behaviors?

Method

Subjects

Subjects from this study were examined from MarineLand France (MLF). One adult female killer whale (*Orcinus orca*), WIK, was studied along with one adult male killer whale, INK, and two juvenile males, MNA and KJO. Ages ranged from seven to 22 years old. WIK was the matriarch of the group.

Measures

Creative behaviors were measured using two definitions of creativity from the Torrance Tests of Creative Thinking, flexibility and fluency (Table 1). Flexibility represents the ability to produce many types of behaviors and had three operational definitions: energy, type, and repertoire. The energy operational definition had 10 levels, low, medium, high, homogeneous low, homogeneous medium,

homogeneous high, low and medium, low and high, medium and high, and low medium and high (Table 2). High energy behaviors were generally defined as behaviors that took effort, like aerials, or behaviors that were performed with high intensity (e.g., loudness for vocalizations). Medium energy behaviors were represented by behaviors that took moderate effort like a pec slap that fell between high and low effort or behaviors that produced substantially more water than other behaviors (e.g., fluke splash that produced moderate amount of water spray). Medium energy behaviors were also represented by behaviors that were performed with medium intensity (e.g., mid-volume vocalizations). Low energy behaviors were represented by behaviors that took low effort, like a small squirt, or behaviors that were performed with low intensity (e.g., quiet whistle). The type operational definition also had 10 levels, motor, vocal, bubbles, homogeneous motor, homogeneous vocal, homogeneous bubbles, motor and vocal, motor and bubbles, vocal and bubbles, and motor vocal and bubbles (Table 3). The repertoire operational definitions were, yes, the behavior was in the animal's training repertoire, and no, the behavior was not in the animal's training repertoire. Fluency represents the number of behaviors produced and had four operational definitions, total number of reinforced behaviors, number of reinforced behaviors out of the total number of behaviors performed, total behaviors performed, and highest number of consecutively reinforced behaviors before a behavior was not reinforced.

Table 1
Creativity Variables Defined

Creativity Variable	Creativity Variable Definition	Operational Definitions
Flexibility	The ability to produce many different kinds of behaviors	Energy Type Repertoire
Fluency	The number of behaviors produced	Total number of reinforced behaviors Number of reinforced behaviors out of the total number of behaviors performed Total number of behaviors Total number of consecutively reinforced behaviors

Table 2
Flexibility—Energy Operational Definition

Operational Definitions	Levels Within Operational Definition	Explanations and Examples
Flexibility (energy)	1 = Low	Behavior performed with minimal effort (e.g., quiet whistle, small squirt)
	2 = Medium	Behavior performed with moderate effort (e.g., tail slap with moderate water spray)
	3 = High	Behavior performed with effort (e.g., airplane, aggressive bark)
	4 = Homogeneous low	Multiple behaviors during trial that had the same low energy level (e.g., quiet whistle and small squirt performed together)
	5 = Homogeneous medium	Multiple behaviors during trial that had same medium energy level (e.g., tail slap with moderate water spray and mid-volume whistle performed together)
	6 = Homogeneous high	Multiple behaviors during trial that had same high energy level (e.g., airplane and aggressive bark performed together)
	7 = Low+medium	Separate behaviors of low and medium energy level performed during trial (e.g., small squirt and mid-volume bark performed together)

	8 = Low+high	Low and high energy level behaviors performed during trial (e.g., quiet whistle and airplane performed together)
	9 = Medium+high	Medium and high energy level behaviors performed during trial (e.g., mid-volume whistle and airplane performed together)
	10 = Low+medium+high	Low, medium, and high energy level behaviors performed during trial (e.g., small squirt, mid-volume whistle, and aggressive bark performed together)

Table 3

Flexibility—Type Operational Definition

Operational Definitions	Levels Within Operational Definitions	Explanations and Examples
Flexibility (type)	1 = Motor	Behavior performed using body parts (e.g., pec slap, spy hop)
	2 = Vocal	Behavior performed involving noise (e.g., burp, whistle)
	3 = Bubble	Behavior performed using bubbles (e.g., bubbles, jacuzzi)
	4 = Homogeneous motor	Multiple motor behaviors performed during trial (e.g., pec slap and spy hop performed together)
	5 = Homogeneous vocal	Multiple vocal behaviors performed during trial

	(e.g., burp and whistle performed together)
6 = Homogeneous bubble	Multiple bubble behaviors performed during trial (e.g., bubbles and jacuzzi performed together)
7 = Motor+vocal	Motor and vocal behaviors performed during trial (e.g., spy hop and burp)
8 = Motor+bubble	Motor and bubble behaviors performed during trial (e.g., pec slap and jacuzzi performed together)
9 = Vocal+bubble	Vocal and bubble behaviors performed during trial (e.g., burp and bubbles performed together)
10 = Motor+vocal+bubble	Motor, vocal, and bubble behaviors performed during trial (e.g., pec slap, burp, and jacuzzi performed together)

Each killer whale was individually trained in either a large or small pool to respond to the innovate behavioral SD or cue presented by the trainer. The subjects learned to respond with a different behavior than previously performed at each SD. Training sessions allowed the subjects to become familiar with the create task. The training sessions were conducted by MLF from 2019-2020.

All killer whales completed testing sessions that were videotaped for coding at a later time. All test sessions occurred early in the day and were completed for one animal at a time. The killer whales were given the SD as many times as possible in a session. When a different behavior was performed, the killer whale received a randomly

selected form of reinforcement from the trainer. Trainers terminated a session if the killer whale seemed to lack motivation in their behaviors, food was running low, or the same behavior was repeated three trials in a row. MLF testing sessions were conducted in 2020 with each killer whale receiving 12 sessions. Six sessions used a standard reinforcement procedure with a consistent amount of reinforcement given regardless of behavior performed. Six other sessions were conducted using a variable reinforcement contingency that elicited greater motivation for novel or unusual behaviors.

A trainer from MLF reviewed archived testing session videos from MLF, and correct behavioral data were coded. Resulting correct behaviors were then coded for the variables flexibility and fluency. For reliability purposes, 25% of trials in each session were recoded by a trained research assistant for correct behavioral data.

A chi-square test of independence was conducted to assess whether individual killer whales produced behaviors at different energy levels than one another. A chi-square test of independence was conducted to assess whether individual killer whales produced different types of behaviors. A chi-square test of independence was also conducted to assess whether individual killer whales produced different quantities of behaviors unique to their repertoire. A one-way ANOVA was conducted to assess whether individual killer whales produced different quantities of reinforced behaviors. A one-way ANOVA was conducted to assess whether individual killer whales produced different quantities of behaviors. A one-way ANOVA was conducted to assess whether individual killer whales produced different amounts of consecutively correct behaviors before producing an incorrect behavior. A one-way ANOVA was also conducted to examine the relationship between individual killer whales and percentage of correct behaviors produced out of the total numbers of behaviors produced.

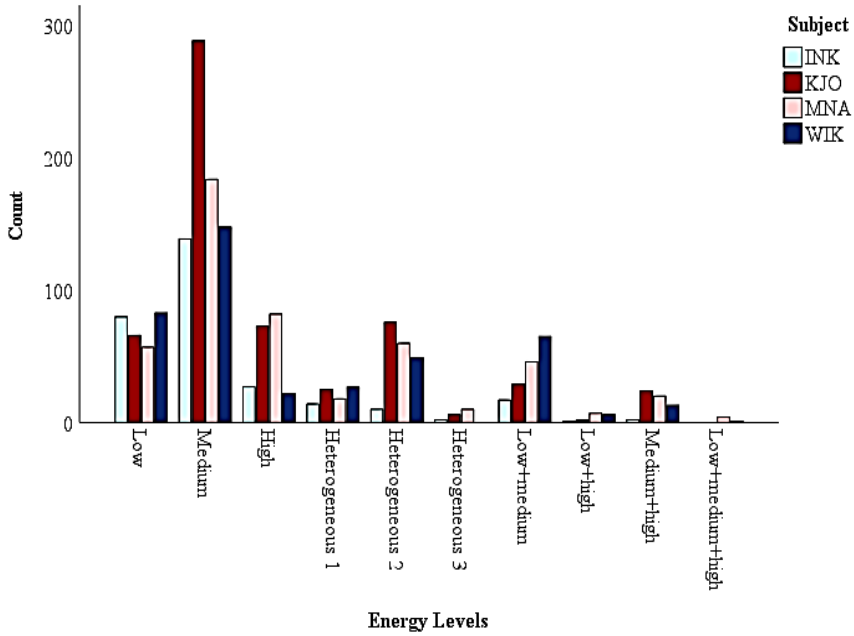
Results

A chi-square test of independence was performed to examine the relationship between individual subjects and energy levels of behaviors produced. The relationship between the variables was significant, $\chi^2(27, N = 4) = 173.85$, $p < .05$, $\varphi = .312, V = .180$ (Figure 1). Individual killer whales from MLF differed from one

another in the level of energy that they put into the behaviors that they produced. WIK produced more low, heterogeneous low, and low and medium energy behaviors than expected (adjusted standardized residual = 5.7), MNA performed more high energy, heterogeneous high, and low medium and high energy behaviors than expected (adjusted standardized residual = 4.4). KJO produced greater medium behaviors than expected (adjusted standardized residual = 3.8), and INK produced much more low energy behaviors than expected (adjusted standardized residual = 5.8). This suggests that older animals produced lower energy behaviors, while younger animals produced higher energy behaviors.

Figure 1

Flexibility—Energy Comparison of Individual Killer Whales

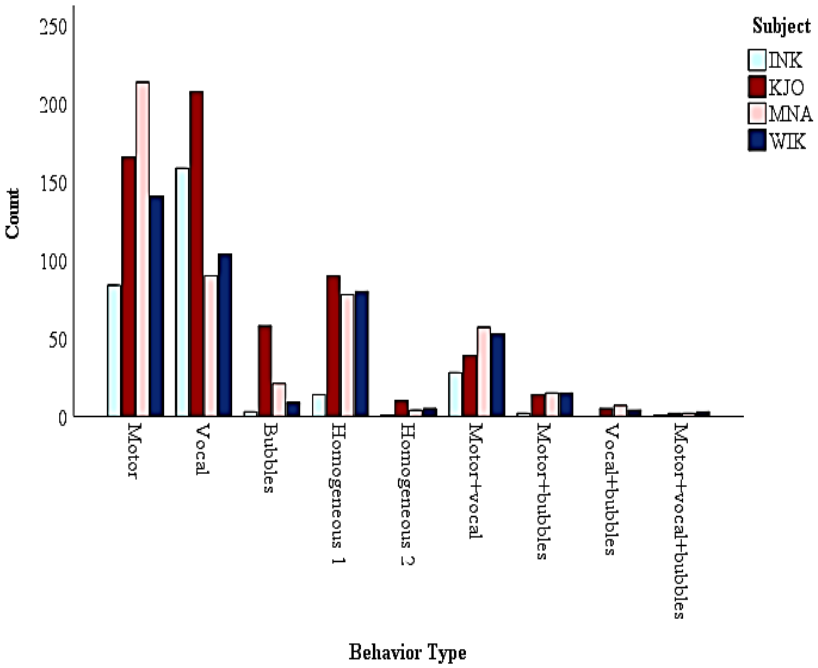


A chi-square test of independence was conducted to examine the relationship between individual subjects and types of behaviors produced. The relationship between the variables was significant, $\chi^2(24, N = 4) = 201.72, p < .05, \varphi = .336, V = .194$ (Figure 2). Individual killer whales from MLF produced different types of

behaviors. WIK produced more heterogeneous motor and motor and vocal behaviors than expected (adjusted standardized residual = 3.1). MNA produced much more motor behaviors than expected (adjusted standardized residual = 5.5). KJO produced more vocal and bubble behaviors than expected (adjusted standardized residual = 6.4), and INK produced more vocal behaviors than expected (adjusted standardized residual = 9.3). Consistently producing certain types of behaviors further suggests that individual killers whales may have had preferences in the behaviors that they produced.

Figure 2

Flexibility—Behavior Type Comparison of Individual Killer Whales



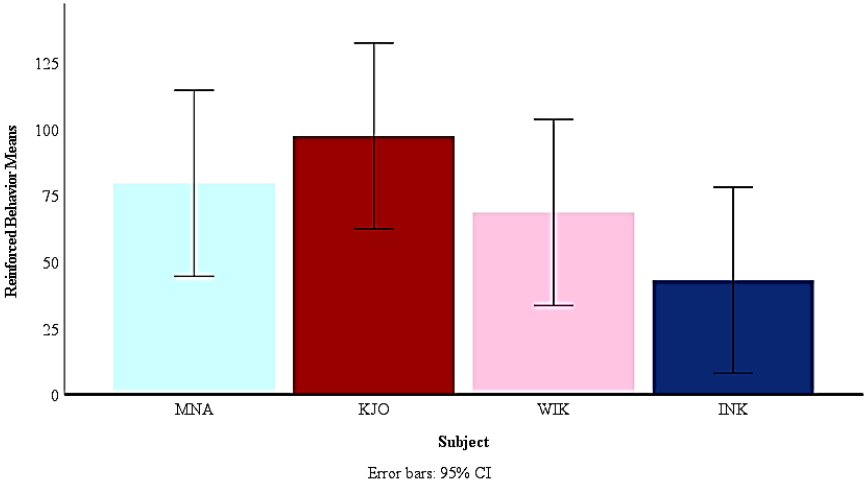
A chi-square test of independence was performed to examine the relationship between individual subjects and behavioral repertoire. The test indicated that behavioral repertoire was similar between individual killer whales, $\chi^2(3, N = 4) = 2.74$, $p > .05$. Killer whales

from MLF produced behaviors most commonly associated with their repertoire and training experiences.

A one-way ANOVA was conducted to examine the relationship between individual killer whales and quantity of reinforced behaviors produced. The test indicated that individual killer whales produce similar quantities of reinforced behaviors, $F(3, 20) = 1.83$, $p > .05$. Killer whales from MLF performed similar amounts of reinforced behaviors. However, the younger killer whales, KJO ($M = 97.50$, $SD = 68.74$) and MNA ($M = 79.67$, $SD = 32.57$), produced larger quantities of correct behaviors than WIK ($M = 68.67$, $SD = 25.66$) and INK ($M = 43.17$, $SD = 17.90$).

Figure 3

Fluency—Number of Reinforced Behaviors



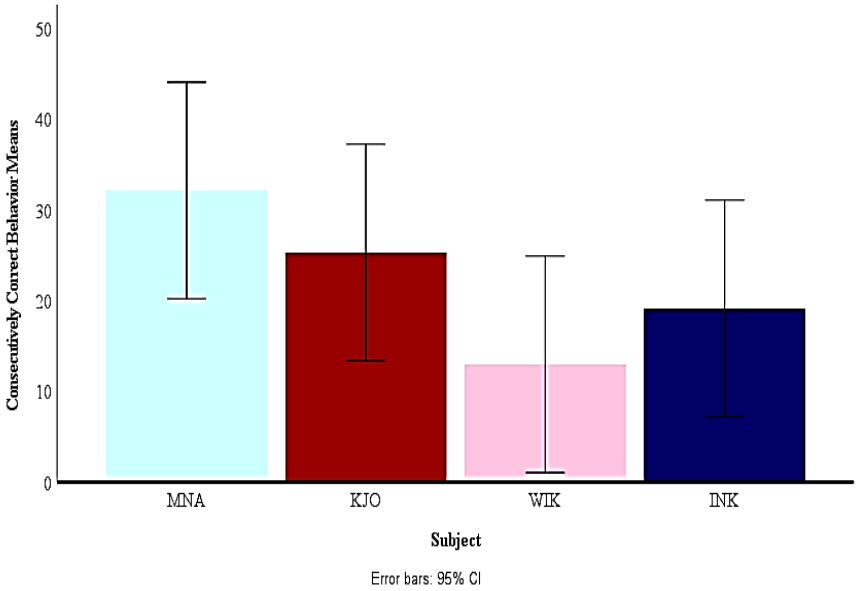
A one-way ANOVA was performed to assess the relationship between individual killer whales and the number of total behaviors produced. The test indicated that individual killer whales produced a similar amount of behaviors in total, $F(3, 20) = 1.53$, $p > .05$. Although individual killer whales produced similar amounts of behaviors the youngest of the group, KJO ($M = 108.17$, $SD = 72.37$), produced more

behaviors than MNA (*M* = 87.83, *SD* = 31.84), WIK (*M* = 86.17, *SD* = 31.10), and INK (*M* = 55.50, *SD* = 14.10).

A one-way ANOVA was conducted to assess the relationship between individual killer whales and number of consecutively correct behaviors. The test indicated that the individual killer whales produced similar quantities of consecutively correct behaviors, $F(3, 20) = 2.06$, $p > .05$. Although, MNA (*M* = 32.17, SD = 19.78) produced the greatest quantity of consecutively reinforced behaviors than KJO (*M* = 25.33, *SD* = 15.73), WIK (*M* = 13.00, *SD* = 3.69), and INK (*M* = 19.17, *SD* = 11.62).

Figure 4

Fluency—Consecutively Correct Behaviors

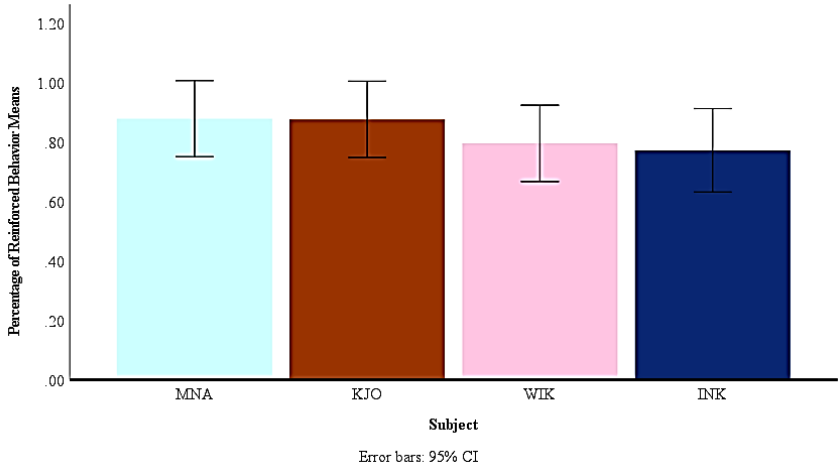


A one-way ANOVA was conducted to examine the relationship between individual killer whales and percentage of correct behaviors produced. The test indicated that individual killer whales produced very similar percentages of correct behaviors, $F(3, 19) = .75$, $p > .05$. All killer whales performed about 80% of their total behaviors correctly.

This indicates that killer whales responded well when asked to be creative during innovate sessions.

Figure 5

Fluency—Percentage of Reinforced Behaviors out of Total Behaviors



Discussion

Creativity is a construct that has been examined in various species of cetaceans. However, killer whales have never been assessed for creativity. While killer whales' cognitive abilities are largely unknown, past research on wild killer whale social traditions has indicated that imitative learning most likely facilitates this complex cognitive ability (Abramson et al., 2013). It has also been suggested that individual killer whales can potentially distinguish between the highly similar shared calls of their matrilineal relatives (Nousek et al., 2006). Given that killer whales are large brained, highly trainable, and socially advanced it is especially important to conduct creativity research with killer whales under human care. This type of research can provide cognitive enrichment to the killer whales while also creating the opportunity for researchers to gain a better understanding of cognitive functioning and functional adaptability in killer whales.

The purpose of this study was to assess whether individual differences existed in the way a group of killer whales responded when

asked to be creative by their trainer. Although this study focuses on killer whales under human care, the results can be applied to multiple species (bottlenose dolphins. Kuczaj & Eskelinen, 2014; rough-tooth dolphins, Pryor et al., 1969). The measure of creativity used in this study has not yet been applied to animals, however it has been applied to human children (Kim, 2006). While some researchers believe that the TTCT may be subject to cultural bias in human creativity research, it is unknown whether the same issues exist when TTCT are used to measure animal creativity. This gap in knowledge demonstrates the need for extensive research involving TTCT and various species of non-human animals to determine whether TTCT accurately represent creativity.

Two factors of creativity identified by Torrance were examined in the current study—flexibility and fluency. Flexibility was measured with three different operational definitions: energy level of the behavior performed, type of behavior performed, and presence of repertoire behavior. Individual differences emerged for two of the definitions, energy and type of behavior. Younger killer whales performed more than twice as many high energy behaviors (e.g., loud high-pitched whistle) than older killer whales. The youngest killer whale of the group performed the most medium energy behaviors (mid-volume bark), homogeneous medium behaviors (mid-volume bark and squirt with moderate water spray performed together), and bubble behaviors (e.g., jacuzzi). The eldest killer whale of the group performed mostly low energy behaviors (e.g., small squirt), and performed twice as many vocal behaviors (e.g., bark) than motor behaviors (e.g., pec wave). The second youngest killer whale of the group performed the most low medium and high behaviors (e.g., low, medium, and high energy behaviors performed together within a trial), and twice as many motor behaviors than vocal behaviors. This display of behaviors indicates that older killer whales perform behaviors that require less effort, which could be do to age, body size, or possibly preference. While the youngest killer whales of the group generally performed similar quantities of behaviors, each killer whale also seemed to prefer a particular type of behavior. Interestingly though, all animals preferred to perform behaviors within their behavioral repertoire, given that the

majority of their exhibited behaviors represented previously trained behaviors.

Fluency was measured with three different operational definitions: correct trials, percentage correct, total trials completed. While individual differences were insignificant, the youngest killer whale in the group performed the most reinforced behaviors and twice as many reinforced behaviors as the oldest killer whale. However, the second youngest killer whale performed the most reinforced behaviors in a row before performing a behavior that was not reinforced, which possibly suggests an advanced understanding of what was being asked during create sessions. While the second youngest killer whale possibly had an advanced understanding of what was being asked during create sessions, all killer whales in the group generally understood what was being asked of them. About 80% of behaviors performed by each killer whale were reinforced, which also suggests that each killer whale was engaged during individual sessions.

Limitation and Future Directions

Dudzinski et al. (2018) suggested that behaviors produced in training sessions could be influenced by individual differences in trainers and animals, schedules of reinforcement, and differential reinforcement (i.e., magnitude and preference). Individual killer whales may respond differently to different trainers which can cause inconsistences in performed behaviors. A killer whale's motivation can also affect the behaviors that they produced. Lack of motivation could result in lower energy behaviors, therefore a session with low motivation can impact testing data (Dudzinski, 2018). In this study, trainers from MLF, varied the reinforcement that was given to killer whales, ended creativity sessions when the killer whales appeared to lack motivation, and used the same trainers for individual killer whales to control for these influences. Future studies should also assess originality and elaboration to truly understand the scope of the killer whale's cognitive ability and motivational level.

Many existing studies involving killer whales discuss limitations that arise from difficulties in observing the same killer whale continuously. Researching killer whales under stimulus control allows for increased control over confounding variables and

observations. Although this study involves killer whales under human care, it is possible that knowledge regarding their cognitive functioning can offer insight into what is known about free-ranging killer whales and their behavioral repertoire. Studies involving free-ranging killer whales have shown that they exist in highly advanced societies and learn from one another through imitation (Abramson et al., 2013). Calves have been observed imitating the foraging and communication behaviors of their mothers and other adults in their groups (Guniet, 2011; Finn, 2009; Simila & Ugarte, 1993). Advanced foraging and communication skills can increase the overall well-being and fitness of calves. Therefore, creativity in killer whales could contribute to the cultural innovation and general welfare of groups of free-ranging killer whales, considering that less creative individuals could imitate creative individuals. An increase in creative groups of killer whales could eventually lead to more advanced foraging and communication strategies.

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Mapping of the interstellar helium focusing cone with time-of-flight (TOF) spectra from the Magnetospheric Multiscale Mission Hot Plasma Composition Analyzers (MMS-HPCA)

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Observations within the undisturbed solar wind environment from November 24th, 2020 to February 26th, 2021, including the Earth's encounter with the interstellar neutral helium focusing cone, have produced a measurement of helium ion flux that allows this focusing cone to be mapped out. These observations were made with the Hot Plasma Composition Analyzer of the Magnetospheric Multiscale Mission (MMS-HPCA). This instrument, initially intended to study the composition of hot plasma involved in magnetic reconnection, is well-suited to detect and analyze pickup ion populations outside of Earth's magnetosphere. This marks the first time that pickup ion measurements have been made with physical units of flux rather than arbitrary counts. As expected, the results of this measurement demonstrates that the ion flux increases and decreases with the angle of the Earth relative to the location of the cone's focal point. As MMS-HPCA changes its position that results in increasing this angle, the pickup helium ion flux decreases as expected. Measurements inphysical units facilitate modeling of the interactions producing the pickup ions and their initial density values in the near interstellar medium.

I. Introduction

The Solar Wind (SW) is a constant stream of plasma particles propagating radially from the Sun. The SW interacts with the local interstellar medium (LISM) and defines the bounds of our solar system. The interaction region, known as the termination shock (TS), is where the Solar Wind decreases in speed and becomes heated. The motion of the heliosphere through the LISM produces a constant wind of neutral particles entering our solar system. Charged particles originating from the LISM are rejected by the magnetic field at the termination shock. This effect is explained by the Lorentz force, which causes charged particles to take curved paths in the presence of a magnetic field.

Neutral particles propagating past the TS that have trajectories near the Sun are gravitationally focused downwind of the Sun into a focusing cone. Due to variations in mass,each species has its own focusing cone and corresponding focal point. The cone associated with neutral helium has a focal point approximately 1 AU from the Sun. Due to the presence of the cone, the increased local neutral density enhances ion production in the region. These ions are produced in the rest frame of the outwardly propagating interplanetary magnetic field (IMF). The newly born ions become associated with, or picked up, by the IMF and begin gyratory motion about the field. Their mechanism of associating and moving with the IMF has given these ions the name pickup ions (PUIs). Helium pickup ions are increasingly observable as the Earth passes through the focusing cone from mid-November to mid-December.

Despite the similarities in compositions of the Sun and the LISM, PUI's defining mechanics and single charge states allow us to distinguish them from SW ion populations. PUI formation and their association with the IMF cause them to become "frozen-in" and co-move with the SW. The PUI gyratory motion, however, leads to a broad velocity distribution with a sharp cutoff at approximately twice the SW velocity. In addition, their interactions with the IMF and self-interactions result in scattering of the ions in pitch angle, causing the ion populations to form closed shells in velocity space (Gloecker et al., 1998; Gomez et al., 2019) It's also important to note that PUIs are only singly charged because they are formed far from the Sun. In contrast, SW ions assume multiple charge states because they are

formed close to the Sun, possibly in the Solar Corona (average temperature 2 million degrees Kelvin). Interstellar hydrogen doesn't form a focusing cone-like more massive species. The gravitational environment of the Sun is in competition with the pressure exerted by the Solar radiation environment, more specifically with Lyman-alpha ultraviolet photons. Also, the Solar radiation environment is more likely to ionize neutral hydrogen because of its low ionization energy. These two effects combine resulting in a hydrogen depletion region within 5 AU from the Sun (Kowalezka et al. 2018).

The first detection of helium pickup ions produced from LISM neutrals was reported in Mobius et al., (1985). While previous studies have successfully mapped the helium focusing cone, this study marks the first time that the cone was measured in units of physical flux, rather than arbitrary counts. The results agree well with the cone studies of Gloecker et al., (2004) and Noda et al., (2001) which measured the extent of the helium focusing cone in counts.

II. Observation and Analysis

The data used for this study come from the Hot Plasma Composition Analyzer of the Magnetospheric Multiscale Mission (MMS-HPCA) from November 24th, 2020 to February 26th, 2021 in the undisturbed solar wind environment. Ten intervals were chosen that met the required criteria. The first criterion is that the MMS probes must be in the solar wind environment and outside of the Earth's bow shock. To ensure this location, we require intervals with an anti-sunward x-component of the bulk proton velocity with a magnitude of greater than 200 km/s. The second criterion is a geocentric distance of greater than 15 times the radius of the Earth (R_E)

To maximize counting statistics, counts from all four MMS probes were summed for each interval. With the summed counts, flux was determined with (1):

$$Flux = \frac{n_{He+}}{G \cdot E \cdot \Delta\tau} \quad (1)$$

where n_{He+} is the summed counts of He+, G is the geometric factor of ($cm^2\ sr\ eV/eV$), E is the centroid energy in eV, and $\Delta\tau$ is the product of 895 ms for the acquisition time, 2 energy acquisitions, 16^2 azimuths and elevations, the number of moments, and 4 probes.

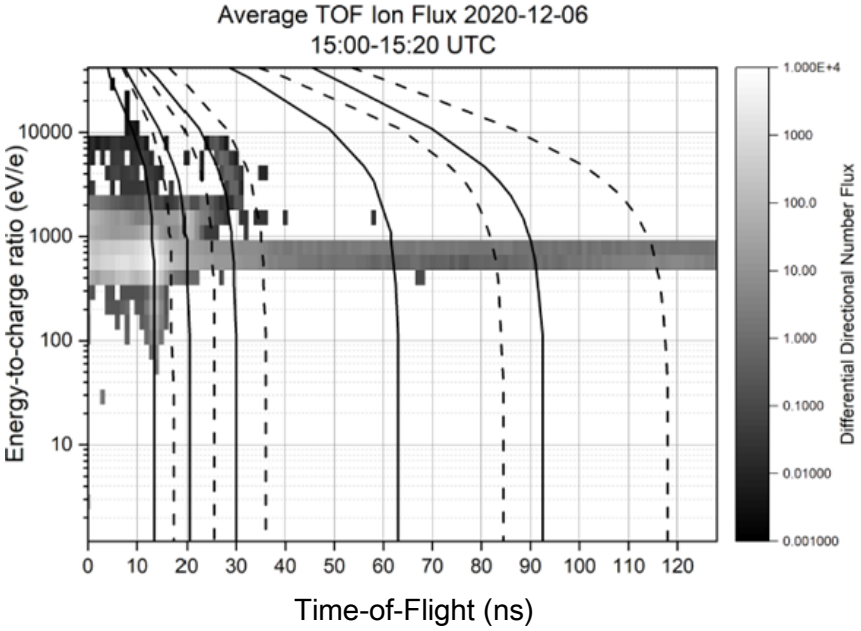

Figure 1: Average Time-of-Flight mass spectrum plot measured by MMS-HPCA during the interval of 2020-12-06 15:00-15:20 UTC. The plot spans 128 nanoseconds and has 32 E/q levels. This particular interval coincides with the estimated peak of the helium focusing cone. The flux peaks at about 562 to 782 eV/e which can be identified as the solar wind due to its beam-like nature. Spurious coincidences occurring out to 128 ns are attributable to the high solar wind count rates. Each pair of solid and dashed lines represent the TOF ranges for different species. The first of these pairs is the energy-dependent TOF ranges for hydrogen ions in the HPCA. The next pair of solid and dashed lines bracket the TOF ranges for doubly charged helium and the third pair of lines are for singly charged helium. Helium flux measurements above E/q = 782 eV/e were included for the helium study.

MMS-HPCA is an ion-optical instrument that scans space plasmas in both energy-to-charge ratio (*E/q*) and solid angle with an electrostatic analyzer (ESA). Positively charged particles exiting the ESA are accelerated by a negative 15 kV potential into carbon foils. Interactions in the foils neutralize the ion and produce secondary electron emission. HPCA determines time-of-flight (TOF) by signals generated by the neutralized ions and secondary electrons. Figure 1 is an example of a TOF spectrum used in this study for the interval 2020-12-06 15:00-15:20 UTC. Particle identities are determined using their TOF and *E/q* values. The solid and dashed line pairs seen in Figure 1 indicate TOF ranges for predetermined ion species. Starting from the left, the first pair of solid and dashed lines bracket the energy-dependent TOF range for hydrogen ions (H^+) with $\frac{m}{q} = 1$. The next pair of lines bracket the TOF range of doubly charged helium (He^{2+}), also known as alpha particles, with $\frac{m}{q} = 2$. Alpha particles are a solar wind species providing greater confidence that the probes are in the SW environment during this time interval. The alphas are finely distributed on a few energy levels centered around ≅1 keV to 1.1 keV. The third pair of lines indicate the TOF range of singly charged helium (He^+) with $\frac{m}{q} = 4$. While the SW contamination contributions occur within this TOF range, they are clearly separable from the bulk of the helium PUI population occurring at higher energy. Helium is 4x more massive than hydrogen, the primary species in the SW. A helium particle moving with the same speed as a hydrogen particle will have an energy that is four times higher. Since He^+ is clearly separated from the SW, its summed flux is easily found.

Intervals Selected with Corresponding Calculated Angle and Flux

Angle (°)	Interval (UTC)	Flux ($cm^{-2}sr^{-1}eV^{-1}s^{-1}$)
-24	2020-11-12 (13:11-	2.638485
0	2020-12-06 (15:00-15:20)	4.728621
11	2020-12-17 (2:30-2:48)	3.243453
21	2020-12-27 (16:38-16:49)	1.890672
32	2021-01-07 (8:05-8:14)	1.127821
42	2021-01-17 (11:37-11:56)	0.911835
53	2021-01-28 (6:22-6:30:30)	0.793354
67	2021-02-11 (8:52-9:02)	0.783819
79	2021-02-23 (7:25-7:34)	0.676446
82	2021-02-26 (17:32-17:45)	0.594467

Table 1: Intervals selected for this study along with their corresponding calculated angle out of the cone and flux

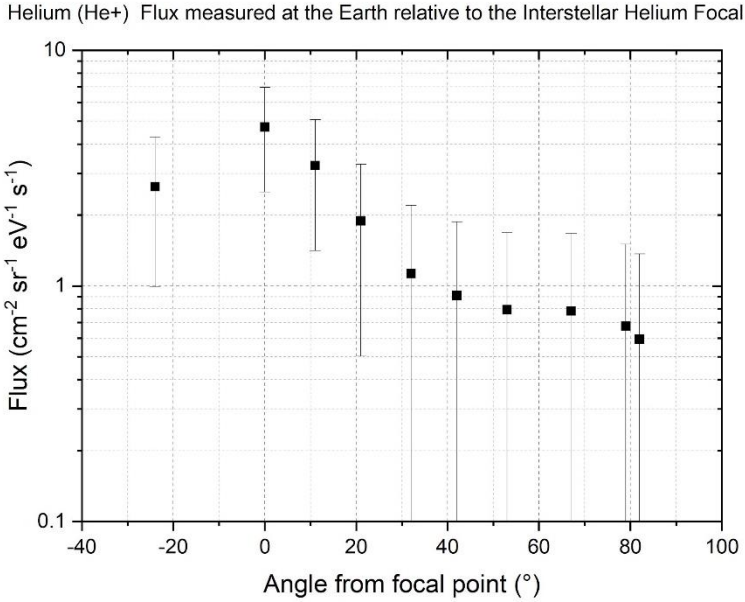

Figure 2: Helium (He+) flux measured at the Earth relative to the interstellar helium focal point. This plot was made from data in Table 1. The angle represents the angle of the Earth relative to the focal point of the helium focusing cone spanning from -24° to 82°. These time periods are from November 12, 2020, to February 26, 2021. The peak flux value is at 0° where the Earth is at the focal point. The addition of November 12th's data allows us to see that there is a clear peak in the data on December 6th. The angle of the Earth and the corresponding flux values are inversely correlated.

The flux of helium ions falling within the third set of lines, excluding spurious counts of the solar wind, was summed over energy. The summed He^+ flux for each interval and its corresponding calculated angle of the Earth are found in Table 1. The fluxes were plotted with their corresponding angular displacement outside of the cone. The resulting plot is shown in Figure 2.

As shown in Figure 2, the peak of the plot occurs at 0° and corresponds to December 6, 2020. This study focused heavily on intervals after December 6, 2020. However, an additional interval on

November 12, 2020 was used to demonstrate the motion of the Earth into and out of the interstellar focusing cone. From November 12, 2020 to December 6, 2020, singly charged helium flux increases. Following the peak on December 6, 2020 through February 26, 2021, the flux steadily decreases as the Earth moves out of the focusing cone and the concentration of neutral helium decreases as well. As expected, the concentration of gravitationally focused neutral helium is the highest at the focal point of the cone and is easily identified as 0° on December 6, 2020 as shown in Table 1 and Figure 2. The error bars in Figure 2 are due to the limitations in energy-to-charge and angular measurement of MMS-HPCA.

III. Conclusion

Data collected with the four MMS-HPCA in the SW, when the instrument operated in the highest resolution mode possible, also called burst mode, allow accurate mapping of the interstellar helium focusing cone with helium PUIs. The intervals were chosen using strict criteria in location, and proton bulk velocity. Unlike previous efforts, mapping of the He+ focusing cone was accomplished in measurements of particle flux. This study accomplished this goal with just ten intervals of burst data and despite the reduced data volume the results agree well with those of previous studies, which measured the cone in counts. Observations of the focusing cone in physical units are useful for the purposes of modelling the interactions between the heliosphere and LISM. The large amount of data collected by the MMS mission, in flight since 2015, allows investigation of the seasonal and the long term effects of these heliosphere-LISM interactions, which further extends the interest in these studies, and has far-reaching implications in stellar astrophysics.

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