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The McNair Journal is the official journal of the Ronald E. McNair Scholars Program at the University of Nevada, Reno. The program is designed to provide research opportunities and other related academic experiences that promote the acquisition of the doctoral degree (Ph.D.) for first generation, low-income and underrepresented college juniors and seniors. The McNair program is federally funded at $220,000 per year. The program was created by Congress in an effort to increase the number of underrepresented persons pursuing teaching, research and administrative careers in higher education.

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The Fully-Extended Research Version of this Journal Can Also Be Found At:  
Foreword:
It is my great pleasure to introduce the University of Nevada, Reno McNair Scholars Journal. The University received its first federally funded McNair Scholars award on October 1, 2003 after successfully competing in a U.S. Department of Education request for proposal. The program is federally funded at $220,000 per year for four years with high potential for continued funding. We are very grateful for the additional support provided to our students from the graduate school. The program is named for astronaut and Challenger crew member Ronald E. McNair. The purpose of the program is to assist undergraduate students from backgrounds that are traditionally underrepresented in graduate school to prepare for doctoral study.

The National Academy of Sciences recently released a report called Rising Above the Gathering Storm. The report includes startling statistics about our county’s ability to remain competitive in the world economy. The study stated that in 2004 China had more than 700,000 students graduate with degrees in science, technology, engineering, and mathematics; India had 350,000; the U.S. had only 72,000 graduates in those fields. According to the NAS report, both corporate and scientific leaders predict major problems for our country’s economic future unless we are able to harness significantly higher rates of our country’s intellectual capital. Graduate education becomes ever more important for students from all socio-economic and ethnic backgrounds. Our McNair Scholars are preparing to become part of a highly educated generation that will contribute to a prosperous future for our country. Our scholars will also serve as believable role models and mentors for those who follow in their footsteps.

Although many services are provided to McNair scholars, the heart and soul of the program is found in the relationship that scholars establish with their academic mentors. The research articles published in this inaugural journal are the product of that relationship. I would like to acknowledge the scholars whose papers were selected for publication and offer my most sincere thanks to our academic faculty who have given so generously of their time and talent to mentor our scholars. Congratulations to all who have contributed to the success of the emerging McNair Scholars Program.

Rita Escher, Director
Background:
The purpose of the Ronald E. McNair Post-Baccalaureate Program is to encourage undergraduates from backgrounds that have been historically underrepresented in university faculty and research professions to pursue doctoral degrees. The federally funded program is in its third year at the University of Nevada, Reno. Dr. Ronald McNair, whose journey to become an astronaut inspires all who seek to achieve ambitious dreams, is a fitting namesake for the program. Although Dr. McNair died in the explosion of the Challenger space craft, his strong message of self determination still resonates with those who strive for excellence:

“Whether or not you reach your goals in life depends entirely on how well you prepare for them and how badly you want them.”

-Ronald E. McNair, Ph.D.

Program Overview:
The foundation of the McNair Scholars Program is the summer research institute. For seven weeks, scholars engage in research projects closely guided by academic faculty mentors. For many students, the summer institute provides their first experience conducting original research and their first opportunity to work closely with a faculty mentor. The relationship forged between scholar and mentor can be the most significant academic connection that a scholar makes at the university.

In addition to conducting research, scholars also take part in GRE preparation workshops during the summer institute. During the academic year, scholars participate in McNair seminars that assist them to complete competitive graduate school applications and provide information related to financing graduate education. Scholars attend national McNair conferences where they present their research and connect with other scholars and faculty from across the country.

In addition to receiving $2,800 research stipends during the summer institute, scholars also benefit from waived application fees at many graduate schools. GRE fee waivers are also available to McNair Scholars. The greatest benefits, though, are not financial. The McNair program enables scholars to form lasting bonds with fellow scholars and with academic mentors. These relationships allow scholars to see themselves in roles they might not otherwise have considered possible such as professors, researchers, and administrators in institutions of higher education.

Eligibility:
Students are eligible for the McNair program if they have completed at least 30 credits, but not more than 92 credits and have a cumulative grade point average of at least 2.9. Students must also meet the federal criteria for selection: Neither parent has a bachelor's degree and the student demonstrates financial need OR the student is a member of a group that is traditionally underrepresented in graduate school: African American; Native American/Pacific Islander; Hispanic/Latino. Students must be U.S. citizens or eligible non-citizens (eligible for U.S. federal aid).

Application Process:
Applications are available on the McNair web site or from the McNair office located in suite 100 of the Thompson Building. www.unr.edu/stsv/saos/mcnair.
Carol Bishop is a conservation biology major from Sun Valley, Nevada. She is a member of the Golden Key International Honor Society, Tau Sigma Academic Honor Society for Transfer Students – UNR charter member, and Phi Kappa Phi. She has worked as a field and lab assistant that provided an opportunity for her to collect water samples from the Truckee River, research information about the Lahontan Cutthroat Trout and examine soil samples of Yellow Star Thistle and participated in Cheatgrass experiments. Carol gave a poster presentation at the 2005 Rocky Mountain McNair Conference in Colorado. Carol has been accepted into the Resource Economics graduate school program for fall 2006 at the University of Nevada, Reno and has received a graduate assistantship.

**ABSTRACT**

*Atriplex confertifolia*, or shadscale, is an important shrub in salt desert areas of the Great Basin. There is recent evidence of extensive die-off, and many possible causes have been investigated. Previous research has not investigated whether there are shrub-shrub interactions that are further modifying its abundance and limiting its recruitment. By studying shadscale’s spatial relationships using size-specific analyses, we will be able to infer if these relationships are influencing its life cycle. Both grid and transect measurements were taken in four study sites: two in unburnt areas and two in burnt areas. All size classes of shrubs were significantly clumped under both fire histories. Hence, there is no evidence of negative shrub-shrub interactions detected using spatial analyses tested at multiple scales. Interestingly, the strong spatial aggregation of shadscale detected at all scales suggests positive interactions may be occurring, and this may be particularly important in burnt areas.
INTRODUCTION

Spatial pattern analyses have long been used to help understand plant interactions (Miriti, Howe et al. 1998). These analyses have supported hypotheses about the role of competition and interference in arid regions (Fowler 1986), which results in a random pattern, and have supported hypotheses about a “nurse plant” or facilitation effect where large plants help the survival of smaller ones (Silvertown and Wilson 1994), which results in a clumped pattern. Combining pattern effects of competition and facilitation could lead to the formation of a dual pattern, resulting in a difference of dispersion pattern by size class (Phillips and MacMahon 1981). Smaller plants tend to be clumped while larger plants tend to have random patterns. A dual pattern of clumps of heavy plant cover within a low cover matrix has been detected in arid regions world wide, but studies of these patch dynamics are lacking (Aguiaar and Sala 1999), as is a general conceptual approach toward spatial interactions and the functioning of arid ecosystems (van de Koppel and Rietkerk 2004).

Shrubs are important structuring agents in deserts. The focus of most research has been directed toward effects of shrubs on understory plants. Both water and nutrients are more abundant under shrubs (Aguiaar and Sala 1999; Tielborger and Kasmon 2000): water abundance is the result of increased infiltration (Rietkerk, Boerlijst et al. 2002), nutrient abundance could result from trapped soil and animal activity (Silvertown and Wilson 1994) or increased litter (Fowler 1986), and consequently shrubs facilitate the growth of a wide variety of annuals and other perennials (Silvertown and Wilson 1994). However, direct tests of intraspecific shrub-shrub interactions are infrequent, and these interactions could be important in modifying the actual distribution or abundance of these important structuring agents.

_Atriplex confertifolia_ occurs throughout the Great Basin and is a prominent native shrub in salt desert regions (Dobrowolski and Ewing 1990). It dominates the lowest, most arid zone which comprises 30% of the Great Basin (Knapp 1996). Its ecological adaptations of drought tolerance and resistance to overgrazing enhance its importance as a major browse resource for all classes of livestock and mule deer during winter and spring in addition to the fruit being a food source for game and song birds (University 2004). Shadscale (_Atriplex confertifolia_) also significantly impacts local fire ecology. Undisturbed stands of shadscale were fire resistant prior to the invasion of exotic annual grasses (Meyer, Carlson et al. 1998) because of shadscale’s high salt content which makes it burn poorly and because of insufficient biomass to carry the fires from shrub to shrub (Knapp 1996).

While its abundance seems to be cyclical in nature over long periods (Meyer, Carlson et al. 1998), there is recent evidence of extensive die-off (Dobrowolski and Ewing 2000). It has been reported that young plants are not subject to historical causes of mortality in the other size classes (Dobrowolski and Ewing 1990). Several causes of the demise of _Atriplex confertifolia_ have been investigated, including homopterous (Nelson, Haws et al. 1990), disease (Nelson, Weber et al. 1990), salinity, and moisture stress (Weber, Nelson et al. 1990). Previous research however, has not studied whether there are shrub-shrub interactions that are further modifying its abundance and limiting its recruitment.

Shadscale, because of its longevity, is an ideal species for a spatial pattern analysis to infer if there are shrub-shrub interactions by life stage or size class. By studying _Atriplex confertifolia’s_ spatial relationships using size specific analyses, we will be able to infer if there are direct shrub-shrub interactions that are influencing its life cycle. We predict that smaller size classes of Atriplex are more intensely aggregated than larger classes, that larger individuals are dispersed or over-dispersed in space, and that there are consistent differences between burned and unburned sites in the size, density, and distribution of Atriplex, and that fire will change Atriplex’s spatial pattern and influence its life cycle.
STUDY SITE AND METHODS

STUDY SITE
The study area is a salt desert in central northern Nevada between Rye Patch Reservoir, the Trinity Mountains and the Majuba Mountains (www.brrc.unr.edu). Elevations range between 4,183 and 4,215 feet on the sites (GPS data). Annual average precipitation is 7.93 inches and annual snowfall averages 7.8 inches (wrcc@dri.edu). Temperatures in the area range from an average maximum in July of 94.2 degrees Fahrenheit to an average minimum in January of 17.8 degrees (wrcc@dri.edu). The southern part of the study area was burned in 1999 (Haubensak 2004). Within the study area, four sites were demarcated: two in the unburned northern area and two in the burned southern area. Each site was 25 by 25 meters and situated 20 meters from and parallel to the road to prevent interference from edge effects.

GRID SAMPLING
Each site was divided into 625 one-meter quadrates. Within each quadrate, plant occurrence, size, mortality, and reproductive status were recorded. Plant size parameters were measured at the major axis of possible width and classified as follows: small 0-30 cm, medium 30-60 cm, and large 60 cm or larger.

TRANSECT SAMPLING
Transects were run through the middle of the sites perpendicular to the road. Measurements were taken at one- meter intervals. The distance was measured to the closest plant on the left side from the tape, then the distance from that plant to its unused nearest neighbor in the same forward direction to the left. The length of the major axis, minor axis, and height were recorded for each shrub in the transect study. Soil cores were taken at each site for possible nutrient and seed bank analysis.

RESULTS
There were significantly more shrubs in all status categories in unburned areas (Figure 1; F = 14.04, p < 0.0001, n = 900). The same trends held for mean shrub density and for proportion of shrubs in each status category (p < 0.0001).

Figure 1. Shrub densities in all life stages by fire history.
There were more medium-sized shrubs under both fire regimes, and the most significant difference in density was between small-sized alive shrubs between the two site types (Figure 2).

**Figure 2.** Shrub densities by size class and fire history.

Using Hill’s TTLQV (a blocked variance procedure), significant coarse scale aggregation or clumping of shrubs was detected at all sites under both fire regimes (Figures 3 & 4). The clump size of shrubs ranged from 2m² to 20m² and there was no difference between sites in the coarse mean clump size (One-way ANOVA, $F = 0.06, p = 0.8, n = 12$).

**Figure 3.** Hill’s TTLQV for shrubs at burned sites.

**Figure 4.** Hill’s TTLQV for shrubs at unburned sites.
Fire history significantly impacted intershrub (or paired shrub-shrub) distances with shrubs at burned sites being farther apart (Figure 5; $F = 5.06, p = 0.026, n = 100$). However, this difference was driven primarily by the response of a single burned site having shrubs spaced much farther apart.

**Figure 5.** General fire effect on intershrub distance.

The absolute relative difference in shrub size did not significantly predict the distance between individual shrubs within a pair (each site tested independently; Figure 6).

**Figure 6.** Intershrub distances for burned and unburned sites.
In general, co-occurring nearest shrub sizes within pairs were positively correlated but this did not differ by fire regime. The spatial aggregation was consistently and significantly clumped (Figure 7; Hopkins’ test statistic, $p < 0.05$, $n = 25$ per site) at all four sites although shrubs at burned sites were more strongly aggregated.

![Figure 7. Index of spatial pattern by site.](image)

**DISCUSSION**

There were significantly more Atriplex shrubs evident in unburned areas at all life stages sampled. Fire is not the friend of this species. There was weak evidence of differences in spacing with one unburned site having greater intershrub distances. At a coarse 1 by 1 meter scale, however, shrubs were significantly clumped under both fire histories. Clump size of shrubs ranged from 2 m$^2$ to 20 m$^2$, and there was no difference between sites in the coarse mean clump size. The relative difference in size between pairs of shrubs did not predict intershrub distance. Furthermore, the mean size of co-occurring nearest shrubs was positively correlated across the entire area sampled. At a fine-scale (direct shrub-shrub) level, shrubs were significantly aggregated and this trend was more pronounced in burned sites for all size classes of shrubs. Hence, there is no evidence of negative shrub-shrub interactions detected using spatial pattern analyses tested at multiple scales. Interestingly, the strong spatial aggregation of Atriplex detected at all scales suggests positive interactions may be occurring and this may be particularly important in burned areas.
WORKS CITED


Mary Czerwinsky is an elementary education major from Sparks, Nevada. She maintained an overall 3.93 GPA, was on the dean’s list since fall 2002 and received several academic scholarships. Mary presented her research project at the 2005 Rocky Mountain McNair Conference in Colorado. She plans to teach one year before enrolling in graduate school.

ABSTRACT

Native Americans have the highest dropout rate of any ethnic or racial group in the United States, twice that of the national average. This is a case study on a Native American college student and a closer look at educational resiliency in the Native American community. The case told through the eyes of a Native American college student investigates the following questions: 1. What made this student more resilient than his counterparts? 2. Is resiliency promoted in Native Americans the same way that it is promoted in all students? 3. What can instructors do to better support Native Americans on their educational paths? The study will conclude with a comparison of data currently available on Native American resiliency and higher education.
BACKGROUND
Resiliency is the ability to overcome the hardships that people face such as divorce, alcoholism, poverty and racism. Most researchers use the term resiliency in regards to at-risk children and their ability to overcome the challenges placed before them. Robert Brooks and Sam Goldstein (2003) stated:

> Resilience is the capacity to deal successfully with the obstacles in the road that confront us while maintaining a straight and true path towards life’s goal. In the past the concept of resilience has typically been confined to children who have experienced major adversity in their lives. However, we believe that the concept of resilience can and should be applied to all children, that all children face different challenges in life and that the children who have developed what we call a ‘resilient mindset’ will handle these challenges with greater effectiveness and success (p. 1).

This means that all children who are going to be successful must be resilient even if they are not considered at-risk. Benard (1995) observed in her research that a large number of at-risk children develop the needed resilience to succeed:

> “Some longitudinal studies, several of which follow individuals over the course of a lifespan, have consistently documented that between half and two-thirds of children growing up in families with mentally ill, alcoholic, abusive, or criminally involved parents or in poverty-stricken or war-torn communities do overcome the odds” (p. 2).

What is the most important factor that promotes resiliency? This is a good question with many different answers. Bruce D. Perry (2002) argues, “Resiliency cannot exist without hope. It is the capacity to be hopeful that carries us through challenges, disappointments, loss and traumatic stress. The child who is capable of thinking that things will be better—that the bad feelings and situation he now faces will improve—will be more resilient” (p. 25). Edwards (2001) argues, “This is due in part to an inborn capacity for resilience which helps them to develop social competence, problem-solving abilities, a critical consciousness, autonomy, and an innate sense of purpose” (pp. 15-16).

Different factors help children become resilient, but is resiliency the same across cultures, or are some factors more important in fostering resiliency in different cultures? I will explore this issue by conducting a case study on a Native American college student to see what helps him to overcome his academic challenges. Furthermore, I will explore what elements support one who has faced hardships succeed in high school and even college.

Statement of Problem
Native Americans have consistently had a higher dropout rate than White students. In his study of Native American and Alaska Natives, Reyhner (1992) found that the rate was twice as much:

> American Indian and Alaska Native students have a dropout rate twice the national average; the highest dropout rate of any United States ethnic or racial group.
About three out of every ten Native students drop out of school before graduating from high school both on reservations and in the cities” (p. 1).

**Percent of 10th Graders in 1980 Who Later Dropped Out of School**


*Source: National Center for Education Statistics (1989) Dropout rates in the United States, High School and Beyond data, Table 9, p. 26*

This is not a new problem; it is one that has been overlooked for decades. When dropout rates are analyzed, researchers often cite the causality in the Native American students who are not succeeding. In his article, Clark (1997) states that one of the factors causing the failure in education in Native American children is their belief that an education will not benefit them:

One explanation for the failure of minority students that has received a great deal of attention in the last decade is found in the work of John Ogbu (1982), who maintains that students, as well as their peers and their parents, are convinced that graduation from school will not help them break out of the cycle of poverty.... [they] share a fatalistic perspective that there will never be opportunities of jobs for them. Therefore, these students develop the attitude of belief that there is no reason to try to succeed in school (p. 73).

This is a case study about educational resiliency in the Native American community. It will be told through the eyes of a Native American college student. We investigated the following questions: 1. What made this student more resilient than his counterparts? 2. Is resiliency promoted in Native Americans the same way that it is promoted in all students? 3. What can instructors do to better support Native Americans on the educational path?

**Native Americans**

It is widely acknowledged that Native Americans have performed below the standard in educational situations, and the answers to “why” are varied. Some experts feel that cultural problems are the reason that Native Americans drop out in such large numbers. Jon Reyhner (1992) argues, “Dropout prevention starts with caring teachers who give students every chance for success in the classroom through interactive and experiential teaching methodologies, relevant, and culturally appropriate curriculum” (p. 2). In his article, “The American Indian Child,” Clark (1997) argues that the poverty level of the American Indian child is a strong factor in the Native American’s lack of success in school:
Research clearly shows that poor children are more likely to drop out of school than are their more advantaged peers. This does not mean that growing up poor will itself determine whether a child will drop out of school; however, it does indicate that unless the burden of poverty is alleviated by the distribution of resources and the commitment of sympathetic and dedicated teachers and administrators, it is much harder for a child to succeed.

Unfortunately, for American Indian children that assistance has not been generally available. Instead, many educators and researchers have mislabeled the conditions of poverty as the conditions of culture and its incongruence with the school environment. Thus, it becomes very easy, as well as convenient to blame school failure among American Indian children on the students' culture (p. 63).

The answer to this problem probably is a combination of cultural discontinuity and the poverty level of Native Americans. In many instances, Native Americans are losing their culture, but they have not adapted to the culture of the majority. They are stuck in this limbo where at this time they don't feel like they belong anywhere.

The 2000 U.S. Census Bureau report shows that the number of Native American families living below the poverty level is more than twice that of the national average. Also, there are twelve percent more single mothers in the Native American community. These two factors alone are bound to have a significant impact on the children in the community. The Native American community is facing many problems. The quality of the education their children are receiving is just one minor problem. Even in families with two parents, the poverty rate is greater than that of the total population.

NATIVE AMERICA IN POSTSECONDARY EDUCATION

The number of high-school graduates going on to college is on the increase. What has not increased is the number American students prepared for the college experience. They score lower on entrance exams and take fewer, if any, preparatory classes in high school. The number of Native Americans completing the recommended core curriculum is lower than the national average. This is after a quadruple of the percentage completing the core curriculum.


- 64 percent of American Indian and Alaska Native families are married couples
- 27 percent of American Indian and Alaska Native families are headed by a female
- Native Americans participate in the labor force at similar rates as the general population
- Men had higher rates of participation than women for both American Indians and Alaska Natives, and the total population
- Median income among all American Indian and Alaska Native families was $21,750
- Married couples had the highest median income at $28,287
- Families headed by females had a substantially lower median income at $10,742
- Median family income for the general population was higher at every level than that of Native Americans
- 17 percent of American Indian and Alaska Native families lived in poverty compared with 6 percent overall
• Families headed by a female had a poverty rate of 50 percent compared with 31 percent of the general population
• In 1990 9 percent of American Indian and Alaska Natives had received a bachelor’s degree or higher, less than half that of the general population
• In 1990 20 percent of the total population had received a bachelor’s degree or higher
• In 1992 most Native American college-bound high-school graduates failed to meet all five criteria used to assess student competitiveness in the college admissions process
• Among Native American undergraduates, 35 percent faced four or more risk factors that threatened their ability to enroll in a postsecondary institution and ultimately complete a degree
• 24 percent of American Indian and Alaska Native college-bound high-school graduates completed a college preparatory curriculum compared with 56 percent of all college-bound high-school graduates
• Only 2 percent of college-bound American Indian and Alaska Native high-school graduates had a combined SAT score of 1,100 or better compared with 22 percent of all college-bound high-school graduates

Case Study
The studies that I have found focus on the students who have dropped out of school, instead of capitalizing on Native Americans who have been successful. In this study, I analyzed why a select Native American is able to succeed while so many of his peers do not. The study is guided by three lead questions: 1. What made this student more resilient than his counterparts? 2. Is resiliency promoted in Native Americans the same way that it is promoted in all students? 3. What can instructors do to better support Native Americans on the educational path?

Case Study Report
The subject of this study is a male Native American, twenty years old, who is in his third year at the university. He is enrolled in a pre-medical track and anticipates going on for advanced studies at the University. In high school, he focused on a college track and took courses that he believed would help him to study in his pre-med major. He reports that he “always did well in school and got good grades.” This student (pseudonym of Jim) reports that both his parents and his stepfather graduated from college. He reported that his mother “gave up her fast-paced job to become a teacher so she could be more involved in Jim’s education.”

In response to the first question (1. What made this student more resilient than his counterparts?), Jim said that it is easier for him because he was not raised on the reservation like his cousin. He was at a much higher income level than his cousins, aunts and uncles. He had the family support for education that he felt his cousins did not have, and this, he said, was something that made a difference for him. Alcohol and drugs are a major problem on the reservation, according to Jim, and this is also true in the case of his aunts and uncles. The uncles are usually not in the home, which leaves his aunts trying to support their children and not being able to be there for additional support, like school and homework.
In response to question 2 (Is resiliency promoted in Native Americans the same way that it is promoted in all students?), Jim was not as aware of an answer. He said that in high school, he always saw school as not optional. In contrast to his cousins, this was not as evident. He does see himself as a Native American. The major factor he sees is the income level and the neighborhood in which he lived, that is, a middle class neighborhood. He said that the people on the reservation feel they do not have as many opportunities as he did and seem not to try to change this situation. In a frank statement, he said that some of the people on the reservation do not want to change because they do not want to lose government assistance.

In response to question 3 (What can instructors do to better support Native Americans on the educational path?), Jim did not have much to contribute. He suggested that we support Native Americans because they are not getting support at home. This is especially true for Native Americans who live on the reservations.

In a presentation at a McNair Scholars Conference, a Native American presenter offered these findings on how teachers can provide support for Native American students in their classrooms. First, he stated that teachers need to have an expectation of success for their students. He added that no one encouraged or provided him with strategies and this was especially difficult as he lived on a reservation. Secondly, he found that he was successful because he found a passion, that is, a reason to investigate something or to develop a personal interest. In his case, he was intrigued by the explosion of The Challenger and wanted to look more closely at science. This spurred him to become a much better student and eventually a college graduate who is now working on an advanced degree.

Conclusions
The findings from the case study are unique as they do not align with the research on Native Americans who have struggled and overcome challenges. In this case, the subject is one who has not faced obstacles but has looked at the situation of his family on the reservation and compared their lives and outcomes to those of his own. In a way, this is interesting as the subject, himself, was able to draw conclusions based on what helped make him resilient.

The study appears to support the research that poverty plays a powerful role in the educational dropout rate of Native Americans. Although this is not the only cause, it continues to appear as one of the factors in studies on Native Americans and school completion. It is important that future studies continue to explore questions such as those raised in this case study and use thereof Native Americans who are living in poverty and living in different income brackets. In this way, the cases will provide a rich understanding of challenges that continue to be confronted by Native American children.


Marti Howell

Mentor: Dr. Donica Mensing
Major: Journalism
Research Topic: “Letter to the Editor: Serial Killers and Their Correspondence to Newspaper Editors and Staff”

Marti is a journalism major from the Reno, Nevada, area. She has received numerous scholarships and awards including the Scripps Medal and the Warren Lerude First Amendment Award. She was selected to represent the Reynolds School of Journalism at the National Society of Professional Journalists Conference in Columbus, Ohio and at the Environmental Journalists Association in Washington, DC. She was the news editor for the university newspaper Sagebrush, has published articles in the Lahontan Valley News and several online publications including University of Nevada’s Zephyr and the Society of Environmental Journalists online publication. She presented her research project at the 2005 University of New York at Buffalo McNair Scholars Conference. She has been accepted into the Reynolds School of Journalism graduate school master's program at the University of Nevada, Reno and has received a graduate assistantship. Her long-term goals include a career in academia and pursuing a Ph.D.

ABSTRACT

As journalists are attracted to stories of serial murder, so are some serial killers compelled to communicate with the media. This study will examine cases of newspapers in receipt of materials from alleged serial murderers. Using a qualitative approach to individual case studies, this paper will include cases spanning four decades. This paper will provide background information on standard editorial; policy and will note ethics theory pertaining to the receipt of materials sent to editors of American newspapers. In addition, this paper will look at publication decisions in each of the case studies and attempt to illustrate factors that dictate those decisions.

“Crime is something shameful, and it is highly dangerous to advertise criminals as if they were as interesting as Presidents or Prime Ministers or film stars or professional footballers.”

~ Honorable Robert Bernays, British MP, 1938
Introduction

This is an ongoing research project that will attempt to closely examine the motivations of newspaper editors involved in the decision to publish or not to publish materials sent to their newspapers by suspected serial killers.

This paper provides background research for a forthcoming qualitative study of the phenomenon of serial murderers who write to the media. This research includes two case studies – those of confessed Kansas serial killer Dennis “BTK” Rader and the unsolved case of the Zodiac Killer of the San Francisco Bay Area.

This paper provides the information necessary to embark upon an interview-intensive study of the unique relationship between these particular criminals (serial murderers) and one medium with which they sometimes communicate (newspapers).

Granted, interviews of journalists and editors involved in correspondence with serial killers will not result in a comprehensive understanding of the nature of their relationship. However, as these situations are relatively rare and vary greatly in detail, individual case studies may well be the best way to examine them. Though time consuming, this type of qualitative research will provide an intimate and in-depth view of the journalists – and, consequently, the newspapers – involved in the receipt of materials from alleged serial murderers.

This research may be useful to newspaper editors as they create or revise editorial policy in an increasingly violent environment. Experts speculate that as many 150 serial killers may be in operation in the United States at any given time. When these criminals reach out to the media, they often make publication demands under threat of more violence. (courttv.com) Such circumstances place the media in a chillingly difficult position. This case study will allow other editors to see how their colleagues handled their brushes with serial murderers who contacted the press.

A potential limitation of this study is the method of self-reporting involved in personal interviews. However, unlike the alleged serial killers, journalists tend to report facts and are not, as a whole, prone to lying. In addition, some issues – such as the reporters’ states of mind – can only be examined through the interview process.

Prior to interviews of media personnel in regards to correspondence received in past cases, it is crucial to know the background of the cases in question. This paper, in the interest of preliminary research, will examine the specific publication facts of two cases: Dennis Rader, the confessed “BTK” serial killer of Wichita, Kansas, and the Zodiac serial killer of the Bay Area, who remains an unknown subject.

The facts of these two cases represent opposite ends of the spectrum in several regards. The BTK case is the most recent. New developments surface in this case almost daily. The Zodiac case is one of the oldest, occurring in the late 1960s and early 1970s. BTK worked – and communicated with the media – in a semi-urban area over the course of three decades. The Zodiac operated in a larger metropolis and his period of communication spanned only a few years. Also, the BTK murders were solved in 2005. The Zodiac Killer has never been identified.

Finally – and perhaps most significantly – the materials obtained by the press in the Zodiac case were, for the most part, published by the newspapers in question. By contrast, most of the materials sent to the Wichita press by BTK were not published. One theory as to why these editorial decisions were made has to do with the implicit or explicit threats made by the letter writers to take more victims if the newspaper does not meet publication demands.
**Literature Review**

There are a number of issues that involve the media’s interaction with the criminal and the criminal justice system. After all, crime is news. These issues range from media access to criminal proceedings to media saturation of high-profile cases, from the media’s ability to sabotage an investigation by releasing guarded information to its potential for aiding in preventing and even solving crimes through its reporting. Another ethical consideration in crime reporting is the idea that the media can – and frequently does – make a criminal well known to the general public.

Much has been written about the relationship between the criminal justice system and the media. Many criminal court cases grapple with the question of media access during trial. These cases, many of them involving famous defendants or sensational crimes, are covered extensively, regardless of actual access during trial (AP 2002).

Other works examine the effect of media coverage on the criminal. One such article explains the desire of many criminals – particularly murderers – to see themselves in the spotlight. It also explores the potential dangers associated with making a criminal a “household name” (Making the criminal a celebrity 2002).

There is also a lot of information available on the criticism often levied at the media after reporting details of high-profile murder cases. One example involves the case of Wayne Williams, the convicted Atlanta Child Killer. After the *Atlanta Constitution* printed the police department’s intention to use fiber evidence to find the killer, Williams took to stripping his victims and tossing their bodies off of bridges to destroy that evidence. Ultimately, he was captured by officers staking out one such bridge. Richard Ramirez, also known as the Night Stalker, sought out victims in their homes in Los Angeles and San Francisco. When Bay Area media outlets reported that police were attempting to identify the suspect based on shoe prints found at crime scenes, Ramirez promptly disposed of his sneakers and left the area. This work is significant in that it brings to light one of the trends in the media-audience-criminal effect loop (Carlson 2000).

Ann Rule’s book “Kiss Me, Kill Me,” provides specific examples of instances in which newspaper coverage of a murder led directly to the capture of the murderer. The most compelling of these cases involves the capture of a perpetrator more than thirty years after the crime was committed (Rule 2004).

There are, of course, many works about serial killers themselves. A psychiatrist’s book chronicles one doctor’s journey to discover the secrets of the minds of serial murderers. Throughout the book, the author refers to how the media treated these infamous criminals. Though choppily written, the book does give the reader a look into some of the possible motivations of her subjects. Spanning forty years, it also provides a peripheral illustration of the evolution of crime coverage by the media (Morrison 2004).

On the other hand, little has been written about the direct relationship between the criminal and the media. One specific criminal type whose correspondence to the press is of certain interest is the serial killer. He often threatens to exact more violence if the media does not grant him the attention he demands. There are numerous cases in which a murderer communicated directly with the media prior to his capture, often while he is still an active serial killer.

Confessed serial killer Dennis Rader, also known as the BTK killer, is an example of a rare relationship between a serial murderer and a specific newspaper. Including thirty years of communication, the case of the BTK killer and his correspondence to the *Wichita Eagle-Beacon* provides unprecedented access to the words of a serial murderer. It also touches on how this contact affected the staff at the daily newspaper. A recent newspaper article recounts the facts of this unique case. (Strupp 2005).
In at least three other cases, a murderer sent correspondence to a newspaper. David Berkowitz, better known as the Son of Sam, sent letters to columnist Jimmy Breslin during a 1977-78 killing spree that left six people dead and seven wounded. The Zodiac Killer sent a number of letters to San Francisco newspapers. Though never captured, police believe they know who the killer was, based in part on the correspondence. An investigation of the Zodiac Killer by the San Francisco Chronicle’s Robert Graysmith supports the theory. Ted Kaczynski wrote to newspapers nationwide, finally submitting a 65-page manifesto to the New York Times and the Washington Post. (crimelibrary.com, zodiackiller.com)

A valid line of study would examine the editorial policy of newspapers as it pertains to correspondence from alleged criminals, specifically, serial murderers. A case study of newspaper journalists who have received letters, packages or other correspondence from alleged serial killers will reveal a great deal about the dynamics of the criminal-journalist relationship. This intensive interview-based, qualitative research will attempt to enhance our understanding of how journalists respond – professionally – to such contact. It will also expose any existing protocol within the newspaper’s editorial policy as it relates to criminal solicitation of the publication and/or its agents.

Case study: Confessed BTK killer and his correspondence to the media

When the Wichita Eagle-Beacon received a letter in October of 1974 claiming responsibility for the murders of four members of the Otero family, they had no written editorial protocol regarding such correspondence. In fact, thirty-one years later, the paper still does not have such a policy.

“We do not have a specific ethics policy regarding information sent by the public,” Wichita Eagle Editor Sherry Chisenhall said in a recent interview. “Our general policy is to verify all such information the same as we would other material we report” (Personal interview).

In the case of the October 1974 letter, the investigation to determine authenticity began with a call to Wichita authorities. The writer of the letter had included details of the crime known only to the police and the murderer. The Wichita Eagle elected not to print the letter – in full or in part. Newspaper staff immediately turned the material over to the police to aid in their investigation.

Should the editor of the Wichita Eagle have chosen to withhold the letter from law enforcement, legal precedent would have been on the paper's side. The Supreme Court, ruling in cases such as “Zurcher vs. Stanford Daily” in 1978, has noted that law enforcement searches of newspaper offices and seizure of documents therein may hinder the operation of a free press. The Fourteenth Amendment, according to Supreme Court Justices Potter Stewart and Thurgood Marshall, affords the press the right to operate free of the burden of physical disruption of newsrooms. (Cornell Law)

When the Wichita Eagle chose to voluntarily turn over materials related to the BTK case to authorities, it began building for itself – and other media outlets – a body of ethical decisions in this arena. The paper’s decision would impact the evolution of editorial protocol in the matter of correspondence suspected to be from criminals.

BTK continued to communicate with the Wichita Eagle-Beacon (later renamed simply the Wichita Eagle) throughout his long criminal career. In other letters to the press, the serial murder suspect related details of additional murders and named himself “BTK.”

“The code words for me will be: Bind them, torture them, kill them,” read a letter to the Wichita Eagle-Beacon in 1978. “BTK, you see he (is) at it again. They will be on the next victim.”

In January of 1978, a letter signed “BTK” was sent to the media. It included a parody of a nursery rhyme and specific information regarding the March 17, 1977 murder of 24-year-old Shirley Vian. Police linked the letter to the killer through facts revealed in the poem.
The *Wichita Eagle-Beacon* again elected not to print any part of the correspondence in the paper. A reporter did, however, write a story stating that the letter was received and believed to be from the person who murdered Vian. A month later, BTK sent a letter to the newspaper claiming responsibility for seven murders and threatening to kill others.

In April of 1979, the press received a package containing items stolen from a woman’s home. The writer claims to have engaged in a failed attempt on the woman’s life. This is the last known contact with BTK until March of 2004. The September 1986 murder of Vicki Wegerle was the last killing attributed to the self-named BTK killer.

On March 19, 2004, after the *Wichita Eagle* published a story on the anniversary of one of the murders, BTK resumed his conversation with the media. In a flurry of letters and packages to the press and the police, BTK stated that he was still alive and in the area. Again, he used items taken from his victims to prove his connection to the murders.

The *Wichita Eagle* maintained its original publication decision. No part of the correspondence was published and all materials were turned over to law enforcement officials almost immediately.

One of the items recovered by officers in that exchange was a computer floppy disc. It was this piece of evidence that led to the February 26, 2005 arrest of 60-year-old Park City code enforcement supervisor Dennis Rader. Rader later confessed to murdering ten people in the Wichita area between 1974 and 1991. In July of 2005, The *Wichita Eagle* released to the public most of the content of the letters sent to them by the BTK killer. Dennis Rader was already in custody.

Throughout the period that the newspaper was receiving correspondence from the serial murderer, it never wavered from its editorial decision to refrain from printing the material. The paper was also consistent in its transfer of materials to law enforcement in a timely fashion.

Since his arrest, Rader has filed a number of court motions designed to broaden his access to the media. The *Wichita Eagle* has not commented on these matters. The content of Dennis Rader’s writing to the newspaper included statements of his intention to kill additional victims in the future. It did not, however, include detailed threats of violence with definitive timelines or demand any specifics of publication.

**Case study: The Zodiac killer and his correspondence to the media**

One of the most prolific of correspondents suspected to be serial killers, the Zodiac sent 18 letters and cards to editors of several California newspapers in the 1960s and 1970s. His case has similarities to that of BTK but also some significant differences.

The Zodiac Killer generally targeted young couples in secluded areas around San Francisco. He used a variety of weapons and committed his assaults and murders during both daylight and nighttime hours.

Like BTK, the contents of the Zodiac’s correspondence to the media included details and evidence from previous crimes to establish his credibility. All materials sent by the Zodiac were marked “Please Rush to Editor” and included information or items from recent Bay-area murders. By contrast, Rader wrote of his crimes sometimes years after they had been committed. This factor may have also lessened the threat level in the minds of newspaper editors in the BTK case. The Zodiac also chose his own title and often signed his correspondence with a symbol. The Zodiac sent materials to the editors of the *San Francisco Chronicle*, the *San Francisco Examiner* and the *Vallejo Times-Herald* from July of 1969 until July of 1974.

Authorities believe that the Zodiac Killer took his first victims on December 20, 1968. At approximately 11:15 p.m. on a remote Vallejo, California lovers’ lane called Lake Herman Road, Betty Lou Jensen, 16, was shot five times and killed. Her date, 17-year-old David Faraday was shot as he attempted to flee his station wagon. The Zodiac would later provide details of this crime in a July 31, 1969 letter to the *Vallejo Times-Herald*. 
Cab driver Paul Stine was shot and killed in his taxi on Saturday, October 11, 1969 at approximately 9:55 p.m. His lifeless body was found falling out of the driver’s door of his cab at the corner of Washington and Cherry Streets in Presidio Heights. Three residents of the quiet San Francisco neighborhood reported to police that they had heard a shot on the corner in the vicinity of the parked taxi. They then saw a man run from the scene. However, as the subject was fleeing from the witnesses in the dark and an evening fog, no identification of the man was ever made. The police who arrived on the scene found Stine dead of a 9mm semi-automatic pistol shot to the head. A large portion of Stine’s blood-soaked shirt was missing.

On October 13, 1969, just two days after the murder, the San Francisco Chronicle received a package from the Zodiac claiming responsibility for the murder of Paul Stine. Enclosed in the package was a piece of the cab driver’s bloodied shirt. The police, upon receipt of these materials, verified the authenticity of the correspondence. Although they did publish certain pieces of material they believed were from the Zodiac Killer, editors at all of the newspapers involved in this case turned all items over to law enforcement authorities immediately. (Note: There is no record that any of the journalists involved in either of these cases was ever anything less than cooperative with the police.)

Like most criminals who engage in a cycle of murder and authenticated correspondence with the media, the Zodiac expressed a desire to be recognized in some public fashion. He was counting on the media to make him famous and was quite clear about how he wanted the press to assist him—and what would happen if they did not. He made implicit threats.

The Zodiac's letters included taunts, maps of potential targets, diagrams of explosive devices and cryptograms. He demanded that all of the newspapers print the cryptograms, claiming that within them, was concealed his identity. In a desperate attempt to appease the Zodiac, both San Francisco papers printed three of them. Two San Francisco educators saw the cryptograms in the paper and solved one of the puzzles. The police said that while the message it contained was disturbing, it did not reveal clues to the writer’s identity.

Like BTK, the Zodiac also threatened to kill more victims. Unlike BTK, he said he would carry out these threats in coming days if the newspapers failed to publish his work. On November 9, 1969, one such letter informed the editors of two newspapers that the Zodiac intended to plant an explosive device on a Bay Area school bus. For several days in the wake of that letter, San Francisco Police patrol units followed school buses on every mile of their routes.

The most striking difference in these cases is that several editors – including those at both major San Francisco papers – chose to publish excerpts from the Zodiac letters soon after they were received. Editors in receipt of materials from BTK did not publish those writings and did not release any of the material to the public until after Rader’s arrest for the murders.

The Zodiac killer was never identified. While the police had several leads and a few suspects, no significant breaks in the case were ever made. The threats levied in his case were imminent and specific. This undoubtedly complicated the editors’ decisions regarding publication. (www.zodiackiller.com)

**Editorial decisions in additional cases**

Unabomber Theodore Kaczynski demanded that the New York Times and the Washington Post publish his 65-page manifesto under threat of more bombing victims. The cost involved in complying with the Unabomber’s request was such that the Times and the Post decided to share the expenses and publish a special section.
This case, like that of the Zodiac, demonstrates the effectiveness of threats by a serial killer on publication decisions. Neither publication had anything to gain by publishing Kaczynski’s work – save the sparing of one of his potential victims. The publication of the document led to the eventual capture of Kaczynski.

The “Son of Sam” letters sent to Boston columnist Jimmy Breslin were not published during David Berkowitz’s 1977-1978 killing spree. The editors involved in that decision said they felt that publishing the material would result in public panic. (www.crimelibrary.com)

**Common thread? Publication decisions**

Ultimately, the decision to publish or not to publish materials suspected to be sent by serial murderers lies with the editor. The First Amendment protects his decision to publish those materials should he so desire. While editors like Sherry Chisenhall of the *Wichita Eagle* cite authenticity as a key factor in publication decisions in such cases, it would appear that community safety plays a crucial role. In each case, whether the material was published or not, consideration of the potential for more lives lost weighed heavily on the journalists. Many decisions were, in fact, based almost entirely on this consideration.

**Conclusion**

More in-depth interviews and additional case studies in this ongoing research project will attempt to more carefully examine the motivations involved in the decision to publish or not to publish materials sent to newspapers by suspected serial killers.

Initial indicators suggest that how such editorial decisions are made has to do with the implicit or explicit threats made by the letter writers. In the case of BTK, the threats were vague. Future murders were not contingent on the media’s cooperation with the writer’s publication demands. BTK’s threats were implicit and, perhaps as such, did not appear to have consequences as grave as those of the Zodiac.

Most of the editors at the Bay Area newspapers chose to publish excerpts from the Zodiac letters. The threats levied in his case were imminent and contained specific details. There were explicit threats spelled out in the event that the writer’s publication demands were not met.

Other matters for consideration for future research in this area of study include suspects in custody who request court intervention to allow them access to the media and law enforcement demands for disclosure of materials sent to the media by suspected criminals. In addition, the use of new technology by alleged criminals to communicate with the media is poised to take center stage. As criminals become more sophisticated users of communication technology, the manner in which they contact the press will evolve.

**Subjects**

The following newspapers were directly involved in the BTK and Zodiac cases:

- *The Vallejo (California) Times-Herald* in reference to the Zodiac Killer (unsolved).
- *The San Francisco Chronicle* in reference to the Zodiac Killer (unsolved).
- *The San Francisco Examiner* in reference to the Zodiac Killer (unsolved).
- *The Los Angeles Time* in reference to the Zodiac Killer (unsolved) and Richard Ramirez, otherwise known as the Night Stalker.
- *The Wichita (Kansas) Eagle (-Beacon)* in reference to Dennis Rader, also known as the BTK Killer.
The following is general contact information for the aforementioned publications:

- **The Vallejo Times-Herald**
  Ted Vollmer - editor tscjnews@thnewsnet.com

- **The San Francisco Chronicle**
  901 Mission Street
  San Francisco, California 94103
  (415) 777-1111

- **The San Francisco Examine**
  450 Mission Street
  San Francisco, CA 94105
  letters@examiner.com

- **The Wichita (Kansas) Eagle**
  825 E. Douglas
  Wichita, KS 67201-0820
  (316) 268-6000
  FAX (316) 269-6799
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Opening quote:


*Wichita Eagle* Editor Sherry Chisenhall. Personal interview via e-mail. (October 18, 2005). schisenhall@wichitaeagle.com.


Ching was born in Pingtong, Taiwan. She is a management major with a minor in marketing. She has continuously been on the College of Business Dean’s list by maintaining a 4.0 GPA. She has received several scholarships and was invited to be inducted into the Golden Key Honor Society. She has served as treasurer of the International Business Student Chapter Club and as a member of Phi Theta Kappa International Honor Society. She presented her research project at the 2005 Rocky Mountain McNair Conference in Colorado, before three upper division classes at the University of Nevada, Reno and at the 2005 International College Teaching Methods & Styles Conference held at The Silver Legacy Resort in Reno, Nevada. She has been accepted into the MBA program at the University of Nevada, Reno and was offered a graduate assistantship. Her future plans include pursuing a Ph.D. in an area of business so she will be able to teach at the college level.

ABSTRACT

While academic dishonesty is a widespread problem, past research has indicated that the problem is more severe in business schools and causes an adverse impact on the future of business. This study will focus on a comprehensive study of academic dishonesty among business students, concentrating on their beliefs, reasons, practices, and perceived solutions. To obtain special insights on issues concerning academic dishonesty among business students, ten in-depth interviews were conducted and a questionnaire drawn from the interviews and the literature was administered to 223 students in 11 undergraduate business classes at a middle-sized university. Results were analyzed by using SPSS application to show business students’ views toward academic misconduct along with their rating, their level of practice in such misconduct, and their reason for it. In addition to quantitative questions, the survey includes three qualitative questions asking what instructors, administrators, and students can do to minimize academic dishonesty.
INTRODUCTION

Academic dishonesty is a widespread problem on college campuses. Surveys of college and university students have reported the high rates of academic misconduct, from 47% to 100%, in which students admitted engaging in various forms of cheating (as cited in Brown & Choong, 2003; Chapman et al., 2004; Lupton et al., 2000; Pino & Smith, 2003; Sims, 1993). Additionally, some business schools have a higher rate of academic dishonesty than other schools at the college level. A survey distributed to students at a comprehensive, private, Catholic university revealed that among five major categories, including Arts & Science, Business, Education, Law, and Nursing, Business majors had the highest level of observed cheating on exams, ranging from 17.60% to 66.30%; the highest level of willingness to assist others in cheating, ranging from 5.4% to 23.30%; but the lowest level of reporting cheating to authorities, ranging from 0% to 11.30% (as cited in Brown & Choong, 2003).

Academic dishonesty has an adverse impact on individual students, educational processes, values, and the society (Whitley & Keith-Spiegel, 2002; Cizek, 2003). In academic dishonesty, the negative consequences for students include disadvantages and unfairness to those students who do not engage in academic misbehaviors. For example, when instructors assign grades based on the class average, non-cheaters may score lower than they otherwise would, as cheaters increase the average grades (Whitley & Keith-Spiegel, 2002). Moreover, it will be frustrating for honest students who put effort into their schoolwork to see cheaters receiving the same rewards (e.g., same grades). This may diminish the honest students’ learning motivation (2002). In addition, when students observe instructors or administrators ignoring the actions of students who engage in academic misbehaviors, both cheaters and non-cheaters may come to think that unethical and dishonest behaviors are acceptable and permissible, leading to negative character development in students (2002). The situations above posed an essential question: what impact would this situation have on a student’s “perception of the goals of learning and assessment” (Cizek, 2003).

In addition to negative consequences for individual students, academic dishonesty also undermines educational processes and values. Academic dishonesty prevents instructors or administrators from obtaining accurate information about students’ performances or being able to assess student learning processes (Whitley & Keith-Spiegel, 2002; Cizek, 2003). As a result, instructors would not make appropriate changes in their teaching methods or structures to assist a student’s learning. For example, when cheaters raise the class average in test scores substantially, they push some non-cheaters into the lower tail of a normal distribution curve. The test score would not reflect a student’s true performance and true ability to learn. The instructor might not be able to adjust his or her teaching methods to fit their students’ learning needs. In addition to inaccurate information about a student’s performance and assessment, academic misbehavior would undermine the educational mission of transferring knowledge (Whitley & Keith-Spiegel, 2002). Students who engage in academic misconduct to get through their college education would neither obtain the knowledge for their degree nor participate in the intellectual and moral development that education is supposed to foster (2002).

When education fails to deal with academic dishonesty and to follow its own correct course with regards to integrity or ethics, the basis of society will be undermined. Those (students) who willfully are involved in behavior that is inappropriate to the work place, having previously set a bad example in earlier efforts (2002).

Students committed to academic misconduct are likely to become engaged in employee dishonesty (Sims, 1993; Nonis & Swift, 2001). Therefore, academic integrity and ethics are essential to business education, which is mandated and promoted by the Association to Advance Collegiate Schools of Business (AACSB) whose role is as “a standard setter and facilitator in business education.” The AACSB requires accredited business schools take actions on ethical issues of education.
BACKGROUND

To understand what constitutes academic dishonesty and what can be done to minimize it, the definition of academic dishonesty and relative factors should be examined. Academic dishonesty consists of various forms of misconduct, which can be categorized into a widely accepted definition of academic dishonesty defined by Gary Pavela:

- **Cheating:** intentionally using or attempting to use unauthorized materials, information, or study aids in any academic exercise. The term academic exercise includes all of forms of work submitted for credit or hours.
- **Fabrication:** intentional and unauthorized falsification or invention of any information or citation in an academic exercise.
- **Plagiarism:** deliberate adoption or reproduction of ideas or words or statements of another person as one's own without acknowledgement.
- **Facilitating academic dishonesty:** intentionally or knowingly helping or attempting to help another engage in some form of academic dishonesty (as cited in Whitley & Keith-Spiegel, 2002, p. 17).

In addition to the widely accepted definition, academic misconduct includes:

- **Misrepresentation consisting of providing false information to an instructor concerning an academic exercise, including such behaviors as giving a false excuse for missing a test or deadline.**
- **Failure to contribute to a collaborative project involving not doing one’s fair share.**
- **Sabotage consisting of actions that prevent others from completing their work (as cited in Whitley & Keith-Spiegel, 2002, p. 17).**

The definition of academic dishonesty at most schools is similar to the widely accepted one but doesn’t include the additional forms, as the case at the middle-sized state university where the sample is taken. The university’s academic standards along with its academic dishonesty procedures are shown in Appendix A.

Studies have suggested that academic dishonesty is related to individual characteristics, including gender and grade point average (GPA). Males have generally been found to participate in academic dishonesty more than females, and students with lower GPA cheat more than students with higher GPA (Brown & Choong, 2003; McCabe & Trevino, 1997). However, Whitley (1998) indicated that GPA isn’t related to cheating (as cited in Brown & Choong, 2003).

Researchers have also found that Academic dishonesty is associated with contextual factors:

1. **Peer behavior and peer disapproval.** Knowledge of peers’ cheating behavior facilitates students making the decision to cheat (Dawkins, 2004; McCabe & Trevino, 1997). When students perceive their peers’ disapproval of academic misconduct, they are less likely to engage in such misconduct (McCabe & Trevino, 1997).

2. **Attitude and perceived opportunity.** Boline found that unless students perceive that it is wrong to engage in academic misconduct, they are likely to cheat when there is a favorable opportunity (such as a low chance of getting caught and lenient punishment for cheating) (2004).

3. **The degree of academic ethics.** Pino and Smith found that students with strong academic ethics--prioritizing their studies over leisure activities and studying on a regular basis and in disciplined fashion--earn higher grades and are less likely to commit academic misconduct. In contrast, students possessing lower academic ethics are most likely to commit academic deviant behaviors (2003).
The perception of classroom environment. Pulvers and Diekhoff discovered that classroom environment significantly relates to academic dishonesty and students' justification for their cheating behavior. Students are likely to engage in academic dishonesty and to justify their academic misbehavior as they perceive less opportunity to interact with their instructors, low level of enjoyment of classes, and unclear and unorganized class activities (1999).

The relationship between the instructor and student. Stearns found that students who give positive evaluation of their instructors' behaviors, such as the instructor communicates his or her interest in students, are most likely to perceive a good student-instructor relationship and less likely to commit acts of academic dishonesty (2001).

Campus climate. Petress found that most students cheat because they perceive cheating is widespread and accepted behavior (everyone is doing it). Additionally, he indicated that the failure of parents, teachers, and administrators to maintain a proactive stance on academic misconduct partially contributed to students' academic deviant behavior (2003).

Researchers have also suggested a set of solutions to lower the amount of academic dishonesty. To prevent acts of academic dishonesty and promote academic integrity in the classroom, the instructor can engage in commonly suggested practices: spacing students during exams, discussing with students the importance of academic integrity along with its policy, and using multiple versions of exams and different exams every semester (as cited in Stearns, 2001).

McCabe and Pavela found that the cheating rate on campuses without an honor code are significantly higher than on campuses with traditional and modified honor codes; in addition, large campuses with modified honor codes, focusing on student leadership and intensive programming promoting the importance of academic integrity demonstrate their success in reducing academic misconduct (2000). In addition, the faculty's effort to show interests in students' learning can reduce students' engagement in cheating (Chapman, et, 2004).

Saunders studied the effect of new departmental policies on plagiarism and found that a clear departmental policy on academic dishonesty and a departmental effort to promote the policy can significantly reduce plagiarism (1993). A departmental effort includes having a uniformed policy printed on every course. Moreover, faculty effort to encourage and support students maintaining academic integrity can have a positive effect on rooting out plagiarizing. If the faculty takes care to explain and demonstrate examples and forms of plagiarism, students will have clear guidelines toward plagiarism and are less likely to plagiarize.

While academic dishonesty has been widely studied within various colleges and majors, few studies focus on a comprehensive study of academic dishonesty among business students as to their beliefs, reasons, practices, and perceived solutions. Such a focus is the highlight of this study, which will focus on three special areas that have rarely or have not been examined by other researchers. First, ten in-depth interviews were conducted in which the business students revealed special insights on issues concerning academic dishonesty. Moreover, this study investigated the relationship between students' beliefs (their ratings on the ethical level of acts of academic dishonesty) and practice (the level of participation in the acts) for which past research presented inconsistent results. The result indicates that students' beliefs toward academic misconduct have significant impact on their tendency to participate in such deviant behavior.

Finally, this study emphasized the solutions posted by the studies based on a qualitative method as to what instructors, administrators, and students can do, which has not been done by other researchers. The findings provide new insights to the identified solutions in the literature.
METHOD

This is a two-part study. First, an in-depth interview was conducted at the College of Business Administration (COBA) at a middle-sized state university. Ten business students were interviewed about their beliefs, observations of cheating behavior, and perceived solutions concerning academic dishonesty. The interview input was used in the design of a questionnaire.

The questionnaire included six sections consisting of 60 questions based on the input from the in-depth interview and the literature. The belief and practice sections included the same twelve practices of academic dishonesty, partially taken from the literature on academic dishonesty (with particular reliance on Brown & Choong, 2003). In the belief section, participants were asked to rate the ethical level of each listed practice by using a 5-point scale, with 1 being “very unethical” to 5 being “very ethical”. In the practice section, participants were asked to rate how often they participated in each of the listed practices by using a 6-point scale, with 1 being “never”, 2 being “infrequently”, and 6 being “frequently”.

The climate section consisted of eleven modified questions, taken from the literature on academic dishonesty (with particular reliance on Bolin, 2004). In this section, participants were asked to rate their perceived climate of the COBA associated with academic dishonesty by using a 5-point scale, with 1 being “strongly disagree”, 3 being “neither agree nor disagree”, and 5 being “strongly agree”. The reason and justification section included fifteen statements taken from the literature regarding the reasons students commit academic misconduct. Participants were asked to think of a typical COBA student who has committed academic misconduct and rate the likelihood that each listed statement would be a reason for the behavior by using a 5-point scale, with 1 being “very unlikely” and 5 being “very likely”. The solution section contained five items from the literature used to minimize academic misconduct, and participants were asked about what instructors, administrators, and students can do to lower the amount of academic dishonesty at the COBA by using any of the listed items and responding with their own ideas.

The survey was administered to students in eleven undergraduate business courses in the summer 2004 semester, and it asked students to answer the questionnaire voluntarily and anonymously. The final data set comprised 223 students’ responses to the questionnaire (with missing data in each section except the practice section). Among 220 respondents, 50.9% were male and 49.1% were female, while the undergraduate business student population is 55.5% male and 44.5% female in spring 2004. About 175 (78.5%) respondents were business majors (the actual undergraduate business student population is 1,543), followed by other majors (9.9%), and Art and Science majors (6.3%). In terms of class standing, 1.9% were freshmen, 7.9% were sophomores, 30.5% were juniors, and 54.0% were seniors, while the actual undergraduate business freshmen, sophomores, juniors, and seniors were 17.9%, 17.1%, 24.7%, and 40.3% respectively. The majority of the respondents (79.1%) were full-time students in the spring 2004 (taking 12 credits or more), while the actual business population is 76.4% full-time students. About 30.7% of the participants had a GPA under 3.0 and about 69.3% participants had a GPA of 3.0 or higher. Among 214 students who responded to ethnicity, a majority (65.4%) of respondents were white followed by Asian, 20.1% and Hispanic, 6.8%, while the actual business-student population who is white, Asian, and Hispanic is 68.2%, 8.8%, and 8.8% respectively.
RESULTS

In the in-depth interview, business students in the COBA at the university revealed the academic dishonesty issues that have occurred in the COBA. These issues mainly focus on instructors’ teaching and testing methods for class and their adverse impact on students, such as introducing unfairness to the educational process and demotivating students’ learning interests. The issues compiled from personal experiences and anecdotes are as follows.

Issue 1: the instructor’s use of the same or similar contents for tests, including quizzes and exams and of the same version of tests for different sections of the class.

- Some students perceived it as the instructor giving them the opportunity for misconduct. They only needed to study the questions and answers on the past exam paper, although they admitted that by doing so, they might not be able to obtain a holistic picture of the subject for the class.
- Some students perceived the instructor’s use of the same version of tests as the invitation for “incorporation” among students in different sections of the same course. Students who took exams in the earlier section gave the content exam to the students who would take the exam in the latter section. They viewed this behavior “not as cheating but as incorporation.”
- A few said that the instructor was “too lazy” to change the content of the tests. It should not be their fault to take “the opportunity to cheat.”

Issue 2: unequal access to past exam papers.

- Some students agreed that unequal access to past exam papers introduces unfairness and disadvantages. They learned that if they didn’t have access to past exam papers, they would have “trouble to finish the exam in time or pass the exam” for the exam required a lot of calculations, as did their peers who didn’t have the access.
- The majority of the students also perceived the phenomenon of students desperately searching for past exam papers.
- Some students felt “angry” to learn others who only studied the past exam papers for the exam the day before the exam received better grades than them.
- One student admired some professors who distributed past exam papers (the entire exam paper, not a portion of it) on the Web to give students equal access to past exam papers. The instructor, the student added, “also can retrieve the exam paper so that no student will have the past exam papers.”

Issue 3: the instructor’s use of the same or similar assignments, including paper, project, and Web site building.

- Some students viewed the instructor’s use of the same or similar assignments as temptation or encouragement for students to cheat. It is fairly easy to “obtain the same assignment from the students who previously attended the class, make minor change on it, and turn it in as one’s own.” The instructor neither paid attention to nor detected the similarity of the assignments. It is “the quick way to get by with heavy school workload.”
- A few referred to others’ assignment only for understanding the assignment. They felt the instructor should provide an example of the assignment for students’ reference.
- One student said the instructor “may retain students’ term papers and use Turnitin, anti-plagiarism software, to detect the similarity between students’ assignments.” The instructor also can use the software to detect electronic plagiarism.
Issue 4: the instructor’s use of test questions only in problem form, requiring formulas and problem-solving steps memorization.

- Some students agreed that while the instructor’s use of test questions only in problem form may improve their problem-solving skills, they learned little about the concepts for the subject. To pass the test, students only needed to memorize the formulas and steps for solving problems. To the extreme, “students who got an A- didn’t even know what some terms stand for.”
- A “key” to obtaining a decent grade on this type of test is studying past exam papers in addition to memorizing formulas, some students added.
- Some said students are just human and they tend to be lazy. Thus, when there is an easy way to get by in the class, there is no reason for them to study hard, especially, when “they are there only for a degree.” The instructor should include some multiple-choice questions or fill-in the blank to test students’ understanding of the concepts. At the least, these will force students to read the textbook.

In the survey research, 223 students responded to the survey. Table 1 lists students’ views toward academic misconduct along with their ratings. The top three academic behaviors that students deemed “very unethical” include the following: 180 (80.7%) students rated submitting someone else’s work as yours or asking someone else to do your work; 155 (69.5%) students rated using unauthorized information during an exam; and 132 (59.2%) students rated partially or entirely submitting someone else’s language, ideas, thoughts or work without proper or complete acknowledgement (plagiarism). For the three behaviors above, about 1.3-2.7% of 223 students rated them as “very ethical”.

As shown on Table 1, the three academic behaviors that were considered the most ethical include: using previously submitted work for one course to fulfill academic requirements in another course (only 15.2% of the 223 students rated it as “very unethical”); using previous exams even though the instructor would disapprove if he/she discovered it (24.7%); and collaborating on an assignment when the instructor asked for individual work (25.1%).

| Table 1: Students’ Belief toward Academic Behaviors (n=223) |
|----------------|----------------|
|                | Very Unethical | Very Ethical |
| 1 Using unauthorized information during an exam (e.g. notes) | 155 37 18 6 3 | 69.5% 16.6% 8.1% 2.7% 2.7% |
| 2 Collaborating on a take home exam without the instructor's permission | 73 79 42 20 8 | 32.7% 35.4% 18.8% 9.0% 3.6% |
| 3 Using previous exams even though the instructor would disapprove if he/she discovered it | 55 79 57 19 11 | 24.7% 35.4% 25.6% 8.5% 4.9% |
| 4 Giving students in later sections questions or answers of the exam that you have taken at an earlier time | 87 75 38 12 10 | 39.0% 33.6% 17.0% 5.4% 4.5% |
| 5 Obtaining questions or answers of an exam from a student who has taken the exam | 94 69 35 15 9 | 42.2% 30.9% 15.7% 6.7% 4.0% |
| 6 Collaborating on an assignment when the instructor asked for individual work | 56 82 62 17 5 | 25.1% 36.8% 27.8% 7.6% 2.2% |
| 7 Submitting someone else's work as yours or ask someone else to do your work | 180 22 12 4 3 | 80.7% 9.9% 5.4% 1.8% 1.3% |
| 8 Taking full credit for a group project without doing your fair share of the work | 117 66 26 8 5 | 52.5% 29.6% 11.7% 3.6% 2.2% |
| 9 Partially or entirely submitting someone else's language, ideas, thoughts or work without proper or complete acknowledgement or citation | 132 52 28 5 4 | 59.2% 23.3% 12.6% 2.2% 1.8% |
| 10 Using previously submitted work for one course to fulfill academic requirements in another course | 33 47 69 38 34 | 15.2% 21.1% 30.9% 17.0% 15.2% |
| 11 Falsely citing a source or attributing work to a source from which the referenced material was not obtained | 93 73 45 7 4 | 47.7% 32.7% 20.2% 3.1% 1.8% |
| 12 Making up or changing data to support the ideas or theories stated in a assignment or a project | 110 68 36 5 3 | 49.3% 30.5% 16.1% 2.2% 1.3% |
Table 2 summarizes students' perceived climate of the College of Business Administration (COBA) associated with academic dishonesty. More than 59% of the students either agree or strongly agree with six items on the table. Instructors support the policies concerning academic dishonesty (78%); students are well informed about the academic dishonesty policy and the risks of academic dishonesty (67.7%); instructors do an adequate job of explaining policies on academic dishonesty (65.9%); and the penalties for academic dishonesty at COBA are severe (59.2%).

Table 2: Students' Perceived Climate of Academic Dishonesty (n=223)

<table>
<thead>
<tr>
<th>Item</th>
<th>Strongly Disagree</th>
<th>Neither Agree Nor Disagree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Students are well informed about the academic dishonesty policy</td>
<td>7</td>
<td>19</td>
<td>64</td>
</tr>
<tr>
<td>and the risks of academic dishonesty.</td>
<td>3.1%</td>
<td>8.5%</td>
<td>28.7%</td>
</tr>
<tr>
<td>2 Plagiarism and cheating on tests occur frequently at COBA.</td>
<td>20</td>
<td>51</td>
<td>113</td>
</tr>
<tr>
<td></td>
<td>9.0%</td>
<td>22.9%</td>
<td>50.7%</td>
</tr>
<tr>
<td>3 I have personally observed another student cheating on a test</td>
<td>66</td>
<td>28</td>
<td>68</td>
</tr>
<tr>
<td>more than once at COBA.</td>
<td>29.6%</td>
<td>12.6%</td>
<td>30.5%</td>
</tr>
<tr>
<td>4 My closest academic friend would strongly disapprove if he/she</td>
<td>15</td>
<td>30</td>
<td>63</td>
</tr>
<tr>
<td>found out I had cheated in a course.</td>
<td>6.7%</td>
<td>13.5%</td>
<td>28.3%</td>
</tr>
<tr>
<td>5 A typical student at COBA would strongly disapprove if he/she</td>
<td>11</td>
<td>29</td>
<td>83</td>
</tr>
<tr>
<td>found out I had cheated in a course.</td>
<td>4.9%</td>
<td>13.0%</td>
<td>37.2%</td>
</tr>
<tr>
<td>6 A typical students at COBA would report someone who had cheated</td>
<td>45</td>
<td>53</td>
<td>90</td>
</tr>
<tr>
<td>on a test.</td>
<td>20.2%</td>
<td>23.8%</td>
<td>40.4%</td>
</tr>
<tr>
<td>7 The chance of getting caught of cheating or plagiarizing at</td>
<td>13</td>
<td>40</td>
<td>93</td>
</tr>
<tr>
<td>COBA is high.</td>
<td>5.8%</td>
<td>17.9%</td>
<td>41.7%</td>
</tr>
<tr>
<td>8 The penalties for academic dishonesty at COBA are severe.</td>
<td>7</td>
<td>10</td>
<td>73</td>
</tr>
<tr>
<td></td>
<td>3.1%</td>
<td>4.5%</td>
<td>32.7%</td>
</tr>
<tr>
<td>9 Instructors do an adequate job of explaining policies on academic</td>
<td>5</td>
<td>22</td>
<td>48</td>
</tr>
<tr>
<td>dishonesty.</td>
<td>2.2%</td>
<td>9.9%</td>
<td>21.5%</td>
</tr>
<tr>
<td>10 Instructors understand the policies concerning academic</td>
<td>2</td>
<td>10</td>
<td>39</td>
</tr>
<tr>
<td>dishonesty.</td>
<td>0.9%</td>
<td>4.5%</td>
<td>17.5%</td>
</tr>
<tr>
<td>11 Instructors support the policies concerning academic dishonesty.</td>
<td>5</td>
<td>6</td>
<td>38</td>
</tr>
<tr>
<td></td>
<td>2.2%</td>
<td>2.7%</td>
<td>17.0%</td>
</tr>
</tbody>
</table>

Three of the items on Table 2 are relative to the climate of the plagiarism and cheating along with their rating are as follows: About 44% of the students either strongly disagree or disagree that a typical student at COBA would report someone who had cheated on a test. In contrast, 15.2% students either agree or strongly agree with this item, and 40.4% of the students neither agree nor disagree. About 26.9% of the students either agree or strongly agree with the item of that I have personally observed another student cheating on a test more than once at COBA. About 31.9% of the students either strongly disagree or disagree that plagiarism and cheating on tests occur frequently at COBA. In contrast, 17.7% students either agree or strongly agree with this item, and 50.7% of the students neither agree nor disagree.

Table 3 presents the frequency of students' participating in each of the 12 practices, including the percentage and number of students. The practice with the highest level of participation is using previously submitted work for one course to fulfill academic requirements in another course; 69% (consisting of the percentage from infrequently to frequently) of the students admitted they have done this. More than 50% of the students have admitted to engaging in five of the practices.
These practices include collaborating on a take home exam without the instructor’s permission (58.3%); using previous exams even though the instructor would disapprove when he/she discovered it (57.8%); giving students questions or answers of the exam that you have taken at an earlier time (52%); obtaining questions or answers of an exam from a student who has taken the exam (51.6%); and collaborating on an assignment when the instructor asked for individual work (59.2%). Among students who admitted to participating in the practices above, most of them (from 24.2% to 33.6%) indicated that they engage in these practices infrequently.

As shown in Table 3, the practice with the lowest level of participation is submitting someone else’s work as yours or asking someone else to do your work (83.9%). More than 65% of the students indicated that they have never committed any of the five practices listed. These practices include taking full credit for a group project without doing your fair share of the work (73.1%); making up or changing data to support the ideas or theories stated in a assignment or a project (69.5%); partially or entirely submitting someone else’s language, ideas, thoughts or work without proper or complete acknowledgement or citation (65.9%); using unauthorized information during an exam (63.7%); and falsely citing a source or attributing work to a source from which the referenced material was not obtained (61.9%).

Table 3: Frequency of Students Participating in listed Practices (n=223)

<table>
<thead>
<tr>
<th>Practice</th>
<th>Never</th>
<th>Infrequently</th>
<th>Frequently</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Using unauthorized information during an exam.</td>
<td>142</td>
<td>59</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>63.7%</td>
<td>26.5%</td>
<td>4.9%</td>
</tr>
<tr>
<td>2 Collaborating on a take home exam without the instructor's permission.</td>
<td>93</td>
<td>75</td>
<td>23</td>
</tr>
<tr>
<td></td>
<td>41.7%</td>
<td>33.6%</td>
<td>10.3%</td>
</tr>
<tr>
<td>3 Using previous exams even though the instructor would disapprove if he/she discovered it.</td>
<td>94</td>
<td>56</td>
<td>31</td>
</tr>
<tr>
<td></td>
<td>42.2%</td>
<td>25.1%</td>
<td>13.9%</td>
</tr>
<tr>
<td>4 Giving students in later sections questions or answers of the exam that you have taken at an earlier time.</td>
<td>107</td>
<td>54</td>
<td>27</td>
</tr>
<tr>
<td></td>
<td>48.0%</td>
<td>24.2%</td>
<td>12.1%</td>
</tr>
<tr>
<td>5 Obtaining questions or answers of an exam from a student who has taken the exam.</td>
<td>108</td>
<td>54</td>
<td>26</td>
</tr>
<tr>
<td></td>
<td>48.4%</td>
<td>24.2%</td>
<td>11.7%</td>
</tr>
<tr>
<td>6 Collaborating on an assignment when the instructor asked for individual work.</td>
<td>91</td>
<td>64</td>
<td>31</td>
</tr>
<tr>
<td></td>
<td>40.8%</td>
<td>28.7%</td>
<td>13.9%</td>
</tr>
<tr>
<td>7 Submitting someone else's work as yours or ask someone else to do your work.</td>
<td>187</td>
<td>19</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>83.9%</td>
<td>8.5%</td>
<td>3.6%</td>
</tr>
<tr>
<td>8 Taking full credit for a group project without doing your fair share of the work.</td>
<td>163</td>
<td>38</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>73.1%</td>
<td>17.0%</td>
<td>5.8%</td>
</tr>
<tr>
<td>9 Partially or entirely submitting someone else's language, ideas, thoughts or work without proper or complete acknowledgement or citation.</td>
<td>147</td>
<td>55</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>65.9%</td>
<td>24.7%</td>
<td>4.9%</td>
</tr>
<tr>
<td>10 Using previously submitted work for one course to fulfill academic requirements in another course.</td>
<td>87</td>
<td>62</td>
<td>39</td>
</tr>
<tr>
<td></td>
<td>39.0%</td>
<td>27.8%</td>
<td>17.5%</td>
</tr>
<tr>
<td>11 Making up or changing data to support the ideas or theories stated in a assignment or a project.</td>
<td>155</td>
<td>35</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>69.5%</td>
<td>15.7%</td>
<td>8.4%</td>
</tr>
</tbody>
</table>

Table 4 listed students’ justifications concerning the possible reasons for students to engage in academic misconduct. The top three reasons that students rated as likely and very likely for committing academic misconduct include the following: needing to get a high grade received the highest percentage (67.3%); needing to pass a course to graduate received the second highest percentage (62.8%); followed by having no adequate time to study for tests due to a heavy course load (53.4%).
On the contrary, the reasons that students deem least likely for a typical COBA student to commit academic misconduct include: instructors' and administrators' willingness to tolerate cheating, peer pressure (everyone does it), and cheating hurts no one. These justifications received student ratings with the scale of unlikely and the scale of very unlikely, at 69.1%, 67.7%, and 55.1% respectively.

Table 4: Students’ Justification for Academic Misconduct (n=223)

<table>
<thead>
<tr>
<th></th>
<th>Very Unlikely</th>
<th>Very Likely</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Fear of failing the course without cheating.</td>
<td>44</td>
</tr>
<tr>
<td></td>
<td>19.7%</td>
<td>24.7%</td>
</tr>
<tr>
<td>2</td>
<td>Need to pass course to graduate.</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>5.8%</td>
<td>12.1%</td>
</tr>
<tr>
<td>3</td>
<td>Need to get high grade</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>6.7%</td>
<td>12.6%</td>
</tr>
<tr>
<td>4</td>
<td>Had no adequate time to study for tests due to heavy course load.</td>
<td>27</td>
</tr>
<tr>
<td></td>
<td>12.1%</td>
<td>17.9%</td>
</tr>
<tr>
<td>5</td>
<td>Other students are doing it, if he/she does not cheat, he/she will be put at a disadvantage unfairly.</td>
<td>54</td>
</tr>
<tr>
<td></td>
<td>24.2%</td>
<td>26.9%</td>
</tr>
<tr>
<td>6</td>
<td>Had time but did not prepare adequately.</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>5.8%</td>
<td>20.6%</td>
</tr>
<tr>
<td>7</td>
<td>Instructor’s grading is too harsh</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>9.0%</td>
<td>24.7%</td>
</tr>
<tr>
<td>8</td>
<td>Tests are unfair and designed to fail students.</td>
<td>46</td>
</tr>
<tr>
<td></td>
<td>20.6%</td>
<td>30.5%</td>
</tr>
<tr>
<td>9</td>
<td>Course workload is unreasonable.</td>
<td>23</td>
</tr>
<tr>
<td></td>
<td>10.3%</td>
<td>30.5%</td>
</tr>
<tr>
<td>10</td>
<td>Instructor is poor or indifferent.</td>
<td>32</td>
</tr>
<tr>
<td></td>
<td>14.3%</td>
<td>31.4%</td>
</tr>
<tr>
<td>11</td>
<td>Instructor and administrators tolerate cheating</td>
<td>117</td>
</tr>
<tr>
<td></td>
<td>52.5%</td>
<td>15.0%</td>
</tr>
<tr>
<td>12</td>
<td>Peer pressure, everyone does it.</td>
<td>99</td>
</tr>
<tr>
<td></td>
<td>44.4%</td>
<td>18.8%</td>
</tr>
<tr>
<td>13</td>
<td>Cheating hurts no one.</td>
<td>81</td>
</tr>
<tr>
<td></td>
<td>36.3%</td>
<td>21.1%</td>
</tr>
<tr>
<td>14</td>
<td>The possibility of being caught cheating or plagiarizing is low.</td>
<td>46</td>
</tr>
<tr>
<td></td>
<td>20.6%</td>
<td>22.9%</td>
</tr>
<tr>
<td>15</td>
<td>The course is not valuable enough to study hard.</td>
<td>44</td>
</tr>
<tr>
<td></td>
<td>19.7%</td>
<td>19.3%</td>
</tr>
</tbody>
</table>

Tables 5, 6, and 7 respectively summarize students multiple solutions, concerning what instructors, UNR administrators, and students can do to lower the amount of academic dishonesty. These multiple solutions include the student’s using any of the five listed items and responding in their own ideas, and the solutions were placed into different categories, compiled from the literature.

On Table 5, of 172 students who responded to what instructors can do, 98 students gave a similar solution of adjusting test characteristics and having multiple versions of a test; 73 students responded with a similar solution of discussing and explaining the importance of academic integrity and ethics; 66 students gave a similar solution as discussing and explaining academic dishonesty, and its related policies and penalties; and 63 students responded with a similar solution as using techniques to prevent plagiarism.
Table 5: Students’ Solution Concerning what Instructors can do to Lower the Amount of Academic Dishonesty (n=172)

<table>
<thead>
<tr>
<th>Numbers of Response</th>
<th>Percentage of Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Adjust test characteristics and have multiple versions of a test.</td>
<td>98</td>
</tr>
<tr>
<td>2 Discuss and explain the importance of academic integrity and ethics.</td>
<td>73</td>
</tr>
<tr>
<td>3 Discuss and explain academic dishonesty, and its related policies and penalties.</td>
<td>66</td>
</tr>
<tr>
<td>4 Use techniques to prevent plagiarism.</td>
<td>63</td>
</tr>
<tr>
<td>5 Be serious and attentive during testing.</td>
<td>19</td>
</tr>
<tr>
<td>6 Be fair and open about testing and assignment.</td>
<td>17</td>
</tr>
<tr>
<td>7 Show interest in students and facilitate student learning.</td>
<td>14</td>
</tr>
<tr>
<td>8 Miscellaneous.</td>
<td>10</td>
</tr>
<tr>
<td>9 Show a serious attitude and take actions concerning academic dishonesty.</td>
<td>8</td>
</tr>
<tr>
<td>10 Don’t encourage cheating.</td>
<td>1</td>
</tr>
</tbody>
</table>

On Table 6, of 126 students who responded to what administrators can do to lower the amount of academic dishonesty; 71 students gave a similar solution of promoting academic integrity and academic ethics; 36 students responded with a similar solution of constantly informing and disseminating school policies, penalties on academic dishonesty, and be strict with the rules they set; and 26 students gave a similar solution as making sure that instructors understand rules of academic dishonesty and take actions to prevent and punish the acts of academic dishonesty.

On Table 7, of 128 students who responded to what students can do to lower the amount of academic dishonesty, 37 students gave a similar solution of developing a sense of personal responsibility for the academic integrity and learning; 24 students responded with a similar solution of studying hard and more as well as attending class; and 18 students gave similar solution as reporting academic misconduct.

Table 6: Students’ Solution Concerning what Administrators can do to Lower the Amount of Academic Dishonesty (n=127)

<table>
<thead>
<tr>
<th>Numbers of Response</th>
<th>Percentage of Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Promote academic integrity and academic ethics.</td>
<td>71</td>
</tr>
<tr>
<td>2 Constantly inform and disseminate school policies, penalties on academic dishonesty, and strict with the rules they set.</td>
<td>36</td>
</tr>
<tr>
<td>3 Make sure that instructors understand rules of academic dishonesty and take actions to prevent and punish the acts of academic dishonesty.</td>
<td>26</td>
</tr>
<tr>
<td>4 Miscellaneous.</td>
<td>16</td>
</tr>
<tr>
<td>5 Adapt severe punishments for academic misconduct.</td>
<td>10</td>
</tr>
<tr>
<td>6 Establish a system to check the campus climate of academic dishonesty and investigate cases of academic misconduct reported by instructors and students.</td>
<td>8</td>
</tr>
<tr>
<td>7 Establish a system for students reporting incompetent and indifferent instructors in terms of facilitating student’s learning and taking actions toward academic dishonesty.</td>
<td>3</td>
</tr>
<tr>
<td>8 Disseminate and communicate students the examples of academic misconducts without revealing offenders’ name.</td>
<td>2</td>
</tr>
<tr>
<td>9 Hire instructors who poses quality of teaching in addition to research and grant gathering ability.</td>
<td>1</td>
</tr>
<tr>
<td>10 Adopts honor code that binds students to the school system for promoting the importance of academic integrity.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Numbers of Response</td>
</tr>
<tr>
<td>---</td>
<td>---------------------</td>
</tr>
<tr>
<td>1</td>
<td>Develop a sense of personal responsibility for the academic integrity and learning.</td>
</tr>
<tr>
<td>2</td>
<td>Study hard and more as well as attend class.</td>
</tr>
<tr>
<td>3</td>
<td>Report academic misconduct.</td>
</tr>
<tr>
<td>4</td>
<td>Express and communicate disapproval of academic dishonesty.</td>
</tr>
<tr>
<td>5</td>
<td>Miscellaneous.</td>
</tr>
<tr>
<td>6</td>
<td>Stop procrastination and laziness.</td>
</tr>
<tr>
<td>7</td>
<td>Manage time effectively.</td>
</tr>
<tr>
<td>8</td>
<td>Make oneself aware of rules of academic dishonesty and consequences of it, as we</td>
</tr>
<tr>
<td>9</td>
<td>Choose a reasonable workload for both study and work.</td>
</tr>
<tr>
<td>10</td>
<td>Encourage and help other students to study and learn.</td>
</tr>
<tr>
<td>11</td>
<td>Seek help from instructors and other students when having difficulties with courses.</td>
</tr>
</tbody>
</table>

Tables 8, 9, and 10 respectively summarize solutions posed by students (writing in their own ideas); concerning what instructors, administrators, and students can do to lower the amount of academic dishonesty. These solutions were summarized into different categories, compiled from the literature. Each category is separated by the bold sentence with total number of similar answers in the front, and the number prior to each description is the number of similar answers. Although the solutions are somewhat similar to those presented in the literature, they are unique in the way that revealed student’s perspectives. Additionally, some solutions provided special insights that have not revealed in the literature.

Table 8 summarizes 101 solutions posed by students who responded to what instructors can do. The top four categories that received most responses are showing interest in students and facilitating student learning (18 responses), being fair and open about testing and assignment (16 responses), adjusting test characteristics and having multiple versions of a test (15 responses), and being serious and attentive during testing (15 responses). The five solutions that are particular unique compared with those presented in the literature include: 1) being more creative in teaching style and be a good lecturer—cover the pertinent info about topics, 2) Discouraging students who cannot handle the course, and if possible, encouraging them to drop the course, 3) creating tests in which it would be easy to recognize people cheating, 4) reintroduce the Christian morals that universities were originally founded on, and 5) doing something positive for people who don’t cheat.

Table 9 summarizes 54 solutions posed by students who responded to what administrators can do. The five solutions that can be distinguished from the ones in the same categories in the literature are: 1) having an ethics class to enter into the business school that lays out examples of ethical and unethical behaviors in business, focusing on real life examples and consequences, 2) reviewing the teachers and their curriculums and listen to students’ views and complaints, 3) making example of those caught and publicly making students aware of offenders’ actions, without giving out the names of those who have cheated, 4) hiring competent professors that can teach well in addition to research and grant gathering abilities, and 5) encouraging students to do quality, not quantity of work.
Table 10 summarizes 81 solutions posed by students who responded to what students can do to minimize the amount of academic dishonesty. The six solutions that are special when compared with those in the same categories in the literature are: 1) stopping giving other students our work and talking about how well they did on tests without cheating, 2) telling oneself that you need to know/learn the material well to do well in a profession, 3) being upset when someone who cheated received a good grade and revealing those people’s dishonesty to teachers or administrators, 4) keeping an eye out for academic dishonesty, watching for peer cheating that puts you at a disadvantage, 5) figuring out what to consider as “key” or what is “mundane” when you take a test, and 6) taking smaller course load, being reasonable not to overload, and working outside of school less if possible.
Table 8: Solutions Posed by the students to what Instructors can do to lower the Amount of Academic Dishonesty

<table>
<thead>
<tr>
<th>Rank</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>18</td>
<td>Show interest in students and facilitate student learning</td>
</tr>
<tr>
<td>4</td>
<td>More office hours and availability to students who have concerns and let students know you are there to help in anything; don’t act impatient by repeated Q’s.</td>
</tr>
<tr>
<td>4</td>
<td>Be more creative in teaching style and be a good lecturer- cover the pertinent info about topics.</td>
</tr>
<tr>
<td>3</td>
<td>Take into account the workload of students and gauge expectations.</td>
</tr>
<tr>
<td>2</td>
<td>Make assignments that require individual and team effort, and maybe different exams for different students.</td>
</tr>
<tr>
<td>2</td>
<td>Make the course material clear and easy to understand and take interest in making sure students understand lecturers.</td>
</tr>
<tr>
<td>2</td>
<td>Put more emphasis on learning and improving than on the grading system. Base grade on other stuff besides tests so students can have ways to bring up low-test grade. Curve test results; no one is perfect.</td>
</tr>
<tr>
<td>1</td>
<td>Discourage students who cannot handle the course, and if possible, encourage them to drop the course.</td>
</tr>
<tr>
<td>16</td>
<td>Be fair and open about testing and assignment</td>
</tr>
<tr>
<td>9</td>
<td>Before the test give a clear study guide or lectures in class as to the material on exams and allow adequate preparation with regard to whether the students might have another exam in another class on the same day.</td>
</tr>
<tr>
<td>4</td>
<td>Be reasonable on the grading scale and test students on what they’ve been taught so that they don’t feel stressed.</td>
</tr>
<tr>
<td>3</td>
<td>Let students use a note card for subjects that are hard to memorize and also give enough time for exams; sometimes when the class is over, more then half of the class is struggling to finish.</td>
</tr>
<tr>
<td>15</td>
<td>Adjust test characteristics and have multiple versions of a test</td>
</tr>
<tr>
<td>12</td>
<td>Write multiple exams for different sections and change test material each semester; switch questions around on Mc tests.</td>
</tr>
<tr>
<td>2</td>
<td>Abandon multiple-choice exams, as they don’t portray much skill. It’s fairly easy to obtain answer keys to the exam especially, if they are recycled. Multiple exams are good in 100 and 200 level courses.</td>
</tr>
<tr>
<td>1</td>
<td>Create tests in which it would be easy to recognize people cheating.</td>
</tr>
<tr>
<td>15</td>
<td>Be serious and attentive during testing: Stay in the classroom and proctor the exam. Leaving the room is asking people to cheat; be aware of the possibility.</td>
</tr>
<tr>
<td>7</td>
<td>Show a serious attitude and take actions concerning academic dishonesty</td>
</tr>
<tr>
<td>4</td>
<td>Provide examples of why students should not cheat and indicate there is the maximum penalty for cheating.</td>
</tr>
<tr>
<td>2</td>
<td>Seriously discourage cheating before every test and take time to compare tests.</td>
</tr>
<tr>
<td>1</td>
<td>Strive to put fear into the students and don’t give them the opportunity to cheat. If given the chance they will most likely do it.</td>
</tr>
<tr>
<td>6</td>
<td>Provide a secure test environment</td>
</tr>
<tr>
<td>4</td>
<td>Provide monitors during tests or use cameras; have more aids or graduate students to observe during tests.</td>
</tr>
<tr>
<td>2</td>
<td>Pass around different tests with rearranged questions and make sure adjacent persons have different exams.</td>
</tr>
<tr>
<td>5</td>
<td>Discuss and explain academic dishonesty, and its related policies and penalties.</td>
</tr>
<tr>
<td>3</td>
<td>Seriously indicates that cheating gets you an F; there is a no cheating policy.</td>
</tr>
<tr>
<td>2</td>
<td>Make even clearer what constitutes cheating and the severe consequences that come with it, and enforce day 1 in syllabus.</td>
</tr>
<tr>
<td>4</td>
<td>Discuss and explain the importance of academic integrity and ethics.</td>
</tr>
<tr>
<td>3</td>
<td>Reintroduce the Christian morals that universities were originally founded on; Talk about ethics and why they are important.</td>
</tr>
<tr>
<td>1</td>
<td>Do something positive for people who don’t cheat.</td>
</tr>
</tbody>
</table>
4 **Use techniques to prevent plagiarism**
    2 Inspect homework for similarities; use Turnitin.com or other plagiarism finding services to detect students cheating.
    2 Change homework assignments each semester and encourage other students to report cheating, through incentives.

1 **Don't encourage cheating:** Don’t give simplistic assignments that the instructor already knows the students could take home and cheat on.

10 **Miscellaneous**
3 Stop group work. The real world involves group work, but the real world pays for each member, and when they don’t help, they get fired. In school, group work is not for pay, and most students don’t give a crap.
2 Look, cheating is going to happen no matter how much the punishment fit the crime.
2 Everyone needs to do his or her job in a responsible manner.
1 Many students do not subscribe to any ultimate standards of right and wrong so it is useless to speak of academic integrity. To have a dramatic effect on academic dishonesty, instructor should adapt swift and severe penalties.
1 Change textbook.
1 Show trust by giving the same tests and make students want to trustworthy.

<table>
<thead>
<tr>
<th>Table 9 Solutions Posed by the Students to What Administrators can do to lower the Amount of Academic Dishonesty</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>11 Make sure that instructors understand rules of academic dishonesty and take actions to prevent and punish the acts of academic dishonesty</strong></td>
</tr>
<tr>
<td>4 Be more on top of getting teachers to enforce an honesty policy.</td>
</tr>
<tr>
<td>3 Set guidelines to help professors to carry out punishments for cheating and refer info to professors.</td>
</tr>
<tr>
<td>2 Have an ethics class to enter into the business school that lays out examples of ethical and unethical behaviors in business. Focus on real life examples and consequences.</td>
</tr>
<tr>
<td>2 Make sure the instructor doesn’t give assignments that the students could take home and cheat on; make sure the instructor change tests and assignments; make sure the instructor give guideline as to how to do proper citations and papers.</td>
</tr>
<tr>
<td><strong>7 Establish a system to check the campus climate of academic dishonesty and investigate cases of academic misconduct reported by instructors and students.</strong></td>
</tr>
<tr>
<td>4 Understand there might be a problem, monitor constantly, and follow up any leads of academic dishonesty.</td>
</tr>
<tr>
<td>3 Develop a campus wide academic honesty policy, make sure policy is explained very well, and strictly enforce it.</td>
</tr>
<tr>
<td><strong>7 Adapt severe punishments for academic misconduct</strong></td>
</tr>
<tr>
<td>6 Make sure violations are severely punished (e.g. fail student in the class in which they cheat or suspend the student for a semester.</td>
</tr>
<tr>
<td>1 Extreme punishment, automatic dismissed from the university.</td>
</tr>
<tr>
<td><strong>4 Establish a system for students reporting incompetent and indifferent instructors in terms of facilitating student's learning and taking actions toward academic dishonesty.</strong></td>
</tr>
<tr>
<td>2 Review the teachers and their curriculums and listen to students' views and complaints.</td>
</tr>
<tr>
<td>2 Check with students more often about the instructors' behaviors and conduct as well as his performance in the class.</td>
</tr>
<tr>
<td><strong>3 Constantly inform and disseminate school policies, penalties on academic dishonesty, and strict with the rules</strong></td>
</tr>
<tr>
<td>3 Make known cheating penalties, be strict, and explain importance.</td>
</tr>
<tr>
<td><strong>2 Promote academic integrity and academic ethics:</strong> Do something positive for people who don’t cheat and be more creative.</td>
</tr>
<tr>
<td><strong>2 Disseminate and Communicate students the examples of academic misconduct without revealing offender’s name.</strong></td>
</tr>
<tr>
<td>2 Make example of those caught; publicly make students aware of offenders’ actions, without giving out the names of those who have cheated.</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>---</td>
</tr>
<tr>
<td><strong>1</strong></td>
</tr>
<tr>
<td><strong>1</strong></td>
</tr>
<tr>
<td><strong>1</strong></td>
</tr>
<tr>
<td><strong>16</strong></td>
</tr>
<tr>
<td><strong>5</strong></td>
</tr>
<tr>
<td><strong>3</strong></td>
</tr>
<tr>
<td><strong>3</strong></td>
</tr>
<tr>
<td><strong>1</strong></td>
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<tr>
<td><strong>1</strong></td>
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<td><strong>1</strong></td>
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<tr>
<td><strong>1</strong></td>
</tr>
<tr>
<td><strong>1</strong></td>
</tr>
</tbody>
</table>
Table 10: Solutions Posed by the Students to what students can do to lower the Amount of Academic Dishonesty

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td><strong>Study hard and attend class</strong></td>
</tr>
<tr>
<td>12</td>
<td>Study more and waste less time; be more prepared for the test.</td>
</tr>
<tr>
<td>3</td>
<td>Attend class and pay attention.</td>
</tr>
<tr>
<td>12</td>
<td><strong>Develop a sense of personal responsibility for academic integrity and learning</strong></td>
</tr>
<tr>
<td>6</td>
<td>Try to have more integrity, be honest, and ethical. Work harder.</td>
</tr>
<tr>
<td>3</td>
<td>Students should uphold personal standards and be responsible for one's self. Cheating does not allow you to learn the material and is unfair to those who studied.</td>
</tr>
<tr>
<td>2</td>
<td>Stop giving other students our work; should talk about how well they did on tests without cheating.</td>
</tr>
<tr>
<td>1</td>
<td>Tell one's self that you need to know/learn the material well to do well in a profession.</td>
</tr>
<tr>
<td>10</td>
<td><strong>Express and communicate disapproval of academic dishonesty</strong></td>
</tr>
<tr>
<td>6</td>
<td>Don't make it &quot;cool&quot; to cheat; peer pressure; make cheating unacceptable.</td>
</tr>
<tr>
<td>2</td>
<td>Students should be upset when someone who has not worked to earn the grade gets a good grade when cheating and should reveal those people's dishonesty to teachers or administrators.</td>
</tr>
<tr>
<td>2</td>
<td>Point out how harsh are the penalties of cheating, and warn friends of the possible consequences.</td>
</tr>
<tr>
<td>9</td>
<td><strong>Make oneself aware of rules of academic dishonesty and consequences of it, as well as follow the rules</strong></td>
</tr>
<tr>
<td>5</td>
<td>Realize that you can be severely punished if you were to do something like this in the workplace; understand consequences fully, which may end college career.</td>
</tr>
<tr>
<td>3</td>
<td>Don't get caught up in how easy it could be to cheat and follow guidelines.</td>
</tr>
<tr>
<td>1</td>
<td>Cheating is the big thing. I learned the hard way and I would never do it again! I only hurt myself.</td>
</tr>
<tr>
<td>6</td>
<td><strong>Stop procrastination and laziness</strong></td>
</tr>
<tr>
<td>6</td>
<td>Don't wait until the last minute to do everything; keep up with assignments and homework; stop being lazy.</td>
</tr>
<tr>
<td>5</td>
<td><strong>Report academic misconduct</strong></td>
</tr>
<tr>
<td>2</td>
<td>Keep an eye out for academic dishonesty; watch for peer cheating; this puts you at a disadvantage.</td>
</tr>
<tr>
<td>3</td>
<td>Report cheating; speak up when you notice someone looking at your work.</td>
</tr>
<tr>
<td>4</td>
<td><strong>Manage time effectively:</strong> Prioritize and budget time to study; develop better study habits or research habits.</td>
</tr>
<tr>
<td>4</td>
<td><strong>Seek help from instructors and other students when having difficulties with courses</strong></td>
</tr>
<tr>
<td>3</td>
<td>Raise questions before test, go in for help, or create a study group.</td>
</tr>
<tr>
<td>1</td>
<td>Take the time to get with the instructor to obtain a study guide for the test or quiz. Also figure out what to consider as “key” or what is “mundane” when you take a test.</td>
</tr>
<tr>
<td>4</td>
<td><strong>Encourage and help other students to study and learn</strong></td>
</tr>
<tr>
<td>3</td>
<td>Encourage and help others to study and learn.</td>
</tr>
<tr>
<td>1</td>
<td>Make things competitive enough to dissuade cheating.</td>
</tr>
<tr>
<td>3</td>
<td><strong>Choose a reasonable workload for both study and work:</strong> Take smaller course load; be reasonable not to overload; work outside of school less if possible.</td>
</tr>
<tr>
<td>9</td>
<td><strong>Miscellaneous</strong></td>
</tr>
<tr>
<td>3</td>
<td>Stop group work.</td>
</tr>
<tr>
<td>2</td>
<td>It is not my business if someone else wishes to cheat. It's a little late to instill morals in a person by the time they get to college. At this point, instructors just need to watch for it and make sure the punishment for cheating is harsh.</td>
</tr>
<tr>
<td>2</td>
<td>Do not cheat, period.</td>
</tr>
<tr>
<td>1</td>
<td>Business is a harsh world filled with manipulation and cheating... Students learn early by cheating.</td>
</tr>
<tr>
<td>1</td>
<td>Hopefully parents have instilled honor in their children.</td>
</tr>
</tbody>
</table>

Students' participation in academic misconduct is related to gender and their GPA. These relationships are analyzed in this study. As shown in Table 11, as to gender there is a statistically significant difference between male and female for six of the practices. Males reported higher levels of participation in all six practices. Table 12 presents the level of participation by students' GPA with two categories: under 3.0 and 3.0 and over. Participation level is significantly different at the two GPA levels for only one of the 12 practices, which is collaborating on an assignment when the instructor asked for individual work.
<table>
<thead>
<tr>
<th>Practice</th>
<th>Male</th>
<th>Female</th>
<th>F-Ratio</th>
<th>Significant Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.71</td>
<td>1.39</td>
<td>6.562</td>
<td>0.011*</td>
</tr>
<tr>
<td>2</td>
<td>2.12</td>
<td>2.04</td>
<td>0.256</td>
<td>0.613**</td>
</tr>
<tr>
<td>3</td>
<td>2.37</td>
<td>2.22</td>
<td>0.482</td>
<td>0.488**</td>
</tr>
<tr>
<td>4</td>
<td>2.02</td>
<td>2.09</td>
<td>0.172</td>
<td>0.679**</td>
</tr>
<tr>
<td>5</td>
<td>2.08</td>
<td>2.04</td>
<td>0.056</td>
<td>0.814**</td>
</tr>
<tr>
<td>6</td>
<td>2.27</td>
<td>2.13</td>
<td>0.556</td>
<td>0.457**</td>
</tr>
<tr>
<td>7</td>
<td>1.37</td>
<td>1.22</td>
<td>1.985</td>
<td>0.16**</td>
</tr>
<tr>
<td>8</td>
<td>1.57</td>
<td>1.3</td>
<td>5.339</td>
<td>0.022*</td>
</tr>
<tr>
<td>9</td>
<td>1.62</td>
<td>1.39</td>
<td>3.979</td>
<td>0.047*</td>
</tr>
<tr>
<td>10</td>
<td>2.4</td>
<td>2.05</td>
<td>3.847</td>
<td>0.051*</td>
</tr>
<tr>
<td>11</td>
<td>1.92</td>
<td>1.45</td>
<td>9.744</td>
<td>0.022*</td>
</tr>
<tr>
<td>12</td>
<td>1.79</td>
<td>1.31</td>
<td>12.296</td>
<td>0.001*</td>
</tr>
</tbody>
</table>

Note: SPSS Application - ANOVA, Univariate Analysis of Variance

* Significant level < .05  
** Significant level > .05
Table 12: Mean Score of Participation in Listed Practices by GPA

<table>
<thead>
<tr>
<th>Practice</th>
<th>Under 3.0</th>
<th>3.0 and over</th>
<th>F-Ratio</th>
<th>Significant Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>1  Using unauthorized information during an exam.</td>
<td>1.73</td>
<td>1.47</td>
<td>3.543</td>
<td>0.061**</td>
</tr>
<tr>
<td>2  Collaborating on a take home exam without the instructor's permission.</td>
<td>2.29</td>
<td>1.99</td>
<td>2.412</td>
<td>0.122**</td>
</tr>
<tr>
<td>3  Using previous exams even though the instructor would disapprove if he/she discovered it.</td>
<td>2.39</td>
<td>2.17</td>
<td>0.979</td>
<td>0.324**</td>
</tr>
<tr>
<td>4  Giving students in later sections questions or answers of the exam that you have taken at an earlier time.</td>
<td>2.20</td>
<td>1.98</td>
<td>1.223</td>
<td>0.270**</td>
</tr>
<tr>
<td>5  Obtaining questions or answers of an exam from a student who has taken the exam.</td>
<td>2.21</td>
<td>1.97</td>
<td>1.430</td>
<td>0.223**</td>
</tr>
<tr>
<td>6  Collaborating on an assignment when the instructor asked for individual work.</td>
<td>2.48</td>
<td>2.07</td>
<td>4.252</td>
<td>0.040*</td>
</tr>
<tr>
<td>7  Submitting someone else's work as yours or ask someone else to do your work.</td>
<td>1.38</td>
<td>1.26</td>
<td>1.115</td>
<td>0.292**</td>
</tr>
<tr>
<td>8  Taking full credit for a group project without doing your fair share of the work.</td>
<td>1.59</td>
<td>1.36</td>
<td>3.284</td>
<td>0.071**</td>
</tr>
<tr>
<td>9  Partially or entirely submitting someone else's language, ideas, thoughts or work without proper or complete acknowledgement or citation.</td>
<td>1.45</td>
<td>1.53</td>
<td>0.341</td>
<td>0.560**</td>
</tr>
<tr>
<td>10 Using previously submitted work for one course to fulfill academic requirements in another course.</td>
<td>2.33</td>
<td>2.19</td>
<td>0.526</td>
<td>0.469**</td>
</tr>
<tr>
<td>11 Falsely citing a source or attributing work to a source from which the referenced material was not obtained.</td>
<td>1.83</td>
<td>1.63</td>
<td>1.480</td>
<td>0.225**</td>
</tr>
<tr>
<td>12 Making up or changing data to support the ideas or theories stated in a assignment or a project.</td>
<td>1.67</td>
<td>1.49</td>
<td>1.397</td>
<td>0.239**</td>
</tr>
</tbody>
</table>

Note: SPSS Application - ANOVA, Univariate Analysis of Variance

* Significant level < .05
** Significant level > .05

Table 13 summarizes the relationship between student’s belief and practice concerning academic dishonesty. As described in the methods section of this study, the belief and practice sections include the same 12 practices of academic dishonesty with a different rating scale (belief: 1 being very unethical, and 6 being very ethical; practice: 1 being never, 2 being infrequently, and 6 being frequently). In this study it’s assumed that student’s belief toward an academic deviant behavior is significantly and positively related to student’s participation in such behavior. That is, when the student believes an academic deviant behavior is unethical, he or she is less likely to engage in such behavior, and vice versa. The assumption is confirmed in the belief-practice relationship analysis by using the Pearson Correlation, as shown on Table 13. The relationship between a student’s belief and practice for 10 of the 12 listed practices is significantly positive and moderately strong (with significant level = .000 and .41 > Pearson correlation > .60); for two of them is significantly positive and weak (with significant level=.000 and .21 > Pearson correlation > .40). In addition, the means of the two variables, belief and practice, are close to each other, confirming the association between them.
Table 13: Relationship Between Student's Belief and Practice

<table>
<thead>
<tr>
<th>Listed Practices</th>
<th>Mean Belief</th>
<th>Mean Practice</th>
<th>Pearson Correlations</th>
<th>Significant Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Using unauthorized information during an exam.</td>
<td>1.52</td>
<td>1.54</td>
<td>0.393</td>
<td>0.000</td>
</tr>
<tr>
<td>2. Collaborating on a take home exam without the instructor's permission.</td>
<td>2.15</td>
<td>2.07</td>
<td>0.520</td>
<td>0.000</td>
</tr>
<tr>
<td>3. Using previous exams even though the instructor would disapprove if he/she discovered it.</td>
<td>2.32</td>
<td>2.29</td>
<td>0.565</td>
<td>0.000</td>
</tr>
<tr>
<td>4. Giving students in later sections questions or answers of the exam that you have taken at an earlier time.</td>
<td>2.02</td>
<td>2.05</td>
<td>0.496</td>
<td>0.000</td>
</tr>
<tr>
<td>5. Obtaining questions or answers of an exam from a student who has taken the exam.</td>
<td>1.99</td>
<td>2.05</td>
<td>0.575</td>
<td>0.000</td>
</tr>
<tr>
<td>6. Collaborating on an assignment when the instructor asked for individual work.</td>
<td>2.25</td>
<td>2.19</td>
<td>0.541</td>
<td>0.000</td>
</tr>
<tr>
<td>7. Submitting someone else’s work as yours or ask someone else to do your work.</td>
<td>1.31</td>
<td>1.30</td>
<td>0.470</td>
<td>0.000</td>
</tr>
<tr>
<td>8. Taking full credit for a group project without doing your fair share of the work.</td>
<td>1.73</td>
<td>1.43</td>
<td>0.335</td>
<td>0.000</td>
</tr>
<tr>
<td>9. Partially or entirely submitting someone else’s language, ideas, thoughts or work without proper or complete acknowledgement or citation.</td>
<td>1.62</td>
<td>1.50</td>
<td>0.473</td>
<td>0.000</td>
</tr>
<tr>
<td>10. Using previously submitted work for one course to fulfill academic requirements in another course.</td>
<td>2.96</td>
<td>2.22</td>
<td>0.425</td>
<td>0.000</td>
</tr>
<tr>
<td>11. Falsely citing a source or attributing work to a source from which the referenced material was not obtained.</td>
<td>1.90</td>
<td>1.68</td>
<td>0.478</td>
<td>0.000</td>
</tr>
<tr>
<td>12. Making up or changing data to support the ideas or theories stated in a assignment or a project.</td>
<td>1.75</td>
<td>1.55</td>
<td>0.450</td>
<td>0.000</td>
</tr>
</tbody>
</table>

Note: SPSS Application - Pearson Correlation: two-tailed test of significance and flag significant correlations.

DISCUSSION

The results from the in-depth interview provide new insights as to the situational factors, contributing to student’s engagement in academic dishonesty and affecting students’ learning processes. The first situational factor is the instructor’s use of the same or similar content and version of the test. When the instructor repeatedly uses the same content of the test, students tend to only study questions and answers on the past exam papers for the present test. They tend to consider it as opportunity to take advantage of past exam papers rather than cheating. In addition, the instructor’s uses the same version of the test invite students in different sections to collaborate the test by passing the content of the test to each other. The second situational factor is unequal access to past exam papers, which adds a stress to students for desperately searching for the access and puts those without the access at disadvantage.

The two situational factors described above significantly associated with the instructor’s use of test questions only in problem form, the third situational factor. The same content of the test in problem form encourage students for merely memorizing the formulas and studying past exam papers without learning concepts of the subject. Accordingly, it increases the problem of unequal access to past exam papers for students being more desperately searching for the access and for it likely making large difference in grade between students with or without the access to past exam papers. These three situational factors not only introduce unfairness and disadvantages to students who do not the access to past exam papers, but they also undermine transferring the holistic knowledge of the subject of the class to students. The instructor should take these situational factors into consideration when designing the content of the test and its format.
In terms of students’ perceived climate of academic dishonesty, this study shows that only 15.2% of students either agree or strongly agree that a typical student at COBA would report a case of academic misconduct. In the study of surveying 15 undergraduate Chemistry courses (n=172) at the University of Nevada, Reno, 35.7% of the students indicated their intention to report a case of suspected academic dishonesty (Simon, el, 2004). Apparently, business majors are more reluctant to report cheating to school authorities than are chemistry majors, although the two studies adopted somewhat different methods. This confirms the finding from the past research that business majors have a lower rate of reporting a case of academic dishonesty than other majors.

The findings of the relationship between student’s belief and practice indicate that the level of participation and the degree of ethical actions for each of the listed 12 academic dishonesty practices is significantly positive associated; as students rate an act of academic dishonesty is less unethical, they are likely to engage in the act. This finding is consistent with previous study that students tend to rate the act they participate in as less unethical (as cited in Brown & Choong, 2003); however, it contradict with the finding of Brown and Choong (2003) that the relationship only exist in certain type of academic dishonesty practices.

In terms of students’ participation, consistent with past studies, the study found that majority of the students engaged in some forms of academic misconduct at least once during their university career, as more than 50% of the students admitted to participate in six of 12 listed academic misconducts, as shown on Table 3. This study also found that business students tend to engage more in certain acts of academic dishonesty and less in other acts, as shown on Table 3, which agree with the findings of Brown and Choong (2000) whose study also focused on business students. As shown on Table 14, business students tend to participate more in such behavior as obtaining the content of an exam from someone who has taken it (more than 50% of the students in both studies engaged in this practice) and less in such behaviors as turning in work done by someone else, as one’s own work (less than 40% of the students in both studies participated in this practice). Instructors may refer to this finding to alter their tests or assignment methods. For example, to prevent students from obtaining the content of an exam from students who have already taken it, instructors might adjust test characteristics and have multiple versions of a test, which is the solution that students deem most important in this study.

### Table 14: Frequency of Students Participating in Unethical Practices

<table>
<thead>
<tr>
<th>University</th>
<th>Private* (n=252)</th>
<th>Public* (n=231)</th>
<th>UNR (n=223)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>The Practices that students participate more</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Obtaining the content of an exam from someone who has taken it.</td>
<td>81.5%</td>
<td>86.6%</td>
<td>51.6%</td>
</tr>
<tr>
<td>Giving students in later sections questions or answers of the exam that you have taken at an earlier time.</td>
<td>78.8%</td>
<td>83.9%</td>
<td>52.0%</td>
</tr>
<tr>
<td>Collaborating on an assignment when the instructor asked for individual work.</td>
<td>77.1%</td>
<td>85.7%</td>
<td>59.2%</td>
</tr>
<tr>
<td><strong>The Practices that students participate less</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Submitting someone else's work as yours or ask someone else to do your work.</td>
<td>39.5%</td>
<td>45.2%</td>
<td>16.1%</td>
</tr>
<tr>
<td>Taking full credit for a group project without doing your fair share of the work.</td>
<td>28.9%</td>
<td>26.9%</td>
<td></td>
</tr>
</tbody>
</table>

Note: Both studies used a similar, but different set of listed unethical practices concerning academic dishonesty. Both studies used the same scale of rating unethical pratices.

* Data drwan from Brown and Choong (2000).
This study indicates that only one of the listed 12 academic dishonesty practices is significantly negatively associated with GPA (lower GPAs have higher cheating rate). This finding tends to confirm that the past research of cheating and GPA is not related and to against the finding of GAP is associated with cheating.

In terms of students’ perceived solutions to lower the amount of academic dishonesty, the results of this study confirm and add new insights to identified solutions in the literature. As to what the instructor can do, consistent with past research, the top solution posed by the students suggest that instructors should demonstrate their genuine interests in students and facilitate students’ learning using creative means. This, in turn, will create a good instructor-student relationship with respect and trust between the instructor and student, lowering the likelihood of students participating in academic dishonesty (Chapman el, 2004). Another solution that students deem very important indicates that the instructor should test students on what they are taught, give clear study guide or lecture on the material on the test, and provide clear instruction and adequate time for the test and assignment, to reduce student’s stress, which is in agreement with past research (Whitley & Keith-Spiegel, 2002; Cizek, 2003). One of students’ solutions that was a focus of the literature and is worthy to mention is explaining academic dishonesty along with its severe consequences in “syllabus” and discussing it on the first course day. According to Whitley & Keith-Spiegel (2002), “the syllabus is a contract between the instructor and the students” and it should include the following elements to avoid “varying interpretations.”

- A brief, general statement about the importance of academic integrity in higher education.
- A personal statement declaring your [the instructor’s] commitment to upholding academic honesty in your classes.
- How you will deal with any incidents that you observe or that come to your attention.
- A brief list of the types of academic dishonesty in your school’s policy (or reference to where the complete policy can be found).
- A brief list of any types of academic dishonesty that could occur in your particular course that could benefit from oral detail (e.g. oral plagiarism in a class that requires an oral report).
- A brief list of campus resources that may help reduce the risk factors associated with cheating (e.g. writing clinic, counseling center, learning center or tutoring program).
- An invitation to come directly to you to discuss anything that it unclear or confusing regarding the appropriate way to complete assignments.
- An invitation to report incidents of academic dishonesty (2002).

As to what the administrator can do, consistent with past research (Chapman el, 2004), the two solutions that students emphasized on are having and promoting a campus wide academic honesty policy and installing perceived risk and fear by adapting severe punishment for acts of academic dishonesty. As to what students can do to lower the amount of academic dishonesty, students’ solutions add new ideas into exiting solution of expressing disproval of academic dishonesty, which is showing the right attitudes of not making it “cool” to cheat and by expressing “upset” when seeing others’ cheat (cool and upset are two direct words from the students).
In addition, students' posed solutions of stopping giving others one's own work and communicating to oneself the importance of knowing the material for doing well in a profession provide new insight into the identified solution of encouraging student developing a sense of personal responsibility (McCabe & Pavela, 1973). However, for students spontaneously showing right attitudes and developing responsibility for academic integrity, the modified honor code system in which the integrity policy are created and promoted from bottom up, meaning students establish and promote the system with the support of instructor and the administrator, should be enforced (McCabe & Pavela, 2000).

Overall, the solutions posed by the students suggest that to receive the maximum effort of lowering the amount of academic dishonesty, the students, the instructor, and the administrator should work together. The guidelines for these three players corporately create an effective academic integrity programs can be obtained form the center for academic integrity in which more than 200 schools joined together for the mission of promoting academic integrity (2000).

The limitations of this study include the following: First, the students' sample is limited to the students who attended business classes in summer 2004 classes. Thus, the results of findings may not guarantee a true representation of the business student population. Moreover, because the study used self-reported cheating measures for such sensitive topics as academic dishonesty, students may underreport their participation level due to their discomfort for self-incrimination. Therefore, the self-report occurrences of academic misconduct are likely lower than the actual occurrences.
REFERENCES


Appendix A: Academic Standards and Procedures at a Middle-Sized State University where the sample is taken.

Specific to the academic pursuits of students, the University of Nevada, Reno, believes the maintenance of academic standards is a joint responsibility of the students and faculty of the university. Freedom to teach and to learn are dependent upon individual and collective conduct to permit the pursuit and exchange of knowledge and opinion. Faculty have the responsibility to create an atmosphere in which students may display their knowledge. This atmosphere includes an orderly testing room and sufficient safeguards to inhibit dishonesty. Students have the responsibility to rely on their knowledge and resources in the evaluation process. The trust developed in the maintenance of academic standards is necessary to the fair evaluation of all students.

Academic dishonesty is against university as well as the system community standards. Academic dishonesty is defined as: cheating, plagiarism or otherwise obtaining grades under false pretenses. Plagiarism is defined as submitting the language, ideas, thoughts or work of another as one's own; or assisting in the act of plagiarism by allowing one's work to be used in this fashion. Cheating is defined as (1) obtaining or providing unauthorized information during an examination through verbal, visual or unauthorized use of books, notes, text and other materials; (2) obtaining or providing information concerning all or part of an examination prior to that examination; (3) taking an examination for another student, or arranging for another person to take an exam in one's place; (4) altering or changing test answers after submittal for grading, grades after grades have been awarded, or other academic records once these are official.

Disciplinary procedures for incidents of academic dishonesty may involve both academic action and administrative action for behavior against the campus regulations for student conduct. The procedures involve the determination by the faculty member pursuing concerns over alleged cheating or plagiarism as to whether administrative action is warranted, in addition to making a determination as to any academic consequence. Academic action may include: (1) canceling the student's enrollment in the class without a grade; (2) filing a final grade of "F"; (3) awarding a failing mark on the test or paper in question; (4) requiring the student to retake the test or resubmit the paper.

If the student wishes to appeal the academic action of the faculty member a special hearing board will be constituted to investigate the incident and determine whether the student is responsible for dishonesty and, if so, the appropriate academic action as a consequence for this act. The student will be entitled to receive notice of the academic charges and the opportunity to reply to or to rebut the charges before an unbiased board.

More detail information regarding its academic dishonesty procedures can be found on the Web address: http://www.unr.edu/stsv/acdispol.html.
Steve is a mathematics major from Las Vegas, Nevada. He is interested in discrete mathematics, more specifically Combinatorics and Graph Theory. He has worked on campus as a math tutor and an Engineering Academic Support Experience (EASE) Supplemental Instruction Facilitator. He presented his research project at the 2005 Rocky Mountain McNair Conference in Colorado. Steve has been accepted into the graduate program at the University of Nevada, Reno for fall 2006 and has received a full teaching assistantship. He’s on his way towards achieving his ultimate goal of becoming a university professor.

**ABSTRACT**

Combinatorics, Graph Theory and Number Theory are littered with examples of problems that cannot be solved using ordinary analysis techniques. In these situations, probabilistic methods can be used to prove these elusive theorems. This study will investigate random arguments of several mathematical theorems, including Ramsey Theory and prime number counting. To study these arguments, discrete expectation and variance will be examined. Expectation determines what should happen in a given random environment. We use variance with certain inequalities such as the Markov Inequality and the Chebyshev Inequality to establish bounds on the tendency of the random variable to act in accordance with the expectation in general. The Cherinov Inequality will also be discussed; however, its use is limited due to the binomial distribution constraint.
Preface

This book is intended as an introductory guide to Probability Theory with applications in discrete mathematics. Probability Theory is used heavily in other areas of mathematics, particularly discrete mathematics, as a tool to help solve problems that may otherwise be entirely too difficult to think about. While it does have its limitations, Probability Theory is invaluable in finding out whether or not a solution to a particular problem exists or not.

This text will be split into several chapters with the combined goal of giving the reader a better intuitive grasp on Probability Theory and its applications to mathematical reasoning. The first chapter will introduce the basic concepts of Probability Theory and build up enough for the proceeding chapters. The rest of the book will be devoted to exploring the uses of Probability Theory in different areas of mathematics with the bulk of the content being discrete.

My intention is to continue work on this and release it as a book on Probability Theory with Applications to Discrete Mathematics. While at this point, the chapter on number theory is not very comprehensive, the use of probability theory was too nice to not include.

Acknowledgements

I would like to thank the UNR McNair Scholars Program for helping me get this project off the ground. Marsha Dupree and Rita Escher have been valuable sources of encouragement and support. Most of all, I would like to thank my mentor, Dr. Brendan Nagle, without whom I never would have been able to come up with the idea for the probabilistic method. He has been a mentor and a friend, and I appreciate everything he has done.

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Chapter 1
Introduction to Probability

This chapter will present an introduction to the theory of probability. The first section will introduce the reader to the concept of probability and the axioms. Then we will move on to special techniques of calculating probabilities and look at some important properties. The next sections will discuss the concept of expectation and variance, followed by the Markov Inequality and the Chebyshev Inequality. The last sections will discuss independence, the Binomial distribution and the Chernoff Inequality.

1.1 The Basics

The first thing to address is the concept of probability. What exactly is it? There are two sides to this question. There is the logical interpretation of the application of probability and there are the calculations. Let us begin with the conceptual ideas before we begin calculation.

The world is not a perfect environment in which everything can be calculated and accounted for perfectly, not even the world of mathematics. As we have progressed in our sophistication in understanding problems, we see that the problems themselves become more sophisticated and complex. With these problems and the idea that anything can happen, we need a method not for analyzing certainty, but to understand the uncertainty.

Probability is used as a model of what is more or less likely to occur in any given situation. While at first this might seem kind of weak as it offers no guarantee as to an outcome, there are many cases in which a small chance is better than none at all. For instance, suppose that there is a problem and some solution to the problem which you would not expect, but the probability says that this solution will work 99% of the time. Certainly it isn't perfect, but it is better than no solution at all.

Def. 1.1.1 Probability is the quantifiable degree of chance that, given some set of possible outcomes for a given random environment, a particular member of that set will occur.

Now let's start discussing the details. Since probability will be working within random environments, we will start with some notation. Most of the rest of the book will be dealing with random variables, so we will start there.

Def. 1.1.2 A random variable is a variable used to represent a random event. (i.e. the number of heads you get when flipping a coin)

With this in mind let's consider our first example.

Ex. 1.1.1 Suppose we flip a fair coin n times. Then let our random variable X be the number of times heads comes up during those n flips. All of the possible outcomes for X are the set \{0, 1, \ldots, n\}, and each event in this set has its own probability of occurring.

For any given random variable X, let the set \{x_1, x_2, \ldots, x_n\} be the set of all possible outcomes of that variable. Then we will define

\[ P_{\{x_i\}} \]

to be the probability that outcome \(x_i\) occurs. There will be different ways to calculate \(P_{\{x_i\}}\), but for now let's think of it as being the number of ways in which event \(x_i\) can occur divided by the total number of ways in which anything in X can occur. Since we know that \(x_i\) is a possible outcome for X then it is a subset of anything in X occurring.
As such, the number of ways in which event $x_i$ will occur will always be smaller than or equal to the number of ways that anything in $X$ can occur. Hence

$$0 \leq P_R[x_i] \leq 1.$$ 

In other words, the probability of any event is always between zero and one.

Now we have another important fact that we can arrive at logically. If we consider multiple outcomes of an event that are mutually exclusive of one another, we can say that in order to calculate the probability of either of the events occurring, we can add up the total ways that each of them can occur and divide by the total number of occurrences of any possibility. Let the set $S$ be some subset of the set from $\{1,2,\ldots,n\}$ then we have

$$P_R \left[ \bigcup_{x_i \in S} x_i \right] = \sum_{x_i \in S} P_R[x_i].$$

This leads to the fact that if we consider all possible events and the number of occurrences in such a manner, then we naturally get the resulting probability of one. For a random event with $n$ possibilities,

$$\sum_{j=1}^{n} P_R[x_j] = 1.$$

This result is natural because it means that given all possibilities, something will happen, and this we know is always true. Now let us continue with our coin flipping example.

**Ex. 1.1.2** Let’s consider flipping a fair coin once. Then the possibilities for the number of heads that occur are zero and one. Now for each possibility we see that

$$P_R[0] = P_R[1] = 1/2$$

because there are two possible outcomes and each has only one possible way of occurring. Also we see

$$P_R[0 \text{ or } 1] = P_R[0] + P_R[1] = 1.$$

The probability of either getting one or zero heads is certain, as we are going to flip a coin and either it will be heads or not; there are no other alternatives.

These properties are the axioms of Probability and as such are the foundation upon which everything else is built.

### 1.2 Special Properties

The first property which we will discuss is called the rule of addition. While we already touched on this in section one, we will go into some detail here. In order to discuss addition in full, we will need to understand when events are mutually exclusive.

**Def. 1.2.1** Two events are **mutually exclusive** if the intersection of the events is empty. In other words, the events cannot happen at the same time.
For example, if we were to consider the probability of drawing an ace out of a deck of cards or a card with the suit of hearts, these events are not mutually exclusive, as they have the ace of hearts in common.

If we were to add the probabilities of two events that are not mutually exclusive, then we would count the events in the intersection twice. So in order to add the probabilities correctly, we need to use the concept of inclusion/exclusion.

**Prop. 1.2.1** Consider two events, A and B. In order to calculate the probability of either of these events occurring, we will need to use inclusion/exclusion, and the result is

\[ P[R[A \cup B]] = P[R[A]] + P[R[B]] - P[R[A \cap B]]. \]

We can then extend this to as many events as we wish as follows: For n events

\[ P[R]\left[\bigcup_{i=1}^{n} X_i\right] = \sum_{i=1}^{n} P[R[X_i]] - \sum_{i<j}^{n} P[R[X_i \cap X_j]] + \ldots + (-1)^{n-1} \sum_{S \subseteq X} P[R]\left[\bigcap_{X_i \in S} X_i\right] \]

where \( S \) is a subset of \( X \) of size \( m \).

This can be used in all cases, whether the events are mutually exclusive or not. In the case that the events are mutually exclusive, the intersection of the events will be empty and the probability will be zero, not affecting the final probability.

**1.2.1 Conditional Probability**

Consider two events, A and B with probabilities \( P[R[A]] \) and \( P[R[B]] \) respectively. Then if we wanted to calculate the probability of event B happening given that event A has happened, or the \textit{conditional probability} of B given A, we must calculate the probability that both A and B happen and then divide that by the probability that A has happened, since it is given. Thus we have

\[
P[R[B|A]] = \frac{P[R[A \cap B]]}{P[R[A]]} \tag{1.1}
\]

and we will use the notation \( B|A \) to represent event B occurring given that event A has occurred.

**Ex. 1.2.1** Suppose we have a population that where there is a probability of 0.2 of being born with blue eyes and blonde hair, and there is a probability of 0.4 of being born with blonde hair. If we are given someone who we know has blonde hair, than the probability of that person having blue eyes is

\[
P[R[\text{blue eyes}|\text{blonde hair}]] = \frac{0.2}{0.4} = \frac{1}{2}
\]

so \( 1/2 \) is the conditional probability of someone having blue eyes if we know they have blonde hair.

This will lead us into the next topic, which is the notion of independence.
1.2.2 Independence

**Def. 1.2.2** Two events are independent of one another if the outcome of either event does not alter the possible outcomes of the second event.

With that definition, it can be readily observed that conditional probabilities become simpler in that the probability of event B is not affected by whether event A has occurred or not. Hence it follows

\[ P(B|A) = P(B) \]

It follows from this and Eq. (1.1) that

\[ P(B|A) = \frac{P(A \cap B)}{P(A)} \]

From this we can derive the rule of multiplication. Namely, when we wish to consider the probability of two or more independent events occurring, we simply need to multiply the probabilities of each individual event occurring.

\[ P(A \cap B) = P(A) \times P(B) \]

Now that we have worked out some of these terms, let's take a look at an example.

**Ex. 1.2.2** Let us consider rolling a fair die and picking a card from a standard playing deck. These two events are independent from one another since rolling the die is not going to affect the card that we chose and vice versa. There are 52 cards in the deck and 13 hearts, the probability of choosing a heart is therefore \( \frac{1}{4} \). The probability of rolling any one of the six numbers on the die is \( \frac{1}{6} \). Therefore, by the rule of multiplication, the probability of rolling a four on the die and choosing a heart from the deck of cards is \( \frac{1}{24} \).

These properties, while seemingly simple and maybe even obvious, are powerful tools in the application of discrete mathematics, such as the independence of vertices in a graph, which we will cover in a later chapter.

1.3 Expectation and Variance

We have so far discussed the probability of something specific occurring in a random environment. Now we will discuss how this can be used to find out what we expect to happen in a given setting.

1.3.1 Expectation

**Def. 1.3.1** Expectation is the outcome of a random variable that is the most probable to occur, it is also known as the first moment of the data. We will denote the expectation of a random variable \( X \) by

\[ E[X] \]

and likewise for other variables.
To calculate expectation formally, we can consider
\[ \sum_{x \in X} x \cdot P[x]. \] (1.2)

However, there are more intuitive ways to calculate the expectation in many cases.

Using the summation to calculate the expectation leads us to a very nice property, the fact that expectation is linear. If we consider two random variables, \( X \) and \( Y \), each with its own set of outcomes than we can see that
\[ E[X + Y] = \sum_{x \in X \cup Y} x \cdot P[\{x\}] = \sum_{x \in X} x \cdot P[\{x\}] + \sum_{y \in Y} y \cdot P[\{y\}] = E[X] + E[Y] \]

and in general we have
\[ E \left[ \sum_{t=1}^{n} X_t \right] = \sum_{t=1}^{n} E[X_t]. \] (1.3)

This is probably the most useful and powerful tool in probability theory, as it allows for very simple calculations in cases that would otherwise be near impossible to calculate.

One way to calculate expectation of a random variable is to consider its characteristic

**Def. 1.3.2** The **characteristic** of a random variable is given by:

\[ X_t = \begin{cases} 1 & \text{if } X_t \in X \\ 0 & \text{if } X_t \notin X \end{cases} \]

where \( X_t \) is the outcome of the \( t^{th} \) random event.

This takes the random experiment and breaks it down into a binary counting sequence for each individual trial in the experiment. The property of linearity of expectation allows us to take the expectations of the individual characteristics and sum them together in Eq.(1.3).

An intuitive example of this is if we consider the coin flipping scenario in the following manner:

**Ex. 1.3.1** Consider flipping a fair coin 100 times, and let the random variable \( X \) represent the number of heads that can come up. In this case, we can calculate the expectation with the following equation:

\[ \sum_{i=0}^{100} i \cdot P[i] \]

but that requires us to calculate the individual probabilities for each of the 100 outcomes, and this is not an easy calculation. Instead, however, let us consider a characteristic for each flip of the coin

\[ X_t = \begin{cases} 1 & \text{if heads} \\ 0 & \text{if tails} \end{cases} \]
Now we can calculate the expectation of the characteristic variable by the summation method,

\[ E[X] = 1 \times 1/2 + 0 \times 1/2 = 1/2 \]

and because each of the 100 trials are identical, all that is left to do is sum the characteristic equations

\[ E[X] = \sum_{i=1}^{100} E[X_i] = \sum_{i=1}^{100} 1/2 = 50 \]

and this is precisely what we would expect intuitively.

Now we have a manner in which to calculate what we expect to happen in a given situation. In most cases this will not be enough, however, as the expectation may be very weak depending on the situation, and we need a method to calculate the strength of the expectation. In other words we need to know the tendency of the data to stray from the expected value. This leads us into our next topic, that of variance.

1.3.2 Variance

**Def. 1.3.3** The second moment of the data is known as **variance**. It is a measure of central tendency of the data, therefore it calculates how much the data is likely to stray from the expectation. We will denote the variance of a random variable \( X \) as

\[ \text{VAR}[X] \]

and other variables likewise.

To calculate the variance is a tricky matter. Its formal calculation is as follows:

\[ \text{VAR}[X] = E[(X - E[X])^2]. \]

However, this is quite difficult, but from this and using the property of linearity of expectation, we can express this as

\[ \text{VAR}[X] = E[X^2] - E[X]. \]

This makes matters a little easier to get our hands on; however, for practical purposes we will likely need to use other methods or a computer package to calculate the variance.

The most useful of these requires independence of the experiment and restricts it to, two outcomes which is many times the case when using the characteristic equation. In these instances, we can calculate the variance using the binomial formula

\[ \text{VAR}[X] = np(1-p) \]

where \( n \) is the number of trials and \( p \) is the probability that any one trial has the desired outcome.

This is a very useful way to calculate the variance, but it is very limited, as it cannot handle experiments with more than two outcomes and does require independence.
With that being said we now have a method for calculating the variance of the data. Look back at our coin example,

**Ex. 1.3.2** *If we flip a coin 100 times, we know that we expect it to come up heads 50 times. Now we also know that for each trial we have two possible outcomes, heads and tails, each with a probability of 1/2. We also know that each coin flip is independent of all of the others. Hence we can calculate variance* 

\[
Y \cdot E[X] = 100 \cdot 1/2 \cdot 1/2 = 25.
\]

Therefore we know that our variance is 25. This means that the actual results are likely to be within 25 of the expected value. Hence the number of heads is likely to vary from 25 to 75 heads.

Variance alone may not tell us much that is useful about our experiment, but as we will see in the next section, we can apply the variance to the data in several useful ways.

### 1.3.3 Covariance

**Def. 1.3.4** *The covariance of two random variables is a measure of the correlation between the variables and is given by* 

\[
\]

From this we can obtain a bound on the variance of a random variable when it has dependencies.

**Theorem 1.3.1** *The variance of a variable X when it depends on variable Y is bounded by* 

\[
V_{MR}[X] \leq E[X] + \text{Cov}[X, Y].
\]

**Proof.** For a random variable \(X = \sum X_i\). The total variance of \(X\) will be the sum of variance of each \(X_i\) independent of the other variables and the covariance between every pair of variables \((X_i, X_j)\). Thus 

\[
V_{MR}[X] = \sum_{i=1}^{n} V_{MR}[X_i] + \sum_{i \neq j} \text{Cov}[X_i, X_j]
\]

Then for the first term, since \(X_i\) is an indicator variable for some event say \(A_i\). Then if \(P_{MR}[A_i] = p_i\), 

\[
V_{MR}[X_i] = p_i(1 - p_i) \leq p_i = E[X_i]
\]

and it follows that

\[
V_{MR}[X_i] \leq \sum_{i=1}^{n} E[X_i] + \sum_{i \neq j} \text{Cov}[X_i, X_j] = E[X] + \sum_{i \neq j} \text{Cov}[X_i, X_j]
\]

and there we have our result. □
1.4 Markov and Chebyshev

In this section we shall discuss two theorems that were derived to put a bound on the spread of the data, or to observe that there is no bound. Both theorems were first derived by their respective namesakes and Chebyshev is just a stronger version of Markov.

1.4.1 Markov's Inequality

As mentioned earlier, Probability Theory does not tell us anything concrete about a given situation. It is a tool that can be used to show that a particular situation is possible, or perhaps that some given situation is extremely likely to occur. Markov's Inequality will help us do just that.

**Theorem 1.4.1** Given a value $k$ the probability that random variable $X$ will take on a value at least $k$ is at most the expectation of $X$ divided by $k$.

$$P_{X}(X \geq k) \leq \frac{E[X]}{k}$$

**Proof.** First we look at the expectation of random variable $X$ which is

$$E[X] = \sum_{i=1}^{n} i P_{X}[i] = \sum_{i=1}^{k-1} i P_{X}[i] + \sum_{i=k}^{n} i P_{X}[i]$$

which follows naturally by breaking the summation into parts. Now since we have a probability distribution, $P_{X}[i] \geq 0$ and $n \geq 0$ we obtain

$$E[X] = \sum_{i=1}^{k-1} i P_{X}[i] + \sum_{i=k}^{n} i P_{X}[i] \geq \sum_{i=k}^{n} i P_{X}[i]$$

Now note that for this second sum, $i \geq k$ for all $i$ which yields

$$\sum_{i=k}^{n} i P_{X}[i] \geq \sum_{i=k}^{n} k P_{X}[i] = k \sum_{i=k}^{n} P_{X}[i] = k P_{X}[X \geq k].$$

Finally, putting this together we get

$$E[X] \geq k P_{X}[X \geq k]$$

and this is the desired result. $\square$

As we can see, this is limited as it can only be used as an upper bound, and as we will see in an example, the results can be sometimes unhelpful. However, Markov is a building block for the stronger theorems, and its derivation is beautiful.

**Ex. 1.4.1** Let us again continue to examine the coin flipping problem that we have started. We know that when we flip a fair coin 100 times, the expected value for the number of heads is 50. Markov's Inequality will tell us that

$$P_{X}[X \geq 75] = \frac{50}{75} = \frac{2}{3}$$
This tells us that there is less than a 2/3 chance that the number of heads will be at least 75. Intuitively we know that the actual probability of this should be a lot less, so let us consider this in general for n flips of a coin. It can be easily verified that \( E(X) = 0.5n \). Now let's consider what Markov says about the probability of flipping a coin n times and obtaining heads 75% of the time or more.

\[
P_{1/3}(X \geq 0.75n) = \frac{0.5n}{0.75n} = 2/3
\]

and this holds for any value of n!

This example shows the weakness of Markov's Inequality as a stand-alone test. The law of large numbers tells us that if we take an experiment of size n, that as n increases, the value of X will come closer to its expected value. While Markov is not incorrect in its assessment that the probability of flipping heads at least 75% of the time is less than two thirds, it is very precise.

1.4.2 Chebyshev's Inequality

In response to this relative lack of precision, Chebyshev comes along and uses the Markov Inequality to build his own, much stronger inequality, which will give a stronger result in almost all cases, as it uses the variance of the data.

Theorem 1.4.2 Chebyshev Inequality is

\[
P_{\epsilon}(X \neq (1 \pm \epsilon)E[X]) \leq \frac{\text{VAR}[X]}{\epsilon^2E[X]^2}
\]

for a given random variable, X, and some \( \epsilon > 0 \).

Proof. This version of Chebyshev's Inequality is based off of an equivalent statement

\[
P_{\epsilon}(|X - E[X]| \geq \epsilon) \leq \frac{\text{VAR}[X]}{\epsilon^2},
\]

Let's start by showing this statement and then generalizing to our desired result.

Start by defining a random variable \( Y = (X - E[X])^2 \). Then it follows that \( E[Y] = \text{VAR}[X] \). Applying Markov yields

\[
P_{\epsilon}(|X - E[X]| \geq \epsilon) = P_{\epsilon}[Y \geq \epsilon^2] = \frac{E[Y]}{\epsilon^2} = \frac{\text{VAR}[X]}{\epsilon^2}.
\]

From here we want to get our desired result, and we have

\[
|X - E[X]| > \epsilon E[X] = \begin{cases} X - E[X] > \epsilon E[X] & \text{if } X > E[X] \\ X - E[X] < -\epsilon E[X] & \text{if } X < E[X] \end{cases}
\]
This is equivalent to

\[
\begin{aligned}
X > (1 + \varepsilon)E[X] & \quad \text{if } X \geq E[X] \\
X < (1 - \varepsilon)E[X] & \quad \text{if } X < E[X]
\end{aligned}
\]

and we will denote this as \(X = (1 \pm \varepsilon)E[X]\) for shorthand.

Therefore we can find our desired inequality by using the first inequality

\[
F_X[X \neq (1 \pm \varepsilon)E[X]] = P_X[|X - E[X]| < \varepsilon E[X]] = \frac{V_{d_X}[X]}{\varepsilon^2 E[X]^2}
\]

and that is our result. □

Now let us examine the coin flipping example with Chebyshev.

**Ex. 1.4.2** For the general case of flipping a fair coin \(n\) times, with expectation for the number of heads \(E[X] = 0.5n\), and using the binomial variance of \(0.25n\), Chebyshev tells us that

\[
F_X[X \neq (1 \pm \varepsilon)0.5n] \leq \frac{0.25n}{\varepsilon^2 n} = \frac{1}{\varepsilon^2 n}
\]

and if we use this with, say, \(\varepsilon = 0.1\) and \(n = 100\), we obtain

\[
F_X[X \notin [50, 55]] \leq 1.
\]

While this does not seem that much more useful, if we take the limit of the function as \(n\) gets larger we see

\[
\lim_{n \to \infty} \frac{1}{\varepsilon^2 n} = 0.
\]

As \(n\) gets larger, we can see that the probability of the value of \(X\) being outside some specified epsilon region of the expected value is becoming very small in accordance with the law of large numbers.

Not only does Chebyshev’s Inequality give a better estimate for the probability, it also gives both upper and lower bounds, making it a much more powerful method of calculating the probability.
Chapter 2
Graph Theory

This chapter is designed to give the reader some basic knowledge of graph theory. The first section will be the basics of graph theory, including terminology and basic theorems. After that, we will move on to how to use probability theory to graph theory.

2.1 Introduction to Graph Theory

Graph Theory is a relatively young form of mathematics that is already huge in its theory and applicability. There are theorems that have not been solved, and there is an ongoing pursuit to discover theorems that are "from the book" in the words of Paul Erdös, famous mathematician with a deep interest in graph theory.

Def. 2.1.1 A graph is a set of vertices and adjacencies between vertices called edges. We will denote a graph by

\[ G(V, E) \]

where \( V \) is the number of vertices and \( E \) is the number of edges or adjacencies.

This is different than the traditional concept that a graph is a set of points on an x-y axis. While Fig. 2.1 may not look like much, most graphs have fascinating properties.
**Def. 2.1.2** An **empty graph** is any graph that has no edges between any of its vertices.

The empty graph is the simplest type of graph and is sometimes called the trivial graph. Generally there are not too many interesting properties about the empty graph, but it is the basis from which all other graphs are derived. The next type of graphs are more interesting, and it is the opposite of the empty graph.

**Def. 2.1.3** The **complete graph** is a graph of vertices with every possible edge connected.

In other words, every pair of vertices are adjacent to one another. There is a special relationship between any empty graph and the complete graph on a given number of vertices. They are called graph conjugates.

**Def. 2.1.4** For every graph \(G(V,E)\), there is a **conjugate graph**, \(G'(V,E')\) with the same vertex set and edges such that for any two vertices \(x_1\) and \(x_2\), if edge \(x_1,x_2\) exists in \(G\), then it does not in \(G'\) and vice versa.

For vertices:

**Def. 2.1.5** If we consider a vertex \(v\), then any vertices adjacent to vertex \(v\) is said to be in its **neighborhood** which is denoted \(\Gamma(v)\).

**Def. 2.1.6** The **degree** of a vertex is the number of vertices that are adjacent to (or share an edge with) that vertex or the size of its neighborhood; the degree of a vertex \(v\) is denoted \(\deg(v) = |\Gamma(v)|\).

For a graph \(G(V,E)\), a vertex in that graph can have a degree

\[0 \leq \deg(v) \leq v - 1\]

because obviously a vertex cannot have a negative degree or be connected to more vertices than there are in the graph.

The next topic of interest is the edges themselves. How many edges does a graph contain? Is there an easy way to count them? There is a way to count the number of edges in the graph using the degrees of the vertices.

**Theorem 2.1.1** The Fundamental Theorem of Graph Theory says that if we multiply the sum of the degree of each vertex in \(G\) by \(1/2\), then that will equal the number of edges in the graph.

\[
\frac{1}{2} \sum_{v \in V} \deg(v) = |E|
\]

**Proof.** To prove this is quite straightforward. The degree of a vertex is the number of edges that are connected to that particular vertex. If we sum over all the vertices in a graph, then that should cover every edge in the graph. The process counts each edge twice however. Say we are given two adjacent vertices \(x_0\) and \(x_1\). Then we know that there is one edge between them. If we look at the degree of \(v_0\), we see it is one, and the same result for \(v_1\). They both include the same edge and so we must take the total and divide it by two, thereby undoing the double counting.
It follows from the fact that every edge connects two vertices that the total we calculate by summing the degrees will always be twice the number of edges, and therefore we must multiply the sum by 1/2 in order to arrive at the number of edges in the graph. □

There we have our first theorem in graph theory. While it is probably not the most exciting theorem, it is very useful.

We have already discussed some properties of graphs, such as a graph that is complete or empty. Now we will see a few more.

**Def. 2.1.7** A path in a graph is a set of adjacencies between two or more vertices such that if a graph has a path of length \( m \) \( \{v_1, v_2, v_3, \ldots, v_m\} \), it must have edges \( \{v_0, v_1\}, \{v_1, v_2\}, \ldots, \{v_{m-1}, v_m\} \)

---

**Figure 2.2:** Path of size 5

An example of a path is given in Fig. (2.2). We can use this to define a cycle.

**Def. 2.1.8** A cycle is a path in which the first and last vertex are the same. If we have a path \( \{v_1, v_2, \ldots, v_m, v_1\} \), then we have a cycle of size \( m \).
This brings up a lot of questions about cycles as subgraphs. If a graph does not contain a cycle, it is a very special type of graph.

**Def. 2.1.9** A tree is a graph $T(V,E)$ that is acyclic, or does not contain a cycle of any size.

From here we can expand the concept of trees into forests.

**Def. 2.1.10** A forest is a union of one or more disconnected trees.

There is an entire branch of Graph Theory that studies trees and its properties. There are many interesting properties of trees, such as the fact that between any two vertices in a tree, there is only one path that connects them. This is necessary because if there were more than one path connecting two vertices, then the two paths combined make a cycle in the graph which contradicts the fact that it is a tree.

Sometimes we might like to look at what is connected to what. An easy way to examine this is to break a graph into partitions.

**Def. 2.1.11** A bipartite graph is a graph in which the vertices can be separated into two partitions such that there are no edges within either partition. This definition can be extended into the $n$-partite graph, which is a graph that can be split into $n$ partitions such that there are no edges in any of the partitions.
This can reveal many interesting properties of a particular graph. Suppose we assign a color to each partition, then we can effectively color a graph's vertices in such a way that no connected vertices will have the same color.

There is a theorem called the four color theorem that says that any map, such as one of the United states, can be colored in such a way that no two bordering territories will be the same color with as few as four colors. There is a special name for such maps.

**Def. 2.1.12** A **planar** graph is a graph that can be drawn on a plane in such a way that no edges cross.

It is known that all complete graphs on four vertices or less are all planar, but the complete graph \( K(5) \) is not. Also, the complete bipartite graph in Fig. 2.4 is not a planar graph. Wagner’s Theorem states that a graph is planer if and only if it does not contain a minor of \( K_5 \) or \( K_{3,3} \). This result was proven by Robertson and Seymour.

### 2.2 Applying Probability Theory

This section is meant as an introduction on how to use probability theory in graph theory. Since most of the theorems require something slightly different, this section will not be very long.

### 2.3 Some Theorems

In this section, we will review some theorems in graph theory that use probability theory.

**Theorem 2.3.1** Let \( G \) be a simple graph with \( n \) vertices and \( m \) edges, where \( m \geq 4n \). Then

\[
\Pr(C^2) \geq \frac{1}{16} \frac{m - n}{n^2}.
\]
Proof. Consider a minimal embedding of $G$, and let $p$ be a number between 0 and 1 (to be chosen later). Choose independently every vertex with probability $p$, and denote by $G_p$ the graph induced by the vertices that are present in $G_p$.

Let $n_p$, $m_p$ and $X_p$ be the random variables counting the number of vertices, of edges, and of crossings in $G_p$. Since

$$cr(G) - m + 3n \geq 0,$$

for any graph, we certainly have the expectation

$$E[n_p] - m_p + 3n_p \geq 0.$$

Now we proceed to compute the individual expectations $E[n_p]$, $E[m_p]$ and $E[X_p]$. Clearly, $E[n_p] = pn$ because we have

$$E[n_p] = \sum_{i=1}^{n} P_{i} \left[ m_i \in n_p \right] = \sum_{i=1}^{n} p = pn$$

from the fact that the probability of any $i, \in G_p$ is $p$.

It follows from this that $E[m_p] = p^2 m$ because an edge appears if and only if both of its endvertices do. The vertices appear independent from one another, so $P_{j} [m_j] = p^2$ for all $j \in [1, m]$.

Finally, $E[X_p] = p^4 cr(G)$. By the same logic as the edges, $X_k$ appears if and only if all four (different!) vertices are there, and the probability is therefore $P_{k} [X_k] = p^4$ for $k \in [1, cr(G)]$.

By linearity of expectation, we thus find

$$0 \leq E[X_p] - E[n_p] + 3E[m_p] = p^4 cr(G) - p^2 m + 3pn.$$
and with a little algebraic manipulation,

\[
\varphi(G) \geq \frac{p^2 m - 3pnr}{p^4} = \frac{m}{p^2} - \frac{3n}{p^3}
\]

Here comes the punch line: Set \( p = \frac{4n}{m} \) (which is at most 1 by our assumption). Then the previous equation becomes

\[
\varphi(G) \geq \frac{1}{64} \left( \frac{4n}{(n/m)^2} - \frac{3n}{(n/m)^2} \right) = \frac{1}{64} \frac{m^3}{n^2}
\]

and there it is. □
Chapter 3
Number Theory

Number Theory dates back to Euclid and his elements, but only recently has it become a separate division of mathematics. (Recent in this case means within the last couple hundred years). Prime Numbers and all of its mysteriousness are intertwined in Number Theory.

Prime Numbers are one of the oldest mysteries in mathematics. While, at first glance, they appear to be distributed rather randomly throughout the numbers, after closer observation, one can see that they seem to fit a nice trend. That leaves some big questions. Is there a methodical way to compute primes? Is there even a way to count primes? Some of the most famous theorems in mathematics are focused on these questions. One of particular interest is that of Bernhard Riemann. He hypothesized that the zeta function could be used to count exactly the number of primes less than or equal to a number.

Let's start with a very nice proof that will use the probability theorems that we have set up. Consider a number \( n \), and the number of primes \( p \) that will divide into \( n \). Almost all numbers will have close to \( \ln n \) prime factors. A proof of this was first discovered by Hardy and Ramanujan in 1920, but this proof is long and rather technical. In 1934, Paul Turán discovered a probabilistic proof that "played a key role in the development of probabilistic methods in number theory."

Before we are able to look at this proof however, we need to observe some minor results in number theory. First let's look at the partial sum of the reciprocals of primes.

**Theorem 3.0.1** For the sequence of primes at most some number \( n \), \( p \leq n \)

\[
\sum_{p \leq n} \frac{1}{p} = \ln \ln n + C
\]

**Proof.** Let us begin by defining

\[
C(t) = \sum_{n \leq t} c_n
\]

where \( c_1, c_2, \ldots \) is a sequence of numbers, and let \( f(t) \) be any function of \( t \). Then

\[
\sum_{n \leq t} c_n f(n) = C(t) f(t) - \int_{n_1}^{n} C(t) f'(t) dt
\]

when \( f(t) \) has a continuous derivative for \( t \geq n_1 \). We will use this and let \( c_p = \ln p / p \) and \( c_n = 0 \) when \( n \) is not prime. From this,

\[
C(t) = \sum_{p \leq n} \frac{\ln p}{p} = \ln \ln n + \psi(x)
\]

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where \( r(x) = O(1) \). If we take \( f(t) = 1/\ln t \), then

\[
\sum \frac{1}{p} = \frac{C(x)}{\ln x} + \int_2^x \frac{C(t)}{\ln^2 t} dt
\]

\[
= 1 + \frac{\tau(x)}{\ln x} + \int_2^x \frac{dt}{\ln t} + \int_2^x \frac{\tau(t)}{\ln^2 t} dt = \ln \ln x + B_1 + E(x)
\]

where \( B_1 = 1 - \ln \ln 2 + \int_2^{\infty} \frac{\tau(t)}{\ln^2 t} dt \) and

\[
E(x) = \frac{\tau(x)}{\ln x} - \int_2^x \frac{\tau(t)}{\ln^2 t} dt = O \left( \frac{1}{\ln x} \right).
\]

Hence we have what we want. \( \square \)

Now that we have the tools that we need, let's take a look at the following theorem.

**Theorem 3.0.2** Let \( \omega(n) \rightarrow \infty \) arbitrarily slowly, then the number of \( x \) in \( \{1, \ldots, n\} \) such that

\[
|\nu(x) - \ln \ln x| > \omega(n) \sqrt{\ln \ln x}
\]

is \( o(n) \).

**Proof.** We will start by choosing a number, \( x \), from the set \( \{1, \ldots, n\} \) randomly. For a prime \( p \) set,

\[
X_p = \begin{cases} 1 & \text{if } p | x \\ 0 & \text{otherwise} \end{cases}
\]

as our random variable, and set \( X = \sum X_p \) the summation over all primes \( p \leq n \). Then we have that \( X = v(x) \). Our expectation of the variable of \( X_p \) is \( E[X_p] = \frac{\lfloor x/p \rfloor}{\omega(n)} \) because the probability of choosing any number from our set is \( 1/n \) and there are \( \lfloor n/p \rfloor \) numbers in the set that are divisible by \( p \).

From the definition of the floor of a number we observe that \( y - 1 < \lfloor y \rfloor \leq y \). In our case,

\[
\frac{n}{p} - 1 < \lfloor \frac{n}{p} \rfloor \leq \frac{n}{p} \implies \frac{1}{p} - \frac{1}{n} < E[X_p] \leq \frac{1}{p}.
\]

Therefore \( E[X_p] = \frac{1}{p} + O(n) \).

By the linearity of expectation and the previous result,

\[
E[X] = \sum_{p \leq n} E[X_p] = \sum_{p \leq n} \frac{1}{p} + O(n) = \ln \ln n + o(1)
\]

as \( \sum_{p \leq n} 1/p = \ln \ln n + o(1) \), and

\[
\sum_{p \leq n} O(n) = n(n) * O(n) \sim O(1/\ln n) = o(1).
\]
Now we will need to bound the variance. From the previous result on variance,

\[ V_A(X) < \ln(\ln(n)) + \alpha(1) + \sum_{\text{prime } p} \text{cov}(X_p, X_q) \]

For the covariance consider \( p \) and \( q \) to be distinct primes. Then it becomes clear that \( X_p X_q = 1 \) if and only if \( p | x \) and \( q | x \) which happens when \( pq \mid x \). Therefore,

\[
\text{Cov}(X_p, X_q) = E[X_p X_q] - E[X_p] E[X_q] = \frac{|n/pq|}{n} - \frac{|n/p| |n/q|}{n^2} \\
\leq \frac{1}{pq} - \left( \frac{1}{p} - \frac{1}{n} \right) \left( \frac{1}{q} - \frac{1}{n} \right) \leq \frac{1}{n} \left( \frac{1}{p} + \frac{1}{q} \right)
\]

and thus we have

\[
\sum_{p, q \neq p} |X_p X_q| \leq \frac{1}{n} \sum_{p, q \neq p} \left( \frac{1}{p} + \frac{1}{q} \right)
\]

Now if we hold \( p \), the total number of terms \( q \) that will be paired with \( p \) in order to get \( n \) is every prime less than \( n \) that is not \( p \) itself. That leaves \( \pi(n) - 1 \) primes. For the covariance, pair will appear twice \((p, q)\) and \((q, p)\). Using this we get that our sum is

\[
\frac{\pi(n) - 1}{\pi(n)} \sum_{\text{prime } \pi} \frac{2}{p} \leq \frac{\# \ln \ln n}{\#} 2 \ln \ln n = \alpha(1)
\]

Thus the covariance does not affect the variance and \( V_A[X] = \ln \ln n + o(1) \).

Now we can use Chebyshev’s Inequality which tells us that

\[
P_{1\text{c}}(|X| > \epsilon \sqrt{\ln \ln n}) \leq \frac{\ln \ln n + o(1)}{\epsilon^2 \sqrt{\ln \ln n}} \leq \frac{1}{\epsilon^2} \Rightarrow \epsilon = \epsilon(1)
\]

for some constant \( \epsilon \). □
Bibliography


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Adriana is a biology major with a minor in Spanish. She was born in Cali, Colombia and moved to the United States at the age of sixteen. She has received certificates of superior achievement in Spanish and French from the Department of Foreign Languages and Literatures and has translated for the U.S. Immigration Office in Reno, Nevada. She has been on the Dean’s list, received the Gates Millennium Scholarship, Ronald McDonald Scholarship amongst other scholarships during her undergraduate school years. She has had two poems and a short story published in the *Voces* magazine. Adriana spent several weeks in Costa Rica to gather information for her research project and she presented her research at the 2005 University of New York at Buffalo McNair Scholars Conference. She’s planning to enter the Spanish graduate school program at the University of Nevada in fall 2006. She does desire to pursue a doctorate degree in marine biology in the future.

**ABSTRACT**

This research study involves traveling to Monte Alto Natural Reserve in Costa Rica to do an inventory of diurnal butterflies within a period of 16 days. This reserve did an inventory during the dry season of 2002 and found 91 species of butterflies. The objective was to see how many of those species were still there and if any new species could be found. Butterflies were captured using a net and/or by taking digital pictures. Thirty-nine species were found, including twenty-one new species that had not been previously recorded. This study will help the Monte Alto Natural Reserve shape its future conservation plans.
INTRODUCTION

Butterflies are important components of biodiversity as pollinators and herbivores (Wheelwright and Nadkarni 2000). Some species, such as the monarch (*Danaus plexippus*), travel long distances and therefore provide long-distance pollination services for many ecosystems (Losey et al. 1999). Butterflies also provide excellent examples of mimicry in nature (Henderson 2002, DeVries and Penz 2002). Various species of these insects have evolved mimicry to defend themselves from predators, imitating color patterns of other species which have a bad taste or which might be unpalatable to predators.

After birds, the Lepidoptera, which includes butterflies and moths (about 13,500 species of Lepidoptera are said to exist in Costa Rica), are in second place in attracting eco-tourists to the biological hotspot of Costa Rica (Wheelwright and Nadkarni 2000). Out of these thousands of species, around 1,250 are said to be diurnal butterflies (Henderson 2002).

Monte Alto Natural Reserve is part of Costa Rica's rural community tourism (Fig. 2). Founded in June, 1992, Monte Alto is small in area (350 hectares, including 5 kilometers of trails) compared with other natural reserves in Costa Rica, yet it is of great importance to the community of Hojancha as its water source. Located 4 kilometers north of the reserve, this village was suffering in the early 1990's from a shortage of water due to deforestation occurring near the mouth of the Nosara River (Miguel Méndez 2005). With the help of several organizations, including PNUD (Programa de las Naciones Unidas para el Desarrollo/United Nations Program for Development), Tropica Verde, Fondo Canje Deuda Costa Rica-Canada, IMAS (Instituto Mixto de Ayuda Social/Mixed Institute for Social Aid), ICAFE (Costa Rican Coffee Association), CACH (Centro Agrícola Cantonal de Hojancha/Agricultural Center of Hojancha), MINAE (Ministerio de Ambiente y Energía/Energy and Environment Ministry), and the municipality of Hojancha, the project of recovering the river was initiated (Arantxa 2002, United Nations Development Programme). The reserve is constantly receiving donations and is looking forward to expanding by 33 more hectares during the next two years.

In a study done at another reserve in Costa Rica, Las Cruces Reserve (area of 227 hectares), scientists found 196 species of butterflies (Horner-Devine et al. 2003). These scientists were doing their studies during the two main seasons in Costa Rica, the dry season and the wet season. Willmott and Hall (1993) did yet another general research in various places of Costa Rica, including the Tárcoles River, Las Alturas, La Suiza, Virgen del Socorro, Osa Peninsula, Golfito, and San Vito, looking for species of butterflies that DeVries (1987) apparently did not record. These studies allude to a constant need to study species in an area over the years in order to be able to see a pattern or to maintain a more specific awareness of the species biodiversity in the area. A previous study at Monte Alto Natural Reserve on butterflies was done during the dry season (Miguel Méndez 2005). My project took place during the wet season 2005 with the objective of complementing Monte Alto’s previous inventory and adding to the knowledge of the area's biodiversity.

Costa Rica is increasingly devoting its resources to eco-tourism. As more and more people invest in this type of business, scientific research is constantly needed to record any changes in plant and animal populations due to human impacts. Only with reliable data is it possible for governments and ecological attractions to make important decisions that both conserve natural resources and allow for the continuance of eco-tourism. An example of an important decision that the government of Costa Rica took not long ago was to pay private landowners for their contribution to habitat conservation within their lands (Horner-Devine et al. 2003). This decision was taken most likely because the Costa Rican government has realized the importance of taking care of its natural environment that attracts scientists as well as eco-tourists from around the world.
Monte Alto Natural Reserve is part of Costa Rica's rural community tourism (Fig. 2). Founded in June, 1992, Monte Alto is small in area (350 hectares, including 5 kilometers of trails) compared with other natural reserves in Costa Rica, yet it is of great importance to the community of Hojancha as its water source. Located 4 kilometers north of the reserve, this village was suffering in the early 1990's from a shortage of water due to deforestation occurring near the mouth of the Nosara River (Miguel Méndez 2005). With the help of several organizations, including PNUD (Programa de las Naciones Unidas para el Desarrollo/United Nations Program for Development), Tropica Verde, Fondo Canje Deuda Costa Rica-Canada, IMAS (Instituto Mixto de Ayuda Social/Mixed Institute for Social Aid), ICAFE (Costa Rican Coffee Association), CACH (Centro Agrícola Cantonal de Hojancha/Agricultural Center of Hojancha), MINAE (Ministerio de Ambiente y Energía/Energy and Environment Ministry), and the municipality of Hojancha, the project of recovering the river was initiated (Arantxa 2002, United Nations Development Programme). The reserve is constantly receiving donations and is looking forward to expanding by 33 more hectares during the next two years.

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My project attempted to find a larger number of butterflies, including all of the 91 species of diurnal butterflies that the reserve found previously (Monte Alto Natural Reserve literature 2004). Previous data indicate a large number of butterflies in Costa Rica tend to travel during their lifetime: “About 80% of the Pacific lowland butterfly species migrate” (Wheelwright and Nadkarni 2000, Haber 1993), and most of the species return to Costa Rica's Pacific side during the month of May (Wheelwright and Nadkarni 2000).
Another study done in Monteverde indicated that an astounding 53% of the reserve's butterfly species migrate towards the Pacific coast of Costa Rica during the months of April through June (Haber 1993). Thus, I hypothesize that wet-season collecting will add to the 91 species of butterflies already recorded at Monte Alto Natural Reserve because of this reported migration pattern. From the data I will be able to see a pattern of migration in butterfly families at Monte Alto Natural Reserve.

**MATERIALS AND METHODS**

Surveys took place during the daylight hours, and butterflies were captured with nets. Some trails were partially covered with rotting fruit, such as mangoes and plantains because some butterfly species are attracted to rotting fruit (Wheelwright and Nadkarni 2000, Horner-Devine et al. 2003). Pictures were taken of the butterflies in their natural habitat if possible, but many would not remain in one place long enough to get an accurate picture, so these were captured with the net and then placed in envelopes or jars. Eight field guides and a website were used to identify the different species. The field guides of DeVries (1987, 1997) are very well known among scientists doing their research projects in Costa Rica, so they should provide accurate identifications (Horner-Devine et al. 2003, Henderson 2002, Willmott and Hall 1993, Haber 1993). These guides show detailed pictures of the different species and also provide information about specific collecting localities, larval host plants, and adult nectar sources, and individual habits.

**RESULTS**

Fifty-three species of diurnal butterflies were found at Monte Alto Natural Reserve during this 16-day wet-season study. By the end of the 16-day period, the species effort curve reached a peak and stabilized, signaling the end of the study (Figure 3). Of the 53 species, 18 were recorded in the 2002 study, 22 were absent in the 2002 study, and 12 species remain unidentified (Table 1). Of the 12 species that remain unidentified, 4 are butterflies and 8 are skippers. Also, in the 2002 study 14 families were recorded (Table 2), while in the 2005 study 13 families were found. Four families in the 2002 study were not found in the 2005 study, while three families in the 2005 study were not reported in the 2002 study (Figure 4,5).

![Cumulative Species Effort Curve](image)

Figure 3. Cumulative Species Effort Curve. This graph illustrates the rise in the peak of species being recorded until it asymptotes at 53 species during the last few days of the research.
Table 1. Biological inventory of diurnal butterflies found at Monte Alto Natural Reserve during the wet season 2005.

<table>
<thead>
<tr>
<th>Species</th>
<th>Family</th>
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<tr>
<td>Danaus eresimus</td>
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<tr>
<td>Agraulis vanillae</td>
<td>Heliconiinae</td>
</tr>
<tr>
<td>Greta oto</td>
<td>Ithomiidae</td>
</tr>
<tr>
<td>Mechanitis polymnia isthmia</td>
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<td>Melitaeinae</td>
</tr>
<tr>
<td>Morpho peleides limpida</td>
<td>Morphinae</td>
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</tr>
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<td>Pieridae</td>
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<td>Pieridae</td>
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<td>Charis gynaeia</td>
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Table 2. Biological inventory of diurnal butterflies found at Monte Alto Natural Reserve during the dry season 2002 and during the wet season 2005a

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Temenis loathe agata Nymphalidae
Temenis pulchra Nymphalidae
Nica flavila canthara Nymphalidae
Callicore pitheas Nymphalidae
Catonephele numilia esite Nymphalidae
Siproeta stelenes biplagiata Nymphalidae
Siproeta epaphus epaphus Nymphalidae
Anartia jatrophae Nymphalidae
Anartia fatima Nymphalidae
Junonia evarete Nymphalidae
Batus belus varus Papilionidae
Battus lycidas Papilionidae
Parides photinus Papilionidae
Parides montezuma Papilionidae
Parides iphidamas iphidamas Papilionidae
Eurythides philolaus Papilionidae
Papiliothoas nealces Papilionidae
Papilio turquatus tolus Papilionidae
Anteos clorinde Pieridae
Phoebis philea philea Pieridae
Phoebis sennae Pieridae
Aphrissa statira Pieridae
Phoebis argante Pieridae
Aphrissa boisduvalii Pieridae
Eurema proterpia Pieridae
Eurema albula Pieridae
Eurema daira Pieridae
Eurema nise Pieridae
Appias drusilla Pieridae
Itaballia demophile centralis Pieridae
Leptophobia aripa Pieridae
Ascia monuste Pieridae
Memphis euryppyle confusa Pieridae
Anaea aidea Pieridae
Cissia alcinoe Satyrinae-Brassolinae
Cissia calixa Satyrinae-Brassolinae
Cissia hermes Satyrinae-Brassolinae
Opsiphanes tamarindi tamarindi Satyrinae-Brassolinae
Pierella luna luna Satyrinae
Cissia hesione Satyrinae
Cissia retana Satyrinae
Urbanus proteus Hesperiidae
Isthmia isthmia Ithomiidae
Syrmatia aethiops Lycaenidae
Hemiargus isola Lycaenidae
Anthanassa drusilla Melitaeinae
Junonia Nymphalidae
Eurema elathea Pieridae
Catasticta notha Pieridae
Nymphidia ascolia Riodinidae
Mesosemia telegone Riodinidae
Charis gynaeae Riodinidae
Calephelis fulmen Riodinidae
Peropthalma tullius Riodinidae
*The species listed under the line in bold were found in the 2005 study.

**DISCUSSION**

Costa Rica has become a scientific laboratory for the whole world. Its high numbers of species and its people's efforts to protect them make this Central American country a haven for myriad biological studies. In doing this butterfly project at the Monte Alto Natural Reserve, the final objective was to find all of the species that the reserve claims in order to confirm their continued existence in the area and also to find new species to contribute to the natural reserve's list and therefore increase its tourism level.
The data collected from this research supports my hypothesis that a pattern of migration would be observed in different families, yet it did not support my hypothesis that a larger number of butterflies (including the 91 species previously reported) would be observed in the 2005 study than in the 2002 study.

It was hard to identify some of the species in this project due to the similarity of many of these to other species. Dr. Murphy at the University of Nevada, Reno, who has been specializing in butterflies for the past forty years, was asked to confirm the identifications. It was my first time handling butterflies and these animals are extremely delicate and some of the specimens' distinguishing marks might have been deteriorated during the handling process, which might account for errors in identification. For some specimens, for example Junonia, the subspecies could not be identified because the guides' pictures did not match exactly with the species' wing patterns. This might be observed because in different environments some species might diversify somewhat from their species due to mutations, natural selection, or other biological situations.

Some biologists place skippers in the same group as butterflies and others do not. It is hard to find a book that specializes in skippers; it seems like these species have not been studied as deeply as other butterfly species (Alcock 1988). In the future the idea is to contact the North American Butterfly Association and to try to promote Monte Alto Natural Reserve through their website. A translation of this paper into Spanish will be given to Monte Alto Natural Reserve as well, with pictures of the butterflies included. In subsequent studies perhaps it would be best to trap the butterflies using formaldehyde to decrease the chance of damaging their wings by using a net. Also, various butterfly species in Monte Alto Natural Reserve flew high in the tree canopies. Future studies should also focus on tree canopies to account for a more complete species list.

ACKNOWLEDGMENTS

I thank God for giving me and my loved ones a life full of great opportunities to progress. I thank Dr. Peter Brussard for being my mentor during this research project; Dr. Murphy for helping reconfirm the species; Marsha Dupree and Rita Escher for their constant support in the Ronald McNair Program; and my husband and my family for giving me the strength to continue my education. I also thank Chris Gienger for his idea about this project, his support and his enthusiasm.
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   II: Riodinidae." 2.


Haber, W. A. (1993). "Seasonal migration of monarchs and other butterflies in Costa
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   38(0): 201-207.


   "Countryside Biogeography of Tropical Butterflies." Conservation Biology 17(1):
   168-177.


Monte Alto Natural Reserve 2004 Brochure/Literature.


United Nations Development Programme.
### Appendix A

<table>
<thead>
<tr>
<th>Picture and scientific name</th>
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<td><em>Urbanus proteus</em></td>
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<td><em>Eurema elathea</em></td>
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Catasticta notha  

Nymphidium ascolia  

Mesosemia telegone  

Charis gynaea  

Calephelis fulmen  

Peropthalma tullius
Theope publius  
Riodinidae

Pixus corculum  
Riodinidae

Calephelis laverna parva  
Riodinidae

Cissia similis  
Satyrinae

Cissia satyrina  
Satyrinae
Ochlodes sylvanoides 

Pyrgus oileus 

Hylephila 

Achalarus 

Skipper 19 

Diurnal Butterfly Inventory at Monte Alto Natural Reserve
Aaron Modica
Mentor: Dr. Johnson Makoba
Major: Sociology
Research Topic: “Impacts of Globalization on Unionization in Mexico’s Manufacturing Sector”

Aaron is from Oakland, California and is Sociology major. He is a former TRIO scholar (SSS) who has served as a mentor to Upward Bound Program students here at the University of Nevada, Reno. He presented his research project at the 2005 Rocky Mountain McNair Conference in Colorado. He was accepted into the sociology master’s program at the University of Nevada and received a teaching assistantship. His plans include teaching and pursuing a doctorate degree in the future with an interest in Community Studies.

ABSTRACT

While U.S blue-collar manufacturing jobs continue to be sent overseas, the outsourcing of white-collar jobs has begun to draw concerns from professionals and politicians alike. This paper argues that the recent outsourcing trend of U.S service sector jobs in fields such as telecommunications and data processing, while qualitatively different from deindustrialization and the export of manufacturing jobs, is fundamentally similar in that it is a consequence of the search for cheaper labor and a more favorable investment climate overseas. This paper provides a brief discussion of the different approaches to understanding and explaining outsourcing and its relation to deindustrialization; a historical background of deindustrialization and the export of jobs; a discussion of current outsourcing of service jobs; and the role of the state in protecting outsourcing practices by large U.S Transnational Corporations.
Introduction

Although the outsourcing of manufacturing jobs and the deindustrialization process have received considerable attention since the 1970’s, the recent focus on the latest wave of white-collar service and professional jobs being exported across national boundaries has revitalized issues and concerns surrounding offshore-outsourcing and its impact on American workers. This past election President Bush confidently boasted the creation of 308,000 new jobs in March 2004 in support of large tax cuts. Senator John Kerry, however, was quick to point out that overall close to 3 million jobs had been lost in the U.S. and that the Bush administration had the worst jobs record since Herbert Hoover. In his campaign ads, Senator Kerry attacked President Bush for providing “tax breaks for companies that export jobs.”

As the debate over the economy between the two presidential candidates continued, on March 30, 2004, Johnson Controls, maker of auto parts, said that it was going to shift production to Ramos, Arizpe, Mexico and cut 1,065 jobs at plants in Michigan and Kentucky and begin winding down the production of visors at these two plants. Continuing the process of deindustrialization in the U.S. and the outsourcing of jobs to other countries, the cuts were made while Johnson Controls was predicting record profit for 2005, with sales expecting to increase from 8% to 10%.

While blue-collar manufacturing jobs continue to be sent overseas, the offshoring of white-collar jobs has begun to draw concerns from professionals and politicians alike. According to a recent Wall Street Journal article, it was estimated that 1.6 million white-collar jobs will be offshored by 2010 and that as of 2000, 300,000 white-collar jobs had been created in India servicing many U.S. clients. Both deindustrialization and outsourcing have cost millions of Americans their jobs and benefits while companies have gone abroad in search for lower wages in order to increase profit margins and earn super-profits.

This paper argues that the recent outsourcing trend or service sector jobs in fields such as telecommunications and data processing is, while qualitatively different from deindustrialization and the export of manufacturing jobs, fundamentally similar in that it is a consequence of the search for cheaper labor and a more favorable investment climate in developing countries. White-collar jobs, like manufacturing jobs, have become increasingly routinized, menial, and controlled, contributing to the degradation of skill for these positions.

The first part of this paper provides definitions of the concepts of important key terms that are used throughout the paper. The second part provides a brief discussion of the different approaches to understanding and explaining outsourcing and how it is related to deindustrialization. The third part of the paper provides a historical background of the deindustrialization process and job exportation. The final part of the paper discusses the link between deindustrialization, outsourcing, the search for super-profits, and the role played by the state in relation to outsourcing.

Definitions and Concepts: A Conceptual Analysis

Deindustrialization – In this paper, deindustrialization will refer to the widespread disinvestment in a nation’s basic productive capacity. It results from the conscious decision made by corporate managers to either move a productive capacity of production from one location to another or to shut down a facility all together. This process is viewed as partially being the result of outsourcing.

Outsourcing – In this paper, outsourcing describes the process of subcontracting services. In particular, outsourcing refers to the subcontracting of services such as data processing, human resource, and other back-office type work. Since the focus of this paper is job exportation, outsourcing will be used to also include the movement of jobs to other countries in conjunction with the substitution of foreign workers for U.S. labor.
Theoretical Approaches

In his book, *Exporting America*, Lou Dobbs attempts to address the problems of job outsourcing. Although Dobbs acknowledges that the logic of production in the Third World is not new and that outsourcing is connected to deindustrialization as corporations search for profit, he identifies the exportation of American jobs as a moral dilemma based on value-laden decisions. Chief executive officers (CEOs) of U.S. companies are confronted with choosing the interests of the nation or the interests of corporate profits. According to Dobbs:

Greed has overtaken a sense of higher responsibility to shareholders, to community, to employees, and to the public trust. Too many of these businesses are run with an indifference to basic American values and basic American responsibilities like paying fair share of taxes.⁷

While it is true that the decisions concerning the exportation of jobs overseas are made by corporate executives, Dobbs in his explanation does not situate these important decisions within the larger context of global capitalism or class relations. His analysis does not consider that the exportation of jobs is part of the larger process of global capitalism whereby the expansion of transnational capital throughout the world is a fundamental outcome of inherent systemic contradictions of advanced global capitalism. In particular, his analysis fails to consider how contradictions, such as the global exploitation of labor and the accumulation of wealth by transnational corporations (TNCs), are in fact forces that lead to transformations in the global division of labor.⁸ This criticism is relevant when pointing out that while condemning the decision to outsource American jobs, Dobbs confidently defends the cost cutting strategies used by the very CEOs he spends so much time criticizing for exporting jobs to save money. He writes, “I understand business cycles and the harsh necessity of cutting expenses and laying off employees in down cycles and recessions.” Cutting expenses includes offshoring.

Another approach to studying the exportation of both blue-collar manufacturing and white-collar jobs, one that is often held by proponents of these processes, views deindustrialization as a “creative destructive” process that is ultimately beneficial for everyone. “Creative Destruction” refers to the deindustrialization process where plants or firms shutdown and relocate resources to more efficient cost-effective firms that are able to offer consumers cheaper prices and allow the laid-off workers to compete in the “free” market for other jobs.⁹ In support of this view, the Information Technology Association of America (ITAA) in a published report wrote that “offshore IT software and services...has displaced and will continue to displace workers in IT software and services occupations...” and that “increased economic activity creates a wide range of new jobs—both IT and non-IT.”¹⁰ Another powerful entity supporting this view is the International Monetary Fund (IMF). According to an IMF report, deindustrialization is “simply the natural outcome of successful economic development and is generally associated with rising living standards.”¹¹ Here, deindustrialization and the shift to a service economy, one that is increasingly open to outsourcing, is seen as the result of enhanced productivity in manufacturing and increased supply of manufacturing workers, thus forcing the service sector to absorb some of the excess workers.

Two main criticisms of this view are that (1) deindustrialization has not had beneficial consequences for the U.S. working class and (2) that the service sector is not capable of absorbing all of those who were laid off from other sectors and new job seekers. Supporters of the “Creative Destructive” approach view the negative impacts of deindustrialization as temporary “shocks” to the economic system and that other problems are a result of normal business cycles and fluctuations. The approach does not consider the decline in U.S. manufacturing as being partly due to global shifts in manufacturing, reflective of the long-term decline of U.S. economic hegemony. This analysis also fails to consider the struggles between labor and capitalists as being significant in the decision to offshore production. In fact, the IMF concluded that countries that did not eliminate central wage bargaining in the service sector would face “serious challenges”.

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An alternative view on the link between deindustrialization and the outsourcing of jobs, one that will be used in this paper, is the class analysis. This approach holds that both deindustrialization and offshoring occur within the context of class struggle and global competition among the advanced industrial nations. The decisions of TNCs to offshore and disinvest in productive capacity in the U.S. and other advanced capitalist nations are intentional and controlled by individuals who represent and seek to advance the interests of an international capitalist class. Several proponents of class analysis have come to the conclusion that globalization is the logical outcome of the search for the private accumulation of super profits based on the exploitation of workers in the restructured global division of labor. Furthermore, unlike proponents of outsourcing and deindustrialization, advocates of the critical perspective hold that deindustrialization and outsourcing negatively impact the livelihood of the workers in the U.S. and other advanced capitalist countries.

In this paper, I argue that using a class approach allows for a deeper analysis of how the manufacturing sector and the service sector are adversely impacted by both outsourcing and deindustrialization. This position also attempts to look at structural forces and contradictions that motivate companies to relocate production and services abroad. This perspective rejects Lou Dobbs’s explanation of job exportation as being the result of personal sentiments of CEOs. The class approach also discusses how important control of the state is in enhancing the process of offshoring and deindustrialization.

**Historical Background**

The central feature of the structural crises of the U.S. economy has been the decline of industrial production. From 1967 to 1983, U.S. industrial output grew more slowly than that of any other major industrialized nation such as the European Union and Japan, except Britain. Facing increasing competition from other advanced industrialized nations, the U.S. global economic strength has significantly been challenged. After WWII, U.S. economic expansion occurred and generated short run profits. During this post-war economic boom that spanned through the 1950’s and 1960’s, capitalist world industrial output increased more rapidly than in any other 25-year span leading to an over-productive capacity resulting in economic decline in many industries. Following this period, however, slow growth occurred. From 1973-1985 per capita industrial production in the capitalist world declined, with reduction concentrated in the second half of this period. For example, from 1950 to 1983, the proportion of U.S. national income in the manufacturing sector declined from $32 billion to $22 billion. The challenge during this economic downturn was to restore earnings back to boom time levels.

The global competition of other advanced capitalist countries was an important force that contributed to both the outsourcing trend and deindustrialization in the U.S. From 1945 to 1980, besides Britain, the United States experienced the slowest economic growth than any other advanced capitalist country. As manufacturing declined along with profits, competition from other advanced industrialized countries continued to challenge the hegemony of U.S. capital. From 1957 to 1983, the U.S. share in world exports of manufactured goods dropped from 23% to 14% with the share of U.S. TNCs remaining stable. The strategy used by U.S. capitalists to overcome these problems became to free up capital and allow for more investments in the developing world, further integrating workers into the global capitalist division of labor. However, by allowing this, U.S. corporations were able to threaten or move production from one location to the next, to the U.S. South and overseas, in search of lower wages. The manufacturing sector in developing countries since 1960 disproportionately received the bulk share of total U.S. foreign direct investments.

This strategy has assisted TNCs in the class struggle by allowing them to pit workers from different parts around the world against each other. During the 1980’s, many American auto workers viewed Japanese workers as being the cause of lost jobs in the U.S. This, in part, fueled racist violence towards the Japanese, thereby deflecting worker anger away from auto executives.
Investing in the productive capacity of developing nations, especially in terms of the export of manufacturing jobs, had direct impact on U.S. workers in their bid to keep jobs in the U.S. and fight for a bigger share of company earnings. As a result of such disinvestment, U.S. jobs have been eliminated or moved overseas where wages are lower.

Class struggle and the strength of the working class is a very significant factor in the decision for capitalists to disinvest in U.S. industry and to begin the trend to outsource. The role that organized labor played in pressuring owners to spend more out of profits on wages and other employee benefits must be seen as an important factor contributing to the outsourcing of jobs. From 1969 to 1973 the number of strikes per year averaged about 350 while during the same time period the median family income increased by 2.5%. However, from 1989 to 1991 the number of strikes per year averaged around 50, while during the same time period the median family income decreased by a little over 2%. At its strongest point, labor unions in the U.S. during the late 1940’s until the early 1970’s were more able to collectively struggle against the demands of capital in the production process. Many scholars, however, have acknowledged that organized labor in the U.S. has been losing power and influence since the 1950’s. Nationally, union share of the workforce declined from 37% in 1946 to 12.5% in 2004. In the state of California alone, from 1951-1987, union membership as a percent of non-farm wage and salary work declined from 41% to 19.6%. Fifty years ago, a third of workers in the United States carried union cards, now it’s barely one in XX (STUDENT LEFT OUT #). The weakening of organized labor and the increasing international competition both have had important roles in the restructuring of the global economy towards economic liberalization and the intensification of the global division of labor.

Discussion

The central necessity of capitalism is expansion in order to accumulate capital. The aim is to extract more money out of different types of investments than you put into it for further reinvestment in order to expand earnings and contribute to corporate wealth. Thus, capitalist expansion encourages business strategies that save money. In relation to outsourcing, the aim is to find cheaper sources of labor, locations with little to no taxes, and avoid other costly expenditures.

To better understand how economic crisis is related to outsourcing and deindustrialization, we have to understand the accumulation of capital and the falling rate of profit. Although Karl Marx did not discover The Labor Theory of Value, he agreed with the proposition that the value of a commodity is equal to the quantity of socially necessary labor time required for its production. The value of labor depends on the number of hours needed to produce something. This is referred to as the necessary labor time. Marx pointed out that in order to maximize profits, capitalists must extend the number of hours worked while decreasing the necessary labor time (the number of hours a worker is paid). This process leads to exploitation, or how much is produced by a worker above and beyond what they are paid. Thus, a capitalist must increase the rate of exploitation to get more profits or surplus value.

Marx also pointed out that over time, production would become more dependent upon constant capital; in other words, relying upon the usage of machines rather than human labor (variable capital) for production. This meant that as production became more mechanized, less human labor would be required. This is an important point because if human labor produces the value of all commodities in a society, then the reduction of human labor would mean the decline of profits. Thus, strategies must be implemented that will continue to get more and more surplus value out of the working class. For example, the rate of surplus value increased from 150% in the 1950’s to over 300% by the mid 1980’s.

The drive for more profits creates economic crisis in that highly efficient machines are able to produce more goods in relation to that which can be purchased and the over-supply of workers in relation to the number of available jobs.
According to a *New York Times* article, America’s failure to generate jobs, along with outsourcing, has also been due to “the slow process of working through a glut of boom-era investment that continues to litter the economy with underused factories”. Concomitantly, if it exists that factories are underused, then there also exists men and women who are not needed for work.

U.S. TNCS obtain a higher rate of surplus value through the exploitation of foreign workers, while simultaneously weakening U.S. labor unions to increase exploitation here at home. In a Foreign Direct Investment Confidence survey conducted by the Global Business Policy Council, China was rated as the most desirable country to invest in, while a 1993 State Statistics Bureau survey of over 1,000 foreign investment enterprises found that 82% polled investors stated that cheap and abundant labor was their main reason for investing in China. The Bureau of Labor Statistics, when comparing manufacturing labor costs in the U.S. with other global rivals, found that the estimated average hourly compensation for manufacturing in China ranged from $.064 to $1.06 with benefits included! This figure is extremely low compared to the $21.11 an hour made by unionized American workers.

The question of cheap sources of labor also extends to India, where many information technology jobs have been offshored. According to Davies, author of *What’s This India Business?*, “The desire to reduce costs was the highest priority or business driver for outsourcing offshore.” When discussing the cost advantages that take companies offshore, Davies points out that a call center agent in the U.S. earns about U.S. $58,000 annually including benefits, while the direct equivalent worker in India earns about U.S. $12,000. In other words, with the cost of labor greatly reduced, TNCs are able to extract more surplus value out of skilled overseas workers. Davies points out that General Electric Financial Services and American Express reported to have saved over $450 million by taking Brookfield Properties Corp offshore in 2002. As with China, the same Foreign Direct Investment Confidence Index created by the Global Business Policy Council ranked India third in the level of confidence as a country to invest in. While it was reported that China served as an offshore outsourcing destination for labor and assembly purposes, global investors outsourced to India because of its skilled Information Technology, Research & Development, and Business Processing fields.

Foreign Direct Investment is the ownership of productive enterprises in other countries by corporations or capitalists. As the structural crisis of the 1980’s deepened as a result of increased foreign trade debt and growing competition from industrialized countries such as Japan (whose FDI in the U.S. was rapidly growing), the U.S. government exerted pressure to reestablish direct capital export. As a result, Mexico for instance, between 1994 and 2000 received much of its FDI from the United States (63%) compared to Netherlands (8.5%), Canada and Japan (4.3% each). In Mexico, much of the FDI was concentrated in the manufacturing sector (62%) compared to the financial services (14%), and commerce (11%). With more capital being invested into manufacturing, from 1994 to 2000, the number of maquiladora factories increased from 2,085 to 3,590, while during the same time span labor productivity in the maquiladoras went from $8,971 to $20,036,000 per worker. Like China and India, Mexico also provides a large pool of cheap labor. According to the Bureau of Labor Statistics, Mexico has the lowest worker compensation at $2.48 an hour (China is not included in the list). Still, wages as low as $1.75 were found in northern border maquiladoras. From 1994 to 2000, the U.S. increased its foreign direct investment from $4,886.1 million to $9, 851.2 million. The manufacturing sector, as a percentage of total FDI, increased from 57.9% to 62.6%.

Although cheap labor is an important consideration in understanding why corporations offshore, solely focusing on this factor yields an inadequate understanding of offshoring, disinvestment of the productive capacity in the U.S., and economic crisis. Trade between the U.S. and other countries is also a key factor. For example, the Mexican government, in cooperation with free-trade organizations such as the World Trade Organization (WTO), promotes exports through tax and duty concessions.
The maquiladora industry, located primarily along the U.S. Mexico border region where many electronic goods, automotive, clothing, and other industrial material are produced, allows foreign capital and primary goods free importation with no custom clearance, import duties, or most other taxes. The imported inputs incorporated into goods which are exported are not subjected to import tariff or Value Added Taxes (VAT). On the other hand, 100% of all products finished in maquiladoras have to be re-exported.  

In the case of Mexico, as a result of the economic restructuring designed to facilitate free trade through regional trade agreements such as the North American Free Trade Agreement (NAFTA), U.S. TNCs were able to save millions of dollars that otherwise would have been used to pay higher wages, benefits, and taxes in the U.S. NAFTA policies include the lowering of trade barriers, the privatization of public sector industries, and the deregulation of financial markets. Although NAFTA was advertised as beneficial for both Mexican and American workers and economies, it has turned out to primarily benefit large TNCs and the investors, while hurting Mexican workers. While real wages in Mexico have declined by 50% from 1980 to 1996 and an estimated 766,000 manufacturing jobs lost due to NAFTA, the workers in maquiladoras were able to generate $4.8 billion in value added in 1992.  

Workers in sectors of the U.S. economy that have traditionally been buffered from the effects of offshoring, such as computer programmers, have increasingly become more vulnerable to competition from the work of highly educated and trained workers in the Third World. While unemployment rates of all occupations combined in the U.S. fell from a little over 8% in 1983 to 5.6% in 2004, the unemployment rate for computer programmers rose from 2.5% in 1983 to 7.7% in 2004. Between 2000 and 2002 (the last available year of data), total manufacturing jobs fell by 12%, while software jobs within manufacturing dropped by 19%, affecting workers who were told for the past 20 years that they had precisely the skills needed to thrive in the global economy.  

The social consequence of the outsourcing of U.S. jobs to the Third World has placed increasing pressure on both blue-collar and white-collar workers alike to accept lower wages and salaries or have their jobs transferred abroad. As manufacturing jobs continue to be shut down and professional jobs continue to be outsourced, workers in both areas are forced to seek employment in the service sector where wages and benefits are much lower. This process contributes to the growing inequality in the U.S. According to a report published by the Congressional Budget Office research study, the gap between rich and poor in America is the widest in 70 years. From 2000 to 2002 the number of poor people increased by 1.7 million to 34.6 million; the poverty rate rose from 11.7% to 12.1%; and median household income fell by $500, or 1.1%, to $42,409. In conjunction with these figures are U.S. Census Bureau statistics that show that the number of Americans living in poverty increased by 1.3 million in 2003 to total approximately 35.8 million people.  

**The Role of the State in Deindustrialization and Offshoring**  

Although deindustrialization and outsourcing have adversely impacted the working class and are beginning to affect those in white-collar professions, the state is used to develop and implement domestic and foreign political decisions that benefit the owners of capital and support outsourcing. While outsourcing has many economic consequences, the decision to outsource is the result of political forces that shape how the economy is managed and society is controlled. In a recent interview, Treasury Secretary John Snow defended outsourcing by saying that it "is part of trade" and that "there can't be any doubt about the fact that trade makes the economy stronger." With outsourcing contributing to increased unemployment in such sectors as computer and information services, and the suppression of wages both in the U.S. and overseas, corporations receive incentives such as tax breaks that encourage offshoring. As wealth and political influence is accumulated and concentrated in the hands of fewer companies through corporate mergers, the influence that corporations have concerning government policies becomes more apparent as capitalists utilize the state to promote or protect their economic interests both at home and abroad.
One specific example of how the state is used by capitalists operating through TNCs to further their own political and economic interests can be found with the General Electric (GE) Corporation and its role in helping create a corporate tax policy that reduced taxes for TNCs, resulting in a shift of production from the U.S. to Mexico. In October of 1993, when discussing the benefits of the North American Free Trade Agreement (NAFTA), a representative from GE testified before the House Foreign Affairs Committee that “sales to Mexico could support 10,000 jobs for GE and its suppliers” and that “jobs depend on the success of this agreement.” However, in spite of this claim, in 1997 the Department of Labor’s NAFTA Trade Adjustment Assistance program (NAFTA TAA) certified that General Electric laid off 2,304 workers due to NAFTA, and of those 2,254 due to the relocation of production facilities from the U.S. to Mexico. In fact, a GE spokesperson in that same year was unable to cite any evidence of job gains due to relocating. This is in line with the fact that today GE’s workforce consists of a total of 23,000 workers, 17,000 of which are located in foreign countries.

Despite layoffs, outsourcing, and inability to achieve its projected job growth, GE was able to help shape corporate tax legislation that, according to its own lobbyist and congressional aids, would help allow it to save millions of dollars. This move to restructure U.S. international tax codes came as a response to the World Trade Organization's (WTO) 2002 findings (made on behalf of complaints made by the European Union) that (1) the longstanding Foreign Sales Corporation (FSC) tax breaks for certain U.S. exporters (including GE) were illegal and (2) tax breaks made under the Extraterritorial Income Act (ETI) were also illegal. As a result of the WTO ruling, GE stood to lose “hundreds of millions” a year in savings from export subsidies from the U.S. government.

In response to the WTO rulings, in September of 2004, the U.S. House of Representatives agreed to meet with the senate to discuss H.R. 4520, the “American Jobs Creation Act of 2004.” The major objectives of the Tax Relief for America’s Job Creators Act were to (1) enhance U.S. competitiveness by reducing corporate tax rates for both large and small domestic manufacturers and (2) create more American jobs by reducing taxes for manufacturing done in the United States, ending sanctions and encouraging business investment that will generate American job growth. Specifically the act would repeal FSC/ETI from the U.S. tax code so that the U.S. would be in compliance with the WTO.

Although previous forms of tax subsidies for U.S. companies were going to be repealed, this did not mean that companies would no longer continue to receive indirect forms of tax subsidies. To offset this loss and “revise the tax code to its like,” lobbyists for GE began pushing for legislation that would allow GE to continue to receive tax breaks in spite of the WTO rulings. In the Senate, GE was able to win a provision to make overseas leasing income tax-deferrable, while in the House Ways and Means Committee GE was able to win foreign tax credits.

From many of its manufacturing activities that could be used to reduce taxes owed on profits from its lucrative financial services division, GE Capital. With these new provisions, GE managed to avoid losing $5billion in export subsidies and secure $519 million in tax breaks over the next five years. Currently, after selling 60% of its stake in GE Capital International Services to General Atlantic Partners LLC and Oak Hill Capital Partners LLC, GE continues to own 40% of the company stake and continues to outsource back office processing to workers in India, while the other two companies seek more clients to offshore their services to.

With large amounts of concentrated wealth, TNCs such as GE are able to spend vast sums of money to have their political and economic interests represented. According to PoliticalMoneyLine.com, GE spent $7.54 million last year alone on lobbying and its political action committee, through which it donates to congressional candidates, ranking among the top 10 of all corporations this year in total donations. Along with large amounts of cash to contribute, many of the tax lobbyists for GE and other corporations are former government officials. This represents the essence of Washington D.C.’s “revolving door syndrome”.

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For example, GE’s Washington office is headed by former deputy Budget Office Director for the White House Nancy P. Dorn and employs former chairmen of the Senate Finance Committee Max Baucus (D-Mont.) and Lloyd Bentsen (D-Tex.). In the end, the tax bill was able to pass the House of Representatives 339 to 65 and the Senate 92 to 3.

The role of the state also extends to host governments where TNCs are relocating to. In Mexico, the state has been effective in controlling the work force in favor of the neo-liberal economic policies promoted under NAFTA that assist TNCs to accumulate capital by relocating production to maquiladoras. Recently, the National Action Party (PAN) and Mexican President Vicente Fox’s Institutional Revolutionary Party (PRI) have joined together to pass labor law reform known as The Abascal Project that would “make new union organizing all but impossible, leave existing unions virtually powerless, abolish longstanding labor protections, and turn overall power in the workplace to employers.” It is estimated that roughly 90% of all Mexico’s collective bargaining agreements are negotiated by non-independent, pro-government, pro-company unions. In regards to NAFTA, instead of being an arbitrator between workers and capital, the Mexican government in alliance with official unions has continually acted on behalf of the interests of domestic and international capital and has been obstacles for labor rights, union activity, and higher wages.

Conclusion

In regards to white-collar information service jobs and blue-collar manufacturing jobs, the evidence indicates that the search for super-profits resulting from cheap labor and tax incentives is occurring and will most likely continue in the near to medium future as the result of structural crisis of global capitalism. As a result, the search for higher profits will continue to lead to the outsourcing of many U.S. jobs. As the U.S. economy continues to experience a shift towards the service sector, industries such as computer software and telecommunications are likely to experience continued vulnerability to outsourcing as cheap labor in the Third World and global competition remain high priorities for TNCs.

As many U.S. TNCs continue to report super-profits through the exploitation of wage-labor at home and on a global scale with state approval, the question of whether workers in the U.S. and in the Third World will be able to resist such exploitative economic practices that result in adverse social impacts becomes ever important to address. Future research in the areas of labor organization/unionization and cross-border solidarity will be beneficial in understanding how unions are restructuring to adapt to an increasingly globalized economy. Furthermore, as the role of the state becomes increasingly significant in facilitating the global expansion of capital by TNCs through international and domestic political and economic policies, further study on counter-movements/protests to state practices will be useful in helping to understand the changes and transformations occurring in society as a result of the conflicting nature of economic practices such as outsourcing and deindustrialization.
Endnotes


38. www.politicalmoneyline.com


Diego Pulido

**Mentor:** Dr. Michael Webster  
**Major:** Psychology  
**Research Topic:** “Correlation Between High Anxiety Levels and Face Perception”

Diego grew up in Colombia before moving back to the United States. His major is psychology but he is very interested in computers and foreign languages. He was inducted into the Golden Key International Honor Society and has worked towards receiving an honors diploma. Diego was the first McNair scholar to present his research at an open forum that was held on the University of Nevada, Reno campus. He is fluent in Spanish, English and French and he’s still learning Italian and Portuguese. His hobbies include playing football (aka soccer in the U.S.), running, playing the classic and electric guitar. He loves traveling to various countries. He plans to enroll in a cognitive science or cognitive psychology program in graduate school.

**ABSTRACT**

Previous research involving face perception indicates that there are special mechanisms for coding faces in our brain. This research project examined the level of trait anxiety of the participants and their classification of anger and fearful facial expressions. It is predicted that when confronted with an ambiguous face composed of two emotions (angry/happy or fear/happy) the more anxious the participant is, the more differently he/she will judge an ambiguous face than will a less anxious participant.
INTRODUCTION

Face perception represents a very important task in people’s lives. Our capacity to perceive different characteristics in the faces we all see every day allows us to judge different personal attributes such as age, gender, identity, ethnicity and emotions. Even when we are all exposed to a large number of faces in our lifetime, we are still able to differentiate amongst them and identify their variations as well as their unique traits. This ability is very important for all of us as social beings in our social contexts.

Previous research involving face perception indicates that there are special mechanisms for coding faces in our brain. For example, there is evidence that upside-down faces become harder to recognize and characterize (Yin, 1969) compared to our perception of inverted non-face objects. Various investigations have used functional brain imaging (fMRI), electrophysiological recordings, and other types of neuroimaging, to identify a special region in the human brain involved in the process of face perception (Kanwisher, McDermott & Chun, 1997). Research has identified two regions in the human extra striate cortex responding particularly to faces. One of these is located in the mid-fusiform gyrus (FFA) and the other in the inferior occipital gyrus (IOG) (Hadjikhani & de Gelder, 2002). It appears that these ventral temporo-occipital areas of both hemispheres in the brain are necessary for face recognition, with some degree of specialization on the right (De Renzi, Perani, Carlesimo, Silveri & Fazio, 1994). But perhaps some of the most significant evidence for these special mechanisms in face perception arises from the inability to recognize faces altogether. This can result from selective damage caused by a stroke, a skull/brain injury or hypoxia in any of these areas of the brain (Grüter, 1999). Patients with Prosopagnosia, or “Face Blindness,” can name parts of the face and point to them, although they are unable to recognize a given familiar face and consequently are unable to name it (Damasio, 1982). All of this evidence shows us that face perception is a special perceptual process.

Very important as well, especially within our social context, is our ability to perceive facial expressions. Expressions provide perhaps the most effective means of communicating emotion (Etcoff & Magee, 1992). Emotional facial expressions let us know about another person’s feelings, as well as a person’s mental state (Bruce & Young, 1998). Previous research has yielded information on infants as young as 12 days old being highly responsive to and recognizing different facial expressions by trying to imitate the facial movements they see (Meltzoff & Moore, 1977), as well as one-year-olds who would not crawl over what looked like a cliff if their mothers showed a fearful facial expression, but would do so if the mother was smiling instead (Sorce, Emde, Campos, & Klinnert, 1985).

The study of facial expressions dates back to 19th century, when Charles Darwin (1872) wrote The Expression of the Emotions in Man and Animals. In his work, Darwin analysed the nature of facial expressions and stated his disagreement with the idea that each individual species was created with a specific set of behaviours, placing emphasis on the continuity of expressive behaviours across species (Bruce et. al, 1998). This calls for the idea that facial expressions may be universal, which would agree with Darwin’s argument. It has also been previously stated that people, in general, are very skilled at understanding other people’s facial expressions and appear to develop this ability at an early age (Nelson, 1987). In his aim to study possible universals regarding facial expressions, Paul Ekman (1972) went to Papua New Guinea, a country with a predominantly preliterate, isolated culture, where people had never seen television, magazines or photographs and had seen few or no outsiders. Thus these people did not have the opportunity to acquire facial expressions from other cultures. Natives from this culture were read various brief stories and then asked to choose a photo amongst a group of photos of different facial expressions that would fit the story previously told. As visually isolated as this culture was, their expressions of emotion were the same as it would be in any other part of the world (Ekman, 1972).
Even though when it may be appropriate to display emotions may vary, and languages may differ in how many words exist for each emotion (hence influencing the emotion caused by a certain word and making some people unable to think about an emotion in a culture that lacks a word for such) (Ekman, 1992)), basic emotional categories have been found in nearly all cultures. These include happiness, anger, sadness and disgust (Ekman, 1972). This tells us that there may be an innate process controlling emotional face expression.

In a study set to test whether perception of facial expressions is categorical, Nancy Etcoff and John Magee (1992, p.229) stated rationale as follows: “If expressions are perceived categorically, then within a series of facial expression stimuli differing by equal physical increments between two different emotions or between an emotion and a neutral state, the probability of identifying the expression as a particular emotion should not vary linearly across the series but should change relatively quickly at some boundary. Crucially, pairs of faces differing by a given physical amount should be discriminated more accurately when that difference straddles the category boundary.” According to this definition, small physical differences in a pair of faces should be easier to distinguish if they fall in two separate emotion “categories” than if they fall within the same. Results indicate that facial expressions of anger, fear, happiness disgust, sadness and neutrality are perceived categorically (Etcoff et. al, 1992). It is evident that “categorization is an adaptive feature of perception and cognition that allows us to respond quickly and appropriately to features of our environment” (Pollak & Kistler 2002, p. 9072). It is hence socially very important to pay special attention to the way people categorize the different facial expressions they judge every day.

There are between the different categories certain boundaries, which could be seen as the “turning points” from one expression of emotion to another. Perceiving in terms of categories allows people to assess changes between categories efficiently at the cost of noticing subtle changes in a stimulus (Pollak & Kistler, 2002). These categorical boundaries are not only perceived between emotions, but also between faces expressing an emotional category and a neutral face, suggesting that neutral faces are perceived as a separate category (Etcoff et. al, 1992). These “boundaries” have been used in previous research, such as in that of Webster, Kaping, Mizokami and Duhamel (2004), who measured the boundary between male and female faces or between two ethnicities. In this research, it was discovered that the category boundaries chosen by the participants appeared to be shifted towards the category that the participant him/herself belonged to. This means that both males and females tended to choose gender boundaries in a male-female array of faces that were shifted towards their own gender (Webster et. al, 2004,). These findings suggest that “observers may generally be more sensitive to how a face differs from their own category” (Webster et. al, 2004, p.559). Webster et. al.’s research (2004) also found the same effect for the difference among people in their perceptual boundaries between Caucasian and Japanese ethnicities.

On the other hand, there is research that claims that as far as facial expression goes, people tend to define and shift certain categorical boundaries more towards their own states rather than away from them, and thus in the opposite direction that Webster et. al. had found. In a study trying to find anxiety-related bias in the classification of ambiguous facial expressions, Richards, French, Calder, Webb, Fox and Young (2002) argue that high socially-anxious individuals displayed enhanced sensitivity to fear compared to low socially-anxious people when fear was one of the two component emotions in the faces being observed. This means, in other words, that people tend to perceive the boundary between two different facial expressions as shifted more towards their own emotional states. Hence, if there is an effect of anxiety on categorical face perception, then the results of Webster et. al. and Richards et. al. show that this effect could go either way toward bias categorical boundary. There is also previous research related to the possibility of enhancement of fear and anger detection in anxious individuals, such as in a study by Sprengelmeyer et. al (1997), which was focused on obsessive-compulsive disorder and the processing of disgust. Other research with supportive evidence by Pollak & Kistler (2002) involved abused children and evaluated their discriminatory abilities of basic emotions. They found that abused children tended to over-identify anger as opposed to non-abused children.
The present experiment is concerned with the level of trait anxiety of the participants and their classification of anger and fearful facial expressions. Based on previous research on face emotions and how they are perceived, it is predicted that when confronted with an ambiguous face composed of two emotions (angry/happy), the high-anxiety participant will judge an ambiguous face differently than a low-anxiety participant. We predict similar effects of anxiety on the perception of fear/happy ambiguous faces.

**EXPERIMENT**

This research examined whether participants with high-trait anxiety tend to perceive ambiguous faces between angry and happy as more angry than less anxious participants, and whether highly anxious participants tend to perceive ambiguous faces between fear and happy as more afraid than less anxious participants.

**Methods**

Judgments of variation in faces are often classified in categories like gender, ethnicity or emotional expression, among others. There are also subcategories within these, such as happiness, sadness, fear and anger within the category of emotional expression. For this experiment, a two-alternative-forced-choice (2AFC) was used in order to measure the boundary between two expression categories. The participants had to make a forced-choice classification of a composite morphed image by pressing a button box, thus classifying the image into one of the two categories. For this experiment, we morphed a face from an angry expression to a happy expression or from an afraid to a happy expression to create an array of 100 faces. Face number 1 was either the angry or afraid face. Face 100 was the happy face and face number 50 was the equal mixture of an angry/happy face and an afraid/happy face respectively (See Figure 1).

*The Two-Alternative-Forced Choice*

The 2AFC task provides a well-established psychophysical method to determine a participant’s perceptual judgements. Following the presentation of a variable stimulus (Sv), the observer is forced to choose one of two alternative responses (e.g. was the face shown happy or afraid?). The built-in staircase procedure adjusts the presented Sv according to the observer’s last choice. Sv will shift in the opposite direction of the observer’s choice. Accordingly, the newly presented Sv will shift in the opposite direction until the observer reaches a reversal point where response changes from the previous trial. At the reversal point, the image (1-100) is recorded and later averaged over a number of trials. The number of reversals must be set to take the observer within his or her threshold. Therefore the average of the reversal images represents the point along the given morph sequence where both choices are equally likely to be chosen.

*Stimuli*

Frontal-view male and female face images were taken from the Matsumoto and Ekman JacNeuF and JACFEE (1998) image set. The images are greyscales and extraneous parts, such as hair and ears removed by an oval mask (420 x 630 pix) so that only the internal face was visible. Each pair of faces was morphed, using Gryphon Morph Version 1.5. These pairs of faces were morphed to form a series of 100 images between two emotional expressions (happy/angry and happy/afraid). The full images measured 600 x 700 pixels displayed at approximately 10 degrees visual angle. For this experiment, the two expressions come from the same individual.
Participants

Participants included 36 undergraduate students of psychology at the University of Nevada, Reno. For each participant, we recorded their gender and ethnicity. All of the participants for this experiment were naïve to the purpose of the study. All of the participants took part in the experiment with informed consent. The experiment was approved by the UNR IRB.

Display

The stimuli were controlled by a Sony Vaio Pentium 4 and displayed through an Nvidia Riva TNT2 Model 64 (Sony) graphic card on a Sony Multiscan 20se II Trinitron monitor.

Procedure

The experiment began with a grey-coloured background on the screen and instructions to participants to press 4 on a numerical keypad if they thought the face they saw appeared angry or 6 if the face looks happy. The face flashed on the screen for 0.5 seconds and was separated from the next face by a blank screen shown for 0.3 seconds. The face kept flashing until the necessary number of reversals reached the “neutral” point for each participant. This part of the experiment was followed by two more sets of faces with the exact same procedure to make three sets of happy/angry faces in total. Then three sets of faces varying from happy to afraid were shown in the same way and with the same procedure as the previous three sets of happy/angry faces. In order to improve the reliability of the scores, each participant classified each one of the six morphing twice in order to later calculate the reliability between the first and second trial of the face task.

Once this part of the experiment was finished, the participants answered a set of five different questionnaires that assess levels of trait anxiety in individuals.

Questionnaires

The first questionnaire used in this experiment was the Brief Version of the Fear of Negative Evaluation Scale (BFNE) (Leary, 1983), a 12-item questionnaire which attempts to evaluate to what extent someone is afraid of the unfavourable evaluation by others. The second questionnaire was the Penn State Worry questionnaire (PSWQ) (Meyer et al, 1990), which has 16 items and attempts to measure the trait of worry. The Third questionnaire was the Social Interaction Anxiety Scale (SIAS) (Mattick & Clarke, 1998). Its purpose is to assess fears of general social interaction. It was decided to use the 20-items version as opposed to the 19-items version. The fourth questionnaire was the Intolerance of Uncertainty Scale (IUS) (Freeston, Rheume, Letarte, Dugas & Ladoceur, 1994), a 27-item questionnaire that assesses the degree to which an individual has difficulty tolerating uncertainty. Finally, the fifth questionnaire used for this experiment was the State-Trait Anxiety Inventory (STAI) (Spielberger, Gorsuch, Lushene & Jacobs, 1983), a 20-item scale to assess state and trait levels of anxiety.

Results

1. Questionnaires

The scores these questionnaires yielded show that the participants in this experiment are representative of the population that has been evaluated by these questionnaires in previous studies. There is a substantial range of scores, which shows that differences in trait anxiety among the participants varied significantly. Table 1 shows the Mean, Standard Deviation and Range for all five questionnaires.
2. **Face Settings**

The results from the different face settings also show that perception of facial emotions varied greatly among the participants. This indicates that the participants chose a wide range of differing categorical boundaries to represent the faces that appeared ambiguous to each one of them and, hence, that their face perception varied in a significant way. Table 2 shows the mean; standard deviation and range for the mean nulls for the 6 face pairs. Face pairs 1 to 3 varied between “angry” and “happy” expressions. Face pairs 4 to 6 varied between “fearful” and “happy” expressions.

3. **Correlation between the Face Settings**

The correlation between the different face settings was analyzed. It is evident that the participants placed the boundaries between the different face pairs in a reliable and consistent way. Each participant found each continuum of angry/happy faces to be equally angry and equally happy between the angry/happy face pairs. The same result was obtained for each continuum of the set of afraid/happy faces. Table 3 shows the strong correlation that was discovered between the different face pairs in a correlation matrix.

4. **Correlation between Mean of Face Setting and Questionnaires**

After the questionnaires and face setting responses were gathered, they were analyzed to test for any possible correlation between the ways the subjects perceived the varying faces and their levels of trait anxiety. Table 4 shows the analysis of this data. Correlations were modest between the questionnaires, but strong between the face pairs.

5. **Correlation between Mean of Face Setting and Questionnaires with Reliable Subjects**

The lack of correlation between the face settings and the questionnaires’ scores might have occurred because some subjects could not reliably judge the faces, thus contributing noise to the results. For the case of the face settings, this was tested by making the participants respond to each face pair twice. Reliable subjects will have similar and consistent results between trials. Unreliable subjects will have inconsistent and varying results between trials. It was thus decided to look at the range between the two trials for each participant, calculate the mean range for each face setting, and exclude any participant whose range was twice this mean. Again, the reason behind this decision was to exclude the participants that for any given reason were inconsistent in assessing a categorical boundary for the facial expressions being perceived. This allowed us to retain the correlations for consistent participants. The correlation between reliable subjects’ face settings and the five questionnaires was recalculated and the results are shown in Table 5. As seen on the table, there was now a significant correlation between the face setting of angry/happy and the Social Interaction Anxiety Scale (SIAS). This was a negative correlation of -0.59 and was highly significant (p< .005). The settings for this condition are shown on a scatter plot in Figure 3.

**Discussion**

Taking into account the concept of categorical face perception, this experiment attempted to assess the categorical boundary between two expressions by forcing people to say whether a face looks either happy or angry in the first set of three morphing faces between these two facial expressions, and forcing people to say whether a face looks happy or afraid in the second set of three morphing faces between these other two facial expressions. This boundary occurs at the image for which the participant is likely to offer either response. The five different questionnaires attempted to assess the anxiety levels of the participants. One of our main questions was to see if the measures of face perception gathered from the experiment were significantly correlated to the questionnaires’ measures of anxiety of each participant. The other main question of this experiment was to ask in what way people with different personality traits rate faces with varying facial expressions.
First of all, it was found that all the participants varied widely on the way they categorized different facial expressions. Given this, a question arises: was this variation correlated with the personality characteristics of the perceiver? This was analyzed by comparing the different face settings and the five questionnaires to test for possible correlations between these results. Most correlations were weak, but one correlation was significant. The face setting of facial expressions along the angry/happy continuum was strongly negatively correlated with the Social Interaction Anxiety Scale (SIAS), which assesses social anxiety. The fact that this was a negative correlation means that the more socially anxious a person is, the more likely this person is to see an ambiguous face as a happy face. It is not clear why this effect occurs in this way, though notably it is in the opposite direction to the biases found by Richards et. al. (2002), who showed that a high socially-anxious person is more likely to see an ambiguous face as more fearful than a low socially-anxious person.

What led the more anxious participants to choose the happier face in the present case? It could be that the anxious participants engage in a form of psychological defense in order not to see (or pretend not to see) the faces that would be more distressing for them to see: those of someone else being angry. By this account, the participants may be setting their categorical boundary closer to their own personal trait in order not to have to deal with a possible distressing and angry facial expression image.

However, an alternative is that the results of this experiment are in fact consistent with the concept that “observers may generally be more sensitive to how a face differs from their own category” (Webster, et. al., 2004, as noted). In previous research, Webster et. al. (2004) found that males and females rate genders differently and that Japanese and Caucasian participants also rate ethnicity in a different manner. In this research, Webster et. al. (2004) showed that “females and males tended to choose gender boundaries in a male-female continuum that were shifted towards their own gender.” Webster et. al. also found the same principal among Japanese and Caucasian faces. These findings seem to support the results of the experiment done for the research presented here with regard to the direction of the categorical boundaries chosen by the participants in this experiment.

The results of this experiment suggest that there is a negative correlation between high socially-anxious people and the way they set the categorical boundary in an angry/happy face continuum, or simply the way they perceive an ambiguous face. The findings of this research show that high socially-anxious people tend to see these ambiguous faces as happy. Future research examining the correlation between the Social Interaction Anxiety Scale (SIAS) questionnaire and the way a larger group of participants perceive ambiguous faces along the angry/happy face continuum will help to clarify to what extent this finding is possible to replicate. This may also lead to more research that investigates the way that highly anxious people perceive faces around them, hence hopefully helping them interact with their surroundings in a less distressing way.
BIBLIOGRAPHY

Bruce, V., Young, A. (1998). In the eye of the beholder, the science of face perception. Oxford University Press.


Table 1

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<tr>
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Figure 1
Figure 2
He grew up in the small town of Waukegan, Illinois, which is about forty miles north of Chicago. Eric is double-majoring in History and English Literature with a minor in Medieval and Renaissance Studies. He wants to become a university professor and one day plans to write books on fiction and on historical points of interest. He has received general and departmental scholarships during the time he’s been a student at the University of Nevada, Reno. He presented his research project at the University of Maryland – College Park 7th Annual McNair Scholars & Undergraduate Research Conference in spring 2006. In his spare time, he enjoys playing chess and competing in chess tournaments.

ABSTRACT

The Second Punic War begins in 219 B.C. with Hannibal's attack on Saguntum and ends with Hannibal's defeat at Zama against Scipio in 202 B.C. In their writings, the Roman historians are unanimous in their belief that Hannibal was ultimately responsible. Though they cite various reasons for this, they examined a few other causes for the war. The main primary sources for all historians are Polybius and Livy, but both have their biases, and there are still questions regarding their research methods and accounts. By examining these Roman, and some Greek, historians, this paper seeks to partially absolve Hannibal's responsibility.
According to most historians, Rome had been responsible for the start of the First Punic War by coming to the aid of her allies when it was unethical to do so. Carthaginian economic aggression, so the argument goes, had forced Rome's hand. The cause of the Third Punic War, however, was Carthaginian treachery on the one hand, and the great instigator 'Masinissa' on the other. But what the causes of the Second Punic War were remains somewhat of a mystery. After the attack on Saguntum, many of the ancient historians believe that Hannibal was its primary cause; however, much importance was also given to 'Hannibal's Oath', which he took as a small boy at the will of his father Hamilcar Barca, who hated the Romans after they had won the First Punic War. Yet another possible cause is the importance of the Mediterranean Sea and Carthage's unenviable and rotten aristocracy, which placed Hannibal in an untenable situation, thereby making war inevitable.

As is well known, Hannibal was the Carthaginian general who set out to reduce the power of Rome by turning her allies against her. Rome's hold on the various peoples of Italy was problematical and perhaps tenuous. A Carthaginian force, led by a superior commander who was on the move continuously in Italy, might have been able to turn Rome's allies against her. This plan, according to most historians, has been credited to Hamilcar Barca, Hannibal's father.

However, there was a flaw in the plan—Carthage had been heavy-handed in its dealings with other peoples, whereas Rome's leaders usually left the culture and religious views of the conquered peoples primarily intact. In all probability such peoples knew which master would be the harsher on them, though they preferred neither Rome nor Carthage.

The main outlines of the Second Punic War are well known. In the beginning, Hannibal was successful, winning several encounters against the Romans: the Battle of the Trebia, the Battle at Lake Trasimene, the defeat of Minucius, the Battle of Cannae, and the escape from Fabius Cunctator (the delayer). But without support from Carthage and furthermore the unfortunate death of his brother Hasdrubal at the hands of Caius Claudius Nero in the Metaurus Campaign, Hannibal weakened (indirect proof of this is the Battle of Zama, where Hannibal had the inferior army in comparison to Scipio's) and could only, in the end, maintain himself and his army as a passive nuisance within Italy. In short, too many of Rome's allies remained loyal to her and Hannibal had failed to unhinge their support of Rome.

This is but a short background on Hannibal. To get a fuller picture, we have to consult past historians, both Greek and Roman, and look at some of the modern historians and what they have to say, which should illuminate some of the possible causes of the Second Punic War as well. The purpose of this paper will be primarily to examine the primary sources we have in the writings of Polybius, Livy, Appian and Dio Cassius, while also looking into some other sources that offer some interesting points as well some oddities.

In the First Punic War (264-241 B.C.) between Rome and Carthage, the two most important elements were Carthaginian sea power and the island of Sicily. Carthaginian sea power was important because it held mastery over the Mediterranean, thus creating somewhat of a problem for Rome and that city's expansion efforts. In the words of G.P. Baker, an historian in the 1920's, "Sicily was important due to its geography, which provided a natural jumping off point to either side of the Mediterranean Sea" (Baker 34).

Another idea is the importance of Sicily as a granary, yet this point needs clarification. The final outcome of both these dynamics is so important that they ultimately provided a continued reason for the war that followed. The lull in the interim was more of a 'bridge' to the Second Punic War rather than a lasting peace, with Hamilcar Barca being the 'chief representative' of that bridge.

Carthage was already a great power at sea and had been so for a long time, dating back to the Athenian defeat at Syracuse in 413 B.C. under the walls of 'Gelo' and the subsequent Carthaginian invasion of Sicily in the year 409 B.C. If Rome really did fear for her coastal cities, as seems likely, then something had to be done, for Rome did not have a navy, and the island of Sicily provided a convenient jumping off point for further Carthaginian interests.
The engine that moved Carthage to such great wealth and power was avarice, according to early 1920's historian G.P. Baker who writes, “Again, it is a general testimony of all who came in contact with them that the Carthaginians had a love of money bordering upon the absurd: and if money is not an `intermediate process' it is nothing” (Baker 18). This mental twist was a typical Carthaginian characteristic.

Such a Carthaginian state of mind could not have been content with the mastery of the Mediterranean Sea and the subsequent control of all wealth in this area. With the island of Sicily under its control as well, it’s possible that Carthage might have wanted more, if indeed the Carthaginian mindset was one of greed as is written of them. This put pressure on Rome and is why the Romans had to act quickly in coming to the aid of her allies at Messana in 279 B.C.

Along with the Mediterranean Sea and Carthaginian greed as possible causes for the First Punic War, one historian also adds the traditional view of the element of 'jealousy' on the part of Rome to the list of probable causes: “The real origin of the wars against Carthage lay in the jealousy of Rome for the power at sea of the Carthaginians, and her fear lest the possession of Sicily by Carthage should become a threat to her own dominion in Italy” (Dodge 122).

While this latter idea is certainly plausible, it should be remembered that the Roman Army had always held a measure of success against the Carthaginians on land. It wasn’t until the arrival of the Spartan commander Xanthippus in 256 B.C. that things started to change in this respect. If Rome was fearful of Carthage’s possession of Sicily, it was most likely after Xanthippus, and not before, for it was this commander that changed the Carthaginian military in the field and created the tactics that would be used later. It was the Spartan Xanthippus that laid the foundations for a Carthaginian army to be successful in the field. During the 1920's and 1930's the popular historian G.P. Baker, making use of Polybius, the ancient Greek historian, had this to say about Xanthippus:

Among the new recruits who signed on with their mercenary army was a Spartan named Xanthippus. If any mysterious signs betokened that this man was a god in disguise, the Carthaginians failed to observe it. They only observed that Xanthippus passed certain criticisms upon his military superiors. Called to answer for it before the War Council, the Spartan made such an impression upon the board of generals in their mood, that they gave him a free hand to fight the war in his own way... Several important consequences ensued which affected the whole subsequent course of events. Xanthippus had appreciated that the Carthaginians, although they possessed war-elephants, were ignorant of the tactical methods of employing them in the field. He proceeded to use them, as no Carthaginian had ever been able to use them before; and he also invented a method of envelopment by cavalry. (Baker 41-42)

Shortly thereafter, Xanthippus promptly destroyed most of Regulus' army and had the remnants in fear behind the walls at Apsis (255 B.C.). The Roman historian Livy praises Xanthippus highly when he says, “I should not admit that the birth of the Spartan Xanthippus was a luckier event for Carthage than mine was for Rome, and my confidence would grow by the very fact that the valour of a single man could put such weight into the scales" (Livy 558). Xanthippus disappeared shortly after instructing the Carthaginians, but not before he had taught Carthage that the problem did not lie in the men in the field as much as the Carthaginian commanders who were leading them. If it were not for Xanthippus, Carthage may have taken longer to go from a sea power to one that was also dominant on land.

Another event that also points to the historical significance of the Mediterranean Sea is the fact that the Carthaginian Bomilcar failed to fight Marcellus off Cape Pachynon in 212 B.C. while in command of a larger fleet (Lazenby vi). The Romans, despite the loss of many ships due to the often violent nature of the Mediterranean Sea, had clearly wrested control of it from the Carthaginians by the end of the First Punic War. In doing so, it interrupted the heretofore uncontested control of it by the Carthaginians.
The famines and the lack of money that we hear about so often in the accounts of the Third Punic War and Carthage's troubles with 'Masinissa' in the interior come from years of no longer being in control of the Mediterranean Sea. The significance of Bomilcar's actions indirectly suggests that both of the Carthaginian political parties foresaw events that lay ahead. Hanno's Party and its desires for peace can be seen as a timid solution to not lose everything in the hopes that the situation may only be temporary, while the Barca faction may have felt the situation to be more untenable, requiring more forceful methods to achieve results. This idea consistently maintains itself through the Roman historian Appian's account of the Third Punic War, but hints at problems earlier resulting from the loss of the First Punic War.

In light of all this, it's possible to say that the greedy nature of the Carthaginians was none other than a well-developed sense of their geographical location and the problems that often came with it, though Roman historians say nothing of this. It was not the best place to forage or to grow things. Armies often had trouble sustaining themselves, and sieges didn't enjoy the same success on the Carthaginian side of the Mediterranean Sea. As long as Carthage was strong and in control of the Mediterranean, their location was inherently strong, but when had they lost control of that sea to the Romans, Carthage weakened and was stressed.

The sharing of the Mediterranean Sea would not have interested Carthage since that would also mean a constant competition with Rome, and when it came to commerce and trade, there would be a constant search for a better price from either Rome or Carthage with regards to buyers from the east. Such a situation would be untenable and would in the end result with Carthage being slowly squeezed to death.

Other motives for the start of the Second Punic War primarily come from both Roman and Greek historians; however, any student of the Punic Wars must be careful because there is an underlying consistency which suggests that the previous accounts may be biased. In many ways, the reasons for the cause of the Second Punic War are still open to interpretation and historians are limited in their interpretation due to the earlier highly subjective accounts from the primary sources that have come down to us.

As an historian, Appian has been criticized for his lack of accuracy in the details, when he gives them. He sketches a reasonably correct outline of what happened or what he believes to have happened. His pleasant writing style has an inherent logic to his works and is noticed by many scholars. This latter note on his writing style makes Appian a little tricky. He is a favorite hunting ground of German scholars. Appian is writing roughly between the time of A.D. 95 and A.D. 165, the year of his death (Appian ix, x, xi).

The historian Appian provides a motive for Hannibal starting the war, thus making his among the first causes of the Second Punic War. In his work, Appian's Roman History, he writes:

But the enemies of Hamilcar and Hasdrubal in Carthage persecuted the friends of those men, despising Hannibal on account of his youth, and he, believing that this persecution was originally directed against himself and that he might secure his own safety by means of his country's fears, began to think about involving it in a great war. (Appian 309)

This adds weight to the idea above that Hannibal may have been under some pressure and that the political climate in Carthage, specifically the tug of war between Hanno's Peace Party and the War Party headed by the Barca family, may have been the deciding factor. Appian's powerful political motif implicates Hannibal directly and indirectly puts the blame on Carthage's rotten aristocracy.
The Army of Italy is itself proof of the power of the War Party behind the Barcas, specifically Hamilcar Barca. When Hannibal inherited it after his father’s untimely death and after Hasdrubal's assassination (the man Hamilcar entrusted because Hannibal was yet too young), it was a first-rate army that was capable of great things. Appian notes this well in his description of Hannibal and the Army of Italy crossing the Alps:

When he came to the Alps and found no road through or over them (for they are exceedingly precipitous), he nevertheless boldly began to climb them, suffering greatly from the cold and the deep snow. He cut down and burned wood, quenching the ashes with water and vinegar. Having thus rendered the rocks brittle he shattered them with iron hammers and opened a passage, which is still in use over the mountains and is called Hannibal’s Pass. As his supplies began to fail he pressed forward, the Romans remaining in ignorance even after he had actually arrived in Italy. With great difficulty, six months after leaving Spain, and after suffering heavy losses, he descended from the mountains to the plain. (Appian 309-310)

Among modern historians, it is no longer certain which route Hannibal took over the Alps, and the hardships that may have been faced are only speculative considering that the route cannot be found. Hannibal's mercenary army was a mixture of Carthaginians, Numidians, Africans, Spaniards, Gallic, and Balacreans.

Appian's political motif makes a lot of sense and fits well with the loss of the Mediterranean Sea and Carthaginian greed, but it still seems that more evidence is needed if we're to prove that the loss of the Mediterranean Sea fueled the Carthaginians’ hatred for the Romans because it disrupted their one common vice—the love of money.

According to John Rolfe, the biographer Cornelius Nepos, a precursor to Plutarch, lived sometime between the years 99 B.C. and 24 B.C. in the town of Ticinum (modern day Pavia). But this is not a certainty for little is known about him and the best manuscripts of Nepos are no longer in existence. Nepos is writing his Great Generals of Foreign Nations shortly before the death of Atticus in 32 B.C.

Nepos implicates Hamilcar Barca, Hannibal's father, as the primary cause of the Second Punic War. In his interesting work Great Generals of Foreign Nations, Nepos writes:

But Hamilcar, after crossing the sea and coming into Spain, did great deeds through the favor of fortune. He subdued mighty and warlike nations and enriched all Africa with horses, arms, men and money. As he was planning to carry the war into Italy, in the ninth year after his arrival in Spain, he fell in battle, fighting against the Vettones. It was this man's inveterate hatred of Rome that seems to have been the special cause of the Second Punic War. For his son Hannibal was so affected by his father's constant entreaties that he preferred to die rather than fail to measure his strength against the Romans. (Nepos 625)

This particular cause, too, cannot be discounted, for we know that Hamilcar was busy preparing for war with Rome. Hamilcar's hatred for Rome had been very much a part of him since he had taken part in the First Punic War. Hannibal would have seen first hand the constant preparations being made for war on his father's part. What isn't clear is how much Hannibal understood of the politics between the two parties in Carthage or to what degree he would have been affected by the sight of Hamilcar's preparations for a renewed war with Rome.

According to Nepos, although it is Hamilcar Barca who is ultimately responsible by his wanting to continue the war, Nepos does not neglect Hannibal’s part in starting the war by crossing the Alps:
When he came to the Alps separating Italy from Gaul, which no one before him had ever crossed with an army except the Grecian Hercules—because of which that place is called the Grecian Pass—he cut to pieces the Alpine Tribes that tried to keep him from crossing, opened up the region, built roads, and made it possible for an elephant with its equipment to go over places along which before that a single unarmed man could barely creep. By this route he led his forces across the Alps and came into Italy. (Nepos 629)

The mythology in Nepos' narrative can be discarded, but Hannibal mostly likely did “cut to pieces those Alpine tribes that tried to keep him from crossing.” This latter point may be the reason why historians can't say with any degree of certainty which path Hannibal took across the Alps. A closer look at the methods used by these Alpine tribes for discarding their dead (and perhaps their enemies also) might uncover something at a later date.

Cornelius Nepos also spoke of Hannibal's true genius on the battlefield. He tells his readers just how much the Romans were at a disadvantage whenever and wherever they came across Hannibal in the field:

It would be a long story to enumerate all his [Hannibal’s] battles. Therefore it will suffice to add this one fact, to show how great a man he was: so long as he was in Italy, no one was a match for him in the field, and after the battle of Cannae no one encamped face to face with him on open ground. (Nepos 633)

Other than implicating Hamilcar Barca as a cause of the Second Punic War, Cornelius Nepos also mentions the now `infamous oath' taken by Hannibal as a small boy upon the altar of Baal, as requested by his father Hamilcar. This controversial oath was supposedly used by Hannibal to nullify the Syrian King Antiochus III's suspicions of him. We have to be careful when dealing with the ancient historians, especially the Roman ones, because they often placed speeches into the mouths of the historical figure, a method of adding more weight to their argument perhaps. Nepos gives us the Roman intrigues and Hannibal's oath as well when he writes:

For not to mention Philip the V of Macedon, whom from afar he [Hannibal] made an enemy of the Romans, he fired Antiochus, the most powerful of all kings in those times, with such a desire for war, that from far away on the Red Sea (the Persian Gulf) he made preparations to invade Italy. To his court came envoys from Rome to sound his intentions and try by secret intrigues to arouse his suspicions of Hannibal, alleging that they had bribed him and that he had changed his sentiments. These attempts were not made in vain, and when Hannibal had learned it and noticed that he was excluded from the king's more intimate councils, he went to Antiochus, as soon as the opportunity offered, and after calling to mind many proofs of his loyalty and his hatred of the Romans, he added: My father Hamilcar, when I was a small boy not more than nine years old, just as he was setting out from Carthage to Spain as commander-in-chief, offered up victims to Jupiter (really Baal), Greatest and Best of Gods. While this ceremony was being performed, he asked me if I would like to go with him on campaign. I eagerly accepted and began to beg him not to hesitate to take me with him. Thereupon he said: 'I will do it, provided you will give me the pledge that I ask.' With that he led me to the altar on which he had begun his sacrifice, and having dismissed all the others, he bade me lay hold of the altar and swear that I would never be a friend to the Romans. For my part, up to my present time in life, I have kept the oath, which I swore to my father so faithfully, that no one ought to doubt that in the future I shall be of the same mind. Therefore, if you have any kindly intentions with regard to the Roman people, you will be wise to hide them from me; but when you prepare for war, you will go counter to your own interests if you do not make me the leader in that enterprise. (Nepos 627)
This is extremely interesting because if true, then it means that both the Romans and Hannibal had to be careful in their dealings with Antiochus III. This wasn't the case when Rome dealt with Antiochus IV not long after the end of the Second Punic War. With Antiochus III and Hannibal now gone, the Romans could now deal with Antiochus IV more confidently, even arrogantly and it showed when the Roman envoy Caius Popilius Laenas appeared to meet with him for the first time in Egypt:

At the request of Egyptian King Ptolemy VI, Rome sends Ambassador Caius Popilius Laenas to Egypt. He has with him an impressive fleet and orders from the Roman Senate that Antiochus IV renounces his kingship of Egypt and withdraws from the country. At Eleusis, a suburb of Alexandria, the Syrian and the Roman ambassador come face to face. Antiochus IV requests time for consultation with his advisors, but Laenas draws a circle around the king and tells him to answer before stepping across the line. Humiliated, Antiochus IV complies with Roman demands and returns to Syria in 168 B.C. (Watchtower 231)

This not only reveals 'Hannibal's Oath' to be a real possibility, but it also serves to call into question the motive of hatred on Hannibal's part, since a stronger motive for Hannibal's words would be self-preservation. Roman confidence did not begin with the removal of Hannibal and Antiochus III, but steadily grew from earlier successes into arrogance by this point in time, and when Antiochus III stopped preparing for war, it left Hannibal without means towards that end (a renewed offensive against Rome) and with no chances of returning home to Carthage. It would appear that Antiochus IV in 168 B.C. was nowhere near the leader his father Antiochus III was in 195 B.C.

Polybius also mentions this episode in his work The Histories and it differs but little in the above account:

At the time when Antiochus approached Ptolemy and meant to occupy Pelusium, Caius Popilius Laenas, the Roman commander, on Antiochus greeting him from a distance and then holding out his hand, handed to the king, as he had it by him, the copy of the senatus-consultum, and told him to read it first, not thinking it proper, as it seems to me, to make the conventional sign of friendship before he knew if the intentions of him who was greeting him were friendly or hostile. But when the king, after reading it, said he would like to communicate with his friends about this intelligence, Popilius acted in a manner which was thought to be offensive and exceedingly arrogant. He was carrying a stick cut from a vine, and with this he drew a circle round Antiochus and told him he must remain inside this circle until he gave his decision about the contents of the letter. The king was astonished at this authoritative proceeding, but, after a few moments’ hesitation, said he would do all that the Romans demanded. Upon this Popilius and his suite all grasped him by the hand and greeted him warmly. The letter ordered him to put an end at once to the war with Ptolemy. (Polybius Book 29 Fragments)

Both the Christian and the secular sources agree on Rome's new confidence and if Antiochus IV was surprised at the Roman ambassador's behavior, it was likely because the Romans had never acted in such an arrogant way before, but then Antiochus III and Hannibal were gone.

The historian Lucius Lucius Annaeus Florus has often been criticized for the amount of rhetoric in his work and a lack of accuracy in the details. However, on this latter point, most of the ancient historians were similarly guilty, giving preference instead to a suitable sketch of what actually happened. E.S. Forster writes in his introduction to the work, “We know almost nothing about Florus except that his 'Epitome of Roman History' was used as a school book as late as the end of the seventeenth century" (Florus ix-xii).
Florus also points to Hamilcar Barca as a primary cause for the Second Punic War, but is unlike Nepos who believes that Hannibal was influenced by his father’s action; Florus implies that Hannibal was fully aware of his oath as a boy and was determined to exact vengeance thereby making him solely responsible for his actions. In his work, Epitome of Roman History, Florus writes:

Hence Hannibal, while still a boy, had sworn to his father at the altar that he would exact vengeance; and he was not slow to do so. Saguntum, therefore, was chosen as a pretext for war, an ancient and wealthy Spanish city, a notable but sad example of loyalty towards the Roman people. This city, although it had been granted special immunity under a common treaty, Hannibal seeking pretexts for fresh disturbances, destroyed, partly by his own hands and partly by those of the citizens themselves, in order that, by the violation of the treaty, he might open to himself a path to Italy. (Florus 95)

Florus portrays a much harsher Hannibal with his choice of words in recounting Hannibal’s oath, but the mysterious oath still remains a problem for historians when it comes to finding the causes to the Second Punic War and deciding whether or not Hannibal was definitely responsible without a reasonable doubt.

How important was Hamilcar’s plan to undermine the alliance between Rome and her allies? It is already known that Hamilcar was making extensive preparations to do just this, and so it is not unlikely that Hannibal knew it also and in fact his later actions suggest that he did. Hannibal did not march on Rome, and it remains somewhat of an intrigue as to why he chose not to do so when the Romans were clearly reeling after the ‘Battle of Cannae’ in 216 B.C.

Regarding the ‘Battle of Cannae’ Florus supposedly quotes Maharbal and says, “After this no doubt will be entertained that Rome would have seen its last day and Hannibal might within five days have feasted on the Capitol, if (as they say Maharbal, the Carthaginian, the son of Bomilcar, observed) he had known how to use his victory as well as he knew how to obtain it” (101). Hannibal was probably carrying out the plan as Hamilcar had laid it down, thus it indicates that Hannibal, far from not knowing how to use a victory, was in fact strictly adhering to policy, a policy that was designed to turn Rome’s allies away from her by the presence of an adversary in the field that couldn't be removed from it or adequately countered.

Along the same lines of thought, we can better understand Florus’ odd insinuation (borrowed from Livy) that bad weather kept Hannibal out of Rome. He writes:

…when Hannibal was moving his camp forward from the third milestone, the gods, the gods, I say (and we shall feel no shame in admitting their aid), again resisted his progress. For, at each advance of his, such a flood of rain fell and such violent gales arose that he seemed to be repelled by the gods not from heaven, but from the walls of the city itself and the Capitol. Hannibal fled and departed, withdrawing to the furthest corner of Italy, abandoning the city, the object almost of his worship. (Florus 111)

Florus is not being objective here. The question that beckons is “Was the weather really a deterrent or was Hannibal still adhering to the plan as faithfully as he had since the beginning? If he was adhering to the plan that was brilliantly conceived by his father, Hamilcar, then it serves as a motive with his father Hamilcar as the architect of the Second Punic War and the eldest son as the one who carried it out for reasons still unknown. In either case, the intention was not to march on Rome, but to weaken the hold she had on her allies. A modern historian has added skepticism to this latter idea, where the question is asked, “Was Hannibal’s seemingly endless marching and counter-marching merely opportunistic, or a response to Roman counter-attacks, or did he have some overall plan?” (Lazenby x).
If Hannibal was opportunistic, then perhaps avarice was his weakness, as Polybius has said. And if his actions were in response to Roman counter-attacks, then the plan was still in effect.

Dio Cassius was an historian and public servant and lived from 155 A.D. to sometime after 229 A.D. He is considered more accurate when writing after the time of Julius Caesar and more or less just gives a summary of events that happen before that time. In his own time with the Roman Emperor Commodus, he is more circumspect in his writings about events which passed under his own eyes. His Roman History consists of 80 books of which a great many are in fragments.

The historian Dio Cassius also implicates Hannibal as the cause of the Second Punic War, and he also confirms the fact that his father Hamilcar is responsible from early on. Concerning the Second Punic War, Dio Cassius writes:

It [the war] was brought on chiefly by Hannibal, the general of the Carthaginians. This Hannibal was a son of Hamilcar Barca, and from his earliest boyhood had been trained to fight against the Romans. For Hamilcar said he was rearing all his sons like so many whelps to fight against them, and when he saw that this one had by far the best nature, he made him take an oath that he would wage upon them; accordingly he was engaged in giving him a careful training, particularly in warfare, at the time of his own death, when the boy was fifteen years of age. (Dio Cassius Book 13)

And so Hannibal is the main cause of the Second Punic War again, according to this historian. Does Dio Cassius provide a motive for this action of Hannibal? He does, but he is not as elaborate as Appian when portraying the politics that might be involved in Carthage and is not as harsh and wanton for warmongering as in Florus' account. In fact, Dio Cassius' account makes it looks as if Hannibal needed to pay the famous Army of Italy, for fear of losing their support:

Being now twenty-six years of age, but at once too possession of the army in Spain, and after being acclaimed general by the soldiers, brought it about that command was confirmed to him also by those in authority at home. After accomplishing this he required a plausible excuse for his enterprise against the Romans, and this he found in the Saguntines of Spain. These people, dwelling not far from the river Iberus, and a short distance from the sea, were dependents of the Romans, who held them in honor and in the treaty with the Carthaginians had made a special exception of them. Hence for this reason Hannibal began war with them, knowing that the Romans would either assist the Saguntines or avenge them if they suffered injury. From this motive, then, as well as because he knew that they possessed great wealth, which he particularly needed, and from various other considerations that promised him advantages against the Romans, he made an attack upon the Saguntines. (Dio Cassius Book 13)

There is no doubt that an army needs to be supported and costs a lot of money to do so. An army of mercenaries cannot long remain idle. Hamilcar and Hasdrubal both held them together due to the sheer numbers of different tribes and so there was plenty of fighting to be done in Spain; however, with the Barcas more firmly in control of Spain, the well was running dry by the time Hannibal took over the Army of Italy. Polybius credits Hamilcar for this act of suppression in Spain among its many warlike tribes. In The Histories he says:

As soon as the Carthaginians had brought the situation in Africa under control, they assembled a sufficiently strong expeditionary force, appointed Hamilcar to command it, and dispatched it to Spain. When Hamilcar took up the command of these troops he was accompanied by his son Hannibal, who was then nine years old. He at once crossed the straits by the Pillars of Hercules and proceeded to establish the power of Carthage over the peoples of Iberia.
He spent nearly nine years in the country, during which time he brought many tribes under Carthaginian sway, some by force of arms and some by diplomacy, and he ended his career in a manner which formed a fitting climax to his achievements, for he lost his life after fighting gallantly and with complete disregard for his personal safety in a battle against one of the strongest and most warlike of the tribes. (Polybius 111-112)

The army would be idle without a campaign and what would be Hannibal's reason for being in Spain if not to take command of the army?

This indirectly indicates that Hannibal was probably under some pressure, both at home politically and with the new army he inherited from his father after his death and after the death of Hasdrubal who took over while Hannibal was still too young. If Hannibal was under pressure to begin a war, then he chose the wealthiest and most powerful within reach of his army—Rome.

According to Dio Cassius and many other historians, it was not a stable peace in the interim between the First and Second Punic Wars. It couldn't be with Hamilcar Barca as the bridge between the two and himself constantly preparing to renew the old conflict. But even without Hamilcar Barca's charismatic personality, we're told by Dio Cassius that the situation between Rome and Carthage was doomed and therefore impossible to negotiate because of feelings of jealousy and fear between the two:

As a matter of fact, the Carthaginians, who had long been powerful, and the Romans, who were now growing rapidly stronger, kept viewing each other with jealousy; and they were led into war partly by the desire of continually acquiring more—in accordance with the instinct of the majority of mankind, most active when they are most successful—and partly also by fear. Both sides alike thought that one sure salvation for their own possessions lay in obtaining also those of the others. (Dio Cassius Book 13)

Both sides, powerful as they were, were conscious of the other, and neither Rome nor Carthage could afford the islands of Sicily and Sardinia to be held by the other as a convenient jumping off point to new conquests or endeavors. As we learn from several historians, avarice was already a Carthaginian trait—even before success, but now according to Dio Cassius, Rome had acquired the vice to some extent as a result of her growing power.

Dio Cassius is very objective here and in a sense; if he is correct, then Rome and Carthage are both responsible for their troubles in all three wars. In fact, the study of all three wars together do suggest this idea, but how much Hannibal is responsible for starting the Second Punic War is still an open question, and this insight by Dio Cassius serves only to cloud the issue once again.

Dio Cassius notes that even such a figure as Hannibal himself could not escape the vice of avarice on the part of the Carthaginians:

The Carthaginians, far from voluntarily sending any support to him, were making sport of him, owing to the fact that, although he was continually writing of his favourable progress and his many successes, he also asked them for money and soldiers. They said his requests did not agree at all with his successes: victors ought to find the army they have sufficient, and ought to send money home instead of demanding still more from them. (Dio Cassius Book 13)

Of course, this could be just a later attempt to discredit Hannibal, but it is consistent with the accounts of other historians, both past and present. If Rome was also suffering from the same vice as Carthage, her political system was left unaffected for the most part, whereas Carthage's political system was rotten to the core.
Most of these historians are borrowing heavily from either Livy or Polybius who are closest to Hannibal's time. While there is no overwhelming or convincing evidence that would make Hannibal responsible or not, it seems fairly certain that Hannibal was aware of his situation and that his situation was likely an untenable one. Perhaps he could have returned home to Carthage, betraying all his father had taught him and forgetting the Carthaginian pride that was in him; but to be objective, this would have been difficult for anyone—not just Hannibal. The evidence, though biased, seems to point to the importance of the Mediterranean Sea and Carthage's rotten aristocracy leaving Hannibal with fewer options. It is doubtful Hannibal could have wanted a simpler life since he was part of the aristocracy from birth. His father's plan against Rome was the only viable one available, though it would have been interesting to have seen a genius like Hannibal choose another, separate from both Rome and Carthage.
Bibliography
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Nhit was born in Vietnam and is of Chinese/Vietnamese descent. She is our first scholar that has participated in the TRIO Upward Bound, TRIO Scholars (SSS) Program and the McNair Scholar Program. She has received several scholarships during her years as an undergraduate student. She majored in international business and desires to one day teach environmental law. She presented her research at the 2005 Rocky Mountain McNair Conference in Colorado.

ABSTRACT

This is a qualitative research analyzing secondary data. The purpose of this paper is to examine the inflows of foreign direct investment (FDI) in China and attempt to answer three questions: Is there a shift in the inflows of FDI into China? What incentives does China offer to its foreign direct investors? And who benefits and loses from China’s inflows of FDI? In the first findings, my research suggested four changes took place in the inflows of FDI: China’s traditional FDI suppliers have shifted since 1979; the FDI types have also changed from Equity Joint Venture and Contractual Joint Venture to Wholly Foreign Owned Enterprises; and multinational corporations also began their investments with capital-intensive activities. The second findings suggested that China provides many incentives to foreign investors: a high GDP growth rate, a large pool of skilled labor, a large untapped market, low wages, and undeveloped industries that allow for potential profit. The last findings indicated that Chinese consumers, workers, and foreign invested enterprises benefit from the abundant inflows of FDI at the potential expense of its neighboring countries.
Methodology
This is a qualitative research involving secondary data analysis of peer review journals, published documents, books, and various types of on-line resources. The sources of information are compiled from professional syndicated services data, external databases, Web sites of international organizations and published documents, and documents provided by the United States government and international organizations.

Introduction
China has experienced unprecedented economic growth since 1979, averaging an annual economic growth of 10% (22). Throughout the past twenty-five years the Chinese government disseminated several economic reforms and promulgated many foreign direct investment laws to increase the inflows of FDI. Undeniably, China has succeeded in attracting many foreign investors. In 2002, China exceeded the United States as the recipient of FDI, obtaining a total of $53 billion (22). Although the world FDI inflows declined by 21% in 2002, China’s inflows of FDI continues to proliferate, becoming the second largest recipient of FDI in the world, following Luxembourg (22). Table I shows the inflows of FDI in Asia and the Pacific region. China received significantly more FDI among the developing nations in Southeast Asia. In 2003, China received $53 billion, meanwhile nations like Malaysia, Vietnam, and Thailand received less than $2.5 billion. Table II displays the top FDI recipients in 2002 and 2003. As FDI inflows plummeted in many economic powers such as the Germany and the U.S., China continued to experience a perpetual increase.

Prior to 1979, China received trivial amount of FDI due to its “close policy” promoted by the Chinese government and its former Communist Party leader—Mao Zedong. Chinese people did not speculate that China would become a strong economic leader through the utilization of FDI. As a result of the burgeoning inflows of foreign capital, China has strengthened economic and political stability, enhanced living conditions, boosted job creation, and fostered economic development. Today, China is the second largest (Hong Kong being the first) exporter among the developing market economies such as South Korea, India, Mexico, and Thailand (18).

FDI Defined
According to the World Investment Report, FDI is defined as “an investment involving a long-term relationship and reflecting a lasting interest and control by a resident entity in one economy (foreign direct investor or parent enterprise) in an enterprise resident in an economy other than that of the foreign direct investor (FDI enterprise or affiliate enterprise or foreign affiliate). The two entities engaging in the investment initiatives and any successive transactions occurring among the affiliate enterprises and the parent enterprises, both incorporated and unincorporated” (22).

There are varieties of FDI, including foreign capital financed by international organizations, business transactions conducted by transnational corporations in other nations other than home countries, and investments by individuals of a different country. China has received by way of foreign capital borrowed from Overseas Economic Cooperation Fund of Japan and the World Bank subsidiaries established by Siemens and Wal-mart, and R&D facilities by Microsoft and Oracles. The scope of this paper will only concentrates on investments by multinational corporations also known as Transnational Corporations.

Types of Foreign Direct Investment in China
There are many ways in which a foreign firm can invest in China. The three most prevalent forms include Equity Joint Ventures (EJVs), Wholly Foreign-Owned Enterprises (WFOEs), and Contractual Joint Ventures (CJVs). Traditionally, EJVs dominated FDI inflows because they have a higher tendency to provide greater revenues, lower costs, and less risk than other modes (13).
The People’s Republic of China prefers this method because it absorbs a substantial amount of technology transfer. Through EJVs, both parties are encouraged to engage in mutually beneficial relationships: In exchange for acquiring long-term access into the Chinese market, foreign investors must commit to technological exchange, economic cooperation, impartiality, and compliance with the provisions of the laws, decrees, and relevant rules and regulations of the People’s Republic of China (13).

The second type of FDI is WFOEs. Since 1996, they have been preferred over EJVs. Since 2001, WFOEs “outpaced EJVs at a rate of more than 2 to 1”. In 2002, the number of WFOEs contracts was 22,173 and EJVs only received 10,380 (5). Investors who are drawn to this type of entry mode enjoy flexibility, control, and ownership (13). Through EJVs, an independent business entity is set up with investors’ own capital without a domestic Chinese partner. However, the PRC does not encourage WFOEs because domestic Chinese firms are not absorbing the transference of technology since complete ownership is held by parent enterprises.

The third most popular entry mode is Contractual Joint Ventures. This type of investment differs from EJV in which profit distributions and management are dictated by the quantity of total registered capital given by each partner. The CJV assigns profit and other responsibilities stated by the joint venture contract, and each partner cooperates as a separate legal entity and bears own liabilities (13).

**Special Economic Zones**

China initially attracts foreign companies to establish manufacturing plants to boost its exports. When China adopted the open-door policy, it established four Special Economic Zones in Shenzhen, Zhuhai, Shantou, and Xiamen with the purposes of attracting foreign capital, technology & equipment, experimenting with the market system, training personnel in advanced technology, promoting competition among regions, and increasing employment. Some of the benefits for entering into SEZs include but are not limited to following (19):

- The movement of goods and persons are more liberated
- A wide spectrum of investment options such as finance and commerce
- Exemption of remittance tax and Joint Ventures only required to pay 15% of income tax
- No limitations on the types of investments such as wholly foreign-owned enterprises

Other special zones include Economic & Technical Development Zones (HTDZs), and Private Investment Zones that are dedicated to promote higher transfer of technological innovation into the nation. Because of the numerous incentives provided by SEZs other special zones, they are served as preference zones for foreign investors. The government of China plays a prevalent role in making these special economic zones an effective method in absorbing technological innovations.

**The Government & FDI strategies**

The key actor who promotes and contributes to the increased of investment in the science and technology sector is the Chinese Government. Recently, China’s Ministry of Information Industry (MII) requested that nineteen high-technology research and development projects be funded by the government’s Electronics and Information Industry Development Fund. The objectives are to promote the development of China’s Information Technology industry and to finance research and development in areas that have been identified as strategically important sectors of the IT industry. Projects were solicited from Chinese companies on eight major innovative sectors: software, semiconductors, image processing, digital TV, mobile communications, networking, information security, and components. Contracted companies will be responsible for the development of network game software, digital cameras and processing applications, digital-television equipment, network equipment, network intrusion and management systems, and high-capacity lithium-ion polymer batteries. (12)
Along with soliciting bids to information technology companies, the Chinese government helps with creating a network of institutions, business organizations, and college students to work together towards a common goal—to maximize the incorporation and absorption of information technology, science, and western managerial skills.

Now that we have explored the definition and the various types of FDI, special economic zones, and the role of the government, the focus of the rest of the paper will provide detailed information to answer the three questions suggested earlier.

I. Is there a shift in the inflow of China’s FDI?

There are four changes that occur in the FDI inflows: a shift in FDI suppliers, a decrease in CJVs, an increase in WFOEs, and a higher allocation of investment towards the scientific research and development services.

First, the sources of FDI inflows have changed since the 1990s. China's traditional investors consisted of its regional neighbors. Prior to 1996, Hong Kong, Macau, and Taiwan, Singapore, and Japan have been the primary providers, supplying more than half of China’s FDI. However, this figure steadily declined after the WFOEs law was implemented in 1986. In 2000, the International Bank of Reconstruction identified the consistent decline in FDI from China’s traditional investors. The share of FDI from Hong Kong and Macau was only 38% compared with 50% in 1996 (8). Nations such as France, the U.K, Germany, and particularly the United States are increasing their FDI contributions. Details of FDI sources are explained in Tables III. Table IV shows China's top ten investors.

In addition to receiving foreign capital from different sources, there is also a shift in the types of FDI. More companies are increasingly interested in WFOEs since 1986 when China promulgated the WFOEs law. Less than 1% of China’s total investment was categorized under WFOEs; however, this figure jumped significantly to 37% in 1996. (See Graph I). There is also a dramatic decrease in CJVs from 1986 to 1996: the percentage of CJV declined from 48% to 20%. The EJVs remained somewhat consistent with only a 5% decline in the same period (13).

Since the early 1990s, many European and American multinational companies began to invest in joint research development facilities in China to reduce costs and pursue in global expansions. Approximately 75% of these joint ventures are presently concentrated into seven industries: R&D services, computer programming and data processing, services, pharmaceuticals, instruments, motor vehicles, communications equipment, and computer manufacturing. China Central Television reported in November of 2004 that there are over 600 R&D laboratories in China. The government of China realizes that foreign capital is critical in developing local industries and in participating in the commercial market. Following the leads of successful companies, many more firms are rushing into China with the goal of penetrating into the Chinese market. On June 2004, the two telecommunication giants—France Telecom SA and Telecom Corp. Ltd.—established a joint research and development center in Beijing. The plan requires both companies to contribute $26 million to build the research facility. The R&D facility would be used to test new, sophisticated technology, develop new businesses and application integration, cooperate in equipment procurement and cost reduction, and make personal exchanges (3). In 2004, other large companies such as Phillips, Sony Ericsson, Delphi Corp, Nokia, and Intel have made public announcements on establishing R&D facilities in major cities such as Beijing and Shanghai, with investments as high as $200 million. Table V lists the companies with established R&D facilities, areas of development, and locations of the plants. Table IV lists the current companies that are in the process of constructing R&D plants and their contributions of capital.

II. What does China offer to foreign investors?

There are many reasons for Multinational Corporations to establish business presence in China: large pool of skilled labor, high GDP growth rate, large untapped market, low wages, and undeveloped industries.
1. Large pool of skilled labor

Traditionally only the top 4% of China's students are enrolled in college due to high education costs (18). Today, the expansion of public universities, such as the People's University, Normal University, and China's Medical University, has enabled approximately the top 17% of the students to pursue higher education. Many students with degrees in the science and technology field are best suited for the present and future pharmaceutical and technology firms with the intention to penetrate the Chinese market. China's Education of Ministry estimated that more than 1.5 million students graduated in 2002, and this number is expected to increase to 3.4 million in 2005 (18). Today, students are attracted to work in large cities such as Shanghai, Beijing, and Shenzhen because of better opportunities and compensation; however, the increase of college students in China is actually making it more difficult to find jobs, leaving many students unemployed or working in areas that do not effectively utilize their skills. On the contrary, companies such as Oracle are far from lacking talented individuals in their Chinese subsidiaries. When Oracle planned on hiring twenty-three college students, 4,800 applied (18).

2. High GDP growth rate

Traditional flows of FDI generally flowed among the developed nations (i.e. the U.S, Japan, Germany, the U.K, and Luxembourg). The past decade has altered the way FDIs are transferred. Now, business organizations from developed nations are beginning to explore developing nations—China, India, Vietnam, and Mexico—to establish manufacturing plants or research and development facilities. The increase in cost of labor and production necessitates this type of outsourcing. In other instances, companies must diversify its market because its local markets have been saturated and provide no or very low growth rates. By gaining access to the Chinese market, companies are expected to have a growth rate of 6-8% versus 2-3% in North America and Western Europe (2).

3. Large untapped market

In addition to having high GDP growth, China has 1.3 billion people with increasing consumer demands. Canadian Business found that only 40% of the domestic demands were met in 2003 through foreign purchases from Singapore, Hong Kong, Japan, South Korea, and Taiwan (2). The other 60% was opened for future foreign invested enterprises and key individuals. Prospective investors who take advantage of this large "unserved" market can provide goods and services to those with consumer demands. Products such as color TVs, computers, and cell phones are no longer luxury goods but are commodities. For example, only 25.2 out of 100 people own color TVs, 6.8 out of 100 own personal computers, only 160.9 out of 1,000 people own cell phones (Canada and Japan have a ratio of 377.2 and 636.5, respectively), and only .3 out of 100 people own a car (2). The high GDP growth has allowed Chinese consumers to purchase a variety of products and services, but these needs are not being satisfied completely by the inadequate number of suppliers. The demand for high-end products and commodities is likely to increase over the years as China continues with its economic development process. With rising GDP, consumer purchases are likely to increase over the coming years. For instance, the market for electronic goods is predicted to grow to about half the size of the Japanese market in the next three years (10). A study by Prismark Partners in 2002 suggested five prominent rationales for a successful growth in electronics industry in China: empowered low-cost labor, availability of needed skills, distribution capabilities, entrepreneurial opportunities providing trade and financial centers, and a "favorable political climate" (10).

4. Low wages

Besides gaining access to a potentially large market, foreign invested enterprises have another incentive to do business in China—low-wage labor cost and low material cost. With the abundant supply of labor, wages are much lower in China than in North America or Europe. The author of The Race to the Bottom, Alan Tonelson, who is also a Researcher at the U.S. Business & Industry Educational Foundation, found that there is a tremendous wage disparity between U.S., Ireland, Canada, and China.
An average IT Programmer earns $75,000 annually in the U.S., $23,000-34,000 in Ireland, $28,174 in Canada, and $8,952 in China (21).

5. Undeveloped industries

Although China is one of the fastest developing countries in the world, many of its industries such as its service, petroleum, and IT sectors still need further development. The World Bank estimated that by 2010 China will require $600 billion in infrastructure development (25). China lacks the internal funds and will need outside investors to foster infrastructural expansion.

In order to sustain China’s economic development, its petroleum, coal, mineral, and hydropower resources must be explored. China would require foreign financial support to help develop efficient fuel usage to keep up with its industrial growth. Existing enterprises can be renovated by the backward linkages along this path and include ports, railways, and telecommunication (25). Foreign companies who play a crucial role in the development process can generate high return on investments as experienced by Microsoft, Nokia, IBM, and Siemens.

China’s accession into the World Trade Organization also mandated that it must open up its service sector and allow foreign investors to foster faster development. In 1990, only 13.7% of the FDI was concentrated in the tertiary industry. In 1999, this figure increased almost threefold to 30.3% (24). The service sector that necessitates foreign capital is presently underdeveloped. The required capital supplied by foreign nations can help with its effort to deregulate its financial, tourism, retail, advertising, and telecommunication sectors. In industrialized nations such as the U.S., France, and Germany, the service sector consists of approximately 70% of GDP. To be successful at modernizing its economy, China must welcome global companies to develop its service sector.

III. Who benefits from China’s inflow of FDI?

There are numerous justifications for the need of foreign capital. The primary benefits include supplementing the lack of internal funds, promoting the establishment and development of various industries, permeating weak links in the Chinese economy, developing backward industries in various regions, establishing sophisticated technology and equipment, gaining management expertise from developed nations, expanding exportation, and increasing labor employment (19).

The first group that benefits from China FDI inflows is the domestic Chinese firms. Among the many scholars and international organizations believing that foreign invested enterprises enable the transference of contemporary managerial skills, “state-of-the-art” equipment, and sophisticated technology are the UN and the World Bank. Transnational corporations such as Microsoft, Shell, Oracle, IMB, Nokia, and General Motors brought in managerial and technical expertise to train local employees as a result of their local presence. Hence, local firms obtain access to technology, product design, global brands, and distribution networks. By competing with other large foreign invested enterprises, domestic Chinese businesses increase their competitiveness. Local companies are dominant in producing refrigerators, TVs, and computers. Foreign capital also assists local firms by developing a domestic supply chain. Motorola provides training and managerial programs for its 7,000 local suppliers. Royal Philips Electronics provides assistance on productivity enhancement (4).

The second group that benefits from FIEs is students of universities, colleges, and institutes. Microsoft, IBM, Sony, and Nokia have established R&D facilities in China and are cooperating with Chinese universities and institutions to conduct research to improve the transfer of skills and knowledge to the students. Nokia plans to collaborate with ten universities in China to provide knowledge transfer through training, seminars, and coursework. It is also setting up a “Postdoctoral program” to accelerate technological innovation (4). Another company that is working closely with the Chinese institutions is Oracles. Oracles has two R&D centers in Beijing and Shenzhen with strategic emphasis on “localization and partnership”.

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In 2002, Oracle’s Golden China Initiative invested $70 million to promote education programs and businesses. Oracle also announced in July 2004 that it had signed a “memorandum of understanding” with China’s Ministry of Education to enhance the education of Information Technology in the country” and intend to donate $143 million worth of software to universities in western China’s less-developed regions. Other companies such as Intel and Microsoft also work closely with students of technical institutes and universities to recruit skilled individuals.

Another group that benefits from foreign capital is the foreign direct investors—multinational corporations. Companies such as Siemens, Lucent Technology, Gillette, Toyota, DuPont, and Avon that entered China have experienced high growth rates. To illustrate, Siemens first established a representative office in Beijing in 1982. Since then, Siemens gained advanced access to learn about the domestic market, established relationships with key industrial ministries, and established a strong local presence. Today, Siemens is one of the most successful MNCs in China with over 45 joint ventures, which include telecommunications, energy, transportation, healthcare, and electronics (14).

Chinese consumers can also benefit from foreign capital inflows. The establishment of low-price superstores like Wal-mart and Lowe’s exposes foreign products to the domestic market. Consumers’ tastes and preferences are enhanced by the operations of various MNCs. Furthermore, prices are lowered when competition among local and foreign companies compete for market share. Between 1996 and 2003, the index of consumer electronics and home appliances has declined by 33%. A television costing 936 Yuan was decreased to 292 Yuan in 2003. In the same period, the price of a mobile phone was dropped from 282 to 172 Yuan (4).

Additional benefits are attributable to the growth of the Chinese economy by providing employment. In 1995, FIEs employed nearly 150 million Chinese workers (13). Table VII illustrates the number of FIEs workers in various provinces. China has experienced positive GDP growth since 1980 and has been able to maintain a fair unemployment rate. During the Asian Financial Crisis that collapsed the Thai Baht and severely disrupted other economies such as South Korea and Malaysia, China was experiencing GDP rate of 7.5% (22).

III. Who loses from China’s inflow of FDI?

Although Chinese students, consumers, workers, and FIEs benefit greatly from the inflows of foreign capital, negative impacts of FDI certainly do exist. China’s aggressive strategies to attract FDI essentially impose economic threats to its regional partners. The Association of South East Asian Nations fear that China would lure away domestic investors and that competitive manufactures from China may potentially “flood” their markets and replace their exports in Third World nations (22). Two prominent authors who are affiliated with Singapore’s Ministry of Trade and Industry, Friedrich Wu and Chue Boon Loy, asserted in the Thunderbird International Business Review that “Singapore needs to further leverage on its competencies in infrastructure and logistics, as well as the well-established ASEAN production network for greater economies of scale” to cope with the rapid influx of the semiconductor industry into China (24).

A second controversial issue involves environmental policies. China provides many incentives for corporations to invest in China to speed up its modernization effort. The rise of industrialization means the rise of fuel consumption. Industrial development in the urban areas is contaminating the lakes and air. Many people from the city of Tianjin, Shanghai, and Beijing and many other industrializing areas are confronted with water pollution problems. In 2001, China proposed to spend $5 billion to fight pollution in the Three Gorges area of the Yangtze River. Others studies estimated that the annual pollution costs equal approximately 7-10% of China’s GDP (16). Furthermore, the largest hydroelectric station is to be completed by 2008; China also plans to fund a ten-year plan to build hundreds of wastewater treatment plants and facilities of rubbish treatment in central China.
In 1998 the World Health Organization reported China has ten of the most polluted cities in the world. Half of the Chinese population does not have access to clean water and 90% of urban water bodies are polluted (16). China must continue to better its policies for environmental protection or its people will be faced with severe consequences of health risks such as respiratory and heart diseases.

The third issue deals with the widening of income distribution. Though FIEs provide higher paying jobs than state-owned enterprises, the standard of living in China is, nevertheless, far behind that of the Mexico and developed nations such as the U.S., Singapore, Germany, and Canada. A New York Times study indicated that China’s GDP per Capita is only $5,000, which is significantly lower than Mexico's $9,000 and incomparable with the U.S.’s $37,800 (1).

**Conclusion**

China’s aggressive strategies in modernizing its nation by attracting foreign capital contributes positively to its economy by increasing employment, absorbing technological and managerial skills from developed nations, and allowing college students the unique opportunity to be exposed to sophisticated technology. Its positive impact, however, also imposes economic threats to its neighboring countries and creates environmental pollution. To yield the greatest benefits without imposing high negative consequences and to succeed in industrializing its economy, China must carefully assess its risks and benefits in determining the utilization of foreign capital. In the near future, China must cooperate with FIEs to reduce environmental pollution, to further transparencies in its policies, and to work together with its neighbors to better trading relations.


