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* San José State University and McNair

The Ronald E. McNair Post Baccalaureate Achievement Program was established by Congress in 1986 after the tragic explosion of the Space Shuttle Challenger that killed seven crew members, including Dr. McNair. Funded by the U.S. Department of Education, the program provides institutions with grants to develop and implement successful programs that recruit promising and aspiring low-income and first-generation students and those from backgrounds underrepresented at the doctoral level and prepares them for the rigors of graduate level work. Currently, the program operates at 187 campuses across the country serving over 5000 scholars each year.

Since the McNair Scholars Program's inception at SJSU in 1996, McNair has successfully recruited over 300 low-income and first-generation students and individuals who are underrepresented at the doctoral level. Of those who have completed the program, 98% have earned their bachelor's degree, far exceeding the 16% - 20% for this population nationwide. Eighty percent of our SJSU graduates have finished or are pursuing a graduate school degree, and 100% of our students who are in graduate school are continuously enrolled. SJSU has McNair alumni teaching or studying at universities across the United States, as well as in Germany, Columbia, Kenya, Australia, Turkey, and Morocco. We are extremely proud of our students and our program's successes.

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ACKNOWLEDGMENTS

A MESSAGE FROM THE DIRECTOR

The San José State University McNair Scholars Program is pleased to present the fifteenth SJSU McNair Scholars Research Journal. This journal represents the diverse and practical research experiences of the McNair Scholars during the 2018-2019 academic year.

I would like to congratulate the scholars for their hard work, dedication, and accomplishments during the spring course and in the summer research program. I also wish to express my sincere appreciation to the faculty mentors for their guidance, time, and commitment to the scholars, their research, and the program. A particular word of thanks goes out to the families and extended support systems that made these outstanding presentations possible.

This year, we are honoring Andrea Coto, Ling Le, and Angeles De Santos Quezada. Andrea Coto's work is called**, "**The Effect of Manufacturing Variables on the Mechanical Properties of Biopolymer-bound Soil Composites," and she will be attending Stanford's Department of Civil and Environmental Engineering Master's and PhD program in the fall of 2019. Ling Le's work is called, "Unpacking the Imposter Syndrome and Mental Health as a Person of Color First Generation College Student within Institutions of Higher Education," and she will be attending New York University in fall 2019. Angeles De Santos Quezada's work is called, "English Language Minority Students and Education Policy: A Focus on the Latinx Population," and she will be attending The University of Texas, Austin in the Department of Education.

On the cover of this year's journal, we have highlighted Ling Le and Angeles De Santos Quezada, who both reflect outstanding perseverance, determination, resilience, as well as love and dedication for their work. These students are honored because they are outstanding McNair Scholars and leaders at San José State University. We are so proud of the work these women are doing and will continue to do as PhD scholars.

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Individual Differences in Cyber Security

Biography

Christopher's belief in the importance of education stems from his roots as a first-generation college student. This passion for education is what sprouted his interest in obtaining a PhD in psychological research. His research interests include: motivation, self-efficacy, personality, performance, behavior and end-users in cyber security. Understanding how things work and improving the lives of others is what drives Christopher's research. Working as a communications intern for the County of Santa Cruz Human Services Department has given Christopher professional experience in organizational development. Currently, Christopher volunteers as an undergraduate research assistant for Vectr lab which molded his research experience in the field of human factors. In addition, Christopher volunteers at a local elementary school teaching students to code. In his off time, Christopher enjoys skateboarding, photography, film, fishing, gardening, and eating new foods with the people who make them.

Individual Differences in Cyber Security

Abstract

A survey of IT professionals suggested that despite technological advancement and organizational procedures to prevent cyber-attacks, users are still the weakest link in cyber security (Crossler, 2013). This suggests it is important to discover what individual differences may cause a user to be more or less vulnerable to cyber security threats. Cyber security knowledge has been shown to lead to increased learning and proactive cyber security behavior (CSB). Self-efficacy has been shown to be a strong predictor of a user's intended behavior. Traits such as neuroticism have been shown to negatively influence cyber security knowledge and self-efficacy, which may hinder CSB. In discovering what individual traits may predict CSB, users and designers may be able to implement solutions to improve CSB. In this study, 183 undergraduate students at San José State University completed an online survey. Students completed surveys of self-efficacy in information security, and cyber security behavioral intention, as well as a personality inventory and a semantic cyber security knowledge quiz. Correlational analyses were conducted to test hypotheses related to individual traits expected to predict CSB. Results included a negative relationship between neuroticism and self-efficacy and a positive relationship between self-efficacy and CSB. Overall, the results support the conclusion that individual differences can predict self-efficacy and intention to engage in CSB. Future research is needed to investigate whether CSB is influenced by traits such as neuroticism, if CSB can be improved through video games, and which are the causal directions of these effects.

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Introduction

A survey of IT professionals (Crossler, 2013) suggested that despite technological advancement and organizational procedures to prevent cyber-attacks, users are still the weakest link in cyber security. Subsequently, it is beneficial to further investigate how appropriate responses to cyber risks, called cyber security behavior (CSB), affect individual and organizational security. Despite the advancement of security technology, there has been an increase in attacks utilizing social engineering, such as phishing, which exploits a user's individual vulnerabilities in order to gain access into enterprise computers and personal devices. Hummel (2017) summarized Verizon and Symantec's yearly analysis and discovered that phishing attacks more than doubled between October 2015 and March 2016, rising from 48,114 to 123,555. Analysis of large-scale attacks, such as the Sony Pictures hack in 2014, found that the hack was successful due to a mistake made by one employee (Pelgrin, 2014). However, it is difficult to determine why the employee was vulnerable to the attack, due to the protection of personal information and their identity. This event leaves unanswered questions about how vulnerable employees can be exploited, and if individual characteristics of employees can predict this susceptibility. With this understanding, organizations could be better protected.

Today, technology is used in an endless number of daily information management and communication tasks, such as reaching out to loved ones, completing work tasks, and filing tax returns. As a result, the information we share online is sensitive, and criminals have adopted digital strategies to exploit their victims. By obtaining unauthorized information from users' computers, hackers can leverage the victims' vulnerabilities in many ways, such as identity theft (Frank & Werner, 2007). For example, ransomware has turned into a 70 million-dollar per year criminal enterprise (Everett, 2016). Therefore, it is important to determine what precautionary behavior or technology is necessary to prevent cyber-crime. Objective knowledge of the necessary precautions can be provided by cyber professionals, and other IT staff, but such knowledge is only half of the battle. If precautionary behavior or technology is necessary, it will only protect users who engage in those

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behaviors. Understanding the factors that predict user engagement in proactive cybersecurity is the focus of this research.

What Should Users Do?

Reeder, Ion, & Consolvo (2017) interviewed 231 computer security experts to discover what advice they would give to typical users. For this study, Reeder et al. (2017) recruited computer experts through Google's online security blog. Experts were identified as someone who had five or more years of experience working or studying computer security. Experts' responses were then grouped into 152 pieces of advice (Reeder et al., 2017). All pieces of advice reported by more than four experts were categorized into 15 groups. From this, the top three pieces of advice were regularly updating the operating system (suggested by 90 experts), using unique passwords (suggested by 68), and using strong passwords (suggested by 58). However, Reeder et al. (2017) concluded that only giving users the top three pieces of advice is insufficient because the other less mentioned pieces of advice are equally important. This illustrates the difficult issue of simplifying computer security while communicating best practices, so that the user can successfully adopt the best practices.

As discussed earlier by Reeder et al. (2017), cyber security is complex, which requires knowledge of many disparate behaviors to effectively secure devices. Kelly (2018) distinguished between two observable categories of these behaviors: *threat response* and *cyber hygiene.* Threat response is a user's "ability to prevent an attack from occurring by responding to a specific threat, as well as being able to stop an occurring attack" (Kelly, 2018, p. 129). Some of these responses include correctly identifying phishing emails, scanning a computer for viruses after a warning, and restoring a system to eliminate a virus. Generally, threat response is a user's ability to respond to threats as they attack or attempt to attack their computers. Cyber hygiene is "proactively minimizing vulnerabilities to maintain system security" (Kelley, 2018, p. 129). Examples of this include utilizing strong and unique passwords, backing up data, regularly updating and scanning for computer viruses (Reeder et al., 2017). Overall, cyber hygiene is defense against potential

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attacks and threat response is a reaction to combat current or previous attacks.

Individual Differences

Pelgrin (2014) suggested that constant vigilance is necessary in the ever-changing cyber security threat landscape. One solution to help alleviate users' potential susceptibility to cyber security threats is to develop a way to identify those who are most and least vulnerable. This information would allow a user to potentially evaluate the time and cost necessary to elevate cyber security vulnerabilities. Therefore, it is critical that a user can effectively identify potential cyber security vulnerabilities by using strong measures that will predict future performance. Specifically, Bandura (1982) argued that self-efficacy can be a strong predictor of performance behavior. It has also been suggested that effective self-efficacy measures which maximize the prediction of future performance, should be tailored to measure the domain of interest (Bandura, 1986). Therefore, in an effort to enhance someone's ability to protect themselves online, continuously tailoring and comparing specific measures to discover what unique traits make a user more or less susceptible to cyber security threats would help trainers maximize their training effectiveness (Pelgrin, 2014).

Knowledge

Knowledge is a prerequisite for a user to intentionally execute effective SCB. According to research conducted by Arachchilage and Love, (2014) as a user's level of cyber security knowledge increases, so does their CSB. It was discovered that users high in phishing threat avoidance knowledge led to increased phishing attempt avoidance behaviors and a lack of knowledge was associated with decreased phishing attempt avoidance behavior (Arachchilage & Love, 2014). In addition, knowledge of cyber threat consequences lead to increased caution and awareness behaviors when users were online (Ben-Asher & Gonzalez, 2015). Unfortunately, knowledge of proactive CSB is not sufficient. Liang and Xue (2010) concluded that to increase a user's CSB, they need to understand cyber security threats exist and that those threats can be

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avoided. If a user can detect a threat, but they believe it cannot be avoided, they will not execute proactive CSB to avoid it.

Self-Efficacy

Bandura (1982) suggests self-efficacy can be a strong predictor of performance behavior. "When beset with difficulties, people who entertain serious doubts about their capabilities slacken their efforts or give up altogether, whereas those who have a strong sense of efficacy exert greater effort to master the challenges" (Bandura, 1982, p. 123). Generally, Bandura (1986, 1997) proposed that self-efficacy influences: (1) situations and activities which affect choice behavior, (2) the extent of effort and persistence that individuals will exert to overcome adverse circumstances, (3) the feeling of stress and anxiety, and (4) performance and coping behavior. Consequently, self-efficacy may influence an individual's willingness and ability to comply with training in proactive CSB.

Knowledge affects self-efficacy. Hasan (2003) stated that prior experience with programming and computer graphics applications was shown to increase a user's computer self-efficacy beliefs. This supports claims by Bandura (1986) that self-efficacy is significantly influenced by prior experience, specifically with difficult and unfamiliar tasks (Hasan, 2003). These studies indicate that prior experience and the acquisition of knowledge may be related to a user's self-efficacy.

While it may seem intuitive that knowledge leads to self-efficacy, the reverse has also been demonstrated. Research by Gist, Schwoerer, and Rosen (1989) demonstrated that self-efficacy positively influences the acquisition and application of declarative knowledge in software training contexts (Martocchio, 1997). Martocchio's (1997) study revealed self-efficacy positively correlated to learning in an introductory Windows 3.1 training course.

Self-efficacy has been shown to predict proactive CSB. Rhee, Kim, and Ryu (2009), found that individuals with higher self-efficacy in information security use more security protection software and that individuals with higher self-efficacy in information security demonstrate more security conscious care behavior. They also found that self-efficacy in information security predicted the adoption of cyber security applications, tools, and the applying of updates. Most importantly, high

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self-efficacy in information security scores predicted usage of security software and security care behavior related to computer/internet usage such as backing up important information more frequently, and the use of multiple strong passwords.

Thatcher & Perrewé's (2002) findings suggest stable traits may positively influence computer self-efficacy. Willingness to try new informational technology was positively correlated with computer self-efficacy (Thatcher & Perrewé, 2002). Compeau (1995) found that users with "high self-efficacy used computers more, derived more enjoyment and experienced less computer anxiety" (p. 203).

Personality

Traits such as neuroticism have been shown to negatively influence cyber security knowledge and self-efficacy, which may hinder proactive CSB (Halevi et al., 2016; Kelley, 2018; Semsek, 2011). Kelley's (2018) study found that neuroticism negatively correlated with semantic knowledge. Costa and MacCrae (1992) discovered that individuals who were high in neuroticism tended to also be anxious.

The previously mentioned studies support the idea that neurotic users may push cyber security alerts to the side or give up all together in an effort to reduce their anxiety. This seems like a plausible explanation, as Halevi et al. (2016) found neuroticism to be inversely related to self-efficacy. Similarly, Semsek (2011) found a negative correlation between computer anxiety and computer self-efficacy. It was also discovered that those who were low on self-efficacy also tended to dwell on personal deficiencies (Bandura, 1991) causing the individual to become more self-diagnostic than task diagnostic (Kanfer, 1987). Self-diagnosis is associated with less effective learning (Martocchio, 1997).

In another study, it was suggested that traits such as neuroticism should be broken down and studied specifically (Thatcher & Perrewé, 2002). For example, trait anxiety (TA) had a positive association with computer anxiety (CA). High negative affect users had a negative experience regardless of the situation while high trait anxiety users experienced anxiety under specific situations using information technology (Thatcher & Perrewé, 2002). In turn, this information may assist IT specialists in designing training programs to effectively increase

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a user's computer self-efficacy (Thatcher & Perrewé, 2002). These findings support the notion that cyber-design could be more effective if it was able to consider the users personality when designing and operating defense technology, as personality traits were found to be a significant factor in predicting user behavior across different cultures (Helveti et al., 2016). Other findings indicate that individual traits such as neuroticism might be related to self-efficacy, which may also influence CSB.

Multiple studies have shown that lower levels of self-efficacy correlate with increased levels of anxiety in users which may impede their ability to effectively identify and execute correct CSB as technology continues to grow (Halevi et al., 2016; Liang & Xue, 2010; Semsek, 2011; Thatcher & Perrewé, 2002). A possible explanation for this is Bandura's (1986, 1997) theory which states that self-efficacy reduces a user's anxiety levels. In addition, Bandura (1982) and Brockner (1979a, 1979b) have suggested that end users with high self-efficacy tend to show lower levels of anxiety and increased positive affect, retain more, and better focus on tasks.

Statement of Purpose and Hypotheses

In discovering if self-efficacy is related to vulnerabilities of users, this information can inform trainers and help provide a more effective training program. Considering the ever-evolving threat landscape, it is beneficial to continuously measure and update scales as technology changes in order to accurately assess the threat landscape. This would also allow users to assess their own vulnerabilities in an effort to enhance their CSB. Improved training programs will reduce the potential of cyber security threats, as well as save time and money for users and organizations globally. However, there are few current cyber security training products that use a measurement to effectively identify strong and vulnerable users by focusing on individual differences. Lack of knowledge of how personality predicts CSB may be limiting the usefulness of personality measurement in cybersecurity training. By discovering what individual differences influence cyber security behavior, we can better identify who needs training and improve the content of training.

The goal of this study was to investigate the factors that predict how vulnerable users are to cyber security threats. The factors investigated

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include knowledge, self-efficacy, and personality. The research reviewed here has suggested that neuroticism may affect users' self-efficacy in information security and CSB, leading to the following hypotheses:

> Hypothesis 1. Neuroticism is inversely related to self-efficacy.
> Hypothesis 2. Neuroticism is inversely related to CSB.

Consistent with previously mentioned studies, I propose that users with higher self-efficacy in information security will exhibit the necessary CSB in the following hypothesis:

> Hypothesis 3. Self-efficacy is positively related to threat response.
> Hypothesis 4. Self-efficacy is positively related to cyber hygiene.
> Hypothesis 5. Self-efficacy is positively related to CSB.
> Hypothesis 6. Self-efficacy is positively related to general controllability.

I also hypothesized that knowledge level of cyber security preventative measures would increase a user's self-efficacy and SCB in the following hypotheses:

> Hypothesis 7. Self-efficacy is positively related to knowledge.
> Hypothesis 8. Knowledge is positively related to CSB.

Methods

Participants

Participants were San José State University Students recruited through the Sona Systems research participant system. Students enrolled in introductory psychology courses were given credit upon completion of the online survey. Sona recorded a total of 200 recruited participants, but 183 responses were collected. The resulting sample ($N = 183$) was comprised of 24.6% male and 72.1% female participants. Six participants left gender blank which accounted for 3.3% of the sample. The average age of participants was 19 ($M = 18.5$, $SD = 2.84$). Seven participants left the text box for age blank, one participant indicated they were three years old and one participant indicated they were nine; these were interpreted as typos. Two participants wrote "Over 18" in the text box, so age could not be determined. A total of 11 participants thus did not have ages specified, accounting for 5.9% of the sample.

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Measures

Knowledge Quiz. To test for participants' knowledge of SCB, participants were presented with a 16-question quiz. The first set of nine questions of the quiz was derived from Pew Research Center's cyber security quiz (Olmstead & Smith, 2017). From these questions, one question had seven options, one question and six options, four questions had five options, three questions had three options and five question had four options. Two questions were derived from Microsoft's cyber security IQ quiz which had four options each (Microsoft, 2017).

General Controllability. Users' belief in technology's ability to keep devices secure was assessed using three questions from Rhee's (2009) general controllability survey ($\alpha = 0.697$):

1. In general, threats to information security are controllable.
2. In general, technology is advanced enough to prevent information security threats.
3. In general, there exist means to control information security threats.

Questions were answered on a 7-point Likert-type scale ranging from 1 (s*trongly disagree*) to 7 (*strongly agree*).

Intentional Cyber Security Behavior (SeBIS). To measure intent to comply with current security preventative measures, this study utilized Eagleman's Security Behavior Intention Scale (SeBIS; 2015). The survey was comprised of 16 items ($\alpha = 0.801$). Each item was measured on a 5-point Likert-type scale with the following anchors: 1 (*never*), 2 (*rarely*), 3 (*sometimes*), 4 (*often*), and 5 (*always*). The original SeBIS was divided into four sub categories, however, for this study in was divided into two following the approach of Kelley (2018). The first category is cyber-hygiene, defined as any question which asked the participant how often they engaged in proactive CSB. The second category is threat-response, defined as any question which asked the participant how they would respond to a threat. The survey assessed user's intention to engage in proactive awareness, password use, regularly updating devices, and general device securement. An example of a statement used is "I manually lock my screen when I stem away from it" (Egelman, 2015, p. 2879).

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Self-Efficacy in Information Security (SEIS). To measure self-efficacy in cyber security, participants were given Rhee's Self-Efficacy in Information Security (SEIS; 2009). This survey was comprised of 11 questions (α = 0.965) which were answered on a 7-point Likert scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*).

Personality. Personality was measured using Gosling, Rentfrow, & Swann's (2003) Ten Item Personality Inventory (TIPI). The TIPI is a brief version of personality measures which was comprised of 10 questions to assess participants Big 5 personality traits. Participants rated a list of personality traits on a 7-point Likert-type scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*).

Demographics Questionnaire. A 16 question demographics questionnaire was given to participants asking individuals age, gender, and average use of internet for typical activities.

Procedure

Once recruited through Sona Systems, participants were then given a link to complete the survey through Qualtrics in the following order, self-efficacy in information security, general controllability, security behavior intention scale, personality measure, knowledge quiz, and demographics questionnaire.

Results

Descriptive Statistics

From the sample of 183 participants, there were a few participants with missing data. Three participants had missing data on the general controllability measure which accounted for 1.64% of the sample. Two participants had missing data for the SEIS measure which accounted for 1.09% of the sample. A total of 13 participants had some or all missing data on the SeBIS which accounted for 7.1% of the sample. Four participants did not complete any questions on the survey and there was a total of six participants who had missing data, which accounted for 3.28% of the sample. On the knowledge quiz, 15 participants left a question blank which accounted for 8.2% of the sample. For the knowledge quiz, any unanswered question was interpreted as an incorrect answer. In order to

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maximize statistical power of the sample, pairwise deletion was used on the remaining surveys.

Intercorrelations Among Individual Differences

As a check for the personality measurement, bivariate correlations among other personality traits and between demographic questions were examined. Significant correlations among personality traits were between neuroticism and agreeableness ($r = -.175$, $N = 177$, $p = .020$), neuroticism and extraversion ($r = -.171$, $N = 178$, $p = .023$), neuroticism and contentiousness ($r = -.343$, $N = 178$, $p < .001$), and neuroticism and openness to experience ($r = -.217$, $N = 178$, $p = .004$). Additional correlations were found between extraversion and agreeableness ($r = -.172$, $N = 177$, $p = .022$), extraversion and conscientiousness ($r = .156$, $N = 178$, $p = .037$), extraversion and neuroticism ($r = -.171$, $N = 178$, $p = .023$), and extraversion and openness to experience ($r = .337$, $N = 178$, $p < .001$).

From the demographics survey, there was a significant negative correlation between neuroticism and usage of internet for games ($r = -.180$, $N = 177$, $p = .017$) and between threat response behaviors subscale of CSB and extraversion ($r = -.151$, $N = 175$, $p = .047$).

Tests of Hypotheses

To test Hypothesis 1, that neuroticism would inversely correlate with self-efficacy, a correlational analysis was conducted. A correlational analysis found a negative correlation between neuroticism measured by the TIPI and self-efficacy measured by the SEIS ($r = -.176$, $N = 176$, $p = .020$).

To test Hypothesis 2, that neuroticism is inversely related to CSB, a correlational analysis was conducted. There was no statistically significant correlation found to support Hypothesis 2. There was no significant relationship between neuroticism and the SeBIS total score ($r = -.014$, $N = 168$, $p = .857$), neuroticism and the threat response behavior subscale of CSB measured by the SeBIS ($r = -.147$, $N = 175$, $p = .053$), neuroticism and the cyber hygiene behavior subscale of CSB measured by the SeBIS ($r = .082$, $N = 171$, $p = .289$).

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Supporting Hypothesis 3, that self-efficacy is positively related to threat response, was a significant positive relationship between self-efficacy measured by the SEIS and threat response behavior subscale of SCB measured by the SeBIS ($r = .349$, $N = 175$, $p < .001$).

Supporting Hypothesis 4, that self-efficacy is positively related to cyber hygiene, was a significant relationship between self-efficacy as measured by the SEIS and the cyber hygiene behavior subscale of CSB measured by the SeBIS ($r = .373$, $N = 172$, $p < .001$).

Supporting Hypothesis 5, that self-efficacy is positively related to CSB, was a significant relationship between the SEIS and SeBIS total score ($r = .430$, $N = 169$, $p < .001$).

To test Hypothesis 6, that self-efficacy is positively related to general controllability, a correlational analysis was conducted. There was no statistically significant correlation found to support Hypothesis 6. There was no significant relationship between self-efficacy and the general controllability measure ($r = .136$, $N = 179$, $p = .070$).

Supporting Hypothesis 7, that self-efficacy is positively related to knowledge, was a significant relationship between the SEIS and the knowledge quiz ($r = .233$, $N = 176$, $p = .002$).

Supporting Hypothesis 8, that knowledge is related to CSB, was a significant relationship between knowledge and SeBIS total score ($r = .223$, $N = 168$, $p = .004$).

Table 1
Correlation Matrix

		N	M	SD	1	2	3	4	5	6	7	8	9	10	11
1	Self-efficacy in Information Security (SEIS)	180	46.22	11.64											
2	Threat Response (SeBIS)	177	15.95	3.09	.35**										
3	Cyber Hygiene (SeBIS)	173	38.67	4.56	.37**	.27**									
4	Security Behavior Intention Scale (SeBIS)	170	54.62	6.14	.43**	.70**	.88**								
5	Knowledge Quiz	178	8.22	2.77	.23**	.25**	0.15	.22**							
6	Neuroticism	178	7.56	2.67	-.18*	-0.15	0.08	-0.01	-0.14						
7	Extraversion	178	7.49	3.02	0.01	-.15*	-0.09	-0.14	-0.14	-.17*					
8	Agreeableness	177	9 . 6	1.92	-0.00	0.02	.19*	0.15	0.13	-.18*	-.17*				
9	Conscientiousness	179	10.39	2.03	0.19	0.01	0.07	0.08	0.07	-.34**	.156*	0.15			
10	Openness to Experience	179	9.82	2.18	0.04	0.08	-0.06	-0.01	-0.02	-.22**	.34**	-0.02	.19*		
11	Use of Internet for Gaming	178	2.16	7.76	-0.03	-0.06	-0.04	-0.06	0.06	-.18*	0.04	0.02	0.08	0.04	
12	General Controllability	181	13.19	8.23	0.14	0.07	0.11	0.11	-0.05	-0.03	-0.11	0.08	0.01	-0.09	-0.02

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

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Discussion

All but one of the hypotheses were supported. Overall, the results support the conclusion that individual differences can predict self-efficacy and intent to engage in CSB. Considering the ever-changing threat landscape in cyber security, and given previous research on neuroticism, it is unsurprising that highly neurotic users would exhibit lower levels of self-efficacy. Individuals scoring higher on neuroticism tend to be more anxious, and individuals suffering from social anxiety have been shown to avoid unpleasant situations in an attempt to lower their anxiety. Respectively, it seems plausible that neuroticism may lower a user's self-efficacy in information security; feeling unable to improve one's own security may be an outcome of anxiety.

This research also demonstrates that Bandura's (1982), theory that self-efficacy is a strong predictor of behavior holds in a cybersecurity context. Thus, it may likely explain why self-efficacy would predict CSB, as found in this research. I also hypothesized that neuroticism would inversely relate to CSB. Although neuroticism inversely correlated with self-efficacy, and self-efficacy predicted security behavior intention, no statistically significant relationship was found between neuroticism and CSB. One possible explanation is the measure for CSB (SeBIS) could not accurately assess a user's intention to comply with security preventative measures. For instance, users may have chosen acceptable answers which did not reflect their actual intended behavior, thus biasing the results. The behavior intention scale focused on current best practices which are somewhat commonly known. The SEIS is better understood, with items requiring more expertise in computers not commonly held by the average college student. Questions like this make it more difficult for a user to over or underestimate their ability. It is also possible, although not able to be demonstrated here, that self-efficacy mediates the relationship between neuroticism and CSB. Bandura (1986, 1997) proposed that self-efficacy influences the feeling of stress and anxiety, and performance and coping behavior. It is possible that a user's lack of belief in their ability to effectively comply with proactive CSB might cause an increase in their anxiety. As previously discussed, anxious individuals may avoid situations which increase their anxiety. It is likely that individuals low in cybersecurity self-efficacy might avoid cybersecurity related activities in

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an effort to reduce their anxiety. In turn, this would have a negative impact on their CSB. Therefore, increasing a user's self-efficacy may cause a decrease in neuroticism and an increase in proactive CSB.

An unexpected but significant negative correlation was found between neuroticism and use of internet for gaming. The more often someone reported using the internet for gaming, the more likely they were to score low on the reported neuroticism personality trait. Although spurious correlations are possible, recently, gamers have been recognized as top candidates for cyber security careers (Elder, 2018). In McAfee's (2018) report, they suggested "Gamers quickly learn to continually look for clues, tools and weapons in their quest for success. And they develop persistence, endurance, observation, and logic" (MacAfee, 2018, p. 10). This may explain why users who are more neurotic report lower use of the internet for videos games and lower levels of SEIS. Although there was no direct correlation between CSB and gaming, this finding gives some insight into what traits or hobbies may or may not influence cyber security awareness. Also, considering current research by Elder (2018) and McAfee (2018) has demonstrated gamers are ideal candidates for cyber security careers, it would be worth investigating if CSB can be improved through video games. Video gaming may be an individual difference worth exploring in future research.

Additional positive correlations were found between agreeableness and cyber hygiene. Costa and MacCrae (1992) describe agreeableness as a trait which involves interpersonal behavior. Considering the ever-evolving cyber security threat landscape, often users reach out to their social connections in an effort to obtain the most updated and effective CSB advice. Specifically, agreeableness is associated with trust, straightforwardness and compliance (Costa & MacCrae, 1992). It seems likely that individuals high in agreeableness might reach out to their trusted social circles in an effort to enhance their compliance with beneficiary agreeable CSB. In addition, individuals high on agreeableness have been shown to experience positive affect when engaging in agreeable behavior (Moskowitz & Cote, 1995). This could mean that when individuals high in agreeableness engage in agreeable CSB, it may also cause them to experience positive affect. Therefore, this research suggests

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that engaging users through their social networks may be promising for increasing cyber hygiene, if only for individuals high in agreeableness.

Limitations

Due to the survey-based study being conducted online, there was a relatively high rate of participant nonresponse. It is possible that the lack of responding or lack of attention to the responses affected participant's responses. For example, two participants reported that after opening the Qualtrics link through Sona Systems, they started the survey and paused to come back later but were unable to do so. Additional limitations include a lack of diversity amongst gender, with the majority of the sample comprised of female participants.

Conclusion

Future research would benefit from exploring these personality traits further to better understand the relationships among these constructs, such as through mediated relationships. Additionally, an investigation of neuroticism, self-efficacy in information security and cyber security behavior intention involving a diverse group of post-college students or working professionals would help increase the generalizability of the research. Considering that the finding for neuroticism and self-efficacy support previous research outside of cybersecurity, it may be beneficial to construct and validate a training which targets a user's self-efficacy.

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Unpacking the Imposter Syndrome and Mental Health as a Person of Color and First-Generation College Student within Institutions of Higher Education

After completing her Bachelor of Arts degree in Behavioral Science, Ling hopes to pursue a career in the field of Higher Education-Student Affairs and work towards her ultimate goal of completing her Ph.D. in Educational Leadership. Her roles at San José State University as a Peer Mentor at Peer Connections and an In Solidarity Program Assistant at the Cesar E. Chavez Community Action Center have strongly influenced her passion for working with students of color at institutions of higher education. In addition, her participation in the NASPA Undergraduate Fellows Program (NUFP) has allowed her to expand her professional experience in the field of Student Affairs through internships, conferences, and presentations throughout different regions in the United States. As a future professional in the field, Ling hopes to positively impact first-generation college students through her research and service in Student Affairs.

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Unpacking the Imposter Syndrome and Mental Health as a Person of Color First Generation College Student within Institutions of Higher Education

Abstract

Extant literature on Imposter syndrome primarily focuses on Asian Americans. This current review of literature seeks to make a comparison of Imposter syndrome between two marginalized communities – Asian Americans and African Americans. Imposter syndrome, also referred to as the imposter phenomenon, refers to an individual who doubts their own skills, abilities, successes, and overall capabilities in their life (Parkman, 2016). Asian American students are stereotyped as the model minority and are believed to be intelligent, hardworking, high achieving, and academic and seen to be free from any emotional or adaptive problems. Although these stereotypes are perceived to be positive, they also place a great deal of pressure on Asian American students to excel in school and this can produce increased anxiety and distress. Among African-Americans, shame-proneness manifests differently. It is directly related to a fear of intimacy and self-deprecation (Austin, 2009). Researchers looking at the relationship between Imposter syndrome and mental health among student populations have found it to be a predictor of mental health, it has been found to be positively correlated with anxiety, depression, psychological distress, and minority student status stress (Parkman, 2016). This review will seek to answer which of the two aforesaid stated student populations of first-generation students, Asian American and African American experience a greater detriment in mental health and if there are any specific patterns of mental symptoms of psychological distress that are found among each of these student populations.

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Introduction

My research focuses on imposter syndrome, students of color, first-generation college students, and personal relationships. The imposter syndrome, also referred to as the imposter phenomenon, refers to an individual who doubts their own skills, abilities, successes, and overall capabilities in their life. In the past, research has been conducted on how college students categorize into different levels of imposter syndrome, yet many college-aged students are not aware of the term. The research I am conducting asks the question - How do relationships impact first-generation college students' imposter syndrome and can it influence their success? This question aims to explore and allow educators to understand what leads to students behaving in healthy or unhealthy ways with their family, friends, partners, co-workers, supervisors, and so forth. In addition, it explores the emotional support that first-generation college students need to be confident in their academic and personal goals.

In order to fully understand and break down the research question, it is important to unpack the definitions of each concept that my question examines. For purposes of my research, first-generation college students will be defined as current college students whose parents did not graduate from a four-year university. Imposter syndrome or phenomenon as defined earlier will examine how individuals are impacted by their own self-doubt and overall competence in their success. The research will examine the influence of relationships that students hold with family and academic professors, advisors, or mentors. Relationship factors that will be examined will include communication, emotional support, and happiness. This research is intended to examine what leads to students identifying with the imposter syndrome and if their relationships have a strong influence on them.

Another question my research unpacks is "How do different students of color encounter this syndrome differently?" Within this question, there are also several components that must be unpacked that focus on students from two specific communities: Asian Americans and African Americans. I will also address some points on Latinx communities and how this community may relate or differ when compared to others.

My proposed research addresses existing questions in the literature by finding out what specifically influences the imposter syndrome and

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how those who are affected by it can utilize those around them to overcome it. Specifically, it would allow us to understand what types of students are impacted the most by this phenomenon and how to help current students realize the importance of healthy relationships in their lives. This work is important because college students are generally at times in their lives where they develop intimate, emotional, and personal relationships that influence their higher education and mental development. The literature already acknowledges the importance of having support from an institution towards college students, however, we must understand if these resources will have an impact on students if they are not encouraged to utilize them by people in their lives. As a person of color, myself, I have come to understand the importance of knowing how institutions support my community as well as others as students navigate their experience during their undergraduate journey.

Through literature that focuses on imposter syndrome, I hypothesize that first-generation students are influenced by personal relationships in their lives that either develop or help them overcome the imposter syndrome. Cokley (2013) stated students surround themselves with positive and healthy relationships with family, academic professors, advisors, and mentors then they will be more confident in their own abilities. However, with the presence of negative or toxic relationships in their lives, individuals will strengthen their imposter syndrome. First generation students are less likely to have healthier personal relationships in their lives or support compared to later generation students (Lutwak, 1998).

Origins of the Imposter Syndrome

Studies on imposter syndrome were first conducted in the late 1970s and 1980s. In order to conduct early studies, there were three common main surveys/questionnaires that were used to determine levels of imposterism. In his research, Leary emphasized three different types of studies conducted on the same group of participants over a period of time. All three studies utilized the Imposterism Scale to test their theories which explored how individuals who ranked high with imposter syndrome followed the self-fulfilling prophecy and observation (Leary, 2000). For the purposes of this literature review, I will focus on one study that I found

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most useful that asked the question - Do imposters react as they are expected to when they know they are being observed by strangers? The study tested this theory in multiple ways; one where participants were believed that they were being observed positively and another negatively. Results revealed the imposters would, in fact, behave in the way the observers expected of them when completing tasks. The participants would either complete their task correctly or incorrectly when they learned how challenging or easy a task was expected to be.

Gradually, as the phenomenon became more prevalent in the field of higher education and in the workplace, theories and understandings surrounding it evolved and had a stronger focus from college institutions. Research on the phenomenon expanded to studies related to gender, people of color, culture, mental health, and even environment surroundings (Clancy, 2018). Despite efforts to understand and expand research on imposter syndrome, researchers must continue to discover solutions to help marginalized communities overcome this phenomenon.

In the past, it was believed the imposter syndrome was an issue that women encountered more than men, however, it has been revealed that gender does not play a key role in determining who encounters the syndrome more. From later studies conducted by Jacobs, both men and women confront the syndrome just as equally when not looking at ethnic communities (Jacobs, 2014). However, from their studies, mental health issues remained consistent in the studies that will be further expanded in multiple ethnic groups. Some mental health symptoms that revealed to be salient include symptoms of depression, anxiety, and generally lower self-confidence.

Asian Americans Communities

Previous research has revealed immigrant and minority communities are less likely to utilize mental health services compared to US-born Americans. Abe (2007) focused his study on Asian immigrants which revealed the community does not generally utilize mental health services or bring up the topic within their nuclear families. Abe (year) wanted to determine the reasons why these immigrant Asian immigrants utilized or failed to utilize mental health services and how it affected their communities. Some of his goals were to determine rates of mental health-

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related service use among immigrants and U.S. citizens were utilized, what patterns present among the immigrant population, and if the individuals satisfied with the mental health services they received. Abe's (2007) research believed U.S. immigrants were less likely to utilize even when suggested by a professional compared to a U.S.-born individual who came from the same ethnic background.

Participants of the study were from Asian communities. The qualitative study included face to face or phone call interviews over a 12-month period. Over this period, participants would undergo a series of tests from doctors, psychiatrists, and other professionals to determine if they needed mental health care. The main results concluded that first generation immigrants did not utilize mental health services as much as second-generation Asian Americans. Asian Americans followed similar patterns to first-generation immigrants than third generation Asian Americans. A number of factors indicated that mental health was not considered as great of importance to first-generation immigrants. However, those who did utilize the services had satisfactory rates of service and those with a probable need concluded they were content with their experience.

However, some limitations of the study included that some Asian American populations were lumped together even though they had different languages and backgrounds. The study was very narrow when looking at Asian Americans because within the community there are more cultural groups. It also did not take into account, language, economic background, or regional variations.

Consequently, when Asian American communities do not take advantage of mental health resources or have access to general education on the topic, they are at greater risk for imposter syndrome. This can become prevalent within Asian Americans as they enter college-level education and encounter internal challenges without the skills or knowledge to effectively address them (Liem, 1997).

Latinx/Chicanx Communities

Challenges with depression and anxiety among first-generation Latinx communities arrose from experiences of migration among Latinx adolescents. Hunt (2010) focused on specific topics that impact the

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academic development of these communities through topics of acculturation, migration, documentation status, depression, anxiety, and discrimination. Specifically, Hunt (2010) determined how immigration and acculturation impact the well-being of Latino adolescents and their mental health.

Hunt (2010) predicted individuals with undocumented statuses and those with traumatic migration experiences are more prone to show mental health symptoms and require additional support from their institutions. The participants used in the study came from middle and high schools in North Carolina identified as first-generation Latino youth with parents who were foreign-born. Some health measures that were identified were depression and anxiety. Mental health stressors that were measured were migration experiences and discrimination. The control variables looked at both age and gender, with a parent, education, family composition, and Mexican heritage with little variation (Hunt, 2010).

The results concluded that individuals who were more prone to depression and anxiety came from backgrounds where they themselves and their family did not have legal documentation. Those who did not have much say in their migration to the United States and faced discrimination at school were also more prone to these stressors and mental health-related issues. However, those with good support systems in their family and education showed reduced symptoms of stress, depression, and anxiety. Some limitations of the study included the focus on mainly the Mexican American community; there was no specific analysis on other Hispanic populations. An implication is that the study did not take into account individuals who were not enrolled in school and excluded individuals who dropped out.

Similar to the results of Asian American communities, Latinx/Chicanx communities encountered challenges to imposter syndrome. However, adding to the research of Hunt (2010) and Leyva (2011) found that Latinx students pursuing higher education had greater pressures compared to non-students of color from their family to be successful in their academic pursuits. The ideas of professional development while addressing traditional family/gender roles contributed to stressors individuals in these communities who came from first-

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generation backgrounds.

African Americans/Black Communities

Cokley (2013), compared to Asian American communities, those who identify as African American or Black encounter higher levels of barriers to academic success when assessing the impacts of imposter syndrome. These communities encounter the same challenges of depression, anxiety, and lack of support. However, African American and Black individuals feel they encounter additional racism and discrimination from their institution or place of employment when they are in academic or professional spaces. Often times, these individuals feel misunderstood or feel that they do not have support to reach out and ask for help from superiors, peers, or even faculty members on their campus. This continues to be a challenge for members of this community despite efforts to be more inclusive in spaces where there are few minority students.

In addition to a feeling of lack of support, members of this community may have a much more challenging time if they try to overcome the phenomenon on their own (Liem, 1997). Folks from this community are more inclined to feel shame and distrust which negatively impacts how they form relationships with individuals in their career or within their institutions of higher education. Those who have imposter syndrome throughout their development in academia also have higher rates of encountering prejudice from others and resent those who may appear to do well when unconsciously comparing themselves to peers or colleagues (Cokley, 2013).

First Generation College Students and Mental Health

On college campuses, non-first-generation students report a greater sense of belonging, on average, lower levels of depression/stress compared with first-generation students who had lower levels of sense of belonging and greater levels of depression/stress. First-generation students need but not use services at a higher rate than non-first generation students (Demetriou, 2017).

As discussed in previous research, underrepresented populations underutilize college resources which impact their sense of belonging especially for first-generation college students. Stebleton (2014)

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questioned how much mental health services were used by specific populations on college campuses. Overall, Stebleton hypothesized first-generation college students and people of color do not take advantage of mental health services offered on college campuses. To conduct this research, they surveyed 150 students at six large public research institutions. The findings revealed first-generation students ranked low on sense of belonging and high on levels of depression and stress. When compared to non-first-generation students, they also used fewer counseling services (Stebleton 2014). As opposed to previous articles, the research concludes how communication between students and school faculty or administrators is vital to understand how students feel like they belong on campus.

Additional research (citations) also argued college students who are at risk for mental disorders are increasing dramatically compared to individuals who are not enrolled in school. With an emphasis on college student mental health and broader adolescent and young adult populations, Hunt and Eisenberg (2010) looked at the comparisons in individuals who are enrolled in college and who are not and how they seek assistance for mental health-related topics. They predicted that the current state of mental health in the college student population is low, the risk factors among college students are high, mental health in this population will continue to worsen over the years, and the extent to which students receive mental health services is low. The main results of the study concluded that college students were more prone to develop depression compared to non-college students. The findings were supported by existing research and concluded that the overall commonness of mental disorders has remained at a steady and moderate increase over time. Hunt and Eisenberg (2010) predicted that college students with addiction problems such as drugs and alcohol were less inclined to seek out treatment and ignore their mental health. As compared to barriers such as lack of time, privacy concerns, emotional openness, and financial constraints that prevent students from utilizing mental health services.

In McGowan's (2015) study, he hypothesized that students who are most likely to suffer mental health issues were more likely to be older, low-income, married and have dependents, to enroll in college as part-time students, to enroll in public two-year institutions, private for-profit

institutions, and other institutions that required less than four years before earning a degree/certificate, rated obtaining needed financial aid, expediting the completion of coursework, being able to live at home, and being able to work while attending school as important influences in their decision to enroll at a particular institution. In the study that was conducted, the research focused on first-year students at a four-day leadership retreat they attended before they started classes at their university. The mental health factors they consider were comprised of anxiety, mood disorders, and depression. Their research focused on the development of the students or as they are called campers in the study and how well they understood mental health as a whole. It revealed that in past years there have been great strides to ensure students obtain the proper resources needed on their college campuses. Yet, with the growing population of college students, there still remains a social problem of mental health and those who have access to those resources (McGowan, 2015).

Support from Institutions

Researchers Kumar and Jagacinski (2005) reveal how individuals with the imposter syndrome are impacted by fears they hold toward their achievements. The authors proposed the question that asked if imposter syndrome related fears were connected to a student's ability to achieve goals. Their process used the Clance Imposter Phenomenon Scale where they distributed surveys to over 100 psychology students. The findings that were concluded from the research confirmed their hypothesis that fears and the imposter syndrome are motivated by an underlying fear of failure that influences how imposters construct their goals. They also discovered imposters compare themselves to others and develop an idea where they motivate themselves to outperform others to feel competent (Kumar and Jagacinski 2005).

Chapman's research also contributes to studies on how factors such as a sense of belonging, financial stability, and support of an institution can impact how much confidence a mature student has in college. For this particular study, a mature student is defined as a student who is 21 years or older. Chapman hypothesized mature students are more at risk for imposter syndrome and prompts the question of how mature

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students find support at their college. The study used groups of students from around the United States from different majors, these students were interviewed in person multiple times throughout an academic year. The research focused on themes that were consistent in the interviews and identified prominent issues or challenges the participants shared (Chapman, 2017).

Findings revealed students primarily expressed fear in their academic performance and feared they were judged harshly by their professors if their assignments were not perfect. Consequently, this fear increased pressure from themselves and raised anxiety levels in their own performance and confidence. Chapman also concluded that not only academic staff influenced the participants, but also peer groups such as classmates or friends (Chapman 2017).

Discussion

Intersectional experiences and salient identities have a strong influence on how imposter syndrome impacts cultures and communities differently. Even though many young adults and adolescents encounter the phenomenon early on or when they start school or a new job, there are those who can overcome it. It is necessary that these individuals receive support from mentors, professors, and programs within their institutions. Research has also found that the relationships students develop within their early years of college can have a direct impact on their academic performance. When students have direct personal support, they are less likely to experience imposter syndrome.

As discussed, the roles of mental health, relationships, cultural background have an overall impact on how a student may overcome the imposter syndrome. It can be said that all students of color encounter challenges and even discrimination, but their experiences are different and it is vital to understand how they differ from one another in order to support them effectively. The implications of finding solutions include promoting the use of college counselors at institutions. Solutions to counter this phenomenon include possibly partnering with classrooms to provide proper mental health promotion and awareness. The use of peer mentors and educators would allow students to feel more comfortable

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sharing their feelings with and help promote a stronger sense of belonging and address mental health concerns (Luedke, 2017).

Conclusion

Ultimately, imposter syndrome still continues to be a broad research topic that impacts multiple populations of students, workers, and other individuals in society. As research continues to develop and grow on this concept, it will allow those who are presented with this information to use it as a resource and assist those who are impaired by it. People of color are impacted more by the imposter syndrome compared to non-people of color both mentally and academically. The intersectionalities of mental health and people of color are salient when researching and understanding this phenomenon. It is the responsibility of an institution to assess the needs of their students and provide accessible equitable resources to help them overcome their own challenges. First generation college students and people of color are more likely to confront the hardships that come with the imposter syndrome. Fortunately, institutions of higher education have the means to support these types of students not only academically, but mentally as well as personally.

Ethnic identity groups including Asian Americans, Latinx/Chicanx Americans, and African American/Black community members are strong cultural groups that can be easily overlooked or disregarded by dominant organizations in our society. However, it is important to understand these communities react and develop personal relationships differently depending upon their diverse cultural backgrounds. Overcoming and unpacking the imposter syndrome in the context of institutions of higher education may be a challenging task itself. Yet, it is important to execute continued research to help those who come from marginalized backgrounds in a holistic approach to student development.

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Toxic Masculinity: An Outcome of Colonialism and its Effects on the Latinx/Chicanx LGBTQ+ Community

Biography

Monica is a first-generation student majoring in Sociology and minoring in Chicana and Chicano Studies. Being a first-generation Queer Chicana, much of her research interests intertwine with her identity. Her research interests include Chicanx and Latinx involvement in the Prison Industrial Complex, femininities and masculinities of Chicanxs and Latinxs, the Chicano Movement, masculinity and internalized homophobia, transphobia and sexuality, gender studies, Chicanx and Latinx representation in media, and Colonialism. Monica hopes to pursue a PhD in Ethnic Studies in order to apply the theoretical framework into her career as a potential social justice activist for disadvantaged communities of color. Currently as an intern for the County of Santa Clara, Monica's passion for social justice has increased as she is working on a project to help low-income Latinx individuals from East San José and their families heal from trauma to avoid falling victim to the Prison Industrial Complex by promoting higher education and indigenous healing practices.

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Toxic Masculinity: An Outcome of Colonialism and its Effects on the Latinx/Chicanx LGBTQ+ Community

Abstract

This research examines masculinity in the Latinx community within the U.S. Much of the theory behind masculinity involves discussing toxic masculinity and machismo. To do this, I look at film, poetry, and literature to discuss how toxic masculinity affects Queer Latinxs. Although this research focuses on fictional characters and the analysis of fictional works, these characters' stories do not fall far from current LGBTQ+ Latinxs who may be experiencing the same issues. I examine *La Mission*, *Mosquita y Mari*, *Gun Hill Road*, "I am Joaquin," "La Loca de la Raza Cosmica," *Rain God*, and *What Night Brings*. These pieces work well with one another to show how gay Latino men, Latina lesbian women, and transgender Latina women are affected by toxic masculinity, internalized homophobia and transphobia. With this research I hope to show how the way we construct masculinity as a society, should be reconfigured to something more positive; I also hope to eliminate homophobia and transphobia, as well as violence and hate crimes towards the LGBTQ+ community.

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Introduction

By analyzing film, poetry, novels, and religion popular to the Latinx and Chicanx community I hope to show how masculinity affects the LGBTQIA+ community. In order to do this, I also examine how the colonization of Mesoamerica and the cultural stripping of the indigenous groups of Latin America caused a toxic means of masculinity. During colonialism, toxic masculinity became a survival mechanism that resulted in being considered as part of the culture for several generations.

The colonization of Latin America resulted in a complete shift of culture; the Spaniards believed the indigenous groups to be savages and made them convert to Christianity and follow the traditions of this religion (Mirande 1997). In the present day, many Latinxs are or have been members of some form of Christianity. Christianity considers same sex relationships as sinful and states that women should be submissive towards their husbands which explains why many of the characters I analyze are subject to negative encounters from family members who tell them their actions are against the church. Much of the Latinx culture revolves around religion that stemmed from colonization: therefore, Latinxs are following a culture that is not truly theirs and have involuntarily abandoned their ancestors' language and culture. I am also analyzing media to examine the traits of toxic masculinity that has been accepted as social constructs.

Masculinity and Marginalized Groups

Masculinity is an ideology that is everywhere around us, especially in the United States, a society that primarily operates through patriarchal norms and expectations. According to Gary Barker (2005):

> There is an immense pressure for young men, both Black and Latino to conform to certain standards of toughness and financial prowess – often by any means necessary. By attempting to meet these standards, poor minority men often get themselves in trouble – through violence that ultimately leads to a run-in with the law.

Institutionalized racism makes it difficult for people of color to attain opportunities or succeed in a society that was not built for them.

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Barker (2005) states that, "both Black and Latino men experience the same high rates of incarceration, marginalization in the workplace, and struggle to 'prove' themselves in an economy where they simply cannot be breadwinners." In a study conducted by Ramaswamy (2010), she found that the men she interviewed pointed to male figures as a source of learning manhood. She also states that these men who were raised by single mothers learned about manhood by being self-sufficient and learning how to cook and clean without the need of a woman; however, the men she interviews, "strive to fulfill the 'provider role,' a feature of patriarchal masculinity" (2010: 417).

Racial Identity

In each culture, it is largely assumed that there are different expectations for a man's masculinity. However, if they come to the U.S., it is expected for them to assimilate into dominant norms, "giving up their ethnic and cultural values in favor of the Anglo-Saxon" (Harris et al., 1994: 705). According to Harris et al (1994), "American society is based upon White masculine gender role paradigms, African-American, [and Latinx] males must learn those paradigms as well as the roles and rules expected of them within their own culture" (709).

Gloria Anzaldúa developed her concept of *Nepantla* from W.E.B DuBois's concept of double consciousness, which states that African Americans try to maintain their African American identity or culture while embracing the dominant white American culture as well due to societal expectations. Balancing two identities is a constant struggle for many ethnic groups that do not belong to the dominant white group. Many Latinxs in the United States consider their culture to be a hybrid since it requires them to be both Latinx and American. This is the case for many biracial ethnic groups, who are in the state of *Nepantla* according to Gloria Anzaldúa. Not only does this apply to Mexican Americans, but it also applies to any racial group coming to the U.S. who are stuck in between a borderland by trying to please their American counterparts while doing the same for members of their ethnic background.

Hegemonic Masculinity and Positive Masculinity

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According to Donaldson (1993), Hegemony was adapted by Antonio Gramsci; this term was first developed by Karl Marx, it is when ideas become so dominant, so pervasive, it is accepted as common sense and there is no other way. Donaldson states that Gramsci's adaptation of "'Hegemonic Masculinity' signifies that women exists as sexual objects for men while men are not considered objects for other men" (1993: 644). Despite the fact that males benefit from male privilege, there are certain disadvantages: "Hegemonic masculinity not only excludes certain groups of men from accessing aspects of male privilege (...) it is an impossible ideal that many men are socialized to strive to attain but cannot" (Connell 1995). Arciniega (2008) determined two factors that identify the basis for machismo which include traditional machismo consisting of hypermasculine ideas and *caballerismo* which consists of the positive things a man should do such as connecting to family, showing emotion, and social responsibility. According to Estrada and Arciniega (2015), *caballerismo* is a form of positive masculinity. Positive masculinity can be used for social responsibility; Estrada (2015) uses the example of a man who has prostate cancer and the counselor helping the man, uses the man's responsibility to the family to convince him to get treatment. In other words, positive masculinity can relate to keeping in good health for their family's best interest.

"Machismo"

Being "macho" can be interpreted in different ways depending on who is defining it. Originally, being macho was something associated with Latinx men until it became Americanized. It can now be used to describe famous male athletes or sex symbols as something positive and is associated with "strength, virility, masculinity, and sex appeal" (Mirande 1997). However, according to Mirande's findings, when machismo is associated with the Latinx culture, it is seen as something negative such as "male dominance, patriarchy, authoritarianism, and spousal abuse." When a white male is called a "macho," it is something positive and fondly looked upon; however, when a Latinx male is associated with being "macho" he is seen as an ultimate male dominator and unfavorable amongst women due to negative portrayal of "manly" people of color in society. If we compare the Pre-Columbian era to Spanish colonialism and

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the modern day, we can conclude that this form of masculinity is associated with a colonized mindset.

Many scholars argue that machismo was a reaction from the indigenous groups in response to being emasculated by the Spanish conquistadors. However, Mirande argues that, in fact, machismo was not a response to Spanish conquest but rather it was a form of assimilation since the Spanish men were highly masculine; this is why the current day ideology of "macho" is a colonized mindset, since both the Mexican macho and Spanish conquistador share almost identical characteristics. Another interesting point to note is that in the Spanish language, when a man pursues a woman's attention it is referred to as *conquistando* – conquesting – which shows how colonialism still plays a key role in Latinx masculinity and culture.

Fragile Masculinity

Masculinity is fragile because it only exists as a construct and not as a biological trait as we are socialized to believe. Masculinity is a reaction against passivity and powerlessness, and with it comes a repression of a vast range of human desires and possibilities: those that are associated with femininity (Kaufman 1987:588). Some associate masculinity with power and maleness with machismo; however, they are two different things – one is an idea and the other is biological. Maleness and masculinity are fondly looked upon but many men struggle with the "certainty of the sexuality, needs, fears, and weaknesses [thus creating] a psychology of violence" (Kaufman 1987: 588).

In certain occasions when men feel emasculated, they may resort to violence as a way to prove masculinity, which according to Kaufman, only shows powerlessness for resulting to an extremely negative measure to solve a problem thus enforcing the fragility of masculine ideology (591). Much of this "fragile masculinity" violence includes displaying violence within a "group of men, rape in prisons, and attacks on gay men [or women and] or racial minorities" (Kaufman 1987). Many men use their gender as a form of ideology to prove themselves as men by performing an act of terror on a vulnerable group (Kaufman 1987).

Racially Unequal Access to Male Privilege

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It is often assumed that men benefit from being males; however, that is not always the case. Men of color are disadvantaged and do not benefit from male privilege like their white counterparts. According to Edward Orozco Flores and Pierette Hondagneu-Sotelo (2017), men of color have marginalized masculinities because they experience societal disadvantages such as poverty, unemployment, and institutional racism. An example of marginalized masculinity are Chicano gang members - Chicanxs have been oppressed for much of history. In the present-day, they are denied opportunities to meet the stereotypical notion of the male breadwinner and are thus relying upon alternative measures to prove their dominant role and masculinity such as physical force or aggressive behavior towards women (Orozco Flores and Hondagneu-Sotelo 2017).

According to Majors and Bilson (1992), "hypermasculine gang behavior, dress, and language serve as a way to" replace and satisfy the absence or lack of employment and educational opportunities. Hurtado and Sinha (2016) use the idea of intersectionality to explain that Latinxs in the United States are more likely to experience social injustice simply because of their class, race, ethnicity, and sexuality all at once. With Hurtado and Sinha's point, it makes it clear that despite being a man, there are different privileges if one is of color, lower class, and of the LGBTQI+ community. One can be a man and have privilege within one's racial group, but within the dominant society, a man only fully benefits from male privilege if he is a wealthy white cisgender male.

Toxic Masculinity

Masculinity is toxic because it may encourage males to participate in negative activities such as aggressiveness, heavy drinking, risk taking and virility. However, some scholars argue that masculinity or machismo is a "culturally valued and desirable ideal of courage, honor, virility, physical strength, and as representing a protector, provider, and authority figure" (Abreu et al. 2000, Christensen 1975, Lazur & Majors 1995; Mirande, 1997). Saez et al. (2009) states that previous research on men who are persistent in maintaining a toxic traditional masculine ideology, have a higher rate of physically or psychologically abusing women as well as maintaining attitudes that encourage the sexual harassment of women.

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According to Hurtado and Sinha, within Mexican masculinity, women are perceived as weak and easy subjects for "domination and abuse" (2016: 56).

Additionally, abuse is also something that is prone to happen to weak heterosexual and homosexual men because they are perceived as being more feminine than traditionally masculine men. Those who identify with hegemonic machismo, may resort to "physical domination and abuse" toward the ones who do not fit into the norm of Mexican masculinity. Since masculinity is rather prominent in many cultures, it has even allowed for language to become a male centered discourse. Gloria Anzaldúa critiques how the Spanish language is male dominated and denies females the opportunity to embrace their femininity (2012:76). For example, among multiple women, one would state "*nosotras*" which emphasizes that they are women. However, if all these women were together and a man came along, they would have to change the phrase to "*nosotros*" in order not to hurt the man's masculinity while denying the women's femininity.

Homophobia

Masculinity is associated with males adopting dominant behaviors while women are expected to be submissive towards the male and family. Part of being masculine requires rejecting everything associated with femininity, being emotionless and aggressive, and having a clear heterosexual identity while being homophobic (Saez et. al, 2009). Associating homophobia with masculinity is a sign of internalized homophobia for the men who fear that being gay is not manly thus oppress gay males in order to be manly enough; Kaufman argues that many men who commit acts of violence towards other men are repressing their own feelings of attraction towards men and result to homophobia as a way to cope and overcome anxiety (1987: 594). Furthermore, Kaufman suggests that "men's violence against other men is one of the chief means through which patriarchal society simultaneously expresses and discharges the attraction of men to other men" (1987: 594).

Alfredo Mirande notes that when it comes to homosexuality in the Latinx community, one is not defined as gay but rather by the power they have through a sexual act (1997). Following Mirande's definition, a

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Mexican man can engage in gay sex and maintain his masculine identity as long as he is the dominant figure; this means that the submissive male loses his masculine identity and it is replaced with a feminine perception and subject to discriminatory homophobic comments by peers or their dominant, closeted sexual partner.

Religion and Queerness

In many religions, being Queer is seen as something sinful. When it comes to attraction toward the same sex, many consider it sinful because it goes against God's plan to have man and woman procreate. Same sex couples cannot procreate together and must result to alternative methods to have children which is seen as sinful primarily in Christianity since they are having sexual intercourse for pleasure.

When it comes to members of the Trans community, religions like Christianity see them as sinful because a person is changing their biological sex into a gender which goes against what God ascribed to them:

> Encourage 'Christian' families with monogamous units and Spanish 'sexual ideals'… Such colonial domination rests upon a logic of heteropatriarchy that envisions a gender binary system where men dominate women; thus, communities that have gender and sexual systems not matching this cis-heteropatriarchal system are targeted for transformation so as to enable settler colonial domination (Hidalgo 2016:175).

Many fail to acknowledge that much of the religion in the Chicanx or Latinx community comes from a colonized mindset and that our ancestors had a different lifestyle prior to Christianity. Additionally, some men are not accepting of the LGBTQI+ community due to toxic masculinity which may cause them to fear that by interacting with a Queer individual might make them seem less manly. Anzaldúa states that being Queer is the heterosexual's fear because being Queer is constructed as something different, thus being "lesser, sub-human, in-human, non-human" (2012:40). Furthermore, Anzaldúa states that by being Queer, is the ultimate act of rebellion a woman of color "can make against her

native culture" because "she is going against two moral prohibitions: sexuality and homosexuality" (2012:41). Anzaldúa states that she was raised Catholic and socialized to be heterosexual but she made the choice to be Queer despite the fact that for some, they are born Queer. By choosing to be Queer, she says that it allows her to go back and forth "from the white, the Catholic, the Mexican, and the indigenous" which makes room for *loqueria* (crazies) allowing her to discover the oppression of her ancestors (2012:41).

In the film, *La Mission,* Che and Jesse represent the constant battle an LGBTQIA+ member of the Chicanx or Latinx community faces when having an unaccepting parent. Coming out is hard enough, but it becomes even more challenging when parents or peers are unwilling to accept it or make homophobic comments. Jesse not only deals with the negative comments his father makes, but the comments from his schoolmates as well:

> SMOKE: We next. But we don't play with no faggots.
> NACHO: Aww I think you hurt her feelings.

His Chicanx schoolmates also give him trouble because they cannot understand that it is normal for a Chicanx man to be attracted to other men; especially, these young men who represent a hyper-masculine identity (i.e. tattoos, grillz, baggy clothing, and drug usage). The hyper-masculine identity these men practice, is toxic with its display of aggression, homophobia, and often times, objectification of women. If we compare Nacho and Smoke to Che, Jesse's father, we can assume Che may have acted like these young men during his teen years due to the way he acts now as an older man. Che is very masculine; he boxes, constantly looks and talks about women, has tattoos, works on cars, and has a problem with feminist women by stating that chivalry did not work for him on a recent date:

> CHE: I tried to be a gentleman and hold the door open for her. She said I was oppressing her as a woman.

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It is established that Che has spent some time in prison when Jesse insinuates that Che may have engaged in homosexual acts while in prison such as prison rape or pleasurable acts; this results in hurting Che's masculine ego and starts beating Jesse. Because Che has an extreme homophobic attitude towards his son, he beats him, embarrasses him in front of the whole neighborhood, and threatens Jesse's boyfriend. Che gives up his relationship with his son because of his machista ideology that men cannot be gay, especially if they are dating a white man. Additionally, Che is quite nationalistic. He represents his Chicanx culture rather proudly by teaching the boys from the neighborhood about their indigenous roots and including Aztec paintings on his lowriders. The fact that his son is gay, is problematic enough for him, but the fact that he is dating a white man becomes the ultimate betrayal to Che, someone whose ideology is about reclaiming Aztlan and indigenous roots as well as being free from a colonized mindset. In comparison, Jesse has agency, he is his own person, and does what he pleases. Despite his father's wishes, he continues to see his boyfriend, Jordan and even leaves home when Che threatens Jordan:

> Queer self-identification enables [Jesse] to attack the tacit normativity of gender and sexual duality that causes trauma in Queer persons and their families (and the nation, by extension), which as a consequence may undermine the politics of recognition within Chicana/o familial structures and their love for family members (Kynclova 2017:153).

Similar to Che, Jesse is very proud of his culture as well. The film makes this point clear with the choice of outfit he is constantly seen wearing. He constantly wears Chicanx-related clothing such as the Aztec calendar, or a shirt saying "Xicano" (using X instead of Ch is referring back to the Nahuatl language that was excluded from Mesoamerica's language when it was colonized); he even wears one of these shirts while in a gay club, symbolizing that one can be Chicanx and part of the Queer community. Although some Chicanxs hold the belief that there is only one way to be Chicanxs but in reality, there is not just one way; there are many identities that make up a Chicanxs person – one being part of the Queer

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community. Due to colonialism, much of the ideology on what was "normal" for indigenous culture was seen as sinful or savage-like by the colonizers and made it punishable. This permanently changed the ideas on indigenous practices, altering them into a colonized mindset. For those who did not conform, they were treated as outsiders or killed (Armaline, Fall 2018 lecture).

The film *Mosquita y Mari* helps viewers see how much of the Latinx community is stuck in a cis-heteronormative way of thinking. For example, the characters, Yolanda (Mosquita) and Mari have feelings for each other. While Yolanda begins to do poorly in school, Mari performs better, leading Yolanda's parents to assume she is in a relationship with a boy who is causing her academic decline. It is interesting to note that when it comes to academic downfall, most parents assume that it is due to their child beginning to date the opposite gender and it hardly ever comes to mind that it can be someone of the same gender. This is because we are socialized to think in a heteronormative ideal when it comes to relationships.

In one scene, Yolanda is seen wearing her father's sombrero and dancing. When her mother sees this, she is infuriated and tells Yolanda to put the sombrero "back in the closet." This scene represents her 'coming out' as Queer to her mother because the mother later goes on to rant that Yolanda should not be thinking about relationships with other people; rather she should focus on her academics and everything else will disgrace the family. In this exchange, it is almost as if the mother is telling Yolanda to go back into the closet and continue hiding her sexuality and gender queerness.

A sombrero is usually associated as masculine. By having Yolanda wear it, sparked some discomfort in her mom because it is not associated with cisgender behavior. As Jackie Cuevas suggests, in the eyes of Yolanda's mother, she is seen as a "malflora" which means:

> 'Bad flora' or 'bad flower,' it is a slang term for 'lesbian,' synonymous with tortillera or jota, and may be considered more offensive than 'lesbiana.' The term is a variation of 'manflora,' which can be used to describe a masculine woman or an effeminate man, evoking the association of women's masculinity with both

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supposedly failed masculinity and supposedly inadequate femininity" (2018:68).

Perhaps Yolanda's mother disliked her wearing a sombrero because according to Cuevas:

> It is not lesbianism, same-sex desire, or even sexuality in general but instead genderqueerness that poses greater challenges to the coherence of the Chicanx community… genderqueerness, because of its unreadability, ultimately poses a bigger threat to a Chicanx imaginary than same-sex desire (2018:78).

This is the case because gender queerness does not allow for other individuals to know if a person is a man or woman - a socialized factor that is engrained since the day one is born with gendered-coded toys and clothing. Not knowing someone's gender causes fear in some because it is out of the norm.

On the other hand, Mari represents a masculine figure. She is rebellious, smokes marijuana, skips school, and is constantly job hunting. At first, it seems that Mari is like any other adolescent; however, things change when she sees that her mother is late on the rent payment. After this, she puts on her deceased father's necklace and begins doing all sorts of jobs to help her mother with the rent, as well as helping to feed her little sister. Mari goes to the extreme to help provide for her family throughout the film and even prostitutes herself. After she sells herself, she takes off her father's necklace and tells her mother "she is tired," symbolizing that is she tired of having to fill her father's shoes and act as the sole provider for the family when she is only a young girl. Since Mari is a woman, she has to result to degrading job opportunities that have been created for women by men who wish to exploit the female body.

Although Mari is Queer, the only way she can acquire money is through engaging in a heterosexual act which goes against her sexuality. This means that she is being degraded twice, as a woman, and for being Queer. Many Queer women have to subject themselves to the toxicity of sex work in order to help provide for themselves or loved ones (Barrera Fall 2016). Sex work is something that was created by the means of toxic

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masculinity; most of the people who hire sex workers are men who are seeking sexual pleasure or encounters. This method allows for women who cannot make ends meet to provide services for men as a way of surviving.

Though women or men can experience negativity from presenting gendered traits that do not correspond with their assigned sex, there are transgender people that also experience this same response. Trans women are subject to violence, hate crimes, and murder simply for being assigned the wrong sex. In the film, *Gun Hill Road,* Enrique is completely unaccepting of his trans daughter, Vanessa and he resorts to calling her homophobic slurs. Enrique is also unaccepting of the LGBT community because during his time in prison, he was raped by another male inmate. He sees the LGBT community as a threat due to his trauma and lashes out at Vanessa. Vanessa knows that her family will not accept her, so she decides to live a double life: with her family, she is Michael – with friends who accept her, she is Vanessa.

The constant in-between Vanessa experiences represents the struggle of being in the borderlands; as Anzaldúa says, Vanessa is in the in-between and cannot please both sides. Eventually, Vanessa begins to date a cisgender man who at first wanted to treat her well and take her on dates. However, once he finds out that Vanessa is trans, he automatically sexualizes her, changes their dates into asking Vanessa for sexual favors, and asks if she has received bottom surgery. Chris, Vanessa's boyfriend, carries himself as the ultimate masculine male, wears baggy clothes, baseballs caps, and smooth talks her to perform sexual favors for him. He treats her as a sex slave; when Vanessa confronts Chris about never going on dates and only having sex, he says that dating is "wack." Despite this, they eventually go to have lunch where he acts like he does not know her and is embarrassed to walk with her or hold her hand.

This scene shows viewers his internalized homophobia and transphobia. Chris is embarrassed about being attracted to a trans woman because of the negative stigma society has placed on dating trans women or men. Some people believe the misconception that people transition because they are attracted to their biological sex and for it to be okay to like the same sex, they must change their gender identity; however, this is

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completely wrong. People transition for many reasons and the fact that one likes a person who shares their biological sex, has nothing to do with it. In the film, Vanessa not only has to deal with the negative behavior of her macho boyfriend, but from her father as well. Because Enrique wants to make Vanessa more of a man, he introduces her to a prostitute who sexually assaults Vanessa. Enrique cannot accept Vanessa; thus, he resorts to the extreme to keep Vanessa from being a trans woman. He violently cuts her hair, and states he is doing it "for [Michael's] own good because he loves him."

Earlier in the film while Enrique is in prison, he is raped. This becomes clear when he finds his rapists on the street and beats and kicks him multiple times in the groin while calling him a homophobic slur. This scene holds particular significance, since it explains why Enrique is so unaccepting of the LGBTQ community – in reality, he is frightened and has developed a phobia. Vanessa, a trans Latina, helps viewers realize that not only are trans women subjected to transphobia, and violence, but they are also victims of homophobia due to toxic masculinity or machismo. Additionally, Michael/Vanessa is what we would refer to as Latinx, since they present themselves as both genders. According to Jackie Cuevas (2018), "the 'x' in 'Chicanx,' 'Latinx,' and other terms attempts to move beyond the binary and offers a trans, genderqueer, gender non-conforming, and gender variant intervention that opens up the possibilities of ascribing any gender, or none at all to the term" (20).

Poetry

There are many males outside of television who may feel like Enrique from Gun Hill Road and decide to practice toxic masculinity. In the poem, *I Am Joaquin* by Corky Gonzales, it positively portrays males while excluding the rest of the Chicanx community. Although Gonzales has the right idea to compare the Chicanx identity to Mexican heroes, he fails to include women, the LGBT community, the Chicanxs who are gender non-conforming, and Afro-Chicanxs by labeling Chicanxs as "Chicano" thus referencing it to the masculine word. Additionally, many of the heroes Gonzales mentions are men; women are only mentioned when they seem weak or submissive:

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> I killed those men who dared / To steal mine, / who raped and killed my love / My Wife" or "Faithful women / Who die with me / Or live.

Traditionally, men are seen as protectors of women and must resort to the extreme when a woman is dishonored particularly if that woman is of importance to a man. Killing a man that dared to steal or rape another man's "woman" would restore his honor in society; however, this is actually a colonized mindset. In Pre-Colombian societies women were highly respected, it was a matriarchy (Laduke 1999:52).

Only the Virgin of Guadalupe and the Aztec goddess Tonantzin are mentioned while the rest of the poem focuses strictly on men. By doing this, the poem also shows that the only women worth mentioning are mythical figures who not all Chicanxs believe in, again highlighting another flaw of Gonzales's work. Gonzales's analysis of the Chicanx community is exclusive to Catholic males and submissive women which leads us to conclude that the identity he has claimed as Chicanxs is false and non-inclusive. "I Am Joaquin," is completely male centric; while it does manage to show the different identities that a Chicano has, it also excludes the LGBT community, gender non-conforming Chicanxs, Afro-Chicanxs.

Gonzales mentions that Chicanxs carry indigenous and European roots, thus signifying that Chicanxs are all not exclusively "Mexican" and that it takes different components to define a Chicanx:

> The chattering machine guns / are death to all of me: / Yaqui / T arahumara / Chamala / Zapotec / Mestizo / Español.

However, he fails to include that much of the Chicanx community is indigenous, European, and African, since many slaves were brought to Mesoamerica to work the lands which many indigenous people were killed and needed a replacement. Despite that, although, Gonzales's analysis of the Chicanx identity is largely male centered, he does a well in describing the heinous conditions the indigenous groups faced in Mesoamerica under Spanish rule:

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> Part of the blood that is mine / has labored endlessly four hundred / years under the heel of lustful / Europeans… / I have survived the toils and slavery of the fields.

The concept Gonzales discusses here is related to Tara Yosso's 2005 article, *Whose culture has capital? A critical race theory discussion of community cultural wealth,* specifically in terms of navigational and resistant capital. The ideas in Yosso's work relate Gonzales's poem because the indigenous groups had to navigate their way through the Spaniards to stay alive while others resisted and eventually gained their independence from Spanish rule after 400-500 years:

> *Navigational capital* refers to skills of maneuvering through social institutions. Historically, this infers the ability to maneuver through institutions not created with Communities of Color in mind… *Resistant capital* refers those knowledges and skills fostered through oppositional behavior that challenges inequality (Yosso, 2005: 80).

The community cultural wealth Yosso mentions helps us to understand that much of the Chicanx culture that is often dismissed from dominant culture. The Chicanx culture is a hybrid that consists of Latinx and American customs. Yosso explains what "culture" is and what is important for Chicanxs in the same way Gonzales does. However, the only difference between them is that Yosso is inclusive of all members of the Chicanx community while Gonzales is exclusive to non-Afro-Latinx males. It is important to be inclusive to all identities that make up a Chicanx or Latinx persons because excluding one can be problematic. Many individuals who do not see themselves represented especially Afro-Latinxs – begin to internalize Eurocentric ideas and to discredit their African ancestry or internalize negative stigmas such as colorism. This concept is similar to the LGBT community, gender non-conforming individuals, and women because "I Am Joaquin" excludes all these groups thus making it seem as though they are not real Chicanxs but a submissive or weak version of a Chicano.

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Although Gonzales's intentions were positive, he failed to include much of the entirety of the Chicanx community. Additionally, we should acknowledge that this was written in the 1960s, when equality for Chicanxs was non-existent. At that time, he was trying to capture a nationalistic spirit and show that Chicanxs are worthwhile. However, he did it while excluding important groups that have a history of being treated poorly within the Chicanx community. Although he does mention the indigenous people of Mesoamerica positively, as well as all the abuse they endured, he does not include the African slaves, which makes his analysis of the Chicanx incomplete. The fact that Gonzales excludes the LGBT community gives room for others not to consider an LGBT individual as "the ideal" Chicanx. The lack of inclusivity from Gonzales's part, "takes away nationality and symbolizes a loss of identity… [Chicanxs and Latinxs] are significantly oppressed" (Garcia-Preto 1996: 155). This poem should be revisited or rewritten with more inclusive language; that way, it can help Chicanxs struggling with identity issues since there are groups who have been denied the opportunity to feel proud to be a Chicanx woman, a member of the LGBT community, an Afro-Chicanx, or a gender non-conforming individual.

Due in part to the fact that "I Am Joaquin" is rather male centered, there has been a female response titled, "La Loca de La Raza Cosmica" by La Chrisx in the hope of being more inclusive of the Latinx and Chicanx community. La Chrisx does an excellent job in including all members of the Chicanx and Latinx community – even the ones that are often overlooked such as:

> Soy el welfare / Soy Juvenile Hall / Soy the A.A / Soy being under psychiatric care / Soy dope-pusher

In many situations, there are Chicanxs or Latinxs that deny someone because of their identity such as the way they act, dress, or their sexuality. Such is the case with many Chicanxs who fall into the criminal justice system and spend time in prison -- they are looked at negatively by family members and sometimes considered a waste of space. Although, Chicanxs and Latinxs all live different lives and identify in distinctive ways, a Chicanx, is still a Chicanx:

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> For as different as we all may seem, / When intricacies are compared, / We are all one, / and the same.

Although La Chrisx does not mention anything related to members of the LGBTQ community, she does include women and individuals who have been overlooked by the Chicanx community – something that Gonzales fails to do. Both "I Am Joaquin" and "La Loca" are poems that discuss The Chicano Movement but do so in distinct ways. Gonzales makes it seem as though men are the only ones responsible for the Chicano movement while making women seem weak and submissive. In comparison, La Chrisx makes women seem powerful:

> Soy Radical / soy la Revolucionaria / soy la Chicana en los picket lines / soy la Chicana en los conferences / Soy la Chicana en los teatros / soy la que hecha chingazos por su Raza / soy el grito: "Chicano Power!"

In these lines, La Chrisx shows readers how much of women's voices were ignored during the Chicano Movement as well those of other minority backgrounds, such as the LGBTQ community. The fact that she excludes Queer Chicanx/Latinx members but then later apologizes at the end of the poem, conveys the lack of inclusivity in The Chicano Movement:

> Con mucho cariño dedico esto a las Locas de la Raza Cosmica, / Y si no te puedes ver aqui hermana, solo te puedo decir / "Dispensa"

It is evident that the Chicano Movement was largely male dominated; this is most evident with the fact that it holds the male word of "Chicano" versus "Chicanx," which would show that it is for every Chicanx member, not just males. If the Chicano Movement was as inclusive as everyone states it was, women and Queer voices should have been included when fighting for rights and acknowledgment. Instead, they were ignored by the more mainstream movement ran by men.

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Some may say that the men were fighting for every Chicanx and Latinx but one gender is not intersectional; more genders and people of different backgrounds need to be included for a movement to be considered fair and inclusive. Given this information, it comes to show how toxic masculinity plays a huge role within the Chicanx and Latinx community which has not been eliminated from colonialism. Many machista ideologies are passed on from generations making toxic masculinity and colonized mindsets a generational issue that needs to be addressed.

Literary Analysis

Hyper-masculinity has been a problem for many decades in the U.S., especially in the Chicanx community. For example, American ideologies oftentimes influenced certain ideologies in other countries, such as Latin America and its issues with colorism or discrimination towards indigenous groups and the influence of the patriarchy. These negative influences can reshape cultures in other countries, thus making them more Americanized. This can destroy a country's original culture, which is which is what took place during Spanish colonization. In the novel, *The Rain God,* the protagonist, Miguel Grande is portrayed as the ultimate womanizer: he is macho, quite promiscuous and he uses these traits to manipulate the women in his life.

Miguel Grande represents the ultimate hyper-masculine male. His job title highlights this; he is a police officer, an occupation that is more common among men rather than women. Being a police officer gives him power not just in his community, but in his personal life as well. He has the authority to incarcerate anyone he desires, whether legally or illegally. Additionally, as a womanizer, he cheats on his wife with her best friend Lola and plays with both of their emotions. Miguel's sexuality is a way for him to retain his "manhood," as sexual intercourse is the only physical thing he can control. He can control the number of women he sleeps and the frequency he sleeps with them, but when it comes to having power over other things, it is somewhat difficult for him.

This applies to his relationship with his wife, Juanita. She is submissive and listens to whatever Miguel has to say, but her lack of sexual appeal displeases Miguel. During sexual encounters, Lola allows

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for Miguel to believe he is physically hurting her – something some people may associate with being "manly" – oftentimes men associate violence during sexual encounters as an act of manliness. This allows for Miguel to become mentally and physically satisfied with his toxic definition of "manhood." This love triangle is an example of the virgin-whore dichotomy as Juanita is the virgin, someone who is not fond of sex and is more reserved. In contrast, Lola loves to have sex with multiple partners and is rebellious. Some men find pleasure in this type of triangle because both women have something the other lacks. This leads to the man feeling that he has complete control over both women.

In many cultures, biological sex determines how much power a person will have throughout their lifetime. Similar to America, many Latinx and Chicanx communities have adapted a patriarchal ideology, usually resulting in violent tendencies. Before colonization, the indigenous people of Mesoamerica believed in peace. This later changed with the arrival of the Europeans (LaDuke 1999). Due to this, many people now believe that the Latinx culture revolves around machismo or violence. In addition, many believe that the man of the household holds power over the rest of the family – particularly the women. In the novel, Miguel Grande, heavily emphasizes this role with the control he has over the town as a police officer, as well as his wife. In many patriarchal societies – including Latin America – women are expected to be submissive for their husbands and attend to their every need.

In this novel, there are two characters named Miguel, one is the father and the other is the son: Miguel Grande translates to "Big Mike" while Miguel Chico, is "Little Mike". This shows the power dynamic despite both of them being male. Miguel Grande has more power because he is an officer, Miguel Chico's father, and a heterosexual male. In comparison, Miguel Chico has less power and prestige because despite being male, his "manhood" is not validated, since he is part of the LGBTQ+ community, which is not fondly looked upon, especially in this time era – one to two generations after the Mexican Revolution in a U.S. Border town.

Sexuality is a major drive for a male to be considered "a man," as well as the number of women they are involved with sexually. Because Miguel Grande's son, Miguel Chico and his brother Felix, are both gay, he

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feels that he must make up for it. He believes he must be triple the man to prove to society what his son and brother lack within themselves as men. This is an example of internalized homophobia; it is a way to cope with their sexuality. Rather than accepting his family, Miguel feels ashamed because he must demonstrate himself worthy of being a "man" to make up for his son and brother's shortcomings. According to the documentary, *Tough Guise 2*, men feel that in order to meet American patriarchal standards, they must present features that correlate with violence, hyper-sexuality, and homophobia. With such pressures placed on American men, it makes sense why Miguel Grande acts in such a way: he wants to fit in and it affects him and his culture as a Mexican American male. This relates to Anzaldúa's *Nepantla*, stuck in between two worlds, wanting to embrace a personal culture while still trying to fit into American culture.

In Miguel Grande's struggle to be "manly enough," he has gained control over his mother into what seems like an oedipal complex. In the last chapter of the novel, he tells his mother to calm down and let the women bathe her and she responds by calling him by her husband's name. This act may have been brushed off by some due to her condition; however, she is so sure of it and the rest of the family – including Miguel – do not question it. Miguel Grande's father has not been part of the picture for many years, forcing him to be the man of the household. He has embodied the role of his father, allowing his mother to sexually feed off his character even if there has not been any physical contact between both Mama Chona and Miguel Grande.

It is hinted that Mama Chona and Miguel Grande share something special when one of the women says that they need to call Miguel Grande "the only member of the family who could make their mother obey" (Islas 1991:175). Normally, the power dynamic is flipped, as the parental figure has authority over their offspring; however, in many cultures, the husband or intimate partner of a woman has power over her. Miguel yells at Mama Chona "knowing from their experiences with her… that this made her calm and submissive" (Islas 1991:176). If there was nothing going on between Mama Chona and Miguel, he would have told her to calm down, but in a gentler voice. She is submissive, as though he were her husband. It is also evident that she believes this is the case. Due to these minor details, it shows that there is an oedipal complex between Mama Chona

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and Miguel Grande. The reader is given a glimpse of Miguel Grande having for desire for his mother through the description of his first date with his wife Juanita:

> Her manner, the complete lack of flirtation in her voice, her total indifference to the game of sex, surprised him and filled him with admiration. She was unreachable and incorruptible in the same ways as his mother… she would be the mother of his children" (Islas 1991:99-100).

The Angel family seems to have sexual interests with their parent or child; which is also the case with Felix, Miguel Grande's brother, who has an interesting relationship with his son, Joel. Islas mentions how any disagreement with Joel causes Felix to become irritated with everyone – even his wife – not mention that they slept in the same bed until he turned ten and he constantly cradled him all throughout the night:

> His protective feelings for the child perplexed and disoriented him because they seemed stronger than his desire for his wife (Islas 1991:122).

The above quote leads readers to believe that Felix has a Jocasta complex when it comes to his son. Chicanx issues are heavily influenced through the use of gender, and sexuality from American patriarchy. The U.S is strictly focused on having its men be "man enough" by enforcing violent or hyper-sexually active behaviors at a very young age through the use of films, television, and video games. Although, the Angel family is somewhat middle class, the problem of the patriarchy still plays a role as the women in this novel are subjected to male power and are discriminated against based on their biological sex. When a character presents something outside of the norm, it is looked badly upon and thus results in violence; this is shown through Felix's death towards the middle of the novel. For example, joining the military is looked upon as something very heroic and manly.

When Felix challenges a U.S. Army soldier's "masculinity" by hitting on him, the soldier retaliates with violence by killing Felix. Felix

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represents outside the norm of masculinity which would explain why the soldier let his anger get the best of him through an unconscious desire to stamp out what he considers abnormal. Felix's death is a result of toxic masculinity not being accepting of a Queer individual making a flirtatious gesture toward a cis-gendered, heterosexual male - thus his death was not only a product of machismo, but also a hate crime. This novel helps its readers acknowledge the power dynamic between men and women, as well as the power dynamic between heterosexual individuals and members of the LGBT community. It shows us that despite the differences, we should all look past them and maintain our familial relationships until the very end of our days, similar to Mama Chona looking past her children's non-normative behaviors.

In the book *What Night Brings* by Carla Trujillo, readers are given the opportunity to become aware of what it is like to discover that one is Queer during an era where the LGBTQ+ community was not accepted by society. Marci, the main character, is attracted to girls. However, since she is a girl, she dreams about becoming a boy so that it can be socially acceptable for her to like girls. The narrative takes place in the 1960s which is when the LGBTQ+ community was not as widely accepted. Marci constantly questions her faith because God will not turn her into a boy even though she prays every day for that to happen and attends catechism. It is interesting to note that she prays to God to be a boy, yet in many religions, being transgender is not accepted or is looked at as sinful, which shows us that she is still young in age because her thoughts are not fully developed. Marci begins to question her faith even more when she confesses to a priest that she likes girls. To her surprise, the priest tells her that it is acceptable to like girls, not knowing that the priest is having a same-sex affair with her uncle, Tommy.

When it comes to Catholicism, Marci feels trapped: this becomes evident when she visits her neighbor's bible study group. She states that "[she] didn't have to stay at the MacCormacks' house if [she] didn't want to. That made [her] feel free" (Trujillo 2003:52). In many religions, one is expected to stay throughout the entire service and it is frowned upon if one leaves prior to the ending or if they are not paying attention. Marci attends church and catechism and constantly gets in trouble for asking logical

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questions about God's existence that seem unreasonable to highly religious people like Sister Elizabeth.

Not only does religion call out sins, but it also calls out the indigenous and associates them with Satanism. During colonization indigenous people who refused to convert to Christianity were killed or burned alive as their rituals where seen as savage and satanic-like. Due to this colonized mindset, many Latinxs, deny their indigenous roots and claim to only be of Spanish descent. This mindset is shown in Marci's mother who denies having indigenous blood (Trujillo 2003:33). Much of the ideas behind colonialism includes the concept of colorism. Colorism is favoring people with lighter skin rather than a person with darker skin.

Being brown or darker skin shows a closer connection to indigenous roots, something Christianity did not approve of during colonization; it can also be the case because European colonizers were of lighter skin and wanted to construct indigenous people as the "other." Marci states that during Catechism, Miss Beauchamp, "looked at [their] hands at the start of every class and sent [them] to the bathroom to wash them even if they were just a little browner than [their] real color" (Trujillo 2003:62). Although this novel takes place in the sixties, colorism is still a current issue in many Latinx communities who associate darker-skinned Latinxs or indigenous groups as lower class or as satanic. This can also explain as to why Latinxs who are Queer are not fondly looked upon and why white Queer individuals are more accepted since they are fairer skinned.

Marci's father, Eddie is the ultimate construction of a macho male; he is violent, drinks heavily, has an affair, does not let his wife work, leaves when his pride is hurt by women, and makes homophobic comments, especially towards his younger brother, Tommy. Eddie uses his brother's sexuality for any trivial issue to hurt Tommy both emotionally and physically:

> "Well, well, well," Eddie sneered. "So my queer little brother thinks he can kick his big brother's ass, huh?" He folded his arms up like it would be nothing to beat him up. "Now I sure as hell know that no queer can kick nobody's ass. Just because you got a

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few extra muscles don't mean shit. Because a queer with muscles –
is still a queer'" (Trujillo 2003:131).

It is true that homophobic comments hurt, but they can be
especially debilitating if they come from a family member; particularly a
person who is rather intact with their masculinity – particularly a person
who displays the toxic forms of manhood. These types of comments are
harmful because there is the negative stigma that gay or bisexual men are
not manly enough simply due to their sexual preferences. This is why
some men who display toxic masculinity or are homophobic, are actually
gay themselves.

With the comments and abuse Marci endures from her father, it
only makes her want to be a boy even more. She wants to be able to
defend herself when her father is abusive towards her and her sister and
she wants to be socially accepted. Eddie's behavior affects Marci's mental
health – she is constantly scared and has negative thoughts about her
father and she prays every night for God to either kill him or make him go
away. The novel progresses from Marci being ten to twelve years; a child
having murderous thoughts about her father signals that something is truly
affecting her well-being. Her father's behavior is setting him up for hatred
from his own children. When Marci's father first leaves, she becomes
happier and displays a sense of well-being; this is evidenced in the garden
she is growing. When her father leaves, her garden is beautiful and full of
crops but when he comes back, she states that almost everything is gone
from the garden, thus symbolizing her lack of hope and poor well-being.
With Eddie's return, Marci knows that she will be abused again. Marci
and her sister eventually run away to their grandmother's when Eddie hits
their mother. While away from her parents, Marci meets a girl who is also
attracted to girls. This symbolizes that in order for Marci to truly be
herself, she needs to get away from the toxicity of her abusive father and
her clueless mother who let the abuse happen.

Feminist (Inclusive) Masculinities
Despite there being a negative outlook at masculinity, there are
some masculinities that are positive or inclusive. Scholars like Hurtado

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and Sinha take a different approach when studying masculinity and decide to focus on the positive forms of masculinity rather than the toxic:

> Four major dimensions [are] associated with feminist masculinities – these include emphases on being an ethical human being, having emotionally healthy relationships with others (both women and men), being involved in activism and social justice-oriented activities, and rejecting aspects of hegemonic masculinity. (Hurtado and Sinha 2008: 338).

In Hurtado and Sinha's 2016 study, they found that manhood does not necessarily have to be associated with gender but rather with performing the duties that make a person "a man," such as the responsibility of caring for family which can be a feminine or masculine act. They use the example of single mothers, or mothers who are the main breadwinner of the household and demystify the stereotype that men are the sole providers. Additionally, many men in Hurtado and Sinha's study mention that manhood must be redefined to include women that perform the social constructs often associated with manhood and for the gay men who are often oppressed and excluded from the dominant ideology of machismo.

Discussion

Although many people state that time has progressed along with customs and ideas, many people's beliefs have not. There are still Latinxs who experience homophobia and transphobia from their family members because of religion or societal expectations toward their gender identity. Many of the mentioned characters try to be what society expects of them but soon realize that it is not who they are and are only hurting themselves to please others. When the characters begin to accept themselves that is when they truly become happy and live their lives as they want to. It is also important to note that works like poetry can show toxic masculinity without even realizing it because of hegemonic colonized mindsets. Toxic masculinity is everywhere around us and many fail to recognize that it does affect individuals in a negative way, especially the Queer community who are constantly subject to homophobic or transphobic comments from family members or strangers. Although not all forms of masculinity are

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toxic, the people who practice positive forms of masculinity should spend more of their time educating individuals who present toxic masculinity in hopes of diminishing the negative comments or actions that occur because of societal norms.

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Insulin signal transduction mediates ethanol-induced feeding dysfunction in a fly model of Fetal Alcohol Spectrum Disorder

Biography

Growing up, Manae was always interested in understanding the concepts behind how things work. This led to her passion for Biology. As a first-generation student, she is working hard to earn her bachelor's degree in hopes of pursuing her PhD in molecular biology and genetics. Manae hopes to become a scientific researcher - studying the epigenetic effects of nutrition. She hopes to establish novel results to aid in prevention and mitigation of diseases and disorders related to nutrition. Manae is a proud member of Dr. Rachael French's Behavioral Genetics lab. She really enjoys being a part the research lab as it relates to what she hopes to do in the future. For leisure, Manae likes to take her cute dog on adventures - especially hiking and road trips. Most of the time however, she just likes to stay in bed, watch videos on her phone, and do absolutely nothing.

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Insulin signal transduction mediates ethanol-induced feeding dysfunction in a fly model of Fetal Alcohol Spectrum Disorder

ABSTRACT

Fetal alcohol spectrum disorder (FASD) is the leading cause of congenital intellectual disabilities in the Western World, with a worldwide prevalence of 2-11% of all births. FASD is preventable but recent epidemiological studies suggest that public awareness campaigns have reached the limits of their effectiveness. Therefore, research is shifting from prevention to treatment and mitigation of symptoms. No biological treatments for FASD exist, due in part to the fact the cellular mechanisms of alcohol toxicity are not well-understood. Developmental alcohol exposure (DAE) causes a variety of deleterious effects in both vertebrates and invertebrates, including increased mortality, slow growth, learning and memory deficits, and behavioral changes including feeding abnormalities. In this study, we use the common fruit fly, *Drosophila melanogaster*, as a model to study the effects of developmental alcohol exposure (DAE) on feeding behavior. We have previously shown that DAE causes feeding dysfunction in fly larvae, consistent with phenotypes seen in mammalian models, and that these effects are mediated by the reward molecule neuropeptide F (NPF). In addition, we have shown that DAE reduced insulin signal transduction. Here, we investigate the interaction between reduced insulin signaling and feeding changes in flies exposed to ethanol during development.

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INTRODUCTION

Fetal Alcohol Spectrum Disorder (FASD) is a preventable disorder induced by alcohol consumption during pregnancy; those affected by developmental alcohol exposure (DAE) experience reduced feeding motivation as well as other cognitive and developmental issues (Guevara et al., 2018). Half of all women in the United States drink, and an estimated 50% of all pregnancies are unplanned (Riley and McGee, 2005). 32% of women report that they would continue to drink while trying to conceive (Peadon et al., 2011) and recent evidence suggests that the periconceptual period is a particularly sensitive time for the programming of future disease generally, and for the programming of metabolic syndrome particularly (Gardebjer et al., 2015; McMillen et al., 2008). Thus, focusing on prevention alone is ineffective, so focus has turned to treatment. There is no approved medical treatment for FASD, and relatively little is understood about the molecular mechanisms of developmental alcohol toxicity. Development of effective treatments to mitigate the symptoms of FASD will depend on a thorough understanding of the underlying molecular causes of each symptom.

We previously demonstrated that developmental alcohol exposure (DAE) leads to a dramatic reduction in insulin and insulin-like growth factor (IGF) signaling in 3rd instar *Drosophila* larvae (McClure et al., 2011), and this result is consistent with the effects of DAE in mammalian systems (Breese et al., 1993; de la Monte et al., 2005; Gatford et al., 2007; McGough et al., 2009; Singh et al., 1996). More recently, our group showed that DAE leads to reduced larval feeding and that ethanol induces an elevated expression of neuropeptide F (NPF; NPY in mammals). NPF/NPY expression results in increased feeding, which partially compensates for the anorexic effects of ethanol (Guevara et al., 2018). Finally, in larvae, NPF release can be negatively regulated by insulin (Wu et al., 2005). Therefore, we hypothesized that altered insulin signal transduction as a result of DAE results in increased NPF signaling and protection against the effects of DAE on feeding.

To test this hypothesis, we tested the ethanol-modified feeding behavior of larvae defective in insulin signaling. We predicted an increase in NPF signaling in these mutants, resulting in a partial or complete rescue

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of larvae back to normal eating levels in DAE conditions. However, our data suggest a more complex relationship between insulin and feeding in ethanol-reared flies. Flies mutant for the insulin receptor display the expected rescue of ethanol-induced feeding defects. However, flies with a complete loss of ilp2, the primary fly insulin-like peptide, show the opposite phenotype. Our results indicate that ethanol, insulin, and feeding interact in a complex fashion during development.

MATERIALS AND METHODS

Fly Stocks, Genetics, and Husbandry

Fly stocks were maintained at 25°C on standard corn meal and molasses medium. Fly strains were obtained from the Bloomington *Drosophila* Stock Center (Bloomington, Indiana) and the strains used were: InR^{GC25}/TM3, Sb (Bloomington Stock 9554), *InR^{E19}/TM2, Ubx* (Bloomingston Stock 9646), and *w^{1118};Tl{Tl}Ilp2* Wildtype controls were our standard laboratory stock strain (*w^{1118}, Wild-Type Berlin (w:WTB))*.

Ethanol Rearing

Adult flies were placed in egg-laying bottles, capped with Petri plates containing standard fly food with no ethanol and left to acclimate for a day. On the second day, the plates were replaced with food plates containing 7% ethanol (made by adding 7 mL of ethanol to 93 mL of food) with a small amount of yeast paste in the center. The flies were allowed to lay overnight, then the plates were transferred to a closed tupperware container containing 1 L of 7% ethanol (experimental conditions). Control plates (food with no ethanol) are collected the same way and ultimately are transferred to an identical closed tupperware container containing 1 L of deionized water (control conditions).

Feeding Assays

For larval feeding assays, young third instar larvae were collected at approximately 72h after egg- laying (AEL) (control conditions), or 96 AEL (experimental conditions). The difference is due to the approximately 24-hour developmental delay caused by ethanol-rearing (McClure et al, 2011). This ensures that all larvae are age-matched. Larvae were kept food-deprived for 2 h prior to feeding, while first instar larvae were not starved.

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30 larvae were placed onto 3% agarose plates and allowed to feed on yeast paste containing 0.5% v/v FD&C Blue Dye #1 for 20 min. A larva was considered to have eaten by the presence of blue dye in 3/4 its length.

Statistical Analysis

All statistical analyses were conducted using two-way ANOVA with a Tukey HSD *post-hoc* analysis unless otherwise indicated.

RESULTS
Insulin Receptor Loss of Function Is Protective Against DAE-Induced Feeding Abnormalities

We previously showed that DAE causes reduced feeding, and that this effect is exacerbated by reduced signaling through the neuropeptide F (NPF; NPY in mammals) reward pathway. In addition, we demonstrated that NPF signaling appears to be increased in ethanol-reared larvae, and we hypothesize that this increase serves to compensate for reduced feeding caused by ethanol though an as-yet-unidentified pathway (Guevara et al., 2018). Insulin signal transduction also affects larval feeding. Specifically, NPF makes animals more likely to eat noxious food under conditions of food deprivation, and insulin signaling appears to inhibit the activity of NPF receptor (NPFR1)-expressing cells, such that, when animals are well-fed, DILP signaling leads to reduced feeding (and reduced acceptance of noxious foods) (Wu et al., 2005). We hypothesized that insulin similarly regulates NPF in ethanol-reared animals, such that the DAE-induced reduction in *InR* expression leads to increased release of NPF in the brains of ethanol-reared larvae. This hypothesis predicts that mutations leading to reduced insulin signaling should be protective against the DAE-induced feeding deficits.

To test this hypothesis, we reared animals heterozygous for InR^{GC25} or InR^{E19} (loss of function alleles that reduce InR proteins levels to 57% or 50% of wildtype, respectively) in ethanol and compared their feeding to that of wild type ethanol-reared animals. As shown in Figure 1, ethanol-rearing resulted in wild type larvae being less likely to feed: only 58% of wild type ethanol-reared larvae fed, compared with 76% of control animals. This effect completely disappeared in InR^{GC25} heterozygotes,

<div align="center">69</div>

however: InR^{GC25} heterozygotes grown in control food ate slightly less than wild type animals (61% fed), and there was no effect of ethanol-rearing on InR^{GC25} heterozygotes (57% fed). Similarly, InR^{E19} heterozygotes showed reduced feeding relative to wild type (44% fed), but this phenotype disappeared when InR^{E19} heterozygotes were ethanol-reared (69% fed).
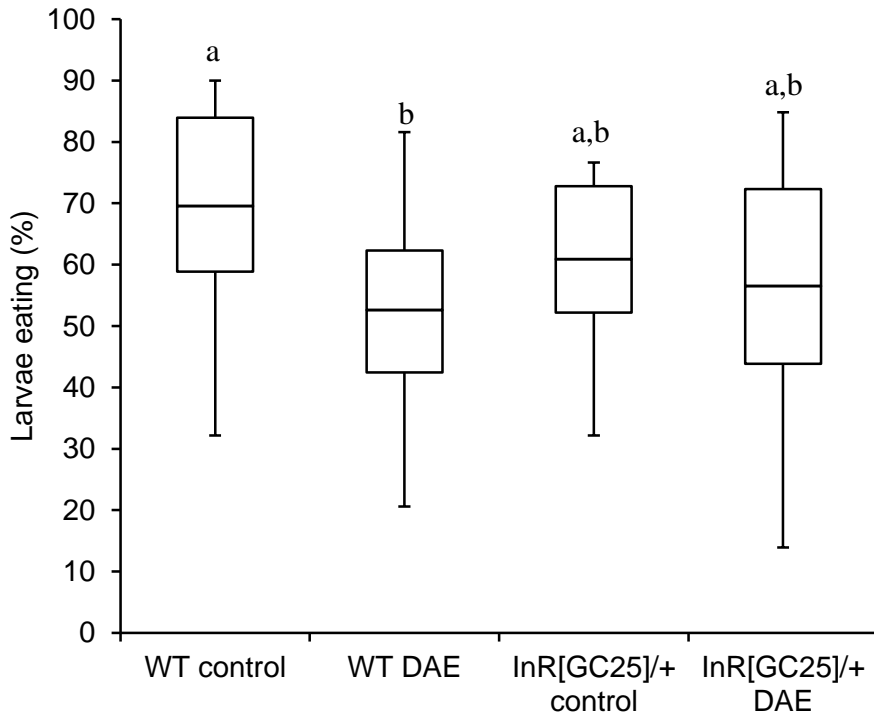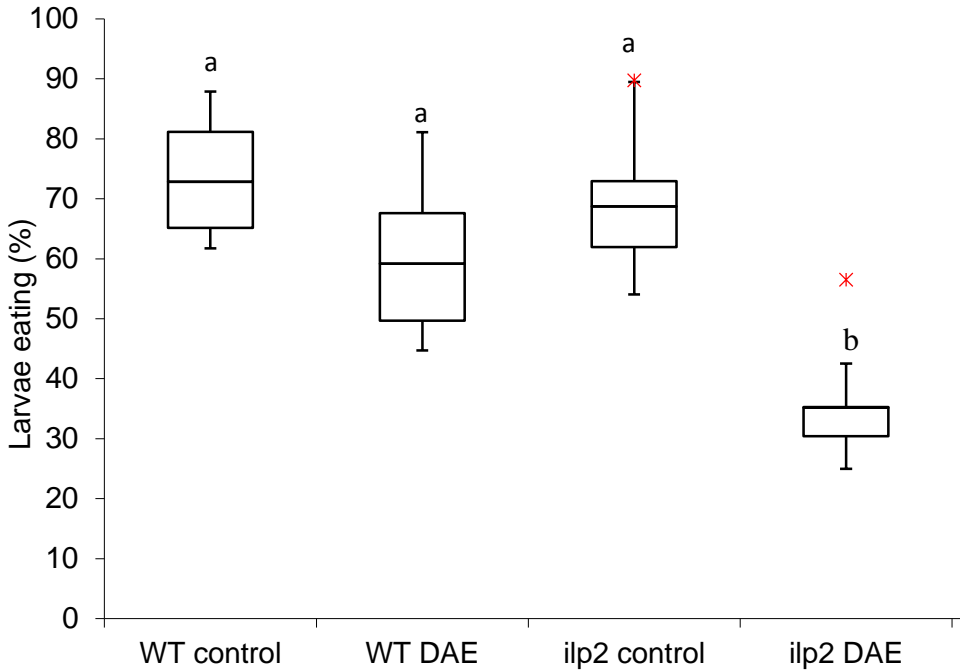

Figure 1: *InR* heterozygotes are resistant to the effects of DAE on feeding behavior. Percentage of early third instar larvae that ate within a 20-min interval after 2 h of food deprivation (N = 8-16. P = 0.0162 for the effect of genotype, P = 0.23 for the effect of DAE, P = 0.0001 for the interaction between DAE and genotype, two-way ANOVA with Tukey's post-hoc analysis). WT: wildtype. Center lines show the sample mean; box limits indicate the 25th and 75th percentiles as determined by R software; whiskers extend 1.5 times the interquartile range from the 25th and 75th

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percentiles. Boxes sharing the same letter do not differ significantly, while boxes with different letters are significantly different (P < 0.05). Stars indicate outliers.

Loss of ilp2 Exacerbates DAE-Induced Feeding Abnormalities

We have previously demonstrated that both InR and the primary fly insulin, ilp2, are reduced by 50-75% in ethanol-reared animals (Mcclure et al., 2011). To examine the effects of mutation of ilp2 on feeding in DAE animals, we reared larvae homozygous for a complete loss-of-function of ilp2 in ethanol and compared their feeding to that of wild type ethanol-reared animals. Unexpectedly, we found that loss of ilp2 has the opposite effect as reduction of InR. As shown in Figure 2, 73% of control animals fed during the assay, while only 59% of ethanol-reared controls fed. Complete loss-of-function of ilp2 does not affect feeding in the absence of ethanol (68% of ilp2/ilp2 animals fed), but ilp2/ilp2 larvae are profoundly sensitive to the effects of DAE on feeding, with only 35% feeding. These results are surprising, because a receptor and its primary ligand would be expected to have the same loss-of-function phenotype, suggesting a complex relationship between DAE, insulin signaling, and feeding behavior in *Drosophila*.

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Figure 2: *ilp2* larvae are sensitive to the effects of DAE on feeding behavior. Percentage of early third instar larvae that ate within a 20-min interval after 2 h of food deprivation (N = 7-8. P = 0.0019 for the effect of genotype, P < 0.0001 for the effect of DAE, P = 0.0098 for the interaction between DAE and genotype, two-way ANOVA with Tukey's post-hoc analysis). Center lines show the sample mean; box limits indicate the 25th and 75th percentiles as determined by R software; whiskers extend 1.5 times the interquartile range from the 25th and 75th percentiles. Boxes sharing the same letter do not differ significantly, while boxes with different letters are significantly different (P < 0.05). Stars indicate outliers.

DISCUSSION

The goal of this project was to explore further the mechanism by which developmental exposure to ethanol changes feeding behavior in *Drosophila*. We previously demonstrated that ethanol-rearing alters

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feeding behavior, and that signaling by neuropeptide F (NPF) is protective against these changes (Guevara et al., 2018). We have also shown that insulin signal transduction is affected by DAE (McClure et al., 2011), and others have shown that insulin signaling regulates feeding through interaction with NPF-responsive cells (Wu et al., 2005; Wang et al., 2016). We therefore investigated the effects of reduced insulin signal transduction on ethanol-induced anorexia in *Drosphila* larvae.

Our results suggest a complex relationship between DAE, insulin, and feeding behavior. Reducing expression of the insulin receptor (InR) results in rescue of ethanol-induced feeding deficits, as predicted (Figure 1). However, complete elimination of the primary *Drosophila* insulin-like peptide, ilp2, has the opposite effect: ilp2 mutant animals are sensitive to the effects of DAE on feeding (Figure 2).

There are several possible explanations for these results. First, our insulin receptor mutants reduce protein levels by about half, and it is not possible to reduce InR levels further, as all mutations in this gene are homozygous lethal. On the other hand, there is no ilp2-mediated signaling in *ilp2/ilp2* mutants. One explanation for this disparity may be positive feedback in the insulin receptor pathway, such that there is a compensatory increase in signaling or expression in animals with a partial loss-of-function, and this explains the rescue seen in the InR heterozygotes.

Another possibility lies in the fact that there are seven fly insulin-like peptides, all of which signal through the same receptor. Our results may reflect a differential requirement for the InR and some of its ligands with regard to feeding behavior. If true, this would be an exciting result, because, to date, there has been no demonstration of distinct behavioral functions for the different ilps. We are currently testing null mutations in all of the remaining six ilps in order to get a full characterization of the role of ilps in feeding behavior in ethanol-reared flies. These experiments are ongoing, but preliminary data suggest that flies with a complete loss of *ilp3* are resistant to DAE-induced anorexia, similar to InR heterozygotes (not shown).

Finally, our results may reflect differences in the functions of ilp2 and the InR in different parts of the feeding circuitry during larval development. Insulin signaling promotes hunger and feeding behavior

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through activation of both octopamine and dopamine signaling, in addition to its effects on reducing feeding through inhibition of NPF signaling (Wang et al., 2016), and dopamine and octopamine receptor expression are both reduced by DAE (Logan-Garbisch et al., 2011). We are currently carrying out experiments to elucidate the signaling relationships between insulin, NPF, octopamine, and dopamine during feeding in ethanol-reared larvae.

ACKNOWLEDGEMENTS

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Gαi and GƳ30A act downstream
of *Tre1* in *Drosophila* courtship

Biography

As a first-generation American and college student, Emily's fascination with the life sciences and passion for service drove her to work in a field that contributes to scientific and human advancement. Outside of her research in the French Laboratory and the McNair Scholars Program, she has been an active member of her campus community; having served as chapter president of Global Medical Brigades, acquiring alumni status in Alpha Omicron Pi women's fraternity, and participating in the San José State University NSF-REU, Research by Undergraduates Using Molecular Biology Techniques (RUMBA). Emily has led one of the three medical brigades she has participated in, providing her with a worldview that has stretched her research interests beyond the scope of biology. She is interested in human genetics, biochemistry, and global health. After earning her bachelor's degree, Emily will continue on to graduate school in pursuit of these research interests with the goal of one day mentoring, empowering, and advocating for students in academia.

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Gαi and Gγ30A act downstream of Tre1 in Drosophila courtship

ABSTRACT

The role of genes in morphological development is well understood for a variety of model organisms, but there remains a gap in our understanding of how genetics mediate behavior. Are there master genes that regulate behavior? Answering this question will lead to a better understanding of the development and function of the central nervous system, eventually allowing us to map out the pathways that regulate specific behaviors. We are using *Drosophila melanogaster* as a model organism and the male courtship ritual as the behavior of interest to study the relationships between genes, neural development, and behavior. *Trapped in endoderm 1* (*Tre1*), a gene encoding an orphan G-protein coupled receptor (GPCR), is required for normal courtship behavior in fruit flies, but how this receptor regulates behavior is not yet understood. Here, we characterize the signaling cascade downstream of Tre1 by testing mutations in the *Drosophila* G-proteins for courtship defects similar to those seen in *Tre1*. Our results demonstrate that Gαi is a candidate downstream effector for Tre1, while also implicating Gγ30A in courtship behavior. Future goals include completing the characterization of the G-protein mutations and conducting experiments to explore the complex interaction between G-protein signaling and courtship initiation.

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INTRODUCTION

Genes are responsible for the development of the central nervous system (CNS), which, in turn, mediates behavior. Many of the genetic pathways underlying morphological development in animals have been identified and well-characterized. In contrast, there is still much to be understood about how a gene or genes specify behavior (Demir and Dickson 2005). Elucidating the roles of genes with regard to particular behaviors has the potential to be a powerful set of tools to map out the molecular pathways that direct the wiring of the CNS.

Courtship behavior is observable and well characterized in *Drosophila melanogaster*, making it a practical model for the purposes of this study. In addition, the behavior is innate – it is "hard wired" into the brain. Only males perform the courtship ritual – and they are able to perform it even if they have been socially isolated since "birth." The courtship ritual is a stereotyped set of six distinct steps that must be executed correctly, and in the proper order, to ensure reproductive success (Baker *et al.* 2001). Because innate behaviors such as this do not have to be learned, they are ideal models for the study of how genes pattern the nervous system to elicit specific behavioral responses. We seek to expand our knowledge on this particular trait as it is so evolutionarily favored it is programmed into the *Drosophila* nervous system.

We previously demonstrated that the gene *Trapped in endoderm-1* (*Tre1*) is required for normal courtship behavior in fruit flies. Specifically, male flies in which Tre1-expressing cells are silenced, or with loss of function mutations in *Tre1*, initiate courtship much more rapidly than wild-type males (Luu *et al.* 2016). *Tre1* encodes an orphan G-protein coupled receptor (GPCR). In this work, we aimed to identify components of the G-protein signaling cascade downstream of *Tre1*. To accomplish this goal, we tested mutations disrupting subunits of heterotrimeric G-proteins for courtship initiation defects. Here, we show that both Gαi and Gγ30A are involved in courtship initiation, and that these genes may reveal a complex role for G-protein signaling in the programming of this behavior.

METHODS

Fly stocks

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Fly stocks were maintained in a 25°C incubator and grown on standard cornmeal/molasses medium. All strains of flies were acquired from the Bloomington *Drosophila* Stock Center at the University of Indiana. Fly stocks used were: *w;wild type Berline (*our laboratory wild type strain, used as the control genetic background), *GƔ30A^{EY11766}(*Bloomington Stock 20695), *GƔ30A^{e0084} (*Bloomington Stock 17891), *GαO^{KG01266}(*Bloomington Stock 13714), *GαO^{MB00893}* (Bloomington Stock 22924), *GαF^{MB10810}* (Bloomington Stock 29157), and *GαI^{EY039776}*(Bloomington Stock 15698).

Courtship assays

For courtship assays, virgin males were kept in isolation for 2-3 days after eclosion. Each male was then presented with a single 1-2-day-old *w^{1118}; WTB* virgin female. Single male and female pairs were placed into custom plexiglass chambers 10 mm in diameter and 6 mm in height, separated by plastic transparencies. Contact between pairs was initiated by removal of the transparencies. Courtship behavior was recorded in infrared light for 20 minutes.

Statistical Analyses

An α level of 0.05 was used in all experiments. Statistics were performed on log-transformed means of wing song latency. Data were analyzed using one-way analysis of variance (ANOVA), followed by Tukey's HSD *post hoc* test. No statistical tests were used to predetermine sample sizes, but our sample sizes are consistent with those reported in previous publications (Tran *et al.* 2014; Luu *et al.* 2015). Data in figures are back-transformed.

RESULTS
Flies mutant for *Gαi* mutants phenocopy *Tre1*

In order to identify the G-proteins that transduce the *Tre1* signal, we began a systematic survey of courtship phenotypes in male flies mutant for all of the *Drosophila* heterotrimeric G-protein genes. The *Drosophila* genome encodes 8 predicted Gα subunits (*concertina (cta)*, *Gαf, Gαi, Gαo, Gαq, Gαs, CG17760,* and *CG30054*). To date, we have tested loss-of-function alleles in *cta*, *Gαf, Gαi, Gαo,* and *Gαq*. We find that mutation of

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cta, Gαf, Gαo, and *Gαq* have no consistent effect on courtship behavior (data not shown). However, mutation of *Gαi* consistently phenocopies the *Tre1* "rapid courtship" phenotype (Figure 1). While control animals initiated courtship in 108 seconds, on average, male flies homozygous for *GαI^{EY03976b}*, a loss-of-function mutation in *Gαi*, initiate courtship approximately three times as fast, in an average time of 32 seconds (P < 0.01, student's T test, N = 24 males). These data are consistent with *Gαi* functioning downstream of the Tre1 receptor in courtship initiation.
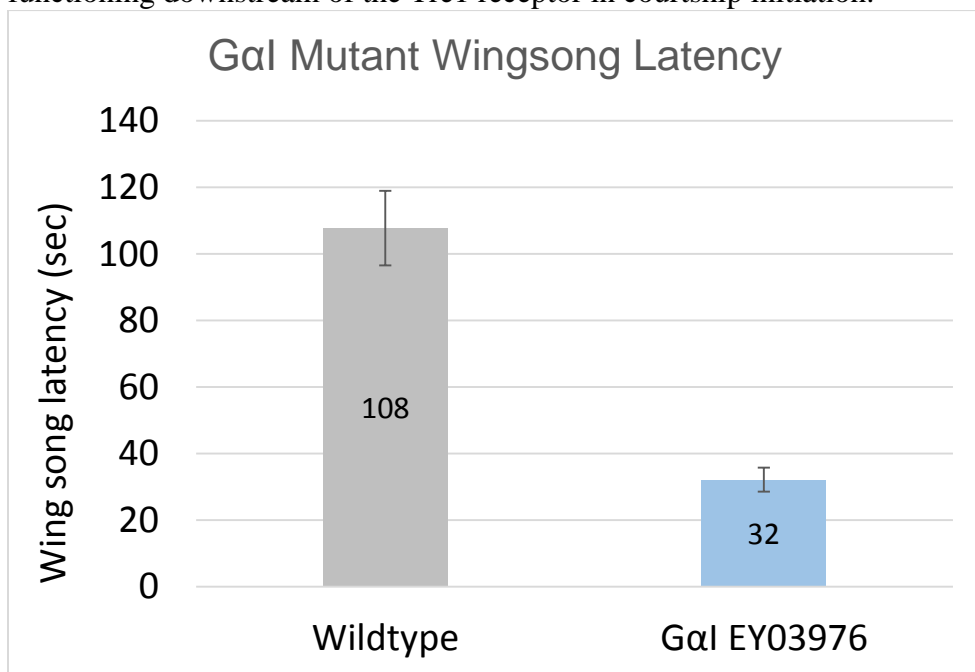
Figure 1. Flies mutant for *GαI* display rapid courtship initiation. *GαI^{EY03976b}* mutant flies initiate courtship in 32 seconds, compared to 108 seconds in wild type controls (*w; WTB*). (p = 8.22991E-10, student's T-test, N = 24 males for each genotype)

GY30A mutants demonstrate slower courtship initiation

The Drosophila genome encodes two Gγ subunits, *Gγ1* and *Gγ30A*. We have tested loss-of-function mutations in both of these genes, and find that, while Gγ1 does not appear to affect courtship initiation, mutation of

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Gγ30A consistently results in a longer time to courtship initiation. Figure 2 shows the average time to courtship initiation for two alleles of Gγ30A. Male flies homozygous for either allele display an increase in courtship initiation (N = 24 males, p = 0.123). Though these results do not achieve statistical significance, the consistency of the phenotype over multiple trials in two independent alleles suggests that Gγ30A is involved in courtship initiation. Additional experiments will be needed to confirm these results.
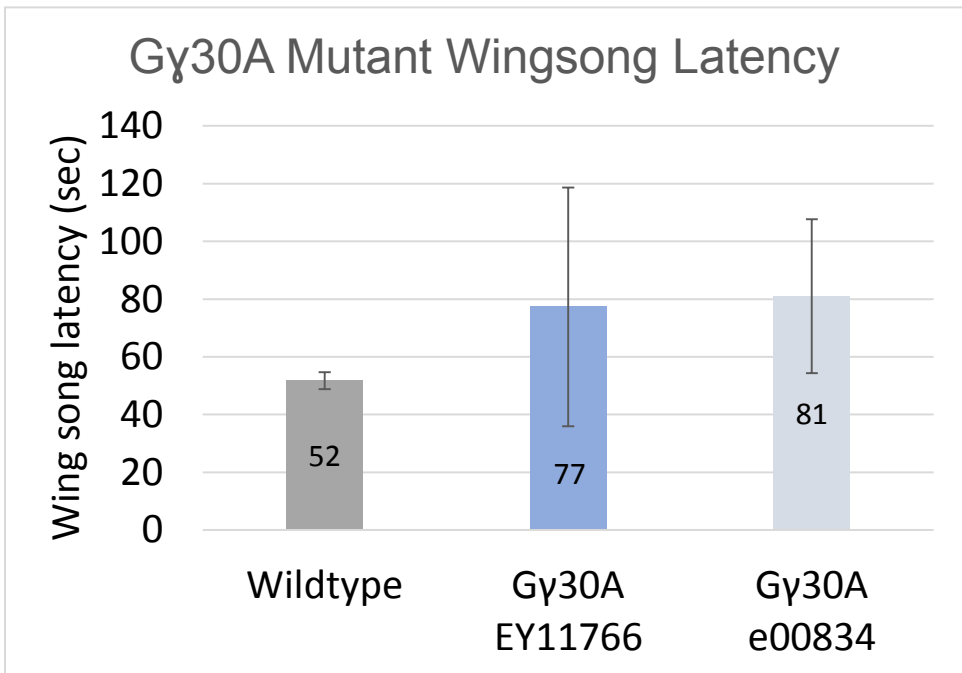
Figure 2. *GY30A* mutant males display slower courtship initiation. *GY30A* mutant males initiate courtship in 77-81 seconds compared with 52 seconds in wild type controls (w; WTB). (p = 0.123, one-way ANOVA, N = 24 males for each genotype).

DISCUSSION

We have begun a systematic analysis of the roles of all *Drosophila* G-protein genes in courtship initiation, in order to elucidate the signal transduction cascade downstream of Tre1. To date, we have screened 5 of

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the 8 Gα subunits, and both Gγ subunits. We find that mutation of Gαi phenocopies the Tre1 rapid-courtship effect (Figure 1), strongly suggesting that Gαi functions downstream of the Tre1 GPCR. When activated, Gαi inhibits the activity of adenylate cyclase (reviewed in Birnbaumer, 2007). In mammals, Gαi is coupled to histamine H3 and H4 receptors (Interpro, http://www.ebi.ac.uk/interpro/entry/IPR003980). This is particularly interesting because we have evidence that Tre1 may function as a histamine receptor, and this would be the first example of a metabotropic histamine receptor in *Drosophila*, and only the second in any invertebrate (Zaki et al., 2017).

We also show evidence that Gγ30A is involved in courtship initiation, but the phenotype of Gγ30A mutants is the opposite of Gαi mutants (Figure 2). This difference in can be explained in at least two ways. First, this result is consistent with the function of Gβγ subunits as inhibitors of Gα activity (Clapham and Neer, 1997). Second, it may be that the function of Gγ30A is independent of Gαi, and the regulation of courtship initiation by G-protein signaling is more complex. In order to distinguish between these possibilities, we will begin testing signal transduction pathways downstream of both Gγ30A and Gαi, including mutations disrupting adenylate cyclase (downstream of both Gαi and Gγ), as well as PI3K (inhibited by Gγ, so expected to phenocopy Gγ30A) and phospholipase C β (activated by Gγ, so expected to have rapid courtship).

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Effects and Solutions on the Human Body After Long-Duration Space Flights

Biography

Jaime is a first-generation student pursuing a B.S. in Aerospace Engineering with a Minor in Astronomy. His research focuses on the effects of microgravity on astronauts in order to find solutions for long-duration space flights to Mars. After graduating, he plans to attend graduate school to continue his dream of making humans an interplanetary species. He believes the purpose of engineering goes beyond making people's lives easier. When used sensibly, human history demonstrates engineering can propel humanity into unimaginable new boundaries. He developed his mission to promote higher education among underrepresented groups in his community and advocate for more students to pursue a career in STEM. His belief is that if we only have one life; to make our lives more meaningful, we should strive to make this world better and to serve the community.

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Effects and Solutions on the Human Body After Long-Duration Space Flights

ABSTRACT

During the Cold War, President John F. Kennedy made it a mission for the National Aeronautics and Space Administration (NASA) to accomplish a lunar landing and return to Earth. The final lunar landing and the last time humans left Low Earth Orbit (LEO) was in December, 1972. However, 47 years have passed and the fascination with traveling into deep space remains alive and flourishing. A major problem with future human missions to Mars is the effects of microgravity and Mars' 0.38g environment. Unfortunately, space medicine is limited and little is known about the effects of microgravity on the human body after one year in space. Is it possible for astronauts to survive long spaceflight missions to Mars? To help address this question, my research focuses on the effects of microgravity on astronauts in order to find solutions for long-duration space flights to Mars. Bone and muscle loss are factors that could lead to severe, unknown consequences on an astronaut's health. My methods included doing an analytical interpretation of historical and contemporary research on long-distance spaceflight. In the future, longer missions are going to require more permanent solutions for humans to be an interplanetary species. The current solutions being used in the International Space Station (ISS) are only to treat individual symptoms separately. Only theoretical permanent solutions were found, such as artificial gravity; therefore, further research is needed. Centripetal acceleration has shown great promise to eliminate microgravity effects but more research is needed to understand the health consequences and the limitations of rotation that humans can sustain.

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Nomenclature

F	=	Force
m	=	Mass
ω	=	Angular velocity
r	=	Radius

I. Introduction

A. Background

Space exploration in the United States began with tensions between the United States and the Soviet Union. Dwight Eisenhower initiated the National Aeronautics and Space Administration (NASA) in 1958 as a way to keep the Soviet Union distracted while the Department of Defense (DOD) focused on a militaristic approach to secure space [11]. As tensions grew between the nations, a competition to reach the moon intensified. In a momentous speech by John F. Kennedy in 1962 that continues to echo in the modern day, he said, "We choose to go to the moon in this decade and do the other things, not because they are easy, but because they are hard, because that goal will serve to organize and measure the best of our energies and skills." [9]. This speech helped to energize the United States to put a human on the Moon and bolstered a movement for space exploration.

In contrast, the Richard Nixon administration (1969-1974) reduced the funding from NASA and actively made efforts to cancel a return to the moon, as well as stop the management of the Saturn V rocket [11]. Although funding was cut from NASA, Nixon wanted the human spaceflight program to continue, so he laid the foundation for the space shuttle program that would be later developed by many presidents after him [11]. With no new mission to return to the moon, George H.W. Bush wanted to reignite the flame for space exploration again so he pushed his plan forward – known as the Space Exploration Initiative (SEI) in 1989 [11]. SEI was a plan to return to the moon and many scientists and engineers pushed for the opportunity to create a plan known as the 90-day report [1, p. 58]. The 90-day report included a summary to start a base on the moon and build a spaceship in orbit for Mars, but it gained scrutiny

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due to the 450 billion dollar cost of the project [1, pp. 58-59]. In the end, the SEI efforts died with no progress made in returning to the moon [11]. The reason for its demise was its high cost and the United States' dwindling focus on space exploration. Without the support of the people, an expensive plan was difficult to justify.

The Columbia space shuttle disaster of 2003 was the first of its kind where there was an engineering problem that led to the explosion of the vehicle eventually killing the passengers aboard. This event influenced George W. Bush to stop space shuttle development because of the increasing cost and to prevent another disaster from happening [11]. However, Bush pushed for an alternative project to replace the space shuttle and gave his approval for the Commercial Space Launch Amendments Act of 2004. This amendment played a critical role in boosting commercial spaceflight for the future and inspiring entrepreneurs to start companies that would change the future of spaceflight. Pappalardo describes that the amendment, "Establishes an experimental permit for reusable orbital rockets. This opens an entire door for spaceport development and a boom in space projects" [12, p. 58]. Without their own active space shuttle, the United States relied on the Russian Soyuz to take them to the ISS until the United States developed a new way to take its own astronauts to the ISS [12, p. 27].

After these events, Barack Obama canceled the Constellation Program started by George W. Bush and moved all the funds to support the deep space capsule called Orion and the Ares rocket [13]. The space capsule Orion and the Ares rocket would be used to leave earth's orbit to return to the moon. Following the lack of leadership and continued reliance on the Soyuz, there was a need for a new competitor to further expand space flight development. In 2014, there was a major push by NASA to increase commercial spaceflight and awarded SpaceX and Boeing billions of dollars to develop their own space capsules to LEO [14]. Elon Musk, the founder of SpaceX, has been a major leader in pushing the limits of space exploration and has successfully made reusable rockets to decrease the cost of sending payloads to space.

Although SpaceX and many other private companies are introducing new ways to travel in space, we still have yet to combat the effects of long-duration spaceflight on the human body. To date, humans

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have conducted constant research in the ISS to further understand the effects of weightlessness and find solutions. In 2015, Scott Kelly and Mikhail Kornienko were one of the first people to complete a one-year mission in the ISS, implying that more extended missions will take place in the future.

B. The reason for NASA's Failure to go to Mars

In Robert Zubrin's book, *Mars Direct*, he criticizes the path NASA took after the Apollo Era, which began in 1961 and ended in 1973 [2, p. 47]. During the Apollo Era, NASA was focused on reaching the moon and many projects were successful, such as the Apollo space program and the first U.S. space station Skylab [2, p. 50]. After 1974, NASA altered their resources to accommodate the new Shuttle Era, which was focused on improving technology for future space missions [2, p. 47]. However, Zubrin points out that instead of making focused technological improvements, scientists wanted to push their favorite technologies without a strategic purpose [2, p. 48]. Zubrin states:

> To make this distinction completely clear, a metaphor may be useful. Imagine two couples, each planning to build their own house. The first couple decides what kind of house they want, hires an architect to design it in detail, and then acquires the appropriate materials to build it. That is the Apollo Mode. The second polls their neighbors each month for different spare house-parts they would like to sell, and buys them all, hoping eventually to accumulate enough stuff to build the house. When their relative inquire as to why they are accumulating so much junk, they hire an architect to compose a house design that employs all the knickknacks they have purchased. The house is never built, but an excuse is generated to justify each purchase, thereby avoiding embarrassment. That is the Shuttle Mode. [2, pp. 48-49]

Here, Zubrin uses a metaphor describing NASA in two time eras where one was focused and driven while the other half was disorganized and lacking a clear direction. Throughout history, we can infer that each United States president had a different agenda and chose to remove

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funding or cut ongoing projects that delayed any real progress to return to the moon or go to Mars.

In 2001, the NASA Administrator, Sean O'Keefe, was not focused on a destination outside of Earth [2, p. 52]. After the 2003 Columbia Disaster, O'Keefe was prompted to cancel future space missions, including one that was meant to repair the Hubble Space Telescope [2, p. 71]. To prevent another space shuttle tragedy, O'Keefe was willing to sacrifice an extraordinary piece of equipment that was important to understanding the universe. Zubrin ends with, "Leadership is required – and for the last four decades, there has been almost none" [2, p. 53]. The Challenger and Columbia disasters were unfortunate in the history of NASA but these challenges are unknown and have always been risky. To continue making progress in unknown territories, risk should not be the stopping factor.

C. Why Mars?

In order to have a settlement and a thriving society, certain requirements are necessary, such as food, fuel and raw materials to build a colony. Growing food is important because it has the potential to reduce the cost of sending supplies to future inhabitants in different planets. Using artificial light to grow crops is economically unfavorable because generating enough sunlight to power a football size of plants requires four thousand kilowatts [1, p. 237]. Zubrin points out that solar and wind power are unable to generate the power necessary to grow crops because at best, only hundreds of kilowatts could be produced [1, p. 237]. If these methods can only generate a limited supply of power, then it would be difficult to grow food for a space colony.

One proposed solution is creating a colony on the moon. Although there have been numerous proposals for this solution due to its proximity to Earth, placing a colony on the moon has significant disadvantages. One factor that makes the moon unattractive is that it has different phase changes; this makes it difficult for plants to grow there [1, p. 211]. It is difficult for plants to grow because there is a constant change in light that is not healthy. The added difficulty is that artificial light to grow plants would not be able to sustain a large colony. The idea of having a colony on the moon is difficult and can cost more money to send supplies. Also,

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since the moon does not have an atmosphere to defend itself from solar flares, it requires a thick shield to protect the plants from radiation [1, p. 237-238]. Having a thick wall would shield the plants from cosmic radiation except it would complicate the mission and add more weight to existing spacecraft, making it costly to implement.

In contrast to the moon and the other eight planets in our solar system, Mars is the only one that has the capacity to harbor and sustain life. Mars resembles Earth because it has a thin atmosphere and has an abundance of raw materials that could be used to build a future colony [1, p.211, 236]. Mars also contains precious metals that were made from its past volcanic activity [1, p. 236]. Since Mars has a thin atmosphere, it is able to block solar flares, allowing plants to grow without a thick shield on its greenhouse [1, p. 238]. Mars has a perfect environment for human survival because it can shield humans from radiation and the raw materials could be used to build a new habitat. A possibility in the future is sending robots to Mars to construct the shelter and by the time humans arrive everything will be ready to be used. The cost would decrease and the new base would not rely on Earth for supplies. Zubrin argues that Mars also has all the building blocks to sustain life and has an abundance of hydrogen, nitrogen, carbon and oxygen [1, p. 236]. These important elements could be used to refuel a spacecraft stationed in Mars and launch itself out after the mission is complete. Water is another important resource that has been found on Mars (frozen) and can be extracted [1, p. 236]. To have a sustainable colony, power is also another important consideration. It is gained by harnessing geothermal energy though deuterium [1, p. 237]. What makes deuterium important on Mars is that it is five times more likely to be found there in comparison to Earth, and it can produce 10,000 kilowatts for power [1, p. 237]. Accessing this large amount of energy could open doors to power more tools or vehicles. This is important because solar and wind power cannot generate enough power to grow plants; therefore, another source of power is needed.

Zubrin stresses the importance of living off the land on Mars [2, p. 15]. Because Mars is the only planet that can sustain human life outside of Earth and has all the necessary building blocks to sustain a colony, this would save money in the long run because there would be fewer resupply

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missions needed to bring food and supplies when the inhabitants could use their surroundings to build a new base.

II. Effects of weightlessness

Astronauts in the ISS do not feel earth's gravitational force acting on them since they are on constant freefall orbiting around Earth. Since no force is acting on them, they are under the effects of microgravity. Similarly, when Astronauts leave LEO to the Moon or Mars they experience the same effects of weightlessness. The human body on earth has adapted to the constant gravitational force pulling them down but when gravity is removed the body reacts negatively.

This research was undertaken because longer space missions are going to be required in the future and current space medicine research is limited. In Gilles Clément's book, *Artificial Gravity*, he details the history of space medicine and conveys that research is limited to only six months of travel in space; little is known after the one-year mark [3, p. 25]. According to Clément, the ideal space mission will take two and half years with a maximum surface stay on Mars of a year and a half [3, p. 6]. Another option to travel to Mars is an opposition class mission because it reduces the mission time by half but also reduces the surface stay on Mars by thirty to ninety days [3, p. 6]. Zubrin criticizes opposition class missions because it limits the amount of research that could be done on the surface of Mars [1, p. 94]. Zubrin states that if mission planners reduce the time, it is also actively hurting the crew because they would be consistently exposed to radiation and microgravity [1, p. 93]. Although Mars is not Earth's twin, it is still able to reduce radiation and microgravity exposure which can help a long-term mission be successful. Crafting giant spaceships and developing propulsion systems is an important engineering problem, but we have overlooked the factors of human challenges that have not changed over the past forty-seven years.

Louis Friedman discusses that human spaceflight ends on Mars because robotic technology has surpassed humans and continues to evolve further [10, p. 4]. Robots will replace humans in deep space missions, and virtual reality will take its place because human adaptation in space has not changed [10, pp. 7-9]. Significant microgravity effects are plaguing human exploration. Although radiation is another factor that poses a

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substantial problem for human safety during spaceflight, this research will focus on the significant effects of microgravity which include bone loss, muscle loss, cardiovascular, and sensory-motor deconditioning.

A. Bone loss

With the absence of gravity in space, there is no constant force acting on the bones, which affects their strength. Bone loss is important because according to Clément, "40% decrease in bone mass might occur for a spaceflight lasting two years" [3, p. 8]. A six-month journey to Mars would be dangerous because the astronaut would not be in their top physical condition, like they would be on Earth. If the future of human spaceflight requires missions longer than six months, there could also be an increased risk of bone fractures [3, p. 8]. Possibilities of fracturing bones could occur during a reentry back to earth or an accidental fall. They will not have the same strength they had before they left earth due to being in space for a long time. There will also be a limited amount of surgical devices that would be taken and the added difficulty is that the blood will not behave the same way outside of a 1g environment. Another challenge is that not enough is known if the 0.38g Mars environment will be strong enough to halt further bone loss, decreasing the health of the astronaut's bones [3, p. 8]. Bone loss is challenging to treat because there are no known solutions [3, p. 8]. Simply taking calcium will not prevent the effects.

B. Muscle loss

Since there is no acting force on the human body in space, the muscles are also affected. The main way an astronaut moves around the ISS is by using fingertips, which decreases the number of times they use their legs [3, p. 15]. As the muscles become weaker, the fibers within the muscles change [3, p. 9]. There are slow and fast fibers within the muscles [3, p. 9]. Slow fibers are resistant against gravity and fast fibers are used with vigorous movement [3, p. 9]. According to Clément, "Studies reveal that about 15-20% of the slow fibers in a tight muscle convert to fast fibers during a 14-day spaceflight" [3, p. 9]. With a progressive increase of fast fibers in space, it also increases the probability of injury [3, p. 9]. When

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astronauts return to Earth, the change in gravity weakens their muscles, making it difficult for them to move due to the fatigue [3, p. 9].

In a hypothetical, worst-case scenario, Dana Carpenter and his team explored what would happen to the human body during a two-year mission to Mars without exercise. The result of their research was surprising; they found loss in knee strength by 15% on a six-month mission to Mars, 18% in the 18 months on the surface of Mars, and an additional 15% loss on a 6 month trip back home [4]. The total muscle strength loss in the knee and ankle would be 48% and 32% [4]. The amount of damage raises concerns because astronauts coming back home could develop permanent damage. Also, the surface of Mars may not be safe for a permanent colony because humans would slowly lose their strength with Mars's 0.38g environment.

C. Cardiovascular deconditioning

Cardiovascular deconditioning is fluid shifting through the human body [3, p. 11]. On Earth, the heart pumps fluids and blood throughout the body, but in space, those fluids travel to the head and chest due to the microgravity [3, p. 11]. This can cause a higher heart rate and a sensation of fullness in the head [3, p. 11]. These effects are dangerous because astronauts returning from a mission or arriving on Mars can experience lightheadedness and fainting [3, p. 11]. This is a huge problem for astronauts because as they arrive on Mars, they will not able to move until they can adapt to Mars's environment. Additionally, we are also unaware of the damage their bodies will sustain for a full two and a half year mission and the amount of time needed to recover. The 0.38g environment that Mars has is different from Earth and this can prove to be a problem.

D. Sensory-motor deconditioning

Sensory-motor deconditioning in space motion sickness because the body is confused in the direction it is moving [3, p. 12]. Generally, it usually takes a few days for a person to adapt [3, p. 13]. A drug known as antihistamine promethazine is used to reduce the effect of motion sickness but there are negative side effects that come with it [3, p. 19]. After arriving back to earth, astronauts need time to recover because they are not able to walk due to loss of coordination [3, p. 13]. As stated by Clément,

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"After flights lasting six months or more, some crewmembers must be physically removed from the vehicle on lifters" [3, p. 13]. An extended time in space can make it difficult for Astronauts to walk and assistance will be needed to pick them up after they arrive. Unfortunately, when they arrive on Mars, there will not be assistance and they would have to rely on their own strength and teamwork.

In 2003, a Soyuz capsule did not land in the anticipated landing point, so the crew had to manually fix the antenna to update their location and get rescued [3, p.17]. Before leaving Earth, this assignment took them minutes; however, after they arrived back on Earth, it took them hours to accomplish [3, p.17]. This could be a scenario if humans arrived on Mars in a weakened state from weightlessness. The plan for Mars is unknown because we do not know if 0.38g is sufficient to stop the effects of bone and muscle loss.

III. Solutions to weightlessness in deep space

In order to address a problem, we have to identify and analyze the issues to take the necessary steps to fix them. Zubrin states, "The point, however, is that an awful lot of research has already been done in this area, and we know what the effects are" [1, p. 134]. Hall makes a similar statement that instead focusing on the individual symptoms the root cause should be solved [14]. Zubrin makes another good argument that studying the effects of microgravity too long can potentially delay the continuation of trying to find solutions [1, p. 134]. Hall and Zubrin are effectively saying that focusing on the problem will not fix it and without seeking a permanent solution, there will not be progress. A significant amount of research has been conducted in the ISS to study the effects of weightlessness, but there has not be a breakthrough to find solutions. Zubrin has not been satisfied with the course NASA has taken because they are not undertaking efforts to go to Mars but have spent a lot time learning about the problems. A larger effort should be made to find possible solutions to the effects of microgravity on the human body; if one focuses too much on the problem after the solution is found, it renders all previous research on the effects insignificant.

Currently, there are few possible solutions that can reduce the effects of microgravity on the human body. Hall says [14], "Current

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countermeasures to musculoskeletal degeneration and other ailments, that rely on diet and medication, are essentially chemotherapies that address only individual symptoms of weightlessness, not the root cause, and run the risk of unintended consequences." Hall gives an example of consuming calcium can lead to urinary stones [14]. By trying to fix one problem, another one can arise. Astronauts in the ISS reduce the effects of muscle loss by doing isotonic and isometrics exercises [3, p. 10]. Isotonic exercises depend on intense movements where weight lifting is involved, and isometric exercises involve pushing against surfaces [3, p. 10]. Exercise with rapid movement like cardio is used to reduce the effects of cardiovascular deconditioning [3, p. 9]. Anti-gravity suits compress the lower part of the body to force fluids to the upper part of the body, which helps the heart circulate the blood more efficiently [3, p. 20].

When astronauts return to Earth from the ISS, there is a rapid reduction of fluids, so they ingest water and salt tablets to reduce these effects. However, this effectiveness is reduced the longer they remain in space [3, p. 20]. When astronauts come back to Earth, they oftentimes have a loss of coordination. The only solution is to reintegrate them back into a 1g environment [3, p. 13]. The difficulty with this is that the 0.38g of the Mars's environment might take longer for them to recover from, or it will continue to pose a problem on their bodies. In the past, exercise has been the main solution to reduce bone and muscle loss in space, but it is not a permanent solution for missions that last longer than six months in space.

Hall makes a strong argument for when NASA will make a serious attempt to develop artificial gravity [15]. Will there be another disaster like challenger to finally consider artificial gravity as the best solution for long distance space flight [15]? There are solutions that are applicable in theory but without proper funding and support, they will not see the light of day.

A. Nuclear Thermal Propulsion

One solution to reduce the effects of microgravity on the human body is minimizing the time astronauts are exposed to microgravity. Chemical rockets have been used throughout human history, but an alternative approach is to use Nuclear Thermal Rockets (NTR). Rocket

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efficiency is based on seconds of specific impulse, meaning the amount in seconds that 1 pound of propellant gives of 1 pound of thrust. Nuclear rockets can produce a specific impulse of 900 seconds compared to chemical rockets that produce a specific impulse of 450 seconds [1, p.114]. According to Robbins, using a nuclear solid core reactor would save 100-days round trip instead of a conventional chemical propulsion system [5]. Instead of taking eight months to reach Mars, there would be reduction to six months that could be beneficial in reducing the adverse effects of microgravity.

To test the theory and make it practical the U.S. undertook a project called the Nuclear Engine for Rocket Vehicle Applications (NERVA) to test the efficiency of nuclear rockets. A fission reaction is when a neutron is absorbed by an isotope—like Uranium 235—and splits the nucleus, releasing more neutrons [6]. NERVA uses fission as its primary source of generating heat by using a continuous chain reaction inside its solid core reactor [6]. To control the chain reaction within the reactor, a moderator is used to reduce the speed of the neutrons and stop the fission reaction [7]. The preferred propellant is hydrogen because of its lightweight properties [6]. As the hydrogen passes through the solid core reactor, it gets heated and expels itself though the nozzle, pushing the vehicle into space [6].

These concepts for nuclear rockets are not mere science fiction; and they were attempted with great results. For example, Zubrin states that, "These engines really worked, and really delivered specific impulses of over 800 seconds, far beyond the wildest dreams of any chemical rocket engineer" [1, p.115]. Although great progress was being made, the NERVA project was terminated due to budget cuts by the Nixon Administration [1, p.115].

B. Linear acceleration

Another likely solution is to create artificial gravity. Artificial gravity is the sensation that mimics Earth's' gravitational force and has the potential to remove the effects of weightlessness. One way to make artificial gravity is through linear acceleration. When astronauts are launched from a space shuttle they experience a few seconds of an opposite force pushing in the opposite direction they are facing [3, p. 35].

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This method of transportation could be used to have a 1g force similar to that of gravity by pushing a rocket with a constant speed [3, p. 35]. This method sounds simple but it is costly because of the fuel requirement needed to have a constant speed [3, p. 35]. Hall also discusses the disadvantage of linear acceleration because it would require a constant energy input [14]. Linear acceleration is a solution to eradicate the effects of weightlessness but has shown to be costly.

C. Centripetal acceleration

The most popular method to develop artificial gravity is through centripetal acceleration. Figure 1 is an example of centripetal acceleration by having particle rotate around the center with the acceleration pointing inward and always being perpendicular to velocity.
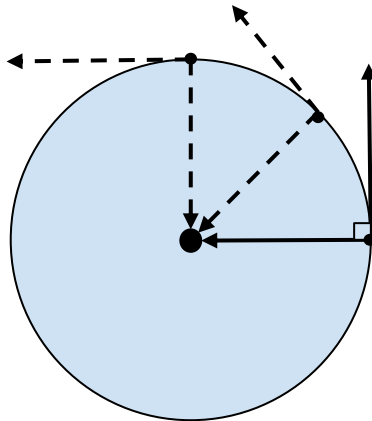
Figure 1: Visual representation of the centripetal acceleration

Centripetal acceleration happens in our daily lives; for example, when a bucket of water is circulated in a circle with a constant speed [1, p. 135]. The water within does not fall because it is being pushed outside at a constant rate [1, p. 135]. Two methods to use centripetal acceleration in space is by revolving the spacecraft or making a centrifuge inside of the spacecraft [3, pp. 33-34]. Essentially the big goal will be to have humans inside a rotating centrifuge to feel a sense of a 1g environment. The difficulty with this idea is the size of the centrifuges. This leads to

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Equation 1 which is a force equal to mass times its radius and angular velocity squared.

$$F = m * \omega^2 * r \qquad (1)$$

If you have a small radius in the centrifuge, you will have to rotate it quicker to make a gravity force adequate for the astronaut to counter the effects of microgravity. Another option is to have a large radius with slower rotation in order for it to have the same effects as a small radius. The difficulty with a small radius is that the spin rate could harm the human inside and the large radius is complicated to implement. Hall has compiled the research of multiple scientists and found that humans can sustain two revolutions per minute to the limit of six revolutions per minute [14]. Anything beyond six revolutions per minute was uncomfortable to astronauts and made their task difficult to complete [14]. Zubrin also explains that if there is a faster rotation, it produces a Coriolis force which makes it difficult for the astronauts to walk in a straight line when the habitat is constantly moving. Hall expresses that [14] ,"On the Soviet satellite Cosmos 936 in 1977, the lifespan of rats exposed to centrifugation during 18.5 days of space flight was significantly greater than that of non-centrifuged control animals." The research that has been done in centripetal acceleration has been positive and tests have proved that artificial gravity is a permanent solution against microgravity. Even though this is the best solution, Clément also points out gaps that still need to be researched that include: rotation speed, length of exposure, Coriolis and the 0.38g Mars effects on the human body, and if the research done on earth will be the same in space [15].

IV. Conclusion and Discussions

The U.S. has proven to be a world leader in space exploration and NASA has been on the forefront to solve the challenges we have to bring humans back to the Moon and travel to Mars. However, everyone has continued to ask the same question - when will we go to Mars? And why haven't we returned to the Moon? It has been 47 years since the U.S. left LEO or made any real plans to make another trip like the Apollo Space Program. There have also been inconsistencies with each president

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pushing a different agenda and cutting funds from NASA expecting a larger outcome. Every time they get defunded, it makes it difficult for the organization to execute plans and delays their projects. For example, when the Richard Nixon Administration cut the funds from NASA they had to retire the Saturn V rocket that took humans to the Moon. Without any real vehicle that could return to the Moon, the Apollo Era ended and there has not been a real push since then. Even though NASA has taken a detour and made the best with existing funding, private companies have started to move in and prioritize space flight. Commercial spaceflight is the future of the U.S. and will be a key player for humans to go to Mars in the future.

Commercial spaceflight has been pushing the boundaries in reusable rockets and Elon Musk has energized the movement of making humans interplanetary species. The push for Mars is getting the U.S. exhilarated but there are many problems that have to be addressed before taking flight. A large amount of progress has been made in improving spacecraft development, but microgravity continues to be a substantial problem for human survival due to the deteriorating effects it has on the human body. There is a significant amount of bone and muscle loss on missions to Mars that increases the chance of an accidental bone fracture. Astronauts will not have the same medical equipment we have here on Earth, complicating the mission even further. After a six-month journey to Mars, astronauts will not have someone to take care of them to recover from their journey. There is also the ambiguity of the length of time it will take to recover from an environment that has 38% of Earth's gravity. They will be facing multiple challenges on their own without the assistance and tools they have on Earth.

Will humans be ready for a voyage to Mars in this decade? The current answer to this question is, "no." A Mars mission will require three years and the effects of weightlessness is catastrophic in the human body. The current solution to fight these effects has been traditionally exercising on the ISS but if longer missions are going to take place there needs to be a permanent solution. NASA has been trying to treat the symptoms of weightlessness individually when there is an obvious solution that can solve everything. The best method that needs to be taken more seriously is having centripetal acceleration on a spacecraft. Movies like the *Martian* offer the idea of having a rotating part of the spaceship to have a 1g

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environment while traveling. This could potentially remove all the effects that come from bone and muscle loss and eliminate sensory motor deconditioning. A centrifuge could be made for the whole spacecraft or shorter to have a small one inside the spacecraft. The idea would be to expose the astronauts to artificial gravity through centripetal acceleration.

V. Future Research

This report was meant to serve as a building block for a more advanced research project to find out if we can travel to Mars and find solutions to combat the effects of microgravity. The longer humans are in space, the more negative side effects will occur, mainly, microgravity weakening their muscles and bones.

My analysis of historical and contemporary research on long-distance spaceflight has shown the best approach to reduce the effects of microgravity will be to develop artificial gravity through centripetal acceleration. The next step is to dig deeper into centripetal acceleration and understand the engineering and design challenges it has to make it more feasible to implement in space. As Clément explains, we still do not know the health effects of different rotation speeds in the centrifuge and the time length of exposure recommended [15]. A future research project can thoroughly investigate who is continuing this research and if there are alternative ways to implement artificial gravity.

Another idea for future research is to explore exoskeleton research and how they can be used on missions to Mars. An exoskeleton would encompass the whole body and it will be an extra set of strength to keep them safe. Astronauts arriving on Mars will have a weak immune system and their bodies will require time to adapt to the new environment. The effects of microgravity would be recent and their poor balance can increase an accident of falling and injuring themselves. They will have to face the new environment on their own without the assistance they receive from Earth. An exoskeleton will help them reduce the stress on their body until they can recover. Exoskeletons are an emerging field in science and using them for space exploration could be a beneficial step for the first mission to Mars.

Additional research for the future is to explore how clothes could evolve to counteract muscle loss. The clothes will be meant for the

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purposes in the ISS because Astronauts are not using their muscles due to weightlessness. Astronauts have traditionally used comfortable clothes like shorts and shirts to move around but this could be an opportunity to develop clothing to grip the body and any movement they do would make them work. This idea needs to be further looked into but there is potential to use every moment they are on the ISS to reduce muscle loss.

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English Language Minority Students and Education Policy: A Focus on the Latinx Population

Biography

Born in Aguascalientes, Aguascalientes and raised in Encarnacion de Diaz, Jalisco, Ángeles came to the U.S. when she was sixteen years old, Ángeles is a senior at San José State University; after graduation, she plans to obtain her master's and Ph.D. in education policy and become a Latinx political advocator and a faculty member in a higher education setting. Ángeles' research interests include (but are not limited to) Latinx immigrant students, Latinx education policy, language minorities in U.S. secondary schools, and the power dynamics within the Education System in our country. She also wishes to examine district, state level, local, and federal funding as factors in the academic success of underrepresented students. Ángeles hopes to promote the representation of Latinx individuals in higher education, as well as bring more equity, fairness, and cultural capital to the different policies for Latinx students across the nation.

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English Language Minority Students and Education Policy: A Focus on the Latinx Population

Abstract

Our federal government allows states to pass and ratify new laws every year. Over the last thirty years, America has experienced a polarized fight over the expansion or reduction of government involvement. In terms of education policy, local districts and governments can play an essential role in the implementation, evaluation, and development of equitable educational opportunities. This paper examines federal and state level policies in the context of English Language Learners' (EL) educational opportunities. In particular, I focus on Mt. Diablo High School, which is located in the Mount Diablo District. According to the California State Department of Education, the percentage of English Language Learners at this school is 33.5%. Out of this percentage, a majority of English Language Learner students at Mt. Diablo High School are Latinx (84.98%). These statistics help to demonstrate that state and district level policies lack inclusivity, student awareness on academic resources, accessibility to career center programs, and a lack of parent and teacher participation. Due to these shortcomings, these policies primarily feed into the undereducation and retention of EL students. By analyzing existing Student Site Council meetings and state-level data sets, I argue that there is a higher need for accountability and support relative to the number of EL students attending Mt. Diablo High School.

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Introduction

During 2013-2014, unaccompanied child migration from Central America to the U.S. reached its peak. According to the article, "As immigration resurges, U.S. public schools help children find their footing" published by the Washington Post in 2016, the influx of immigrant children to our public schools has been a challenge—not only for these newcomers, but also for the teachers, staff, parents, and policymakers. However, as many are aware, migration is not a new topic in this country; in 1965, when The Immigration and Naturalization Act abolished some of the xenophobic quotas in previous times, the demographics of the U.S. significantly changed. Today, one in four children in the U.S. are the children of immigrants (Gandara, 2018).

The United States Department of Education faces the great responsibility of educating every child in this nation. One of the programs that attempts to accommodate newcomers into public schools is the English Learner Development program. According to Laura Hill, a researcher at the Institute of Public Policy in California, the number of EL students in the California education system is around 1.3 million. Any student who enrolls in K-12 education in California and speaks a language other than English is automatically considered and classified as an English Learner student—a status that is meant to be temporary. (Hill, 2018)

The current population of EL students in California public schools is large and diverse. Most EL students are born and raised in the United States; nevertheless, if we compare immigrant EL students to EL students born in the States, there is a significant difference between both groups. For example, EL students who, for different reasons, spend more time classified as EL students (more than 3 years) seem to "get stuck" in the system and are less likely to be reclassified as "fluent." This has been an issue for many districts and state policymakers since the English Learner Development program started. Today, the student population of "ever ELs" has grown to 38 percent in all K-12 institutions in the state of California (Hill, 2018).

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Background and Research on undereducated Immigrant Latinx Students

Pedro R. Portes and Spencer Salas (2014) have an extensive history as researchers in writing and analyzing education policy. In the book, *U.S. Latinos and Education Policy, Research Based Directions for Change*, Portes and Salas raise two important and relevant ideas for this research: 1) despite the multiple reforms that aim to support and increase equal opportunities for quality education for all students, most low-income children (especially from Spanish speaking families) are still undereducated and 2) the fact that "schools remain politically structured to educate and graduate most students subject to group-base inequality below grade level and to house most until they, as a whole, populate the "nation's underclass" (p.3). The first idea supports the argument that there is a need for government funds to repair the gap of success that affects Latinx English Learner students in California. The second factor emphasizes the need for accountability and scrutiny towards these politically-structured institutions. In order to address Portes and Salas' ideas, their research asks: why can't the United States, especially the education system, after decades, organize a better system that effectively and systematically reduces group-based inequality in education outcomes?

Using the term, "undereducation" Portes and Salas explain that this change can occur by "design[ing] a dialectical program" (p.4). This program should be developed and organized by the dominant group and its leadership, whose job is to implement, write, and advocate for policies that maintain the pipeline of undereducated Latinx students in the United States. While Portes and Salas do an excellent job dismantling, explaining, and outlining how policymakers from local to national levels might understand and apply policies for the benefit (or to the detriment) of undereducated children, they do not acknowledge the sources of income for public schools or who controls them. Rather, their intent is to call for politicians, policymakers, and the government to bypass the local level and argue for the need of "scholarship and research to translate how understandings generated therein might be realized at a macrolevel – over the sustained K-12 experiences of Latino children" (p.5). In light of Portes and Salas' intent, this research will help to address how policymakers interpret and write policies for Latinx students.

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Laura Hill (2018) explains the recent reforms made to address the English Learner Achievement Gap. According to Hill, these new reforms aim to alter how California "funds, educates, assesses and holds districts accountable for EL students" (Hill, 2018). The purpose of Hill's article is to examine the facts on English Language Learners academic performance, the assessments and standards that these students are required to meet for their reclassification, and The Local Control Funding Formula to fund these programs. According to Hill, "40 percent of students in California speak a language other than English at home" (Hill, 2018). During the 2016-2017 academic year, more than 1.3 million students were English Learners; out of this number, 83 percent spoke Spanish.

Rebecca M. Callahan and Dara Shifrer's (2016) recent study on English Language Learners further examines the concept of undereducated minorities that Portes and Salas (2014) presented in their study of Latinx students. In their study, Callahan and Shifrer had the task of looking at English Learners' academic exposure in secondary schools. Education policies for English Learner students are meant to fulfil the "linguistic and academic development" of students "without furthering inequity or segregation" (Callahan & Shifrer, 2016). However, despite the policies' purpose, Callahan and Shifrer found that EL students in secondary schools are still "experiencing significantly less academic exposure" and therefore feeding into the undereducated class of Latinxs in public schools (Callahan & Shifrer, 2016).

Their research looks at the courses that EL students have taken during high school as "evidence of academic equity in access and English Learner program effectiveness" (Callahan & Shifrer, 2016). The researchers detail the challenges that many English Learner students face in order to succeed and attain basic knowledge and skills to fulfill high school requirements. The following are the two main challenges that researchers found. 1) The flexibility and authority that Local Education Agencies (LEAs) have to address the needs of their specific population of English Learner students and 2) the "so-called" "Equity Trap" which, according to Callahan and Shifrer, "occurs when teachers develop a false sense of assurance that validates" English Learner students' "low academic expectations based on their proficiency in English" (Callahan &

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Shifrer, 2016). In other words, due to the focus on helping English Learner students understand and speak English, when teachers see that a student is succeeding—even by a small amount—they feel that their job is done. As a result, this feeds into the undereducation of EL students by reinforcing the concept of not asking them to do too much, just what they can manage. This "pobrecito syndrome" makes an educator a sympathizer instead of an emphasizer, thereby making them expect less from EL students in comparison to their peers (Callahan & Shifrer, 2016).

Historically, there are "existing racial and socioeconomic disparities in course taking and achievement" (Callahan & Shifrer, 2016) that impact EL students' opportunities to an equal education. The results of Callahan and Shifrer's study show a significant difference between Native English, Language Minorities, and English Learners, showing that only 11% of English Learners completed all the courses for college readiness preparation compared to 31% for Language Minorities and 38% for Native Speakers (Callahan & Shifrer, 2016). Therefore, their study shows that, despite the existing policies that have been implemented in order to help English Language Learners, they still have unequal access to academic access.

To further address this issue, my research will historicize the laws which relate to the English Learner population. In particular we will describe each law and how the policy tries to or address issues of inclusivity, equity and access to an equal and fair education. These policies are: The Elementary and Secondary Education Act Title VII and the 1994 reform, Equal Educational Opportunities Act (EEOA) of 1974, and No Child Left Behind (NCLB) in 2001. In general, these policies and Acts are federal programs that ensure all children have a fair, equal, and significant opportunity to obtain a high-quality education and reach—at a minimum—a proficiency in challenging state academic achievement standards and state academic assessments, especially for English Learners and low-income students.

Federal Law and Policy Impacting English Language Minority Students

In order to better understand the development of Federal and State policies that impact language minority students, it is important to examine

the historical development of different policies. In particular, I will examine the policies and decisions that have influenced the educational policies implemented for English Language Learner students after the 1954 case, *Brown v. Board of Education*. Specifically, I will look at The Elementary and Secondary Education Act, Title VII and the 1994 reform, EEOA in 1974, and NCLB in 2001.

   Brown v. Board of Education of Topeka, Kansas (1954) is the starting point for a number of changes to increase equity for all students within the classroom. The court's decision not only affected the lives of African Americans in the education system; it also opened the door for the inclusion of other minority groups such as the Latinx student population. (Contreras & Valverde, 1994). Prior to *Brown v. Board of Education*, the legal segregation of African Americans and Latinx students was present in school systems. In terms of Latinx students, schools could legally refuse their entry into the classroom based on their "Spanish-like-surname" and their "language deficiency" and instead send them to "Mexican Schools" (Contreras & Valverde, 1994, Ferri., & Connor, 2005).

   Despite the revolutionary impact that *Brown v. Board of Education* had on the enforcement of equal opportunities for all students notwithstanding their race or color, the fight did not cease. This caused an increase in court cases from different schools, districts, and states in order to fight against the unfair and unequal treatment of students of color. Court cases like those in California (*Romero v. Weakley*, 1955), Colorado (*Keyes v. School District No. 1*, 1973), and Texas (*Cisneros v. Corpus Christi Independent School*, 1970, *United States v. Texas Education Agency*, 1972, and *Morales v. Shannon*, 1975) were important in the constant fight for equal opportunities in education—particularly for English Language Learner students and the policies implemented to assist them (Contreras & Valverde, 1994).

   It was not until April 9, 1965 that President Lyndon B. Johnson signed into law the Elementary and Secondary Education Act (ESEA) for the purpose of bringing "equal access to quality of education" (Jefferey, 1978). Three years later, in 1968, Johnson signed into law Title VII of the ESEA. Title VII was primarily meant to address the lack of English language skills among low-income minority children. This new law also became known as "The Bilingual Education Act," which gave monetary

funds "to support educational programs and develop necessary instructional resources" (U.S. Dep. Of Justice, Types of Educational Opportunities Discrimination). The Bilingual Education Act acknowledged the existence of "unique educational disadvantages faced by non-English speaking students" and began to build awareness for the right to an education among EL students. Nevertheless, the educational opportunities for EL students have not been equal to that of non-EL students (Contreras, A., & Valverde, L. 1994). The ESEA is particularly important in the continuation of monetary disbursement for different minority groups, including English Language Learners students. Financial resources have been in place since the Act was passed into law; however, the constant struggle of a lack accountability for resources, as well as the academic outcomes of the EL population has always been a controversial topic for state, district, and federal legislators and researchers. (Glavin, 2016)

In order to fight the discrimination and unequal treatment of minority groups, the U.S. Department of Justice, under the Civil Rights Division, passed into law The Equal Educational Opportunities Act (EEOA) of 1974. The purpose of this federal law was to "enforce civil rights laws that prohibit the discrimination on the basis of race, color, national origin, language, sex, religion, and disability in public schools and institutions of higher learning" (U.S. Dep. Of Justice, Types of Educational Opportunities Discrimination). After many court cases and different accounts of discrimination, especially for language minority groups, section 1703(f) was added. Section 1703(f) requires State Educational Agencies (SEAs) and school districts to take action in order to dismantle language discrimination barriers and the impediment of an equal education for English Language Learners. Section 1703(f) is also responsible for investigating complaints on SEAs and school districts that do not provide adequate services to English Learner Students. It is worth noting that this Section does not mandate every school to adapt or implement any kind of language acquisition program. Despite the fact that there is flexibility for schools, districts, and states to implement their own "acquisition language programs," the courts have three criteria when it comes to assessing what an "adequate" program must have:

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1. Whether the school's program is based upon sound educational theory or principles;
2. Whether the school's program is reasonably calculated to implement the educational theory effectively; and
3. Whether after a period of time, the results of the program show that language barriers are actually being overcome.

Aside from these three factors, Section 1703(f) also provides examples of conditions which may contradict with the EEOA's "equal and fair opportunity mission" (U.S Dep. Of Education, Developing Programs for English Language Learners: Services). Should a district have any of these conditions, they may be violating the law:

1. Fails to provide a language acquisition program or adequate language services to its English Learners;
2. Fails to provide resources to implement its language acquisition program effectively;
3. Fails to take steps to identify students who are not proficient in English;
4. Funnels out EL students before they acquire English proficiency from EL services;
5. Fails to meaningfully communicate with non-English-speaking or limited-English-speaking parents and guardians about EL with written or oral translations of important notices or documents;
6. Fails to provide language acquisition assistance to EL students because they receive special education services, or fails to provide special education services to EL students when they qualify for these services; and
7. Excludes ELL students from gifted and talented programs based on their limited English proficiency.

The expanded power and authority that states and districts had over the success of the English Language Learner population was granted by the Every Student Success Act (ESSA) in 2015. This Act is the latest reauthorization of the Elementary and Secondary Education Act of 1965.

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After 2001, No Child Left Behind (NCLB) was replaced by the ESSA due to its multiple failures, punitive policies, and its increasing tests on the education system. Under NCLB, there was a mandated set of rules for accountability and standards with little flexibility for the diverse population of students in the U.S. The same approach was implemented in every school across the nation, and the only way for a school to ensure that it was "up to standards" was by devoting most of its time to teaching children how to pass the standardized test instead providing a quality education. This approach was primarily seen in "failing schools," where there was a higher population of Latinx, Black, and English Language Learner Students.

The Every Student Success Act aims to solve the various issues that the NCLB brought to the U.S. education system. ESSA provides the flexibility that schools and districts require in order to meet a student's needs for academic growth. The ESSA includes provisions which help to ensure that every student succeeds. A number of these provisions differ from the NCLB's in relation to English Language Learners; they:

- Advance equity by upholding critical protections for America's disadvantaged and high-need students;
- Require—for the first time—that all students in America be taught under high academic standards that will prepare them for success in college and future careers;
- Ensure that vital information is provided to educators, families, students, and communities through annual statewide assessments that measure students' progress by these standards, and;
- Maintain an expectation that there will be accountability and action taken to enact positive change in America's lowest-performing schools, where groups of students are not making progress, and where graduation rates are low over extended periods of time.

Mt. Diablo High School

Mt. Diablo High School is located in Contra Costa County. It is one of five high schools in the Mt. Diablo Unified District, as well as the oldest. At MDHS, there are five academies, four of which are career-themed California Partnership Academies, where the students "receive cross-curricular instruction that aims to increase the relevance and depth

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of learning in traditional core academic subjects." (WASC Mid-cycle Progress Report, 2018), For my research, I am interested in The "World Academy" population. The World Academy serves students who have just arrived in the U.S. by providing them with access to unique programs which help to accelerate the acquisition of English language skills. It is necessary to point out that the World Academy is also home to students with disabilities and or mental health conditions (WASC Mid-cycle Progress Report, 2018), making them a higher risk population.

Demographics of ELD students

The combined student population of re-designated, fluent English Language Learners, new student arrivals, and long-term EL students is 70% of the total student population at Mt. Diablo High School. From 2017-2018, the total number of EL students was 458, which accounts for 33.1% of the total population. In 2019, the number of EL has not drastically changed; there are 466 students who classify as EL. The reclassification of EL students is rare, with only 20 students meeting the requirements in 2018 (WASC Mid-cycle Progress Report, 2018). It is both concerning and worth exploring the reasons why this phenomenon occurs. (WASC Mid-cycle Progress Report, 2018),

Leadership in Practice

At Mt. Diablo High School, the School Site Council is a group of teachers, parents, staff, and students who work together to develop, review, and evaluate school improvement programs and budgets. Members are generally elected by their peers and the duties of School Site Councils vary from state to state. However, in general, Site Councils make decisions or advise the principal on the school budget and the academic or School Improvement Plan. In addition to academic planning, the Mt. Diablo Site Council is responsible for making decisions on parent engagement, safety, and discipline (CA, School Site Council, 2019).

After examining the bigger picture in regard to Mt. Diablo's progress, the Council and the principal create a plan for improvement. This plan might involve a new academic program, staff member, or parent outreach strategy. For example, one council member might utilize funds to develop a new math program, while another might decide to hire a reading

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specialist. Another council member may decide that hiring an additional teacher to reduce class sizes in a particular grade, or a parent liaison to get more parents involved, would be the best use of money. Because school budgets are limited and many funds can only be spent in certain ways, there are always tough decisions to make. The various decisions and plans for Mt. Diablo programs are developed in the Single Plan for Student Achievement (SPSA) (CA, School Site Council, 2019).

The SPSA is a plan of action to increase the academic performance of all students. California Education Code sections 41507, 41572, 64001, and the federal Elementary and Secondary Education Act oblige every school to submit and agree upon all school plans and programs funded through the ConApp and ESEA Program Improvement, into the SPSA. In the SPSA plan, schools are able to submit expenditures of the programs that support students' performance. This plan is tied to the Local Control Accountability Plan, which deals with budget expenditures (California Department of Education, February 2014).

Mt. Diablo High is required, by the state, to form an English Learner Advisory Committee (ELAC) due to the high population of English Language Learner students. Aside from the Student Site Council, the ELAC plays an important part in advocating for EL students, the programs that assist them, their resources, and how these programs will utilize the money to help EL students. The committee is formed by parents, teachers, students, and staff who primarily support English Language Learners (California Department of Education, English Learner Advisory Committee, 2019). According to the California Department of Education, the ELAC has specific responsibilities, which include:

1. Advising the principal and staff on programs and services for English Language Learners and the School Site Council on the development of the SPSA.
2. Assisting the school in the development of:
   a. The school's needs assessment.
   b. Ways to make parents aware of the importance of regular school attendance.

Future Direction

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Going forward, it would be important to explore the contemporary challenges that English Language Learner students face at Mt. Diablo High School. Future research can be done on agenda setting and the power dynamics of the School Site Council. By attending School Site Council meetings, as well as analyzing how past decisions have or have not made a meaningful impact on the EL community, I believe one can influence a change in the way policymakers propose solutions for existing challenges. Secondly, future research should focus on the leadership, staff, parents, and students who are involved in positions of power, and how they communicate and advocate for the EL community.

Research shows that attending a school like Mt. Diablo High, particularly with their student demographics, teacher turnover rate, and the lack of unawareness on various resources for both students and parents, may be feeding into the "subtractive school system," (Valenzuela, 1999) where uneducated Latinx students suffer the consequences of a racialized and unequal education system.

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Investigation into the Effects of Blade Tip Twist on Noise Reduction for a NACA 0012 Rotor Blade

Biography

Uyen aspires to integrate her passion for learning, aerospace, and art to impact the world around her in a positive way. She is inspired by her family, advisors, and friends around her that give her the confidence to pursue her goals. She is also inspired by the professors and mentors who have helped and continue to help broaden her mind every day. Being a first-generation student has proven to be a challenge as well as a driving force that motivates her to give it her all and try out things she thought she never could. She hopes to make an impact in industry and become a professor in her field in the future. She was involved with Rocket Club earning a level 1 certification from Tripoli Rocketry Association and is a member of the American Institute of Aeronautics and Astronautics. She is also involved with community outreach programs that encourage the next generation of engineers such as the Engineering Ambassadors Program as well as Project Lead the Way here at San José State University.

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Investigation into the Effects of Blade Tip Twist on Noise Reduction for a NACA 0012 Rotor Blade

ABSTRACT

The advancement of the urban air mobility concept is heavily dependent on the public acceptance of the aircraft vehicles used for air taxis. The importance of the perception of noise by humans is crucial to the passing of legislation and proposals working to implement the new transport system. The investigation into how the noise perception can be reduced is vital to the success of the personal air travel industry. The air taxi design has been geared towards the rotorcraft models. Therefore, the investigation into the rotor blade designs is necessary because, similar to helicopters, the main component in noise generation is the rotors and its blades. The blade-vortex interaction creates noise which humans perceive as the most annoying and disruptive type of noise produced by rotorcraft. The blade-vortex interaction noise is due to the interaction between the advancing blade and the vortexes generated by the tips of the previous rotor blade. This study looks into the effect of tip twist on rotor blades. Understanding how twist in a blade will affect thrust production and noise production will aid in the progress of developing the acceptance of the urban air mobility movement. This investigation is carried out through the use of high-fidelity rotorcraft modeling software developed by Continuum Dynamics Incorporated called the Comprehensive Hierarchical Aeromechanics Rotorcraft Model (CHARM) coupled with the aeroacoustic processing package PSU-WOPWOP to produce sound data files at the wake of the rotor blades. The noise reducing parameter under investigation is the tip twist of the rotor blades. Particularly, interest is on how this change affects the frequency of sound pressure levels. The reduction of this type of noise will aid in determining the design of efficient and safe air taxis that will utilize a system of smaller porting stations as drop off zones, similar, only in concept, to those ride-sharing services.

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I. Nomenclature

BVI = blade-vortex interaction
SPL = Sound Pressure Level
dBA = A-weighted decibel, a metric for sound
annoyance
dB = decibel, a measure of sound level
*BWI* = blade-wale interaction noise

II. Introduction

The rise of interest in the Urban Air Mobility has prompted the Federal Aviation Administration to implement requirements and policies about noise restrictions [1]. This means air taxi vehicles must meet noise certification requirements in order to be successfully integrated as a new transportation system [2]. The impacts of air taxis on the community must be considered for successful integration. Such impacts include noise, flight path design, and landing and takeoff zones [1]. Although all the above are integral to the successful integration of air taxis, the impact of noise to communities is the focus of this paper.

The human ear does not linearly relate frequencies in sound to how loud a frequency is. Loudness is defined as the magnitude of the feeling in the human ear due to a change in the air pressure. Human ears are more sensitive to changes in air pressure than they are to constant air pressure meaning noise that frequently changes in pitch is more annoying than a constant noise [3]. In this setting, air pressure is referring to the volume of air that each rotor blade displaces as it rotates. The volume displaced is dependent on the rate at which the blade rotates, amount of pressure the blade absorbs, blade tip velocity, and amount of power used to produce the rotation [4]. The amount of volume displaced and the rate at which the volume is displaced plays into the noise humans hear. The unit of noise annoyance is the A-weighted decibel, dBA. The unit dBA is based off of a logarithmic scale of annoyance [5].The National Aeronautics and Space Administration's (NASA) preliminary fly-over testing of small unmanned air vehicles suggested the tolerance of noise based on the A-weighted sound pressure level to about 65 dBA at $15m$ or 50 *feet* from the source of the noise is an acceptable noise range [6].

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Many air taxi designs resemble that of a helicopter therefore, the main source of noise for air taxis is also from its rotors like it is for helicopters [7]. The general noise mechanisms that have been associated with rotors are discrete loading noise, broadband noise, broadband self-noise, and discrete impulsive noise [8, 9]. As defined by Brooks *et al.*, the discrete loading noise is caused by the blade loading that occurs at lower steady frequencies [8]. The broadband noise occurs due to the blade interacting with the turbulent flow of the wake, also known as the blade-wake interactions (BWI) [5]. The broadband self-noise is described as the noise produced when the blade comes into contact with the turbulent flow surrounding the rotor wake and the boundary layers formed along the blade [8]. The discrete impulsive noise is the blade loading that occurs predominately at the tips of the rotor blade and is distinguished from discrete loading noise by its impulsive nature. This type of noise is also known as blade-vortex interaction (BVI) noise and can over take other types of noise due to BVI noise occurring at the high frequencies [3, 8]. Past investigations into noise reduction suggest there is significance in attempting to employ noise reduction methods that aim to minimize the noise produced within the same plane of the rotor blade [9]. The methods are broken down into passive and active means of reducing noise. The noise mechanisms found in the rotor blade plane are thickness noise and high speed impulsive noise [7, 9]. One passive noise reduction method involves reducing the rotational speed of the rotor [9]. Shi *et al.* [9, 10] noted that the reduced speed of the rotor blade, measured in rotations per minute (RPM), was effective in reducing the noise in-plane of the rotor blade. However, passive methods such as reducing the rotational speed of the rotor negatively affects the performance of the rotorcraft because the thrust production is also decreased [9]. This adversely impacts the amount of weight the rotorcraft can carry on board as well as the safety of the rotorcraft due to increased vibrations found at lower rotational speeds [7]. Malovrh *et al.* [10] discussed a few passive methods including adjusting the tip-path-angle by identifying areas of zero inflow experienced by the rotor blade. Rotor noise consists of the blade-vortex interaction, thickness noise, loading noise, and high speed impulsive noise. The following provides a breakdown of noise types:

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- **Blade-Vortex Interaction Noise:** the impulsive loading noise due to tip vortex interference with the following blade [1]
- **Thickness Noise:** the noise produced by the displacement of fluid by the rotor blade [1] • **Loading Noise:** the noise produced by a force exerted onto the fluid by the rotor blade surface [1]
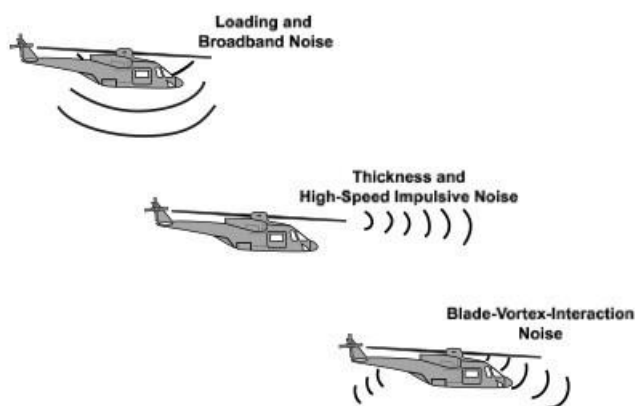
Fig. 1: The three primary rotor noise sources [11].

Blade-vortex interaction (BVI) noise is in the frequency range humans perceive to be the most annoying because of the impulsive nature of BVI noise. BVI noise is generated during low speed descent and during forward flight [7, 10]. These two maneuvers occur often during air taxi operations, so attempts in reducing the production of BVI noise is important in meeting noise restrictions criteria for air taxis. The design mechanisms available to reduce noise is limited for rotorcrafts and must rely on source noise reduction rather than noise control mechanisms [11]. For example, airplane engines have available noise suppression ducts and noise absorbing lining material for their engines that reduces the noise generated by the engine blades. Due to the nature and design of rotorcraft, this is not an option. Source noise reduction can be achieved using passive and active methods of noise reduction. Therefore, most passive attempts to reduce noise leans towards the design of the blade tips in order to gain a balance between noise reduction and overall performance [7, 8].

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Malovrh *et al*. [10] provided a detailed overview of the advanced blade tip configurations that had success in decreasing the intensity of the tip vortex such as the Ogee tip described by Landgrebe and Bellinger [12]. These advanced tip configurations look at the effects of sweep, taper, thickness, and anhedral on the blade tip. Yu *et al*. documented many tip configurations suggested to aid in the reduction of BVI noise. The suggested configurations were parabolic, elliptic, bulge, and vane tips [7]. Brocklehurst *et al*. [13] reviewed the Ogee tip that was designed to decrease the intensity of the tip vortex. The results concluded decrease in tip vortex strength help in reducing the noise production because the advancing blade interacting with the vortex will displace air that are of a lesser pressure difference [10]. Another experiment investigated noise reduction of the BERP blade developed through the British Experimental Rotor Programme. The experiment divided the tip vortex into smaller vortices using sweep and anhedral at the blade tip [13]. The results of the experiment concluded no best design of the blade tip has been developed [13]. Active modes of reducing rotor noise are through high harmonic controls (HHC), single blade control, active twist, and active flaps [9]. These active methods are generally used for the reduction of BVI noise but have been found to complicate flight maneuvers [8].

The investigation into how twist at the tip can affect the noise production is limited, but has had some results that would suggest further work into this could have some good results [9]. The interest in how twist can affect the production of the BVI noise is due to the lower tip speeds associated with smaller rotor blades for the use in air taxis than in traditional helicopters. It was determined that the rotor wake and blade tip vortex strengths have an effect on the generation of BVI noise [11]. The focus of this study is on the affects blade tip twist has on the acoustic signature through analyzing the contour plots of the overall sound pressure levels experienced by fix observer points.

III. Methodology
A. Modeling Code
The modeling program used for this study was a high-fidelity aeromechanics modeling computer program developed by Continuum Dynamics Inc. The modeling program is called the Comprehensive

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Hierarchical Aeroacoustics Rotorcraft Model also known as CHARM. The CHARM code was used to model the aeromechanics of vertical take-off and landing (VTOL) aircraft in steady flight [14]. The CHARM code has the capabilities to accurately generate predictions of the aircraft's vibrations, wake geometry, aerodynamics, performance, and structural loads [14]. This modeling program was coupled with an aeroacoustic prediction code called PSU-WOPWOP which was developed by Pennsylvania State University based from NASA's WOPWOP prediction code. The CHARM code is automatically coupled with PSU-WOPWOP to generate the sound pressure level output files, the dBA output files, the wake geometry files along with many others such as frequency files to aid in understanding the acoustic effects of the rotor [14].

The set up for this study had the CHARM program installed in a Linux environment. The user input files were edited directly within a command shell. The CHARM generated output files were processed using utility programs provided in CHARM. The CHARM output files were processed in PSU-WOPWOP prediction code to generate the overall sound pressure values in dBA. The overall sound pressure level in dBA (OASPLdBA) data was plotted in contour plots for all trials. The delta values between the nominal trial, Trial z0, and consequent trials were also plotted to evaluate the overall effects each change to the blade tip twist had on sound pressure levels experienced by an observer point.

The study design used an airfoil symmetric about the camber line and has a maximum thickness of 12% for the rotor blade. This airfoil was the NACA 0012 airfoil. The characteristics of the rotor blade can be found in Table 1.

B. Rotor Blade Characteristics

The airfoil used for this study is the NACA 0012. This airfoil is symmetrical with maximum thickness of 12% located at 30% of the chord length. The rotor has two blades with an 8 foot radius and chord length of 1.719 feet.

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Airfoil	Number of Blades	Chord	Blade Radius	Taper	Solidity	Tip Speed
NACA 0012	2	1.719ft	8 ft	0.25	0.113	720 ft/s

Table 1: Characteristics of the rotor blade

C. Observer Points

The CHARM code coupled with PSU-WOPWOP acoustic prediction code generates the thickness and loading noise data at specified observer points [14]. The coordinate plane is set up where the +X direction is the advancing direction of the blade, the +Y direction is to the right of the advancing direction, and +Z direction is the direction of the inflow [14]. At the +X axis is where the azimuth angle value is 90 degrees and the +Y axis is at zero azimuth angle [14]. The location of these observer points span azimuth angles ranging from 40 degrees to -80 degrees on the X-Y coordinate plane and an elevation angle range of 0 degrees to 70 degrees in the +Z direction [14]. There are a total of 25 observer points that enclose almost a quadrant of a hemisphere. The observer points are fixed relative to the rotor at a radius of 15m or 50ft from the center of the rotor and are equally distributed in a spherical formation with an observer point located directly below the center of the rotor shaft [14]. See Figure 2 for the distribution of the observer points.

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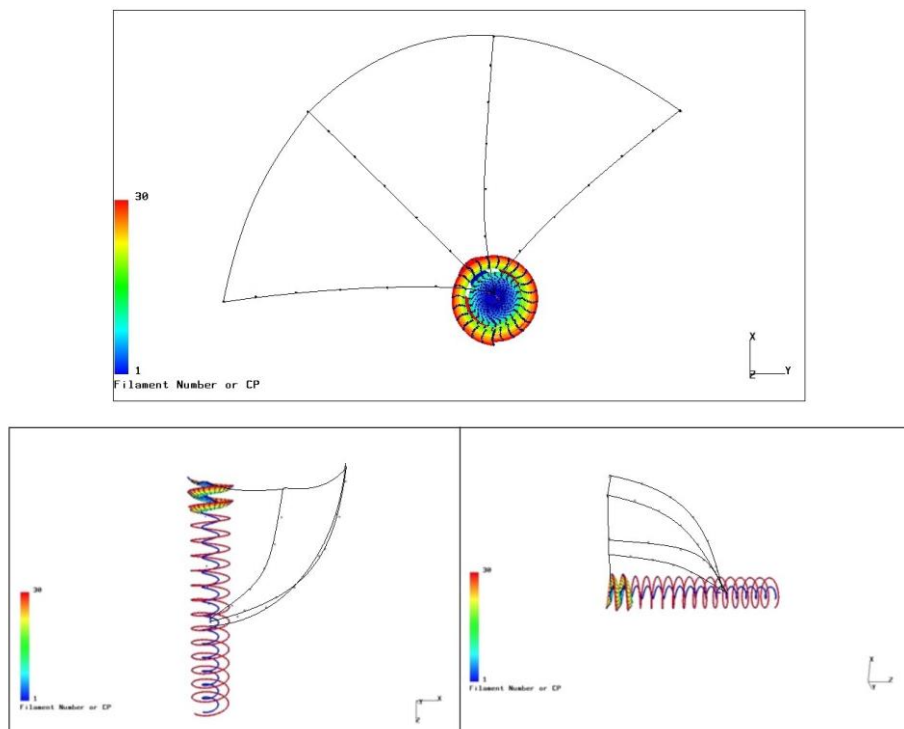
Fig. 2: Top and side views of the azimuth observer points locations spanning from $40deg$ **to** $−80deg$**.**

D. Trials

In order to apply changes to the twist, the rotor blade was divided into 12 segments that were equidistant from one another starting from the tip of the blade to 80% of the blade span. Any change made to the twist of the rotor blade went through linear interpolation between each segment. The preliminary trials tabulated in Table 2 varied the rotational speed and the twist that explored vortex formation at the blade tip. The flow fields of these trials were captured through a built-in executable graphics code in CHARM. The second set of trials tabulated in Table 3 explored effects of varied twist on the overall sound pressure levels. The initial conditions for

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this trial were set at a constant root twist of 20 degrees and a constant rotational speed of Ω= 90 *rad/s*. The third set of trials charted in Table 4 examined the overall sound pressure levels at a constant root twist of 45 degrees and a constant rotational speed of Ω= 90 *rad/s*. The last set of trials in Table 5 and 6 took Trial 5 and 6 of the third set of trials with the same initial conditions and varied the rotational speed. The use of Trials 5 and 6 for varied Ω values were chosen arbitrarily.

Trial	Twist (*deg*)	Ω(*rad/s*)
1	-10.97	90
2	-20.97.	120
3	-20.97	34
4	-20.97	24
5	-20.97	90
6	-46.02	90
7	-49.35	90

Table 2: Preliminary trials with varied twist and Ω

The twist was plotted against the radius in Fig. 3 and Fig. 4 for trial sets one and two. The trails investigated twist in both the positive and negative direction and kept the rotational speed at a constant.

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Trial	Twist (*deg*)	Ω(*rad/s*)
z0	-17.632	90
z1	-22.52	90
z2	-10.513	90
z3	-18.513	90
z4	-26.513	90
z5	5.933	90
z6	13.933	90
z7	21.93	90

Table 3: Trial Set 1 - Initial Root Twist set at 20 degrees and Ω= 90*rad/s*
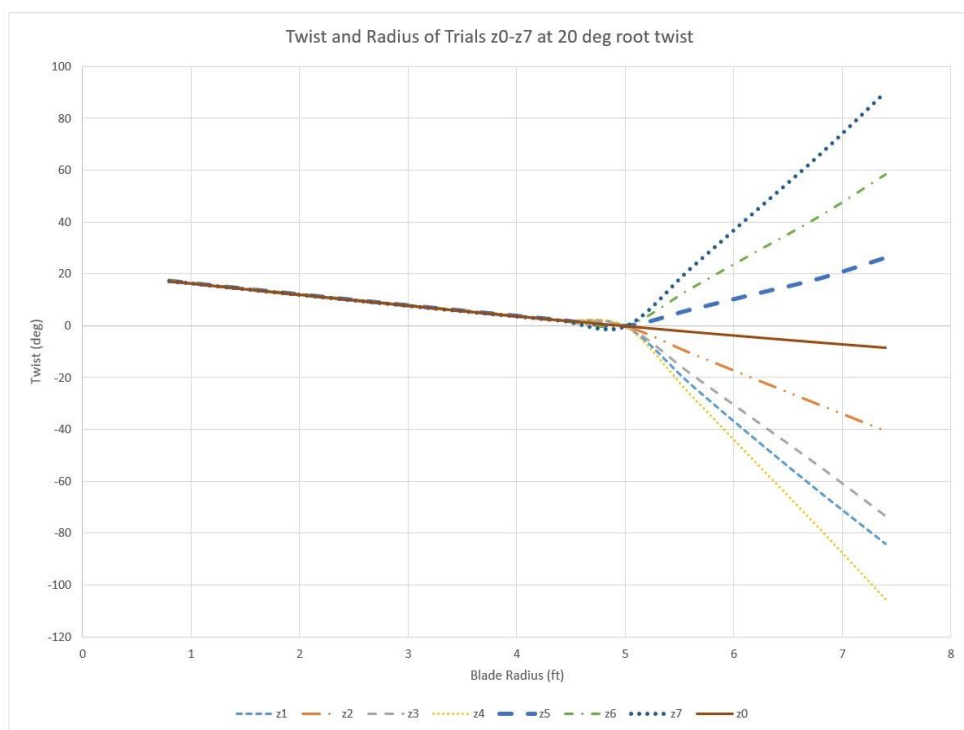
Fig. 3: Comparisons of the Twist and Radius of all trials with 20 *degree* root twist.

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Trial	Twist (deg)	Ω(rad/s)
z0	-22.368	90
z1	-42.375	90
z2	-30.368	90
z3	-38.368	90
z4	-43.632	90
z5	13.922	90
z6	21.922	90
z7	29.078	90

Table 4: Trial Set 2 - Initial Root Twist set at 45 degrees and constant Ω= 90rad/s
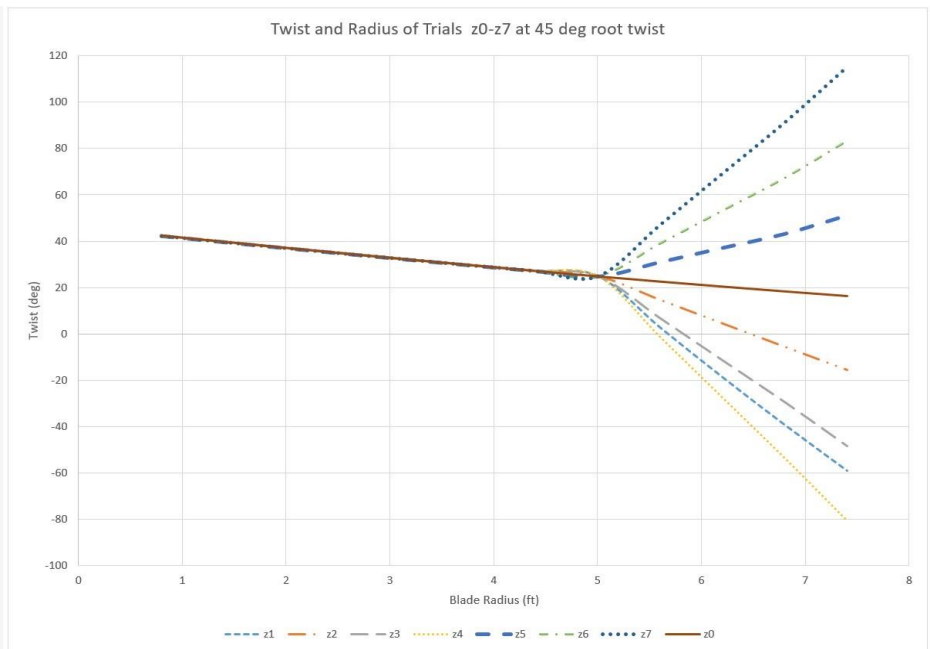
Fig. 4: Comparisons of the Twist and Radius of all trials with 45 *degree* root twist.

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Trial	Twist (*deg*)	$\Omega(rad/s)$
z5	13.922	70
z5	13.922	80
z5	13.922	90
z5	13.922	100
z5	13.922	110
z5	13.922	120
z5	13.922	130
z5	13.922	140
z5	13.922	150

Table 5: Trail Set 3 - Trial z5 at initial 45 degrees root twist and varied Ω values

Trial	Twist (*deg*)	$\Omega(rad/s)$
z6	21.922	70
z6	21.922	80
z6	21.922	90
z6	21.922	100
z6	21.922	110
z6	21.922	120
z6	21.922	130
z6	21.922	140
z6	21.922	150

Table 6: Trial Set 4 - Trial z6 at initial 45 degrees root twist and varied Ω values

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IV. Results

Results from the trials were processed and visualized via flow fields and contour plots. The preliminary trials explored the change in pressure of the blade vortex generated at the tip. This is visualized through flow fields shown in Fig. 8. Flow fields aid in understanding the pressure distribution and flow interaction in the wake of the rotor blades. Trial 2 in Fig. 8 displays a side view of the flow field. Each filament has a distinct pressure from the next. The concentration of filaments and high pressure indicated by the color gradient along the edge of the helix-shaped flow field indicated a strong blade tip vortex. The flow fields corresponding to the trials 2 to 5 showed as rotational speed increased, the pressure of each filament increased and clustering occurred towards the outer edge of the flow. The filaments in trial 2 towards the edge were more spaced out than that of trial 5, but the overall shape of the flow in the top view indicate some downwash may have occurred. The increase in RPM also increased in the intensity of the blade vortex at the tip.

The results from Trial Sets 2-4 were analyzed through contour plots. The plots for Trial Set 2 showed increase in noise production as observer points approached the in-plane of the rotor blade. The contour plot Trial z0-z2 showed a slight increase of 1 dBA in noise at observer point where Θ is 70deg and Φ is at 40deg when the twist went from -22.368 deg to -30.386 deg. The plots for Trial z0-z4, z0-z1, and z0-z3 exhibit an increase in noise production as the twist approached -45 degree twist. The noise production also increased in positive twist configurations. The contour plot for Trial z0-z5 through z0-z7 also displayed increase in noise experienced by the observer points. The noise increased at a higher rate at positive twist than at negative twist.

The contour plots of Trial Set 3 conveyed the effect of rotational speed on noise production. At rotational speed set at $\Omega= 70$ rad/s, the contour plot demonstrated fluctuating noise levels detected by the observer points. As the omega increased, contours began to reach a uniform shape between each observer point. At $\Omega= 100$ rad/s, the noise increase experienced by the observer increased incrementally by 10 dBA with each increase to omega by 10 rad/s up to $\Omega= 130$ rad/s. At $\Omega= 140$ rad/s, the contour plots showed significant increase in not only the blade-vortex interaction noise, but also the loading and broadband noise. From

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140rad/s to 150 rad/s, the observer points at Θ= 10 across Φ values experienced 200 dBA compared to 75 to 80 dBA. As the rotational speed increased, the contour plots exhibited a shift in the formation of BVI noise in a direction towards the rotor plane.In Trail Set 4, the contour plot for Ω= 100 rad/s depicted a small pocket of noise which was inconsistent with the rest of the plots. An assumption was the observer point experienced a small blade wake interaction.

From the results, the noise produced by the rotor blade increased as the rotational speed increased. There was a shift in the concentration of the BVI noise as the rotational speed increased as well. Higher blade speed also meant there was more turbulence at the wake of the rotor and as a result, higher broadband noise was experienced at the observer points directly below the rotor.

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A. **Flow Fields**

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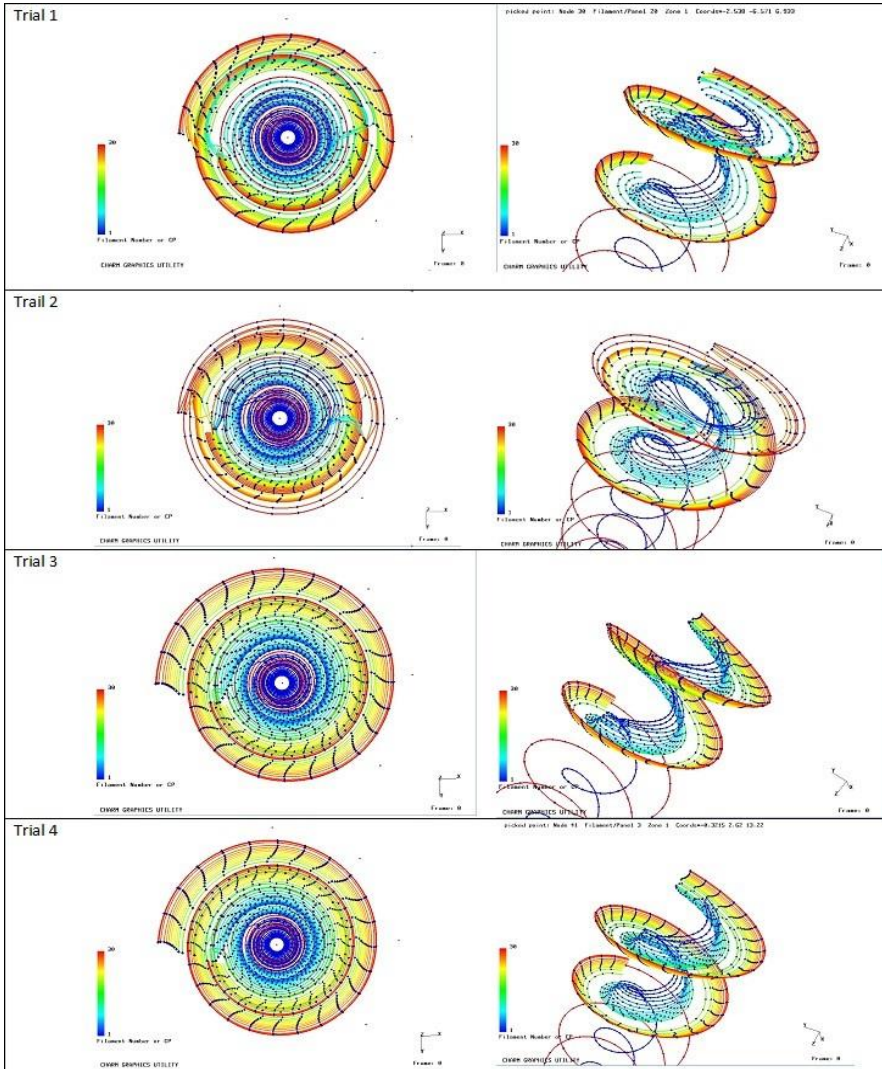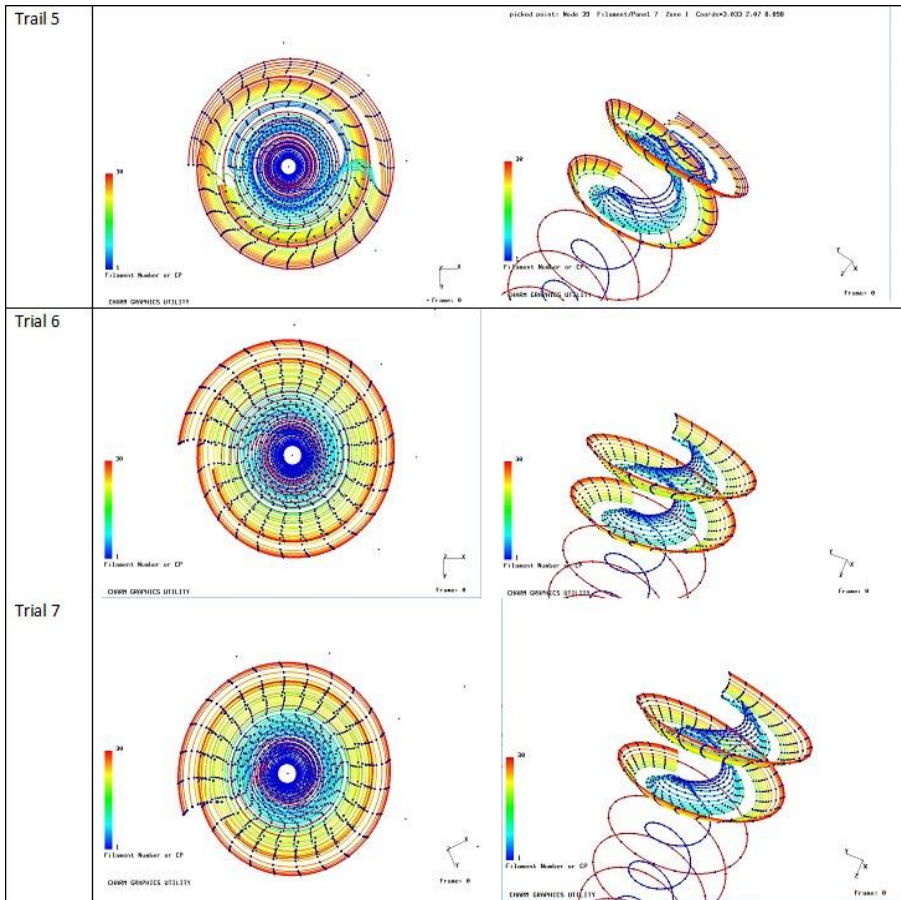
Fig. 8: Top and isometric view of flow fields of preliminary trials 1-7 showing pressure and filament distribution

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B. Contour Plots

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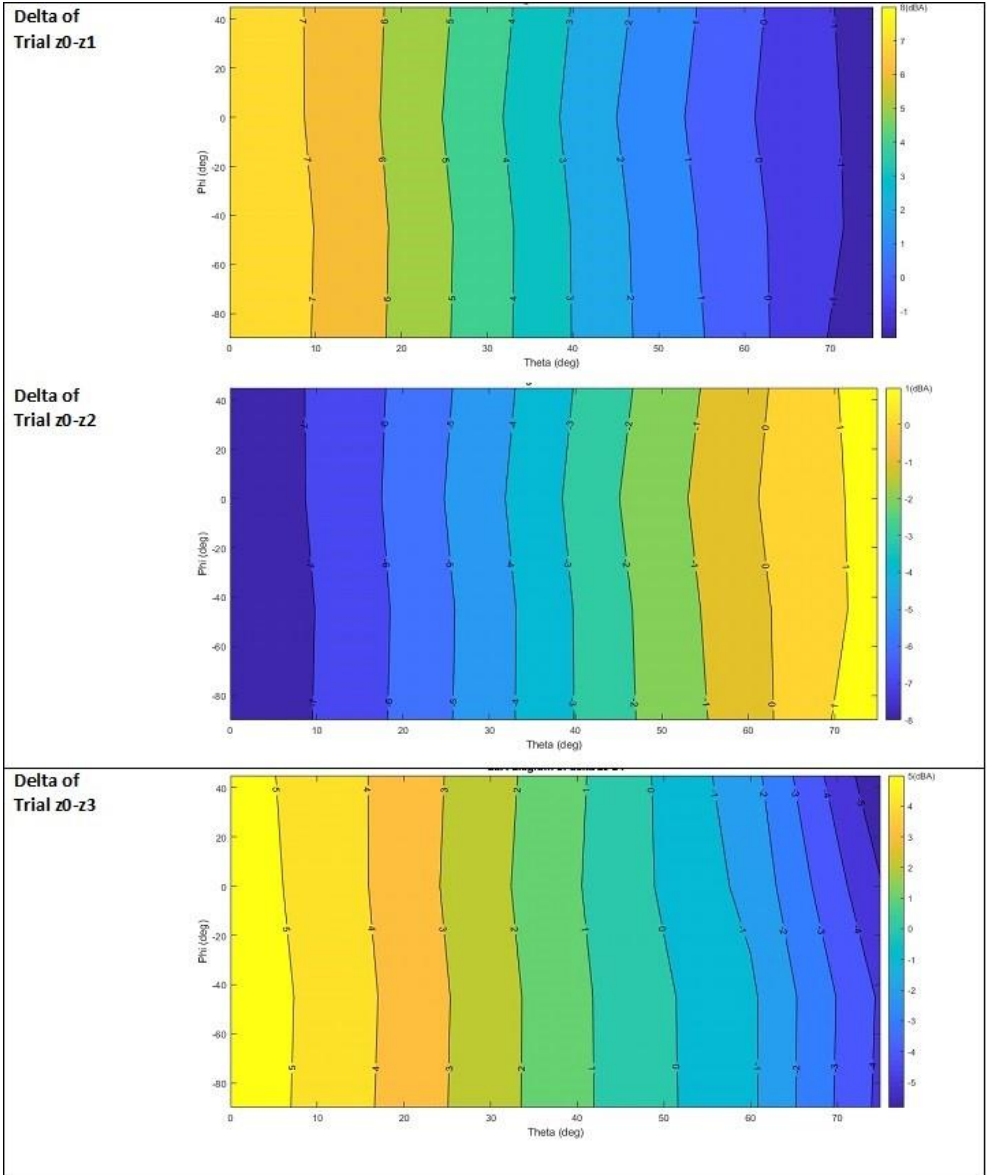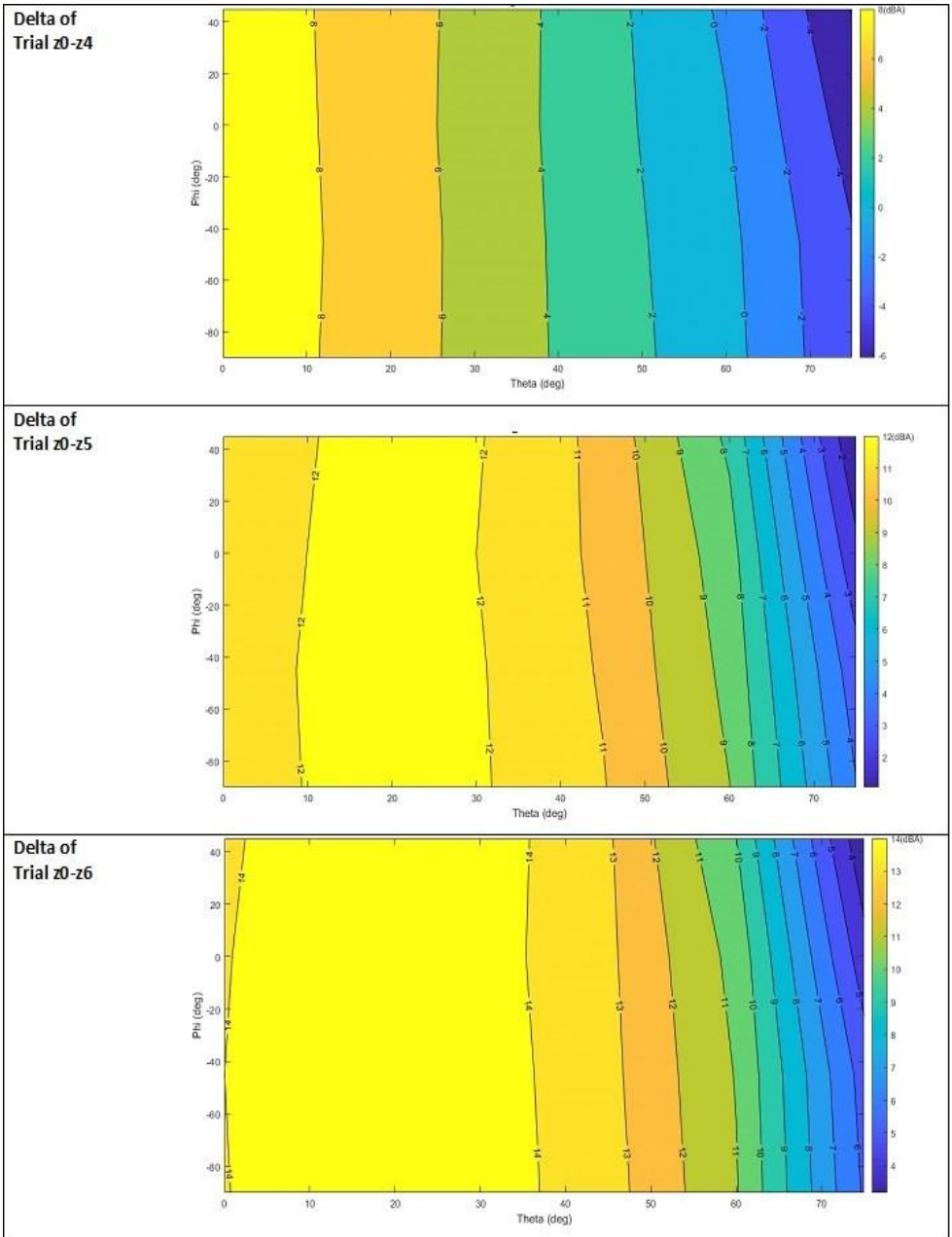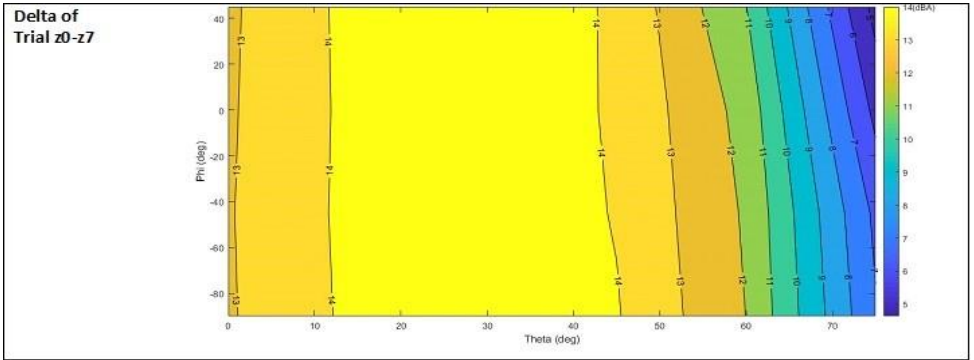
Fig. 5: Trial Set 2 - contour plots showing the sound pressure levels at each observer point

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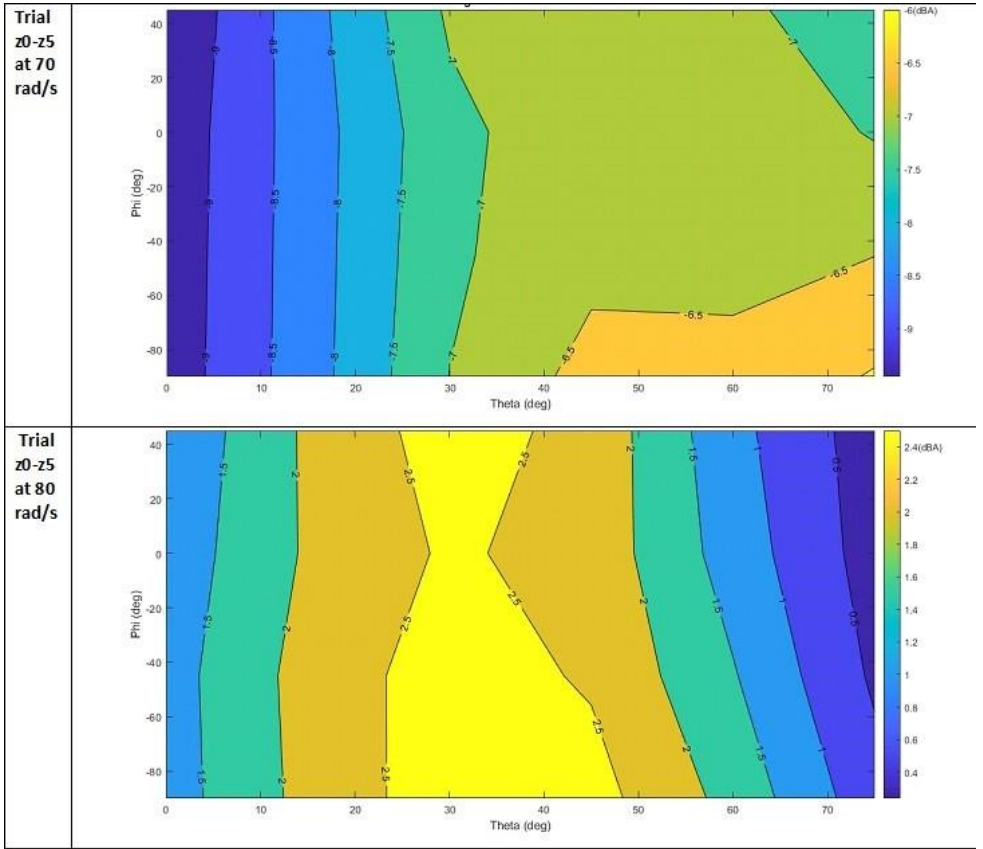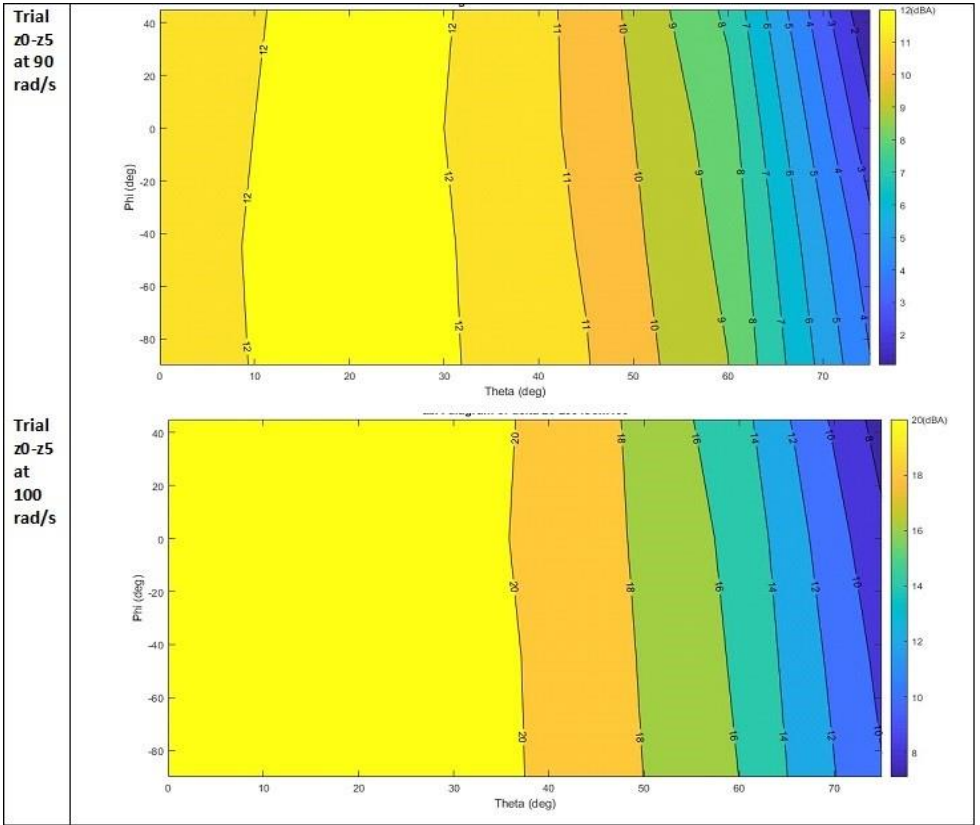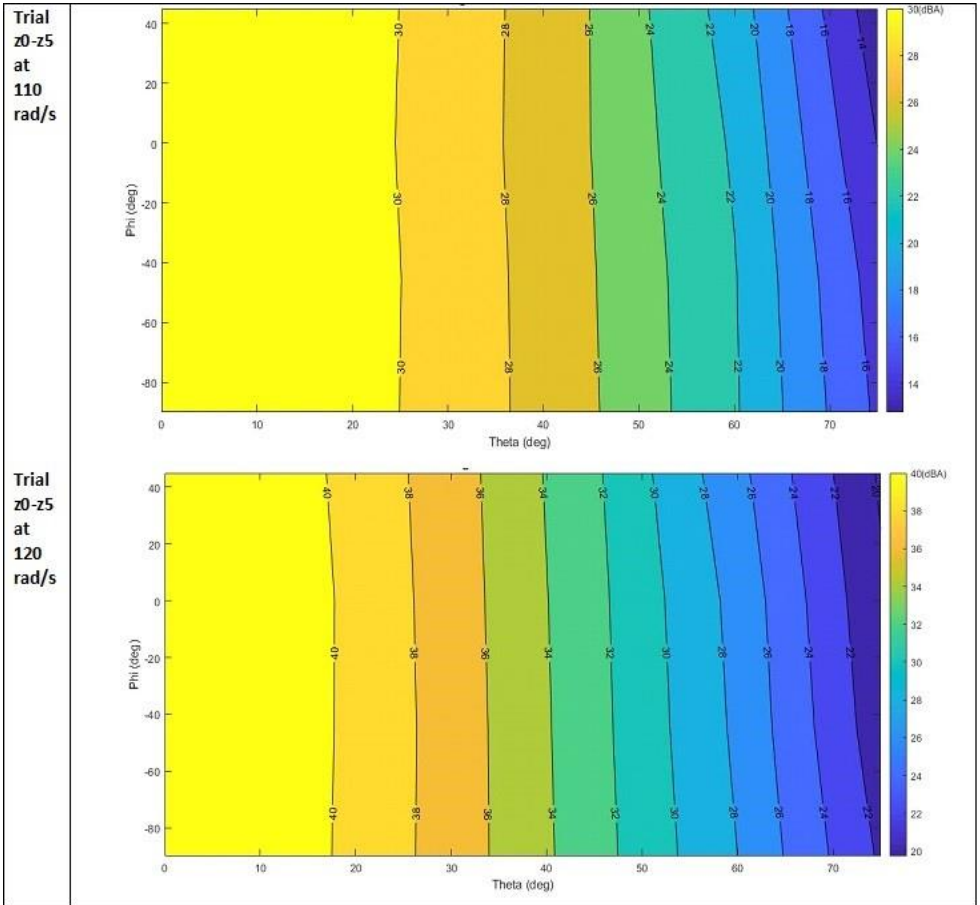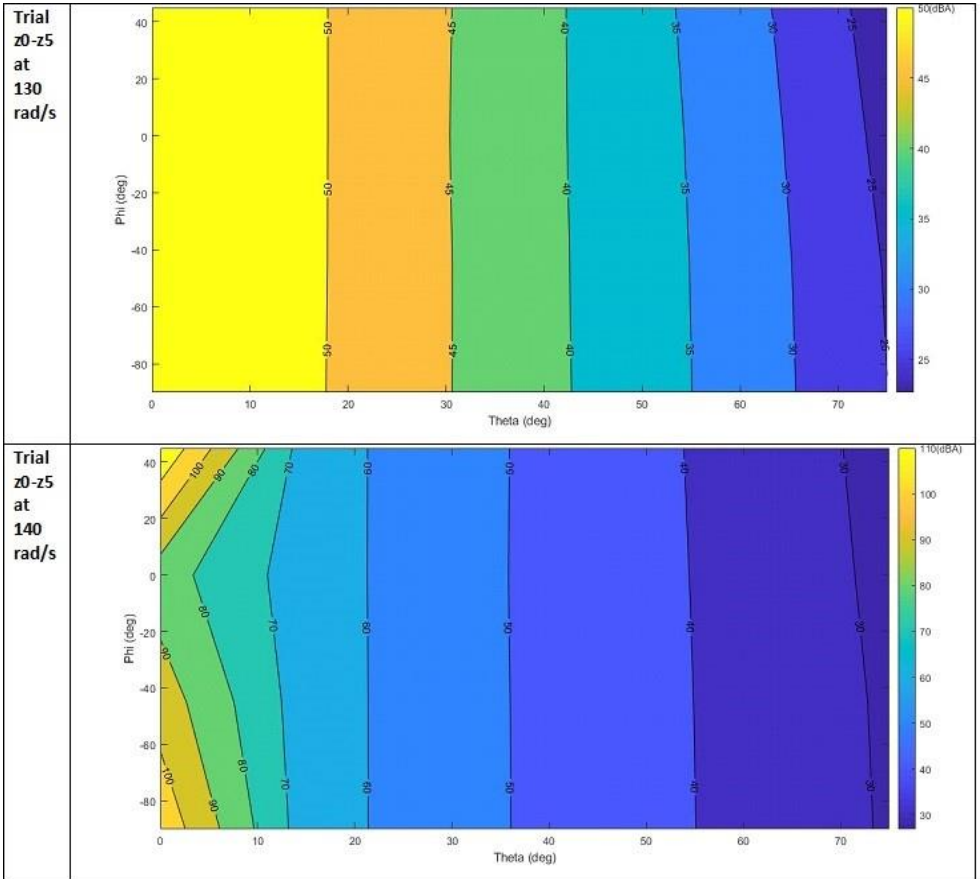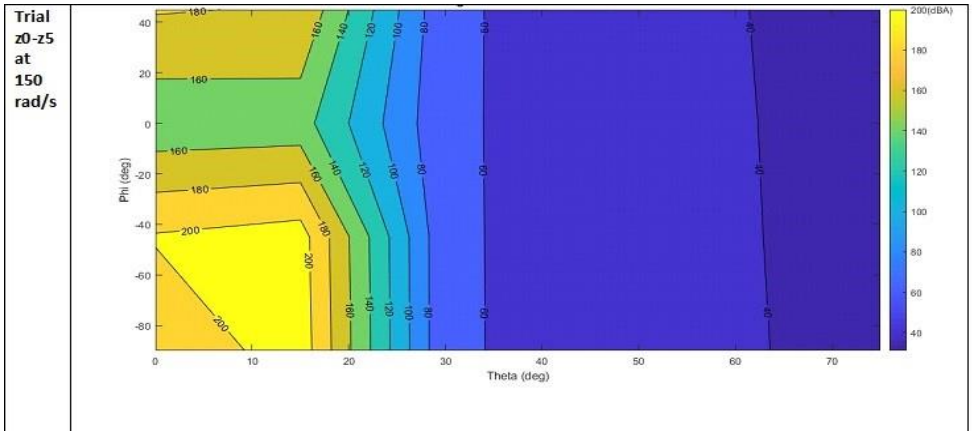
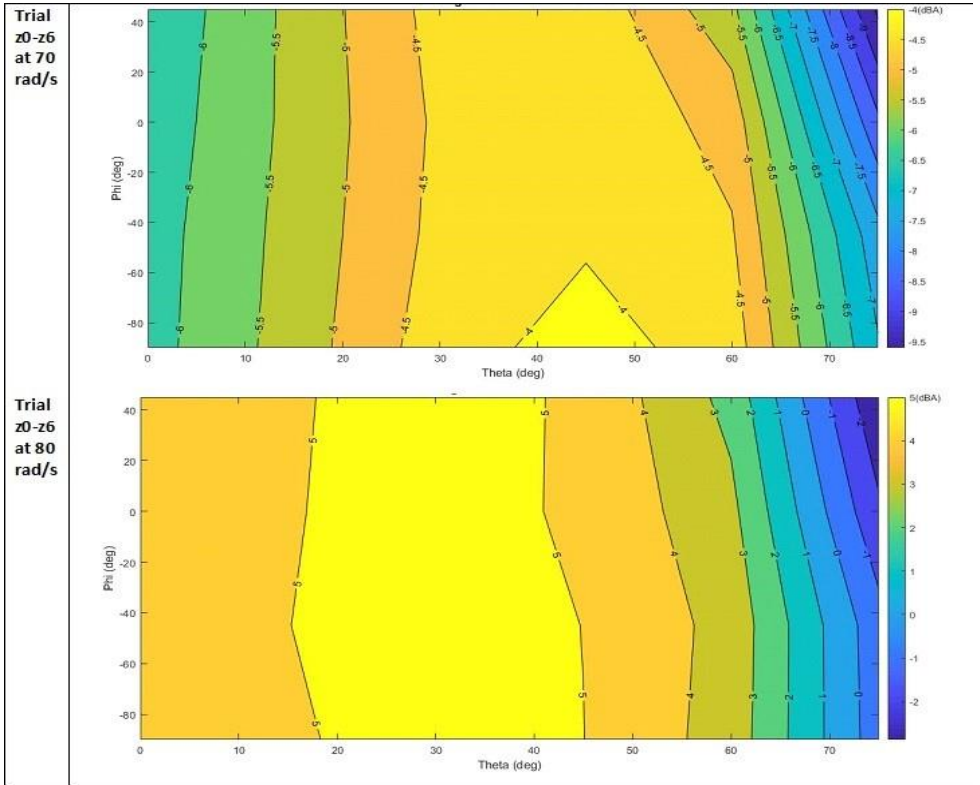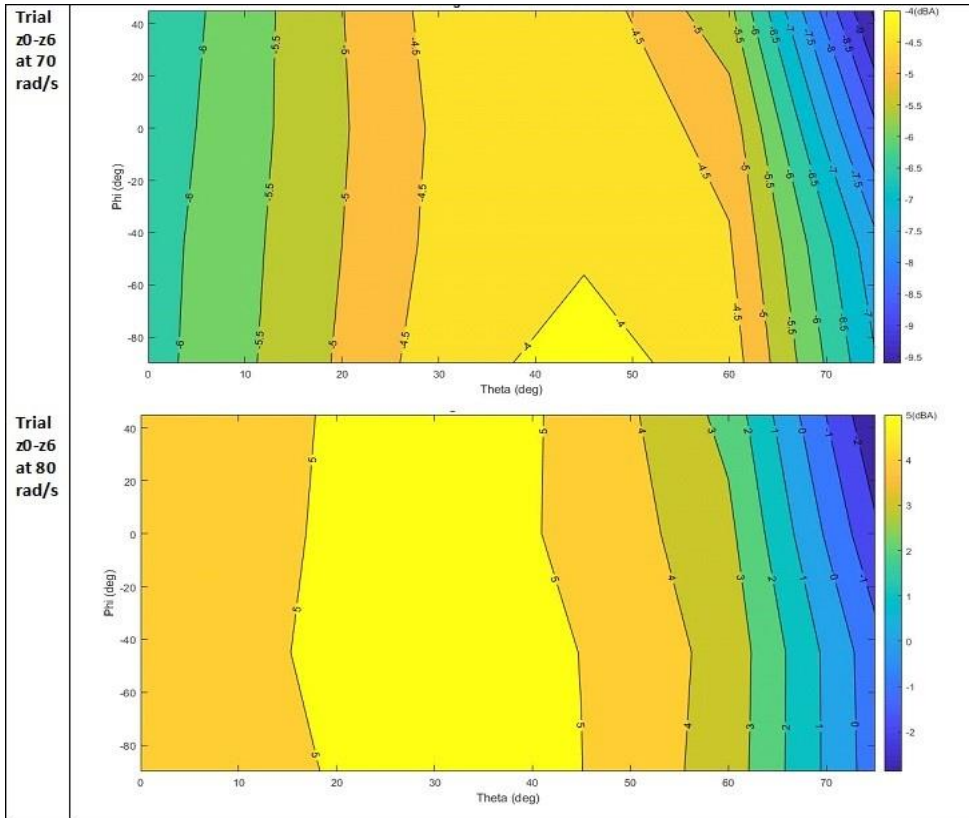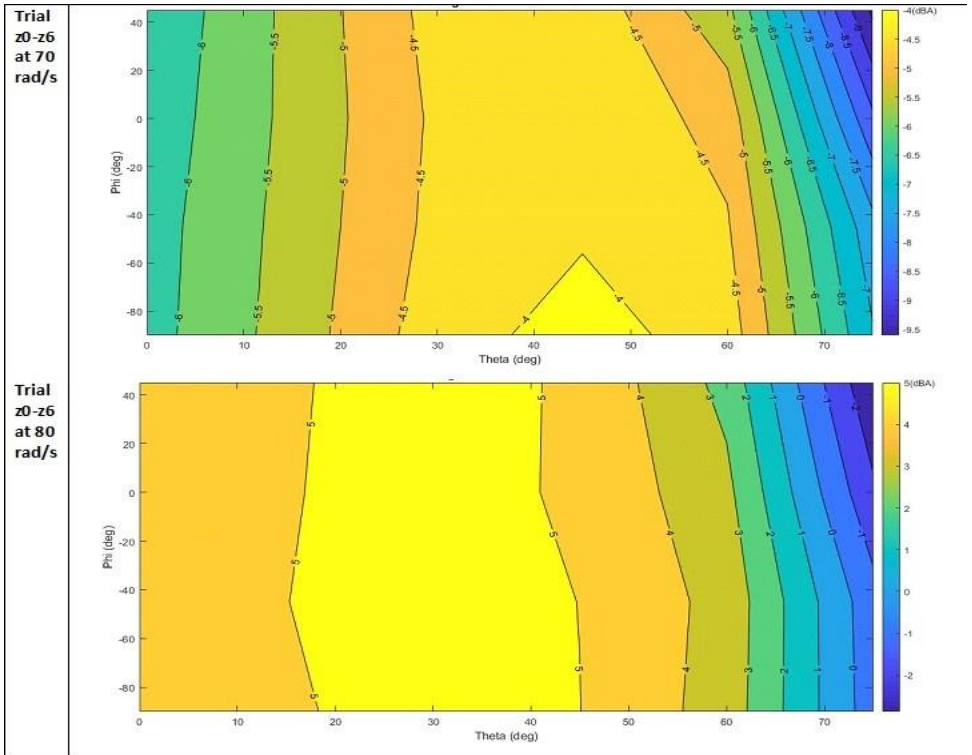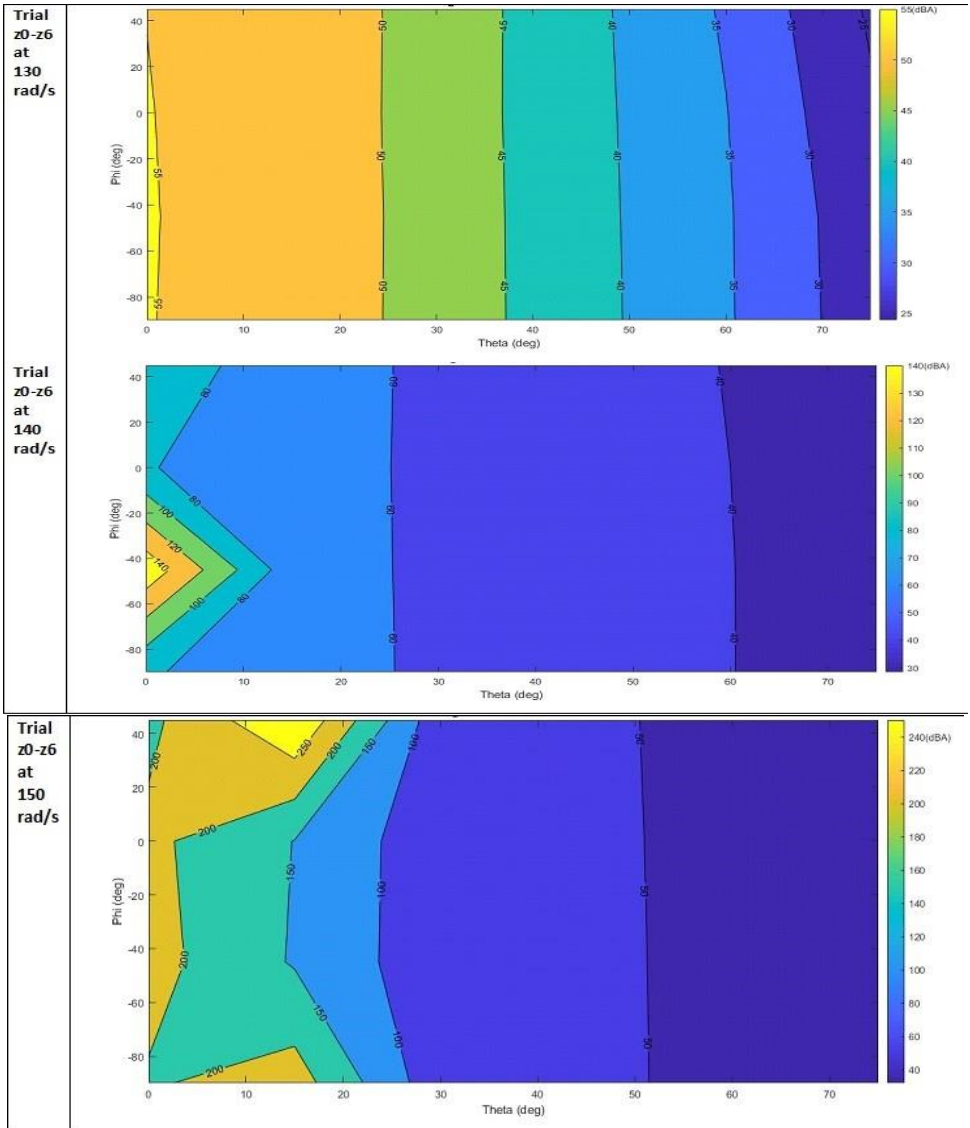**Fig. 6: Trial Set 3 - contour plots showing the sound pressure levels at each observer point**

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Fig. 7: Trial Set 4 - contour plots showing the sound pressure levels at each observer point

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V. Conclusion

The balance between rotorcraft performance and its acoustic signature is a key hurdle the Urban Air Mobility (UAM) community must overcome. Aircraft designers can design a rotor that meets the noise restrictions by addressing a major source of the noise. Blade-vortex interaction noise is a major concern due to humans' perception of the noise. Humans consider BVI noise to be highly annoying and since public acceptance is vital to UAM success focus on reducing this noise is important. Adjusting the twist at the blade tip is a method to reducing the BVI noise because blade tip twist affects the formation of vortices in the following ways. Blade tip twist affects the intensity and the formation location of tip vortices. The results suggested that the intensity of sound pressure level observed at fixed observer points appeared to shift towards the direction of the rotor plane. The blade tip twist seems to influence the position and concentration of blade vortex interaction noise experienced by the observer points below the rotorcraft. Future work would be to investigate whether blade tip twist could be used as a method to affect position of vortex formation to increase the miss distance between the advancing blade and the tip vortex.

VI. Acknowledgements

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