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GO WARRIORS!!!!!

The Wayne State University McNair Scholars Staff

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LONG TERM EDUCATIONAL OUTCOMES FOR SEXUAL MINORITY YOUTH

By William F. Alexander III Major: Spanish Mentor: David Merolla, PhD, Department of Sociology

Most commentators point to the 1969 Stonewall riots as the beginning for the contemporary gay¹ rights movement. However, the experience of sexual minority youth both in and outside of school contexts has only become a national issue in recent decades. For instance, in 1993 a report was published known as "Making Schools Safe for Lesbian and Gay Youth" by the Massachusetts Governor Commission, was the first official call for attention to the experience of sexual minority youth and led to increased scholarly and political attention to these issues. In 1999, the state of California enacted legislation to protect their students from harassment and discrimination based on perceived sexual orientation (Keuhl, 1999). Since the turn of the 21st century, an increasingly large body of research documenting their educational experiences reflects the growing interest in sexual minority students.

To date, research has shown that sexual minority students perform worse in their studies, have lowered educational aspirations, are more likely to become truant, experience mental health difficulties, use drugs, and engage in risky sexual behaviors than their heterosexual peers. However, there is little research investigating the long-term educational outcomes for sexual minority students. That is, researchers do not know if non-heterosexual students obtain fewer years of education by early adulthood as compared to their heterosexual peers. As an increasing number of youth are identifying as non-heterosexual and more diverse family arrangements are becoming more common, it is essential for policy makers and researchers to understand how early school experiences shape the eventual educational trajectories of sexual minority youth. This research uses longitudinal data from the National Longitudinal Study of Adolescent Health (Add Health) to determine whether sexual minority students obtain less education as adults than their peers and how experiences of victimization or bullying may condition these differences.

LITERATURE REVIEW

Some research has looked more generally at how school climates shape student experiences most often showing the importance of a link between the school's campus climate and the developmental needs of the students. For instance, McNeely, Nonnemaker, and Blum (2002) studied connectedness using the Add Health data. The authors used stage-environment fit theory and measured school connectedness by how well the school's characteristics met the developmental needs of the students. This research paper hypothesized that demographic composition, teacher qualifications, and discipline procedures all affected the outcome of how students were connected to their schools. These authors found that the more students are connected to their schools, the less likely they are to engage in violence, use substances, or initiate sexual activity and will report higher levels of well-being. Moreover, the research found that inexperienced teachers, segregated students within a diverse student body and harsh consequences due to strict policies decreased school connectedness and increased the students' risks of engaging in activities such as violence and drug-use.

In addition, the National School Climate Survey has also generally examined how school climates impact sexual minority youth's experiences and educational outcomes as well. For instance, the National School Climate Schedule was one of the first and still remains one of the very few national surveys that illustrate issues that the LGBTQ+² community faces within the nation's schools. The second survey that was administered in 2011 examined the experiences of LGBTQ+ students with regard to indicators of negative school climate including homophobic remarks, biased language, perception of school safety based on personal characteristics, missing days or classes based on violations of their safety, and harassment and assault in school. The results of the survey indicated that LGBTQ+ students' academic achievement, educational aspirations, and psychological well-being were dependent upon four variables: the presence of GSAs, supportive school staff, curricula that are inclusive of LGBTQ+ related issues, and anti-bulling/harassment school policies and laws. These variables were measured through students' experiences at their schools. After a final sample of 8,584 students between the ages of 13 and 20, the participants represented all 50 states, the District of Colombia, and over 3,000 school districts (Kosciw, Greytak, Bartkiewicz, Boesen, Palmer, 2011). The results indicated how LGBT students benefitted from a school environment where there were anti-bullying/harassment laws in place.

Thinking specifically about the experience of sexual minority youth, scholars have also looked at how Gay Straight Alliances (GSAs) can help mitigate negative experiences for these students. The Gay Lesbian and Straight Education Network (GLSEN) presented four major findings based on the presence of Gay-Straight Alliances in schools regarding school safety, access to education, academic achievement for LGBTQ+ students, and access to GSAs in schools. Their report shows that there is a pool of research that shows how sexual minorities often experience less connectedness to schools because of hostile climates in schools, homophobic remarks, bullying, and harassment due to gender expression and sexual orientation. This report indicates positive effects of GSAs in schools. For example, the presence of GSAs decreases in the amount of biased languages that often makes LGBTQ+ students feel uncomfortable in schools, 57% compared to 75%. The second major finding was that the presence of GSAs helped LGBTQ+ students acclimate to schools and feel more connected, ultimately increasing their access to education. The third major finding was that GSAs helped students to identify professional staff who are allies, which contributes to their overall comfort in school and has a positive impact on their academic achievement. The final major finding was that most students do not have access to GSAs or other student organizations/ support groups that address specific issues related to the LGBTQ+ community.

There has also been other research that used the Add Health survey in order to measure school outcomes such as school troubles, attitudes, and performance. Specifically, Russell, Seif, and Truong (2001) measure school outcomes for sexual minority students who report same-sex attraction within the context of four relational domains: teacher, social, family, and peer. Russell, Seif, and Truong (2001) state that each of these relational domains has an impact on students' negative attitudes about school and that sexual minority youth's feelings about their teachers play an important role in explaining school roles.

There is also research related to victimization and bullying related to school outcomes, but the outcomes and variables are different from my proposed research study. For example, Birkett, Espelage, and Koenig (2009) examined Lesbian, Gay, Bisexual, and Questioning (LGBQ) students and identified if they often have negative outcomes like depression, suicidality, drug use, and school difficulties. They used the Dane County Youth Assessment (DCYA), which was a survey that was administered amongst 7th through 12th grade students, in order to assess their opinions, concerns, attitudes, behaviors, and experiences as youth. This survey provided educators, administrators, service providers, policy-makers, and more with information for planning programs in middle schools that support the development of sexual minorities. The study supported the claim that more students were more likely to have negative outcomes due to the moderating effects of homophobic bullying.

There has also been recent publications on examining the influence of positive school climate and parental relationships on the mental health outcomes of sexual minority students, especially questioning students. For example, Espelage, Aragon, Birkett, and Koenig (2008) fill a gap in literature by examining influences of positive parental relations and positive school climate on mental health outcomes for high school students who are questioning their sexuality. The study composed of 13,921 high school students from the Midwest defines homophobic teasing and examines how high school students, especially sexual minorities, experience and perceive their experiences at school based on bullying, homophobia, school climate, etc. Espelage, Aragon, Birkett, and Koenig (2008) found that sexual minority youth were more likely to report high levels of depression, suicidal thoughts or feelings, and drug-use, while "students who are questioning their sexual orientation reported more teasing, greater drug use, and more feelings of depression and suicide than either heterosexual or LGB students.

In sum, researchers have only recently begun to investigate the immediate educational experiences of sexual minority youth. Most research, to date, has determined that sexual minority youth are at increased risk for negative outcomes in terms of bullying, mental health, and academic achievement. Fewer studies have looked at the long term outcomes of these early school experiences. In this research, I will use nationally representative data from the Add Health survey to determine if sexual minority youth have lowered educational attainment in adulthood and if these differences are conditioned by mental health and victimization. My research will investigate the following hypotheses.

Hypothesis

H1: Youth with same-sex attraction will attain less education than their heterosexual counterparts.

H2: The effect of high school experience variables will vary by gender and sexual orientation.

METHODOLOGY

This research will use secondary public data from the National Longitudinal Survey of Adolescent Health (Add Health), a nationally representative survey of 7-12 graders in the United States during 1994-1995. The Add Health is collected by the Carolina Population Center at the University of North Carolina at Chapel Hill. The Add Health Data followed the original cohort through 2008 when the respondents were between 24-32 years of age. This data is one of the most well-known longitudinal surveys for studying the experience of youth and has been used in hundreds of scholarly publications. The total sample size for the Add Health data is 8,000, of which I will retain roughly 5,000 cases for my analyses. In order to conduct a statistical analysis of the data, I will use Statistical Package for the Social Sciences (SPSS). I used SPSS in order to group participants based on gender identity and sexual attraction. After grouping participants and variables, I used SPSS to measure variables and to conduct a regressive analysis. Through the regressive analysis, I obtained coefficient models and tested correlations between specific variables.

Table 1. Descriptive Statistics for All Variables

		Same-Sex	Same-Sex	Opposite	Opposite
		Attracted	Attracted	Attracted	Attracted
	Total	Male (N=304)	Female (250)	Male (N=2844)	Female (N=3106)
Victimization	.616	.947 ^{sf, of}	.570 ^{sf, om, of}	.864 ^{sf, of}	.361 ^{sm, sf, om}
	(.978)	(1.238)	(.986)	(1.115)	(.711)
Self-Esteem	1.889	1.858	1.773 ^{om}	1.930 ^{sf,of}	1.863 ^{om}
	(.829)	(.873)	(.897)	(.817)	(.828)
Depressive Symptoms	.486	.491 ^{sf, om}	.640 sm, of, om	.416 sm, sf, of	.536 ^{om, sf}
	(.409)	(.406)	(.476)	(.362)	(.433)
Family Income	47.701	44.875	45.947	47.615	48.194
	(56.355)	(49.721)	(41.305)	(58.209)	(56.266)
Intelligence	3.876	3.845	3.823	3.882	3.877
	(1.097)	(1.103)	(1.104)	(1.116)	(1.079)
Expects College	6.416	5.870 ^{of}	6.338	6.071 ^{of}	6.780 sm,om
	(2.267)	(2.578)	(2.183)	(2.406)	(2.046)
White (1= Yes)	60.41%	56.25%	62.80%	60.86%	60.21%
Asian (1=Yes)	3.20%	1.97%	1.60%	3.59%	3.09%
Public Assistant (1=Yes)	9.16%	8.08%	11.43%	9.02%	9.21%
Parents Married (1=Yes)	70.15%	67.56%	62.44%	70.57%	70.62%
Parents' Education	5.578	5.222	5.583	5.637 sm	5.558
	(2.335)	(2.311)	(2.472)	(2.305)	(2.351)
Educational Attainment	5.620	5.073 ^{sf,of}	5.744 sm,om	5.335 ^{sf,of}	5.896 sm,om
	(2.026)	(2.228)	(1.973)	(2.009)	(1.984)

Source: National Longitudinal Study of Adolescent Health (Add Health)

Note: sf= mean different from same sex attracted female, sm= mean different from same sex attracted male om= mean different from opposite attracted male, of= mean different from opposite attracted female (p<.05)

VARIABLES

Romantic attraction and gender serves as the primary independent variable for this study. Romantic attraction is constructed using two measures in the Wave 1 and Wave 2 surveys. The questions ask the youth if they ever felt attracted to a male or female. Students who reported attraction to their own gender in either Wave 1 or Wave 2 were coded as having a same-sex romantic attraction. Additionally, I combine romantic attraction with gender to create four discreet groups, same-sex attracted males, same-sex attracted females, opposite-sex attracted males and opposite-sex attracted females. Table 1 shows that the sample consisted of 304 same-sex attracted males (4.76%), 250 same-sex attracted females (3.84%), 2,844 opposite-sex attracted males (43.73%), 3,106 opposite-sex attracted females (47.75%).

Victimization is next independent variable and is constructed from five questions asking the youth if 1) they had a knife or gun pulled on them, 2) were shot, 3) had been stabbed 4) got into a physical fight or 5) were jumped. These questions are combined into one binary variable indicating any victimization. As we see in table 1, the mean level of victimization was .616. In addition, same-sex attracted males (.947) reported more victimization than both same-sex attracted females and opposite-sex attracted females. Same-sex attracted females (.570) reported less victimization than same-sex attracted males and opposite-sex attracted males. Opposite-sex attracted females (.361) reported the lowest levels of victimization than any other group.

Self-esteem is a composite variable consisting of the youth's response to the following three questions, "I am just as good as other people" "I am hopeful about the future" "I feel like life had been a failure." Responses to these questions are combined to make a self-esteem composite. According to table 1, the total mean level of self-esteem was 1.889. Opposite-sex attracted males (1.930) reported the highest levels of self-esteem

while same-sex attracted females reported the lowest with a mean level of 1.773. All groups excluding opposite-sex attracted males reported lower mean levels than the total mean level (1.889).

Depressive symptoms is a composite variable consisting of youth's responses to the following six questions, in the past two weeks, how often have you "been easily bothered by things" "had a poor appetite" "had the blues" "had trouble keeping my mind focused" and "felt depressed" "felt too tired to do things." Responses to these questions are combined to make a depressive symptoms composite. According to table 1, same-sex attracted females reported the highest levels of depressive symptoms with a mean level of .640. Same-sex attracted males (.491) reported levels closest to the total mean (.486). Same-sex attracted females and opposite-sex attracted females (.536) reported higher levels of depressive symptoms compared to same-sex males and opposite-sex attracted males (.416). The difference between the means of same-sex females (.640) and opposite-sex attracted males is high.

Intelligence is an item that asked each respondent to rate his or her intelligence relative to others. Responses ranged from 1 "Moderately below average" to 6 "Extremely above average." There were no differences across the groups in intelligence.

Expects College represents the answer to a single item asking the students to gauge the likelihood that they would graduate from college. Responses ranged from 0 "No chance" to 8 "It will happen." Opposite- sex attracted females had aspirations (6.780) higher than either same-sex attracted males (5.870) or opposite-sex attracted males (6.071).

Family income is the final independent variable which has a total mean of 47.701. Same-sex attracted males (44.875) and same-sex attracted females (45.947) reported lower estimated family income values than their heterosexual peers. Same-sex attracted males are more likely to have lower family incomes compared to opposite-sex attracted males (47.615) and opposite-sex attracted females (48.194).

I will also include control variables of race, gender, parental education, parental marital status, and whether the family received government assistance during their youth. Race is captured by two binary variables. *White* (1=Yes) and *Asian* (1=Yes) compare white and Asian students respectively, to all students from all other racial backgrounds. *Public Assistance* (1=Yes) compares students who reported receiving public assistance at time 1 to all others. *Parents married* (1=Yes) compares students whose parents indicated they were married at time 1 to all other students. The dependent variable, educational attainment, is a measure of each respondent's educational attainment in 2008 ranging from 1 "completed 8th grade or less" through 11 "completed doctoral degree." Table 1 shows that both same-sex attracted (5.744) and opposite-sex attracted (5.896) females attained more education than both same-sex attracted (5.073) and opposite-sex attracted (5.335) males.

	Model 1	Model 2	Model 3
Same-Sex Attracted Male	376 +	117	.043
	(.207)	(.187)	(.174)
Same-Sex Attracted Female	.598 **	.669 **	.527 **
	(.222)	(.200)	(.188)
Opposite-Sex Attracted Female	.612 ***	.674 ***	.490 ***
	(.082)	(.074)	(.073)
Victimization			196 ***
			(.039)
Self-Esteem			.139 **
			(.044)
Depressive Symptoms			098
			(.093)
Family Income		.003 ***	.002 ***
		(.001)	(.001)
Intelligence			.342 ***
			(.034)
Expects College			.170 ***
			(.017)
White (1= Yes)		.024	.103
		(.081)	(.076)
Asian (1=Yes)		.200	.408 +
		(.233)	(.218)
Public Assistant (1=Yes)		707 ***	525 ***
		(.149)	(.140)
Parents Married (1=Yes)		.421 ***	.339 ***
		(.085)	(.080)
Parents' Education		.306 ***	.222 ***
		(.017)	(.016)
R ²	.026	.214	.317

Table 2. Coefficients from Regression Models for Academic Attainment

Source: National Longitudinal Study of Adolescent Health (Add Health) (N=6,504) Note: +p<.10; *p<.05; **p<.01 ***p<.001

RESULTS

Table 2 presents the coefficients from my regression models for academic attainment. Accounting for sexual attraction, Model 1 shows that both opposite-sex attracted and same-sex attracted females had more educational attainment than opposite-sex attracted males, whereas same-sex attracted males attained extremely lower levels of education than opposite-sex attracted males. Model 2 indicates a positive relationship between educational attainment and family income and a negative relationship between receiving public assistance and educational attainment. It also shows that there is a positive association between educational attainment and parents' education. Accounting for education and if parents were married, there is a positive relationship between parent's marital status and educational attainment that is indicated in Model 2 as well.

Model 3 indicates that as victimization increases, educational attainment decreases amongst all groups but same-sex attracted and opposite-sex attracted females still achieve higher levels of education despite victimization. Model 3 also shows a positive relationship between intelligence (how intelligent do they feel) and educational attainment. Depressive symptoms are showed in Model 3 indicating that depressive symptoms are not largely associated with educational attainment. Opposite-sex attracted females were the most likely to attain high levels of education despite other variables. Considering racial identity, Asians and whites were more likely to attain higher levels of education compared to non-Asians and non-whites.

	Model 1	Model 2	Model 3
	Victimization	Intelligence	Depression
Same-Sex Attracted Male	.068	-1.275 +	152
	(.223)	(.685)	(.274)
Same-Sex Attracted Female	.476 *	258	.556 *
	(.214)	(.783)	(.305)
Opposite-Sex Attracted Female	.568 ***	.544 *	.767 ***
	(.084)	(.268)	(.109)
Moderator	148 **	.332 ***	.247
	(.050)	(.048)	(.152)
SS MaleXModerator	035	.342 *	.279
	(.157)	(.172)	(.410)
SS FemaleX Moderator	.108	.194	149
	(.180)	(.188)	(.457)
OS Female X Moderator	176 *	014	630 ***
	(.085)	(.064)	(.189)
R ²	.318	.318	.320

Table 3. Coefficients from Selected Interaction Effects Regression Models for Academic Attainment

Source: National Longitudinal Study of Adolescent Health (Add Health) (N=6,504) Note: +p<.10; *p<.05; **p<.01 ***p<.001



Table 3 presents results from an interaction analysis. The models in Table 3 are estimated to determine whether particular variables have a differential effect on educational attainment based on gender-sexual attraction status. Model 1 uses victimization as the moderator. Model 1 also indicates that victimization has a negative impact on educational attainment. In addition, the significant, negative coefficient for the interaction term suggests that this effect is more negative among opposite-sex attracted females. Figure 1 shows this pattern graphically; specifically, the figure shows that although victimization has a negative impact on educational attainment for all groups, the slope for opposite-sex attracted females is far steeper than other groups.



Model 2 utilizes intelligence as the moderator. Model 2 shows that intelligence has a positive effect on educational attainment. The significant interaction effect suggests that the effect of intelligence is more positive among same-sex attracted males. Figure 2 shows this pattern graphically. Specifically, Figure 2 demonstrates that although intelligence has a positive effect for all four groups, the positive effect of intelligence on educational attainment is most pronounced for same-sex attracted males.



Finally, Model 3 uses depression/ depressive symptoms as the moderator. Model 3 indicates that depression has a non-significant relationship with educational attainment. However, the interaction effect indicates that depression has a negative effect on educational attainment among opposite-sex attracted females. Figure 3 shows this pattern. Specifically, Figure 3 shows that although depression has a negative association with educational attainment for opposite-sex attracted males and same-sex attracted females, the effect is much more negative among opposite-sex attracted females.

DISCUSSION AND CONCLUSIONS

The primary goal for this paper is to assess the long term educational outcomes of sexual minority youth and to determine if their educational attainment is conditioned by mental health and victimization. By using nationally representative data from the National Longitudinal Study of Adolescent Health, I separated participants into four representative groups consisting of same-sex attracted males, opposite-sex attracted males, same-sex females and opposite-sex attracted females. This research improves upon the theoretical idea that early school experiences shape eventual trajectories of educational attainment for sexual minority youth. While most research currently only covers topics related to school climate, biased language, violence, bullying, and other variables that affect immediate and short term psychological and social development for sexual minority youth overall educational attainment.

My first hypothesis was that youth with same-sex attraction will attain less education and will be less likely to achieve their desired educational levels. In fact, this hypothesis is rejected because results show that same-sex attracted males had lower educational attainment, but same-sex attracted females had higher levels of educational attainment. Same-sex attracted males were less likely to obtain their desired level of educational

attainment than their female peers (both same-sex attracted and opposite-sex attracted). Although many sexual minorities experience high levels of victimization, victimization has a different impact on long term educational attainment for same-sex attracted males than same-sex attracted females. More research should explore the differences in the educational experiences of sexual minority youth by gender. In addition, scholars should not generalize the experiences of sexual minority youth without considering the impact of gender, as this research shows the experiences of same-sex attracted males and females can diverge substantially.

Consistent with expectations, victimization has a negative impact on educational attainment. Specifically, Model 3 of Table 2 indicates that as victimization increases, educational attainment decreases. Interestingly, the data also indicated that victimization has the strongest effect among opposite-sex attracted females. Thus, scholars should focus more research that focuses on the long term effects of victimization on opposite-sex attracted women.

Moreover, my findings indicate that depressive symptoms only had a strong negative effect among oppositesex attracted females only. Thus, scholars should explore why victimization impacts opposite-sex attracted females more than same-sex attracted males and females and opposite-sex attracted males. Depressive symptoms had a non-significant relationship with educational attainment. Model 2 shows that intelligence (how intelligent participants feel) shared a positive relationship with on long term educational trajectories for same and opposite sex attracted youth, especially same-sex attracted males. Therefore, it is extremely important that educators figure out a way to increase how intelligent students feel about themselves, especially same-sex attracted males.

LIMITATIONS AND RECOMMENDATIONS FOR FUTURE RESEARCH

Although this research is unique in that it examines how victimization and mental illnesses condition long term educational outcomes of same and opposite-sex attracted males and females, there should also be other studies that test data from other longitudinal studies. The questionnaires could also include more questions that ask students to identify with being either straight, lesbian, gay, bisexual, queer, transgender, or transsexual, etc. These questions would be supplemental to the same questions that were asked in the National Longitudinal Study of Adolescent Health about sexual attraction. Self-identification questions will help to identify other dynamics of identity development that may have an impact on educational attainment and development. For instance, questions about whether students were "out" as sexual minorities may give further insight into their experiences. In addition, the data from the Add Health did not show a nationally representative gap in educational attainment between blacks and whites. This longitudinal data also is not representative of the unique experiences that participants might experience. I suggest that more qualitative data, such as narratives, surveys, and interviews, be conducted in order to speak to the individual experiences of same-sex attracted youth. It is also important to measure other variables that might impact educational attainment amongst same-sex attracted and opposite-sex attracted youth. Also, there are other ways that scholars might group participants and recode educational attainment results from the survey that might or might not change the results from the experiment. Thus, it might be beneficial for scholars to try recoding educational attainment in order to see if there is a difference in the results. NOTES

- 1. I use the terms such as "gay" "lesbian" and "straight" to refer to well know categories of people based on their sexual orientation. However, when describing the respondents in my data, I use "same-sex attracted" and "opposite-sex attracted" because the survey did not ask respondents how they identified, only who they were attracted to.
- 2. LGBTQ+ is a general term that includes various sexual orientations and identities, including but not limited to Lesbian, Gay, Bisexual, Transgender, Queer, Questioning, and many others.

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Advertisement Appeal and Presentation Format: Aligning to the Individual User's Interests

By Morad S. Alkarsh Major: Information Systems Management Mentor: John Heinrichs, PhD, Department of Management & Information Systems

ABSTRACT

The virtualization of knowledge has given individuals greater access to search for and discover information. As information becomes readily available, individuals are making decisions faster and with greater insight. Thus, it is believed that internet-based advertisements that clearly appeal or target individuals' unique information search requirements will be more successful and achieve greater conversion rates. Therefore, the justification for this research is to better understand how to target individuals based upon their behavioral actions and search patterns. This developed profile of the individual allows organizations to develop a more engaging and dynamic website based upon the individuals' unique information requirements. Thus, building dynamic, smart, personalized websites that cater to the individual helps the organization provide the individual with better information based upon their developed profile.

INTRODUCTION

With the continuing evolution of the internet, organizations are reaching out to individuals using internet-based (inbound) marketing as opposed to traditional marketing approaches. These internet-based marketing approaches focus on the development of content-rich, personalized, smart, and responsive websites. These websites are then crawled and indexed by search engines so that individuals can develop keyword specific queries to locate desired content. Thus, querying search engines has become one of the most popular ways for individuals to discover information and as such, the internet has fundamentally changed the way individuals search and find information that they use to make decisions.

Coupled with the shift of having individuals using search engines to locate information, search engine advertising has also evolved. Organizations are increasingly using the advertising capability of the internet to communicate their messages and as a result, United States advertising expenditures are rising. Specifically, search engine advertising has become a major form of online advertising with 37% of non-mobile search and 28% of mobile search 4th Quarter 2014 ad revenue related to internet searching (IAB, 2015) with "sponsored search advertising as the most dominant form of online advertising" (Chan, Xie, & Wu, 2011). By utilizing search engine advertising, an organization can present their website content to individuals when those individuals search using specific keywords or keyword phrases. This targeting capability provides the organization with invaluable opportunities as the targeting capability is based upon the individuals' own search queries (Berman & Katona, 2013).

Furthermore, the use of data on an individual's browsing behavior can be used to improve the overall appeal of the organization's website content (Lambrecht & Tucker, 2013). Browsing data that is unique to the organization can be used to personalized and customize the organization's website content for the individual. This browsing data can be used to better target advertisements to individuals who fit a particular profile. Yet, there is very little evidence to show if or how tailoring advertising content to the individual's observed preferences or search behavior is effective (Lambrecht & Tucker, 2013).

RESEARCH QUESTION

This research focuses on providing insights into several questions to determine how the organization should promote an online academic program. Specifically, using Inbound Information Technology (IIT) as the topic being searched, the following questions will be investigated.

- How effective are the search and display advertisements in influencing / informing college-bound graduate individuals for further inquiries into the Inbound Information Technology (IIT) program?
- How effective are emotional appeal advertisements versus factual appeal advertisements in encouraging further student inquiries about the IIT program?
- How effective are low, medium, and high complexity presentation formats on landing pages in encouraging further student inquiries about the IIT program? and
- Which advertisement appeal / presentation format combination is more effective in encouraging further student inquiries about the IIT program?

According to the Marketing Science Institute (2015), understanding the guidelines for digital marketing activities such as using online search and display ads is a research priority. Further, the emergence of mobile searching has complicated the ability to measure advertising effectiveness (Chennamaneni, et al., 2011). Mobile represents a new advertising channel for communication. The purpose of this research is to enhance our understanding of how to tailor advertising content to be effective. To accomplish these objectives, this research utilizes a two by two by three experiment with advertisement appeal (argument strength valence and advertisement wording) and presentation format (low complexity, medium complexity, or high complexity landing page) as the three dimensions. The research objective is to develop a more comprehensive profile of what interests' individuals by investigating their search behavioral actions.

LITERATURE REVIEW

Individual's use of the internet has evolved from solely a tool used for accessing information to a tool of discovery. Individuals are using the internet to conduct research and discover information on various topics of interest. It is predicted that by 2020, individuals will manage over 85% of their relationship with the organization without interacting with a human (Gray, 2015). Therefore, in order for the organization to be discovered by individuals while they are conducting their research, links to the organization's website pages must be highly visible on the search engine results pages. Ideally, the organization's website detailing the relevant program or topic should be located on the first page of the search results for their keyword-based search queries. The organization can accomplish this by using on-page search engine optimization (SEO) techniques to increase their visibility in the organic search results.

In combination with SEO techniques to being discovered organically, organizations can also be discovered by focusing on search engine advertising (SEA) campaigns. The objective of SEA campaigns is to have the organization's specific information listings appear in the search engine's paid results section (Warack, 2015). Thus, SEA campaigns provide the opportunity for high visibility for organizations using paid customized advertisements on search results pages as well as developing advertisements targeted for the search engine's display network.

SEARCH ENGINE ADVERTISEMENT

Paid Search Engine Advertisements (SEA) for the search engine results page consist of four short line text statements that are placed on the edges of search engine results pane surrounding the organic search engine results (Atkinson, Driesener, & Corkindale, 2014). Three key components of online text advertisement that appears in the search results pane include the headline, the display URL, and the description. The headline consists of up to 25 characters; the display URL consists of up to 35 characters; and the description can cover two lines with each line consisting of up to 35 characters.

Each of these key components in the online advertisement serves a different purpose. The headline is used to gain the individuals' attention so it focuses on the theme or unique aspect of the program or topic whereas the description creates the advertisement appeal using combinations of words focused on the argument strength and wording appeal. The description contains specific emotional or statistical information that is used to influence the individual's decision-making process. Atkinson et al. (2014) indicate that the headline should include the identification of the brand or program but should not contain a question, as questions are associated with underperforming click-thru-rates for the advertisement. Further, their guidelines indicate that the first line of the description should contain an expansion or boasting of the offer presented in the headline and then the second line of the description should contain the call-to-action and/or price of the offer (Google, 2015c).

Given the previously defined structure for the advertisement, what are the characteristics of the words or phrases to be used in the SEA? Rutz et al. (2011) report that broad keyword searches lead to more return visits whereas narrow or focused keyword searches do not. Rutz et al. (2011) argue that a narrow keyword search phrase indicates an individual knows what s/he is searching. This individual probably has reached a decision and is attempting to determine if the SEA offer fits their needs. A broad keyword search phrase is indicative of information gathering.

ADVERTISEMENT APPEAL

The literature has conceptualized emotion in various ways (Batra & Ray, 1986; Chandy et al., 2001) either by treating each emotion as a unique construct or by treating emotions collectively on a scale from negative to positive (Bagozzi and Moore 1994). Emotions, however, are bipolar states (Bagozzi, et al., 1999) and can be anchored with emotional appeal and factual appeal. Thus, these bipolar states can possess a valence of either positive affect or negative affect (Xie, Donthu, Lohtia, & Osmonbekov, 2004).

An advertisement's emotional appeal is one in which feelings are emphasized to induce an emotional response from the individual. These emotional appeals tend to be subtle, indirect, and could include the development of story or other indirect mechanism focused on gaining an affective reaction (Okazaki, Mueller, & Taylor, 2010). This emotional appeal is conceptualized as a mood conveyed through development of emotional text that may not be directly related to the program or topic. In this advertising appeal, emotions are emphasized to induce a feeling reaction and usually contain no rational reasons and are abstract and subtle in its appeal.

In contrast, an advertisements statistical or factual appeal is to encourage rational thinking on the part of the individual. Advertisements using a factual appeal are usually direct and often specify the organization's brand name and/or make recommendations. These advertisements explicitly mention factual information which can encompass comparisons with other competing programs, unique features of the program under investigation, or other factors that may be relevant to the individual (Okazaki, Mueller, & Taylor, 2010). Thus, the dimensions of the rational appeal include thinking, explicitness, and fact. Statistical advertisement information could include information focused on themes such as projected increase in job offers, projected income with the degree, current graduation rates, and current job placement rates. Therefore, this appeal is conceptualized as a message making explicit (or implicit) mention of the product (or program). The objective is to induce rational thinking by the individual (Okazaki, et al., 2010).

Consumer behavior literature has shown that when individuals have defined preferences, they are more likely to respond positively to advertisements displaying specific information. Lambrecht and Tucker (2013) found that generic advertisement appeals are more effective. The complex hard sell is not effective until consumers are in the final stage (Lambrecht & Tucker, 2013). Advertising wording appeal focuses on the textual elements of the advertisement resulting in an individual's actions (i.e. click-through and purchase). The advertising wording appeal is a research question that has not been addressed in the marketing literature (Rutz & Trusov, 2010). This discussion on advertising appeal leads to the following hypotheses.

H1: Display / search advertisements with positive induced emotions will result in higher click-through rates than advertisements without emotions.

H2: Positive wording in display / search advertisements will result in higher click-thru-rates than negatively worded display / search advertisements.

PRESENTATION FORMAT

Based upon the theory of complexity (Berlyne, 1960), the relationship between the level of complexity and advertising effectiveness has an inverted "U" shape. Researchers argue that the number of visual features on a web page affects the individual's attention, attitudes and purchase intentions.

An important component of the display network advertisement or of the landing page the individual is directed to by the search advertisement is the complexity of the advertisement or landing page. This complexity can involve multiple factors such as structural elements, hyperlinks, background colors, images, or text. These various factors can be manipulated to adjust the level of perceived complexity. The complexity of the display advertisement or landing page can mitigate the desired effect of the advertisement (Chun, Song, Hollenbeck, & Lee, 2014). The presentation format of an advertisement that is rated as highly complex can result in the individual having difficulties identifying the relevant information and then disregarding rather than remembering the presented information.

Berlyne (1960) identified several structural elements of complexity and posited that individuals perceive an advertisement or landing page as being more complex as the number of distinguishable elements is increased. To manipulate the level of complexity of an advertisement or landing page involves the various background colors, the number of hyperlinks, images, videos, and the length of the advertisement or landing page (Geissler, et al., 2001; Stevenson Bruner & Kumar, 2000). Content-based elements, such as animation, audio, images, text, and video, essentially comprise the structural information categories. Geissler, et al. (2006) argues advertisement or landing page complexity influences an individual's attention, attitudes, and intentions. This discussion leads to the question of how the complexity of the advertisement influences the evaluation of the program resulting in the following hypothesis.

H3: Individual response to the advertisement will be a) low for low complexity presentation format, b) high for medium complexity presentation format, and c) low for a high complexity presentation format.

METHODOLOGY

This research study is conducted at the individual search / display advertisement level. The format and structure for both the display and text-based search advertisements used in this study were developed by the

researchers following extensive literature review. These display and text-based advertisements focus on the various aspects of the Inbound Information Technology program (<u>http://inbound.business.wayne.edu/iit</u>) and appeared on the Google search results page and on the Google display network.

Currently, the Google search engine is the most prevalent and widely used search engine for both desktop and mobile devices (Sterling, 2014). Further, Google provides its pay-per-click (PPC) advertising system (AdWords) for creating and displaying ads on the search results pages and on display network partner sites. Therefore, this research focused solely on using Google to display the text and display images. Thus, the advertisements for this research project were created using the AdWords and Google Web Designer tools. The display advertisements display on the Search Display Network that includes Google Search, Shopping, Google Maps, Groups, and non-Google search sites that collaborate with Google to show search ads (Google, 2015b).

DESIGN

To investigate the effectiveness of the various characteristics of the advertisement, a two (argument strength: strong vs. weak) by two (advertisement wording: positive vs. negative) by three (landing page presentation format: low vs. medium vs. high complexity) between-subjects design experiment is to be used. The two characteristics of argument strength and advertisement wording determined the advertisement appeal. Argument strength focused on using specific words whereas the advertisement wording focused on the text in the advertisement. The landing page design is to be manipulated to generate the desired presentation formats for testing.

The generic process is for the individual searching for information to be presented with either the search textbased advertisement or the display network advertisement. When the individual clicks on the advertisement, the individual will be taken to one of the twelve landing pages. The individual reviews and evaluates only one version of the landing page from the set of 12 potential landing pages. They are able to scroll up and down the landing page as they evaluated it. The individual will then be presented with the request to complete the survey.

SELECTION OF PARTICIPANTS

Subjects for this research study will be recruited from three different sources. The first recruitment source is from individuals who clicked on the search / display network advertisements as they performed keyword searches and then opted-in to this research study. The second recruitment source is from students who, as part of a class exercise, volunteered to participate in this study. Previous researchers have indicated that the college students are used because students generally tend to be experienced and frequent web users and are "most likely to yield meaningful results that are useful for understanding the behavior of web users in years to come" (Brackett & Carr, 2001; Gallagher, Foster, & Parsons, 2001). The third recruitment source is from individuals who were provided by a major online survey firm. In all circumstances, individuals will be presented with the informed consent form and will have the opportunity to either opt-in or opt-out of the study.

STIMULI

The target product for this research study is an academic program. The presentation of the landing page for the search advertisement focused on creating a template using common structural elements and then manipulating the unique landing pages using variety and volume of specific elements thus ensuring that the focus is on the complexity of the landing page. The landing page templates were identical with the header containing the logo and the name of the academic program but not a navigation menu. The main section of the landing page contains the sidebar on the left and the main content area on the right.

focused on the advertisement slogan, theme, and enhancing the text from the advertisement. The slogan was "Enhance Your Career with Inbound Marketing." The theme encompassed job opportunity, salary potential, and career enhancement. The main content area on the right contained the images and text that are manipulated. The footer contains the site map and Inbound Information Technology course links. The advertisements and landing pages used in this study are designed using the professional development tools of Google AdWords, Google Web Designer, and HubSpot Content Optimization System (COS).

RESULTS

Manipulation Check

To ensure that the respondents perceived the advertisements as the researchers intended, a manipulation check is first performed. The landing page presentation format consisted of a question where the respondent rated the landing page for three bi-polar values using a 7-point scale where the respondent rated these values on a scale between the two extremes. The three bi-polar values are complex – simple, complicated – uncomplicated, and dense – light (Lambrecht & Tucker, 2013; Chun, Song, Hollenbeck & Lee, 2014). The argument strength consists of a question where the respondent rated the landing page for six bi-polar values using a 7-point scale where the respondent rates these values on a scale between the two extremes. The six bi-polar values were emotional – intellectual, implicit – explicit, impression-based – evidence-based, imaginative – factual, appealing – convincing, and image centered – feature centered (Okazaki, Mueller, & Taylor, 2010). The advertisement wording appeal consists of a question where the respondent rates these values on a scale between the two extremes. The five bi-polar values were bad – good, unpleasant – pleasant, unfavorable – favorable, negative – positive, and uninformative – informative (Chun, Song, Hollenbeck, & Lee, 2014; Mitchell & Olson, 1981).

A mean value will be calculated for the versions of the advertisement wording appeal, argument strength, and landing page presentation format. The results should confirm that the argument strength, advertisement wording appeal, and the landing page presentation format are perceived as the researchers intended.

MEASURES

There are a variety of variables available for analysis from this study. The survey focuses on attitude, believability, irritation, and argument strength for the advertisement appeal, complexity, attitude, and attention span for the presentation formation, and intention toward the program. Information regarding the use of mobile devices, opinions regarding mobile devices and continuity, immediacy, searchability, and portability for mobile devices will also be collected. Additional information regarding the user's demographics and user's browser, operating system, and other technical information will be captured as well as qualitative information including the rank of advertisement in search results page (Yoo, 2014), impressions, quality score, and the click-through rate of keyword search advertisements.

DISCUSSION / CONCLUSION

This research experiment provides data to determine which presentation format of the advertisements and/or landing pages in combination with the various advertisement appeals will be more effective at reaching individuals. Organization needs to consider the advertisements responsiveness in the context of a multistage decision process.

This research project has several goals. The first goal is to tailor the IIT website and the website experience to the individual. The second goal is for the organization to become proactive in creating a more dynamic website that caters to the needs of the individual. Finally, the third goal is in determining how best to fulfill the individual's information needs and best-fit ads through all the information gathered. The research focuses on determining the lifecycle stages and developing profiles.

Universities face challenges with the expansion of the internet requiring the use of marketing techniques to become found. Marketing by higher education organizations can be defined as discovering the educational needs, wants and expectations of potential students and satisfying them by offering degree programs and other forms of education. Yet, higher education prospects have some of the longest lead times, with the average being 2-3 years before converting (Staynton, 2015).

LIMITATIONS

This research project does not control for gender or cultural diversity (Goodrich, 2014; Okazaki, Mueller, & Diehl, 2013). The research results are focused on Michigan, Northwest Ohio, and Southeastern Ontario and are focused on a very specific academic program. Further, given the constraints of the research project, there will be minimal time and limited geographic reach to gather the empirical data. Kireyev et al. (2013) argue that there exists an interaction between paid search advertisements and display network advertisements. They argue that display network advertisements interact with the search advertisements. Future research should address these limitations and identified issues.

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THE LAND BRIDGE PROJECT: USING UNITY 5.0 TO RE-CREATE AN ANCIENT CIVILIZATION

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ABSTRACT

The Land Bridge Project has been a long, ongoing collaborative effort between researchers at Wayne State University and the University of Michigan to create a virtual simulation of the Alpena-Amberly Land Bridge, a land bridge that connected Michigan and Ontario and divided Lake Huron 10,000 years ago. The simulation was created to help archaeologists at the University of Michigan pinpoint likely locations along the bottom of Lake Huron to search for ancient Paleo-Indian artifacts, hunting blinds, and camp sites.

Originally created using Microsoft's XNA framework, the simulation is becoming dated and harder for people to use to the point where it cannot run on newer machines properly. Because of that, the research team decided to port the Land Bridge Project to Unity 5.0, newer 3D game development software that greatly simplifies programming, management, and optimization of the simulation, while allowing the research team to release the simulation to the public. This paper discusses in detail re-creating the land bridge in Unity 5.0. It discusses how the land bridge was divided into 21 different regions using NOAA data and screenshots from the simulation's original XNA version, and then imported into Unity 5.0 as height-maps. Detailed instructions for creating regions in this manner are provided.

INTRODUCTION

For the past several years, Dr. Robert Reynolds and his research team at Wayne State University have been working on a long-term project colloquially call "The Land Bridge project", which is a collaborative effort between them and researchers at the University of Michigan to create a virtual world simulation of the Alpena-Amberly land bridge that connected northern Michigan to Canada across Lake Huron 10,000 years ago. The team originally created the virtual environment using Microsoft's XNA platform (referred to throughout the paper as "XNA") and the XNA version of the simulation has served as the flagship demonstration of the project until now.

As time went on and technology became more advanced, the XNA virtual environment became obsolete to the point where it is difficult to run on newer computers because it requires an older version of Direct X. Because XNA is not optimized for 3D game development, most of the algorithms, designs, and basic functions a 3D game requires have to be coded and updated by hand. The original simulation requires a very advanced expertise in order to program, manage and update and because of that managing it takes time and effort that can be better spent optimizing the cultural algorithms themselves.

Because of this, the research team decided to port the simulation to Unity 5.0. Unity 5.0 is newer 3D game development software that greatly simplifies the creation of 3D games, allowing a user to develop environments artistically by simply importing terrain height-maps and using tools to color in textures and

generate terrain by hand. Unity 5.0 can not only run on newer machines but through its user-friendly design and pre-made engine takes out much of the time, effort, and work that would be required to make a 3D game from scratch. Porting the Land Bridge simulation to Unity 5.0 will allow the research team to take advantage of these features, allow other members of the research team to easily access and update the simulation in a simple and timely manner as needed. Because Unity 5.0 allows a 3D game to be exported into multiple formats, porting the simulation will also allow us to turn the simulation into a fully-fledged game to be released to the public, allowing them to participate in the project.

I was allowed to join the research team to help port the simulation. I am a McNair scholar who has been trained in Unity 5.0 through game programming classes taught by Dr. Robert Reynolds at Wayne State University. In those classes I demonstrated talent in level and terrain design. Because of my skill, my task in the group is to take overhead images generated by the older XNA engine, which are derived from NOAA scans of the bottom of Lake Huron, convert them into height-maps that can be processed in Unity 5.0, and with them re-create the land bridge.

OBJECTIVE

The land bridge simulation is being ported to Unity 5.0 to better simulate conditions on the Alpena-Amberly land bridge as they were 10,000 years ago. The Unity 5.0 port will allow us to model caribou movement throughout the landscape much easier and through that make it easier to identify and mark spots that ancient Paleo-Indians might have placed hunting blinds at. These locations will be marked and sent to archaeologists at the University of Michigan so that they might explore those locations below Lake Huron and potentially find ancient artifacts. In so doing, we and the archaeologists hope to learn more about the ancient Paleo-Indians that lived in the area. The Unity 5.0 port will allow us to release the simulation on multiple platforms so we can let the public help us find hot spots, give them a chance to explore the land bridge as it was 10,000 years ago, have them help produce usable knowledge that can be used by experts in the field, and promote the usage of citizen science.

BACKGROUND

The Alpena-Amberly land bridge is a land bridge that connected northeastern Michigan to western Ontario 10,000 years ago. It is only 8 miles wide, is 80 miles long and divided Lake Huron into two smaller lakes, the larger of which is called Lake Stanley. Dr. John O'Shea, an archaeologist at the University of Michigan, found evidence that caribou used to cross the land bridge to migrate and forage for food, and that ancient peoples called Paleo-Indians would hunt caribou on the bridge [1]. Because not much is known about Paleo-Indians due to the fact that they existed before recorded history, we have to rely on dig sites to learn anything about them. These sites are rare and hard to find, with land sites often paved over accidentally, and because of that archaeologists like Dr. O'Shea have been looking for them at the bottom of Lake Huron. Because it is difficult and expensive to dive to the bottom of a lake to look for artifacts, Dr. O'Shea and his team need a precise way to figure out good spots that are most likely to have artifacts in them. Virtual simulations are used for this purpose.

Ethymetry of Lake Huron with Topograph



Dr. Robert Reynolds, who received his doctorate from the University of Michigan, has been helping Dr. O'Shea look for potential dig sites along the land bridge through the use of virtual simulations for many years. In 2009, Dr. Reynolds released a paper discussing his A.I. algorithm called "Cultural Algorithms" [3] which is used in the land bridge simulation. Over the years, many people including several McNair scholars have helped add to and optimize the simulation, creating the virtual landscape using Microsoft's XNA platform and modifying the A.I. In 2011, James Fogarty released his master's thesis detailing his modifications to the A.I. and the results after running the simulation many times [4]. Several papers have been released through the years that give updates on the land bridge simulation, including one written in 2014 by Dr. Reynolds, Dr. O'Shea, current research team member Areej Salaymeh, among others [5].

Which leads us to the present situation. Chapter 4 of the book "Caribou Hunting in the Upper Great Lakes" describes in depth how the older XNA version of the simulation generates terrains. Under the section "The 3D Virtual World" [6], the process can be summarized as using large swaths of tab-delimited data, setting a minimum height, easting and northing was determined from the data, and used to generate the height of points that were then mathematically drawn in. Large tables of this data had to be manually inputted into the XNA program, by hand, every time a region was to be made. This is very difficult, very time-consuming, and requires very advanced skill with the XNA framework, which is why the research team chose to port the simulation to Unity, which does not require those tables of data at all to generate height-maps or terrain.

I joined the research team in October of 2014 as a part of the McNair Scholar's Program research institute. I was an active student in Dr. Reynolds's game programming classes, which taught Unity 5.0, and I have used my skills in the program to develop a simple, quick and easy technique to generate height-maps, and from them usable terrains, from screenshots generated by the XNA version of the Land Bridge simulation.

METHODOLOGY

To properly model the movement of caribou, and through that, pick out choice dig locations, there had to be an environment for the caribou to actually move around in. Because the simulation is being ported to Unity 5.0, the environment must be re-created so that the rest of the research team can place in scripts that will control plants, trees, the caribou A.I., and hunting blind placement. The virtual environment is split up into 21 different regions. Each region is represented in Unity as a terrain in its own unique scene. In Unity, one can import what is called a height-map which is a 2D greyscale image that tells Unity how to generate a terrain. The brighter the color of a certain section, the higher that section will be drawn in Unity. Height-maps allow Unity users to create complex and detailed levels without having to draw everything into Unity directly. Each region was created using height-maps that were created from top-down aerial screenshots generated by the old XNA version of the simulation as discussed above.



Figure B: A map of the land bridge's 21 different regions.

To create a region, first I made a new scene for it. Each scene is named Region1-X, where X stands for which of the 21 regions that scene will hold. The naming system is just for convention. Then I select GameObject > 3D Object > Terrain to make a new terrain. The terrain length and width are then resized to 2000 units in size; this is the maximum size terrain Unity will allow one to create and the terrains have to be blown up to that size to process the height-maps correctly. Making the terrains smaller will squish and distort the land, negatively impacting the accuracy of the simulation.

Creating the height-maps can be arduous and frustrating if a specific set of steps are not followed to the letter. Because Unity will only accept .raw files as height-maps, I used Adobe Photoshop CC 2014, but any recent version of Photoshop will do. The first thing I do is open one of the XNA-generated satellite images into Photoshop. Figure C: Before Preparation – The original XNA-generated image has color and is not a perfect square. This must be changed for Unity to generate a terrain from it. Green colors indicate land, blue colors indicate water.



Unity requires that images have specific qualities for it to use them as height-maps. As I discussed, they must first be saved as a .raw file. They must also be greyscale; 8-bit or 16-bit is irrelevant but I prefer to use 8-bit as it's the default for my version of Photoshop. The image resolution must be 72 pixels per inch, and the image must be a perfect square. The last two qualities are the most important, because if the image resolution is not precisely and exactly 72 pixels per inch, the terrain will be corrupted when the height-map is imported, and if the image is not a perfect square, Unity will not process it at all.

First I make the picture a perfect square. Instead of blowing up the image size to force into the shape of a square, which would distort the region, I change the canvas size and add extra pixels to the smaller side; this extra space is then colored with the deepest blue color available so that when the height-map is processed, all the user will see is extra water on that side. The extra water does not impact the accuracy of the terrain in any way because it is outside of the actual area of the land and manifests as lake water which is inconsequential to the simulation. I add this extra water to the bottom or the right of the image as a convention.

Figure D: Adding space to the bottom of the image to make it a perfect square. Added space is in the darkest blue available; coloring it this way makes the added space stand out from the rest of the natural water.

Next I go to Image > Mode > Grayscale to change the image to greyscale. When I do this, I also set the image resolution to 72 pixels per inch. Whether the greyscaling is set to 8-bit or 16-bit is irrelevant because Unity can deal with both and will not process the terrain any differently because of it. After the image is changed to greyscale, I then go to Image > Image Size and set the resolution from 96 pixels per inch to 72. Changing the resolution is crucial, even though it shrinks the image somewhat, because Unity will process the height-map incorrectly and the terrain will become corrupted. To demonstrate this I show these two images:

Figure E: A corrupted terrain. Not setting the resolution to 72 pixels per inch will cause serious errors when one imports the heightmap into Unity. Sharp rises and divets that should not be there will show up and part of the land will be cut off or, as can be seen at the left of the image, artificially extended.



Figure F: An almost completed region, with the proper resolution, processed in Unity. Notice how it looks much more similar to the original image than the previous terrain.



As one can see, this processed region matches the shape and form of the original image, except it is mirrored. To fix this, I perform the last step which is to flip the image in Photoshop. I go to Image > Image Rotation > Flip Canvas Horizontal, then I save the image as a .raw file and import it into Unity.

Now that the .raw file is successfully created and imported, the region itself must be smoothed out and colored in Unity. The reason the region still looks bumpy despite the steps taken to create the .raw file correctly is

because of noise from the original NOAA imagery the image files are based off of. The noise is irrelevant with the very deep areas that form the bottom of the lake areas, but the land needs to be smoothed out not so much for aesthetic reasons but because the caribou A.I. objects won't be able to traverse the terrains if it is not.

Smoothing is a straightforward process, all I do is choose the Smooth Height tool, pick the fourth brush from the top left and carefully go over the land smoothing things out as much as I can. Coloring is also simple, all I do is choose the Paint Texture tool, then I press the Edit Textures button, I select Add Texture and then I choose the default Grass (Hill) texture.

The last step is to insert water. I use the default Daylight Simple Water that is free with Unity; in the final product this will be replaced with more realistic-looking custom water. To put in the water, I first create a giant water region, label it Lake Huron and fill in the huge deep areas surrounding the land. Placing the water is simple and straightforward; I simply use the position adjustment tool in the upper-left-hand corner of the window to drag the water to where it is supposed to be. I also adjust the height to match the apparent water levels in the original image.

As one can notice, each terrain will have holes that stand out in the land. These holes are the location of bodies of water and also need to be filled in. To do this, I create smaller Daylight Simple Water objects, name them Pool 1, Pool 2, and so on, and place them in the correct position and at the correct height.

The size of each Pool object will of course be different depending on the hole it's supposed to fill. Filling in these holes with water is an important step since these bodies of water are places caribou would congregate at and therefore are extremely important factors for the A.I. and for potential hunting blind placement.

Figure G: Water placement in region creation. Note that the region looks flipped over because of the image flipping from before. The main camera will be turned such that the player (and the A.I.) will see the land from the right orientation.



After the water is placed, the region is completed. As a final step I place a First Person Controller on the land and play-test the region to make sure the land is smooth enough to traverse and to make sure it looks right.

Figure H: A first-person screenshot of the final product. The two pools are natural indentations that we have observed from the NOAA data and were likely filled with water 10,000 years ago.



RESULTS

I have produced a preliminary 3D realization of the 21 NOAA regions that, taken together, comprise the land bridge. The landscape will be the basis for the Unity 5.0 port of the Land Bridge simulation. The regions that have been created are very basic, bare land due to the fact that land is all that is required for the rest of the simulation to work. Several A.I. algorithms, including the cultural algorithms used to control the caribou, will dictate where the actual flora and fauna will be placed depending on conditions such as the season and weather.

Figure I: A first-person view of Region 1-1. Trees, grass and other flora and fauna will be added using A.I.



CONCLUSION

This paper has demonstrated the power and efficiency of software like Unity 5.0. Through its use I have greatly simplified not just land creation for the Land Bridge Project, but opened the door to updating and simplifying the project as a whole. Unity 5.0's artistic tools and general user-friendliness turned a process that once required so much time and technical expertise that few members on the research team could do it at all to a

quick, fairly simple process that requires some working knowledge of Photoshop and an hour at most. In the future, these techniques could be applied to the development of a variety of different virtual worlds -- including modern cities -- for entertainment, city planning, scientific research, and many other different applications.

Future work will involve optimizing and updating the regions as needed, fixing any errors I may come across.

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APPENDIX
















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INCARCERATION OF ADOLESCENTS IN ADULT PRISONS: ADULTS' RECOLLECTIONS OF THEIR EXPERIENCES AND ITS IMPACT ON ADULT ADJUSTMENT

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ABSTRACT

During the mid 1980's through the 1990's, wide-spread media coverage lead to the drafting and implementation of 'get-tough' on crime policies aimed at 'violent' juvenile offenders. This draconian policy change has resulted in the incarceration of thousands of *adolescents in adult prisons* across the United States. What we do not know are the long-term implications of housing youthful offenders with the nations most notorious adult prisoners. As hundreds of youthful offenders – now adults- are being released after decades of imprisonment, we yet to understand how their experience will affect their reintegration back into society, their adjustments within their families, or how they will see themselves in relation to both. The goal of the current qualitative study was to interview four adults (3 males ages 44, 37, and 18 – and 1 female age 41) who were sentenced as youth to adult facilities. This goal of the interview was to obtain data on how the Participants felt about their experiences of incarceration, post-release transition, the impact of experiences, and their perceptions of the needs of youth in the criminal justice system. A review of the interviews revealed both common themes about participants' experiences as well as their impact and perception of youth needs. The findings reveal a need for more developmental and holistic approach to the adjudication of youth offenders from sentencing through community transition.

INTRODUCTION

Juveniles versus Adolescents- Definition and Prevalence

For the purposes of crime, "Juvenile" offenders are defined differently amongst the 50 states. All of the states, except 9, currently define the juvenile criminal age limit as that of 16 years old. This stands in stark contrast to evidence from the developmental sciences, where empirical evidence documents the biological, psychological, social, economic transitions of adolescence is a period of transitions reaching into the third decade of life (Steinberg, 2005). (Commission, 1996)For the purposes of this research, adolescence entails Early Adolescence (10-13), Middle Adolescence (14-16) & Late Adolescence (18-22). For the purposes of this study, "juveniles" will be interchangeable with "adolescence". The transfer of a juvenile offender to the adult correctional system represents the extreme end of the sanction continuum for youths. Although juveniles represent a minority of inmates in adult prisons nationwide, they are a growing presence. Adolescents and their families resulting from arrest, prosecution, and detention, fall disproportionately on minority communities, as minority youth are overrep-resented at every stage of the juvenile justice system. A parallel trend has been well documented in adult probation (Commission, 1996). (Snyder & Sickmund, 1999)For example, although African-American juveniles age 10 to 17 constitute 15% of the total population of the United States, they constitute 26% of juvenile arrests, 30% of delinguency referrals to juvenile court, 45% of juveniles detained in delinguency cases, 40% of juveniles in corrections institutions, and 46% of juveniles transferred to adult criminal court after judicial hearings (Snyder & Sickmund, 1999). The number of offenders younger than 18 admitted to state prisons more than doubled from 3,400 in 1985 to 7,400 in 1997 (James Alan Fox, 1996). Despite a lack of empirical evidence supporting its effectiveness in treatment and prevention, the transfer of juvenile offenders to the adult correctional system continues to be popular amongst the "tough on crime proponents.

The Trends in Juvenile Crime

From 1980's to the mid-1990, violence at the hands of the youth became a focal point in mainstream society creating a real public concern (KL Jordan, 2011). Juvenile arrest rates rose by more than 60%. Juvenile arrests for murder increased by more than 100% for this same period. A key concern to this spike in violence is that the victimization at the hands of these youths was committed against peers of similar ages. This resulted in prosecutors and authorities labeling these troubled youths as "super predators" thereby justifying and rationalizing their treatment as adults, including imposing adult, draconian, sentences within adult institutions amongst the nation's most notorious adult offenders (Dilulio, 1995). A careful consideration of the patterns of youth crime and violence does not support such a depiction and suggest offenses tend to be "cyclical in unpredictable ways" (Zimring, 1998). The media's portrayal of violent juvenile crime trends is similarly not inaccurate feeding a public fear of a nationwide trend towards future generations of dangerous youth. However, data suggest that there is no unitary trend in the recent history of youth arrests for violent crime. The lack of a pattern implies that no generalization about the behavior of the current cohort of youths can be empirically supported, meriting caution in the implementation of harsh criminal sanctions toward youth.

Legislators focused on increased punishment, through the transfer of the most serious offenders so the juvenile court can focus their limited resources on those youths whom they viewed as more amenable to treatment (Mears, 2003). Mears' 2003 assessment of the empirical research on juvenile waiver strongly encourages the need for more studies that assess how effective waiving youthful offenders to adult courts and facilities is in achieving these purposes.

Forty-seven states changed their laws to allow increased prosecution of juveniles as adults in a variety of ways: (I) by increasing the number of offenses for which juveniles can be transferred to adult court after a judicial hearing ("judicial waiver"); (2) by lowering the age at which juveniles can be transferred, designating certain offenses for which juveniles are automatically prosecuted in adult court, or by saying that for some offenses there is a presumption that the juvenile should be prosecuted in adult court, but he can try to prove that he is amenable to treatment and get a "reverse waiver" back to juvenile court (various forms of "automatic" or "legislative" waiver); and (3) by giving prosecutors the authority to decide in individual cases whether young people should be charged in juvenile court or adult court ("prosecutorial waiver" or "direct file").

States Differ - Michigan's Treatment of Juveniles

Michigan is currently 1 of the 9 states that treats 17 year-olds as adults in terms of crime and punishment, even though 18 years is the age of independence that equates to the autonomous privileges of adulthood. Yet, all states have empowered their courts and/or their respective District Attorneys' office, with the ability to waive juveniles ages 12 thru 16 from the juvenile court system to the adult for purposes of adjudication and housing. This policy is known as "waiver legislation" referring to automatic waiver of juvenile offenders from the juvenile system so that they can be adjudicated as adults. The significance of this policy for the lives and futures of 17 year-old youth who are arrested, charged, and housed amongst our communities' most hardened criminals is poorly understood. We know little about the long-term implications of housing youth offenders in adult correctional populations. The tough-on-crime slogan that embodied the mantra for tougher laws for juvenile offenders began several decades ago without thought to its residual effects on youths' re-entry into their communities. After 20-30 years of this policy in action, those sentenced to adult prisons in their youth are now being released back into their communities, providing an opportunity to understand the impact of said

policy.

Effects of Waiver Legislation

Waiver legislation results in the long-term incarceration of juveniles in adult populations with little understanding of its implications for those sentenced or their families and communities upon their eventual release (Singer S. I., 2003). Although there has emerged a body of research on the front end of waiver (the decisions that officials make in deciding whether to treat a youth as an adult offender), there is little research on the post-sentencing (back-end waiver decisions) of these youths (Singer S. I., 2003). Few studies have directly compared the correctional service experiences of youth in juvenile detention with those in adult prisons (Irene Y. H. Ng, 2012). Researchers have found that experiences in juvenile facilities are more positive than in the adult facilities. For example, respondents in juvenile as compared to adult facilities reported that they received more counsel, found treatment more helpful, and viewed staff more favorably (J. Lane, 2002).

Needs of Juvenile differs from that of Adult Offender

Among the arguments against the incarceration of juveniles in adult prisons is the lack of rehabilitative programs, especially those that target the youths' developmental needs (Fagan, 2008). The greatest concern, if the assertion of the current research is correct, is that most offenders will be released back to the community without having received educational, mental health and employment services that they need to lead successful adult lives and not reoffend (Goebel, 2005).

Much of the research over the past several decades has focused on the punitive aspect of juvenile treatment, focusing on what is best for society's security needs and concerns. Harsh sentences and long-term imprisonment have satisfied the short-term, security concerns of the community. However, now that juveniles are being released after decades behind bars, the focus of research has recently shifted towards the effects of juveniles' long-term incarceration in adult facilities. This begs the question of whether correctional services for juveniles are better suited to meet the psychosocial needs of the targeted youth. Interestingly enough, the research and opinions of experts is split. While some argue that adult correctional facilities better serve the needs of the juveniles, few prisons house juveniles separately from adults. Most juvenile offenders are housed in the adult general population (Austin, 2000). There is little evidence of efforts to customize programs for the needs of juvenile offenders in the adult prisons. Rather, most facilities, both juvenile and adult, suffer from overcrowding and inadequate services and treatment (Redding, 2003).

In Michigan, overcrowding and budget constraints have compelled officials to make cuts in human resources, creating a system that lacks a trained staff equipped with the skills and tools needed to service the needs of the juvenile population (William J. Sabol Ph.D., 2007). In comparison, each public juvenile facility in Michigan has professionally trained teachers and social workers (Dixon, 2007). In a national survey of youth in residential placement by the Office of Juvenile Justice and Delinquency Prevention, incarcerated youth were found to have higher risks of mental health, physical health, and educational needs than the adult population with which they are housed, but services were found to be inadequate relative to the risks and needs associated with these juveniles (Sedlak, 2010).

The Impact of Imprisonment – Recidivism as a Focus

A troubling finding is that approximately 75% of the juveniles that have once been imprisoned subsequently reoffend (Snyder & Sickmund, 1999). Even a conservative study resulted in findings that over 50% of the youths will return to prison at least once (Greve, 2001), and up to a third of those initially sentenced will continue on a path of crime and punishment for a long period. In a large 15-year study of California youths who have been

incarcerated, the findings were that 96% of imprisoned juveniles were arrested again in their adult years (Haapenen, 1990 (Alex R. Piquero, 2001)). This area of research has, for the most part, been dominated by the search for alternative treatments for juvenile offenders, as opposed to the study of the long term implications of youth imprisonment – whether with adults or not.

The Dangers of Housing Juveniles with Adults

The increased incarceration of juveniles in adult facilities is contrary to juvenile justice policy over the last 25 years. In 1974, in response to evidence of widespread abuse of children in adult jails Congress passed the Juvenile Justice and Delinquency Prevention Act in response to the widespread abuse of children in adult jails (Sarri, 1973). This statute prohibits states from confining juveniles in adult jails except for brief periods after arrest (the removal provision) and during such brief periods requires sight and sound separation of juveniles from adult inmates (the separation provision). Although it took the states a number of years to comply with the Act, as of 1996, 48 states and jurisdictions are in compliance with the removal provision.

Fifty-three states and jurisdictions are in compliance with the separation provision. During the time the states were coming into compliance, terrible tragedies occurred. A 15-year-old girl in Ohio ran away from home and returned voluntarily, yet she was ordered into the county jail for five days by a judge "to teach her a lesson." On the fourth night, a deputy jailer sexually assaulted her. Seventeen-year-old Chris Peterman was held in a jail in Boise, Idaho for not paying \$73 in traffic fines. Over a 3-day period, he was tortured and finally murdered by other prisoners in the cell. Robby Horn, 15 years old, was repeatedly ordered into jail in Kentucky for truancy and running away from home. After an argument with his mother, he was ordered back into the jail by a juvenile court judge. Within half an hour, he hanged himself. Kathy Robbins, also 15, was locked in a county jail in rural California for being in the town square on Saturday night after the 10:00 p.m. curfew. After a week in jail, she hanged herself. Another girl in Indiana was locked in jail for stealing a bottle of shampoo. She had a history of mental health problems, which were not detected by the staff, and she, too, hanged herself (S. Rep. No. 105-108, 1997). More recently, in Ohio, six adult prisoners murdered a 17-year-old boy while he was incarcerated in the juvenile cellblock of an adult jail (Bell).

The danger of suicide by young people in adult facilities is especially noteworthy. A landmark U.S. Department of Justice study in 1980 reported that *juveniles are almost eight-times more likely to commit suicide in adult jails* than in juvenile detention facilities (Flaherty, 1980). This 8-to-1 ratio is a particularly concerning when viewed in light of findings from a national survey of juvenile facilities, which reported that 970 young people committed 1,400 acts of suicidal behavior in the 30 days prior to the survey. These figures translate into a yearly estimate of 11,000 young people committing 17,000 suicidal acts each year.

The dangers of confining juveniles in adult jails are demonstrated by the experience in Kentucky, one of the few states that has *not* been in compliance with the jail removal provision of the Juvenile Justice and Delinquency Prevention Act. Over a 13-year period, there were four suicides, one attempted suicide, one accidental death, three sexual assaults, and two other assaults involving juveniles in Kentucky jails. Nine of the incidents involved status offenders (e.g., truants, runaways, and "incorrigible" youth–who would not even have been considered criminals if they were adults).

The dangers are similar when young people are incarcerated in prisons. A 1990 study found that juveniles in adult institutions are five times more likely to be sexually assaulted, twice as likely to be beaten by staff, and 50% more likely to be attacked with a weapon than in juvenile youth facilities (Fagan, 2008). As Professor Jeffrey Fagan of Columbia University notes, "because they are physically diminutive, they [juveniles] are subject to attack . . . They will become somebody's 'girlfriend' very, very fast" (Zimring, 1998). The prevalence of sexual assault is so common that it appears to have become widely expected and accepted. As one corrections officer indicated, "A young inmate's chances of avoiding rape were almost zero; he'll get raped within the first twenty-four to forty-eight hours.

Current Study

Empirical evidence sheds light on the fact that the needs of the juvenile offender differ in comparison to that of the adult offender. Research also shows that the adult prison system has less resource for juveniles compared to juvenile facilities (Flaherty, 1980). Trends in juvenile crime have relatively stayed the same over the past several decades (or have gone down) (Zimring, 1998), while the juvenile population within the adult penal system has more than doubled in the past several decades. We do not know are the long-term implications of housing these juveniles with adult offenders. It has yet to be fully examined the adolescent's transition back into society after having been housed with adult offenders.

The goal of this study is to understand better the long-term implications of housing adolescent offenders with adult offenders, the efficacy of existing practices, and the needs of the youth currently in the system. The study will be done by way of narrative methods, which allows for Thematic Analysis (themes in how the adolescents responded to their imprisonment with adults and in their transition back into society). This study will provide important information that is missing in the field.

METHODS

Procedures

The participants for the current study included 3 males and 1 female age 18-44. I recruited them because I was previously aware that they had spent time in prison as adolescents with adults. Each person agreed. One person was approached but declined, stating that the experiences remained painful to discuss.

Each participant was individually interviewed at the research laboratory or office of the researcher's mentor at Wayne State University. Each participant first received an information sheet that described the study, purpose, method, risks, benefits, compensation, and confidentiality practices. The interviewer reviewed the information sheet with the participant and answered any questions before beginning the study procedures. Signed informed consent forms were not obtained because the study was conducted as anonymous without collecting any identifying information. This project received exempt approval from Wayne State University Institutional Review Board before any recruitment or interviews took place. Each interview took approximately 1 to 1.5 hours.

Study procedures included a series of questions about basic demographic characteristics (e.g., age, race/ethnicity, employment, education) and a semi-structured interview about participants' experiences of incarceration as a juvenile within an adult prison setting. The interviews were conducted by the researcher's mentor, who is a clinical-developmental psychologist with decades of experience conducting similar interviews. The researcher was also in the room during the interview to write down participants' responses. Upon completion of the interview, the participant was debriefed and questions were answered. Because of the personal nature of the interview, the researchers checked in with the participant to assess for interview-related distress and provided each participant with a list of community resources for psychotherapeutic services should they wish to talk further.

Participants

Because this was a small qualitative study, I will provide a brief biographical sketch for each participant using pseudonyms without any identifying information. These biographical sketches are based on information provided by participants on their demographic information sheet and during the interview.

Participant 1 "Rick".

Rick, a 44-year old Puerto-Rican born male, who moved from Puerto Rico at the age of 11 with his mother and sibling. Rick was raised by his mother and stepfather. Rick described his stepfather as abusive. He believes his mother married his stepfather for financial security. Rick, wanting to support his mother, chose to drop out of school at an 8th grade level to earn money illegally. Rick was 15 years old at the time of his arrest and incarceration within the Wayne County Jail. He spent 2 consecutive years at which time Rick was formally charged as an adult and placed in with adult offenders. Rick was sentenced to Natural Life Without the Possibility of Parole for 19 total convictions including Manufacturing & Delivering of 650 grams of cocaine or more, attempted murder, and conspiracy to commit murder. An amended drug law resulted in a sentence of Life with the possibility of parole; Rick served 22 consecutive years in prison from the age of 15. Rick obtained the following education while imprisoned: GED, Janitorial Certification, Auto Service Certificate, self-study, Culinary Arts Certificate, and some college level classes offered while Pell Grant was still available.

Participant 2 "Angelica".

Angelica, 41 year old white, Mexican female, described the struggles of "fitting-in" at school, coupled with peer bullying, which influenced her into "hanging-out" with the "wrong crowd." Angelica was 17- years at the time of her incarceration within Wayne County Jail. She was convicted of armed robbery, murder and assault with intent to commit murder. Her role was that of the get-away driver. She dropped out of school in the 11th grade and earned a GED via a summer program pre-imprisonment. Angelica served 16 years and 8 months.

Participant 3 "Brad".

Brad, a 37 year old African American male, charged and convicted of armed robber and attempted murder at the age of 18, described his childhood as educationally conscience. His mother was a Special Education Teacher, and promoted educational values towards Brad. He describes his need for money, coupled with the older peers in his neighborhood that were obtaining money illegally, as that which influenced his decision-making towards the criminal life-style. Brad was 18 years old at the time of his arrest and placement into Wayne County Jail. Sentenced to 20 years, *Brad* served 18 ½ years in an the Michigan Department of Corrections Adult prison system.

Participant 4 "William".

William, an 18-year old African American male, was 17-years old when placed in the Wayne County Jail for an armed robbery charge. After spending 6 months in the county jail, William was convicted of attempted armed robbery and released with time served under the Holmes Youthful Trainee Act, providing an opportunity to earn his way to cleaning his record from the attempted robbery charge. William, not knowing his biological father, lived with his mother and two siblings for most of his life. He described how his low self-esteem from the way he looked led him to become a bully. William said that that he wanted to make money and that the only examples of making money in his environment was that of criminal activity.

MEASURES

Each person participated in a semi-structured interview derived from the Trauma Meaning Making Interview (TMMI; Simon, 2007; Simon, Feiring & McElroy, 2008). The TMMI format was similar to that used in other studies; however, the questions were adapted for the current study to elicit participants' narratives regarding their experiences of incarceration as juveniles in adult facilities and transitioning back into the community upon

release. Narrative methods are uniquely suited for examining how individuals process major events because they provide a window into speakers' cognitive and emotional lives (Bruner, 1986) and they reveal the constructive process by which individuals organize and evaluate past events in light of current conditions (Simon, 2010).

Participants were first asked to describe the *circumstances of their crime and what brought them to prison*. Next, they were asked to provide 3 words or phrases that captured their *incarceration experiences*. Once the descriptors were obtained, the interviewer asked participants to describe a time that was illustrative of that aspect of their experiences. This sequence of obtaining descriptors and memories was repeated with respect to participants' experiences of *transitioning from incarceration* back into the community. Next, participants were asked to describe how they *coped with their* experiences and to identify any ways of coping that were particularly helpful or unhelpful to them. The next section of the interview inquired about participants' current perceptions of the *impact of their experiences* on how they view themselves, relationships, and the world more generally. The final section of the interview was added as a *needs assessment* to gather participants' recommendations for servicing juvenile offenders in the juvenile justice system from sentencing through release.

Answers to each question were written down by the researcher during the interview process. After the data were collected, I transcribed these notes and reviewed each section of the interviews for common and idiosyncratic thematic content. These themes are described below in the results section.

RESULTS

Interview Summaries

The interviews were rich in fact, reflection, and emotions. To provide a sense of the nature of the experiences and the richness of the interview, this first section of results summarizes the content of the interview responses for each participant.

"Rick".

Rick spoke of the difficulties he has expressing his emotions, yet, considers this inability to be an asset that serves as protection from being "hurt". Rick reflects upon the impact the experience had, and continue to have, on him, and specifically points to the moment that he began to succeed within the confines of prison –and, transcending those wire fences: "When I matured enough to understand that no one will do it for you, if you are not mature enough to accept that, then you wont succeed." According to Rick, his ex-wife has described him as "emotionless". Rick attributes his classification as Security Threat Group-II (Gang Leader Status) that forced him being transferred approximately every 6-12 months, over a 22 year period, as conditioning him to be able to adapt and adjust to any situation or circumstance, which he considers to be an "asset". He said that "nobody is gonna give you nothing… you gotta do it yourself…" Rick also says that he is charismatic and "everyone likes him…" That he is a "people person".

Rick was asked to think of 3 words or phrases that best describe what it was like to be an adolescent housed with adult prisoners: *Tough, Man-Up,* and *It Is What It Is.* When asked why he said "tough", Rick described how he was forced to prove himself, more so, than the average prisoner, due his age. Rick was taken to Jackson Maximum Facility, as opposed to the Riverside Correctional Facility –where male prisoners 20 and under are

sent, because of his affiliation as a gang leader while in the County Jail. Yet, in the Michigan Department of Corrections, such reputations mean little. As, Rick said, "Wayne County Jail was different... they knew who I was... I was Prince of the Spanish Cobras. But, in prison, its different... I did not have that."

He describes the first day in prison, waiting on the phone. He said that no one would give him an opportunity to use a phone, so he chose the biggest black guy that was using one of the numerous phones on the prison yard, and began to beat him until he was unconscious. Only then did he begin to receive respect.

Rick's use of the phrase *Man-up* overlaps his descriptive word of *Tough*: "There was constant fighting. I couldn't cry in front of anyone. I would break down in my cell at night." Rick spoke about how he felt compelled to remove his own mother from his visiting list to fill his needs of staying *tough* and *Manning-up*. By accepting personal responsibility for his circumstances, and not blaming anyone, Rick feels he *manned-up*. Accepting responsibility is the basis of his descriptive phrase *It Is What It Is*. Rick expresses that he had to accept responsibility and become mature enough to give into the system... even though he does not believe in it.

Rick was then asked to think about 3 words or phrases that best described his return back into society: Difficult, A lot of Barriers, and In Order to Succeed - You Must First Give.

According to Rick, his *difficulty* in the transitional process was centered on financial constraints and demands. Rick "left" society owning 2 homes outright, which were next door to each other. He purchased one for his grandmother and one for himself. Upon his release, he stayed with his grandmother in said home. He was led to believe that the adjacent home, "his home", was being rented out. A few months later, after mentioned to his niece that he would tell the lease that the lease will soon be up. Only then was he told that the deeds to both homes were lost due to back taxes. He explains how Michigan Prisoner Re-Entry Initiative that funneled millions of federal dollars supposedly to assist in prisoner's re-entry. Rick asserts that this program did complete its mission and purpose. He was compelled to work 2 minimum wage jobs that still did not support his needs.

Rick described his largest *Barrier* as that of his parole agent that continuously threatened to "lock" him "back up" if he doesn't maintain a job and pay his restitution fees. He spoke of the stress that these continued threats would make on his psyche.

When asked how has this experience impacted how you see the world, Rick says that he sees the world to be "different". He describes this generation as having a sense of entitlement. He questions people's motives and sees relationships as being used for means of material gain, instead of the intrinsic value. He sees himself as being able to enter any environment, observe it, then adjust in a way that allows him to succeed within that environment. Rick says that he was placed into a hostile environment and forced to adjust. He says that the penal institute has taught him how to adapt to any environment and still succeed.

When asked what he thinks the needs of an adolescent who commits a crime are, Rick stresses education and sentencing changes. He passionately exclaims that adolescents surely should not be housed with adult. Rick suggests that each adolescent be assigned a psychologist, guidance through mentorship, and transitional help in the form of housing, mentorship, and job training.

"Angelica".

Angelica –at first- found it challenging to describe the perceived changes, both positive and negative, that this experience has had on self, relationships, and world-views since she was a "kid" when she went in. When asked to describe her experience as a 17 year-old imprisoned with adults with 3 words or phrases, Angelica's response is: *Loneliness, Just Tell Me What To Do, and Survival.* Angelica was 1 of 3 teenagers housed at Scott's Women's Correctional Facility in 1991-1994. Angelica's loneliness was compounded by the fact that the few other teenagers refused to "hang-out" with her. This loneliness made it challenging, she says, the first five years in

trying to "negotiate prison life." Her mission was to survive, and her method was trying to please those around her in an attempt to avoid all aggressive and violent confrontations. She describes the adults that she was housed with as prostitutes, strippers, and drug addicts, so the impressions experienced came from influences from women with such backgrounds. She recalls one such friend, a Madame from a Columbian Whore house, teaching her that she should never let herself get ugly, or else her life will be worth nothing. "She would make me starve myself with her, then I would have to sneak to eat," described her friendship with this adult offender. Angelica reflects that she wanted to please her friend, just as she wanted to please all those around her to not get that "angry" at her.

Angelica described her phrase *Just Tell Me What To Do* as the tool she used to get through brutal rapes. Her first experience of being raped took place at the age of 17, while housed in Wayne County Jail's multi-prisoner quarters that housed 10-20 women. She was gang-raped by 5 women. In following, multiple experiences of being raped came at the hands of male correctional staff. She described the sexual assaults that included battery. Her only weapon: *"Just tell me what to do..."*

Angelica described *Survival* as "focusing on the things I could control, how I was responding to people who hurt me." She would get wrapped in a book... or, jog really, really fast and for long periods of time. "Then I'd feel like I beat that person that hurt me." Angelica says that she learned how to adapt, and this learned ability is what enabled her survival.

Angelica was also asked to use 3 words or phrases that best describe her transition (release) back into society: *Fast, Like a Dream, & A Work-in-Progress.*

Angelica said that the first 4 years we "so fast" as she delved into school, work, and volunteer work in the rescuing of dogs within the streets of the City of Detroit. She reflects that she did not stay busy intentionally. She now realizes that she filled her days with activities so that she would not have to "think about all of the pain." Angelica looks back on her experience with the rescuing of dogs as being therapeutic in her transition. She saw herself, and the other juveniles housed in adult prisons, in these dogs in that they too have been "thrown away and forgotten about by society."

Its Like a Dream reflects how "everything fell into place" upon her release: Job, School, Thesis Program, home placement, etc. Even with all of the "problems", Angelica gives thanks to God for her transitionary opportunities and challenges.

Angelica sees herself as a *work-in-progress* because of all that she missed out on:

"I was 35 when I got out... I miss out on a lot. I didn't know how to act around men... I behaved like a 17 year old girl." She described her lack of social skills in both intimate and familial relationships. Her lack of social skills compounded her stress. For example, she describes how not understanding "normal life experiences" like a baby shower, or how to dress like a businesswoman instead of prostitute, added to her stress. If she didn't read it in a book, then Angelica says she didn't know how to respond to the new experience.

Angelica's difficulty in transitioning was compounded after having a child 4 years after being released. She questioned everything: *Would I be a good mother? Are bad things that happened to me going to happen to her? Are the police going to come and take me away?* She explained that her paranoia of the police was not rational, since was no longer on parole. Angelica fell into post-partum depression and developed an eating disorder: "I would go shopping for a sheet cake, bring my baby home, rush to feed her and put her in bed. I would then proceed to eat the entire sheet of cake, vomit its' entirety, then discard all of the evidence before her baby's father would arrive home from work.

Angelica was asked for her thoughts and opinion on the needs of adolescents who commit crimes. She stressed not housing adolescents with adults. In addition, she thinks that families of the adolescent's returning home

should be counseled and educated in the struggles that the returning juvenile will face in transitioning back into society.

"Brad".

Brad began his imprisonment amongst adult offenders at the age of 18. When asked to think of 3 words or phrases that best describe what it was like to be an adolescent in an adult prison, Brad said: *Terrified, Hopelessness,* and *Confused.* Brad said that the terror began when he heard the judge say that he would spend the next 20 years in prison. The next terrifying experience Brad describes is the arrival to one of the

nation's most notorious prisons: Michigan Reformatory (MR). He described MR as looking similar to that of "Dracula's Castle" with armed guards walking a 4-story wall that protects the perimeter. "Shackled from headto-toe, I was ushered into MR as everyone was yelling and staring at the new arrivals… You hear these stories about MR, coupled with the images of television and movies, you just don't know…" The first night, as Brad laid in his cell, he wondered, "What am I going to do?" The second day at MR, he witnessed another prisoner stab a fellow prisoner in the eye: "In order to walk our of here the same way that I walked in, I realized that I would have to make some adjustments in how I communicate and relate… I knew that I may have to do something that I did not want to do, in order to survive." Brad expressed how it was "normal" to be on the phone and witness a person next to you, also using the phone, to be stabbed right in the neck. So, it was routine for him to get off the phone quickly with his family in order to say out of the line of fire.

Brad describes the experience of being incarcerated with adults as *Hopelessness*. He explains, in hindsight, the difficulty of an 18 year-old to grasp the concept of 20 years in prison. Brad says that for the first 6 years, it was a process in-and-of itself to be able to understand, and accept, the sentence. Every night, he says, hopelessness would creep in. With every denial in the appeal process, that hopelessness would be reinforced. Losing people, from them moving-on or death, added to Brad's sense of hopelessness. Then, as Brad describes, you throw in the negative, violent environment coupled with extended stays in solitary confinement as a result of behavioral adjustment issues that is commonplace for anyone entering an environment such as prison, let alone an adolescent, then the hopelessness is compounded further. During one such experience in solitary confinement as an adolescent, the staff decided to feed Brad "Food Loaf" which is a prison dish for certain prisoners in solitary that is made by placing all the contents of the tray –mile, fruit, meat, carbs, etc.- into a blender, then baking it into a loaf, which is then placed in the freezer and given to those who misbehave while in solitary. Brad asserts that he did no harm, thus, the food loaf was unwarranted. So, Brad refused the food loaf, passed through a little slot in the door, for 4 consecutive days. Brad's rationale was that he did not violate any rule while in segregation. After 4 days, they relented, and placed him back on the regular tray.

Brad described a transitional process that he had to endure upon being released from solitary confinement back into general population: "Even when you come out of isolation you must readjust because the indelible impression is that this may happen at any time." He explained that the realization of no control adds to the hopelessness.

Brad described the first year as wrought with confusion that was expressed through tears in the darkness of the nights. He was confused as to why "this happened". The appeal process confused him. His love ones passing added confusion to his relationship with God: "It was particular events that triggered the confusion."

When Brad was asked to think of 3 words or phrases that best describe his transition out of prison, he said: *Ecstatic, Prepared,* and *Patient.* "Everyday I wake up and it feels wonderful not being incarcerated... In college class... Just driving down the street," describes Brad of his transition back into society. He believes that this ecstatic feeling is rooted in his accomplishments since being home only 4 months: second semester of college, full-time work, relatively new car, and a pleasing relationship. He theorizes that otherwise he may be bitter.

Brad says that he can describe his transition as being prepared for in that he was registered for college, had obtained necessary skills and tools while imprisoned, and surrounding himself with like-minded individuals who discussed goals and achievement. He maintained the mantra, "Don't get ready... Stay ready." He articulates his experience well, "Once the person makes a conscience decision not to be overcome by the environment, then that person is empowered in a manner that when they get out of prison what they face may seem almost trivial or minute.

Brad describes his transition as a need for him to be patient with himself, and others need to be patient with his adjustment. He is struggling to learn social skills, especially in intimate relationship, thus, he says he is

learning to be patient with himself. He is trying to be more patient in relationships because of his conditioning in prison to be able to severe all ties with absolutely anyone, at any moment. And, he is trying to be patient to not allow his past experiences to negatively effect his present moments. "Mine is the socialization which effects relationships. When asked how he sees himself in his relationships, Brad says that those that are in his life now are those that were in his life in a supportive way during his imprisonment. He understands that there is a great possibility that he has a "wall" up... A "subconscious" part that says that "I know that you will not be there for me if I need you, so its not worth me investing in this relationship." When asked how this experience has affected him, Brad says that it has done so both negatively and positively. Negatively, in that he describes himself as "not sociable" as people would like him to be. He also is not as sociable as he himself would like to be. Brad says that he understands that in order for him to succeed that he will need relationships, "so I must become more social." Sometimes he says that he loses sight of the fact that he needs others, yet, he has been conditioned to not only depend solely on self, but also not to trust others. Brad describes this experience as being positive in the sense that it has taught him how to be a conqueror: "I have overcome... and, I continue to overcome."

When asked what is his opinion as per what adolescents need who are in the system, Brad expresses that the first change the system needs in how it treats and punishes adolescents is in the attitudes of those in power to change or perpetuate such treatment. The prison industries purpose was to provide jobs for the rural areas that suffered depressive years in high unemployment. The books Brad read, while taking an Inside-Out Program via Michigan State University while imprisoned, outlined the systematic plan to provide jobs in these rural areas through a prison boom on the backs of minority Black and Latino males 17-29. He is pessimistic that such a change in attitude will occur, since it is about money.

Brad emphasizes the need to keep adolescents away from that of the adult prisoner population because of the impressionableness of the youth. He describes the lack of necessary programs for youths in prison, and the reality that they are shaped and molded by the modeling of their adult peer prisoners: "They need to be isolated in an environment that is conducive to growth." They need positive role models and mentors. He says that these similar needs are present upon transition back into society.

"William."

William is currently 18 years old and just served 6 months in Wayne County Jail's Adult Detention Center. While not housed "with" adults, the 17 year olds in Wayne County Jail are currently being housed together –separated in two groups: Felony Charges & Misdemeanor Charges. William was facing armed robber, a felony, thus he was housed with other 17 year-olds all facing charges involving violent felonies including Felony Murder, Attempted Murder, Rape, etc. When asked to think of 3 words or phrases that best describes his experience, William said: *Need Street Sense, Scary*, and *A Repeating Nightmare*.

William described the environment as one in which a person needs some street sense in order to survive. He witnessed youths extorting other youths for commissary. He saw unknowing youths come into the environment and gamble with others, a trap laid out for those lacking street sense. This inevitably would end in extortion, assaults, fights, and violence.

William explained how the Wayne County Jail section that housed the youths had a preceding reputation: word was that you get "rolled over" the first day you get there. This caused great stress for William to the level in which he has described this experience as "Scary". William explained that this means jumped by the gangs that have already formulated within that environment. So, William and a peer being transferred with William from another Jail, vowed to protect each others backs. Once there, Williams "partner" welched on his promise, and approximately 15 youths demanded Williams food and hygiene products purchased with the little money that William had sent to him. When William refused, they began to brutally assault him. William didn't tell and, eventually, they simply ignored William thereby leaving him alone.

He also described the court process as scary: "they have all the control... Everyone is against you... Especially if you have a court appointed attorney." He explains how his court appointed attorney tried to trick him into taking a plea by lying about the sentencing guidelines William was facing.

William described his experience as a "Repeating Nightmare": "You would be sleeping good, then when you awaken you see the same thing, same person, same television shows, same food, same everything." He said that the stress was heightened because no one would put money on the phone so that he may call or send him money. He said that his mother sent a little, but he understands because she must support his siblings. He describes it as a nightmare because "you think it's the end... its over... you feel as if people forgot about you."

When asked about his transition back into society, William says that he used his time to make goals and plans... and, now, he is walking the steps towards their accomplishment. He says that the adolescents need mentors... people to come and speak with them... That "they are lost and simply need education, guidance, and skills." He said that is was a "bad experience" but that it helped him by giving him tools gained through experience. William points to one particulate lesson learned: "Now I put myself around those who have a plan. No negative people allowed around me and my crew... no selling drug and no violence."

The 3 words or phrases William chose to describe his transition back into society were: *Obstacles, Achieving My Goals,* and *Being True To What I Said.* He described how he created a plan while imprisoned that centered around his passion for singing and acting. He also made plans for a clothing line, which he admits that he lacked in the understanding of how much capital it would cost to start-up. His greatest obstacle has been finances and the difficulty in obtaining a livable wage. Yet, he says that he is being true to what he said because he is achieving his goals.

Results of Thematic Analysis

As a qualitative study, my aim was to do conduct content analysis of participants' responses to the different interview sections of the interview to extract common themes in their experiences of incarceration, transition, and post-traumatic change.

Themes related to incarceration as a juvenile housed with adult.

Participants responses to questions about their experiences of incarceration included themes relating to intense, overwhelming emotions; realizations that expressing these or any vulnerable emotions threatened their survival in the prison context, and extended periods of adjustment lasting many months in which participants struggled to adapt and survive.

All participants responded similarly in terms of how it was to experience imprisonment as an adolescent with adult offenders: their emotions resonated and centered on *fear*.

Themes related to transitioning from prison to community.

Participants expressed great bouts of joy, even while being interviewed, now years later. They express gratitude for their freedom, even in the midst of great obstacles and challenges. Their greatest struggle has been socialization.

Themes related to coping strategies.

The male participants relied heavily upon violence, aggression, and a need to prove their manhood. The theme was survival and the theme to resolve conflict within the prison text was violence and aggression.

The female exercised the tool of submitting to her assaulters. All of the youths had conqueror mind-states, i.e. they were determined to survive no matter what.

The responses from the male participants differed significantly then the one female in that the male participants relied heavily on aggression and violence to ensure survival, while the one female participant relied on a submissive tactic in that she would plea her assaulter/attacker/rapist to simply tell her what they wanted from her: *"Just tell me what to do."*

Themes related the impact of their experiences (posttraumatic change) of incarceration and transition – personal, relational, world- views.

Participants find it extremely challenging to trust the people and world around them. They also find it challenging to socialize, so much so that it threatens their relationship. They are struggling to trust enough to invest in relationships with those around them, even though they profess that relationships are needed for their success.

It is interesting that there exists a theme amongst all participants of not trusting people, yet, simultaneously understanding the need for relationship building for personal and professional success. They all acknowledged their difficulties in socializing with others, even family.

Themes related to participants' <u>perceptions of the needs</u> of youth who are or have gone through similar experiences.

Participants spoke of how the needs differ for youths than adults, yet, they point out, those needs are never met in adult facilities. They all said that, first and foremost, adolescents should not be housed in adult prisons. They also agreed that they need psychotherapy of some sort, and they all expressed the need of positive mentors both while in custody and upon release. It is interesting that all four participants stressed education for the youth; a facet of the adult correctional system of Michigan greatly lacks. Lastly, the participants say what is lacking, yet needed the most, is job training and a livable wage.

All of the participants were emphatic that the adolescent offender must not be housed with adult offenders or treated as an adult offender. The theme was that an adolescent has differing needs because they are still developing. And, because juvenile offenders are still very impressionable, all of the participants have great concern over the housing and treatment of these juveniles in adult prisons.

DISCUSSION

The goal of the current qualitative study was to interview four adults (3 males ages 44, 37, and 18 – and 1 female age 41) who were sentenced as youth to adult facilities about their experiences of incarceration, post-

release transition, the impact of experiences, and their perceptions of the needs of youth in the criminal justice system. The participants had vivid recollections of incarceration experiences that overwhelmed their still-developing coping skills with supports. They described in detail the terror experienced entering the adult prison environment. Just as clear, Participants recalled their release with joy and excitement. Yet, they all experienced significant struggles and obstacles in their attempt to successfully reintegrate back into society. The experience of being housed in such an oppressive environment has left the participants struggling to socialize and 'fit in' with their peers who have not had a similar experience.

Interpretation & Analysis

The interview findings suggest that when adolescent offenders are housed within an adult population their natural social development is interrupted through fear, trauma, uncertainty, hopelessness, and a lack of educational opportunities. The findings also suggest that such an experience negatively affects the adolescents' transition back into society and the way they relate to others. The developmental impact of housing these adolescent offenders within an adult population negatively impacts the way they relate to others (both pre-and post- release) and the world: *the theme was that of a desire to be sociable, but an inability (or the know-how) to socialize*. They view others as untrustworthy, and the world as unfair. Their experiences of imprisonment with adult offenders created a sense of hopelessness. This hopelessness was rooted in their belief that the world they know has discarded and forgotten about them.

Another theme that appeared to resonated amongst all the participants, but more so on the older ones, leading one to believe that the long-term imprisonment has had a significant affect on how they relate with others and the world around them: *no one will do it for you*. They older participants appeared to be less eager to accept new people into their lives because of a perception that you cannot trust people to be there for you in times of need.

Interviewing "William", the 18 year-old, shed light on what an adolescent is undergoing, emotionally and psychologically, during the trial and sentencing phases of the Court process. The interview data shows an adolescent paralyzed by fear of the unknown. It also revealed a callousness of the criminal justice system, in that these youths facing felony charges are being tossed into the County Jail with no special consideration of their mental, emotional, or psychological needs as youths being imprisoned in an adult setting. While William's challenges and fears centered on the court process, the older participants having undergone the court process decades ago centered their attention on the transitional challenges of socializing and job attainment. The participants' greatest challenge, as a result of being confined as a youth within an adult prison, has been that of relating to others.

There still exists a huge gap in what we truly understand are the ramifications of housing adolescents with adult offender. In the future, a larger study should be considered. This particular study focused on a small number who have been relatively successfully since their release. A larger study involving participants with varying degrees of success (job, school, relationships) should be pursued to better understand the implications of housing adolescents with adult offenders. A longitudinal study could prove beneficial in revealing how the adolescent adjusts over time.

RECOMMENDATIONS

As one who has walked the proverbial mile, I have found my experience of being and adolescent housed with adult offenders as, quite frankly, the most traumatizing experience of my life. In order for an adolescent to survive (defined as not being harmed physically) in an adult prison, the adolescent must adapt to, and perfect, a means of resolving confrontation with excrement violence and aggression. The adult prison system's rules of engagement and social norms have inverse relationship to that of mainstream society: it resolves conflict

through violence. I coped through education. The goal of educating myself, ceaselessly, provided for meaning and purpose. Yet, what I unwittingly did was contribute to my transformational process. It is through the increasing of ones social, emotional, and interpersonal skills that an adolescent offender will succeed whether housed with adult offenders or juvenile offenders. Both populations lack these developmental skills preimprisonment. Those skills are not functionally learned, or practiced, in an adult prison environment. Quite to the contrary, the adolescent offender is encouraged to isolate, avoid, and not trust those around them. The long-term implication of relating to a world in such a manner, for longer periods of time, is not functional for the returning adolescent back into society. Considering that 95% of all violent offenders receive parole, it begs the question, what kind of returning citizen do we want transitioning back into our community?

Limitations and Future Directions

At the age of 16, I was charged, imprisoned, convicted and then sentenced to 22 years in prison. I was housed with adult offenders from the inception of my imprisonment. I served 19 years in 16 different adult prisons. Thus, there does exist a potential for bias in the interpretation of the data.

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DEVELOPING TOOLS TO IDENTIFY KINASE-SUBSTRATE PAIRS

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ABSTRACT

Cellular signaling controls cell function and is maintained though phosphorylation, catalyzed by enzymes called kinases. Kinases carry out phosphorylation by transferring a phosphorylgroup from ATP to cellular proteins. Aberrant kinase activity is implicated in diseases therefore, identifying the substrate of kinases is important in understanding cell signaling pathways. Here work is being done to create a tool that can identify kinase substrate pairs,termed KCLASP, Kinase Catalyzed Crosslinking and Streptavadin Purification. This cross linking method uses an ATP Analog to covalently link the peptide and kinase together by UV irradiation. The analog in this study is ATP-arylazide (ATP-ArN3). As a proof of concept study, biotinylated kemptide was combined with lysates carrying the known kinases of this substrate, PKA. After the incubation, the ATP-ArN3 should covalently link the PKA and Kemptide together, thus labeling PKA with Biotin. This study focused mainly on synthesis and purification of biotin-kempitde and carrying out cross linking reaction with a Trifluoroaceticacid (TFA) control to prove that cross linking in the experiment worked well. However, The TFA control failed to show a reduction in biotin labeling. In Future, TFA cleavage conditions will be optimized to achieve phosphoroamide bond cleavage.

INTRODUCTION

Cellular signaling is the process from which sells are created and destroyed, and controls all aspects of the cells behavior. (Deng 2510) The failure to maintain signaling causes many diseases, including but not limited to, cancer. (Seifert 5968) Cellular signaling pathways rely on phosphorylation reactions that are catalyzed by protein kinases. (Seifert 5968) Phosphorylation refers to the post translational modification where Kinases transfer a phosphoryl group onto proteins from ATP. Overactive kinase activity leads to cancer. (Deng 2510) Therefore, kinase inhibitors have become necessary for development of anti cancer drugs. (Deng 2510) An important step in understanding hw kinases are involved in disease is to discover the substrate proteins of kinases. The research discussed is aimed at developing a tool for kinase-substrate pair identification.

Previously in the Pflum lab, researchers investigated the use of ATP analogs used for Kinase Identification. ATP analogs are derivatives of ATP, such as ATP-ArN3 (ATP-aryl azide Figure 1) were different functional groups are attached to the prophet position of ATP. Suwal was able to perform the first phopshorylation-dependent kinase-substrate-crosslining with this ATP-ArN3. (Figure 2)Through the process of crosslinking, the kinase was able to be identified. The process included using ATP-ArN3, peptide ROX-13, Kinase Able and UV irradiation to covalently link the kinase to the substrate.

Figure 1: ATP-aryl azide (ATP-ArN3)



The project discussed in this proposal is an extension of prior Pflum lab work; a proof of concept experiment. This study is the basis of the tool called KCLASP(Kinase Catalyzed Cross-linking and Streptavidin Purification) that the Pflum lab is trying to develop(Figure 2). If this is successful than researches have a new tool to create inhibitors or activators to use for cancer fighting drugs and other cellular disorders regulated by cellular signaling. The project discussed here will be focus on synthesis and purification of the biotinylated peptides required for the cross linking reaction. The other focus on this paper is on the TFA Control experiment to determine that the Cross-linking process is working.



Figure 2: KCLASP: The substate (Kemptide) is phosphorylated by the ATP analog (ATP-ArN3) and the kinase(PKA) of the substrate. Once UV irradiation is introduced the ATP covalently links the substrate to the kinase, therefore labeling the kinase with biotin and allowing one to identify the kinase.

JUSTIFICATION OF NEED

For years, scientists have studied the process of phosphorylation. A well known basic understanding of phosphorylation is that it is the process of which a phosphate group (PO4³⁻) is added to a Protein. The enzymes that add the phosphate on the protein is known as a Kinase. The process of phosphorylation involved in cellular signaling where a message from outside of the cell is relayed to the cell interior allowing cells to respond to extreme stimuli. People understand how Phosphorylation happens and what it does but, there are underlying questions like: Why does it happen? What is the cause? What kinases spark which reaction and phosphorylate what? The process is something that needs to be researched and throughly understand because it holds opportunities and answers to our cellular functions and is a process that has come to be understood as one of the most important mechanisms in regards to cell regulation. (Heilmeyer V).

Besides the work in the Pflum lab that was previously described, there are few methods out there that have been used to try and identify kinase-substrate pairs. One method was conducted by Kiochi Fujii. The lab synthesized peptides supported by Fmoc chemistry, this is commonly used to synthesis peptides. After the peptides were synthesized, biotin would be added to the N- Terminus. The kinase mixture, which included the well known PKA , was then mixed together with the peptide and placed on a streptavidin plate. The streptavidin and biotin have a high affinity to each other. After that, Positional Scanning of Oriented Peptide Library (PS-OPL) was than used to find where the researches could then find the substrate position. (Fujii) This method is great with identifying phosphorylation sites but still lacks the ability to find specificity with the kinases that are doing the phosphorylation. Deng biotinylated proteins, that is he added biotin to the proteins. He then introduced a phenyl azide group to the kinase. He then used UV light to couple the reaction. This would help strengthen the reaction and then they kinase would be labeled to the protein. Unlike the first method, the method Deng created made gave researchers the ability to specifically identify kinases and the peptides they directly labeled.

The work by Blethrow and Shokat with ATP analogs has helped in identifying kinase substrate pairs. Shokat used N6-modifried ATP analogs including chemical tags with mutated kinases that can accept the N6-modified ATP analog and tag the protein substrates. were the most efficient analogs to use in Kinase identification. They attached transferable tags to the phosphate of modified ATP. They used CDK1 kinase and the ATP analog [N6-(benzyl)ATP-γ-35S] to label endogenous substrates in cell extracts. This experiment yield positive results and the lab was able to identify many CDK1 substrates.

The available methods for kinase-substrate identification are useful but they are not perfect. For example, Shokate's method is not amenable with all the kinases. Therefore novel methods are required for kinase-substrate pair identification. This is especially important given that our K- CLASP method can be applied to identify unknown kinase-substrate pairs. It will help uncover novel signaling pathways, which could be crucial in determining the role of kinases in diseases.

METHODOLOGY

Synthesis of Biotin-kemptide and Purification

1. Subjects

Biotin-kemptide (peptide)

Biotin-GGGGLRRASLG (Amino acid sequence)

2. Material

- 1. Synthesis
 - 0.15 mmol Fmoc-glycine-wong/ 0.45 mmol of corresponding Fmoc amino acids

0.90 mmol HOBt (Hydroxybenzotriazole)

0.6 mmol DIPCDeltaT

20% Piperdine

DCM (Dichloromethane) DMF (Dimethylflormamide) Kiaser Reagents

2. Purification

HPLC grade H₂O

HPLC grade Acetonitrile THF (Tetrahydrofuran) DCM (Dichloromethane)

DMSO (Dimethyl sulfoxide) DMF (Dimethylflomamide)

1:1 DCM and Ether

Ethyl Ether

Phenol H2O TFA

5% Thioanise

EDT (1,2-ethanedithiol)

3. Procedure

A. Synthesis

Peptide synthesis vessel was rinsed with DCM and DMF. Vessel was then attached to shaker. Then 0.15 mmol of Fmoc-glycine wong resin was added and dissolved in DMF. The mixture was left to sit for one hour. 20% Piperidine was then added two times to deprotect the mixture. DMF was drained and Piperidine was pored on the mixture. The mixture was allowed to shake for 15 minute. Process was repeated. Solution was then drained and beads were washed 10 times with DMF. A hot water bath was prepared at this time. EtOH was used to clean a testable and DMR was drained from the

beads. The test tube was used to collect a small sample of the beads. To ensure beads would not dry, DMF was added to the vessel. EtOH was used to rinse the beads 3 times and the Kiaser Rest was performed. A positive reaction would confer that reaction was decoupled. Beads would yield a blue color. The amino acid that follows Fmoc-glycine wong was added to the vessel. DMF was used to dissolve a mixture of HOBT and the amino acid. The mixture was then added to vessel with DIPCT. The vessel was leftto shake overnight. The process was repeated for each amino acid until biotin was added.

B. Cleavage and Purification

The beads were washed with DMSO four times and then with DMF ten times. The Kiaser test was then performed . A negative result was needed (coupled.) The beads were then rinsed 4 times with THF and 7x with DCM. 1:1 DCM and Ether was used to rinse the beads. The beads were rinsed 10 times with Ether. Phenol solution, water, TFA, 5% Thionaise and EDT were mixed to gather to be added to the beads, this should be allowed two hours. Four falcon tubes were filled with ether and placed in a -80C fridge for about two hours. Into the Ether filled, the mixture was drained.Drain mixture into one of the Ether filled falcon tubes. The mixture should contained the cleaved Kemptide mixture. The remaining cleavage mixture was then used to rinse the beads. A cloudy, white precipitant should form. At -4C and 1100 RPM the product was centrifuged. The product is left at the bottom after the suppressant was dumped out. The mixture has Ether added and was vortexed. The remaining Ether was added and centrifuged at the same condition.Process was reported until Ether is gone. Product was left to dry in hood overnight. 95% Water and 5% Acetonitrile both HPLC grade solvents were used to dissolve the peptide. The high-performance liquid chromatographer was used to run the sample and collect the product at the highest peak.

3. Instruments

MALDI (Matrix-assisted laser desorption/ionization) HPLC (High-performance liquid chromatography) PEPTIDE SYNTHESIS SHAKER

4. Data Analysis

To ensure that we synthesized and captured the biotin-kemptide, 1 μ L sample was spotted on the MALDI Plate mixed with 1 μ L (-cydno-4-hydroxycimamic acid matrix. Then the ions were observed by positive mode. Molecular mass for kemptide is 1225.6.

TFA Control Experiment

1. Subjects

Crosslinking reactions

2. Material

 H_20 1x Buffer

150 µg Hela Lysate

4mm ATP

 $4mm N_3$

100 μg Kemptide

50% TFA

2 SDS-PAGE Gels

1x Loading Dye

10% BME (Beta-mercaptoethanol) SDS Buffer

Gel Electrophoresis Device

Gel Electrode PVDF Membraine Transfer Buffer

3.03g Tris Base

10% MeOH

14.4g Glycine

2 Filter Papers

%5 Milk/PBST

anti-PKA Antibody

Secondary Mouse Antibody

1x PBST

3. Procedure

Four different epindonff tubes were filled with a mixture of H20, 1x Buffer, 150 µg of Hela Lysate. To the tube, 4mm of ATP were added and sat for 15 minutes at room temperature. 4mm N3 was then added and to each sample and incubated for 5 min at 31C. To each tube 100 µg biotin-kemptide was added and allowed to shake under UV irradiation for two hours at 31C. This was when the reaction coupled. At this point ATP was expected to covalently link biotin labeled substrate and the kinase. After two hours, Samples 1 and 3 were put on ice. 50% of TFA was then added to samples 2 and 4, which were incubated for one hour at 31C. The Speed Vac was used to evaporate the remaining TFA. Water was added and the samples were spun again but for 15 mins. This process was reported 3 more times. Water was added to each sample so that were equal amounts. Loading dye was added to all the samples. The amount of loading dye needed = amount of sample divided by 3. 1x loading dye and 10% BME were mixed together to create the loading dye. The loading dye should be blue, if it is slightly yellow add small amounts of Tris Buffer 8.8 PH, a 1 µL at a time. Two gels were ran, one for Western Blot the other was for a Ruby Stained Gel. The Western Blot was used for a Pka Blot and a Biotin Blot. The Western Blot Gel had the samples in twice. The order of the samples was the Marker, then sample 1, then 2, then 3, then 4. The sequence was repeated again in the same gel. Samples were billed at 95C for 1 minute and centrifuged at 6RPM for one 10m 110V, then 60m 200V.

Sypro-Ruby Staining

The Sypro-ruby staining was use to see all the proteins in the gel. The same amount of proteins should be present in all four lanes. The gel was removed and then Sypro-Ruby Fixing solution was added. The gel sat for two hours. Sypro-Ruby Staining solution was added to the gel and left to sit overnight. Destaining Solution was added for about 1 hour. Water was used to rinse the gel and read with the Typhoon machine.

Wester Blot

Tris Base, Glycine, 10% MeOH, and water were mixed together to create the Transfer Buffer. The gel had the stacking layer off and was then rinsed in water and soaked i Buffer on a rocker for five minutes. A PVDF membrane was cut and Methanol was used to rinse the membrane. Membrane was than rinsed with water then soaked in buffer for 5 mins on rocker as well. "Sandwhich" and filter were soaked in buffer. The sandwich was assembled Black-Filter-gel-Membrane-filter-White. It was then added to the electrode and place in container. To the device, an Ice pack was added and buffer. The device was covered in ice and ran for 120 minutes at 90V. 5% Milk/PBST was used to block the membrane overnight. From here, the membrane was cut in half. One half was analyzed for the PKA signaling and the other was used for Biotin signaling. Added to the PKA Membrane was the anti-PKA antibody with 5% milk/PBST, it was allowed to sit for one hour. 1X PBST was used to rinse the membrane 3 times. The secondary antibody was added in a dark room, since it was light sensitive, and sat for one hour. For the Biotin Membrane, 4% milk/PBST was made and the antibody was added. The addition of the Biotin Antibody was done in the dark because it was also light sensitive. The membrane was let sit on the rocker completely covered for one hour. After one hour the milk was rinsed away with PBST. The membrane were looked at with the Typhoon Machine.

4. Instruments

- Shaker
- Gel Electrophorus
- 5. Data Analysis

After the samples were transferred onto the PVDF Membrane, it was analyzed using a Typhoon Scanner that can read the proteins that have been transferred and labeled. From here, one can see whether the TFA reduced the PKA labeling and compared that to the samples that did not contain PKA. Also, this was used to ensure that there was not a possible reduction of proteins.

RESULTS

Figure 3: Biotin-kemptide Crude Semi: ACN 5-17/11min, 17-18.5/5min, 18.5-19.4/9min



After the synthesis of Kemptide, HPLC was used to analyze the presence of the peptide. This was the first attempt to purify the Biotin-kemptide using the HPLC to run the sample and identify where the peptide was. The first method we used to run it was under a span of 11 minutes. Here we saw two peaks with poor separation. The peaks at 5 min should not be collected for it represents the void

Figure 4: ACN 5-25% in 16mins 1.25 gradient



The second trial that we ran was more successful. This time it was run for 16 mins under the starting conditions 5% ACN and 25% water. This time there was a sharp peaks that was obviously our peak. We collected from the beginning of that large peak until it started to trail off. The peak was at 18 minutes and about 0.50 AU.

Figure 5: Reinjection of 100ug peptide (10ul of 10mg/mL peptide diluted in100 ul water) ACN 5-25% in 16mins 1.25 gradient



The collected peak was lyophilized and re-injected to see if the product was pure. In Figure 5 you can see one clear sharp peak and it occurs at the same point that our product does. This is our product and it is pure.

> Figure 6: Blank injection ACN 5-25% in 16mins 1.25 gradient



As a control, a black injection was run. From here we can assume that our product that we collected has no contamination and is pure Blank injection shows that it was the column that had the contamination or possible air bubbles.

MALDI of Purified Peak in positive mode Exact Mass: 1225.6 Observed :1226.9



Figure 7 The collected product was spotted on a MALDI dish and then put though the instrument. MALDI Data shows that our collected peak is indeed our product since it shows the correct mass.



1,3 ---> Crosslinking Reaction without TFA

2,4 —-> Crosslinking Reaction incubated with 50% TFA

Biotin 1: As expected slight reduction in biotin labeling is observed for samples 2 and 4.

Sypro-Ruby Stained Gel 1: All lanes equal.

PKA 1: The PKA Western Blot shows reduction for samples 2 and 4.

Biotin 2: Labeling looks equal for all four lanes. No reduction observed. The TFA Control did not go as planned.



1,3 ----> Crosslinking Reaction without TFA

2,4 ---> Crosslinking Reaction incubated with

Sypro Ruby Gel 2: All lanes show similar protein levels, no reduction of proteins.

PKA 2: There is no PKA signal in any of the lanes.

DISCUSSION

The syntheses and purification of our Biotin-kemptide was successful. The first run though the HPLC Instrument gave a peak that was not sharp enough so I did a second run by changing the gradient. (Figure 4) The second run showed a clear peak which was collected as the biotin- kemptide. After the product was completely collected the product was spotted on the MALDI. The exact mass of kemptide is 1225.6 and the observed was 1226.9 in the positive mode indicating that we have the correct product. (Figure 7) That is a difference of 1.3. To be completely sure that the product was pure, a reinjection was carried out on the HPLC analytical column, to make sure it did not contain any other contaminates. The image that was taken shows a nice sharp peak but there were other smaller peaks at the begging and end. (Figure 5) This could be signs of contamination within the product itself or in the column. To be sure a blank was run with the column and it corresponded with the extra peaks observed in the reinjection, indication that the extra peaks are not coming from the sample. (Figure 6) From this it was concluded that our product was pure. With the HPLC readings and the MALDI confirming the molecular mass of the peptide, we confirmed that our biotin-kemptide is correct.

After the biotin-kemptide was synthesized, cross linking reactions were carried out to see if PKA is getting biotin labeled. During cross-linking, the substrate and the kinase are being covalently linked though the phophoroamide linkage. As a control, the TFA experiment was done to show that cross-linking occurs though phosphoroamide bond. TFA has the ability to cleave the phosphor amide bond. Cleavage of the phosophoramide bond should cause reduction in biotin labeling. So, by proving there is a reduction in biotin labeling, we can then assume that the cross linking does occur though the phosphoroamide linkage.

(Figure 8B) In the first trial, we are looking for reduction in the biotin signaling. Here, in lanes 2 and 4, there are only slight reductions in signaling (Figure 8A). Ideally, those lanes should have a significant decrease of signaling. The Ruby Stain showed all four samples have the same amount of proteins in each lane. That means that there was no protein reduction in any of the samples and that there are equals amounts of protein in each sample. This is just to show that they can be compared equally. Samples 1 and 3 are just the cross linking samples while 2 and 4 are the crosslinking samples with the TFA control. In the PKA membrane there were a decreased signaling, indicating that the amount of PKA in lysates was affected by TFA treatment. Therefore, it is not conclusive if TFA treatment reduced biotin labeling though the cleavage of phophoroamide linkage. (Figure 8C) Desired results would yield the same signaling of PKA in all four lanes. These results were not what I was looking for. The cross linking part of the experiment went over well. Samples 1 and 3 had biotin labeling and PKA labeling. The reduction of Biotin for samples 2 and 4 was a good sign but complete reduction is what we were looking for.

In the second TFA experiment (Figure 9), the incubation of samples 2 and 4 with TFA were increased. There was no biotin reduction (Figure 9A). The Ruby stained gel showed no signaling reduction (Figure 9B). This means there were equal amounts of protein present. There was little to no PKA signaling(Figure 9C). This lack of biotin reduction means that the TFA control did not work. The lack of PKA signaling means that the cross linking reaction was a failure. There were equal amounts of proteins so we used the right amount of proteins so that may not be the problem. In the lab we make our own ATP-Analogs. Possibly, the ATP ArN3 that was used may not have been a good aliquot. I know the Kemptide was good and the other products were decent quality so I assume that the aliquot was not good quality.

Overall, I was able to create a pure Kemptide for the experiment and show cross linking in that experiment but was unable to make the TFA control work. TFA is very hard to work with because of its high acidity, it could be possible that to much TFA is added or the concentration is to high. In the future I could possibly work in the reducing the TFA time or adding smaller amounts of TFA. Also, the samples that were incubated with TFA always are acidic afterwords, even after speed vac. Maybe more speed vacing the two samples more could create better results.

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ANALYSIS OF HDFS MOUNTING METHODS

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ABSTRACT

Hadoop is an open-source software framework for storing and processing big data in a distributed fashion on large clusters of commodity hardware. Essentially, it accomplishes two tasks: massive data storage and faster processing. To manage storage resources across the cluster, Hadoop uses a distributed user-level file system. This file system — Hadoop Distributed File System (HDFS) — is written in Java and designed for portability across heterogeneous hardware and software platforms.

In this paper, we will look at various mounting methods for HDFS and how they compare against each other. HDFS is not a POSIX (Portable Operating System Interface) compatible system and hence it is not possible for existing applications to communicate with HDFS and access data stored in HDFS. In order to make HDFS a POSIX compatible file system, we need to mount HDFS as a local file system. There are various methods available to mount HDFS using FUSE but we will be mainly looking at contrib/fuse-dfs. We will compare it to HDFS NFS Gateway method.

Introduction about HDFS is presented first along with its advantages and disadvantages followed by brief details about various mounting methods. Then, we will look in details about two methods mentioned above. We will also show how to implement those methods and explain results of some tests performed on them. The in-depth comparison will be useful in deciding why HDFS NFS Gateway mounting method is a better choice compared to FUSE method. This will be followed by recommendations that can be made to the current HDFS NFS Gateway method.

INTRODUCTION

Hadoop is a "flexible and available architecture for large scale computation and data processing on a network of commodity hardware". Hadoop is an open source framework for processing, storing and analyzing massive amounts of distributed unstructured data. Originally created by Doug Cutting at Yahoo!, Hadoop was inspired by MapReduce, a user-defined function developed by Google in early 2000s for indexing the Web. It was designed to handle petabytes and exabyte's of data distributed over multiple nodes in parallel. Hadoop clusters run on inexpensive commodity hardware so projects can scale-out without breaking the bank [1].

Each node in a Hadoop instance typically has a single namenode; a cluster of datanodes form the HDFS cluster. The situation is typical because each node does not require a datanode to be present. Each datanode serves up blocks of data over the network using a block protocol specific to HDFS. Data in a Hadoop cluster is broken down into smaller pieces (called blocks) and distributed throughout the cluster. In this way, the map and reduce functions can be executed on smaller subsets of your larger data sets, and this provides the scalability that is needed for big data processing [2]. HDFS is not fully POSIX-compliant, because the requirements for a POSIX file-system differ from the target goals for a Hadoop

application. The trade-off of not having a fully POSIX-compliant file-system is increased performance for data throughput and support for non-POSIX operation. HDFS was designed for mostly immutable files and may not be suitable for systems requiring concurrent write-operations.

STATEMENT OF THE PROBLEM

Since HDFS is not POSIX compatible, it creates limitations such as [3]

- Limited support of traditional applications
- No support of UNIX utilities, which requires using the **hadoop dfs get** command or the **put** command to copy data

For example:

- Command to list directory contents In UNIX: Is In HDFS: hadoop fs –Is
- Command to output file content and can also be used to concatenate and list files In UNIX: cat filename.txt In HDFS: hadoop fs –cat filename.txt
- After the initial load, data is read-only

HDFS cannot be mounted directly by an existing operating system. Getting data into and out of the HDFS file system, an action that often needs to be performed before and after executing a job can be inconvenient. To address POSIX limitations, various methods have been developed over the years that support mounting HDFS as a local file system. Majority of the methods are based on FUSE (File System in User Space) [4]. FUSE is a virtual file system has been developed to address this problem, at least for Linux and some other UNIX systems.

LITERATURE REVIEW

Current projects that can be used to make HDFS mountable are [4]:

- contrib/fuse-dfs: it is built on FUSE, some C glue, libhdfs and the hadoop-dev.jar
- fuse-j-hdfs: It is built on FUSE, FUSE for java and the Hadoop-dev.jar. Allows export of that mount point to other machines. Writes are disabled. rmdir, mv, mkdir, rm are supported, but not cp, touch, and the like.
- hdfs-fuse: It is similar to contrib/fuse-dfs project.
- Webdav: WebDAV stands for Distributed Authoring and Versioning. It is a set of extensions to the HTTP protocol that lets users collaboratively edit and manage files on a remote web server. Provides mountable access from Windows clients. Known Issues [5]:
 - 1. On Windows you can mount WebDAV resources only in case when WebDAV server binds 80 port.

- 2. Moreover, Windows clients need service WebClient to be running. On Windows 2003 server it's blocked by default, so you have to make it starting automatically.
- 3. Another one Windows XP's and later issue is that it's client cannot download files more than 50Mb from the server.
- HDFS NFS Proxy: it is an NFS4 server for HDFS [6]. It exports HDFS as NFS without use of fuse. Written entirely in java and uses the HDFS java API directly.
- native-hdfs-fuse: It doesn't use libhdfs or otherwise start a JVM it constructs and sends the protocol buffer messages itself. The implementation supports random file writes too.
- HDFS-NFS-Gateway: It supports NFSv3 and allows HDFS to be mounted as part of the client's local file system.

METHODS

Of the methods mentioned above, we will compare contrib/fuse-dfs and HDFS-NFS-gateway.

contrib/fuse-dfs:

This method supports reads, writes, and directory operations (e.g., cp, ls, more, cat, find, less, rm, mkdir, mv, rmdir). It doesn't support commands like touch, chmod, chown and permissions yet.

Installation: Install fuse-dfs and all necessary dependencies as follows [7].

To install fuse-dfs on CentOS or RHEL 6:

\$ wget http://archive.cloudera.com/redhat/6/x86_64/cdh/cdh3-repository-1.0-1.noarch.rpm \$ sudo yum --nogpgcheck localinstall cdh3-repository-1.0-1.noarch.rpm \$ sudo rpm --import http://archive.cloudera.com/redhat/6/x86_64/cdh/RPM-GPG-KEY-cloudera \$ sudo yum install hadoop-0.20-fuse

To install fuse-dfs on Debian or Ubuntu 10.10 and earlier:

\$ wget http://archive.cloudera.com/one-click-install/\$(lsb_release -cs)/cdh3-repository_1.0_all.deb \$ sudo dpkg -i cdh3-repository_1.0_all.deb \$ sudo apt-get update \$ sudo apt-get install hadoop-0.20-fuse

To install fuse-dfs on Ubuntu 12.04 and higher:

\$ wget http://archive.cloudera.com/one-click-install/maverick/cdh3-repository_1.0_all.deb \$ sudo dpkg -i cdh3-repository_1.0_all.deb \$ sudo apt-get update \$ sudo apt-get install hadoop-0.20-fuse

Mount:

Once fuse-dfs is installed, mount HDFS using FUSE as follows.

\$ sudo <u>hadoop</u>-fuse-dfs dfs://<name_node_hostname>:<namenode_port> <mount_point>

Once HDFS has been mounted at <mount_point>, you can use most of the traditional filesystem operations (e.g., cp, rm, cat, mv, mkdir, rmdir, more, scp). However, random write operations such as rsync, and permission related operations such as chmod, chown are not supported in FUSE-mounted HDFS.

Installation pre-requirements and instructions can also be found at https://wiki.apache.org/hadoop/MountableHDFS#Fuse-DFS.

Known Issues [4]:

- 1. Writes are approximately 33% slower than DFSClient.
- 2. Reads are approximately 20-30% slow even with read buffering.

HDFS NFS Gateway:

The NFS Gateway supports NFSv3 and allows HDFS to be mounted as part of the client's local file system. Currently following usage patterns are supported [8]:

- Users can browse the HDFS file system through their local file system on NFSv3 client compatible operating systems.
- Users can download files from the HDFS file system on to their local file system.
- Users can upload files from their local file system directly to the HDFS file system.
- Users can stream data directly to HDFS through the mount point. File append is supported but random write is not supported.

Installation: (For brevity, installation instructions are only for non-secure mode.)

Suppose root is the server name and hduser is the proxy user name.

Add following configuration changes in **core-site.xml**:

```
<property>
<name>hadoop.proxyuser.nfsserver.groups</name>
<value>root,hduser</value>
<description>
//description to explain the property
</description>
</property>
<name>hadoop.proxyuser.nfsserver.hosts</name>
<value>*</value>
<description>
//description to explain the property
</description>
</property>
```

Add following configuration changes in **hdfs_site.xml**:

<property> <name>dfs.nfs.dump.dir</name> <value/tmp/.hdfs-nfs </value> </property>

Start/stop NFS services:

- Stop nfs/rpcbind/portmap services provided by the platform (commands can be different on various UNIX platforms): service nfs stop service rpcbind stop
 Start package included portmap (needs root privileges):
- hadoop portmap OR hadoop-daemon.sh start portmap
- 3. Start mountd and nfsd.

No root privileges are required for this command. However, ensure that the user starting the Hadoop cluster and the user starting the NFS gateway are same. hadoop nfs3 OR hadoop-daemon.sh start nfs3

Note, if the hadoop-daemon.sh script starts the NFS gateway, its log can be found in the hadoop log folder.

Stop NFS gateway services.
 hadoop-daemon.sh stop nfs3
 hadoop-daemon.sh stop portmap

Mount:

The users can mount the HDFS namespace as shown below:

mount -t nfs -o vers=3,proto=tcp,nolock \$server:/ \$mount_point

NLM is not supported so mount option "nolock" is needed. Once mounted, the users can access HDFS as part of the local file system.

Known Issues:

1. Hard link and random write are not supported yet.

Installations and pre-requirements instructions can also be found at <u>http://hadoop.apache.org/docs/r2.7.1/hadoop-project-dist/hadoop-hdfs/HdfsNfsGateway.html</u>.

RESULT/FINDINGS

Some of the tests along with expected results on HDFS mounted using NFS Gateway are as follows:

1. Copy a file from local system folder to mounted folder

cp /home/hduser/file.txt /mnt/hdfs/file.txt

- Create a dir in mounted folder. cd /mnt/hdfs Once inside hdfs directory, mkdir testDir
- Create a text file inside testDir folder cd /mnt/hduser/testDir vi test.txt ← this command will open vi editor, enter or copy/paste text and save the file

We can verify that file was copied, new directory was created and new file was created inside directory created and stored in HDFS using the following command

hdfs dfs -ls (This will display file.txt testDir/)

hdfs dfs -ls testDir/ (This will display test.txt)

(Assume that only files stored in HDFS are the one created after being mounted) We can also verify using the HDFS web interface.

I also copied a compressed file.

cp /home/hduser/hadoop-2.6.0.tar.gz /mnt/hduser/ (this will copy hadoop-2.6.0.tar.gz to HDFS)

Then I tried to uncompress the folder. Assume that current working directory is /mnt/hdfs

tar –xvzf hadoop-2.6.0.tar.gz

This command failed to retrieve all files in the folder. While some files were extracted successfully, some files raised I/O error. Comparing folder size of the hadoop-2.6.0.tar.gz in destination folder is much smaller than the one in source folder.

Other problem with NFS Gateway is inability to random write to files so it has to save all the data to a temporary directory (/tmp/.hdfs-nfs by default) on the local file system on the given node prior to writing it to HDFS [9].

It can be concluded from the outcomes of the various commands that basic POSIX operations are supported in mounted HDFS.

However, mounting using FUSE method has many problems such as [10]:

- 1. It requires client installation and software must be installed on every machine that will read or write form the Hadoop cluster.
- 2. If Hadoop API changes, then software must be upgraded on each client which is not efficient.
- 3. FUSE only works on LINUX.
- 4. It is very slow as FUSE runs in user space. In Hadoop FUSE, FUSE calls libhdfs, a C/C++ wrapper which in turn call corresponding JAVA API method which then communicates with the server.
- 5. It can make the host run out of memory. It uses path to generate the NFS file handle. Its pathhandle mapping can make the host run out of memory.
- 6. If work around the memory problem, it could have correctness issue. FUSE may not be aware that a file's path has been changed by other means.

CONCLUSION

In this paper, we looked at various mounting methods. We compared two methods in details – HDFS FUSE and HDFS NFS Gateway. Based on work mentioned above, HDFS NFS Gateway is more robust and efficient and should be preferred over the FUSE method. Unlike FUSE, NFS Gateway doesn't require software to be installed on each and every client. Also, HDFS can be mounted either on the client that contains namenode or datanode without affecting the functionality. Once mounted, various applications can directly communicate with the HDFS. Mounted HDFS can be used to send data to local applications. It can also be used to retrieve data from local applications.

POSSIBLE IMPROVEMENTS

As stated in Conclusion, NFS Gateway is the preferred method. Even though it supports appends to file, it still however doesn't support random write. Hadoop vendors such as mapR have developed technologies that support random reads/write to the files.

Other improvements that will be implemented in future [11] are:

- Other NFS protocol versions
- Better security, e.g., Kerberos
- Submount support

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A SPATIAL ANALYSIS OF THE ELEMENTAL COMPOSITION OF FUGITIVE DUST WITHIN METROPOLITAN DETROIT

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ABSTRACT

The exacerbation of environmental factors to be reported in this study related to asthma are; legacy contaminants and particulate matter. The notable risks of environmental pollutants being a major causative factor as an asthma trigger denotes the need to identify the causal relationship between asthma and environmental pollutants in a more detailed manner.

The methodologies for this study on particulate matter (PM) component analysis evaluated the amount of particulate matter in the air as well as its composition. A major focus of this investigation was verifying the absolute relationship and abundance of lead and metals in urban areas. The design was to ultimately understand soil and lead resuspension rates, one's exposure during gardening to lead in the soil or their homes, and exposure to lead from outdoors is kicked up and bought indoors. The concentration of lead in other elements such as the dust in street sediments and street materials was hypothesized as well as the measurement of both values visual difference in composition.

It was determined that industrial areas would naturally have higher Pb concentrations due to the lack of foliage; making these areas less likely places for playgrounds and schools due to health risks from traffic exposure due to busy roads. This was only an approximation of real exposure.

BACKGROUND

Particulate matter (PM) is dusts that are solid particles that primarily come from soil. Fugitive dust is a resuspended PM composed of soil minerals, such as calcium and iron but may also encompass lead, brake dust and tire particles. It is termed "fugitive" because it is not discharged to the atmosphere in a confined flow stream and common sources of fugitive dust include unpaved roads, agricultural tilling operations, aggregate storage piles, and heavy construction operations (17). Asthma is a chronic lung disorder that is characterized by airflow obstruction, bronchial hyper-responsiveness, and inflammation (1). Airborne (PM) is an environmental trigger of asthma and has been linked to adverse health impacts including aggravation of respiratory conditions and premature death (2). In Michigan, it is estimated that over 750, 000 adults and 250, 000 children have asthma, affecting roughly 15% of the residents over their lifetimes. The risk is not spread evenly over the populace and the rate of asthma hospitalization is four times higher for African American children and adults compared to Caucasians. The city of Detroit's rate for hospitalization is three times higher than Michigan in its entirety (1). Recent research interest has been focused on road dust resuspension as one of the major sources of atmospheric PM in an urban environment and given the variability of the PM_{10} fraction of road deposited sediments; the understanding of the main factors controlling this pollutant is incomplete. Road traffic emissions include not only gases and PM released from motor exhausts but also non-exhaust particles derived from wear and tear of vehicles, road surface and, as well as resuspension due to the turbulence generated by vehicle wheels (11). Attention is often focused on the PM fraction small enough to enter deep into the respiratory tract, which are $PM_{2.5}$ particles smaller than 2.5 μ min diameters (2). Once resuspended, these particles are generally defined as non-exhaust or road dust emissions in urban environments that are currently representative to a PM source comparable to or even greater than exhaust emissions that are mostly for PM_{10} (11). Exposure to PM from roadways implies an increased exposure to ultrafine particles and to PM_{10} and $PM_{2.5}$ emissions from tailpipes, brakes wear, tire wear and road dust (13). The incidence of asthma can be attributed to multiple triggers but environmental pollution is known to be a major causative factor, which includes gaseous pollutants such as ozone, nitrogen dioxide, and sulfur as well as airborne PM (1). However, the contributions of the brake wear, tire wear, and road dust to the total concentration of metals in roadways has been associated with adverse health effects and linked to an increased risk of respiratory illness.

The elemental composition, patterns of distribution and possible sources of street dust are not common to all urban environments, but vary accordingly to the peculiarities of each city and/or community (12). These common features and dissimilarities in the origin as well as the nature of the street dust have been investigated through a series of studies with the most comprehensive sampling campaign carried out in the Norwegian capital during the summer of 1994 (12). One of the numerous geochemical features of urban environments is that they can be regarded as spatial domains where a steady flow of incoming trace elements is subject to changes in their physicochemical state before being disposed of and accumulated within their limits (12). The statistical analyses of the results obtained in the Norwegian study suggest that chemical elements in street dust can be classified into three groups: "urban" elements (Ba, Cd, Co, Cu, Mg, Pb, Sb, Ti, Zn), "natural" elements (Al, Ga, La, Mn, Na, Sr, Th, Y) and elements of a mixed origin or which have undergone geochemical changes from their original sources (Ca, Cs, Fe, Mo, Ni, Rb, Sr, U)(12). Road dust integrates a geochemical description of the local environment that soil can't, as soil is not as dynamic as road dust due to the effects of suspension on the "natural" elements from grass. The direct route of exposure the road dust provides is eliminated in the case of soil therefore leaving soil resuspension and/or mobilization as the most important source of "natural" elements, while "urban" elements originate primarily from traffic and from the weathering and corrosion of building materials (12). The data for lead (Pb) seem to prove that the gradual shift from leaded to unleaded petrol as fuel for automobiles has resulted in an almost proportional reduction in the concentration of Pb in dust particles under 100 µm in addition to the spatial distribution of Pb in the city strongly suggest that lead sources other than traffic (i.e. lead accumulated in urban soil over the years) may contribute as much lead, if not more, to urban street dust (12).

Atmospheric PM pollution from traffic compromises not only direct emissions but also non-exhaust emissions because resuspension of road dust that can produce high human exposure to heavy metals, metalloids, and mineral matter (14). Random samples of schoolchildren were studied using the International Study if Asthma and Allergies in Childhood phase II protocol with skin-prick tests, measurements of specific immunoglobulin E and lung function. Traffic exposure was assessed via traffic counts by an emission model which predicted soot, benzene, and nitrogen dioxide (NO_2) (16). A key task for establishing mitigation or preventive measures is estimating the contribution of road dust resuspension to atmospheric PM mixture (14) and in the study Quantifying road dust resuspension in urban environment by Multilinear Engine. The application of data from an urban background site identified that resuspension was responsible for 37% of total traffic emissions respectively in PM_{10} (14). Traffic counts were associated with current asthma, wheeze and cough and this cough was associated with soot, benzene and (NO_2) , current asthma with soot and benzene, and current wheeze with benzene and (NO_2) . No pollutant was associated with allergic sensitization (16).

High vehicle traffic was associated with asthma, cough, and wheeze, and in children additionally exposed to environmental tobacco smoke, with allergic sensitization; so the effects of socioeconomic factors associated with living close to busy roads cannot be ruled out (16). There have been many epidemiologic studies examining the potential impacts of ambient PM on health, and some have shown an association between PM and morbidity and mortality (5). Conflicting results have been reported for the relationship between traffic exposure and inception of atopy (16). Nevertheless, it seems clear that children are the sector of the population at the highest risk (12). The effect of traffic on the prevalence of asthma and atopy at school age was investigated in a representative population (16). Interest in the levels of contaminants associated with street dust has risen in the last decades, particularly in light of the impact of high blood-Pb levels in children living in urban areas (15). Traffic counts were associated with current asthma, wheeze and cough and this cough was associated with soot, benzene and (NO_2) , current asthma with soot and benzene, and current wheeze with benzene and (NO_2) . No pollutant was associated with allergic sensitization (16).

The objective of this study is to evaluate the spatial distribution of respirable resuspended fugitive dust. The health implications of inhalation and/or ingestion of dust particles with high concentrations of trace element is the subject of intense debate and the results of research to date are contradictory (12). Despite their burden in urban particulate air pollution, road traffic non-exhaust emissions are often uncontrolled and information about the effectiveness of mitigation measures on paved roads is still scarce (11). To this end, we have evaluated the variation in the availability of road dust in industrial and residential communities as well the elemental composition. There is a credible need, therefore, for assessing the concentration levels of trace elements in street dust. A methodology was devised and applied to collect samples randomly from various sites to quantify ambient PM_{10} concentrations. This work provides useful profiles concerning resuspension of urban dust and the areas where this fugitive dust is preeminently lethal.

METHODS

To evaluate how the elemental composition of urban dust and resuspended urban PM vary spatially, possibly providing insight into health disparities roughly 120 sites in and around Metropolitan Detroit were analyzed. The variation of these urban zones ranged from having high industrial concentrations to high population concentrations which result in higher automobile densities. Dust samples were acquired from the storm drains within the city. Each sample bag was labeled with the coordinates of the location, the intersection, the date, and a sample identification name. The sample ID consisted of four letter from the street it was taken from and a six digit number which was the day, month, and year it was obtained. Aerial photos were taken for further analysis of the sample. The initial strategy was to wait two to three days after a rain event and collect dust samples from one hundred eighty randomly selected locations throughout the city concentrating on Southwest Detroit and the Marathon Refinery. Two weeks was the time frame prediction for sample collection however, due to the unexpectedly high volume of rain events this Spring/Summer and time constraints we went out as often as we could.



Figure 2: Sampling area within Metropolitan Detroit

Hypothesis

The elemental composition of street dust collected in the gutter of roadways will increase in industrial and heavily urban areas.

Sieving:

This procedure is used for obtaining samples of the desired (250um – 100um & >100um) particle sizes. Note: This SOP is not designed to determine the size fractions of soils

Materials for sieving:

- Copper lead free sieves (1 mm, 0.5 mm, #60, #140, #300, sieve cap, and the collection pan)
- Sieve shaker
- Sabot for sieves
- Compressed air
- 1. Remove excess soil from copper sieves using compressed air
- 2. Assemble the sieves in order with the largest on the top (1 mm, 0.5 mm, #60, #140, #300, and the collection pan)
- 3. Place soil sample in the top of the 1 mm sieve.
- 4. Run sample through sieve shaker for approximately 10 15 mins.
- 5. Place the soil retained on the #140 sieve in new sample bag with the sample ID following the formula "Original Sample ID"- 250
- 6. Place soil collected in the collection pan in a new sample bag with the sample ID following the formula "Original Sample ID"- 100
- 7. Mark log book with appropriate information, including weights for both samples.
- 8. Seal and store sieved bags in boxes.

Digestion vessels were cleaned by washing with liquid nox detergent, rinsing with ultrapure water (> $180M\Omega$), heated trace-metal grade HCL wash, and rinse with ultrapure water. Syringes and sample bottles used to process digestions were subjected to ultra-clean procedures to eliminate the possibility of trace metal contamination, with the exception of the rubber caps on the syringe plungers which were soaked in ultra-pure water for more than 24 hours. Special care was taken (maintaining an air gap) during experiments to prevent possible contamination from the rinsed rubber caps. The ultra-clean process consisted of soaking syringes and bottles in 18% hydrochloric acid, 35% nitric acid at $20^{\circ}C$, 35% nitric acid at $45^{\circ}C$, and ultra-pure water for approximately 24 hours.

This method is intended to completely extract/solubilize metals from soil samples allowing for the determination of the total lead (Pb) content. Please note that this method will not completely extract lattice bound minerals. SOP is based on US EPA Method 3051A Microwave Assisted Acid Digestion of Sediments, Sludges, Soils, and Oils and is specifically written for use on the CEM MARS Express Microwave Digester.

Notes:

- Procedures in this document require trace metal cleaning. Please see the trace metal cleaning SOP (SOP-Trace Metal Acid Washing.docx) for details.
- Samples and digestion tubes should be completely dry before digestion.
- All sets of samples being run should contain a NIST standard, two blanks, and a spiked and unspiked control.

Materials:

- Light duty tissue wipes (i.e. Kim Wipes) (VWR 82003-820)
- Trace metal washed 50 ml centrifuge tubes (VWR 89039-662)
- Trace metal washed 30 ml HDPE wide mouth bottles (VWR 414004-110)
- Trace metal washed 30 ml syringes
- Trace metal washed syringe 0.45μm PTFE filters (Microliter Analytical supplies Inc. F25-1045)
- Purple nitrile gloves (VWR 32930-744)
- NIST Standard 2586, Trace Elements in Soil Containing Lead from Paint
- One un-spiked control sample
- One spiked control sample
- 10 ml pipette
- Disposable scoops (VWR 80081-190)
- Two 8 qt plastic containers

Preclean filters:

- 1. Prepare a 100mL 6.8% solution of trace metal grade nitric acid in Nano pure water (10mL of nitric acid + 90mL Nano pure) and two 100mL beakers filled with Nano pure water.
- 2. Using a new trace metal clean syringe (SOP-Trace Metal Acid Washing.docx), draw ~20mL of air into syringe followed by 5mL of 6.8% nitric acid solution.
- 3. Attach new filter.

- 4. Pass the 5mL of nitric acid through syringe taking care not to allow the black plunger not to contact the bottom 5mL of syringe.
- 5. Remove filter
- 6. Draw ~20mL of air into syringe followed by 5mL of first Nano pure rinse solution.
- 7. Pass the 5mL of Nano pure water through syringe taking care not to allow the black plunger not to contact the bottom 5mL of syringe.
- 8. Remove filter
- 9. Draw ~20mL of air into syringe followed by 5mL of second Nano pure rinse solution.
- 10. Pass the 5mL of Nano pure water through syringe taking care not to allow the black plunger not to contact the bottom 5mL of syringe.
- 11. The filter is now clean. Place filter on new Kim Wipe to dry in hood, covered by second Kim Wipe.
- 12. Repeat steps 2-11 using the same solution for up to 50 new filters.
- 13. When complete, dispose of Nano pure rinses down drain with water and nitric acid solution in hazardous waste container.

Digesting the sample:

- 1. Remove the cap from a digestion tube, place it on a scale, and zero the scale.
- 2. Slowly add approximately 0.50 g soil (0.45-0.55 g) using the scoop
- 3. Over the sink, rinse the scoop with Nano water and dry it well with a light duty tissue wipe.
- 4. Repeat this process with each of the samples, making sure to record the exact mass of each sample being put into the digestion tube. Do not put the caps back on the tubes.
- 5. After all of the digestion tubes have soil in them, move them over to the hood, and, while wearing acid washing gear, add 10 mL of 68% Nitric Acid to each tube (from the pump located in the hood with the Flame AA), put both caps back on securely, then put the tubes in the canister.
- 6. Place the canister in the microwave for digestion, making sure that the space between 17 and 18 is centered.
- 7. Pick the digestion program that corresponds to the number of samples being tested from the following list, and press start.
 - EPA Method 3051 Xpress for 8-24 Samples
 - EPA Method 3051A 40 MODI Xpress for 24-40 Samples
- 8. Leave the digestion tubes in the microwave overnight, or at the very least for a few hours, to make sure they have cooled down enough to handle.

Diluting/Centrifuging the Samples:

- 1. Label an empty trace metal washed centrifuge tube for each sample and weigh the tubes, record the weight.
- 2. Using a pipette, add 10 mL of Nano-water to each centrifuge tube.
- 3. Wearing acid washing gear, move digestion canister from the microwave to the hood.
- 4. Carefully pour the contents of each digestion tube into its corresponding centrifuge tube.

- 5. Rinse each digestion tube, using 10 mL of Nano-water and the pipette, and then pour into centrifuge tube.
- 6. Repeat the above step, so there is a total of 40 mL in the centrifuge tubes creating a 17% nitric acid solution.
- 7. Place the empty digestion tubes into one of the 8 qt containers and the tops the other 8 qt container
- 8. Weigh and record the weight of the full centrifuge tubes.
- 9. Put samples in the wrist action shaker, for twenty minutes each (up to 12 samples can be shaken simultaneously).
- 10. Put samples in the centrifuge (only 4 at a time), and let the samples centrifuge for 20 minutes at 4000 rpm (there is a line indicating this point on the machine).
- 11. Clean digestion tubes (SOP-Trace Metal Acid Washing.docx).

Filtering the Samples:

- Move centrifuge tubes to the hood, along with the appropriate number of 30 mL bottles (labeled with the sample number AND centrifuge tube number), plastic syringes, and filters.
- Secure a filter to the bottom of syringe, remove the plunger of the syringe, pour in 15 mL of the sample, and push it through the syringe in clean 30mL bottle (SAFETY NOTE: Be sure to angle the syringe away from you so that if acid were to squirt out, it would not be directed toward you)
- 3. Repeat the above step, for the same sample, with another 15 mL (There should be 30 mL of sample in each bottle and 10 mL of sample left in the bottom of the centrifuge tube).
- 4. Discard empty syringes and filters in the trash.
- 5. Repeat steps 1-4 for all the samples.
- 6. Pour the excess sample from the centrifuge tubes into the waste bin and label it.

ANTICIPATED RESULTS AND DISCUSSION

This study anticipates there being increased concentrations of lead and other respirable pollutants in industrial and heavily urban areas. Several methodological limitations should be considered. As sieving is noticeably a very labor intensive endeavor, only 16% of the sieving was completed. The initial stages of the digestion process were completed which includes acid washing. Since such a small percentage of the sample were, sieved it wasn't cost effective to send the samples out to be appropriately analyzed. The analysis needed to be outsourced and the time wasn't available to do so.

The advantages of this study are selfish in the sense that I learned a great deal about a subject that was foreign in knowledge but close in relation as I am an asthma sufferer. Detroit's large surface area, Google's GIS mapping feature, as well as GPS Tour's application were also advantageous. There was no participation or reporting bias with regards to measurements and sampling. This study put everything from the environmental aspect of Civil and Environmental undergraduate curricula in perspective.

APPENDIX

Sample data sheet

Name:				
Date:				
Time:				
Location Description:				
Sample ID:	igit data (DDMMAYY)	sampla number. For example	, the first cample collected	l nagr tha
intersection of Warren and Cass Ave. o	on March 20, 2015 wo	ould have a Sample ID of: WA	ARCAS-200515-1	neur the
	G	Slocation		
	Gr	SLOCATION		
Latitude:		Longitude:		
GPS Unit (circle one):	Ga	rmin GPS 72	Google Maps	Cell Phone
	Other:			
Sample Description:				
Photo Taken: Yes	No	File Name:		
Other Notes:				

SAMPLE INFORMATION

Sample ID	Latitude	Longitude	Locations
MLK040615	42.345277	-83.062222	Second Ave and M.L.K. Blvd
MIR040615	42.344722	-83.070277	Miracles and Marvin Gaye
GRND040615	42.0441667	-83.077777	Grand River and Alexandrine
BLVD040615	42.3461111	-83.108611	Grand Blvd and Edsel Ford
BUCH040615	42.3327778	-83.12083333	Buchanan and Livernois
JOHN040615	42.3225	-83.13305556	John Kronk and Central
DIX040615	42.2930556	-83.15458333	Dix and Sanders
DUMF040615	42.120555	-83.148611	Dumfries and Sanders
STKR040615	42.2875	-83.1452777	Fort and Stocker
LOYO040615	42.33611	-83.148611	Lonyo and Kirkwood
LINC090615	42.362777	-83.083333	Holden and Lincoln
DEX090615	42.3575	-83.107777	Dexter and W Grand Blvd
DEXA090615	42.370555	-83.117777	Dexter and Atkinson
OAKM090615	42.390555	-83.138888	Livernois and Oakman Blvd
OAKD090615	42.3858333	-83.14466	Oakman Blvd and Davison Ave
LES090615	42.407222	-83.181388	Lesure and Pilgrim
HUBB090615	42.420833	-83.189444	Hubbell and Outer Dr
PEMB090615	42.4375	-83.206111	Pembroke and Mansfield
SOUT090615	42.4388889	-83.052777	Southfield Rd and Fargo
FENM090615	42.4436111	-83.2186111	Fenmore and Circle Dr
STAH090615	42.4372222	-83.2280555	Stahelin and Pembroke
BURG090615	42.4302777	-83.255833	Burgess and Cambridge
MCIN090615	42.419444	-83.263611	McIntyre and Grand River
BEAV090615	42.415	-83.2663888	Beaverland and McNichols
LAMP090615	42.387222	-83.253888	Lamphere and Barbara
KEND090615	42.388611	-83.241388	Kendall and Stout
CHIC090615	42.365	-83.236666	W Chicago and Evergreen
ASPK090615	42.4083	-83.208673	Asbury Pk and Grandmont
BALT180615	42.3675	-83.074722	Baltimore and Second
EUCD180615	42.378055	-83.0755555	Euclid and John R
CHIH180615	42.383055	-83.093888	Chicago Blvd and Hamilton
HMTN180615	42.390277	-83.097777	Hamilton and Tuxedo
PTKN180615	42.4075	-83.109166	Pitkin and Hamilton
WARD180615	42.425555	-83.11	Woodward and Savannah
JONR180615	42.431453	-83.1023443	Brentwood and John R
HULL180615	42.4413889	-83.089166	Hull and Seven Mile
REMN180615	42.4425	-83.078888	Fleming and Remington
SUNT180615	42.4402778	-83.061388	Sunset and Outer Dr
ROBN180615	42.331427	-83.0457538	Conley and Robinson
CANF180615	42.40583333	-83.044444	Caniff and Alpene
WEST180615	42.3905556	-83.070555	Westminister and Card
ALTR230615	42.3875667	-83.947667	Mack and Alter

STJN230615	42.3887639	-83.9847194	St. Jean and Warren
OUTD230615	42.4338722	-83.01426111	Outer Dr and Seven Mile
BEWK300615	42.3744975	-82.988748	Mack and Bewick
CNFD300615	42.3809918	-82.9866778	Canfield and Montclair
LKVW300615	42.3975	-82.96555556	Lakeview and Southhampton
CNPK300615	42.4	-82.95833333	Chandler Park and Alter
ORDR300615	42.4102778	-82.96083333	Outer Dr and Elmdale
HAYS300615	42.4255556	-82.96527778	Cedar Grove and Hayes
SVNM300615	42.4352778	-82.96805556	Seven Mile and Queen
CORN300615	42.4383333	-82.97444444	Corain and Gratiot
FAIR300615	42.4441667	-82.97833333	Fairmount and Anvil
RENO300615	42.4466667	-82.98305556	Edmore and Reno
SHNR300615	42.4419444	-82.98555556	Shoeneherr and E State Fair
SRTG300615	42.4330556	-82.96555556	Hayes and Saratoga
MRNG300615	42.4327778	-82.96027778	Morang and Faircrest
KLLY300615	42.4338889	-82.95333333	Kelly and Moross
HOOV300615	42.4413889	-83.005	Hoover and E State Fair
BRNG300615	42.4455556	-82.99138889	Bringrae and Fairport
PLKY300615	42.4355556	-82.98638889	Pelkey and Pinewood
LINN300615	42.4316667	-82.98055556	Linnhurst and Gratiot
GREN300615	42.4275	-82.98833333	Greiner and Alcoy
GLEN300615	42.4094444	-82.99638889	Glenfield and Gunston
CONR300615	42.4134838	-83.0080136	College and Connor
KMPA300615	42.4380699	-83.019492	Kempa and Yolonda
CHIP210715	42.4408333	-83.1622222	Chippewa and Washburn
NORT210715	42.4388889	-83.1547222	Northfield and Pembroke
PRAR210715	42.4344444	-83.1461111	Prarie and Eight Mile
NORF210715	42.4436111	-83.1388889	Norfolk and Gardendale
ROSL210715	42.4369444	-83.1369444	Roslyn and Chesterfield
FAIR210715	42.4194444	-83.13083333	Fairway and Seven Mile
STRT210715	42.43694444	-83.1288889	Strathcoma and Balmoral
MERR210715	42.4205556	-83.11	Merrill Plaisance and Second
ROSA210715	42.4108333	-83.1186111	Rosa Parks and Puritan
LABL210715	42.4008333	-83.1130556	Labelle and Woodrow Wilson
DEQU210715	42.4180556	-83.0822222	Dequindre and E McNichols
JUST210715	42.4180556	-83.05722222	Justine and Davison
CLFF210715	42.4263889	-83.1280556	Cliff and Nevada
MILB210715	42.4436111	-83.02555556	Milbank and Stotter
LYND210715	42.395	-83.1633333	Lyndon and Birwood
STOE210715	42.3658333	-83.1397222	Stoepel and Chicago
NRFD210715	42.3566667	-83.1291667	Northfield and Ivanhoe
MAGN210715	42.3341667	-83.10361111	Magnolia and Scotten
BAGL210715	42.3222222	-83.0880556	Bagley and Grand Blvd
JEFF210715	42.3116667	-83.0819444	Jefferson and Vinewood
WILL250715	42.35	-83.0652778	Willis and Second

BRSH250715	42.345	-83.0508333	Brush and Alfred
ERSK250715	42.35083333	-83.0411111	Erskine and Riopelle
CHAT250715	42.3433333	-83.0336111	Orleans and Chateaufort
CONC250715	42.3525	-83.0088889	St. Paul and Concord
GOET250715	42.3658333	-83.0025	Maxwell and Goethe
GRAT250715	42.3738889	-83.0183333	Warren/Gratiot/Grand Blvd
DWYE250715	42.3913889	-83.04	Dwyer and Dorothy
GEOR250715	42.3936111	-83.0227778	Georgia and Van Dyke
PALM250715	42.4083333	-83.0241667	Palmetto and Van Dyke
YEME250715	42.3991667	-83.0552778	Yemans and
MARS250715	42.3836111	-83.0572222	St. Aubin and Marston
LOTH250715	42.3694444	-83.0805556	Lothrop and Third
STAN250715	42.3555556	-83.0902778	Stanley and 14th
14TH250715	42.3472222	-83.0858333	14th and Grand River
VERM250715	42.3288889	-83.0719444	Marantette and Vermont
TRUM250715	42.3288889	-83.065	Trumbull and Labrosse
FORT250715	42.3272222	-83.055	Fort and Third
CLIFF250715	42.3347222	-83.0508333	Washington and Cliff
BEAU250715	42.3313889	-83.0402778	Beaubien and Larned
STAU250715	42.3355556	-83.0247222	Franklin and St. Aubin
CASS250715	42.3369444	-83.0558333	Cass and Montcalm
TOLE130815	42.3202778	-83.10583333	Toledo and Campbell
SCHA130815	42.2872222	-83.16444444	Schaefer and Clarann
ROSE130815	42.2805556	-83.17	Rose and Dora
CLMN130815	42.2777778	-83.19166667	Coleman and Allen
OUTR160815	42.25068	-83.151183	Outer Dr and 8th
9TH160815	42.244519	-83.157166	9th and Southfield
CHAN160815	42.246447	-83.175433	Chandler and Garfield
GRNT160815	42.253028	-83.161906	Grant and Montie
SALL160815	42.253938	-83.175433	Salliote and 10th
FRAN160815	42.265081	-83.160393	Francis and Liddesdale
SCHF160815	42.288986	-83.166391	Schaefer and Greenfield

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THE MAIN ORGANIZATIONAL ASPECTS THAT AFFECT JOB SATISFACTION AT A DETROIT RESTAURANT

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ABSTRACT

Job satisfaction is a very popular subject studied in the field of psychology and can relate to all of its subsets, specifically industrial organizational psychology. The study of job satisfaction can benefit organizations by allowing the employers to better understand their employees and workplace. The participants of this study were 18 to 50 year old employees of 1917 American Bistro; a single non-chain metro Detroit area restaurant. The restaurant is black owned and all of the employees are of the same ethnic background. There is only one owner, who manages 22 employees. The primary goals of this study were to find the importance of the main organizational aspects that affect job satisfaction in a metro Detroit restaurant, to diagnose problem areas at this particular restaurant, and to provide a guide for improvement of future job satisfaction among employees. The employees were given a 13 question job satisfaction survey. It was found that hours were the strongest predictor of job satisfaction. It was recommended to the owner of 1917 American Bistro that more hours should be given to the employees in order to increase their satisfaction with the job.

Job satisfaction is a very popular subject studied in the field of psychology and can relate to all of its subsets, specifically industrial organizational psychology (workplace psychology) for the purpose of this study. Job satisfaction is understood to be an affective response to the job viewed either in its entirety or with regard to particular aspects such as pay, supervision etc. (Tett, Meyer, & John, 1993). Studying job satisfaction can help the employee and the corporation. Specifically, employees might find that their job might be a reason for their current happiness or unhappiness. Corporations can find out whether or not they have happy employees; if not they can figure out what aspects the employees are not satisfied with and how they can make the workplace better for their employees immediately.

The job every individual holds is a big part of the person's life. Job satisfaction is a very important factor to always investigate. Tait, Padgett, and Baldwin (1989) found that there is an average correlation of .44 between job satisfaction and life satisfaction. That suggests that there is a positive relationship between the two. Different studies have been done and concluded with several answers on whether or not job satisfaction influences life satisfaction or vice versa.

One theory is called the spillover hypothesis and that states that the satisfaction from other areas in life can somewhat spillover into job satisfaction; and that satisfaction from a person's job can spill over into other life areas (Near et al., 1980). Another theory is that aspects of work and non-work have a lot in

common, such as friendship, status, and personality, so that both are closely linked to satisfaction with life as a whole (Near et al., 1980).

It is obvious to wonder what factors cause job satisfaction. The following factors have been identified as common aspects of job satisfaction; pay, room for advancement, hours, relations, customer relations, dress code, work breaks, rules, personal interest, work stress, performance appraisals, and training. Pay is an odd aspect in terms of job satisfaction because the overall correlation between job satisfaction and pay is relatively low, typically .15 to .17 (Clark, 1998a). Although research does not suggest that pay and job satisfaction are not correlated; people sometimes base taking a job because of its pay, pay equality is a big factor in the workplace, and changes in pay are very important. Based on those aspects, pay is a relevant factor in assessing job satisfaction.

Employee relations are very important when measuring job satisfaction. For European workers, having "good relations" at work with management and colleagues was the strongest predictor of job satisfaction (Argyle, 2001). Argyle (1989) also stated that, "Positive effects on job satisfaction and productivity have been found when workers engaged in time-wasting jokes and games". It can be speculated that good relationships with coworkers can minimize on the job stress and increase interest and motivation.

It is a question whether or not performance ratings affect the employee's level of job satisfaction. Performance ratings and job satisfaction have not been found to be correlated. However, Spector (1997) states that this might be an underestimate since the measures of performance often have reduced range and there may be rater biases. It could be the case that some raters show favoritism to some employees and overrate their performance, and some raters don't favor other employees and underrate their performance. There are often times when employees are told to rate their own performance and may tend to overrate themselves.

Job stress and job satisfaction are definitely related in a couple of ways. The main features of jobs that make them stressful according to Argyle are level of skill, job overload, repetitive work, danger, environmental stress, and role conflict (2001). Along with those issues, an employee's personality can worsen job stress. Caplan (1975) has conducted research providing evidence that work is more stressful for those whose talents or personality do not match their position. Too much stress at work can lead to a decrease in job satisfaction that can sometimes result in burnout of depression.

Taken together the previous literature points to the aspects mentioned having a significant influence on an employee's job satisfaction and it would be beneficial to workplaces everywhere to find the specific impact different factors have on job satisfaction. The influences of these factors on job satisfaction can only be found by repetition of research in different workplaces.

AIMS

Primary goals:

1. To find the importance of the main organizational aspects that affect job satisfaction in a

metro Detroit restaurant.

Secondary goals:

- 2. To diagnose problem areas at this particular restaurant.
- 3. To provide a guide for improvement of future job satisfaction among employees.

METHODS

Participants: The workers were from 1917 American Bistro, a single non-chain metro Detroit area restaurant. The ages of the employees range from 18 to 50 years old. The restaurant is black owned and all of the employees have the same racial origin. There is only one owner, who manages 22 employees.

PROCEDURE

A job satisfaction survey created specifically for this place of business was administered to employees. The survey consisted of the following questions: The first question concerned the pay of the employee (How satisfied are you with your pay?). The second question asked about workplace advancement (How satisfied are you with your chances to move up at your job?). The third question asked about work hours (How satisfied are you with the amount of hours worked per week?). The fourth question asked about work relations (How satisfied are you with relationships with coworkers?). The fifth question asked about interactions with customers (How satisfied are you with your day to day interactions with customers?) The sixth question inquired about the employee's dress code (how satisfied are you with your work uniform?). The seventh question asked about work breaks (How satisfied are you with your work breaks?). The eighth question asked about the job rules and regulations (How satisfied are you with the rules and regulations at your job?). The ninth question asked about performance appraisals (How satisfied are you with your performance rating?). The tenth question asked about the employee's job training (How satisfied were you with your training?). The eleventh question asked about how interesting the job is to the employee (How interesting is your job?). The twelfth question asked about on the job stress (How stressful is your job?). The thirteenth question asked about the employee's overall job satisfaction (How satisfied are you with your job as a whole?). The answers to the questions were based on a 1 to 7 Likert Scale ranging from not at all to very much.

The survey was estimated to take about 10 to 15 minutes to complete and was administered one time only. The answers were kept confidential and there were no identifiers. The researcher traveled to the restaurant to administer the surveys to employees. Employees completed the surveys privately one at a time. No debriefing was necessary because there was no deception used. A written guide to improvement of the employee's job satisfaction and organization as a whole based on the researcher's interpretation of the results was given to the owner of the restaurant. All procedures were approved by the institutional research board at the researcher's university.

RESULTS

For initial data screening, frequency, skew, and kurtosis were checked. Job interest was negatively skewed beyond the cutoff of -1.96 (-3.14). Initially there were 16 subjects that responded out of 22. There was 1 outlier on the variable of job satisfaction. To correct this skew the N was reduced to 15 subjects after dropping the outlier.

Further analysis was done via Pearson Correlation to see what variables correlated with job satisfaction. Advancement (.740), Hours (.820), Breaks (.669), and Rules (.651) were significantly correlated at the 0.01 level with job satisfaction. Pay (.555) and Training (.613) were significantly correlated at the 0.05 level with job satisfaction. For other correlations see Table 1.

All variables were entered for a multiple regression analysis to see what predicted job satisfaction. The initial analysis was not significant so variables were dropped one by one from the analysis. The final model yielded that hours significantly predicted job satisfaction. 67.2 percent of the variance in job satisfaction is explained by hours (F (1, 14) = 28.65, p<.001; t (14) = 5.35, p<.001). Refer to Figure 1.

DISCUSSION

Advancement, Hours, Breaks, and Rules were significantly correlated with job satisfaction. Those correlations were not expected because past research showed more information about pay, employee relations and performance ratings. It was not expected that hours would be the strongest predictor of job satisfaction than the other variables. The reason could be that servers in a restaurant take more tables the more hours they are on the job and ultimately make more money and are more satisfied with their job.

The participants in the study seemed very uninterested in this study and that could have altered the results of the survey data. If this study is repeated, the researcher suggests compensating the participants. According to previous work mentioned above, 1917 American Bistro is a bit different in what variables should correlate with job satisfaction in the workplace. It was expected that employee relations would have been the strongest predictor of job satisfaction. Future research should compare 1917 American Bistro to other workplaces to see if the same variables are significantly correlated with job satisfaction at different types of organizations. It is expected that the results of this study will assist the owner of 1917 American Bistro make the workplace better for the employees, with hopes that it can be a guide.

LIMITATIONS

During the procedure of this study, some things didn't go as expected. The researcher planned to only to make one trip to the restaurant and administer the surveys to all of the employees but actually had to make 3 trips to the restaurant because all of the employees were at work at different times and days of the week. Time should have been specifically allocated for diagnosis of problem areas in the restaurant because researcher didn't have much time to observe.

In addition to procedural issues, these results should be interpreted with caution. The model could be over fit due to the fact that the independent variables were dropped one by one until all predictors were significant, which was the variable hours. Additionally, there was a small sample size so the representativeness of the results could be questionable.

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Figure 1: Hours significantly predicts job satisfaction; more hours predicts higher job satisfaction.

Table 1

Correlations Between Organizational Variables

				Coworker	Customer				Performance		Job	Stress	Job
	Pay	Advancement	Hours	Relations	Interaction	Uniform	Breaks	Rules	Rating	Training	Interest	Level	Satisfaction
Pay	1	.826**	.716**	.539*	.530*	0.29	.674**	0.493	0.294	.582*	0.34	-0.5*	.555*
Advancement	.826**	1	.748**	0.383	0.277	0.21	.678**	.499*	.571*	.637**	0.228	-0.538*	.740**
Hours Coworker	.716**	.748**	-	0.462	0.492	-0.218	.806**	.629**	0.353	.633**	0.283	-0.359	.820**
Relations Customer	.539*	0.383	0.462	1	.661**	-0.112	0.321	0.355	0.054	.539*	0.331	-0.213	0.406
Interaction	.530*	0.277	0.492	.661**	1	0	0.453	0.264	-0.036	0.386	0.464	-0.185	0.232
Uniform	0.29	0.21	-0.218	-0.112	0	1	-0.15	-0.155	0.248	-0.156	0.134	-0.285	-0.204
Breaks	.674**	.678**	.806**	0.321	0.453	-0.15	1	.737**	0.373	.821**	0.243	-0.528*	**699.
Rules Performance	0.493	.499*	0.629^{**}	0.355	0.264	-0.155	.737**	1	0.359	.813**	-0.031	-0.724**	.651**
Rating	0.324	.571*	0.353	0.054	-0.036	0.248	0.373	0.359	1	.532*	0.286	-0.431	0.4
Training	.582*	.637**	.633**	.539*	0.386	-0.156	.821**	.813**	.532*	1	0.184	-0.683**	.613*
Job Interest	0.34	0.228	0.283	0.331	0.464	0.134	0.243	-0.031	0.286	0.184	1	-0.126	0.095
Stress Level	-0.5*	-0.538*	-0.359	-0.213	-0.185	-0.285	-0.528	-0.724	-0.431	-0.683	-0.126	1	-0.462
Job Satisfaction	.555*	.740**	.820**	0.406	0.232	-0.204	0.669^{**}	.651**	0.4	.613*	0.095	-0.462	1

* = P<0.05 ** = P<0.001

URBAN FLOODING IN THE CITY OF DETROIT

By Owen Pierce, Wayne State University Major: Civil Engineering Mentor: Joseph Hummer, PhD, Department of Civil & Environmental Engineering

ABSTRACT

Urban flooding is a problem in the City of Detroit, primarily attributed to the abundance of impervious surfaces located throughout the city. It is believed that by incorporating green infrastructures into the current combined sewer system, in Detroit, then the chances of flooding can be significantly reduced. One such infrastructure is called a grass median. A grass median is a grass strip in the center of a street or highway that separates the opposing travelling traffic directions. It was hypothesized that this type of green innovation would insure a reduction in the chances of flooding in Detroit. In order to test this hypothesis, the center lane of a one-half mile stretch of Grand River Avenue, in Detroit, Michigan, was chosen for further analysis. First the center lane was measured, recording a width of 12 feet. Then by using the Rational Method, the runoff rate for the center lane as pavement, and then as grass, was calculated and recorded. The results in this report prove that by implementing green infrastructures into the current combined sewer system, in Detroit, the chances of flooding can be significantly reduced. The findings reveal that by installing grass medians on all 7 of the major roads in the City of Detroit (Gratiot Ave, Michigan Ave, Fort St, Jefferson Ave, Van Dyke, and Woodward Ave), a total savings of 101,090,160 gallons of storm water per day can be achieved.

INTRODUCTION

During the summer of 2014, Detroit and surrounding communities experienced a storm that is categorized as one that has a one out of one hundred, or one percent, chance of occurring in a certain location, during any given year. Scientists call this type of storm a 100 year storm, and the drainage infrastructure of Detroit was challenged by a two-day steady rainfall. There was major flooding in the Macomb, Oakland, and Wayne counties (including major arterials, freeways, parking lots, and much more), and storm and sewage water had found its way into the basements of many of the homes of Detroit Metropolitan Area residents. The drainage system was overloaded with the fallen storm water, causing thousands of dollars in damage and thousands more in clean-up costs. How could a city with a drainage system in place develop such a large flooding problem? What changes can be made to assist the drainage system when such a storm arises again?

One main cause of urban flooding is the presence of impervious surfaces. According to Lance Frazier (2005) in Paving Paradise: The Peril of Impervious Surfaces, "Impervious surfaces can be concrete or asphalt, they can be roofs or parking lots, but they all have at least one thing in common—water runs off of them, not through them" (p. A457). An impervious surface is one that restricts or prevents water from percolating into the ground. Pavement is one type of impervious surface, as water does not pass through it into the ground. Rooftops are also impervious surfaces.

When it rains over an area that is covered with impervious pavement, the water that falls is prohibited from seeping back into the earth, and therefore either runs off into the drainage system, at a certain velocity, or gets trapped on the surface of the ground with nowhere to go. According to Lance Frazier (2005), "Impervious surfaces collect particulate matter from the atmosphere, nitrogen oxides from car exhaust, rubber particles from tires, debris from brake systems, phosphates from residential and agricultural fertilizers, and dozens of other pollutants" (p. A458). The more pavement there is, the higher the runoff rate of the storm water, which in turn would cause more water to enter into the drainage system, faster. As the rate of flow increases, some of those particles and pollutants, are likely to be picked up by the high velocity storm water as it runs along the surface of the pavement toward the drain. When entering into the drainage pipes, the particles and pollutants fall to the bottom as the water rushes through, leaving behind a build-up of sediment and debris that will only continue to get larger over time.

This is no different than a build-up of cholesterol in an individual's arteries. Without a change in diet, a person's arteries will continue to be clogged up with cholesterol, and without taking preventative measures a medical emergency, such as a heart attack, could occur. Much in the same way, if preventative measures are not taken to reduce the amount of runoff that enters into the drainage system, and the speed at which it enters, then a noticeable flooding catastrophe could occur, just like the August 2014 flood.

According to the Detroit Water and Sewage Department (2013), "Most of the storm water runoff from the City of Detroit is conveyed through the City's combined sewer system which uses a single pipe to convey sanitary waste from residences, industries and businesses, along with storm water drainage" (p.5). Having a combined sewer system to transfer sanitary waste and storm water is the same as a heart trying to pump a normal amount of blood to the rest of the body, but with fewer arteries. With less places for the blood to travel, the arteries would become overloaded with blood and essentially burst open. In the same way, when it rains in the City of Detroit, the combined sewer system becomes overloaded trying to hold both storm water and sanitary sewage. The result ends up being a "burst" of the drainage system and water starts to seep into the basements of people's homes, troughs of freeways, and everywhere else.

As reported by Ken Kunkel, a National Oceanic and Atmospheric Administration scientist, "All models point to bigger storm events in the Midwest" (as cited in Bienkowski, 2013, More Immediate Concerns Section, sentence 4). Detroit is a part of the Midwest, and as shown in Figure 1, rainwater has increased over the years in that city. Notice how the orange line steadily rises over the years. The blue line represents the line of best fit and visually tracks the average increase in inches of rain from 1959 to 2012.



Figure 1. Wetter in Detroit, "Sewage adds to Detroit's headache" (2013). This figure illustrates a steady rise in rain since the 1960s, in Detroit.

Due to the change in weather patterns, there has been an increase in rain water over the years. With the large amount of pavement located in the city, the velocity of storm water runoff has increased, which has continued to overload the combined sewer system, leading to an increase in the chance of flooding. Therefore, this report is designed to address one of the main causes of urban flooding in the City of Detroit, impervious pavement, not just from the August 2014 flood, but from the habitual flooding that occurs throughout the year, and to discuss research on one possible solution to try and mitigate this recurring problem.

LITERATURE REVIEW

The environment is holistic; it functions as one unit. The many different parts of it depend on each other to survive and thrive. Analogous to the human body, when one part of the environment is out of balance, the other parts make a change to try to bring everything back into balance. Despite the consequences that arise, whether they are good or bad, the goal of the environment is to become whole again.

According to the American Iron and Steel Institute [AISI] (1980) in *Modern Sewage Design*, "The basic philosophy applied to the design of storm drainage facilities, followed in the past and still widely practiced today, is to collect as much storm water runoff as possible and rapidly discharge it through a system of pipes to the nearest outlet" (p.43). They go on to say that "it has become apparent that in many instances we have ended up creating new problems, which now may become very difficult and expensive to solve" (p.43). This work was published in 1980 and describes three of the "new...major problems" as: "**high peak**

flows, excessive erosion, and damage due to flooding," (p.43); thirty-five years later, the very same problems plague the City of Detroit.

As reported by the Detroit Water and Sewage Department (2013), "The combined sewer system services the entire population of the City of Detroit" (p.5), approximately 700,000 people. (U.S. Census, 2010). Two major problems with a combined sewer system arise when compared to a system where the sanitary sewerage and storm water are separated. Since both types of effluent are treated in a combined system, larger treatment facilities are required, whereas in a separated system, only the sanitary effluent is treated. Larger facilities require more money, and more paved land which adds to the abundance of impervious surfaces. Then, for systems where an oversized treatment plant is not economically feasible, the storm and sewer effluent will back up through stormwater pipe connections into basements and waterways, causing potentially noxious and harmful contamination and pollution.

While separate stormwater and sanitary sewers is preferred, the cost of replacing a combined sewer system with a separated one can cost billions of dollars that many poorer cities, like Detroit, simply do not have. For example, the City of "Atlanta...spent \$4 billion over the past decade separating its sewer and storm water systems" (Bienkowski, 2013). According to the 2010 census, Atlanta had just over 400,000 people (U.S. Census, 2010), substantially less than the population of Detroit. Thus, if it cost Atlanta \$4 billion to replace a combined sewer system with a separated one it can be reasonably concluded that it would cost Detroit, a larger city, at least \$4 billion to complete a similar replacement. In fact, according to Chris Gautz in "Storm Drain System Metro Detroit Michigan" (2014), "A 2001 report from the Southeast Michigan Council of Governments found that between \$14 billion and \$26 billion was needed by 2030 to maintain and improve Southeast Michigan's sewer infrastructure" (Gautz, 2014). According to Karen Kabbes, of the Environmental and Water Resources Institute at the American Society of Civil Engineers, "new pipes may not be the answer...It's stepping back and looking at the whole system" (Gautz, 2014). Kabbes goes on to say that we need to find ways to lessen the burden of the current drainage infrastructure and, "One of the easiest and cost effective ways to do that is using green infrastructure" (Gautz, 2014). A green infrastructure includes a variety of avenues that would allow storm water to be naturally absorbed back into the earth. Examples include, rain gardens, green roofs, and installing pervious concrete in parking lots. One such green infrastructure is called a grass median.

Medians are physical separations between streams of traffic in the center of a travel way. Medians can be either pervious, typically grass or other landscaping, or impervious. According to InDOT, the Indiana Department of Transportation (2013), "the available median types [are]: flush, flush with concrete median barrier, raised, or depressed" (p.22). The raised and depressed median types are ideal when constructing grass medians. When a grass median is installed, a section of impervious pavement is removed and replaced by grass, thus returning that section of earth back to its original state. A raised median has a raised island with a concrete curb on either side. InDOT, in dscussing medians, has particular specification for median designs. For example, InDOT specifies that "The minimum width should be 8 ft. This assumes a minimum 4-ft raised island with 2-ft curb offsets on each side adjacent to the through travel lanes" (Indiana Department of Transportation, 2013). However, according to InDOT, the desirable width is "an 18-ft median width," including "a 12-ft turn lane, a 2-ft curb offset between the opposing through lane and raised island, and a minimum 4-ft raised island" (p.24). The figure below illustrates a raised median design as given by InDOT.



Figure 2. Raised Median, "INDIANA DEPARTMENT OF TRANSPORTATION—DESIGN MANUAL" (2013).

This figure shows the breakdown of a raised median.

Figure 3 depicts a depressed median. A depressed median has an inward sloping island, along with two sloping shoulders on either side of the island. As noted by InDOT (2013), "It should be as wide as practical," with a "minimum center longitudinal grade with an unpaved ditch [that] should be 0.5%," and "a 4-ft flatbottom ditch in the center should be considered" (p.25). A drainage inlet should also be installed to catch the storm water that does not get absorbed. Notice the large amount of area that is available for the instillation of grass.



Figure 3. Depressed Median, "INDIANA DEPARTMENT OF TRANSPORTATION—DESIGN MANUAL" (2013). This figure shows the breakdown of a depressed median.

Since reducing the pavement in the City of Detroit is helpful in diminishing the amount of runoff, as well as the velocity at which it flows, installing grass medians in the center lanes of all of the major streets (such as Grand River Avenue, Van Dyke, Gratiot, Jefferson, Fort, Michigan, and Woodward) in Detroit will result in a noticeable reduction in the amount of storm water that makes it way in the sewer system, and therefore will make a significant impact in reducing the overall chances of flooding.

METHODOLOGY

In order to see if installing grass medians in the center lanes of the major streets in Detroit will make a significant impact in the reduction of storm water from the sewer system, it needs to be determined if there is a difference between the runoff rates of pavement as opposed to grass. To test this, the following materials are needed:

- Google Maps measurement tool- This is used to perform all of the necessary measurements. To access, right click and select the final function that says "measure distance." A white dot should appear on the screen. You can select the dot and move it around. When your desired location is achieved, then scroll through the map to your destination and press on the exact spot that you want to stop at. Then record the measured distance.
- Calculator, pencil and paper.

A parking lot is selected, and these tools are used to perform the following tasks:

- Measure the dimensions of the lot (length and width), with the units in feet (ft) and find the Area (A) of the lot, measured in feet squared (ft²). Once the Area is found, convert to acres by dividing by the conversion factor 43,560 (ft²/acre).
- Calculate the Time of Concentration (Tc) by using the Kirpich Formula displayed below in Figure
 The Tc tells you how long, in minutes, it takes for a drop of water to travel from the furthest point from the nearest outlet to the nearest water outlet. Note that Tc is only dependent on the length and the slope, and is independent of the surface type.



Figure 4. Time of Concentration, "Balch Springs, Texas, Stormwater Ordinance" (2004).

This figure shows the Kirpich Formula along with an explanation of the variables in the problem.

For the average slope, 0.001 (ft/ft) will be used.

3. Calculate the Rainfall Intensity (I) by using the formula displayed below in Figure 5. For the purposes of this report, the formula for a 100 year storm will be used.

Rainfall intensity, I. The rainfall intensity, I, should be computed using the following equations: $I_{2 YR} = 19.489 T_c^{-0.5991}$ $I_{5 YR} = 20.837 T_c^{-0.5597}$ $I_{10 YR} = 22.099 T_c^{-0.54}$ $I_{25 YR} = 24.911 T_c^{-0.532}$ $I_{50 YR} = 26.799 T_c^{-0.5223}$ $I_{100 YR} = 29.035 T_c^{-0.5186}$

Figure 5. Rainfall Intensity, "Balch Springs, Texas, Stormwater Ordinance" (2004).

This figure shows the formula to find the rainfall intensities for a 2 year, 5 year, 10 year, 25 year, 50 year, or 100 year storm.

4. Determine the Runoff Coefficient from the chart located below in Figure 6.

Runoff Coefficient, C. be as follows:	The runoff coefficient, C, to be used in design flow rate calculations shall
	Unimproved land, C=0.30 Parks and open space, C=0.40 Low density residential (Lot size greater than 1 Acre), C=0.50 Medium density residential (Lot size greater than 0.5 Acre), C=0.60 High density single family residential, C=0.70 Apartments, C=0.80; Industrial and Commercial, C=0.85; Urban, C=0.90; Paved areas, C=0.95;

Figure 6. Runoff Coefficient, "Balch Springs, Texas, Stormwater Ordinance" (2004). This figure depicts a chart that has the coefficient for each specific category of land.

For the purposes of this report, the coefficient C=0.30 will be used when calculating the runoff rate for grass, and the coefficient C=0.95 will be used for pavement.

- 5. Calculate the Runoff Rate (Q) by using the equation **Q=CIA**, where (C) is the Runoff Coefficient, (I) is the Rainfall Intensity, and (A) is the Area in acres. The units for the final answer are (ft³/s).
- 6. Divide the Q for pavement by the Q for grass, and note the difference.

Once this information is determined for the selected area, steps one through five will be repeated to find out the difference in Q for the center lane of a half-mile stretch of Grand River Avenue, in Detroit. By doing this, the runoff rate savings will be calculated, and by converting the runoff rate to gallons, the amount of water saved from entering into the sewer system will also be known. The conversion results will be presented as gallons of storm water per day, saved by replacing the pavement with grass in the center lane for the half-mile stretch. Then, the results from this small area of road will be used to infer the effects of replacing pavement with grass on larger areas of road.

DATA/RESULTS

The results for the parking lot examination are as follows:

Parking lot with grass:	Parking lot with pavement:
1. L=104.19 ft W=94.8 ft	1. L=104.19 ft W=94.8 ft
A=L x W = (104.19 ft) x (94.8 ft)= 9,877.212 ft ²	A=L x W = (104.19 ft) x (94.8 ft)= 9,877.212 ft ²
A= 9,877.212 (ft ²) / 43,560 (ft ² /acre) = 0.227acres	A= 9,877.212 (ft ²) / 43,560 (ft ² /acre) = 0.227acres
2. $T_c = 0.0078 L^{0.77} S^{-0.385}$	2. $T_c = 0.0078 L^{0.77} S^{-0.385}$
= 0.0078 (104.19 ft) ^{0.77} (0.001 ft/ft) ^{-0.385}	= 0.0078 (104.19 ft) ^{0.77} (0.001 ft/ft) ^{-0.385}
=3.989 min	=3.989 min
3. $I_{100yr} = 29.035 T_c^{-0.5186}$	3. I_{100yr} = 29.035 T _c ^{-0.5186}
= 29.035 (3.989 min) ^{-0.5186}	= 29.035 (3.989 min) ^{-0.5186}
= 14.168 ft	= 14.168 ft
4. C = 0.30	4. C = 0.95
5. Q = C I A	5. Q = C I A
= (0.30) x (14.168 ft) x (0.227acres)	= (0.95) x (14.168 ft) x (0.227acres)

Q = 672.638 ft ³ /s	Q = 2,130 ft ³ /s	
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With the parking lot paved, the runoff rate is set at 2,130 cubic feet per second (cfs). On the other hand, with the same parking lot as all grass, the runoff rate is set at 673 cfs. By dividing the paved runoff rate by the grass runoff rate, it is revealed that runoff from pavement is about 3 times greater than that of grass. Thus, by simply replacing an area of pavement with grass, the runoff rate of that area will be reduced by a factor of three. With this information in mind, the results of comparing a grassy half-mile center lane of Grand River Avenue and a paved one are as follows:

Half-Mile of Grand River with grass:	Half-Mile of Grand River with pavement:
1. L=2,640.19 ft W=12 ft	1. L=2,640.19 ft W=12 ft
A=L x W = (2,640.19 ft) x (12 ft)= 31,682.28 ft ²	A=L x W = (2,640.19 ft) x (12 ft)= 31,682.28 ft ²
A= 31,682.28 (ft ²) / 43,560 (ft ² /acre) = 0.727acres	A= 31,682.28 (ft ²) / 43,560 (ft ² /acre) = 0.727acres
2. $T_c = 0.0078 L^{0.77} S^{-0.385}$	2. $T_c = 0.0078 L^{0.77} S^{-0.385}$
= 0.0078 (2,640.19 ft) ^{0.77} (0.001 ft/ft) ^{-0.385}	= 0.0078 (2,640.19 ft) ^{0.77} (0.001 ft/ft) ^{-0.385}
=48.057 min	=48.057 min
3. $I_{100yr} = 29.035 T_c^{-0.5186}$	3. I_{100yr} = 29.035 T _c ^{-0.5186}
= 29.035 (48.057 min) ^{-0.5186}	= 29.035 (48.057 min) ^{-0.5186}
= 3.897 ft	= 3.897 ft
4. C = 0.30	4. C = 0.95
5. Q = C I A	5. Q = C I A
= (0.30) x (3.897 ft) x (0.727acres)	= (0.95) x (3.897 ft) x (0.727acres)

Q = 0.85 ft ³ /s	Q = 2.69 ft ³ /s

Per the results, the runoff rate of 2,640.19 feet of Grand River, when paved, is found to be 2.69 cfs. The runoff rate of 2,640.19 feet of Grand River, as grass, is 0.85 cfs. It is again revealed that by changing a halfmile center lane of Grand River Avenue from pavement to grass it reduces the runoff rate by a factor of three. Subtracting 0.85 cfs (grass) from 2.69 cfs (pavement) results in 1.84 cfs. Thus, by switching the pavement to grass, there is a savings of 1.84 cfs of water. Multiplying the savings of 1.84 cubic feet per second by the conversion factor of 7.481 gallons per second (gps), it revealed that there is a savings of 13.765 gps of water, just by changing a half-mile of Grand River Avenue from pavement to grass.

DISCUSSION/CONCLUSION

As previously stated, with the large amount of pavement located in the City of Detroit, the velocity of storm water runoff has increased, which has continued to overload the combined sewer system, leading to an increase in the chance of flooding. However, by reducing the amount of pavement located in the city, there is a significant savings in the velocity of storm water runoff, which would lessen the burden of the combined sewer system, and decrease the overall chance of flooding. Changing pavement to grass with the installation of a 12 foot wide grass median on a half-mile stretch of Grand River Avenue in Detroit, Michigan, will result in a reduction of 1.84 cfs, which equals to a savings of 13.765 gps, resulting in **1,189,296 gallons of storm water per day saved**. There are six other major arterials in Detroit: Gratiot Ave, Michigan Ave, Fort St, Jefferson Ave, Van Dyke, and Woodward Ave, and the average mileage open for installing a grass median in the center lane is about 6 miles per road. If these six roads are factored in, then that equals to approximately **101,090,160 gallons of storm water per day saved** from entering into the combined sewer system. That is approximately 6% of the gallons allowed through the primary water treatment plant in the City of Detroit.

Just by making a small change to the center lanes of 7 major roads in Detroit, 6% of the total gallons of water per day that are allowed through the primary water treatment plant can be saved from entering into the drainage infrastructure, causing a significant decrease in the chance of flooding. While it goes without saying that this is by no means the ultimate solution to the problem of urban flooding in the city, it is part of the solution, as it is a significant step in the right direction. Grass medians, either depressed or raised, offer a convincing savings in the amount of storm water. These types of medians are just a few ways of implementing green infrastructures in the City of Detroit. By implementing green infrastructures throughout the city, flooding would dramatically decrease, and the city would be more ready to take on any storm that comes its way. The greener Detroit, and any other city, can become, the better off it will be.

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Sources of Conflict Between Non-Marital and Marital Couples

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ABSTRACT

This analysis compares some main sources of conflict between couples in non-marital and marital relationships. Data was previously collected from parallel studies and four fitness-relevant issues to include infidelity, financial issues, deception, and sexual incompatibility were then examined for their possible role in conflict between couples. Non-marital relationship conflict was assessed using the 'Relationship Dissolution Questionnaire'. Marital conflict was assessed by the Marriage and Relationship Questionnaire. A final analysis was made in seeking to understand the importance of kindness in relationship success.

INTRODUCTION

There are many benefits for why one may seek romantic relations. People in relationships produce fewer stress hormones (Maestripieri, Baran, Sapienza & Zingales, 2010), as well as have better mental health (Brown, 2000; House, Umberson & Landis, 1988; Wilson & Oswald, 2005). Studies have shown that married couples enjoy health benefits to include longevity of life (Johnson, Backlund, Sorlie & Loveless, 2000; Kaplan & Kronick, 2006; Wilson & Oswald, 2005; Wood, Goesling & Avellar, 2007) and improved heart-health (Alviar, Rockman, Guo, Adelman & Berger, 2014; Kiecolt-Glaser & Newton, 2001), especially for women (Zhang & Hayward, 2006). Additionally, both men and women in relationships enjoy the benefits of division of labor (Van Willigen & Drentea, 2001). A desire for interpersonal attachment is pervasive (see Baumeister & Leary, 1995) and thereby forms the basis from which these benefits are sought.

When two people continually share the same space, resources, or interests; however, conflict is sure to arise. Conflict is one of the major analytical sources of discourse among scholars, and ubiquitous in social life (Brehmer, 1976; Graber, Laurenceau, Miga, Chango & Coan, 2011; Graziano, Jensen-Campbell & Hair, 1996; James, 1987; Tillet & French, 2010; 2012). Relationships abound with conflictual interactions are much less beneficial and sometimes harmful. In extreme cases, unresolved conflict may lead to violence (Horwitz, Santiago, Pearson & LaRussa-Trott, 2009). In some cases, however, conflict has the potential for positive outcomes. It can help to relieve tension and may promote unity and further pair-bonding between couples with intrinsic differences (Coser, 1956; Kriesberg, 1998; Pruitt & Rubin, 2003). A majority of research dealing with conflict between couples is focused on its resolution (Atthowe, 1961; Bar-Tal, 2000; Druckman & Diehl, 2006; Fincham, Beach & Davila, 2004; Kriesberg, 2007; Kurdek, 1994; Pistole, 1989; Recchia, Ross & Vickar, 2010; Sternberg & Dobson, 1987). In this study, the interest is in examining areas of contention most often observed in non-marital and marital couples.

In a groundbreaking work, Spanier (1976) established the areas of conflict field; introducing the Dyadic Adjustment Scale. Many scholars have built upon this conceptual framework including Bloom, Hodges & Caldwell (1994) and Kurdek (1994). Areas of conflict were grouped into six distinct categories: power, social issues, personal flaws, distrust, intimacy, and personal distance. Even with this framework, however, there is a lack of qualitative investigation regarding comparison of conflict between couples in non-marital and marital relationships. The framework is also broad in the sense that it does not specifically identify sources of conflict in romantic relationships such as infidelity, money issues, deception and sexual incompatibility. These specific sources of conflict may greatly impact romantic relationships; the ways in which I will discuss in detail. Moreover, it's worth noting that culture helps to shape the way a person defines, interprets and responds to conflict (Klevens et al., 2007) and so the development of any one empirically conceptual model may not be suitable for multicultural reference. The sources of conflict discussed herein pertain to couples in the U.S. within current socio-historical context.

INFIDELITY

Infidelity is a major elicitor of conflict among romantic couples (Bohner, Echterhoff, Glaß, Patrzek & Lampridis, 2010) and may take the form of emotional or sexual infidelity. Men and women, however, seem to differ greatly in reactions to sexual and emotional infidelity (Brase, Adair & Monk, 2014; Wade, Kelley & Church, 2012). Evolutionary psychologists have examined these issues and it has been proposed that men become more jealous of sexual infidelity, whereas jealousy is more likely to be provoked in women by emotional infidelity (Bohner & Wänke, 2004a; 2004b; Buss, Larsen, Westen & Semmelroth, 1992; Pietrzak, Laird, Stevens & Thompson, 2002; for a review see Sagarin, 2005). Women find emotional infidelity more threatening because it could lead to a loss of resources gained from that mate. Conversely, for men the risk of sexual infidelity is more threatening because of the inherent risk of cuckoldry (Buss & Haselton, 2005); which is to say, the risk of the wife bearing another man's offspring, and then the husband providing for offspring that are not his.

Sexual jealousy is closely tied to infidelity as a common source of contention among romantic couples with proposed evolved sex differences (Buss et al., 1999; Dillon et al., 2014; Penke & Asendorpf, 2008; Nannini & Meyers, 2000) and is a leading source of men's intimate partner violence (Arnocky, Sunderani, Gomes & Vaillancourt, 2015). Non-marital couples are more likely to experience infidelity than married couples (Treas & Giesen, 2000). This may reflect a lower degree of commitment between dating partners (Roscoe, Cavanaugh & Kennedy, 1988). However, infidelity, it seems, may be more important of an issue in marriages as the couple shares more resources and are more invested in the union (Poortman & Mills, 2012). Divorce is commonly a dire consequence of spousal infidelity (Shackelford, 1998).

FINANCIAL ISSUES

Another major source of contention among couples is related to finances. Marital and non-marital couples frequently debate over finances (Papp, Cummings, & Goeke-Morey, 2009). Financial disputes are more salient to couples than those who are relationally distant; quite often lead to unresolved anger, and are associated with more precarious conflicts compared to other areas of disagreement (Dew & Dakin, 2011; Stanley, Markman & Whitton, 2002). Financial disputes are also more predictive of divorce than other common areas of marital dissatisfaction (Dew & Dakin, 2009; for a review see Dew, Britt & Huston, 2012). Social exchange theory may help explain the importance of financial issues, such that partners seek fairness in exchange and finances which helps to foster high-quality relationships (for a review see

Cropanzano & Mitchell, 2005). Control, on the other hand, is usually obtained through financial withholding (Branigan, 2007; Branigan & Grace, 2005; Siegel, 1990).

Financial issues may not be as important of an issue in non-marital relationships. Cohabiting individuals often keep their financial resources separate and split the costs of the relationship (Heimdahl & Houseknecht, 2003). This may reflect, yet again, a lower degree of commitment between dating partners (Roscoe, Cavanaugh & Kennedy, 1988). A study which aimed to understand the social role of marriage in low-income single mothers has shown that young mothers will simply dissolve a union if economic benefits from the cohabitation are not met (Edin, 2000). This may suggest that financial issues aren't a major source of conflict until children are involved or expected, though further research would allow for additional interpretation.

DECEPTION

Intimate relationships are built on neither complete honesty nor trust. Individuals in relationships are frequently faced with opportunities within which to substitute conveying truthful information to their partner and with minimizing the damage that conveying other dishonest information might cause (Bowers, Elliot, & Desmond, 1977; Metts & Chronis, 1986; Turner, Edgley & Olmstead, 1975). Appeasing one's romantic partner through the use of deception may help to avoid conflict (Buller & Burgoon, 1998). Indeed, couples frequently view it as an effective method of conflict avoidance (Peterson, 1996). The primary goals associated may be in establishing control (Guthrie & Kunkel, 2013) and avoiding relational uncertainty (Jang, Vangelista & Dailey, 2013), such as the degree of confidence in the relationship. Knobloch and Solomon (2002) noted that specific events within an intimate relationship are sure to increase the magnitude of relational uncertainty, to include moments of doubt and notable changes in intimacy; however, the use of deception is particularly influential (Planalp & Honeycutt, 1985).

Individuals have a greater tendency to lie to those who are relationally distant (DePaulo & Kashy, 1998) though, lying among romantic partners is quite common (Cole, 2001; DePaulo & Kashy, 1998; Knox, Schacht, Holt & Turner, 1993). The use of deception pertaining to sexual issues is especially prevalent (Knox et al., 1993; Muehlenhard & Shippee, 2010; Wiederman, 1997). Moreover, the recent rise in computer-mediated communication (CMC) has offered increasing opportunities to lie to one's partner (Drouin, Tobin & Wygant, 2014). The use of deception is yet another important source of conflict between romantic couples (Guerrero, Andersen & Afifi, 2001). Not surprisingly, deception has been shown to have negative effects on relationships (Cole, 2001; Peterson, 1996), such as overall relationship dissatisfaction by interfering with mutual trust. While some studies have shown that the use of deception is more prevalent in non-marital relationships (Knox et al., 1993; Shusterman & Saxe, 1990) it is impossible to determine its frequency given the nature of this widespread occurrence. What's more, Levine and McCornack (1992) noted that a "truth bias" develops over time in intimate relationships which lowers the accuracy of detecting each partners' lies.

SEXUAL INCOMPATIBILITY

Sexual activity between couples helps to create an emotional and physical bond. The feeling that sexual interest has diminished or has been lost, however, is particularly distressing for a romantic partner (Hiller, 2006). Strategic conflict theory takes an evolutionary approach and may help us to understand sexual incompatibility. It suggests that men's and women's evolutionary mating strategies are different such that this (alone) leads to considerable conflict between men and women in relationships (Buss, 1989a; Buss &

Schmitt, 1993). The strategic conflict model also proposed that some main causes for relationship dissolution are that women will terminate the union because of male sexual aggressiveness, whereas men will likely do so in response to female sexual withholding (Buss, 1989a), consistent with the mating strategies of each. This difference can be traced back to the parental investment theory (Trivers, 1972) which states that the sex that endures the greatest minimal investment (women) tends to be choosiest in mate selection.

Crowe and Ridley (2000) introduced a behavioral-systems framework describing sexual incompatibility as an incompatibility of sexual interest. The framework suggests that this incompatibility between romantic couples usually takes the form of female reluctance or male demands. Their work signifies, again, observed gender differences with links to individual feelings and sexual expression. These individual feelings are significant such that women who feel distress or experience a sexual dysfunction report more sexual incompatibility with their partner (Witting et al., 2008). Forms of sexual functioning that women experience, in relationships, may be particularly dependent on their own perceptions of compatibility (Lawrance & Byers, 1995). A study by Offman and Matheson (2005) found that women's perception of incompatibility with a romantic partner was associated with sexual depression and anxiety, leading to an overall decreased sexual satisfaction.

Sexual incompatibility issues may also be central to deception, compounding cause for conflict, and are a leading cause of relationship uncertainty (Planalp & Honeycutt, 1985). Given this, it is highly likely that sexual incompatibility will lead to dissolution of the union, especially when there is a lower degree of commitment, often found in non-marital couples. Conversely, sexual incompatibilities aren't likely to appear in a marriage until later stages in which preoccupation with career and child-raising duties and activities becomes prominent (Trainer, 1975). Although married couples commonly seek counseling services to remedy sexual incompatibility issues (Doss, Simpson & Christensen, 2004; Ellis, 1953; Masters & Johnson, 1965), this source of conflict can also quite often lead to unresolved resentment and predict divorce (Amato & Previti, 2003; Burns, 1984).

KINDNESS

One important issue central to conflict in romantic relationships is the presence of kindness. Kindness has been found to be an important quality sought in mates across all cultures (Buss, 1989b; Buss, 2007; Li, Bailey, Kenrick & Linsenmeier, 2002; Li & Kenrick, 2006). Kindness is likely to ease tensions and has been found to promote mutual engagement and cooperation between people (see Andersen, Saribay & Thorpe, 2008). Individuals who treat their partner with contempt and criticism not only harm the established love in the relationship; they also harm their partners' ability to fight off illness (Kiecolt-Glaser, Glaser, Cacioppo & Malarkey, 1998). By exhibiting kindness, partners are maintaining improved health, strengthening respect and confidence, and creating a stronger bond; which helps to promote passion. Kindness, in a way, glues couples together.

HYPOTHESES OF THE CURRENT STUDY

Based on previous empirical evidence and research, it was hypothesized that important sources of intimate relationship conflict include the following: infidelity, financial issues, deception, and sexual incompatibility. Kindness was also included in this study. The reasoning was that a lack of kindness would reduce partner unity and lead to more instances for conflict.

The specific research questions examined in this paper are:

- 1. Is infidelity more important in non-marital relationships or in marriage?
- 2. Are financial issues more important in non-marital relationships or in marriage?
- 3. Is lying more of an issue in non-marital relationships or in marriage?
- 4. Is sexual compatibility more important in non-marital relationships or in marriage?
- 5. Is kindness more important in non-marital relationships or in marriage?

MATERIALS AND METHODS

Participants

Participants were evaluated through the use of two separate questionnaires. One of the two questionnaires examined non-marital relationship issues. For this study, non-marital participants were recruited through Mechanical Turk. It was deemed appropriate to use this form of survey administration because it yields a more diverse sample over other online survey websites (Casler, Bickel, & Hackett, 2013). 480 participants were recruited; however, after accounting for confounding variables, the final sample was 410 (181 women, 211 men, and 18 who did not indicate their gender; see DeLecce & Weisfeld, 2014). All couples were recruited from within the United States. The mean age of participants who completed the study was 31.92.

The second study examined marriage issues. Over 2,600 married couples were recruited from the U.S., Britain, China, Russia, and Turkey, although, for the purpose of this study I only use data collected from the United States, in which there were 480 couples who completed the questionnaire. A representative middle-age range of couples was sought. All married couples were recruited from predominantly urban areas such as Detroit. This strategy was practical such that urban areas have dense populations of married couples (see Dillon et al., 2015). However, the samples were non-random and therefore do not represent the entirety of married couples. The mean age for husbands in this study was 42.35 and 39.94 for wives.

Materials

Non-marital couples completed the Relationship Dissolution Questionnaire (RDQ), a modified questionnaire used by Perilloux and Buss (2008), designed to explore relationship difficulties (DeLecce and Weisfeld, 2014). More specifically, questions were asked pertaining to dissolution of relationships and unions in non-marital couples. The Relationship Dissolution Questionnaire consists of five categories from which participants offered responses that either were specific to the break-up or were ranked using a tenpoint scale with lower scores indicating more problems. The second and third categories were meaningful to this study in comparing data to the marriage study. The second category explored various circumstances surrounding a breakup, such as various dimensions and reasons for the dissolution to include infidelity, lying, finances, differences in values, and loss of interest. The third category explored various partner characteristics, although only kindness will be used for the purposes of this study.

The marriage participants (from the second study) completed the Marriage and Relationships Questionnaire (MARQ) developed by Russell and Wells (1986). The MARQ consists of 179 multiple choice questions, with an additional small section pertaining to children (the original version consisted of 235 multiple choice and true/false items; see Russell & Wells, 1993). The multiple choice answers from participants were completed privately and each spouse placed the completed questionnaire in a sealed

envelope, which was paired with the other spouse's questionnaire for collection. All items were answered using a five-point Likert scale (with higher scores indicating the most likely concern for eliciting conflict). The questionnaire was designed to offer a better understanding of marital respondents' feelings both about themselves and about the relationship.

DATA ANALYSIS

The responses from these parallel studies were collected, examined, and compared to the corresponding items. Regarding the RDQ: item 2, sub-item A, was used from 'Category 2: Circumstances Surrounding Breakup' in order to determine the importance of infidelity in relationships. Also from category, item 2, sub-item B, is used to rank the importance of deception. Sub-item D, was used for financial matters and sub-item F was used for sexual matters/incompatibility. From 'Category 3: Partner Characteristics' I utilize item 2, sub-item D for examining the importance of kindness.

Regarding the MARQ; items 110 ("Do you find sexual fulfillment outside your marriage?") and 144 ("Do you worry about your spouse being unfaithful?) were used in examining the importance of infidelity in marriages. Items 13 ("Is money a problem in your marriage?") and 43 ("How much does money really matter...?") were used in examining the importance of financial issues. Items 62 ("Is your spouse totally honest...?") and 80 ("Does your spouse really know what you think and feel?") were used in examining the importance of deception. Items 65 ("Do you find sexual fulfillment in your marriage?") and 83 (Do you wish your spouse was more sexually responsive to you?") were used for the importance of sexual compatibility. Finally, items 19 ("Are you kind to your spouse?") and 64 ("Is your spouse kind to you?") were used in examining the importance of kindness.

The responses from the MARQ were designed to be tested using a five-point Likert scale. Some of the items, here, were reverse coded to make sure that all numbers represented the same level of severity (e.g. some items 1 = very much, whereas in others 5 = very much). The responses from the RDQ required this coding as well as Winsorization in order for these items to be compatible with the five-point scale used on the MARQ, as they were originally coded to use a ten-point scale. After this coding, all items were on a five-point scale with lower values indicating high cause for conflict. One-sample t-tests were then conducted to determine the statistical significance of issues between the non-marital and marital couples.

RESULTS

The assumption of major sources of conflict, based on previous research, was tested for each of the items using one sample t-tests. Each source of conflict from the non-marital couples was compared to the corresponding source of conflict from marital couples. Results were significant at alpha of .05. Bar graphs (see Figures 1 and 2) and a table (see Table 1) were utilized in order to display visual representations of the data collected using the one-sample t-tests. Of the four main sources of conflict tested, there was one item found to be more important in non-marital relationships, with the other three items found to be more important in non-marital relationships. The kindness item was found to be more important in non-marital relationships.

In this study, it was found that infidelity is more important of an issue for non-marital than for marital couples as there was a statistically significant difference in the scores for non-marital (M = 3.78, SD = 1.70) and marital couples (M = 4.57, SD = 0.73), t(370) = -8.98, p < .001.

Financial issues were found to be more important to marital couples with a statistically significant difference in the scores for non-marital (M = 4.54, SD = 1.02) and marital couples (M = 3.68, SD = 0.98), t(388) = 16.66, p < .001. Sexual incompatibility was also more important for marital couples, with a statistically significant difference in the scores for non-marital (M = 4.79, SD = 0.68) and marital couples (M = 3.55, SD = 1.07), t(390) = 35.89, p < .001. There was no significant difference in the importance of deception for non-marital (M = 3.86, SD = 1.34) and marital couples (M = 3.78, SD = 0.88), t(393) = 1.19, p = .236.

Finally, the kindness item, which sought to determine the overall importance of kindness in romantic relationships, was found to be more important for non-marital couples, as there was a statistically significant difference in the scores for non-marital (M = 2.81, SD = 1.19) and marital couples (M = 4.27, SD = 0.77), t(380) = -25.52, p < .001.





Table 1	. Descriptive s	tatistics and t	values for all v	ariables						
	The importat	ice of	The importan	ice of sexual	The importan	ice of	The importan	ce of	The importan	e of kindness
	infidelity on	conflict	incompation	ity on conflict	deception on	contract	nnanciai issu	es on conflict	on relationshi	p success
	Non-marital	Marital	Non-marital	Marital	Non-marital	Marital	Non-marital	Marital	Non-marital	Marital
Mean	3.78	4.57	4.79	3.55	3.86	3.78	4.54	3.68	2.81	4.27
StDev	1.7	0.73	0.68	1.07	1.34	0.88	1.02	0.98	1.19	0.77
-	-8.98 **		35.89 **		1.19		16.66 **		-25.52 **	
Note. *	= p < .05, ** = p ·	< .001								

DISCUSSION

This study has sought to investigate the importance of four main sources of conflict in intimate relationships, including infidelity, financial issues, deception and sexual incompatibility. The importance of kindness was also examined here, as a lack thereof in intimate interpersonal interactions fosters negative communication and conflict.

Several main findings emerged from this experiment. First, there existed strong inclination for key sources of conflict in either non-marital or marital couples. In particular, non-marital couples find that infidelity and a lack of kindness are strongly associated with conflict; more-so than with marital couples. Conversely, strong indicators of conflict for marital couples were financial issues and sexual incompatibility. There was no significant difference in the importance of deception for non-marital versus marital couples.

A second main finding was that although subjects showed some variance in what elicits conflict, the results are mostly consistent with previous assumptions. Dating relationships are usually shorter in duration than marriages; thus, one might expect lower prevalence of infidelity because partners may still be enjoying the "honeymoon" phase. However, this does not appear to be the case. Infidelity has been identified as a top reason for conflict in non-marital relationships. Women who are actively dating are more likely than married women to report having a "secondary sex partner" (Forste & Tanfer, 1996), likely the result of a lower degree of [formal] commitment that characterizes dating relationships. Another interpretation of these results involves social mores. Married couples may be less likely than their dating counterparts to admit to infidelity because it is viewed as a more serious transgression (Blumstein & Schwartz, 1983).

Infidelity has been identified as a top reason for divorce, especially regarding a woman's extramarital affairs (Betzig, 1989; Shackelford, 1998). This would be further reason to keep it a secret. Clinicians consistently view infidelity as one of the most difficult problems to treat and one of the most damaging issues for a relationship (Whisman, Dixon & Johnson, 1997). A study from 2001 found that in the U.S., males and females are equally likely to be unfaithful and socioeconomic status matters in that positive financial means are related to the likelihood of infidelity (Atkins, Baucom & Jacobson, 2001). Women are more likely to forgive their partner for infidelity than are men (Lawson, 1988; Shackelford, Buss & Bennett, 2002); however, women may also be more susceptible to suffering physical and psychological problems, including depression, anxiety, and overall relationship dissatisfaction as a result (Betzig, 1989; Cano & O'Leary, 2000).

Third, the deception item was not found to reach statistical significance for either non-marital or marital couples. The aforementioned "truth bias" that develops over time in a relationship may help us understand the reason for non-significance of this item. Married couples are expected to adhere to different social norms than couples who are dating (see Thornton, 1989). For this reason, it may be that deception is viewed as more important to marital couples. It is also a factor that in non-marital relationships there is a lower degree of commitment by both partners; and thus, lying is not considered to hold the same weight. It has been found that everyday lies are usually told with a lower frequency in closer relationships than in less intimate ones (DePaulo & Kashy, 1998). People value honesty within relationships. When deception takes place in order to conceal transgressions in intimate relationships, it is often perceived as reprehensible. Consequently, this often leads to difficulty in restoring trust (Schweitzer, Hershey, & Bradlow, 2006) which has been firmly established in a marriage.

Fourth, financial issues followed previous empirical evidence, indicating greater conflict in marriage. Cohabiting couples believe financial security is important for marriage. Prior research found that the majority of people (72%) identify economic factors as a prerequisite for the relationship to result in marriage (Smock, Manning & Porter, 2005). Having positive financial means is important, though women,

more than men, place high value on economic resources (Buss, 1989b; 2007). The capacity to provide for a family is always kept in mind. Worldwide, a common reason for wives divorcing their husbands is failure to provide resources in some capacity (Betzig, 1989). Financial disputes were less common for non-marital couples. Many such couples, with or without cohabitation, often keep their financial resources separate. Yet again, this may certainly reflect a lower degree of commitment present.

Fifth, sexual incompatibility, here, was found to be more important to marital couples. The results were surprising given previous research, but may be indicative of the higher degree of commitment involved in marital relationships. In a dating relationship, one or both partners may simply dissolve the union if sexual incompatibility is present. It has been found to increasingly elicit conflict in some manner when individuals enter the relationship with many previous sexual partners (Rhoades & Stanley, 2014). The higher the number, the greater predicted chance the marriage will end in divorce. Moreover, and importantly, sexual satisfaction is positively associated with perceived sexual compatibility (Smith, Becker, Byrne & Przybyla, 1993) and sexual agreement between intimate partners (Purnine & Carey, 1997; 1999). Preoccupation with career and child-raising activities in later stages of the relationship deter greatly from sexual fulfillment, as does the natural decrease in novelty and infatuation for one another.

Lastly, kindness has been shown, time and again, to be an important quality sought in a mate (Buss, 2007). Individuals who are viewed as cruel and unkind are not desirable (Buss, 1989b). Here it was determined that, when comparing this quality in non-marital and marital relationships, it is more important to non-marital couples. After the initial "honeymoon" period begins to subside and true feelings and motives emerge, kindness may be re-evaluated. If both partners feel that equity is present, the relationship may continue. This reasoning is such that kindness would be more important for non-marital couples because in order for partners to express greater commitment and consider marriage, it has been fairly well established that each exhibits satiating kindness toward one another.

When a relationship is going well and is beneficial, both partners tend to be satisfied. This satisfaction is derived from one another, a matter of mutuality and of reciprocation. Personal interaction and quality of treatment between couples matter, especially for long-term success of the union. We know from prior research that intimacy coincides with decreased levels of negative emotion (Aune, Aune & Buller, 1994), and this is true for conflict as well (Braiker & Kelley, 1979). In other words, for a relationship to be successful, kindness must be present. Based on the results of this study, it may also be correct to state that kindness, much like financial security, is a prerequisite for the relationship to result in marriage.

This research takes the field one step closer toward understanding the nature of interpersonal interactions in intimate partner relationships and, more specifically, of the differences between non-marital and marital relationships. The participants involved in these studies described sources of conflict in their relationships differently depending on their relationship status. We are now further along in understanding relationship difficulties and differences. However, the issues over which conflict arises seem to warrant more research and interpretation. While some evolutionary theories can help us explain sex differences in conflict, others may yet help us understand the overall nature of interpersonal and intimate partner relationships.

LIMITATIONS

The current study attempts to integrate use of multicultural views in discussing empirical evidence; however, only results from the U.S. were used, and thus, results do not represent multicultural variance often found in interpersonal issues. As noted previously, no single empirically conceptual model is suitable for explaining these differences in conflict as cultures vary in many ways. These data, therefore, are

appropriate for explaining differences in conflict for couples within the U.S. only. The study also fails to identify common areas of conflict for LGBT couples (see Kurdek, 1994). Data from homosexual participants were discarded from analysis (see DeLecce & Weisfeld, 2014). Additionally, the sexual incompatibility item in this study does not take into account variance often found in intimate relationships. Even though sexual incompatibility is a major source of contention among intimate partners, it is not clear from the results whether this stems from physical (e.g. sexual functioning) or psychological incompatibilities (e.g. perceptions of compatibility). Findings were also limited for marital samples, as they were largely non-random and drawn from urban areas.

FUTURE DIRECTION

A future direction for expanding on the current study would be to further examine items from both the RDQ and MARQ to determine all of the significant sources of conflict between couples. Here I chose to concentrate on four main sources of conflict. Much research and empirical evidence supports the claim that the four sources of conflict (plus kindness) discussed herein are substantial; however, items on the convergent parallel studies could identify further sources of conflict not discussed here. It would be especially interesting to determine the relative significance of these items compared to other items (such as differences in values, loss of interest, unequal degrees of commitment, and other reasons) noted in those studies.

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THE GENRE OF PLATO'S REPUBLIC

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ABSTRACT

In an attempt to better understand how Plato wrote the *Republic*, I set out to classify it as a genre of ancient Greek literature. I used Aristotle's *Poetics* to survey the different types of genre, which includes epic, tragedy and comedy, to discover and compile a list of elements that each one possesses. I noticed that there are three, mutual categories of elements for each genre, which are elements of character, of composition and of content; this means that each genre is apparent through the presence of distinct elements in three comparable ways. Due to time constraints, I only explored the first four books of the *Republic*; but I looked for and counted the elements of epic, tragedy and comedy gathered from the *Poetics* within the *Republic*, and I built a graph that reflects the usage of elements that belong to tragedy. The conclusion may be drawn that Plato wrote and intended for readers to understand the *Republic* as a tragedy.

INTRODUCTION

Reduced to a single book, Plato gives us through the *Republic* an impressive and comprehensive reading of his metaphysics, his theology, his ethics, his psychology, his pedagogy, his theory of art, his politics and his model of the perfect city. The *Republic* is considered the greatest of his surviving works, and it is arguably the 'highest point' ever reached with philosophy by any of the ancient thinkers (Jowett). The impact of this document is even visible today through the number of fields it has and continues to pervade with its influence. For within this centuries-old document, we still find 'modernity and contemporary savor', cleverly and artistically packaged for anyone to read and enjoy (Durant). Hence, it is the most famous and widely read of Plato's philosophy; many people hold that its contents ought to be taken and read seriously.

The way in which Plato wrote the *Republic* is especially significant and is worth mentioning here. Plato had taken and refined for himself a medium of expression that was rare and relatively new in his time – the dialogue – on which he imposed 'the structure of unbendable logic' and 'the style of pleasurable poetry' (Durant). This mixture of logic and poetry hardly detracts from the overall quality of the *Republic*, but it does, however, from its overall clarity. Indeed, Plato never clearly 'spells out' what these dialogues are, nor does he instruct us on how they should be interpreted – whether straightforwardly or poetically (Mark). Consequently, we cannot say for sure how the *Republic* should really be taken and read, and it is possible that we have been doing so wrongly. A closer study of how the *Republic* was composed is needed in order to discover the best approach for interpreting it content overall.

LITERATURE REVIEW

We may feel inclined to view the writing-style of the *Republic* as having little to do with its overall meaning. It seems unlikely that Plato would jeopardize any task of his by being less than direct with his readers; one might judge that Plato simply uses dialogue to make the *Republic* easier to understand. But we cannot

make this assumption. For within the *Republic* itself, we find in abundance the use of wit, humor and irony; we find ourselves reading and interpreting myths, riddles and parables; we are often baffled by Plato's departure from cultural norms; and we learn that apparently Plato has no problem making strategic use of certain 'falsehoods'. We simply cannot tell, says Durant, 'whether he is literal or speaks in metaphor; whether he jests or is in earnest'. The *Republic* is not merely and straightforwardly the philosophy of Plato, but rather the 'great literature' of a dramatist-philosopher (Durant).

Allan Bloom has suggested that the *Republic* is best interpreted as a Greek comedy; he thinks that the *Republic* may be reduced to absurdity, when fully read and understood. To Bloom, building the perfect city is only the apparent goal of the *Republic*; but since Plato says that that constitution requires a functional union of politics and philosophy, he could not have thought it possible himself. For Plato demonstrates in a number of places within the *Republic* their strict incompatibility: the philosophic life, he holds, leads to happiness, while the political, corruption. Plato, then, must have wrote the *Republic* sarcastically, according to Bloom, by 'taking the city with infinite seriousness, beautifying it with every artifice, making it a veritable Callipolis', and then proving it despicable and hilariously impossible. Plato's actual goal, according to Bloom's interpretation, was to cleverly promote a happy life of philosophy at the expense of any political involvement.

It is difficult, however, to read the *Republic* as Bloom suggests. For Plato grew up in Athens during the Peloponnesian war and witnessed the 'political chaos' that followed (History). The *Republic*, Ferrari thinks, is Plato's sincere attempt address with philosophy the very problems of his own city, by limiting political leadership to philosophers alone. Plato's philosopher, though, writes Harman, would have to sacrifice 'his perfect moral rectitude' and 'his love of truth'; to 'prove himself false to the Idea of the Good' and to perpetrate lies to his community; to become most unhappy as Plato describes, by an involvement in politics as Plato demands. But Harman thinks that Plato gives us this picture to depict his philosophers as reluctant, choosing to rule only at great cost; for Plato wanted to depict them as heroes in Greek tragedy: already honorable and admirable, yet enhanced by a willing commitment and sacrifice for the community. Plato, then, on Harman's interpretation, wrote the *Republic* as a tragedy.

On the one hand, if Harman's interpretation of the *Republic* is correct, then we should begin reading the *Republic* according to our knowledge and expectations of tragic poetry in order to understand its content properly. On the other hand, if Bloom is correct about the *Republic* being a comedy, and Plato never intended for it to be taken seriously, but rather as sarcasm, irony, or an elaborate joke, then we must read it accordingly for the same reason. Joshua Mark reminds us how Plato wrote poetry as a young man, and was interested in a literary career as a playwright; so Plato was unquestionably familiar with the literary techniques of comedy, tragedy, and even epic. Having a better idea of how Plato wrote the *Republic* would instruct us further on how it should be read; but to simply read the *Republic* straightforwardly without investigating more its literary features would be a mistake. Readers must, says Mark, approach the writings of Plato as carefully as one would a poem.

Within the *Republic*, however, Plato seems most disdainful of poetry. Halliwell describes him as obsessed with it: he combats its 'falsehoods and fictions' with philosophy and censorship, thinking traditional poetry would undermine the education system of the *Republic's* perfect city. Plato resolved even to ban the writers of such material, 'before whom we should bow down', he mocks, 'as someone holy, wonderful, and pleasing', but send away as 'unlawful' nonetheless (398a); for they misrepresent truth, often praising what is unjust and blaming what is just. Plato permits only the more 'austere and less pleasure-giving' storytellers, lest his citizens become 'worse and more wretched than before' (*Republic* 606). This could pose a problem for interpreting the *Republic* via poetry; for it seems hypocritical for Plato to use, even in part, what he largely condemns.

To avoid this problem, I suggest we view Plato's ban as one that applies to his perfect city alone, should it ever exist. The *Republic* itself, we could say, was developed in order to have an impact on Plato's contemporary city. Goldhill says that Plato knew well the 'educational force' of poetry, and its 'power over an audience': it causes its hearers to respond 'as if their ears were under contract to listen' (*Republic* 475d). Plato could have saw and used poetry as a way to introduce and teach doctrine of his own. Durant assures us that Plato is hardly adverse to such a strategy: for 'Plato', he remarks, 'has in sufficient abundance the very qualities he condemns. He inveighs against poets and their myths, and proceeds to add one to the number of poets and hundreds to the number of myths'. Although we are mostly familiar with Plato as a philosopher, 'the young poet and playwright', Mark suggests, 'was always present' during the crafting of his work.

To the extent that we neglect or overlook Plato's use of any literary devices in the *Republic*, we risk misunderstanding important aspects of the text. A careful read with an understanding of ancient Greek poetry would be very helpful for a final analysis of the *Republic*; indeed, it could allow us to discern the literary structure and goals of the text by viewing it through the lens of a specific genre. We know that genre is identifiable at least by a significant number of distinct, literary elements; perhaps the actual genre of the *Republic* may be identified likewise – via the presence and use of certain elements. In order to classify the Republic in this way, then, and so discover the best approach to its content, we should look for a substantial number of occurrence of elements indicative of either tragic, comedic or epic poetry.

METHODS

This project will have two stages. In the first stage, I will collect data from two sources: Aristotle's *Poetics* and Plato's *Republic*. From the *Poetics*, I will gather information that concerns the necessary and unique elements of comedic, tragic and epic poetry. I will afterwards organize those elements into three, measurable categories: *Character* (elements pertaining to character-roles), *Content* (elements pertaining to common, recurring themes), and *Composition* (elements pertaining to structure and arrangement). From the *Republic*, I will note how often said elements occur, that I may discover whether Plato used more often elements of comedy, tragedy, or epic. Due to time restraints, I will only explore the first four books of the *Republic* in this way. In the second stage, after having discovered which elements are present within books 1 - 4 of the *Republic*, I will build a graph that reflects the percentage of elements that belong to each genre; this will serve as probabilistic evidence that Plato intended the *Republic* as one of those three genres. For whatever genre that may be, I will confirm the results further by exploring the rest of *Republic* to see if it lacks any of the elements that Aristotle attributes to that genre within the *Poetics*.

RESULTS



The Number of Epic, Tragic and Comedic Elements found Books 1-4 of the Republic

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Genre	Characters	Composition	Content	Overall
Greek Comedy	7	8	38	53
Greek Tragedy	12	15	53	80
Greek Epic	9	13	32	54

Figure 1.1

Figure 1 is a graph that represents the numbers provided in **Figure 1.1.** It displays the number of elements that appear within books 1 - 4 of the *Republic* for each, measurable category that each genre have in common – character, composition and content; it also displays the overall number of elements present for each genre, which is simply the sum of elements from each category. The Results show that Plato used more elements that belong to tragic poetry overall, as well as for each individual category. We could take these results as showing that Plato intended the *Republic* to be read as tragedy rather than epic or comedy.

The Literary Elements *not* found within the *Republic*, but expected of Epic, Tragic and Comedic Poetry

Literary Elements from the <i>Poetics</i>	Elements within the <i>Republic</i>	Greek Epic Poerty	Greek Tragic Poetry	Greek Comic Poetry
Inferior		~		√
Admirable		~		
Noble Characters			~	
Hero		~	~	
Small Family			~	
Disgraceful				~
Real Characters			~	~
Laughable				~
Important to Culture*		~		
Prologue		✓	~	~
Chorus	NO		~	~
Episodes		~	√	~
Multiple Stories	NO	✓		
Unrestricted Time	NO	✓		
One day			~	
Speech-form			~	
Narrative		✓		
Imitation of Action			~	
Imitation of Character		✓		~
Historical Orientation			√	
Simultaneous Imitation	NO	~		
Blindness		~	~	
Recognitions		~	~	
Reversals		~	~	
Serious			✓	

CHARACTER

COMPOSITION

Silly/ Not Serious	NO			\checkmark
Cultural Taboo			√	
Cultural Praises*		√		
Plausible			√	
Reasoning/Opinions			√	\checkmark
Suffering/ Pain			√	
Overcoming		~		
Disgust				~
Change in Fortune		~	~	
Pity			~	
Fear			~	
Reconciliation	NO			~
Gods in Discord*	NO	~		
Convictions*		~		
Divine Intervention*			~	
Fate (taken seriously)			~	
Jokes/Humor				~

CONTENT



Figure 2 is a chart listing the elements gathered from Aristotle's poetics, with the exception of those few marked with an asterisk¹. The checked boxes indicate that an element may be found within the above genre; the boxes that contain 'NO' indicates that an element is absent from the *Republic*. Note the highlighted box: here we see that the *Republic* lacks an element that tragedy possesses, accordingly to Aristotle – namely, a chorus. This poses a potential problem to the conclusion that Plato intended the *Republic* as a tragedy, as the data suggests in **Figure 1** and **1.1**.

DISCUSSION

It may seem odd to consider the *Republic* a tragedy, since it does not possess a chorus, as shown in **Figure 2**. Halliwell notes that choruses are almost always present in tragic poetry, singing between scenes, witnessing and responding to events with commentary and eulogy. Scodel points out, however, that Exagoge, e.g., does not appear to have a chorus, though it is recognized as a tragedy; she thinks that the

¹ I used *Classical Mythology* for these elements. See Reference section.

lack of remains from the fourth century and later could be why "we do not see often much variety". But since choral song and dance were ritual activities that were "perverted" within tragedy, Plato would have regarded the use of chorus as impious any way, even though it was all for "pretend" (Scodel). Moreover, since a chorus was used to address the large audience that watched the poetic performances, Plato would have no need for this particular element: Plato believes that mass education is impossible and prefers the 'Socratic conversations', which was between a small number of individuals. We may still consider the *Republic* a tragedy, then, although it is lacking a chorus.

My research broadens the way in which we are prepared to approach the *Republic*, and perhaps the other dialogues of Plato; but it is not without problems. The main problem concerns my use of Aristotle's *Poetics* to gather information for each genre. Although Aristotle was closer to Greek poetry than any of us today, and probably one of the 'greatest literary theorist in history', he had his 'own prejudices', Scodel notes, and mostly discusses the elements he deemed noteworthy. Moreover, since we do not have the complete *Poetics*, the number of elements for comedy and epic are significantly fewer than for tragedy. One might think it no coincidence that the *Republic* possesses more elements of tragedy, as the elements gathered from the *Poetics* mostly pertain to tragedy. This, undoubtedly, affected the results; in the future, gathering information from another source would be better.

Another potential problem with my research involves looking for the elements from the *Poetics* in the *Republic*. It is possible that others would not come up with the same list of elements as I have, which would lead to different outcomes. We could strengthen the methodology in this area by having a more universally agreeable list of elements and way of identifying each element². If we were to make the improvements mentioned, and others presently unknown, I suspect that more literary elements indicative of tragedy will still be found in the *Republic*. For tragedy seems to be an appropriate genre for Plato to make known his philosophical and political convictions. Tragedy, we are told, is a 'drama of words', making use of 'new languages of persuasion and philosophy' to stimulate and even 'overturn traditional values' (Burian). I agree more with Harman than Bloom, that Plato was not 'insincerely setting up problems that he never intended to solve', but was deeply concerned for the wellbeing of his city (Harman). Further study would still have to be done, however, to reinterpret the *Republic* overall to make this judgement.

APPENDIX

<u>Character</u>

Epic: (327a; 328b; 329d; 357; 401c; 409d; 412d; 414; 415e)

Tragedy: (327-b; 328b; 412d-e)

Comedy: (336b; 337b, c, d)

Composition

Epic: (336d; 347d; 352d; 354; 358d; 386a; 389d; 390d; 404b; 407b; 409c; 411b; 416)

Tragedy: (329a; 331e; 338c; 336d; 348a)

² I have provided the sections from the *Republic* in which I identified one or more elements from **Figure 2** in the **Appendix** section.

Comedy: (327; 328, b, c; 357)

Content

Epic: (329a; 331d; 336b; 338a; 342c; 344d; 346d; 348b; 357a; 358d; 362d; 367e; 368b; 372d; 375d; 376d; 386a; 389d; 390d; 398e; 404b; 407b; 409c; 411b,d; 416; 417b; 419; 420; 421c; 424c)

Tragedy: (331d; 333d; 334b, d, e; 335e; 339d; 346e; 347a, c; 350c; 357b, d; 358c; 359d; 362d; 363b, c, e; 364d; 365b; 368b; 375d; 377b, d; 376c, d, e; 380; 381d; 383a, c; 386b, c, d; 387, b; 389e; 390b; 391, b; 392; 403; 404; 407; 408c; 409c; 411; 415c; 416e)

Comedy: (327c; 330c; 331d; 334b, d; 335e; 337,b, d; 338c, d; 340d; 341b, c; 343, d; 345b; 346e; 347a; 348d; 349b; 350c, e; 351d; 352e; 358; 392d; 397e; 405b, c; 408b; 411b, d; 413b; 414c; 422c, d, e)

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REPRESENTATION RINGS OF CYCLIC GROUPS OVER AN ALGEBRAICALLY CLOSED FIELD

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ABSTRACT. We calculate the Jordan canonical form for the tensor product of invertible Jordan block matrices over an algebraically closed field k, or equivalently we calculate the direct sum decomposition of a tensor product of (isomorphism classes of) representations of the algebra $k[x^{\pm 1}]$.

1. Introduction

The tensor product of two indecomposable representations of a group can be decomposed as the sum of indecomposable representations. Finding the decomposition is known as the Clebsch-Gordan problem. We solve the Clebsch-Gordan problem for the tensor product of invertible Jordan block matrices over an algebraically closed field of characteristic zero and the representations of cyclic group of order p over a field of characteristic p.

Finding the Jordan canonical form of the tensor product $J_m \otimes J_n$ of Jordan blocks J_m and J_n over a field of characteristic zero has been solved by various authors including K. Iima and R. Iwamatsu [2], A.Martsinkovsky [4], and A.Vlassov [3]. In addition, K. Iima and R. Iwamatsu [2] proved an algorithm for computing the Jordan canonical form of Jordan blocks in characteristic p although the algorithm is tedious and costly in time. Our results differ due to an user-friendly, explicit formula for the Jordan canonical form of the tensor product of Jordan blocks of size less than or equal to p. This applies to the representations of a cyclic group of order p. S. P. Glasby, Cheryl E. Praeger, and Binzhou Xia [3] had previous proved a few relationships in characteristic p.

First, we give background information, which will be followed by linear algebra proofs generalizing the formulas for $J_2 \otimes J_n$ in both characteristic zero and p and for $J_m \otimes J_p$ for $p \ge m$ in characteristic p. Then we will provide computations of the representation ring $\operatorname{Rep}(\frac{\mathbb{F}_p[x]}{(x^p-1)})$ or in other words $\operatorname{Rep}_{\mathbb{F}_p}(\mathbb{Z}/p\mathbb{Z})$ and a formula in the representation rings in characteristic p, $J_m \otimes J_n$ when $m \le n \le p$. Afterwards, in characteristic p,

$$\operatorname{Rep}(k[C_p]) \cong \mathbb{Z}[J_2] / \left((J_2 - 2)U_{p-1}(\frac{J_2}{2}) \right)$$

where U_{p-1} is the (p-1)-st Chebyshev polynomial of the second kind. In characteristic zero,

$$\operatorname{Rep}(k[\mathbb{Z}]) \cong \mathbb{Z}[k^{\times}][J_2].$$

Applications of representations of cyclic groups over fields of positive characteristic show up in arithmetic geometry, K-theory, cryptography and physics. In

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arithmetic geometry and K-theory, the action of Frobenius on integral étale cohomology has its reduction to the residue field of the representation of a cyclic group over a field of positive characteristic. This is used to compute zeta-functions of algebraic varieties and thus the number of rational points on the algebraic varieties. Elliptic curve cryptography field that utilizes arithmetic geometry for codes. In physics, the description of fundamental particles by representations of SU(2) or SU(3) is analogous to Gell-Mann's description of the standard model which explains how the basic building blocks of matter interact. Almkvist [1] mentioned that the characteristic zero representation of SU(2) is closely related to the characteristic p representations of cyclic groups.

2. Background

Definition 2.1. Let $J_n(\lambda)$, a **Jordan block**, be a $n \times n$, upper triangular matrix whose entries are all λ on the diagonal, 1 on the superdiagonal and 0 elsewhere.

$$J_n(\lambda) = \begin{pmatrix} \lambda & 1 & 0 & \cdots & 0 \\ 0 & \lambda & 1 & \ddots & \vdots \\ 0 & 0 & \lambda & \ddots & 0 \\ \vdots & \vdots & \vdots & \ddots & 1 \\ 0 & 0 & 0 & \cdots & \lambda \end{pmatrix}$$

Definition 2.2. Given an endomorphism, we can choose a basis such that the matrix describing the endomorphism is the **Jordan canonical form matrix**, J: a diagonal block matrix of submatrices where each entry is a Jordan block, $J(\lambda)_i$.

$$J = \bigoplus_{i=1}^{n} J(\lambda)_{i} = \operatorname{diag} \underbrace{(J(\lambda)_{1} \oplus J(\lambda)_{2} \oplus \dots \oplus J(\lambda)_{n})}_{(n \text{ in total})} = \left(\begin{array}{ccc} (I(\lambda)_{1} \oplus J(\lambda)_{2} \oplus \dots \oplus J(\lambda)_{n}) \\ (I(\lambda)_{1} \oplus I(\lambda)_{2} \oplus \dots \oplus J(\lambda)_{n}) \\ 0 & J(\lambda)_{2} \oplus \dots \oplus J(\lambda)_{n} \\ 0 & 0 & J(\lambda)_{3} \oplus \dots \oplus J(\lambda)_{n} \end{array} \right)$$

Definition 2.3. Let $K, J \in M_n(k), P \in GL_n(k)$. If

$$K = P^{-1}JP,$$

then K is **congruent** to J (or isomorphic) and is denoted by $K \sim J$.

Definition 2.4. A tensor product is an operation on two square matrices resulting in a square matrix as follows. If A is an $n \times n$ matrix and B is an $m \times m$, then

the tensor product, $A \otimes B$, is the $mn \times mn$ block matrix.

$$A \otimes B = \begin{pmatrix} Ab_{1,1} & \cdots & Ab_{1,m} \\ \vdots & & \vdots \\ Ab_{m,1} & \cdots & Ab_{m,m} \end{pmatrix}, i.e.$$
$$A \otimes B = \begin{pmatrix} a_{1,1}b_{1,1} & a_{1,2}b_{1,1} & \cdots & a_{1,n-1}b_{1,m} & a_{1,n}b_{1,m} \\ a_{2,1}b_{1,1} & a_{2,2}b_{1,1} & a_{2,n-1}b_{1,m} & a_{2,n}b_{1,m} \\ \vdots & & \ddots & & \vdots \\ a_{n-1,1}b_{m,1} & a_{n-1,2}b_{m,1} & & a_{n-1,n-1}b_{m,m} & a_{n-1,n}b_{m,m} \\ a_{n,1}b_{m,1} & a_{n,2}b_{m,1} & \cdots & a_{n,n-1}b_{m,m} & a_{n,n}b_{m,m} \end{pmatrix}$$

Definition 2.5. If field k contains a root for every non-constant polynomial in k[x], the ring of polynomials in the variable x with coefficients in k, then it is **algebraically closed.**

Definition 2.6. A representation of a group, G, over a field k is a group homomorphism from G to the general linear group, $GL_n(k)$.

$$\rho: G \to GL_n(k) \ni \rho(g_1g_2) = \rho(g_1)\rho(g_2) \ \forall g_1, g_2 \in G.$$

Theorem 2.7. Jordan-Schur Theorem (Camille Jordan, classical) Any invertible matrix M over an algebraically closed field is conjugate to a matrix J in Jordan form, and this matrix is unique up to permutation of the Jordan blocks. *i.e.*

$$M = C^{-1}JC.$$

We will discuss all of the group representations of a cyclic group to a general linear group $(\mathbb{Z}/m\mathbb{Z} \to GL_n(k))$ or equivalently any matrix, M whose m^{th} power is the identity matrix. Furthermore by Jordan-Schur Theorem and the Structure theorem for finitely generated modules over a principal ideal domain, we can take two group representations

$$f: G \to GL_n(k)$$
$$g: G \to GL_m(k)$$

and tensor them to obtain a group representation,

$$f \otimes g : G \to GL_{mn}(k)$$

which is defined by

$$(f \otimes g)(x) \to f(x) \otimes g(x).$$

Previous papers (refer to [2] and [4]) have easily found the Jordan canonical form of the tensor product of two Jordan blocks where at least one of the Jordan blocks has zero eigenvalues. We will calculate the more exotic case of invertible Jordan blocks. To simplify our calculations, we let the eigenvalues be 1.

Proposition 2.8. We can compute the Jordan form of the tensor product of two matrices with any nonzero eigenvalues, in terms of the Jordan form of the tensor product of matrices with eigenvalue 1.

Proof.

$$J_n(\mu) \otimes J_m(\nu) = (J_n(1) \otimes J_1(\mu)) \otimes (J_m(1) \otimes J_1(\nu)) \cong J_n(1) \otimes J_m(1) \otimes J_1(\mu) \otimes J_1(\nu)$$
$$\cong J_n(1) \otimes J_m(1) \otimes J_1(\mu\nu).$$

3. Jordan canonical form of the tensor product of a Jordan block of size 2 and a Jordan block of size n

We will compute the Jordan canonical form of $J_2 \otimes J_n$ strictly using linear algebra!

Theorem 3.1. In an algebraically closed field k, $J_2 \otimes J_n \sim \begin{cases} J_{n-1} \oplus J_{n+1} & \text{if } char(k) \nmid n \\ J_n \oplus J_n & \text{if } char(k) \mid n \end{cases}$.

After taking the tensor product of the a Jordan block of size 2 and a Jordan block of size n, we have the subsequent results,

$$L = (J_2 \otimes J_n - I), A = J_2(1), B = J_2(0), a_i = \binom{n}{i}, \text{ and } \mathbf{x} = \begin{bmatrix} x_1 & x_2 & \dots & x_{2n} \end{bmatrix}^T.$$

Lemma 3.2. The dimension of the 1^{st} generalized eigenspace of L is 2.

Proof.

$$L = \begin{bmatrix} B & A & 0 & \dots & 0 \\ 0 & B & A & \dots & 0 \\ 0 & 0 & B & \dots & 0 \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & 0 & \dots & B \end{bmatrix}$$

To calculate the dimension of the 1^{st} generalized eigenspace of L, consider the set of equations given by $L\mathbf{x} = \mathbf{0}$:

```
x_{2} + x_{3} + x_{4} = 0
x_{4} = 0
x_{4} + x_{5} + x_{6} = 0
\vdots
x_{2n-2} + x_{2n-1} + x_{2n} = 0
x_{2n} = 0
```

Note 3.3.

$$x_{2k} = 0$$
 for $k \ge 2$ and $x_{2k-1} = 0$ for $k \ge 3$.

Thus there are three nonzero variables, x_1, x_2 , and x_3 . Since $x_3 = -x_2$, leaving two free variables, and the dimension of the 1st generalized eigenspace of L is 2.

Remark 3.4. Following from the algorithm of the Jordan canonical form the number of Jordan blocks in the decomposition is equal to dimension of the 1^{st} generalized eigenspace of L.

Lemma 3.5. The dimension of the n^{th} generalized eigenspace of L is

$$\begin{cases} 2n-1 & \text{ if } char(k) \nmid n \\ 2n & \text{ if } char(k) \mid n \end{cases}.$$

Proof.

Note 3.6.
$$BA = AB = \begin{bmatrix} 0 & 1 \\ 0 & 0 \end{bmatrix}$$
 and $B^{k} = \mathbf{0} \ \forall \ k \ge 2$.

$$L^{n} = \begin{bmatrix} B^{n} & a_{1}B^{n-1}A & a_{2}B^{n-2}A^{2} & \dots & a_{n-1}BA^{n-1} \\ 0 & B^{n} & a_{1}B^{n-1}A & \dots & a_{n-2}B^{2}A^{n-2} \\ 0 & 0 & B^{n} & \dots & a_{n-3}B^{3}A^{n-3} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & 0 & \dots & B^{n} \end{bmatrix} = \begin{bmatrix} 0 & 0 & \dots & nBA \\ 0 & 0 & \dots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \dots & 0 \end{bmatrix}$$

To calculate the dimension of the n^{th} generalized eigenspace of L, the only equation satisfying $L^n \mathbf{x} = \mathbf{0}$ is $nx_{2n} = 0$. If $char(k) \nmid n$, then there exists 2n - 1 free variables and the dimension of the n^{th} generalized eigenspace of L is 2n - 1. If $char(k) \mid n$, then there exists 2n free variables and the dimension of the n^{th} generalized eigenspace of L is 2n.

Proof of 3.1 follows from 3.2 and 3.5

$$J_2 \otimes J_n \sim \begin{cases} J_{n-1} \oplus J_{n+1} & \text{ if } \operatorname{char}(k) \nmid n \\ J_n \oplus J_n & \text{ if } \operatorname{char}(k) \mid n \end{cases}$$

4. Jordan canonical form of the tensor product of a Jordan block of size m and a Jordan block of size p in in characteristic p

Using linear algebra once again, we compute the Jordan canonical form of $J_m \otimes J_p$ for $p \ge m$ in characteristic p.

Theorem 4.1. $J_m \otimes J_p \sim mJ_p$ for $p \geq m$ if char(k) = p

We will prove this by the following lemmas. Let,

$$L = (J_m \otimes J_p - I), A = J_m(1), B = J_m(0), a_i = \begin{pmatrix} p \\ i \end{pmatrix}, \text{ and } \mathbf{x} = \begin{bmatrix} x_1 & x_2 & \dots & x_{mp} \end{bmatrix}^T.$$

Lemma 4.2. The dimension of the 1^{st} generalized eigenspace of L is m.

Proof.

$$L = \begin{bmatrix} B & A & 0 & \dots & 0 \\ 0 & B & A & \dots & 0 \\ 0 & 0 & B & \dots & 0 \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & 0 & \dots & B \end{bmatrix}$$

To calculate the dimension of the 1^{st} generalized eigenspace of L is m. By Rank-Nullity theorem, the dimension of kernel of L is m since $\dim(ker(L)) = mp - m(p-1) = m$.

Lemma 4.3. The dimension of the p^{th} generalized eigenspace of L is mp.
Proof. Let

$$L = (J_m \otimes J_p - I), A = J_m(1), B = J_m(0), \text{ and } a_i = {p \choose i}.$$

$$L^{p} = \begin{bmatrix} B^{p} & a_{1}B^{p-1}A & a_{2}B^{p-2}A^{2} & \dots & a_{p-1}BA^{p-1} \\ 0 & B^{p} & a_{1}B^{p-1}A & \dots & a_{p-2}B^{2}A^{p-2} \\ 0 & 0 & B^{p} & \dots & a_{p-3}B^{2}A^{p-3} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & 0 & \dots & B^{p} \end{bmatrix}$$

Note 4.4. $B^p = \mathbf{0}$ and p divides $a_i \forall i$.

Thus in characteristic $p, L^p = \mathbf{0}$ and the degree of the p^{th} generalized eigenspace of L is $p \times m$, or mp.

Proof of 4.1: Correlating 4.2 and 4.3, we obtain,

$$J_m \otimes J_p \sim m J_p$$
 for $p \geq m$ if $char(k) = p$.

5. Computations for the representation ring of cyclic group of order p over a field of characteristic p

The representations $\operatorname{Rep}(\frac{\mathbb{F}_p[x]}{x^p-1})$ equivalently, $\operatorname{Rep}_{\mathbb{F}_p}(\mathbb{Z}/p\mathbb{Z})$, is the set of conjugacy classes of invertible square matrices, M such that $M^p = 1$. The $\frac{\mathbb{F}_p[x]}{x^p-1}$ -module is just a \mathbb{F}_p -vector space endomorphism such that $x^p = 1$.

From computing the Jordan canonical form of the tensor product of Jordan block matrices over a field, \mathbb{F}_p the following Jordan canonical forms were computed from using the following steps. First, tensor product the two commutative Jordan Block matrices over the desired characteristic field. Then subtract the corresponding identity matrix and calculate the generalized eigenspaces until the k^{th} dimension results in a generalized eigenspace of mn. The first generalized eigenspace calculates the number of Jordan blocks. The second generalized eigenspace will correspond the coefficients of Jordan blocks where each Jordan block coefficient is either 1 or 2 depending on the size of the eigenspace. Repeat for the third generalized eigenspace where each Jordan block coefficient is either 1 or 2 or 3. Repeat until the last generalized eigenspace of mn calculates the coefficients of the Jordan block is mn. This algorithm was automated by a computer program.

$$\operatorname{Rep}(\frac{\mathbb{F}_2[x]}{x^2 - 1}) \cong \frac{\mathbb{N}[J_2]}{J_2^2 = 2J_2}$$

$$\begin{split} \operatorname{Rep}(\frac{\mathbb{F}_3[x]}{x^3 - 1}) &\cong \frac{\mathbb{N}[J_2, J_3]}{J_2^2 = 1 + J_3, J_2 J_3 = 2J_3, J_3^2 = 3J_3}\\ \operatorname{Rep}(\frac{\mathbb{F}_5[x]}{x^5 - 1}) &\cong \frac{\mathbb{N}[J_2, J_3, J_4, J_5]}{Y_1} \end{split}$$

where
$$Y_1 =$$

 $J_2^2 = 1 + J_3, J_2J_3 = J_2 + J_4, J_2J_4 = J_3 + J_5, J_2J_5 = 2J_5,$
 $J_3^2 = J_1 + J_3 + J_5, J_3J_4 = J_2 + 2J_5, J_3J_5 = 3J_5,$
 $J_4^2 = J_1 + 3J_5, J_4J_5 = 4J_5,$
 $J_5^2 = 5J_5$
 $\operatorname{Rep}(\frac{\mathbb{F}_7[x]}{x^7 - 1}) \cong \frac{\mathbb{N}[J_2, J_3, J_4, J_5, J_6, J_7]}{Y_2}$
where $Y_2 =$

$$\begin{split} J_2^2 &= 1 + J_3, J_2 J_3 = J_2 + J_4, J_2 J_4 = J_3 + J_5, J_2 J_5 = J_4 + J_6, J_2 J_6 = J_5 + J_7, J_2 J_7 = 2J_7, \\ J_3^2 &= 1 + J_3 + J_5, J_3 J_4 = J_2 + J_4 + J_6, J_3 J_5 = J_3 + J_5 + J_7, J_3 J_6 = J_4 + 2J_7, J_3 J_7 = 3J_7, \\ J_4^2 &= 1 + J_3 + J_5 + J_7, J_4 J_5 = J_2 + J_4 + 2J_7, J_4 J_6 = J_3 + 3J_7, J_4 J_7 = 4J_7, \\ J_5^2 &= 1 + J_3 + 3J_7, J_5 J_6 = J_2 + 4J_7, J_5 J_7 = 5J_7, \\ J_6^2 &= 1 + 5J_7, J_6 J_7 = 6J_7, \\ J_7^2 &= 7J_7 \end{split}$$

6. Generalized formula for characteristic p in the the representation ring of cyclic group of order p

The previous computations will be generalized.

Theorem 6.1.

In characteristic
$$p$$
 if $1 < m \le n$, $J_m \cdot J_n = \begin{cases} \sum_{i=1}^m J_{n-m+2i-1} \text{ if } m+n < p+1\\ (m+n-p)J_p + \sum_{i=1}^{p-n} J_{n-m+2i-1}\\ \text{ if } m+n \ge p+1. \end{cases}$

Proof. Base Case: By Theorem 3.1,

$$J_m \cdot J_2 = \begin{cases} J_{m+1} + J_{m-1} & \text{if } m$$

It is known by law of associativity that for $1 < m \le n$

$$J_m \cdot J_{n+1} = (J_m \cdot J_n) \cdot J_2 - J_m \cdot J_{n-1}$$
 if $n < p$.

We can proceed in the induction and assume $1 < m \leq n$ for the remainder of the proof.

Suppose: $m \le n < p$ and $J_m \cdot J_n =$

$$\begin{cases} \sum_{i=1}^{m} J_{n-m+2i-1} \text{ if } m+n < p+1\\ (m+n-p)J_p + \sum_{i=1}^{p-n} J_{n-m+2i-1} \text{ if } m+n \ge p+1. \end{cases}$$

Then, $J_m \cdot J_{n+1}$

 $\int_{-\infty}^{m} J_{(n+1)-m+2i-1} \text{ if } m+n < p+1 \text{ and } m \le n$

$$= \begin{cases} {}^{i=1} \\ (m+(n+1)-p)J_p + \sum_{i=1}^{p-(n+1)} J_{(n+1)-m+2i-1} \text{ if } m+n \ge p+1 \text{ and } m \le n \end{cases}$$

$$= \begin{cases} \sum_{i=1}^{m} J_{(n+1)-m+2i-1} \text{ if } m + (n+1) < p+1 \text{ and } m \le n \\ (m+(n+1)-p)J_p + \sum_{i=1}^{p-(n+1)} J_{(n+1)-m+2i-1} \text{ if } m + (n+1) \ge p+1 \text{ and } m \le m \end{cases}$$

Finally, one can verify for $m \le n = p$ Theorem 6.1 is equal to Theorem 4.1.

Remark 6.2. Over the field of characteristic zero the same formula holds as though $p = \infty$.

7. Relations of the representation ring of cyclic group of order p over a field of characteristic p and characteristic zero

The representation ring of $k[C_p]$ for a field of characteristic p > 0 is isomorphic to the ring of integers with J_2 adjoined modulo the following relation.

Theorem 7.1. Suppose k is an algebraically closed field of characteristic p > 0,

$$\operatorname{Rep}_k(C_p) \cong \mathbb{Z}[J_2]/((J_2 - 2)U_{p-1}(\frac{J_2}{2}))$$

where U_{p-1} is the (p-1) Chebyshev polynomial of the second kind.

Proof. Theorem 8.1 shows that all relations in $\operatorname{Rep}(k[C_p])$ are obtained from the formulas from J_2J_n for n < p and J_2J_p . We have that $(J_2 - 2)J_p = 0$, since $J_2J_p = 2J_p$. Almkvist showed $J_p = U_{p-1}(\frac{J_2}{2})$ where U_{p-1} is the degree (p-1) Chebyshev polynomial of the second kind [1].

Theorem 7.2. Suppose k is an algebraically closed field of characteristic zero,

$$\operatorname{Rep}(k[\mathbb{Z}]) \cong \mathbb{Z}[k^{\times}][J_2].$$

Proof. Proof is identical using Theorem 6.1 for the characteristic zero case or equivalently when m + n .

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