ASTRA

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From ***Chancellor James Schmidt***

"You cannot help but learn more as
you take the world into your hands.
Take it up reverently, for it is an old piece of clay,
with millions of thumbprints on it." — John Updike

If asked to describe what a university should be about, I doubt I could come up with a more compelling picture than John Updike's idea of taking the world into your hands.

At its best, higher education connects learners with the wonder and complexity and messiness and brilliance of the world in which we live. It provides ways for learners to literally and figuratively poke, pry and touch new ideas, different perspectives, deep traditions and outrageous postulations. It should be tactile as well as cerebral, providing space for the deep reflections and spirited debates out of which new knowledge emerges.

But more than this, higher education provides opportunities to leave a thumbprint. To begin what I hope is a lifelong habit of individual work, service and living that shapes the world for the better.

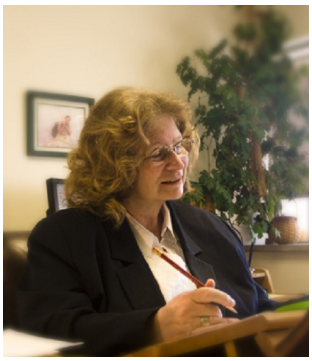
This issue of ***Astra*** is one of those unique thumbprints. In these pages you will discover what happens when nineteen amazing young women and men take an idea or theory into their hands, turn it, weigh it, and leave their special mark. They do so with academic rigor and with the creativity that reflects the tradition of learning at UW-Eau Claire.

This collection of good work reflects not only the thumbprints of the talented authors, but also their instructors and this university. For almost two decades, director Patricia Quinn has helped literally hundreds of McNair students touch the world. This year she will retire and we wish her much joy. She leaves a legacy of caring for and challenging her students. She has been their champion and toughest critic, finding her greatest joy in their success. Thank you, Patricia, for exemplifying the best of a UW-Eau Claire education.

Along with Patricia and her staff, our UW-Eau Claire faculty mentors, listed on the previous page, work closely with our scholars, helping them explore and discover their individual passions, and testing their thinking against the best. I want to recognize and thank all our mentors for the hours of dedication they provide. Our university prides itself on the quality of our instruction, led by faculty who get to know their students by name.

The outcomes of that dedication have been amazing. More than 180 UW-Eau Claire McNair scholars have received prestigious national and international awards since 2001 – awards from the National Science Foundation, U.S. Department of State's Peace Corps Fellowship, the Woodrow Wilson International Center and the Rhodes Trust. The list goes on, impressive in both the scope of excellence these awards represent and in the quality they recognize. The work of our McNair scholars here in Eau Claire leaves its imprint around the world.

As chancellor of UW-Eau Claire I have the singular privilege of seeing young scholars thrive under the mentorship of our faculty and staff. Together we share the world with the women and men who will shape it for another generation. It is in good hands.



From ***McNair Program Director Dr. Patricia Quinn***

Wait! This publication before you shouldn't exist. The odds against its authors simply persisting to college graduation make one shiver: among 'their kind' twelve or fewer out of 100 make it. Students from the demographic pools wherein McNair recruits its Scholars—underrepresented American minorities and 1st-generation students from low income families—barely have a showing among baccalaureate recipients. Even less do ones such as these pursue advanced degrees.

But this publication's authors defy those odds. This publication shows what happens when talented 'outliers' gain the right resources—like intentional mentoring from caring university professionals and membership in a learning community marked by both academic energy and racial/ethnic diversity. The authors whose articles appear here all entered (or will shortly enter) graduate school after UW-Eau Claire. Those enrolled in graduate programs are all paid to be there. Yes, all. Among these nineteen authors stand two NSF Graduate Research Fellows, a Han-Kierkegaard Fellow, a Rhodes Scholar, and two McNair Graduate Fellows. The rest enjoy assistantships or internships from their graduate institutions to meet costs as they pursue their next degrees. When you read the articles that describe the projects that these UW-Eau Claire McNair Scholars undertook as undergraduates, you will understand why top-flight doctoral institutions welcomed them into their departments and research groups. Read between the lines of the articles: you'll grasp why UW-Eau Claire's McNair Program has produced the greatest number of doctoral-degree holders of any McNair Program in the State of Wisconsin. Yes, with 40 doctoral recipients to date, UW-Eau Claire's McNair Program outperforms those at Wisconsin's three doctoral institutions.

As I write these words my sojourn with McNair, a seventeen year adventure, winds down. After directing the program through this final fall semester, I'll start out in a new career, as a novelist in the slipstream genre. The job I leave included much technical writing: the one that's waited for me promises writing no less complex, but decidedly freer and deeper. Yet how could that new work not help but tap the substrate of assorted knowledge and still dormant possibilities that inevitably and relentlessly accumulated over years of meaningful work and associations in the Academy? Already my first novel started evolving this past year-and-a-half. Its impatience gained a definite nudge from a certain McNair Scholar (one whose own scholarly and creative works grace this ***Astra***): laboring through a difficult transition to graduate school, he asked me, half-jokingly and half-seriously, to "just write a story in which I'm a hero." I did, with the initial intent that the separate chapters, arriving in his mailbox about every three to six weeks apart, would keep him going. (He did.) But those who write creatively know so very well that the characters in a story or novel take a hand too, more often than not leading their so-called creator into scenarios, landscapes and perspectives she'd never before envisioned . . . just like the McNair Program did. Just like the McNair Program did!

So, thank you, Glenn. Thank you, Nathaniel. Thank you, McNair Scholars. Thank you McNair Mentors. Thank you present and past McNair staff members, and thank you Dr. Michael Wick, the ever-supportive "guardian angel" of our UW-Eau Claire Program. Long—seventeen years long--has this UWEC employee known she's had the best job in the institution!

Journal Disclaimer

While the McNair Program staff has made every effort to assure a high degree of accuracy, rigor, and quality in the content of this journal, the interpretations and conclusions reached in each paper are those of the authors alone and not of the McNair Program. Any errors of omission are strictly the responsibility of each author.

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An Investigation of the Interaction between Maternal Relationship Quality, Peer Aggression Tendencies, and Friendship Quality in Young Adults

by:
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Advisor: Dr. Jennifer Muehlenkamp

Abstract

The current study investigates a possible link between maternal relationship quality, friendship quality, and the likelihood of young adults to engage in peer aggression behaviors. Attachment theorist John Bowlby posited that early caregiver relationships are crucial to an individual's forming the set of social competencies and behaviors that carry over into their future relationships (Bowlby, 1969). Furthermore, Bowlby's theory of Maternal Deprivation suggested that a neglectful mother will prompt her child to behave in an ambivalent manner; that is, the child will act both lovingly and aggressively toward the mother in reaction to the mother's positive or negative behavior. This phenomenon finds a parallel in friendships characterized by peer aggression: the aggressor in a friendship acts positively towards a friend to keep him or her close, and aggressively towards the friend to punish his or her unwanted behavior. Other prior research has shown that child ambivalence towards a parent could predict poor quality relationships, i.e., those characterized by aggressive behavior (Surjadi et al, 2013). A 60-item survey to measure maternal relationship quality, friendship quality, and engagement in peer aggression was administered to college-aged students in Spring 2014. Students who reported low quality relationships with their mother also reported lower quality friendships and higher engagement in peer aggression than students who reported average or high quality relationships with their mothers. However, engagement in peer aggression did not mediate the relationship between maternal relationship quality and friendship quality.

Introduction

Peer victimization involves a process in which one becomes a target for the aggressive acts of a peer. This can take many forms, such as physical and relational (Grotpeter and Crick, 1996). Those who experience peer aggression demonstrate an increased likelihood to develop high levels of distress, adverse psychological symptoms, and poor social adjustment (Daniels, Quigley, Menard, and Spence, 2005). Similarly, having strong friendships features prominently in college students' health and success (Swenson, Norstrom, and Hiester, 2008). Yet, a recent study of university students that examined peer-victimizing behaviors found that 44.5% of participants had been targets of peer-victimization, while 29% of the sample had reported acting as aggressors (Al Badayneh, Al –Khattar, Al –Kresha, and Al –Hasan, 2012). The importance that peer relationships play in college students' well-being warrants understanding those mechanisms that may contribute to relational aggression or peer victimization.

Rispoli, McGoey, Kozoil, & Schreiber (2013) found that the social competence children display at the time of kindergarten is relative to responsive parenting displayed at infancy; parental responsiveness in infancy had a positive, direct relationship to social competency in kindergarten through attachment security at two-years of age and preschool emotional supportiveness of parents. The results of Rispoli et al. (2013) suggest that parent-child relations are a key factor in

developing prosocial competencies later on in life. Attachment theorist John Bowlby forwarded the idea that the quality of the earliest bonds an individual makes with others, namely with his or her mother in childhood, strongly determines the quality of attachments he or she will form in later relationships. Bowlby reasoned that many factors contribute to a person's mother holding the most significant role in shaping a child's attachments—for instance, persons' conception and gestation within the mother. Evolutionarily infants rely on the protection and resources provided by their mothers to survive. In his work on maternal attachment Bowlby developed the Theory of Maternal Deprivation, which supports the idea that if a mother physically or emotionally neglects her child, the child will begin to develop both a hatred towards the mother and a strong desire to obtain her love. Subsequently, the child will act in ways both to express its anger towards the mother but also to keep the mother close. An example that illustrates the Theory of Maternal Deprivation would be a child throwing a temper tantrum, then soon after, acting lovingly and apologetic. The consequence of experiencing uncorrected Maternal Deprivation, Bowlby posed, would be flawed attachment formation throughout one's life, a condition affecting the quality of subsequent relationships (Bowlby, 1969).

Theoretical Interpretations and Questions

As I developed an understanding of Bowlby's framework on mother-child attachment, I noticed how this framework might apply to friendships characterized by peer aggression. I reasoned that just as a child may act ambivalently towards a neglectful mother, so too an aggressor in a friendship might act both warmly and aggressively toward the other friend in an attempt to exercise social control. Acting ambivalently allows a person to convey displeasure towards anything undesirable that their friend does and still act warmly enough to keep that friend close. Peer aggression in a friendship may lower its quality since aggressive behaviors can manifest themselves as conflict and conflict is negatively related to overall friendship quality (Bukowski, Hoza, & Boivin, 1994). Thus, drawing from Bowlby's theories on attachment, I expected that a child who experienced low-quality mother-child relationship could very well engage later in life in peer aggression within their friendships.

This connection between mother-child relationships and the quality of peer friendships is important to investigate since it could reveal whether maternal relationship quality functions as a precursor to establishing the quality of certain future relationships. Understanding the bases of high quality relationships assists persons to improve relationships that in turn encourage sound mental health. In the current study I hypothesize (H1) that individuals who report a low quality relationship with their mother will show higher levels of peer aggression and (H2) lower levels of friendship quality when compared to individuals who report average or high quality relationships with their mother. In addition, I propose that (H3) peer aggression will mediate the relationship between maternal relationship quality and friendship quality.

Methods

Participants and Sampling Procedures

Participants (47 men, 247 women, M age = 20.03 years, age range 18-23 years) were recruited via emails sent to the honors program, and the philosophy, social work, and sociology departments at the University of Wisconsin-Eau Claire. Students of the psychology department were recruited via the SONA Research Participation System. The survey was open between April 7th, 2014 and May 7th, 2014. Participants accessed the survey from a computer of their choice, were ensured anonymity, and were given the option to exit the survey at any time. A total of 332 people participated in the survey. Twenty-six cases were removed for incomplete data, and 12

cases were removed that lay outside of the age threshold (18-23). Thus, 294 cases informed data analysis.

Measures

The Quality of Relationships Inventory (Pierce, Sarason, and Sarason, 1991) measures the quality of relationships characterized by social support. In previous studies the instrument (a composite of the subscales Support, Conflict, and Depth) has shown acceptable reliability (Cronbach's alpha 0.79 – 0.88) when used to measure the relationship quality between an individual and his or her mother, father, or best friend. In the current study, the instrument was utilized to measure participants' reported maternal relationship quality. To test our hypotheses, participants needed to be grouped according to the quality of the relationship they had had with their mothers (low, average, high); to establish these groups, data-points for all items on the subscales of Support, Depth, and Conflict were totaled to establish a reading of overall relationship quality. Subsequently, the mean was taken (M = 78.53, SD = 13.08) and then the three groups were stratified by their relation to the mean (low quality being one standard deviation or more below the mean, and high quality being one standard deviation or more above the mean. The remainder of cases lay within one standard deviation of the mean and were considered average quality).

The Friendship Qualities Scale (Bukowski, Hoza, and Boivin, 1994) measures friendship quality as a composite of five dimensions inherent in friendship: Companionship, Conflict, Help, Security, and Closeness. The instrument has shown acceptable reliability (Cronbach's alpha 0.71 - 0.86 on all subscales) in prior peer reviewed studies in which the instrument was used in a population of fifth and sixth grade youth. Although previously only used in populations with a younger target age (8-12 years), the Friendship Qualities Scale was selected as a measure for friendship quality because the survey items could be directed towards an older demographic (18 – 23) without significant change, while the instrument would still maintain its integrity. In our preliminary reliability analyses, the scale of Security showed low reliability (Cronbach's alpha 0.36) in comparison to the other subscales of the instrument. All items in this subscale were reexamined and the decision was made to reverse code the item: "If I said I was sorry after I had a fight with my friend, he would still stay mad at me." After reverse coding this item the reliability for the Security subscale reached a level congruent with the other subscales on the instrument.

The Young Adult Social Behavior Scale (Crothers, Schreiber, Field, & Kolbert, 2008) was utilized to measure participants' likelihood of having engaged in peer aggression behaviors. The instrument measures participants' reported relational and social aggression behaviors and interpersonal maturity. When used within a population of young adults (aged 18-25), this instrument showed adequate reliability on all of its subscales (Cronbach's alpha 0.73 – 0.76). Within the current study, the subscales of Relational Aggression and Peer Aggression were aggregated to create a subscale of "Peer Aggression" for the purpose of achieving an adequate reliability threshold for data analysis purposes.

The three prior scales were aggregated within a ***Qualtrics*** survey instrument and accompanied by a short questionnaire on participants' demographics (age, year in school, biological sex); the order of appearance of the three instruments (Quality of Relationships Inventory, Friendships Quality Scale, and Young Adult Social Behavior Scale) was randomized among the participants.

Results

Data were analyzed for differences related to participants' sex, age, and race/ethnicity.

None appeared for age or race/ethnicity; However, significant differences in Friendship Quality by sex appeared, but not on the other variables. We controlled for sex differences in our formal data analyses.

An ANCOVA was conducted to test hypotheses one and two (H1 and H2). Hypothesis one was partially confirmed. Individuals who reported low and average maternal relationship quality reported higher levels of engagement in peer aggression than individuals who reported high maternal relationship quality $F(2, 294) = 6.22$, $p < .05$ (Figure 1). Hypothesis two also received partial confirmation. Individuals who reported low and average maternal relationship quality reported lower levels of friendship quality than individuals who reported high maternal relationship quality, $F(2, 294) = 3.96$, $p < .05$ (Figure 2).

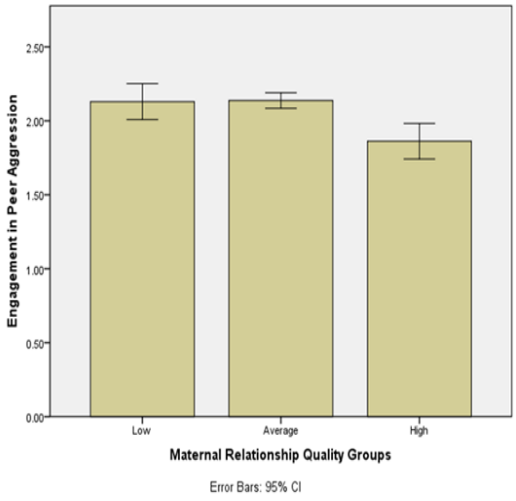

Figure 1

To test the third hypothesis, we ran a bivariate correlational analysis investigating the relationship between total friendship quality, maternal relationship quality, and peer aggression. No significant correlational relationships appeared between any of these three variables ($p > .10$). A weak, positive correlation was found between Maternal Relationship Quality and Friendship Quality, $r(292) = .11$, $p > .10$. A weak, negative correlation was found between Maternal Relationship Quality and Peer Aggression, $r(292) = -.08$, $p > .10$. Lastly, a weak, positive correlation was found between Friendship Quality and Peer Aggression, $r(292) = .01$, $p > .10$. We then infered that peer aggression did not mediate the relationship between Friendship Quality and Maternal Relationship Quality. The third hypothesis was thereby rejected.

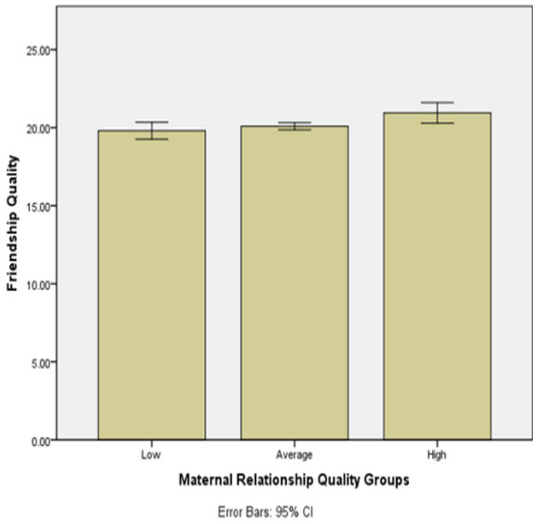

Figure 2

Discussion

H1 and H2 were partially supported, i.e., individuals who reported high Maternal Relationship Quality reported higher levels of Friendship Quality and less engagement in Peer Aggression than did individuals who reported low or average levels of Maternal Relationship Quality. H3 was not supported, namely Peer Aggression did not mediate the relationship between Friendship Quality and Maternal Relationship Quality. Much like those of Rispoli et al. (2013), our findings showed that parent-child relations, namely those mother-child relations in our case, that are characterized by supportiveness and secure attachment may prove a key factor related to the

formation of prosocial competencies.

The results of H1 and H2 contradicted in part our original hypotheses, in that we anticipated significant differences in Friendship Quality and engagement in Peer Aggression between the low and average/high groups, but instead found significant differences between the low/average and high groups. What our results suggest is that perhaps it is the experience of a high quality mother-child relationship that may explain more of the difference in social relationships and behaviors than the experience of a low-quality mother-child relationship. High-quality mother child relationships provide a significantly different context for facilitating prosocial development of social capacities.

The study had several limitations. Foremost, we lacked a solid foundation of empirical research that explicitly investigated mother-child relations, friend, and peer aggression. To investigate the research questions, I drew from theories of development and research on friendships and social behavior, and identified three prior peer-reviewed measures that appeared appropriate instruments to investigate the hypotheses. From what I understood, the current study presented a novel investigation of the parallels between pro and antisocial behaviors of mother-child relations and the quality of friendships. While novel studies can contribute creative approaches to the development of the field, they are significantly hindered by the lack of established, sound methodology. In hindsight, we recognize that the current study's methodology could have been improved through adding a measure of social-desirability bias into our instrument; this could have indicated whether participants responded truthfully or responded in a manner that appeared to them as "socially appropriate." Further improvements could have included a larger sample size and more equitable sex representation, factors that could have altered our findings.

Despite its shortcomings, the current study can promote further investigations of possible links between mother-child relations, friendships, and peer aggression. Our current results do suggest that differences exist in the friendships and aggressive behaviors of persons who have a high-quality relationship with their mothers versus persons who have a low or average quality relationship with their mothers, thus justifying further research on this topic. Mother-child relationships may set the ground for the formation of social competencies and behaviors that contribute to the development and quality of future relationships. If a pronounced link between mother-child relationship quality and prosocial development exists, then identifying ways that encourage parents to best structure their parenting and build positive relationships with their children ensures that their children will develop prosocial capacities that support healthy relationships.

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Towards Defining a Formula for Highly Effective Graphic Imagery in Digital Environments

by:
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Advisor: Ms. Wanrudee Buranakorn

Abstract

As advertisers seek an ever wider scope of audiences for their products, they need to understand how artistic appeal (to date mostly western-articulated) intersects with what attracts and dictates eye movement (mostly biologically-articulated). This research seeks common ground between the visual and digital worlds. The visual world refers to the environment one observes directly with the eyes, unnegotiated by the screen of a computer, tablet, cellphone or other technological device. The digital world refers to the pixel-constructed environment one observes on the screens of technological devices. Certain elements simultaneously accommodate the eye's quick movement across visual and digital objects and facilitate the even quicker interpretation of the objects by viewers. No one disputes that graphic images, whether positive or negative, shape viewers' notions of reality. But is the digital evironment the equivalent of visual space, or somehow different? Is it possible to "learn the code" of highly effective digital graphic imagery?

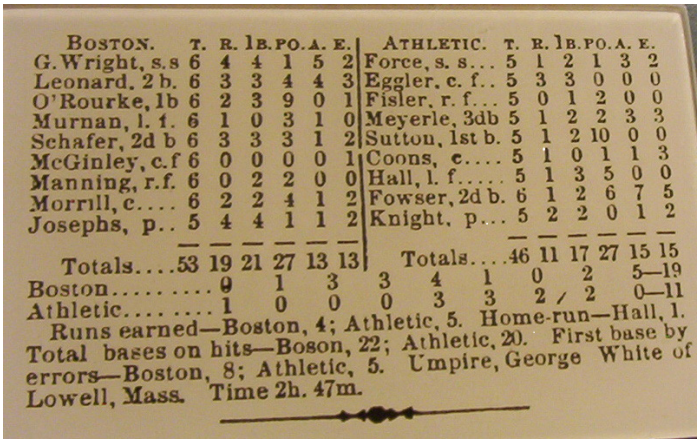
Digital communication grows at an unprecedented rate, as do expectations regarding its quality, speed, and reliability. This connectedness ties individuals together in ways still not fully known or understood. We do know, however, that communication through web pages operates on a "visual first" hierarchy; this underscores the importance on the part of web designers to understand humans' engagement with digital image structure, and to do so with reference to both western and non-western audiences. This pilot project begins with a small sample of the former population and queries, "Is it possible to establish common 'vision trails' on the part of different western individuals as they each observe the same digital image?"

Introduction

Vision Rules!

Educational researchers suggest that approximately 83 percent of human learning occurs visually, and that the remaining 17 percent takes place through the other senses—11 percent through hearing, 3.5 percent through smell, 1.5 percent through touch, and 1 percent through taste.[1] Visual information provides a stronger vehicle for idea conveyance and communication than oral language, and even breaks barriers created by language. The common set of traffic symbols used across the respective linguistic zones of Europe provides one example of this.[2] Visual communication bypasses dialect and in some instances even time: the Lascaux and Grotte Chauvet cave paintings, for example, express the same stories today as they did thousands of years ago.[3] Eyesight, more than the other senses, has provided the strongest aid to defense and preservation for humans throughout history. For example, the urge one has to look out over water when crossing a bridge—i.e., when exposed and assessing the surrounding open terrain—demonstrates the demand eyesight has on our unconscious.[4] This characteristic of eyesight, when reinforced by appropriate design principles, creates an especially ergonomic viewing of information-rich visual data.

Today's advertisers compete for potential customers' attention within visual and digital environments that lie close to the saturation point. Hence, advertisers benefit from understanding the amount of time and the approaches viewers use when they navigate and make sense of visual and digital information. "High resolution data dumps"—i.e. content rich depictions that are easy to quickly reference and understand[5]—are nothing new. For example, the box scoring system (Figure 1), which dates back to the 18th century, reported sporting results along with other facets of play that occurred during the game. The box scoring system offered fans precision understanding of what happened without their ever seeing the game itself. This method of information organization persists in the sports section of many newspapers today. Because of their effectiveness, box scores have not changed, but rather adapted to fit the digital presentation of the daily sports report. Organized information reinforces quick comparisons between variables based on visual elements, with the result that viewers grasp more directly the topics in presentation. In the 21st century, corporate identity combines traditional (pre-digital) methods of advertising—i.e., newspaper and magazine ads, billboards, flyers, brochures, and posters—with digital media such as the web site. To create and maintain a cutting edge image on the internet, an organization, institution, or business gains from investing in research and development of viewer interface and market anticipation that accommodate a global audience.



BOSTON.	T.	R.	1B.	PO.	A.	E.	ATHLETIC.	T.	R.	1B.	PO.	A.	E.
G. Wright, s.s	6	4	4	1	5	2	Force, s. s...	5	1	2	1	3	2
Leonard, 2 b.	6	3	3	4	4	3	Eggler, c. f..	5	3	3	0	0	0
O'Rourke, 1b	6	2	3	9	0	1	Fisler, r. f...	5	0	1	2	0	0
Murnan, l. f.	6	1	0	3	1	0	Meyerle, 3db	5	1	2	2	3	3
Schafer, 2d b	6	3	3	3	1	2	Sutton, 1st b.	5	1	2	10	0	0
McGinley, c.f	6	0	0	0	0	1	Coons, c....	5	1	0	1	1	3
Manning, r.f.	6	0	2	2	0	0	Hall, l. f.....	5	1	3	5	0	0
Morrill, c....	6	2	2	4	1	2	Fowser, 2d b.	6	1	2	6	7	5
Josephs, p..	5	4	4	1	1	2	Knight, p...	5	2	2	0	1	2
Totals....	53	19	21	27	13	13	Totals....	46	11	17	27	15	15

Boston..... 0 1 3 3 4 1 0 2 5—19
Athletic..... 1 0 0 0 3 3 2 2 0—11

Runs earned—Boston, 4; Athletic, 5. Home-run—Hall, 1. Total bases on hits—Boson, 22; Athletic, 20. First base by errors—Boston, 8; Athletic, 5. Umpire, George White of Lowell, Mass. Time 2h. 47m.

Figure 1: Box score for Boston vs. Athletic Game, 1876. (Source: Wikimedia Commons.)

Vision's Rules

This research seeks confirmation of the existence of common vision trails in a digital environment--that is, (1) the simplest means whereby viewers navigate a digital image to perceive its content, and (2) the organizers of such trails. Designers and artists have long employed certain principles to create effective images for the visual world—the Principles of Design (PoD) and the Elements of Design (EoD). The PoD consist of Balance, Proportion, Rhythm, Emphasis, and Unity (Appendix A). The counterparts of PoD, the EoD, allow for resolution to the overall composition: these include Line, Shape, Direction, Size, Texture, Color, and Value (Appendix B). The various combinations of PoD and EoD render an innumerable number of artistic possibilities and explorations. The task of creating work the public will really "see" entails an artist's understanding of responsibility to past design movements, but also to his or her knowing that once mastered, the rules may also be broken. The following reviews specific principles important to this research project. It also addresses balancing images and text to ideally impart information, and how digitally-based media force a new density into that balance.

a) Fixed to Fluid Frames

A frame is meant to draw and maintain viewers' attention on what lies within it. I employed framed digital images of a certain aspect ratio (16:9) in this project in order that the rectangular frame associated with a photograph would correlate closely with the shapes of modern computer monitors and smartphone screens.

The introduction of widescreen computer monitors triggered a paradigm shift in web site structure, from a fixed to a fluid layout. In the former fixed layout with a typically 4:3 aspect ratio, the web site content remains true to the original dimensions of the design and is anchored in the center of the screen. In a fluid layout, on the other hand, the content adjusts to fit the monitor or device's screen. Along with widescreen computer monitors, [6] many smartphones echo widescreens' 16:9 aspect ratio. Together they have pushed the move to fluid layout for web sites.

(b) Persistence of Recognition: The Role of Real Edges and Implied Lines

Most researchers agree that edges and lines provide particularly rich sources of image information; hence, the organization of these features belongs within an efficient description of the image.[7] Humans identify the outlines and the edges of implied space when they look at a picture, and generally they continue to recognize objects when the whole reduces to a line drawing. Can one duplicate this persistence of recognition phenomenon when decreasing the resolution of a digital image? As the resolution of the digital image decreases, does the content of the image break down and dissolve, simplifying the viewer's navigation of this space while preventing strong lines from directing his or her eye movement? Rather like the experience of cloud gazing, does the eye, in the absence of strong lines wander through the space now built from soft interpretations of light? Is this new, low resolution environment both more inviting and less abrasive than a high resolution one? The latter, which is filled with definable content, could trigger past associations, and thereby a predictable vision trail through the digital image.

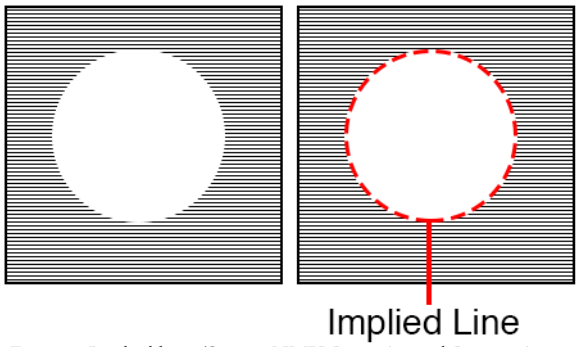


Figure 2: Implied line. (Source: NMU Dept. Art and Design. Apr. 1, 2013.)

Humans possess the ability to quickly identify patterns and to complete several visual tasks daily without reflection. For example, we effortlessly walk over varying terrain without watching where we step. We remain blind to the rest of the page and our physical surroundings when focusing on the words of this sentence right now before us. We also have the ability to complete missing lines, and thus create the visual illusion called implied lines.[8] (Figure 2) These visual capabilities have been academically analyzed for centuries and cultivated through the rhetoric of the art and design community.

(c) Balancing Text and Image to Accommodate Data Desnity

Setting a new standard of originality in technical drawings, Leonardo da Vinci produced highly refined presentations that integrated sketches with text—the first infographics. If the text became challenging, a viewer (a client, workers, apprentices, a forgetful Leonardo) could observe the illustrations presented on the same sheet as the text, and vice versa. Edward Tufte summarized Leonardo's approach, and the basis of all infographics, "...those who reason about evidence often seek to place different forms of communication in a common visual field and to treat all forms—verbal and nonverbal—as colleagues in explanation."[9]

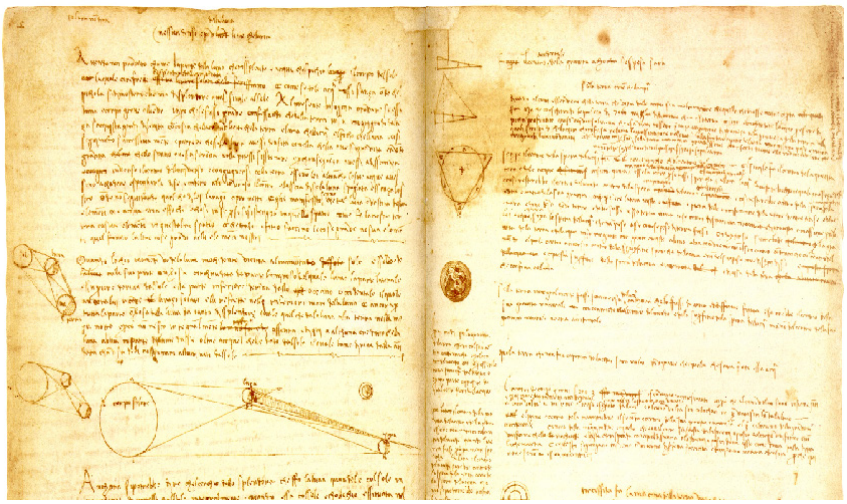


Figure 3: Leonardo da Vinci. Codex Hammer 2a, Folio 2r and Folio 35v.

Another application of text and image integration followed Leonardo's 16th century effort in the work of cartographer Charles Joseph Minard (1781-1870). Minard's concept of analytic design provided the viewer large amounts of information for his or her confirmation of correlating statistics. This method of idea dissemination created a richly informative visual display, one in which each part of the visual creation became relevant on its own, but contributed as well to the creation's larger meaning that revealed itself within the overall design. Minard's analytic graphics were (and remain) dynamic creations that communicated to both literate and non-literate viewers—even literate persons who did not know French would have appreciated the visual message. Multivariate analysis, the name given to the interpretive method used when decoding such dense infographics, peels back the layers of accumulated data to find otherwise unnoticed patterns and perspectives.[10]

Minard specialized in figurative maps—or analytic graphics—that laid out data as spatial flows over distance and time. His subjects ranged from ancient languages and migrations to the military campaigns of Hannibal[11] and Napoleon (Figure 4). The latter is considered one of the most famous graphics in the world;[12] it presents the volume of French soldiers heading into battle as a line of ever-tapering thickness. The line falls across the routes (and

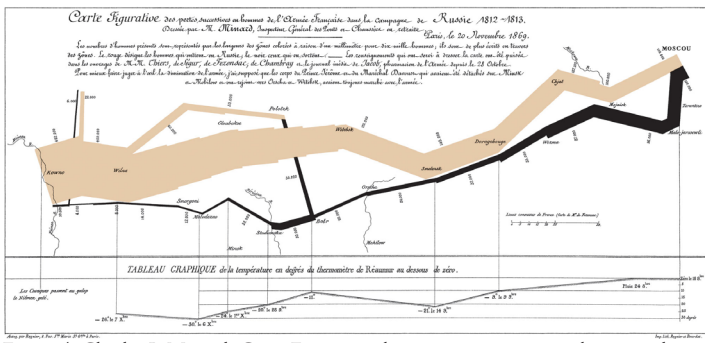


Figure 4: Charles J. Minard, Carte Figurative des pertes successives en hommes de l'armée française dans la campagne de Russie 1812-1813. (Paris: Regnier et Dourdet, 1869).

hence, the distances) the army traveled, the rivers they crossed, the freezing temperatures they endured, and other geographical terrain the military traversed when advancing (beige line) and retreating (black line). This graphic opened people's eyes to the toll of human lives the French army suffered in the attempt to take Moscow in 1812; the assault was launched with 518,000 men of whom a mere 36,000 returned—a loss of approximately 93% of the total army. Minard so loathed Napoleon that he excluded the emperor's name from the graphic completely. "Analytic presentations," Tufte comments, "ultimately stand or fall depending on the quality, relevance, and integrity of their content."[13]

(d) Ever Denser Text and Image Integration

Contemporary designers would benefit from reexamining the infographic in reference to the continuously expanding conglomeration of raw data aggregated on the internet. Because computing processes volumes of information at speeds beyond human capabilities, viewers can find themselves passively watching and waiting for glitches as indications that "something" happened. One of these algorithmic glitches, for example, caused the stock market to drop nine points without a complete trace as to where all the money went.[14]

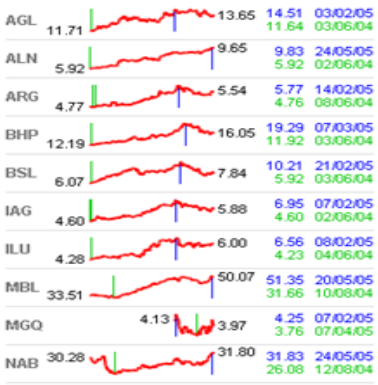


Figure 5: Ten Sparklines Displaying Stock Market Data.

One especially noteworthy contemporary designer has adapted infographics to today's conditions of data density. Sparklines were developed by the modern day da Vinci of data visualization, Edward Tufte. Like infographics, sparklines contain large amounts of information displayed in an especially efficient manner—namely, within the boundaries of a single line of text. A sparkline could fit into this space here | |; the data it contains embeds directly into the sentence. Sparklines display and encourage rapid comparison of trends over time, as in the stock market figures (Figure 5) or the win-loss performance of major league baseball teams.

"Dow Jones 80-09" (Figure 6), a print from the *High Altitude* series (2008-10) by photographer and digital artist Michael Najjar, presents another example of data-dense text and image integration. This work portrays the internet's impact on economic activity. Initially the viewer of "Dow Jones" registers a wonderful picture of a mountain range. Then the viewer notices the title of the work and all of a sudden realizes that this mountain range represents the activity of the Dow Jones from 1880-2009. Najjar masterfully combines attractive photographic elements with the Dow's x- and y-axis grid that delineate a longitudinal interpretation of space.


Figure 6: Michael Najjar, "Dow Jones 80-09" High Altitude Series (2008-10).

The photo elegantly contrasts the fragility of the market economy with the apparent strength and endurance of the mountains,

even though the viewer acknowledges that the mountains' ridgelines have been manipulated by the artist. One possible result is that the viewer will choose to see either the natural beauty of the mountainscape or will observe the informative data of the sparkline. A more likely result, however, is that the observer will bring together the data information and the mountain imagery to produce a third, more complex and provocative interpretation that arises out of the interplay between the two layers.

Creating a hybrid information display that combines Minard's analytic graphic, Tufte's sparklines, and Najjar's digitally manipulated nature images would provide a product so dense in information and artistic rendering that an observer could not completely grasp its meaning in one viewing, but likewise, could not leave it because of its magnetic aura of information.

Methodology

Approach

This experiment ultimately seeks to determine whether or not it is possible to establish a consistent path of eye movement, or vision trail, on the part of different individuals when they observe the same digital image. While the final answer will only appear after repeated trials with subjects from respective sociodemographic, age, gender, and cultural groups, the groundwork for the answer began with the affordable, reproducible methodology that follows.

Inspiration for this methodology came from 1879 Paris, France where Louis Émile Javal worked in psychological optics to reveal the phenomenon he called fixations and saccades, the eye's points of pause and scanning when reading text.[15] These stop/start eye movements that typify reading words also occur when humans view imagery. I reasoned that if all, or a large majority of, viewers produced consistent vision trails when viewing digital images, then the structure and content of these trails could be observed and analyzed with the intention of applying such biological preferences to the principles of digital image design.

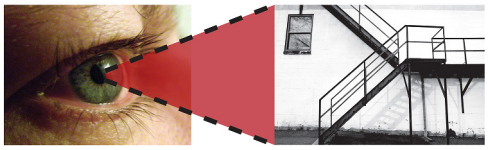


Figure 7: A Subject's Eye Fixated on the Test Image at Highest Resolution.

Model Description

To set up an environment to test this hypothesis, I started small—specifically, to survey whether a sample of computer users at my midwestern, comprehensive university (a mixed group of "mainstream" and multicultural students and professionals) produced consistent vision trails for six digital images. I had each subject view the six black & white digital images, rendered in five various resolutions—at 270 dpi, 36 dpi, 10 dpi, 5 dpi, and 2 dpi. Varying the resolutions, I reasoned, would lessen observers' identification of actual objects within the images. Using PoD and EoD, I predicted viewers' fixation points on the images, as well as the path their eyes would take from fixation point to fixation point.

Figure 8: Microsoft webcam (width 0.94"/ 45.9mm) and areas of focus on the face.

Gaze-tracking technologies, used in many fields ranging from marketing and advertising to public safety and cyberpsychological studies, plot how humans observe various situations

and environments. However, the price of such equipment places it beyond the budget of most individuals; hence, my study used Ogama open source software[16] and inexpensive products from which I developed a custom eye-tracking camera system.

I dismantled a Microsoft HD webcam, removed the infrared filter from within the device, and replaced it with a higher magnification lens that enabled the camera to focus on the eye with the camera further from the subject's face. A filter blocked out all light but infrared. Two infrared lights, placed on either side of the widescreen laptop monitor, generated reflections or "glints" in each subject's iris that the Ogama eye-tracking software then calibrated. The system thereby "locked on" to the subject's pupil, enabling it to follow the eye's point of focus around the computer screen.

Figure 9: Infrared light source creates "glint" in subject's eye.

The camera captured subjects' eye movements as they viewed a slideshow of the thirty images on a 15.6" widescreen Dell laptop computer monitor. At the same time that the camera recorded, the Ogama software tracked the glints of infrared light reflecting in the subjects' irises. This provided qualitative data on where the subjects looked during their viewing of each image.

The purpose of this experiment wherein the neurophysiology of eye movement met artistic perspective was to ascertain if, as cognitive research suggests, certain eye movements would indicate a state of heightened viewer engagement.[17] At what point of resolution, measured in dpi, would such engagement become noticeable, or conversely, at what resolution would the picture "dissolve" for the viewer?

Survey and Selection of Subjects

To recruit subjects for the project I contacted persons taking classes or working at my university in the Fine Arts Building during the three-week interim 2011 session and eight-week summer 2011 semester. I also used the "snowball sampling" technique—i.e., I requested that the persons I contacted each recruit "someone like you" to also take the survey. In the end, twenty-nine persons completed a ten-item survey (Appendix C). This instrument explored the

Table 1: Participant Profile				
Gender	Age (M=mean, m=mode)		Status Student=S Professional=P	
male	M=22.3	m=20.9	S=10	P=2
female	M=22	m=20.6	S=13	P=4

Table 2: Participants' Sight & Device Profile				
	corrective lenses	camera	computer	cell phone
yes	15	27	29	29
no	14	2	0	0

visual relevance of text and imagery to the subjects, all of whom daily navigated computers and smartphones, and most of whom reported satisfaction (N=26/29) with the internet. The survey appeared on *Facebook* between June 13 and July 22, 2011. All participants of the gaze-tracking segment of the experiment took part in the survey. Table 1 presents a profile of participants ref-

erencing their gender, age, and university status. Table 2 describes survey participants' ownership of devices and whether they wore corrective lenses.

On the survey, participants estimated the time they spent each day in internet useage (Figure 10), and rated their own photographic and design understanding (Figure 11). In general, respondants observed that they used the internet with ease (Figure 11), but they would like to see more cohesive design in web sites with less intrusive and disruptive advertising. The survey respondants of this pilot study presented a gender-balanced group of mostly college-age individuals who expressed confidence and substantial daily experience with internet usage for work, educational and personal purposes. While almost all participants claimed experience taking pictures (N=27/29), none claimed professional-level understanding of the principles of art and design, and less than half (N=11/29) rated themselves at or above average in this regard. Conversely, more than 60 percent rated themselves (N=18/29) as below average in their understanding of the principles of art and design. In other words, while practiced internet users and camera owners, the subjects of this study possessed little formalized art and design training; such knowledge could have potentially biased their scanning of the test images. From the survey respondants I requested that the fourteen who did not need corrective lenses take part in the gaze-tracking portion of the study. Eight of these actually followed up.

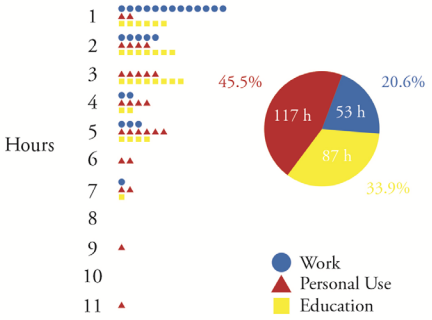


Figure 10: Survey Participants' Internet Usage

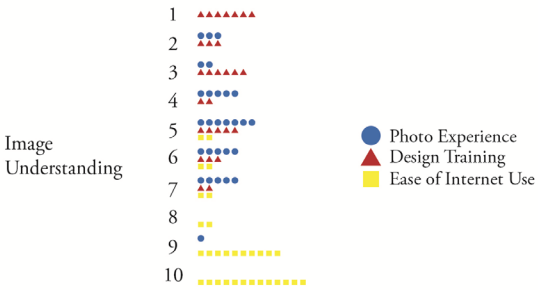


Figure 11: Survey Participants' Image Understanding

What Subjects Saw

(a) Black & White

Subjects viewed six black & white photographic images at five separate resolutions for a total of thirty photographs during pilot gaze-tracking sessions. Appendix D displays the six photographs at highest resolution. All subjects used the same computer in the same interior room (the photo studio) that was lit with ambient light to eliminate any potential glare on the screens. No one besides the subject and I occupied the room during a gaze-tracking session. I read printed instructions to each subject, then during the viewing I sat at the back of the room, outside of the subject's direct and peripheral lines of vision. The room remained silent thereafter. No subjects asked questions or required assistance from me.

Figure 12: The infrared glint in subject's eyes that the Ogama software tracks.

I chose six generic images that viewers would find pleasant but would not elicit a highly charged emotional response from them. These low-key images included a landscape, a picture of buildings' exteriors, two stairways, the interior of a public building, and a close-up of a weathered iron beam. All scenes were devoid of humans or other animals, and all depicted locations the subjects would not recognize or otherwise associate with their personal histories.

Black & white photos rather than colored photos presented advantages in the gaze-tracking: first, their use eliminated associations that particular colors would carry from the subjects' various cultural backgrounds. By suggesting a hierarchy of importance or certain values to a part of the photograph, such color associations might manifest in subjects' fixations and in the trail of fixations their eyes followed. Secondly, black & white photos, unlike color photos, appear the same on different computer screens: while all the subjects in the pilot viewed the images on the same computer, this single screen would prove inefficient in subsequent trials when involving an increased number of subjects. In other words, with black & white photos one could employ multiple computers without introducing a potential confounding factor from different monitors' respective color gradations.

(b) Choosing Images and Timing

Besides their color, the six images chosen for the gaze-tracking section of the study conformed to specific criteria that referenced the PoD and EoD. These images' strict conformance to the PoD and EoD would enable me, I reasoned, to predict the points within each photo at which

Table 3: Image #1 (The Field) Profile Referencing PoD and EoD

PoD Principles	How the Image demonstrates this principle to such an extent that it enables me-- (1) to predict where the eye will fixate; (2) to predict the route the eye will take among the fixation points.	EoD Principles
Balance	Balance of the image is in the light to dark weights marking a distinct horizon line--the tree breaking this line is what acts as the punctum between the upper and lower sections of the image with the lines of the field bringing the eye to the edge of the image and back to the top.	Line
Gradation	Gradation from the light source dithers to darkness in the lower right, again allowing the lines of the field to become a flat plane. The flatness, seen because of the high contrast, encourages the eye to jump from light to dark while it notices subtle details in the sky and the foreground.	Shape
Repetition	Repetition lies in the field, the clouds, and the varying rolling hills that capture differently toned flat spaces. The road acts as a recognizable object but also as a line leading back in space, one that again terminates at the tree that breaks the upper and lower horizon lines.	Direction
Contrast	Contrast is highest between the upper and lower sections of the photograph. Size variation observed with most recognizable content in the middleground.	Size
Harmony	Harmony occurs in the darker areas: the content there blends together and allows the eye to investigate shapes of silhouetted objects. Texture comes out with the clouds and repetitions patterns of the field.	Texture
Dominance	Dominance is seen with the bright light source and the dark foreground. The value changes in the lower section become more interesting that the bright blow out in the sky leading to more time spent on the field.	Value
Unity	Unity occurs due to gradation towards the edge of the image that mutually bring you back to either the bright source or the high contrasting tree in the center of the image.	

the subjects' eyes would fixate, as well as the trail their eyes would take from fixation to fixation. Table 3 presents a profile of Image #1 that references PoD and EoD; by fitting these criteria, Image #1 proved itself an acceptable choice for gaze-tracking.

Figure 13 presents Image #4 with the predicted fixation points indicated by red circles. The size of the circle indicates the relative duration of the subjects' gaze at that point. The blue dashed line indicates the predicted trail the subjects' eyes would take from fixation point to fixation point. I generated corresponding profiles for each of the other five photos, then predicted the fixation points and vision trails for each. The subjects determined the amount of time they spent viewing the thirty images. For the eight subjects this ranged from 15 minutes to 25 minutes, with an overall average total viewing time of 20 minutes.

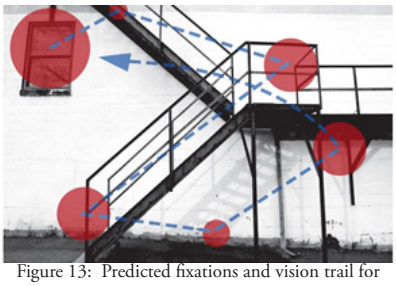


Figure 13: Predicted fixations and vision trail for Image #4

(c) Varying Resolution

Each of the six photographs appeared in five levels of resolution. I chose these five levels to reveal watersheds at both ends of resolution; first, I sought the point at which viewers could no longer discern the photo's content. Secondly, the sequence would suggest when the amount of resolution lay at an unnecessarily high level. Subjects viewed the images from highest resolution at 270 dpi, through a 36 dpi resolution, to a 10 dpi resolution, to a 5 dpi resolution, to the lowest level resolution at 2 dpi. Figure 14 presents this sequence for Image #5.

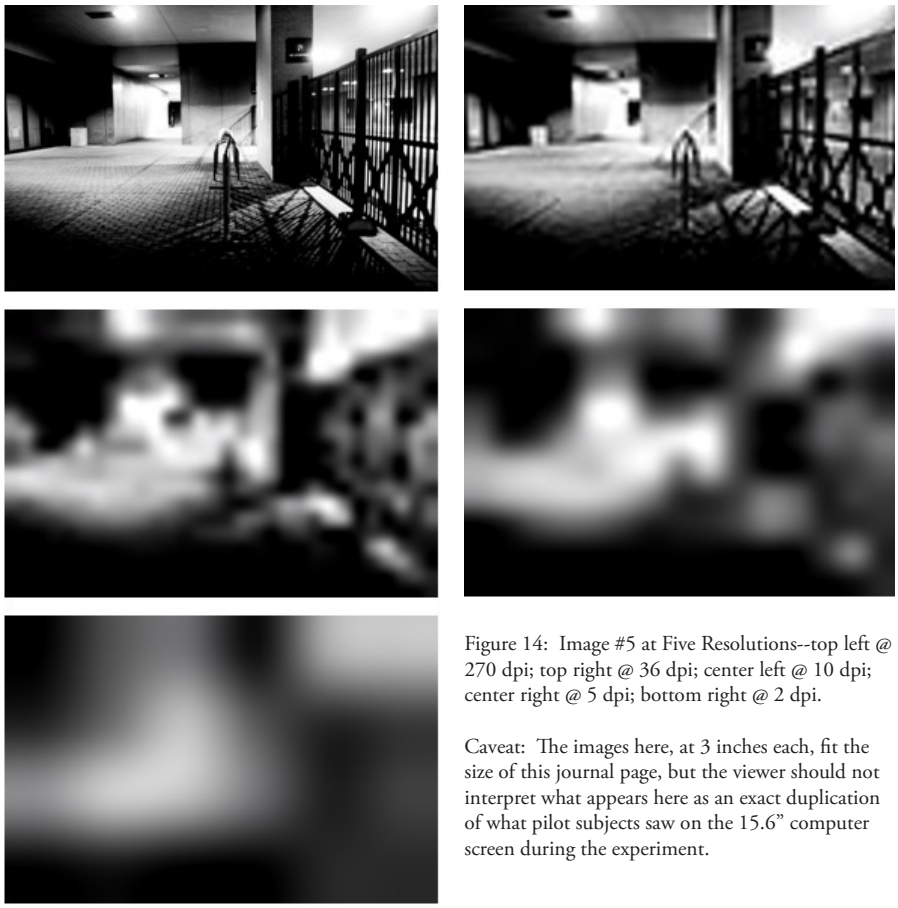


Figure 14: Image #5 at Five Resolutions--top left @ 270 dpi; top right @ 36 dpi; center left @ 10 dpi; center right @ 5 dpi; bottom right @ 2 dpi.

Caveat: The images here, at 3 inches each, fit the size of this journal page, but the viewer should not interpret what appears here as an exact duplication of what pilot subjects saw on the 15.6" computer screen during the experiment.

Results of Gaze-Tracking: Confirmation and Contradiction

The gaze tracking portion of this experiment produced results that confirmed my predictions regarding the location of viewers' fixations. For designers producing or evaluating web sites this means that referencing PoD and EoD will accurately guide their location of "natural hot spots" for content, at least when the site's perceived audience resembles the group that took part in this pilot.

The data, however, contradicted my prediction regarding the path of viewers' fixations; this contradiction persisted across each of the six images and their five various resolutions. Every subject constructed a different path among the fixation points, and every subject demonstrated differences in duration of gaze at each fixation point. Additionally, more differences existed among subjects' saccades when they viewed the lower resolution images. These results speak to the question that originally drove this project: whether the viewing of digital images is somehow a different experience from viewing visual images. Since movement among fixations within an image—i.e., the roaming part of the vision trail—is one key to grasping its content, then a digital image does not necessarily contain the content or the nuance or the balance its creator and sponsor intended.

One final result of the gaze-tracking portion of the study concerns the extent of viewers' ability to see and understand content. The data pointed to subjects seeing content at much lower resolutions (10 dpi) than anticipated—a bias created by their viewing higher resolutions first?

Conclusions

The Ogama open source software and improvised camera provided this user significant power on a relatively small budget. The methodology warranted its use to further expand eye-tracking experiments with varied groups of subjects.

Future directions for this research involve repetition of the experiment with various audiences—for example, with internet users who use corrective lenses, with internet users from various cultures *in situ* as well as with work/student expatriates, and with internet users from age groups and educational levels other than traditional college students.

Also, to further verify the impression that a difference exists for viewers in their interaction with digital versus visual images, the experiment needs a comparison of two groups of subjects—one group that encounters images first visually and then digitally, and another group that encounters the images only visually.

Viewers' interpretations of the content of a digital image involves both fixations and saccades, though heretofore cognitive researchers have emphasized the fixations as the keys to viewer-image interaction. What this project has revealed is the potential of saccades—the portions of the vision trail among its fixations--to contribute to viewers' grasp of digital images' content. After all, the saccades indicate the order of assemblage for fixations—in other words, a hierarchy of how a digital image's "hot spots" line up. Also, just as the duration of respective fixations within an image indicates a hierarchy among its "hot spots," so too, I would suggest, does the duration of the roaming from fixation to fixation. The balance of time spent on fixations versus saccades presents a potential key to viewers' grasp of an image. So too might the duration of the separate saccades (i.e., the parts of the overall vision trail) constitute a subtle but important aspect of viewers' interpretation of a digital image's content. Future trials will incorporate precise timing of fixations and saccades.

Research seeks answers, but it also opens up new inquiries. The future of this research involves a number of possibilities and adjustments. The most immediate is to explore mechanisms that reveal the contribution of saccades in viewer-digital image interaction.

Appendix A: **The Principles of Design**

BALANCE

Balance in design is similar to balance in physics. A large shape close to the center can be balanced by a small shape close to the edge. A large light toned shape will be balanced by a small dark toned shape (the darker the shape the heavier it appears to be).

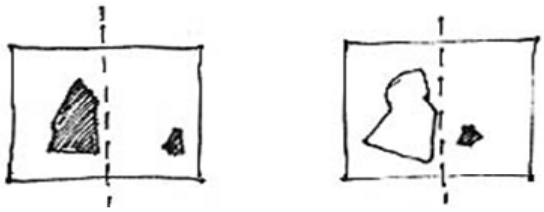


Figure 15: Examples of Balance

GRADATION

Gradation can add interest and movement to a shape. Gradation of size and direction produce linear perspective. A gradation in color from warm to cool and in tone from dark to light produce an aerial perspective. A gradation from dark to light will cause the eye to move along a shape.

Figure 16: Examples of gradation.

REPETITION

Repetition with variation is interesting, whereas without variation repetition becomes monotonous.

The five squares below are all the same. They can be taken in and understood with a single glance.

Figure 17: Example of variation within a series of repeated shapes.

When variation is introduced, the five squares, although similar, are much more interesting to look at. They resist appearance as a group. The individual character of each square needs to be considered, and to do so requires more than a single glance.

To create interest, repeating elements should include a degree of variation.

CONTRAST

Contrast is the juxtaposition of opposing elements e.g., opposite colours on the colour wheel (red with green, blue with orange) or contrast in tone or value (light with dark) or contrast in direction (horizontal with vertical).

The major contrast in a painting should lie at the center of interest. Too much contrast scattered throughout a painting can destroy its unity and make it difficult to look at a work. Unless you seeka feeling of chaos and confusion, carefully consider where to place areas of maximum contrast.

HARMONY

Harmony in painting is the visually satisfying effect of combining similar, related elements. e.g., adjacent colours on the colour wheel or similar shapes.

DOMINANCE

Dominance gives a painting interest, and also counteracts confusion and monotony. Dominance can be applied to one or more of the elements to give emphasis.

UNITY

Relating the design elements to the painting's idea reinforces the principal of unity e.g., a painting with an active aggressive subject would work better with a dominant oblique direction, course, rough texture, angular lines. A quiet passive subject, on the other hand, would benefit from horizontal lines, soft texture and less tonal contrast. Unity in a painting also refers to the visual linking of various elements of the work.

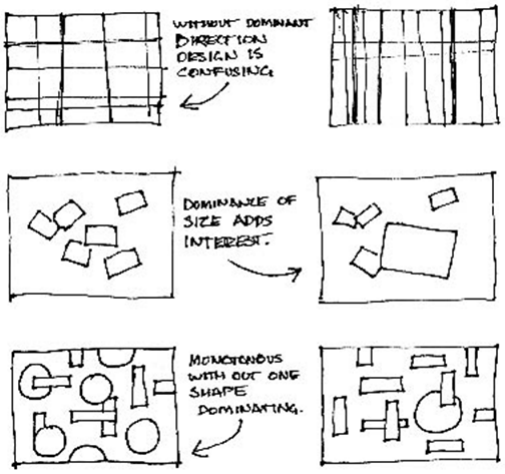


Figure 18: The functions of Dominance

Appendix B: **The Elements of Design**

LINE

Artists and designers consider lines in two ways: the edge created when two shapes meet.

SHAPE

A shape is a self contained defined area of geometric or organic form. A positive shape in a photo automatically creates a negative shape.

DIRECTION

All lines have direction - Horizontal, Vertical or Oblique. Horizontal suggests calmness, stability and tranquillity. Vertical gives a feeling of balance, formality and alertness. Oblique suggests movement and action.

SIZE

Size is simply the relationship of the area occupied by one shape to that of another.

TEXTURE

Texture is the surface quality of a shape - rough, smooth, soft, hard, glossy, etc. Texture can be physical (tactile) or visual.

VALUE

Value is the lightness or darkness of a colour along the greyscale of white to black. Value is also called Tone.

Appendix C: Survey

Defining a Code for Highly Effective Graphic Imagery
University of Wisconsin--Eau Claire: *Department of Art & Design*

This survey explores the visual relevance of text and imagery to its viewers.

ID number (number given): _____

Gender (circle one): **Male -- Female**

Age: _____

Occupation: _____

Please answer the following questions by circling either Yes or No.

1. *Do you use corrective lenses* (glasses or contacts)? **Yes -- No**
2. *Do you own a camera?* **Yes -- No**
3. *Do you own a computer?* **Yes -- No**
4. *Do you have access to the Internet?* **Yes -- No**
5. *Do you own a cellular phone?* **Yes -- No**
   -- If yes --
   -Can you access the Internet from your phone? **Yes -- No**
   -- If no --
   -Please explain the reasoning or reality behind this response.
   _____
   _____
   _____

---------- **Survey continues on the reverse side** ----------

Give a rating of 1 through 10 in regards to:

6. *Your photographic experience*;
   1 being novice and 10 being professional: _____
7. *Your understanding of established elements of art and design*;
   1 being not trained at all; 10 being trained to professional standards: _____
8. *Your ability to navigate the Internet;*
   1 being frustrating and 10 regarding ease: ____
9. *How much time of your day is spent on the Internet?* (in hours):
   - For Work: _____
   - Personal leisure: _____
   - Education: _____

   Total: _____
10. *Are you satisfied by your experiences and use of the Internet?* **Yes -- No**

    -If answered yes, How could that experience be improved?
    _____
    _____
    _____
    _____

    -If answered no, explain:
    _____
    _____
    _____

Thank you for your participation.

Please return this survey to the overseeing administer, and await further instructions.

Appendix D: Images Used in Pilot Study

Note: The author created each of the photographs used in this study.

Image #1

Image #2

Image #3

Image #4

Image #5

Image #6

Notes

[1] Downs, Roger M. and David Stea, eds. *Image & Environment: Cognitive Mapping and Spatial Behavior*. Transaction Publishers, 2005, viii-ix. Also Stolovitch, Harold and Erica Keeps. *Telling Ain't Training*. ASTD Press, pp.19-22; Medina, Jon. *Brain Rules*. Seattle, WA: Pear Press, 2008, pp. 221-31.

[2] Molnár, Éva. United Nations Economic Commission for Europe: Inland Transportation Committee. *The Consolidated Resolution on Road Signs and Signals (R.E. 2)*, revised text. New York and Geneva, 2010. The symbols are depicted in Annexes I to XI b, pp. 19-38.

[3] These include images of horses, a cow, bears, herds, an owl, mammoths, big cats and a woolly rhino. John Mitter suggests that recurring geometric shapes, such as those found in the cave drawings, reflect aspects of the anatomical and neurophysiological characteristics of the human visual cortex. An earlier discussion of cave art, as well as other aspects of the impact of art on the brain, formed the central topic of an issue of *The Journal of Consciousness Studies*, vol. 6-7 (June/July 1999), 116-22.

[4] Shepherd, Stephen V., "Following Gaze: Gaze-Following Behavior As A Window into Social Cognition," *Frontiers in Integrative Neuroscience* 2010; 4: 5 at http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2859805/.

[5] Edward R. Tufte, *The Visual Display of Quantitative Information*, Graphics Press: Cheshire, CT, 2001, pp. 161-76.

[6] W3Schools.com provides estimates for the screen resolutions of the average internet user for the years since January 2000. A condensed version of their report that references the years during and preceding this project appear below (Table 4).

Table 4: Screen Resolutions of Average Internet Users, January 2009-12

Date	Other high	1920x 1080	1366x 768	1280x 1024	1280x 800	1024x 768	800x 600	lower
Jan 2012	35%	8%	19%	12%	11%	13%	1%	1%
Jan 2011	50%	6%	--	15%	14%	14%	0%	1%
Jan 2010	39%	2%	--	18%	17%	20%	1%	3%
Jan 2009	57%	--	--	--	--	36%	4%	3%

Source: W3Schools.com, "Browser Display Statistics," at http://www.w3schools.com/browsers/browsers_display.asp

[7] Morrone, M. Concetta and David C. Burr. "Capture and transparency in coarse quantized images," *Vision Research* vol. 37, issue 18(Sept. 1997): 2609-2629.

[8] Puhalla, Dennis, *Design Elements, Form and Space*, Rockport Publishers: Beverly, MA, 2011, pp. 77-79. For the execution of implied lines see Rockman, Deborah H., *The Art of Teaching Art: A Guide for Teaching and Learning the Foundations of Drawing-Based Art*, Oxford: Oxford University Press, 2000, p. 60.

[9] Tufte, p. 83.

[10] Wise, Barry M. and Paul Geladi, "A Brief Introduction to Multivariate Image Analysis (MIA)," Eigenvector Research, Inc., http://www.eigenvector.com/Docs/MIA_Intro.pdf .

[11] Minard, Charles Joseph, *Carte Figurative des pertes successives en hommes de l'armée qu'Annibal conduisit d'Espagne en Italie en traversant les Gaules (selon Polybe).* Paris: Regnier et Dourdet, 1869. Also see Tufte, p. 176.

[12] Robinson, Arthur H. "The thematic maps of Charles Joseph Minard." *Imago Mundi*, 21: 95–108 (1967). For a multivariate analysis of the elements in Minard's map of Napoleon's campaign see Cheng, Joanne, "Analyzing Minard's Visualization Of Napoleon's 1812 March," June 2014 at https://robots.thoughtbot.com/analyzing-minards-visualization-of-napoleons-1812-march.

[13] Tufte, p. 136.

[14] "What caused the flash crash? One big, bad trade," *The Economist*, October 1, 2010 at http://www.economist.com/blogs/newsbook/2010/10/what_caused_flash_crash.

[15] Louis Émil Javal's work on psychological optics are contained in eight papers for *Annales D'Oculistique*. Tome LXXXIX-11e serie (Mars et Avril, 1878). For an especially accessible description of how the eye moves, see R. L. Gregory, *Eye and Brain*, 5th ed., Princeton, NJ: Princeton University Press, 1998 p. 44.

[16] Ogama open-source software is found at http://www.ogama.net/.

[17] Maughan, Lizzie, Sergei Gutnikov and Rob Stevens, "Like more, look more. Look more, like more: The evidence from eye-tracking," *Journal of Brand Management* (2007) 14, 335–342.

Why Not Neo-Aristotelian Naturalism? A Response to Gilbert Harman

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Abstract

Moral realism is the theory that propositions with moral content—e.g., 'murder is wrong'—are truth functional. In other words, moral judgments can be true or false. Non-cognitivism is the theory that moral propositions are not truth functional. Just as how statements like 'ow!' or 'yikes!' cannot be true or false, moral judgements cannot be true or false because they are just a kind of emoting. Gilbert Harman's non-cognitivist criticism of moral realism goes as such: since moral facts—those things that make moral judgments true or false—do not play any role in explaining why we make the moral judgments that we do, moral realist theories are inferior to more explanatorily efficient non-cognitivist theories. I respond that ethical naturalism—the theory that moral facts are reducible to natural facts—is explanatorily sufficient and able to contend with Harman's non-cognitivism, and thus moral realism should not be dismissed. The ethical naturalism I endorse is inspired by the virtue ethics of Aristotle and the contemporary virtue theory of Rosalind Hursthouse.

Introduction

In this essay I propose ethical naturalism, in the form of Neo-Aristotelian Virtue Ethics (NAVE), as an alternative to Gilbert Harman's moral nihilism and respond to his objections to naturalism. Harman's first objection to ethical naturalism is that if moral facts are reducible to natural facts about functions, then the reduction would be "complex, vague, and difficult to specify."[1] Thus, the burden of proof lies with the ethical naturalist to specify how moral facts reduce to natural facts.

Harman's second objection to ethical naturalism is that, even if the naturalist were to show that the reduction is not complex, vague, or difficult to specify, there would still be no reason why one should continue to use moral language. "There does not ever seem to be…any point to explaining someone's moral observations by appealing to what is actually right or wrong…."[2] If moral language is reducible to natural language and moral language plays no role in explaining moral observations, then what reason would we have to use moral language?

I argue that NAVE provides an adequate response to both of Harman's objections: NAVE provides a clear description of how moral facts reduce to natural facts, and it elucidates a better way of understanding moral language. The NAVE in question is one defended and described by Rosalind Hursthouse in her work *On Virtue Ethics*.[3] I argue that her conception of evaluating living things based on how their natural features facilitate the achievement of their natural ends is sufficiently clear and simple enough to address Harman's first objection. I also argue that the language and terminology provided by NAVE provides a model for language that contains both moral and natural connotation.

[1] Gilbert Harman. "Moral Nihilism," in *Ethical Theory: Classic and Contemporary Readings 4th Edition*, ed. Louis Pojman (Belmont, CA: Wadsworth Group, 2002), 473.

[2] Ibid.

[3] Rosalind Hursthouse, *On Virtue Ethics* (New York: Oxford University Press, 1999).

Harman's Objection

First I will address Harman's general position on the place of moral facts in observation and judgment; then I will show that NAVE may play a role in clarifying this issue. Harman states that moral facts do not play a role in explaining moral judgments like physical facts do in scientific judgments. He presents two examples we should consider. In the first, he has us consider a cloud chamber. As protons pass through the chamber, they create vapor trails. These vapor trails provide observational evidence that confirms the theory that protons, as they pass through the cloud chamber, generate the vapor trail. Furthermore, the theory that posits the existence of protons explains why one observes a vapor trail in the cloud chamber—namely, because a proton has passed through it. It is important to note that, in the vapor trail example, the vapor trail is observational evidence for the theory and the theory helps explain what one observes. Simply stated, the observation confirms the theory and the theory explains the observation.

Next Harman has us consider a second example: imagine walking past some hoodlums abusing a cat and judging that what they are doing is wrong. Also imagine that you have a particular moral theory, and part of that theory is that abusing cats is wrong. In this case, your theory explains why you judged the act to be wrong—you judged the act wrong because your theory states that abusing cats is wrong. But does your judging that it is wrong to abuse cats confirm your theory? It seems it does not. Whereas, in the previous example, the vapor trail is observational evidence that confirms the theory, one's in-the-moment judgment about the rightness or wrongness of abusing cats neither confirms nor denies any moral theory--the judgment just does not seem relevant to confirming the theory. As Harman puts it, "A moral observation does not seem…to be observational evidence for or against any moral theory since the truth or falsity of the moral observation seems to be completely irrelevant to any reasonable explanation of why that observation was made."[4] In other words, assuming that abusing cats is immoral, the immorality of the act does not *explain* why one might think abusing cats is immoral.

It will be helpful to clarify Harman's point with another example. Assume Smith committed a murder, and Brown—the detective—theorizes that Smith is the murderer. Sure enough, Brown finds Smith's fingerprints on the murder weapon--and thus Brown's theory is confirmed. If one were to ask Brown why he believes Smith is the murder, he could point to the evidence that confirms his theory. Now assume Brown also theorizes that murder is immoral. One might again ask Brown why he thinks that way. Herein lies the problem: to what is Brown going to point to as evidence for his theory? He could point to his observation that he always judges that murder is immoral—but that only explains *that* he thinks murder is immoral, not *why*. *That* he makes those certain judgments does not explain *why* he makes those certain judgments. So it would seem that moral judgments can neither confirm nor deny any moral theory.

What would explain why people make the judgments that they do? It seems more likely that people make certain judgments depending on their sensiblities—i.e., what does or does not offend them. One could better explain one's judgments by attributing the offense to one's sensibilities, not to any kind of fact of the matter that is being observed.

Harman's question to moral realists is this: why bother thinking there are moral facts when it is simpler to understand moral theories as determined by human sensibilities? Since moral facts do not play any role in explaining observations, Harman's account is preferable because it assumes fewer things about the world. Namely, there are not any moral facts in the world--just sensibilities.

To be clear, his position is not that realist theories—theories that posit the existence of moral facts—suffer from inconsistency or are implausible; it is instead that realist positions do not provide the best explanations for moral phenomena. As Robert Arrington notes: it "is in

[4] Harman, "Moral Nihilism," 468.

line with Harman's general methodological practice of inferring the best explanation of moral phenomenon."[5] The moral realist, in responding to Harman, would have to provide an account of moral facts that can connect observation and theory (in a manner competitive with Harman's psychological account).

What can the moral realist do at this point? Initially, one ought to consider which view Harman has really knocked out and which view might muster a rebuttal. A significant point from Harman's objection is that the moral realist cannot sufficiently justify her belief in the truth or falsity of some moral proposition by appealing to an observation. The view that moral theories can be justified by one's moral observations can be called moral phenomenalism. For example, when one sees some hoodlums abusing a cat, one might have the phenomenal experience of being offended and reason from there that abusing cats is wrong. The thought might go like this: I get offended at morally wrong things, I am offended at cat abuse, and therefore cat abuse is morally wrong. Harman would object to this line of reasoning because, as he argues, one's being offended by cat abuse is not evidence for the theory that cat abuse is wrong. In this way, Harman has dealt a very lethal blow to moral phenomenalism, and the moral realist who wants to muster a rebuttal must do so without the aid of moral phenomenalism.

One way the realist might choose to respond to Harman's objection is to say that moral facts reduce to natural facts. In other words, the realist could say that there is a fact of the matter when it comes to moral judgments, and that fact of the matter is a normal, empirically accessible fact about the world.

Harman considers a form of ethical naturalism— functionalism—as a potential solution to the issue he raised. In a functionalist account of moral judgment, the observer evaluates a characteristic of an object according to how well it fulfills its function. Hence, moral terms such as "good" or "bad" are evaluations of functions—not special *sui generis* moral terms. In this view, the term "good" does not change meaning when used in a moral context from any other evaluative context. Hence the "good" used in saying "she is a good person" is the same "good" in saying "this is a good knife." Most importantly, "good" is an attributive adjective (i.e., the word "good" derives its specific meaning from the subject upon which it is predicated).[6] An attributive adjective functions differently from a predicative adjective: attributive adjectives may have different meanings depending on the subject uponwhich they are predicated. For instance, whereas the predicative adjective "red" refers to the same color regardless if we are speaking of a "red chair" or a "red phone," the attributive adjective "good" does not refer to the same way of being good for the chair as it does for the phone. When we talk about a good chair, it is a good chair when it supports one comfortably while one sits, whereas a phone is good when it facilitates clear discussion with a distant interlocutor. Using Harman's examples, one might say that a knife is good in the case that it cuts well and that a heart is good in the case that it pumps well. Thus the moral statement "she is a good person" is an evaluation of a person in regards to how well she accomplishes her function.

Harman, however, thinks functionalism is not without its shortcomings. According to Harman, "a person is evaluated in terms of functions, roles, and various interests in a way that is hard to specify."[7] Though it may be simple to establish the proper function of a tool or an organ, it is another—more difficult—case to establish the proper functioning of a person. Even in the case where one is evaluating another based on the role they play (e.g., a teacher), there is still a vagueness of standards that does not permit simple evaluation. Harman's example prompts the following questions: is one a good teacher if one teaches students information, but in doing so

[5] Robert L. Arrington. *Rationalism, Realism, and Relativism: Perspectives in Contemporary Moral Epistemology* (Ithaca, NY: Cornell University Press, 1989), 169.

[6] See P. T. Geach. "Good and Evil," *Analysis* 17, no. 2 (1956)

[7] Harman, "Moral Nihilism," 471.

makes them miserable? Is one supposed to keep them happy, but at the cost of teaching them less? Even in terms of roles, evaluating what constitutes a "good x" presents difficulty due to the vagueness of the standards and interests pertaining to the thing evaluated. Three questions need to be answered: (1) can NAVE provide a specific way of evaluating people? (2) can NAVE provide a simple method of evaluating people? (3) can NAVE provide a way of evaluating people that is not vague?

Evaluating Living Things

A functionalist response to Harman is not closed, especially because NAVE has developed extensively since Harman brought to light the inferential gap problem. In order to adequately respond to Harman's problem in a functionalist manner, the Neo-Aristotelian response requires a clear and specific evaluation method. Scholars like G.E.M Anscombe, Philippa Foot, and Rosalind Hursthouse have worked to refine the Aristotelian conception of virtue to accomplish these exact ends, and no more systematic and comprehensive treatment of this topic exists than in Hursthouse's *On Virtue Ethics*.

Hursthouse's theory expands and further elaborates Foot's naturalist virtue ethics.[8] Foot explored a notably Aristotelian form of naturalism that "seeks to ground ethics, in some way, in considerations of human nature."[9] Furthermore, this approach is a notably eudaimonistic account of human well-being, wherein an individual's well-being, or flourishing, is determined by what kind of thing that individual is.[10] Thus, to evaluate a thing is to understand what kind of thing it is, and what contributes to its well-being. A proper evaluation would take into account the species-specific features of the thing and the natural ends towards which the thing is inclined.

For instance, a cactus is a living thing and also a plant, and so it has certain features and ends relevant to its well-being. Healthy cacti are evaluated by how well their two aspects, their parts and operations, contribute to their two ends, survival and reproduction. And as one evaluates different living things like animals, one adds new features and ends to this list. The parts and operations of animals are still relevant criteria for evaluation, but an evaluation must also include uniquely animal features and ends. For instance, an animal's well-being is determined by more than just its parts and the operations of such parts; the animal also actively interacts with environment. Thus, the characteristic way an animal acts in its environment is important to evaluating its well-being. Along with this added feature comes another end involving characteristic enjoyment of pleasure and avoidance of pain. As the sensorial experience of animals are more complex than those of plants, it is important to take into account the animals' characteristic avoidance and enjoyment of pain and pleasure to evaluate its well-being. An animal cannot be a healthy member of its species if it enjoys hurting itself or does not enjoy satiating hunger or reproducing. Closely related to this end is a fourth pair of features: desires and emotions. An animal that does not fear its natural predator or enjoy reproduction would be considered deficient in regards to its natural aspects. The evaluation becomes more complex when one takes into account social animals, in whose lives the social group plays an important and determinant role. Thus, for a social animal, the well-functioning of the social group is also an important determinant of its well-being.

Thus, four features and four ends appear subject to evaluation: an organism's i) parts, ii) operations, iii) actions, iv) and emotions or desires, and how all these contribute towards the organism's i) survival, ii) reproduction, iii) enjoyment of pleasure and avoidance of pain, and iv)

[8] See Hursthouse, On Virtue Ethics, 195.

[9] Ibid., 196.

[10] While a more direct translation of the word εὐδαιμονία would be "possessed of a good spirit," I will use the phrases "well-being" and "flourishing" to get at the sense of the word.

social functions.

Pointing out the role of rationality in this evaluative system, Hursthouse makes clear, "if there is any truth in ethical naturalism, our ethical evaluations of ourselves ought to exhibit at least a recognizably similar structure to what we find in the botanists' and ethologists' evaluations of other living things."[11] But in evaluating humans, it is crucial to take into account their capacity for rational action. Hursthouse is sensitive to the fact that humans would expect an evaluation of them to "resemble that of a sophisticated social animal with some differences necessitated by our being not only social but also rational."[12] Thus, a fifth feature completes the evaluation, namely reason, and a fifth end accompanies the feature, namely acting from reason.

This method of evaluation makes it possible to identify the virtues and vices of a particular species. The virtues of a species are the character traits that foster the ends pertaining to the species, whereas a vice impedes the ends pertaining to the species. If an individual of a species has the pertinent features and properly fosters the pertinent ends, then that is an example of a "good member of species x." Again, I want to stress that this method of evaluating living things is eudaimonistic—meaning that when we say " x is a good member of the species," we are talking about his or her moral worth along with his or her health and wellness. The term "flourishing"—one of the connotations of εὐδαιμονία —means a member of the species is a healthy, fulfilled, and excellent individual of the species.

This reduction works in the following manner, by taking a sample of the moral language associated with NAVE and substituting equivalent statements until the statement has no moral predicates. Begin with "x is good:" this statement is equivalent to "x is virtuous." Continuing, to say "x is virtuous" is to say that "x is endowed with all of the virtues." To say "x is endowed with all of the virtues" is to say that "x has the character traits that foster the ends determined by its biological species." To say that "x has the character traits that foster the ends determined by its biological species" is to say that "x lives in such a way to foster the ends determined by its biological species."

As this process reveals, the beginning sentence involved a moral predicate. From this beginning one could substitute in an equivalent statement until a sentence that no longer contains a moral predicate is reached. Thus, the NAVE evaluative method allows one to reduce moral statements to statements about natural facts.

NAVE in Regards to Harman's First Objection

With the evaluation method of NAVE thus explained, what remains to be established is how this Neo-Aristotelian naturalist theory provides a defense of ethical naturalism in regards to Harman's argument. To reiterate, Harman's objections are that: 1) NAVE reduction is too complex, 2) NAVE reduction is unspecific, and 3) NAVE reduction is vague.

The first claim is that the reduction is too complex. It is hard to tell precisely what Harman means by this. One might wonder just how complex is too complex. Given the imprecision of this criticism, one may not be able to formulate a fully satisfying rebuttal. Nonetheless, Harman thinks that compared to his moral nihilism—which explains moral judgments in terms of one's sensabilities—the NAVE reduction is too complex. But this is not the case. Both accounts rely on natural facts; both accounts require a fair deal of background theory (biological or psychological), and both accounts require a good deal of philosophical justification. Hence, NAVE is no more complicated than moral nihilism or other emotivist theories.

The second claim is that the reduction is unspecific. Again, this criticism lacks precision. Harman is perhaps stating that the reduction of a sentence with a moral predicate will not pick out a specific sentence about natural facts. In other words, the target theory (moral theory) might

[11] Ibid., 206.

[12] Ibid.

reduce to the base theory (natural theory), but the resulting sentence in the base theory might not be specific. This is not the case. All one would have to do to make the reduction more specific is fill in the variable from the previous sentences. One could even further specify the relevant virtues and ends pertinent to whatever living thing one plugs in for x. This framework for reduction could very easily be more specified, resulting in a more specific sentence in the base theory. Harman might also be saying that this reduction cannot be applied to a specific case. But, as the last example showed, it can be—all one would have to do is plug in a living thing for the variable and specify the pertinent ends and virtues. One might worry that specifying the pertinent ends and virtues might be a challenge, yet Hursthouse's method is very specific about the pertinent ends, and Aristotle and other Aristotelians have provided a very specific list of the virtues.

The third claim is that the reduction is still vague. In other words, the standards people regularly employ for evaluating things like teachers or watches are too vague to really make a hard and fast claim about whether or not those things are good members of their kinds. For instance, some people—when looking for a good teacher—seek someone who can teach students a lot. In other words, the latter come home and know a lot more. Whereas, in opposition, some people are looking for a teacher who inspires their students—they are looking for a teacher who makes the student come home excited about learning. Given the disparity of these standards, Aristotelian functionalism is not a useful theory.

An Aristotelian would make the following distinction regarding "fostering the ends." According to Aristotle, all human action is directed at some good—at an appropriate end. "πᾶσα τέχνη καὶ πᾶσα μέθοδος, ὁμοίως δὲ πρᾶξίς τε καὶ προαίρεσις, ἀγαθοῦ τινὸς ἐφίεσθαι δοκεῖ:…."[13] To reach this end, one must have enough practical wisdom to discern the best way to attain that end. "ἡ μὲν γὰρ ἀρετὴ τὸν σκοπὸν ποιεῖ ὀρθόν, ἡ δὲ φρόνησις τὰ πρὸς τοῦτον."[14] Hence the Aristotelian theory of action imagines an agent directed towards an end who must choose the best means to reach that end.

Harman insists that, because people can have different ideas of what a good x is, this indicates that the standards we have for x are vague. There is a degree to which Harman is right: much disagreement exists when it comes to evaluating things, this disagreement does not arise from vague standards. In light of this means/end distinction, the standard is very explicitly defined—it is the end towards which the thing is directed. Hence, the two teachers of the earlier example do not disagree about what the end of teaching is—obviously it is the best possible education of the students—but they do disagree about the means by which to achieve this end. The standard is not the problem here—the ways of meeting that standard is.

That two agents could find different ways of accomplishing the same end is a fact that most virtue ethicists accept. As Shafer-Landau states in his reflection on virtue ethics, "[v]irtue ethics is actually a form of ethical pluralism. Though there is a single ultimate standard…there are many cases where this [standard] is too general to be of use."[15] Therefore, finding different ways of achieving an end is to be expected, and by extension, so is disagreement about the proper means to achieve a particular end, though the possibility of this disagreement does not undermine NAVE. Why not? I argue NAVE's stability rests upon a distinction between what I will call fruitful vagueness and inert vagueness.

Inert vagueness is the kind of vagueness found in the Sorites Paradox and other similar

[13] "Every skill and every method, and likewise every practice and deliberation, seems to aim at some good:[…] [My translation.] Aristotle, *Nicomachean Ethics*, ed. J. Bywater (Oxford: Clarendon Press, 1894), 1094a.1, http://www.perseus.tufts.edu/hopper/text?doc=Perseus%3atext%3a1999.01.0053.

[14] "For virtue makes the right target, and practical wisdom the way towards that target."[My translation.] Ibid., 1144a.5.

[15] Russ Shafer-Landau, *The Fundamentals of Ethics* (Oxford: Oxford University Press, 2010), 241.

paradoxes due to vague predicates.[16] The Sorites Paradox proceeds as follows: one grain of sand is not enough to make a heap. So, for any number n, if n is not enough to make a heap, then n + 1 is not enough to make a heap. By applying the second premise to an ever increasing value for n, one must conclude that 1 billion grains of sand are not enough to make a heap. The paradox lies in the fact that adding one grain of sand never seems to be enough to really make a heap—yet there must be some amount of sand-grains that distinguishes a heap from a not-heap. But it seems arbitrary wherever one might draw the line. If one states that a heap is greater than or equal to 4,068 grains of sand, then why is 4,067 grains of sand not a heap? If the difference is only one grain of sand, why not say 4,069 is a heap and 4,068 is not? Cases of inert vagueness do not allow for reasonable arguments for where the line is drawn—line drawing in the Sorites Paradox is completely arbitrary.

Fruitful vagueness differs in the following regard: while there might not be a way of determining precisely where to draw the line, one can at least provide arguments for where to draw the line. The teacher example provides an appropriate scenario. Just as with the Sorites Paradox, the teachers are having a difficult time drawing a line between good teachers and bad teachers. Particularly, they disagree about precisely how a good teacher gets his or her students to understand the content. The difference between the teacher example and the Sorites Paradox example is that each teacher could provide reasons for why his or her teaching method is better or worse than the other—hence, the line drawing is not just arbitrary; it is informed by reason.

Fruitful vagueness does not stop the discussion. Having a discussion about where to draw the line between heapness and not-heapness is a fruitless discussion (this is not to say the historical and present investigations into vagueness are fruitless—just that the interminable debate whether 4,067 or 4,068 is enough grains of sand to make a heap is fruitless.) But there can be a lot of very interesting discussion between the two teachers about the means to accomplish their shared end. As Shafer-Landau says, "[t]here is a lot of room for critical discussion about who is virtuous and why."[17] While NAVE might not provide the means for solving all moral disputes, this is not a problem for the virtue ethicist because an important NAVE assumption is that ethics *is* messy—there are not always great solutions or clear answers in studying ethics. As Aristotle states, "[f]or precision cannot be expected in the treatement of all subjects alike […]. Problems of what is noble and just […] present so much variety and irregularity […]."[18] Hence, in an attempt to sketch out a comprehensive moral theory, Aristotle suggests that we be satisfied with a "rough and general sketch."[19]

Harman's objection that ethical naturalism still must deal with vague standards, and thus cannot stand up to his moral nihilism, is met by NAVE's comfort with vagueness. Thus, NAVE can sufficiently respond to Harman's third objection.

NAVE has addressed all three objections Harman has presented. The NAVE method of evaluating living things is specific enough, simple enough, and not burdened by vagueness as Harman has claimed. What remains is to demonstrate how NAVE stands up to Harman's second objection, as stated above.

NAVE in Regards to Harman's Second Objection

A concern one could have about a reductionist theory is that, by reducing the target theory to the base theory, the target theory becomes redundant. This view is called eliminativism; the reduction of the target theory ends up making it obsolete. For example, if behaviorism

[16] See Sean Foran, "The Sorites Paradox and the Ordinary Use of Vague Predicates", *The American Philosophical Quarterly,* 40, no. 4 (2003), 303-318.

[17] Schafer-Landau, 242.

[18] Aristotle, *Nicomachean Ethics*, trans. Martin Ostwald (Prentice Hall: New Jersey, 1999), 5.

[19] Ibid.

is true, then all statements about mental events are reducible to statements about behavior. Why bother to talk about mental events at all? Why use two theories to talk about one phenomenon? Harman shares this concern and challenges the ethical naturalist to explain why, if a moral theory reduces to a natural theory, that moral theory is not redundant. He makes the case that there would be no need to use moral language because the physical language is clearer and would be more practical and simple to use than moral language.

The NAVE solution does not simply replace moral language with natural language. Instead, it seeks to metaphysically ground moral evaluations in physical evaluations. This differs from just reducing a moral theory to a physical theory: the NAVE solution is more than just saying every moral statement is equivalent to some natural statement. Rather, NAVE argues that moral evaluations just *are* natural evaluations and that natural evaluations just *are* normative. I argue that a NAVE theory states that moral propositions are equivalent to natural propositions because these two kinds of propositions refer to the same phenomenon. So, to try and eliminate the moral language from the natural language of the NAVE solution is to throw the proverbial baby out with the bathwater.

An important metaphysical issue lies at the center of this controversy. Harman's primary concern is not metaphysical—i.e., he is not interested in debating whether or not moral facts exist or what kind of things they might be. Instead, he is willing to grant the moral realist's position that moral facts exist. His argument is that—granted that they exist—moral facts just play no role in explaining moral judgments. The NAVE solution, on the other hand, responds that moral facts do play a role in explaining moral judgments. Because the hoodlums of the cat abuse scenario are human beings with certain character traits that are necessary to living a good life, and because their burning a cat indicates numerous vicious dispositions, we judge the act to be vicious. Hence, moral facts do explain why people make the moral judgments that they do—and it is because these moral facts just *are* natural facts that this theory works.

While Harman's concerns are not metaphysical, it is important in principle that the NAVE solution is. Since the NAVE solution conceives moral facts as the same kinds of things as natural facts, the NAVE solution is insulated from Harman's eliminativism.

Conclusion

This defense of a Neo-Aristotelian form of ethical naturalism from Harman's criticisms demonstrated how a NAVE theory might reduce moral facts to natural facts and how it avoids eliminativism. It differentiates between fruitful vagueness and innert vagueness to explain why indeterminateness in the NAVE theory is not problematic. This response might not be sufficient to everyone: for those who seek a moral theory that provides determinate and absolute procedure for resolving moral disagreements, then the NAVE solution might not be the best option. In this way Harman's criticism still stands—not as a major defeater for the NAVE view, but instead as a challenge for neo-Aristotelians to push the theory further.

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The Effect of Birth Date on Yellow Perch (Perca flavescens) Survivorship

by:
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Introduction

Date of birth can have a significant effect on the survival of larval fish. Birth date affects fish mortality by synchronizing with favorable environmental conditions and giving an individual a growth-related advantage. This effect is well documented in many other classes of organisms, including birds and mammals (Wright and Gibb 2005). However, the effect of birth date on survival is less understood in fish (Good et al. 2001). Methot (1983) and Cargenelli and Gross (1996) found evidence suggesting that early birthdates were favored in bluegill (*Lepomis macrochirus*), while other studies have found evidence that late birthdates are favored (Crecco and Savoy 1985).

Environmental conditions, particularly hydrological conditions, also affect mortality. According to Uphoff (1989), rainfall early in the spawning season increased mortality of young striped bass, *Morone saxatilis*. High water conditions make it harder for smaller fish to maintain their position in the water, avoid predators, and find food. Zooplankton, their prey, cannot maintain its position in the water, so high currents can make food scarce for small fish. Numerous studies have shown, however, that increased water levels select against larger fish. These fish may experience difficulty sheltering themselves against high water flow. There may be less cover available for larger fish to avoid strong currents (Angermeier 1984; Pearsons and Li 1992).

In the first few weeks after hatching, fish undergo selective mortality. The extent and direction of yellow perch mortality is not completely understood. Post and Prankevicuis (1987) examined size-specific mortality of yellow perch using otolith microstructure, but did little concerning birthdate. Moreover, they could not conclude whether size-specific mortality had occurred. They found strong size-specific mortality in only one of two populations they examined. The cohort that experienced size-specific mortality saw selection against smaller individuals. Other studies examined yellow perch population dynamics in South Dakota lakes, but these also found that age distributions varied greatly by year and lake (Isermann and Willis 2008).

Two past studies have shown that yellow perch hatch date varies significantly among water bodies. Hatch periods ranged from nine weeks (Fitzergerald *et al.* 2001) to less than 20 days (Powles and Warlen 1988). Varying hatch periods suggest that hatch date could have an impact on yellow perch mortality. Yet, the effect of birthdates on yellow perch mortality is not well understood, particularly in streams (Isermann and Willis 2008).

Yellow perch are common lake and river fish, and an understanding of their survivorship patterns is necessary for conservation efforts. Yellow perch is a popular game species in lakes and rivers across the nation, so understanding this fish's ecological patterns is critical to fisheries management. The current knowledge of yellow perch mortality is incomplete. Most studies have focused on environmental and size-related trends. Furthermore, the majority of yellow perch studies have investigated lakes rather than rivers. Lake ecosystems differ greatly from river ecosystems, so a large gap exists in yellow perch survival data.

We provide basic knowledge of birthdates' effect on yellow perch survival in a river population. Samples of age-0 yellow perch were collected from multiple sites along the shores of the Lower Chippewa River to examine the effect of birthdates of yellow perch survivorship in a single summer.

Material and Methods

Study Site and Sample Collection

Young of the year yellow perch were collected from a 1km stretch of the Chippewa River near Carryville, Wisconsin, just upstream of the Highway H bridge landing, during the summer of 2012 (Figure 1). We included fish from two separate time periods, early summer (5 VI 2012 and 6 VI 2012) and late summer (20 VII 2012). Shallow riffles and pools, both in and out of the current were sampled using seine nets and a backpack electrofisher. Substrate sampled consisted primarily of sand and gravel with submerged woody structures present at times in the backwater pools. Water depth ranged from one to six feet. Environmental factors were examined using outside sources. Upon capture, fish were immediately anesthetized using accepted methods (MS 222 or Alka-Seltzer) and placed on ice. Upon arrival in the lab, fish were thawed, measured, massed and stored in a 95% ethanol solution at room temperature for at least one day before otolith removal.

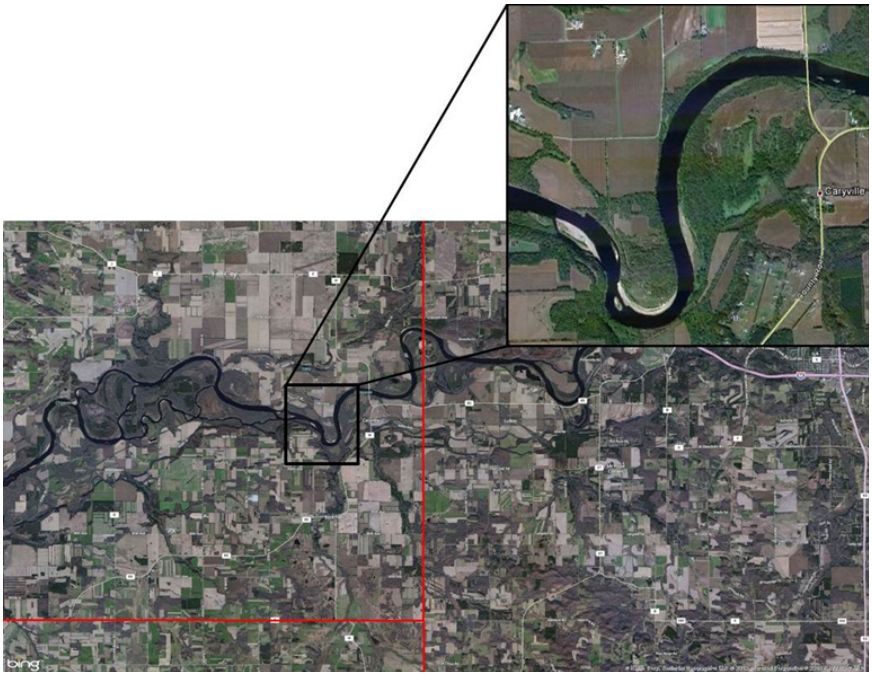

Figure 1: Map of the Lower Chippewa River Basin. Sampling was done in a 1 km stretch of river near Caryville, WI.

Otolith Preparation and Birth Data Calculations

Left and right sagittal and lapillar otoliths were removed from specimens using a dissection microscope with a polarized light source and watchmaker forceps. Fish in which all otoliths could not be readily removed were soaked in a 20% bleach solution to dissolve tissue, thus expos-

ing the otoliths. This was done only in circumstances in which one otolith of each type had been removed prior to bleach exposure so as to ensure that the correct label (left or right) was applied to each otolith. Upon extraction, otoliths were placed in labeled vials containing 95% ethanol solution. Otoliths were separated and stored based on the side of the fish they came from (left or right). Left sagittal and lapillar otholiths were removed from the vials and placed concave side down using a dissection microscope and watchmaker forceps on microscope slides. These were air dried for a minimum of 15 minutes in order to evaporate any remaining ethanol. If the left otolith was not available or had been compromised, the right otolith was substituted. Otoliths were allowed to air dry on the slides for approximately 15 minutes to evaporate any remaining ethanol. A thin layer of Krazy Glue® was applied around the otolith, and a further thin layer over the top, with the concave side of the otolith still down. Upon glue application, otoliths were allowed to dry for a minimum of 24 hours. Once dry, otoliths were ground to the plane of the core, exposing daily rings, using 3M® lapping film.

Otoliths were then imaged at 20x and 40x magnification using a microscope camera and SPOT® imaging software. Rings were counted either manually or by images, depending upon the quality of the image.

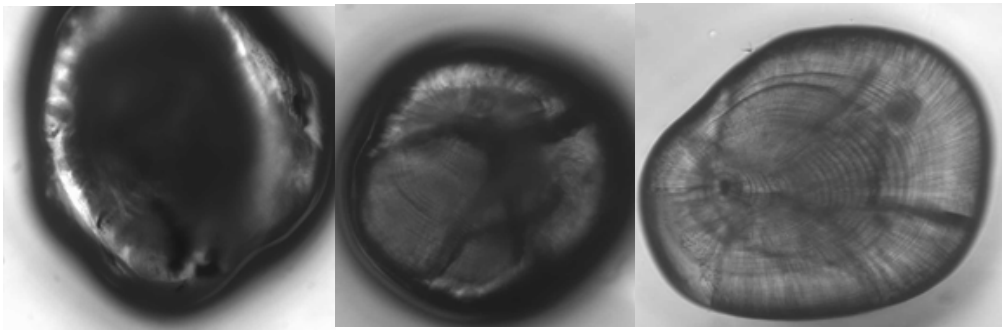

Figure 2: A yellow perch lapillar otolith when, from left to right, unpolished, semi-polished, and completely polished.

Images of otoliths were saved as 100% quality JPEG images from the SPOT® software. Rings counted manually were viewed under oil immersion at 1000x magnification. Counts were done on each otolith by at least two team members. If the counts were not within ten percent of one another, the counts were redone with the addition of a third count. If the counts remained highly variable, the otolith was not included in the data analysis. The mean of the accepted count was recorded as the number of daily rings for the given fish. Average ring count was then subtracted from the Julian date of the fish's collection to deduce the Julian birthdate of the fish.

Validation of Daily Ring Formation

Otolith age calculations start from the assumption that growth rings are deposited daily. Prior to performing their own mortality study of yellow perch, Post and Prankevicuis (1987) validated this assumption in yellow perch. Using linear regression methods, they found a strong, positive correlation between fish age and otolith length. The correlation provides the necessary evidence to assume daily deposition of rings. Additionally, only severe environmental conditions are known to interfere with the daily formation of rings (Campana and Thorrold 35).

Data Analysis

Examination of Age Differences Between Groups

By using back-calculated ages from ototlith increments, the researchers compared the mean Julian age of June fish to the mean Julian age of August fish by a pair-wise t-test. The t-test was carried out using the 5% confidence level as the cutoff for significance.

Development of Survivorship Curves

Fish from both samples were assigned age classes. Each age class was five Julian days in length. Age classes ranged from 95-100 days to 135-140 days. Frequency distributions were produced for each group using Microsoft Excel. Survivorship of fish in each class was modeled using equations put forth by Good et al. (2001):

$$\pi_{0j} = \frac{y_{0j}}{n_0} \qquad \pi_{1j} = \frac{\pi_{0j} S_j}{\sum_{j=0}^{k} \pi_{0j} S_j} \qquad S_j = \frac{e^{\alpha+\beta x_j}}{1+e^{\alpha+\beta x_j}}$$

where π_{ij} represents the probability of a fish occurring in a particular size class, j, at a particular time, i. The June sample time is stated as i=0 and the August sample is stated as i=1. The variable n_i is the total number of fish caught in the time period, and y_{ij} is the number of fish caught in the time period at a specific size. S_j is the probability that a fish will survive age selective mortality (i.e. that it will live through the summer). Since we were primarily interested in the likelihood that a fish survives through the season, estimating S_j is our primary mathematical goal.

S_j is modeled as a sigmoid curve with parameters α and β. α represents the level of change of the curve while β represents the rate of change of the curve. Thus, a large, positive value of β indicates that selection based on birthdates was quite prevalent in the population sampled. A β value of zero indicates no selection based on birthdates.

Laplace smoothing was used to provide a "starting point" for the estimations of α and β. A value of 1 was added to the number of fish in each class size, so that:

$$y_{0j}^{new} = y_{0j} + 1 \qquad y_{1j}^{new} = y_{1j} + 1$$

Using these new values, the data was modeled by minimizing the sum of the squared differences between predicted and observed survivor proportions. This can be stated as:

$$\sum_{j=1}^{k} \left(\pi_{1j} - \hat{\pi}_{1j}\right)^2$$

In models of this nature, an additional parameter is usually present that represents the probability that a fish survives all other non-selective mortality. Non-selective mortality is defined as all other random mortality not based on birthdate. Since this parameter cannot be accurately estimated without data on all other yellow perch mortality, the value for this parameter is assumed to be 1. This eliminates it from the equations (Good et al. 2001). It also leaves Sj as the sole estimator of survivorship. All statistical analysis was conducted in the statistical program R.

Results

Environment

The Summer of 2012 was dry in comparison to the average for the sampling area. However, the month of May, during the yellow perch hatch season, average rainfall was higher than average (Figure 4). The summer in the Chippewa Valley was extremely warm when compared to average temperatures. June and July were two degrees (Fahrenheit) warmer, while August was five degrees (Fahrenheit) warmer when compared to averages (Figure 5).

The mean birth date of the samples was significantly different between June and August (0.0001). Estimates for Sj are shown in Table 1. The survivorship curve generated from the Sj estimates is shown in Figure 6.

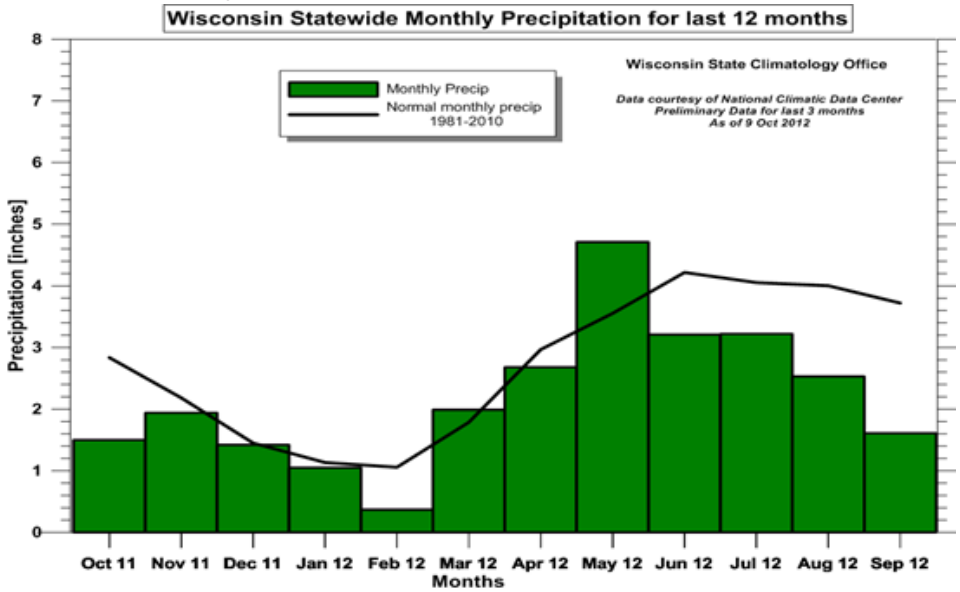

Figure 4: Published rainfall by month for Wisconsin in 2012.

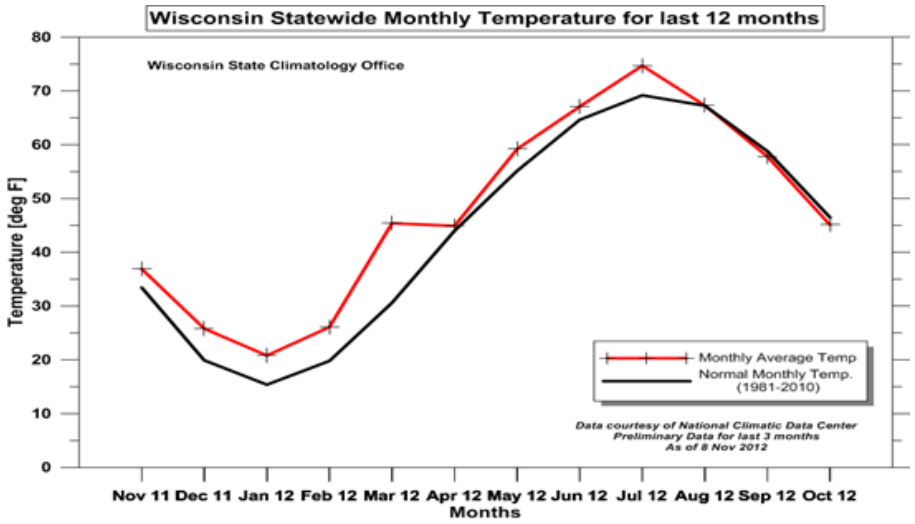

Figure 5: Published temperatures for the summer of 2012 in Wisconsin

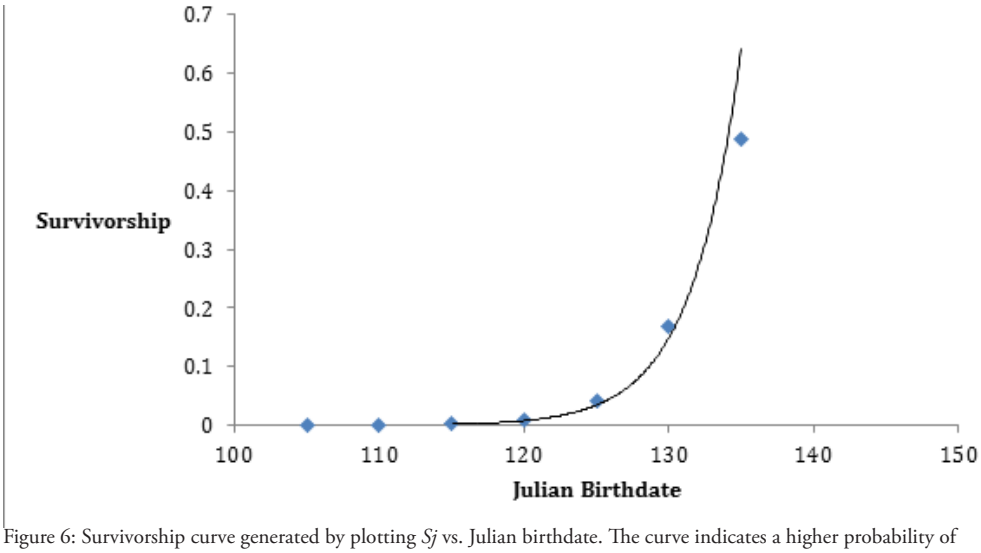

Figure 6: Survivorship curve generated by plotting *Sj* vs. Julian birthdate. The curve indicates a higher probability of survival through the season with later birthdate.

Birthdate Class (Julian Days)	S_j Estimations
105	0.00009
110	0.00041
115	0.00193
120	0.00901
125	0.04109
130	0.16798
135	0.48750

Table 1. Sj estimations associated with birthdate class. Sj is the probability of surviving age-selective mortality.

Discussion

The data indicates a .009% chance of survival for the fish in the 105 birthday class, and of 48% in the 135 birthdate class. Thus, it would seem that fish that hatch later in the summer have a clear advantage.

According to the Wisconsin State Climatology Office, May was an especially wet month (Young 2012). The hatching period for our cohort of yellow perch was mid-April to mid-May. We sampled shortly after this period. The rest of the summer saw drought conditions, and a lower proportion of early-born fish survived through August. It is reasonable to assume that fish born early in the season are larger, so our results match that of Good et al. (2001) in that the larger fish were selected against those hatched in drought conditions.

Predator content in an ecosystem can affect mortality (Post and Prankevicuis 1987). Walleye (*Sander vitreus*) are predators of yellow perch, and as such, it is known that larger walleye populations can cause higher yellow perch mortality (Rudstam 1996; Hartman 1993; Nielsen 1980). In the presence of predators, previous studies of salmon have shown an advantage to being born later in the year (Brannas 1995). The fish that emerge early in the summer are the only ones available for predators to feed upon, whereas fish born later in the summer, have the advantage

of larger numbers on their side, and thereby, they experience lower mortality. Our results remain consistent with this. Our study indicates that the fish born early in the summer experienced much heavier mortality than those born later.

While these findings are consistent with literature on other species, it is important to note that this study is fairly limited in its scope. It covers only a river population of yellow perch and much of the current literature deals exclusively with lake populations. Furthermore, we make the assumption that the perch in our sample site did not simply just leave. This is a reasonable assumption, and even if those originally sampled did leave, other perch in the river likely would have taken advantage of the vacated habitat.

This research leaves ample room for further study. A continuation of this project to address multiple years would serve to solidify our findings and an investigation of first year mortality between lake dwelling yellow perch and river dwelling yellow perch would be beneficial. This study can be used to aid in management efforts as officials search for ways to maximize their investment in their efforts. Knowing that the first fish to emerge appear to experience the highest mortality would serve stocking efforts well. Further research into the environmental factors that play into first year mortality would serve these interests well.

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Climatic Effects in Minor League Baseball

by:
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Abstract

The study of climatic influences on sport performance is typically related to temperature and precipitation. While some argue playing in extreme heat or cold may give a home team an advantage compared to their competitors, others suggest athletes at the highest levels will excel no matter the circumstance. In baseball, studies of the impact weather has on the game have solely concentrated on major league baseball and a majority of these studies have examined either wind or humidity. This study explores the influences of humidity and examines how increases or decreases in atmospheric moisture impact batting averages of teams in Minor League Baseball's Pacific Coast League. Specifically, this project analyzed the home games of four teams over a seven-year span. The teams were selected by location based on differing climatic patterns and were controlled for atmospheric moisture as measured by dew point depression.

Introduction

Many factors shape the game of baseball: the players, fans, stadiums, and as this study aims to prove, even the weather. Obviously weather effects play a role in any given baseball game: a rain delay can send games late into the night or severe weather can cancel a game altogether. However, more subtle weather effects, like wind, temperature, and humidity can play an even larger role. Many studies have sought the relationship between atmospheric processes and the game of baseball. However, each study has produced differing results.

Perhaps the earliest interest in the atmosphere-baseball relationship came in 1986 via a *Baseball Analyst* article by Dick O'Brien. O'Brien looked at ballpark elevation and humidity as factors in home run production. He examined teams in Reno and Denver during the 1977 through 1985 seasons and found that both teams consistently out-produced the rest of the league in home runs. He attributed this to the fact that both home stadiums are significantly higher and drier than the rest of the league. O'Brien concluded the article, "The evidence appears irrefutable. Height plus warm, dry air provides the ideal environment for hitting home runs."[1]

In a later study, Brent Skeeter examined the prevailing wind velocities and directions at baseball stadiums around the country. Using these characteristics, Skeeter identified parks with favorable or unfavorable conditions for home run production. Skeeter determined that rather than follow regional patterns, individual stadiums created distinct micro-climatological wind patterns based on the orientation of the field, seats, and large replay screens. Mark Kraft and Skeeter continued this research by further analyzing how meteorological conditions influenced fly ball distances. They examined wind speed, wind direction, temperature, and humidity effects in relation to how far a fly ball would travel. The pair concluded that in most stadiums, temperature was the most important meteorological variable affecting fly ball distances.[2]

[1] Dick O'Brien. "Ball park Elevation and Humidity as Factors in Home Run Production." *Baseball Analyst* 24, (1986): 20.

Robert Rohli and Gregory Fairers expanded research into other atmospheric effects, investigating the influences of wind speed and direction, and also controlling for humidity using a temperature dew point. They concluded that on a year-to-year scale, lower dew points increased home run production, but on a day-to-day scale wind direction had the most significant impact on home run success.[3]

Supplementing this research, Frederick Chambers, Brian Page, and Clyde Zaidins completed an in-depth analysis of homerun production at Coors Field in Denver, Colorado. The most elevated park (5,127ft) in Major League Baseball, Coors Field has been known as a 'hitter friendly park.' Todd Jones, a relief pitcher for the Rockies, says in his column, The Closer: "For years, baseball people have said Coors Field is where good pitchers go to die."[4] It is not necessarily the altitude directly that causes the problems, but the thin air that leads to a much lower humidity level. He continues: "The lack of humidity is the toughest thing I've had to deal with."[5] The ball has fewer air/moisture particulates to 'grip' as it travels from the pitching mound to home plate and thus cannot move up, down, or to the side as it would at a lower elevation or higher humidity. To combat this, Jones stated, pitchers much change their grip, which generally impacts the effectiveness of their breaking ball. The lack of a consistent breaking ball generally is disastrous for most pitchers' performance. Compounding the impact of an ineffective breaking ball, Chambers et al. hypothesized that due to Coors Field's higher elevation, baseballs should travel 10% farther there than in stadiums at sea level—thus providing hitters more chances for producing a hit. However, additional calculations suggested Coors Field balls fly 6% farther than at sea level due to a prevalent north-easterly wind.[6]

In order to combat the altitude and drier air, the Rockies organization has stored game balls in humidors since 2002. Humidors provide baseballs additional water weight, making them heavier and thus harder to hit as far. Some critics have argued that balls stored in the humidor give an unfair advantage to pitchers, but Edmund Meyer and John Bohn's study revealed that pre-humidor baseballs at Coors Field were below the MLB standards set for weight and size.[7] Once Coors Field officials placed baseballs into humidors, the baseballs actually increased to regulation size. Meyer and Bohn's study concludes that a humidor baseball will break by approximately .02 inches per pitch and that humid baseballs will travel a few feet farther due to aerodynamics, density, and spherical properties.[8]

As the previously citied research demonstrates, wind and humidity have been cited as having the most influence on hitting success, but an accurate measurement of humidity has yet to be identified. Rohli and Fairers indicate that yearly dew point averages did have an impact on a batter's hitting abilities, but our study argues a dew point value alone may not prove the most accurate indicator of atmospheric humidity.[9]

Humidity, the amount of water vapor in a given parcel of air, can be displayed as dew point. However, without an associated air temperature value, interpretation of a dew point value is difficult. Craig Bohren and Bruce Albrecht state dew point is the preferred expression of

[2] Mark D. Kraft and Brent R. Skeeter. "The Effect of Meteorological Conditions on Fly Ball Distances in North American Major League Baseball Games." *The Geographical Bulletin* 37, no. 1 (1995): 8.

[3] Robert Rohli and Gregory Faiers. "A Climatological Interpretation of Major League Baseball Home Run Frequencies." *Sport Place: An International Journal of Sports Geography* 10, no. 6 (2000).

[4] Todd Jones. The Air Up There. Sporting News, (2002): 35.

[5] Ibid.

[6] F. Chambers, B. Page, and C. Zaidins. . "Atmosphere, weather, and baseball: How much farther do baseballs really fly at Denver's Coors Field?" *Professional Geographer* 55, no. 4 (2003): 491-504.

[7] E. Meyer, and J. Bohn. "Influence of a Humidor on the Aerodynamics of Baseballs." *American Journal of Physics* 76, no. 11 (2008): 1015-1021.

[8] Ibid. 1020.

[9] Robert Rohli and Gregory Faiers. "A Climatological Interpretation of Major League Baseball Home Run Frequencies." *Sport Place: An International Journal of Sports Geography* 10, no. 6 (2000).

humidity by meteorologists.[10] Dew point is simply the temperature at which a given parcel of air reaches saturation. Yet the use of dew point alone as a proxy for atmospheric humidity is useless without corresponding air temperate. Accounting for this difference is the dew point depression. The dew point depression is defined as the difference between the air temperature and the dew point temperature. Bertrand Timbal, Pandora Hope, and Steve Charles argued that this measure "takes into account the ability of a warming atmosphere to hold more moisture."[11] Miriam Rorig and Sue Ferguson successfully used dew point depression to classify dry and wet days in Spokane area,[12] while David Schultz used the measure in his analysis of lake-effect snow fall.[13] Ultimately, Bohren and Albrecht argued that this method is an "optimum predictor" of atmospheric humidity.[14]

This study examines the relationships between the amount of moisture in the atmosphere and a team's batting average. This paper argues that teams playing their home games in drier climates will correlate to higher batting averages. This study also suggests that as atmospheric moisture, measured by the dew point depression, changes day-to-day, team success at the plate will fluctuate. Furthermore, researchers have locked onto an accurate measure of atmospheric moisture in studies that pertain to climatic impacts in sports; their efforts will be enhanced through the use of the dew point depression as a proxy to examine humidity's effects on sports.

Methods

Previous studies regarding atmospheric effects on baseball have primarily focused on Major League Baseball players and stadiums. Since 1994, Major League Baseball has seen twenty new stadiums, eight of which have appeared since 2004. Major League Baseball also has multiple indoor parks, which allows the team to control the temperature and humidity in the stadium. For these reasons, this study focuses on Minor League Baseball because all of the stadiums lie outdoors, and, hence, allow for the study of external climatic effects. This study examined minor league teams at locations throughout the United States in order to encompass a variety of differing climatic characteristics.

Illustration 1: Pacific Coast League Locations.

Despite its name, the AAA Pacific Coast League includes seventeen teams across the United States, all with outdoor stadiums. With the exception of the Reno Aces, who built a new park in 2009, and Omaha, who moved to a new stadium in 2011, all have played in the same stadium during this study's timeframe. Data on all seventeen teams was not readily available; hence, a subset of teams was selected on the basis of their locations, climatic differences, and team offensive characteristics. Illustration 1 displays the locations of all teams in the Pacific Coast League.

The teams selected for a more detailed analysis were derived from the completion of a

[10] Craig F. Bohren and Bruce A, Albrecht. *Atmospheric Thermodynamics*. New York: Oxford University Press, 1998.

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[12] Miram Rorig, and Sue Ferguson. "Characteristics of Lightning and Wildland Fire Ignition in the Pacific Northwest." *Journal of Applied Meteorology* 38, no. 11 (1999): 10.

[13] David M Schultz. "Lake-Effect Snowstorms in Northern Utah and Western New York With and Without Lightning." *Weather and Forecasting* 14 (1999): 7.

[14] Bohren. *Atmospheric Thermodynamics*.

City	Bat. Avg	ERA	HR	Temp.	Dew Pt.	DP Dep.	Precip.	BA Rank	ERA Rank	HR Rank	HitSuit	HitSuit Rank	DPD. Rank	Final
Las Vegas	0.293	5.30	143	84	31	53	0.01	1	2	4	7	1	1	0
Albuquerque	0.290	5.13	164	72	36	36	0.03	3	4	1	8	2	3	1
Reno	0.290	5.26	134	67	32	35	0.01	4	3	11	18	3	4	1
Tacoma	0.276	4.76	157	59	47	12	0.05	9	8	3	20	4	16	12
Salt Lake	0.283	5.10	138	68	39	29	0.04	6	5	9	20	5	5	0
Colorado Springs	0.291	5.40	126	63	39	25	0.07	2	1	17	20	6	7	1
Fresno	0.277	4.68	141	75	47	28	0.01	8	9	7	24	7	6	1
Tucson	0.287	4.94	128	80	41	39	0.16	5	6	15	26	8	2	6
Sacramento	0.274	4.29	158	69	49	20	0.01	10	16	2	28	9	8	2
Omaha	0.274	4.42	142	70	56	14	0.15	11	14	5	30	10	14	4
Iowa	0.277	4.59	132	69	55	14	0.17	7	10	13	30	11	15	4
Round Rock	0.269	4.52	142	82	66	16	0.05	15	11	6	32	12	11	1
Portland	0.261	4.81	137	63	48	14	0.06	17	7	10	34	13	13	0
Memphis	0.262	4.35	139	80	62	18	0.15	16	15	8	39	14	9	5
Ok. City	0.272	4.48	127	76	59	16	0.11	12	12	16	40	15	10	5
New Orleans	0.269	4.43	128	79	68	11	0.17	14	13	14	41	16	17	1
Nashville	0.270	4.21	133	74	60	15	0.12	13	17	12	42	17	12	5

Table 1: Hitter Suitability Index.

"Suitability Index." This index combines both climatic data and baseball statistics in order to best examine the relationship between the two. Table 1 represents the calculated suitability index for this study.

The table outlines the creation of a Hitter Suitability Index (HSI). Baseball statistics were collected from each respective team's website, while climatic data were obtained from the National Weather Service for each of the home cities during the months of April through September, in the years 2005 through 2012—the exceptions being Tucson, who relocated to Reno in 2009, and Portland who relocated to Tucson in 2010. The second half of the table ranks each team based on their Bat. Avg, ERA, and HR (one being the best for hitters, seventeen being the worst). These ranks were totaled under the 'HitSuit' column (Hitter Suitability), creating a corresponding rank as the 'HitSuit' value. Table I is ranked based on its HitSuit category.

$$HitSuit = Bat\ Avg\ Rank + ERA\ Rank + HR\ Rank$$

Relating to the climatic characteristics, the 'DPD. Rank' column ranked each team's Dew Point Depression on a scale of one (driest) to seventeen (wettest). The 'Final' column represents the absolute value difference between 'HitSuit Rank' and 'DPD. Rank'. Thus, this roughly displays how closely associated hitting ability is related to dew point depression. (Zero very closely associated and twelve shows no, or an inverse, association.)

$$Final = |\ HitSuit\ Rank - DpD.\ Rank\ |$$

Team Analysis

Based on the results from Table I, this study selected the following teams for a more in-depth analysis: Las Vegas, Colorado Springs, New Orleans, and Iowa (Des Moines). Spatially and quantitatively each of these teams displayed a relationship between weather and hitting success. Las Vegas and Colorado Springs both displayed a positive relationship between the Dew Point Depression and their high batting average. Inversely, New Orleans and Iowa displayed lower bat-

ting averages and consistently lower dew point depressions. Additionally, these teams' locations represent a wide spatial distribution throughout the United States.

All data were collected for approximately 72 homes games per team per year, totaling 2,154 days of data. Games shortened by inclement weather or other factors were included; however games that were started on one day, postponed, and subsequently finished on another date were excluded from this analysis.

Baseball data were collected from the Pacific Coast League's official web site via each respective team from 2005 to 2012 (MiLB 2013). The team batting average was calculated per game by taking the team 'At Bats' and dividing them by the total team hits. By only factoring in the total "At Bats" each team has, the occurrences in which a batter advanced to first base on a 'Walk' (BB) or a Hit By Pitch (HBP) have been eliminated.

Team Batting Average = Team At Bats ÷ Team Hits

National Weather Service data were collected from the web site Weather Underground (www.wunderground.com) which provided daily averages for temperature and dew point for the date of each home game. Daily dew point depression was calculated as a proxy for atmospheric moisture. Table 2 provides a small excerpt of individual baseball and weather data for specific dates, while Table 3 depicts averages of values for the four teams selected for individual analysis.

City	Date	Temp (F)	DP (F)	DP Dep.	Team BA	Team HR
Iowa	4/15/2005	57	43	14	0.096	1
Iowa	4/16/2005	63	51	12	0.303	3
Iowa	4/17/2005	66	52	14	0.212	3
Iowa	4/18/2005	68	55	13	0.352	2
Iowa	4/19/2005	70	60	10	0.333	1
Iowa	4/20/2005	65	59	6	0.312	0
Iowa	4/21/2005	55	52	3	0.241	0
Iowa	4/22/2005	53	46	7	0.344	1

Table 2: Sample Excerpt of Data.

City	Bat. Avg.	ERA	HR	Temp	D.P.	D.P. Dep.
Colorado Springs	0.291	5.40	126	63.38	38.75	24.63
Iowa	0.277	4.59	131	68.88	55.38	13.50
Las Vegas	0.293	5.30	142	84.00	31.25	52.75
New Orleans	0.269	4.43	128	79.13	68.13	11.00

Table 3: Study Team Data.

Results

Correlation analysis is a common statistical procedure used to measure and interpret the strength of the relationship between two continuous variables. While nonlinear correlation tests exist (i.e., exponential and logistic), more common approaches like Pearson's r and the Spearman's test identify the linear association between two variables. The resulting correlation coefficients range between -1 and 1, with the sign indicating the direction (i.e. negative or positive) of the relationship. While Spearman's test measures the relationship of ranked sample data, Pearson's r (or Product-Moment) measures the relationship between two random variables. The use of Pearson's r covers multiple disciplines and has been used in a number of studies to analyze the relationship of weather with a variety of activities (Peredes et al. 2006[15] ; Nankervis 1999[16] ; Schwartz et al. 2006[17] ; Nevers & Whitman 2005[18]). Related to this study, the association between batting aver-

[15] Paredes, *et. al.* "Understanding Precipitation Changes in Iberia in Early Spring: Weather Typing and Storm-tracking Approaches." *Journal of Hydrometeorology* 1, (2006): 101-113.

[16] M. Nankervis. "The effect of weather and climate on bicycle commuting." *Transportation Research* Part A, 33, (1999).

age and dew point depression is measured using Pearson's r.

Table 4 illustrates the results of the Pearson's r test for selected teams. Though the correlations are rather weak for both Colorado and Las Vegas, two of the driest teams, the test nonetheless indicates a significant linear relationship between batting average and the dew point depression. Specifically, as the dew point depression increases (meaning less atmospheric moisture), batting averages increase. Though both results are not significant, the case of Iowa suggests a decline in batting average with increased levels of atmospheric moisture, and the case of New Orleans shows little movement due to the consistently high level of humidity found there throughout the summer. Yet through seven seasons and over 500 games played, Table 3 does provide evidence that the lack of atmospheric moisture is most likely a contributing factor to higher batting averages.

City	R	Sig
Col (n = 525)	0.101	0.021
Iowa (n=540)	-0.082	0.056
NO (n=536)	0.002	0.965
Vegas (n=552)	0.153	0

Table 4: Pearson's r Test.

The purpose of correlation analysis is to examine the strength and relationship between two variables, though the results are not sufficient enough to prove causation.[19] Regression analysis is another common statistical approach that evaluates the impact of a predictor variable on a given outcome. At the most basic level, regression analysis explains how the dependent variable (batting average) will react in the event of the independent variable (dew point depression) changing. The model is expressed as

$$Yi = a + bXi + eii$$

where "a" is the intercept, "b" the slope of the regression line, and eii the estimate amount of error. The resulting coefficient of determination (R2) indicates the amount of variability or how well the explanatory variable (x) explains the dependent variable (y). As a common tool, simple linear regression has been used successfully in many studies predicting the effects of weather on other variables.[20]

Regression analysis was performed on the two teams' batting averages where correlation proved significant (Colorado and Las Vegas). Tables 5-8 show the results of the regression analysis for both teams. Though the R2 results are not impressive, due to the lack of large variations in batting average (each had standard deviations around 0.08), the equation results do indicate a positive and statistically significant relationship between the amount of moisture in the air and batting average. Simply put, as the dew point depression increases by one degree batting averages increased by 0.001 in both Colorado Springs and Las Vegas. Using a similar equation with dew point temperature as the explanatory variable, results indicated a negative relationship due to the complexities associated with temperature and dew point discussed earlier. Again, while the equation itself is rather weak, the significant relationship between the two variables does demonstrate the connection between batting average and dew point depression, as well as revealing that dew point depression is a more accurate measure of humidity than dew point temperature in regards to this experiment.

[17] M. Schwartz, D., R. Ahas, and A. Aasa. "Onset of spring starting earlier across the Northern Hemisphere." *Global Change Biology*, 12 (2006).

[18] Meredith Nevers, and Richard L. Whitman. "Nowcast Modeling of Escherichia Coli Concentrations at Multiple Urban Beaches of Southern Lake Michigan." *Water Research*, 39, (2005).

[19] Kelly Zou, Kemal Tuncali, and Stuart G. Silverman. "Correlation and Simple Linear Regression." *Radiology* 227 no. 3 (2003).

[20] L. Thompson. "Weather and Technology in the Production of Corn in the U.S. Corn Belt." Agronomy Journal 61 (1969): 453-456.

Colorado Springs

Model	R	R Square	Adj. R Square	Std. Error of Est.
1	.101	.01	.0008	.08433115723

Table 5: Model Summary Colorado Springs.

Model	Unstandardized Coefficients B	Std. Error	Standardized Coefficients Beta	t	Sig.
1 Constant	.029	.01		30.302	0
DpDep.	.0001	0	.101	2.315	.021

Table 6: Coefficients Colorado Springs.

Las Vegas

Model	R	R Square	Adj. R Square	Std. Error of Est.
1	.153	.024	.022	.078164610

Table 7: Model Summary Las Vegas.

Model	Unstandardized Coefficients B	Std. Error	Standardized Coefficients Beta	t	Sig.
1 Constant	.257	.013		19.193	.000
DpDep.	.001	.000	.153	3.639	.000

Table 8: Coefficients Las Vegas.

Conclusion

While previous research regarding the climatic influences on baseball determined that temperature and humidity influenced hitting performance, they lacked an appropriate measure of humidity. Dew point temperature, the most common measure of humidity, is irrelevant without temperature connected in the analysis, something previous studies lack. Dew point depression, on the other hand, does take temperature into consideration by simply subtracting the dew point temperature from the air temperature. The resulting number is a better proxy for humidity in that the larger the difference, the lower the amount of atmospheric moisture. Therefore, this study introduces dew point depression into the existing literature examining climatic influences on baseball.

Due to considerable movement of stadiums and the current trend towards indoor stadiums, professional baseball teams were not analyzed here. This study examined Triple A baseball teams in the Pacific Coast League due to the seventeen teams playing in the same ball park during the period of analysis, and the teams covering a wide portion of the United States, thus encompassing large climatic variations. Calculating a Hitter Suitability Index allowed a graphic analysis combining both baseball and weather variables. From this Index four teams were selected for further analysis. Las Vegas and Colorado Springs ranked high on the Hitter Suitability Index (hitter friendly) and were subsequently located in drier areas, while Iowa and New Orleans fell to the bottom of the Index (less hitter friendly) with both illustrating consistently high levels of atmospheric moisture.

Individual analysis of the four teams using Pearson's r correlation determined that a significant linear relationship existed between batting averages and dew point depressions for both Colorado Springs and Las Vegas, but not for New Orleans or Iowa. Though the values for Las Vegas and Colorado Springs were low (0.153 and 0.101 respectively) the positive relation suggests that as the dew point depression increased (meaning drier air) batting averages increased. Therefore, due to the fact that Las Vegas and Colorado Springs hitters experience more "dry" days per seasons, this study indicates the lack of humidity is a contributing factor to the discernible lift in batting averages compared to teams with smaller dew point depressions.

Regression analysis for the two dry teams yielded rather weak, but statistically significant results. While an increase of 0.001 in the batting average may seem negligible, in a sport obsessed with statistics, 0.001 expanded over an entire season yields extra hits increasing potential runs. For example, during the 2013 season, Colorado Springs and Las Vegas had an average of 4,929.5 At Bats, and 1,409 Hits. These average stats resulted in a 0.28583 batting average. Using the regression results, increasing the batting average by 0.001, to 0.28683, would have amounted to an increase of almost 5 hits (4.92) over the course of a season. While seemingly low, this increase in hits could actually have had a marked effect on individual games. If one considers the fact that at least five more batters would come to the plate, each of these batters would have had the potential to bring in, at the worst case, five additional base runners (if hitting five singles), and in the best case, twenty additional runs (five grand slams). In 2013, Las Vegas finished only two games ahead of division rival Sacramento. Theoretically, the potential additional hits provided due to Las Vegas' dry climate could have contributed to their very slim two game lead.

Due to the fact that professional baseball is based on producing revenue, additional studies of the climatic effects on individual baseball players are warranted. Results found here drive questions such as, do players born into a particular climate produce similar results in differing climates? If the previous question is true, can teams then draft players more efficiently to fit their climatic situation? This study provided evidence that hitters are more successful in drier places. Extending from this, additional research could examine if player acclimation to higher levels of humidity could result to higher performance when compared to a player who developed in differing climatic regions. While All-Star players are most likely going to be successful no matter the location, research linking performance to climate could enhance the use of everyday players during the long baseball season.

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Synthesis and Antibody Binding Properties of a Cyclic Dimer Mucin Peptide

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Abstract

In this project, we attempted to synthesize a cyclic mucin peptide with the sequence Gly-Val-Thr-Ser-Ala-Pro-Asp, a known sequence residing on a common repeat domain called the Tandem Repeat Domain (TRD) on the MUC1 mucin protein. MUC1 mucin, a large glycoprotein expressed and tethered on the extracellular surface of epithelial cells, is known for its variety of functions, including cell protection, cellular communication, and signal transduction. Tumor cells express a kind of MUC1 mucin that has a low degree of glycosylation that results in exposure of the protein core. This leads to an immune response against the tumor MUC1 mucin itself in which it targets the TRD that contains the sequence that we plan to synthesize. We observed a cyclic dimer mucin peptide with the sequence Gly-Val-Thr-Ser-Ala-Pro-Asp-Gly-Val-Thr-Ser-Ala-Pro-Asp in addition to the intended cyclic monomer product. We were able to obtain homogeneity with the cyclic dimer peptide, whereas the monomer cyclic peptide was difficult to purify due to contaminant side products and peptide racemization. We hypothesized that the dimer peptide could be equally active, if not more so, since it possesses two halves of the same sequence. Thus, we pursued the characterization of the structure of the dimer peptide and the antibody-peptide binding. We describe here the preliminary results of the binding properties of the cyclic dimer peptide to antibody obtained through Saturation Transfer Difference Nuclear Magnetic Resonance Spectroscopy (STD-NMR). The STD-NMR data indicate that the subject peptide possesses multiple sites of binding, notably Pro, Val, Ala and Asp. The Pro residue exhibited antibody binding at all of its side chain protons while Ala, Val, and Asp are limited to certain groups.

Abbreviations: Glycine – Gly or G; Valine – Val or V; Threonine – Thr or T; Serine – Ser or S; Alanine – Ala or A; Proline – Pro or P; Aspartic acid – Asp or D

Introduction

Mucins, large transmembrane glycoproteins, increasingly generate interest as study targets in the development of vaccines against cancer—in particular, breast cancer—due to the high level of mucin expression on breast tissue cells. Pancreatic, lung and ovarian cancers also attract attention in mucin-based immunotherapy research (Grinstead *et al.* 2002). The structure of the MUC1 mucin contains a 20-amino acid tandem repeat unit constituting the sequence GVTSAPDTRPAPGSTAPPAH on its extracellular domain (Grinstead *et al.* 2002; Singh and Bandyopadhyay 2007). Healthy epithelial cells express MUC1 mucins that are heavily coated with complex carbohydrate structures attached at serine and threonine residues of the repeating sequence (Hollingsworth and Swanson 2004). In addition, the location on the cell surface of the expression is regulated and limited to the apical side (Singh and Bandyopadhyay 2007). On the other hand, tumor-afflicted cells have unregulated expression of MUC-1 mucin that display aberrant carbo-

hydrate patterns (Grinstead *et al.* 2002; Singh and Bandyopadhyay 2007; Hollingsworth and Swanson, 2004). In such cases the glycosylation is greatly reduced, resulting in the exposure of the mucin protein core that induces low levels of immunological responses. The specific monoclonal antibody (mAb) produced by the immune system against tumor MUC1 mucin recognizes the sequence PDTRP in the tandem repeat domain.

In comparison to their linear counterparts, cyclic peptide molecules often have more beneficial effects, such as increased resistance against digestive enzymes, increased intermolecular interaction and a reliable fixed three-dimensional (3D) structure that can be useful in determining active binding sites on both the target protein and the ligand (Denmer *et al*. 2009; Alcaro *et al*. 2004). In contrast, linear peptides are dynamic and therefore are often conformationally unstable. The introduction of conformational constraint (cyclization or attachment to molecular scaffold) on the peptide often leads to increased biological activity and thus foreshadows the therapeutic potential of the cyclic dimer peptide subject. There are four methods of peptide cyclization: 1) head-to-tail, 2) head-to-side chain, 3) side chain-to-tail and 4) side chain-to-side chain. In this study we applied the most common of the four cyclization reactions, the head-to-tail.

In a previous study, we determined that the shortened linear mucin peptide with the sequence Gly-Val-Thr-Ser-Ala-Pro-Asp is capable of binding to a monoclonal antibody, suggesting that the monoclonal antibody may not be as selective as previously thought, as its normal recognition site was accepted to be Pro-Asp-Trp-Arg-Pro (PDTRP). In particular, the proline residue of the peptide sequence Gly-Val-Thr-Ser-Ala-Pro-Asp displayed significant interaction with the antibody. In this study, we report the synthesis and preliminary results on the monoclonal antibody binding properties of a cyclic dimer peptide, which has its sequence repeating twice based on the 7-residue linear mucin peptide with the sequence Gly-Val-Thr-Ser-Ala-Pro-Asp.

Materials and Methods

Solid-Phase Peptide Synthesis of Cyclic Mucin Peptide

The peptide was synthesized via Fmoc Solid Phase Peptide Synthesis (SPPS) (Chan and White, 2000). Fmoc-N-amino acids and coupling reagents HBTU and HOBt were purchased from Peptide International. The amino acid coupling reaction was carried out for 1 hr, followed by washing cycles of DMF (3x), DCM (1x) and then DMF (3x). Argon gas was bubbled through the solution to ensure thorough mixing. The removal of the Fmoc α-NH protecting group was done using 20% piperidine in DMF. After the entire sequence had been synthesized, the ODMab group protecting the carboxyl terminus of the peptide was removed with 2% hydrazine (v/v) in DMF and then dried for cyclization. The cyclization reagents consisted of a mixture of 4x excess of resin of PyBop, HOBt and 2x excess of DIPEA. The cyclization reaction was carried out for 24 hrs. The cyclic peptide was cleaved from the resin using 95% trifluoroacetic acid, precipitated in cold ether, centrifuged to collect the peptide precipitate, washed with cold ether (3x), and dissolved in water. The aqueous peptide solution was washed with cold ether (3x), then lyophilized and collected for LC-MS and HPLC analysis.

Liquid Chromatography-Mass Spectrometry (LC-MS)

The freeze-dried solid peptide sample was analyzed for the presence of the desired product with an Agilent Mass Spectrometer. The buffers used in the LC-MS analysis were 1% ACN, 0.1% HOAc, 98.9% water (buffer A), and 1% water, 0.1% HOAc, 98.9% ACN (buffer B). The parameters used in the mass spectrometer were: 0.5 mL/min flow rate, 5% to 100% B in 20 minute buffer gradient, 20 minute acquisition time followed by a 4 min post run, C18 column, and ESI positive mode (7).

High Performance Liquid Chromatography (HPLC)

The crude peptide sample was purified using a Varian Prostar High Performance Liquid Chromatography System (Chan and White 2000). The method used was a general reverse phase C18 column with ACN as the organic mobile phase and monitored at 220 nm. The flow rate was set at 2 mL/min with a gradual increase in ACN from 0% to 35% B to the 30 minute mark. Fractions were collected manually and freeze-dried for storage and subsequent NMR experiments.

NMR Experiments

All NMR experiments were performed using a 400 MHz Bruker Avance Spectrometer. Generally, peptide samples were at 5-10mM, in 20mM phosphate buffer, 5mM NaCl, pH 5, 90% H2O, 10% D2O, at 7 °C. The 2D NMR (TOCSY and ROESY) data were collected for proton assignments. The TOCSY data give the spin system of each amino acid residue; thus, 1H-1H connectivity through bond within each amino acid residue. The ROESY data allow for 1H-1H connectivity between the sequential amino acids, as well as through space long range interactions between two 1Hs that may be close spatially within 5 Å (Berger 2004).

The STD NMR technique was used to study the binding of peptide ligand interaction with the antibody (Mayer and Meyer 2001). A mixture of 0.1 mM antibody with 1mM peptide ligand was used. In the STD NMR technique, two NMR spectra were collected; one with the on-resonance frequency set at -2 ppm where no peptide signals but antibody signals exist, and the other with the off-resonance frequency set at +40 ppm where there are no signals from either ligand or antibody. The on-resonance spectrum (ISAT) is subtracted from the off-resonance spectrum (IO),(ISTD=IO-ISAT); if there is any proton on the ligand that directly binds to the antibody, it will show a positive signal; the proton closer to the protein will receive more magnetization transfer and its ISTD peak intensity will be higher. If there is no proton involved in the peptide binding to the antibody the resultant subtracted spectrum will have no signals (flat line). This technique was used to identify which proton on which amino acid residue on the peptide had direct binding to the antibody.

Results

The synthesis of the cyclic mucin peptide produced two major products of interest. The proposed reactions that led to the two peptides appear in Figure 1.

LC-MS analysis of the crude peptide sample following synthesis suggested the presence of two dominant masses in the finished product mixture. The distinct peaks of masses 628.31 Da ([M + H+]) and 1255.60 Da ([Mdimer + H+]) in the TIC eluted at approximately 8.75 min and 9.25 min, respectively (Figure 2). These two peaks indicate of a monomer cyclic GVTSAPD ([M +

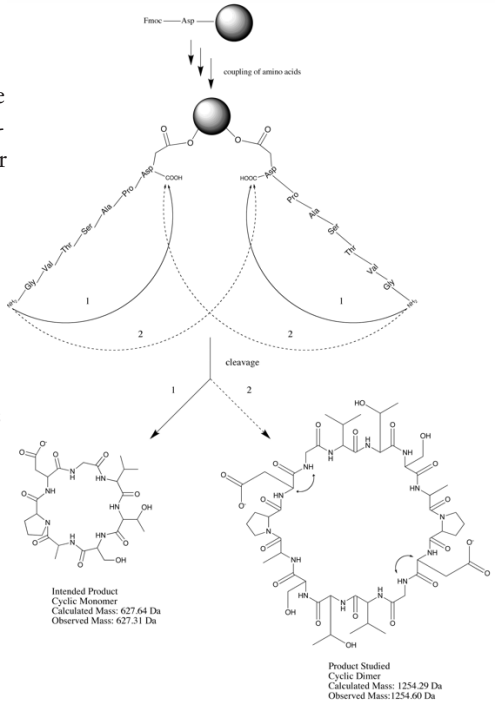

Figure 1. Illustration of the synthesis of cyclic mucin peptide. Two major products of interest were produced, a cyclic monomer of mass 627.3 Da and a cyclic dimer of mass 1254.6 Da. The cyclic dimer peptide occurred via an interchain head-to-tail mechanism. The cyclization reaction was carried out for 24 hrs. Curved arrows in dimer molecule indicate the unique NOE observed that confirms the cyclic nature of this peptide.

H+]calc = 628.64 Da) and a dimer cyclic GVTSAPDGVTSAPD ([Mdimer + H+]calc = 1255.29 Da). The other peaks in the TIC contained no masses of interest and were accepted as contaminants or side products from the synthesis.

The HPLC purification following the synthesis of the mucin peptide produced three separate peaks at approximate retention times of 19.7, 23.6 and 34.0 minutes (Figure 3). Subsequent LC-MS analysis showed that these three peaks corresponded respectively with the cyclic peptide of mass 627.31 Da, the cyclic dimer peptide with mass 1254.60 Da and an elution peak that contained no product of interest. There was no significant peak elution before the 20 minute mark as the amount of ACN pumped through was relatively low. Most of the contaminants and unwanted side products eluted after the cyclic dimer peak at 24 minutes when the amount of organic solvent pumped through exceeded 30%.

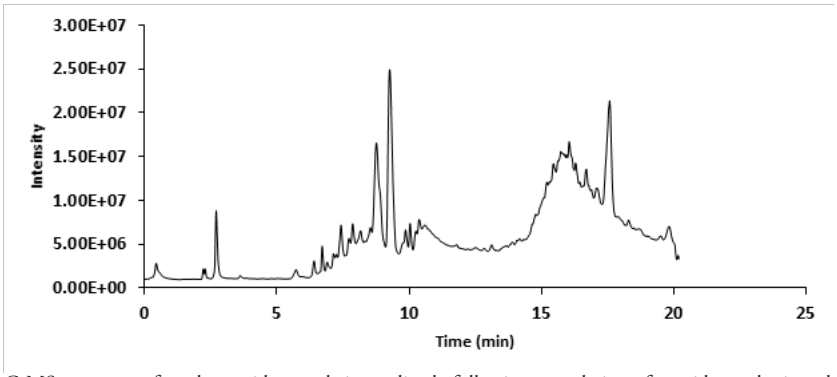

Figure 2. LC-MS spectrum of crude peptide sample immediately following completion of peptide synthesis and extraction. Analysis was conducted with ESI-Positive Mode under 0.5ml/min flow rate using 99% ACN as the organic buffer. Acquisition time was set at 20 minutes with a 4 minute post run. Peaks of interest were a). product of mass [M + H+] = 628.31 Da and b). product of mass [Mdimer + H+] = 1255.60 Da.

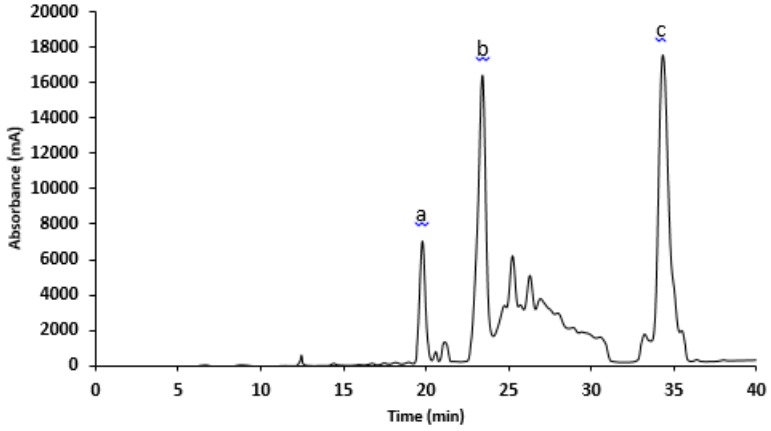

Figure 3. HPLC purification of crude peptide sample. The HPLC chromatogram was obtained from a 500 µL concentrated sample injection. Acquisition time was 40 minutes with a 5 minute post equilibrium/hold and monitored at 220 nm. Chromatogram was extracted from wavelength of 220 nm, a). peak corresponding to the cyclic peptide of interest with mass of [M + H+] = 628.31 Da, b). peak corresponding to the dimer cyclic peptide of interest with mass of [M + H+] = 1255.60 Da, and c). a contaminant found in the crude peptide sample that does not contain any product of interest.

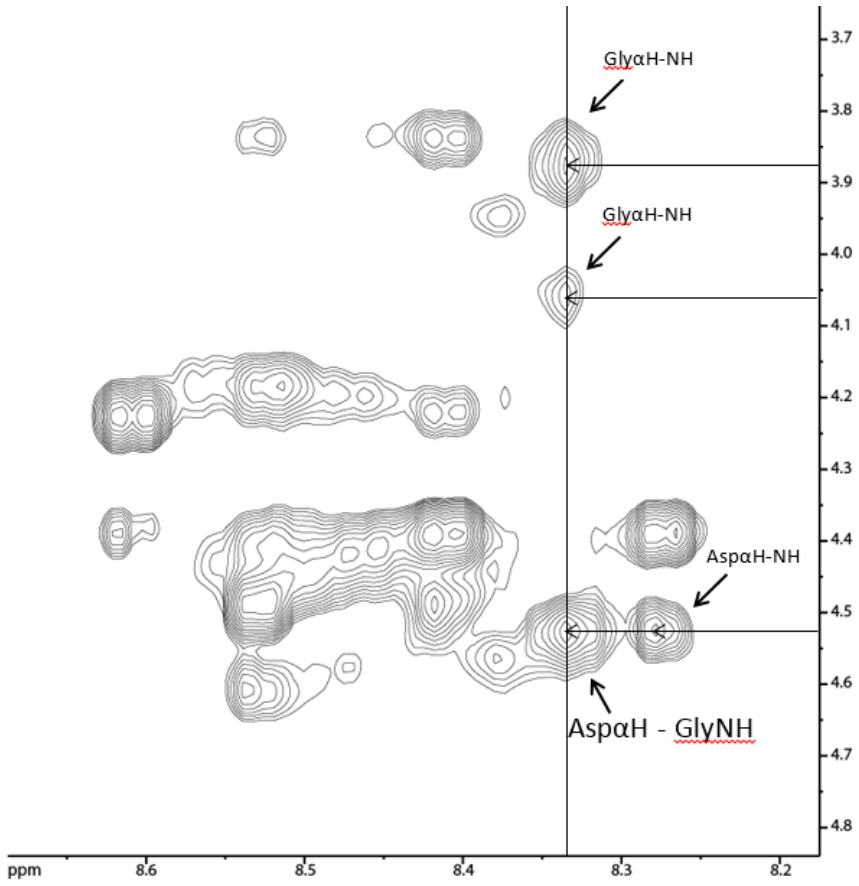

Figure 4. 2D NOESY spectrum of CH-NH region of cyclic dimer peptide. Interactions between α-carbon protons and amide protons of glycine and aspartic acid are indicated. In addition, a unique NOE peak bridging the interaction between adjacent Asp and Gly residues confirms the cyclic nature of this molecule.

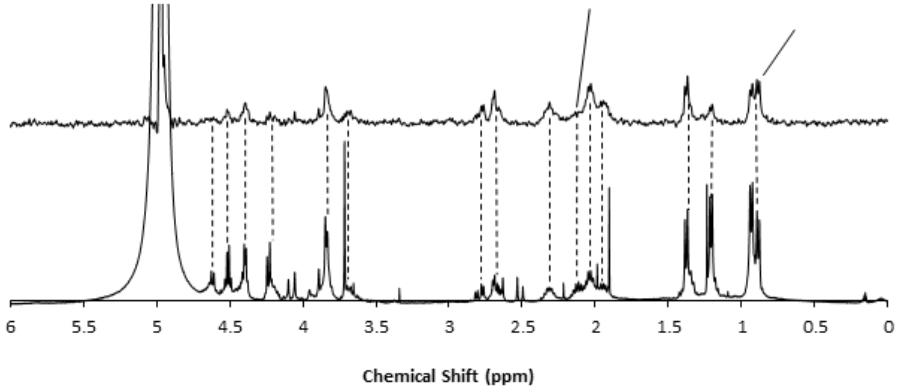

Figure 5. STD-NMR spectrum of peptide-antibody complex on top of normal 1D 1H-NMR spectrum. STD-NMR spectrum was multiplied by a constant of 6 to make peaks visible on the 1H spectrum of the *y*-axis scale. A flat STD spectrum would indicate no antibody-peptide interaction.

The mucin peptide composition was mapped out by assigning the proton (hydrogen) spin systems on the 2D NMR TOCSY spectrum. We were able to successfully map out the peptide backbone NOE peaks on the ROESY data to confirm the correct amino acid sequence. In addition, a unique NOE peak bridging the interaction between the Gly-NH of chain 1 to the Asp-αH of chain 2 was observed (Figure 4), attesting to the presence of a cyclic peptide molecule. In a linear peptide this NOE (i.e., Gly-NH of chain 1 to Asp-αH of chain 2) would not be observed because of the large distance between those two Hs. Also, the NH of the first amino acid residue is broadened due to fast motion, thus rendering it unobservable in an aqueous medium. The binding of the monoclonal antibody to the linear sequence GVTSAPD was confirmed in a previous study. In this study, through STD NMR technique, we determined that the cyclic dimer peptide with sequence GVTSAPDGVTSAPD displayed antibody binding ability with multiple binding residues. Figure 5 shows the results of the STD NMR spectrum of a mixture of cyclic dimer peptide and the MUC1 monoclonal antibody (top trace) compared to a normal NMR spectrum of the mixture (bottom trace). Examination of the STD NMR spectrum showed that there are peaks (STD NMR peaks) corresponding to all the peaks of the normal NMR spectrum, indicating that all residues of the cyclic dimer peptide interact with the antibody. If no interactions occur between the peptide and the antibody, the STD spectrum would be a flat line without any peaks. The fact that all amino acid residues interact with the antibody suggests that this peptide binds better to the antibody compared to the linear version of the peptide (GVTSAPD). This can be expected because the cyclic dimer peptide has the same sequence on both sides of the molecule. Based on the STD NMR peak intensities of the side chain protons, it appeared that the Pro residue had stronger binding than other residues to the antibody, similar to the previous finding for the linear peptide. The peaks corresponding to the protons with the tallest STD NMR signal are Valγ, Alaβ and Proγ (Figure 5). All protons on the Pro residue displayed STD peaks, thus accentuating its significance in the peptide-antibody interface structure. The residue aspartic acid showed markedly enhanced binding (enhanced STD NMR peaks), which was not the case for the linear peptide.

Discussion

Mutant peptide studies have previously confirmed that proline is a crucial residue in antibody recognition. The different protons on Pro displayed STD NMR peaks of similar intensity, suggesting equal peptide-antibody interface involvement. This indicates a binding interface where they are all accessible to the antibody. The analysis of Pro, Val, Ala and Thr suggests that the binding favors a hydrophobic peptide-antibody interface. The side chains of Val and Ala contain no heteroatoms and are therefore hydrophobic. This could explain the similar peak intensities between the two residues. On the other hand, Thr, which contains a hydroxyl group on its β-carbon, has a side chain of different hydrophobicity and displayed a lower intensity STD NMR peak. This is consistent with the postulation that the antibody molecule prefers to interact with hydrophobic residues on the peptide chain.

One striking contrast to this observation is the observed binding of the Asp residue that contains a low hydrophobic side chain. One possible explanation for this is the positions of the residues in the mucin peptide, where the sequential locations of the amino acids determine their binding properties. Pro is an important residue in the binding interaction as all of its side chain protons displayed STD NMR peaks. Because of this, Pro could be the residue that is physically nearest in contact to the antibody, and the residues flanking Pro, such as Asp, would be in optimal position to create intermolecular interactions with the antibody through spatial proximity.

The result is inconclusive whether Ser, Gly or both are involved in the binding as both the Gly-αH and Ser-βH have overlapping chemical shifts (Figure 5). In addition, one of the Pro-

δH peaks also appeared at the same frequency, contributing further ambiguity to that peak (3.8 ppm). Because the Pro residue binds an antibody better, it is likely that part of the intensity of the peak appearing at 3.8 ppm also belongs to Pro-δH. Additional studies will determine whether Ser and Gly or both are comprised in the peptide-antibody interface.

Conclusion

We synthesized a cyclic dimer mucin peptide with the sequence GVTSAPDGVTSAPD and showed that it possessed MUC1 monoclonal antibody binding activity by STD-NMR technique. While ambiguity exists in the binding of Ser-βH and Gly-αH due to overlapping peaks, the results showed that the protons of Pro residues and those of the methyl groups of Ala, Thr and Val had interactions with the antibody; this suggests that the interaction at the binding site of the antibody;with the peptide is of hydrophobic nature. Moreover, the results of this study are consistent with previous related works and accentuate the significance of Pro in the peptide-antibody interface. The results of this study suggest the potential usefulness of the dimer cyclic mucin peptide in immunotherapy that targets tumor cells that express mucin proteins.

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A "Smart" Biphenyl Lactone with a Nitro Acceptor and Methoxy Donor

by:
Asia Marie S. Riel
Advisor: Dr. Bart Dahl

Abstract

We investigated the synthesis of a "tethered" organic biaryl system for the ultimate application in sensing and molecular electronics. We synthesized a biaryl system with a tether that can exist in two states: opened and closed. In the closed state the π-orbital overlap enhances electronic communication between the two rings. In the open state, the π-orbital overlap is at a minimum and electron communication is negligible. This is observed via UV-Vis and fluorescence studies. By changing the pH of the environment we can confirm these conformation switches through the use of UV-Vis and fluorescence studies.

Introduction

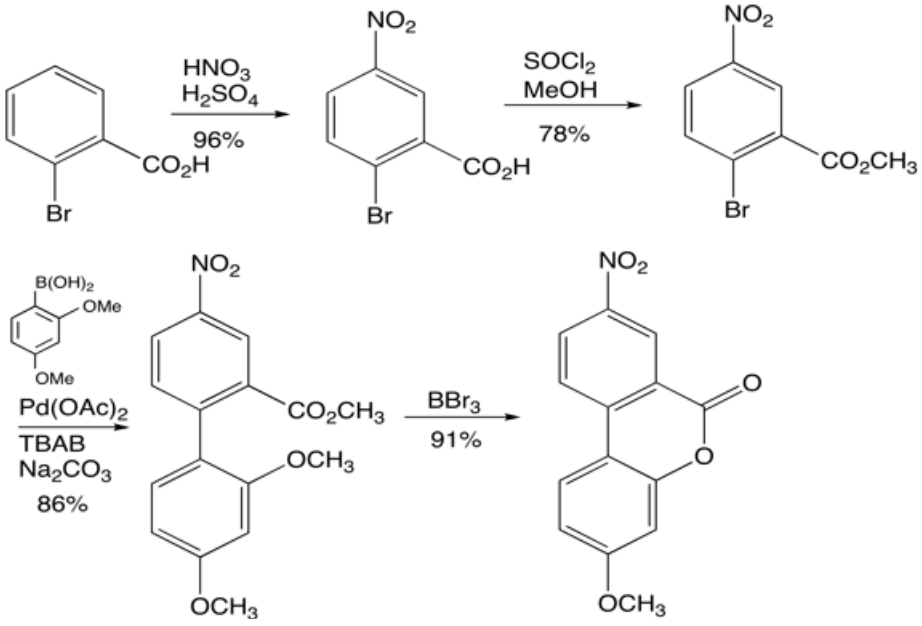
A molecular machine is a molecule that acts like a motor. A useful motor takes in energy, assumes a directed motion, and obtains useful work. Our molecule is similar; it will have specific properties that use pH as an energy input to obtain a directed motion.

Biphenyl lactone has been experimentally determined to have a dihedral angle of 30-40°1, and it achieves the greatest extended π-orbital overlap when planar. The steric hinderance of the ortho hydrogens prevents this geometry. It is known that the dihedral angle of biphenyl-containing compounds greatly affects their physical properties—such as electronic absorption, emission and conductance. Most biphenyl-containing compounds have a static equilibrium dihedral angle, and thus, fixed physical properties. However, our "smart" synthesized molecule contains a reversible lactone "tether" between the two rings that forces a planar geometry.

Results and Discussion

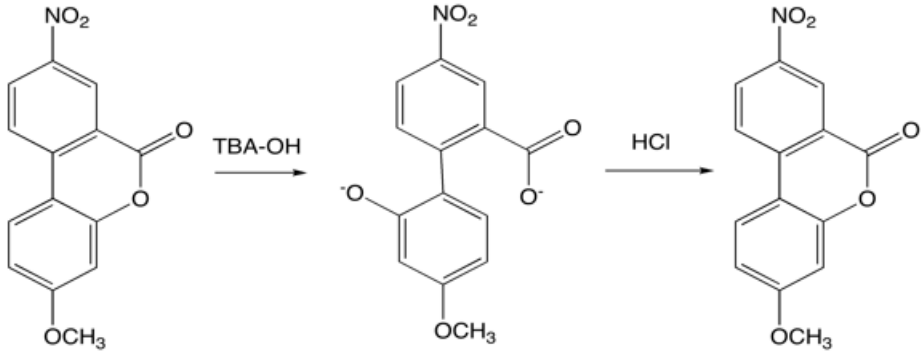
The synthesized "smart" biphenyl lactone contains a methoxy electron donor and a nitro electron acceptor at the 4 and 4' positions that affect charge transfer through the ring system. To reversibly control this molecule, we created a lactone "tether" that locks it into a planar conformation. By varying the pH, we can reversibly open and close the "tether" and thus switch the molecule in and out of planarity. This biaryl lactone was prepared via aromatic nitration and esterification, by microwave-mediated Suzuki Coupling with boronic acid. Closing the "tether" (or lactonization) was achieved using boron tribromide1 (Scheme 1).

We studied the nitro lactone to see how pH affected its overall physical properties when used as a switching stimulus. We dissolved it in a CH3CN and added a base (TBA-OH), that caused the lactone "tether" to spring open into the dianion—a more strictly favorable conformation. We added concentrated acid (HCl) to close the "tether," forming the lactone once again (Scheme 2).



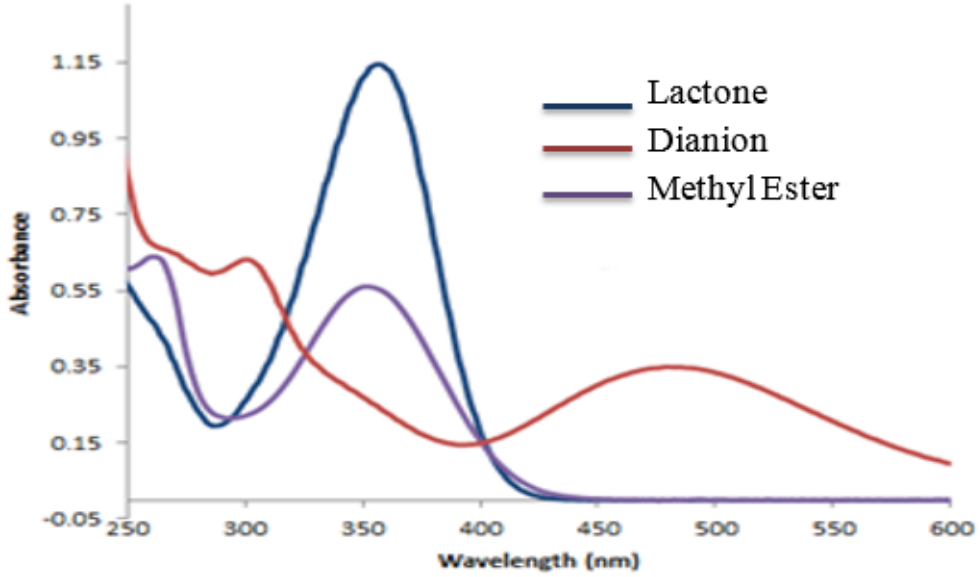
Scheme 1. This is the synthetic pathway used to synthesize the biaryl lactone derivative.
The IUPAC name for this biaryl compound is 3-methoxy-8-nitro-6H-benzo[c]chromen-6-one (nitro lactone).

The biaryl was examined by UV-Vis spectroscopy to determine how effective pH proved as a switching stimulus. The "tethered" lactone has a decreased dihedral angle, which then increases the intramolecular charge transfer (ICT). The nitro lactone was dissolved in acetonitrile and displayed an intense ICT at 365 nm (ε=172185 M-1cm-1). A significant attenuation occured when the lactone was switched into the dianion form, causing the dihedral angle to increase but the ICT to increase to 481 nm (ε = 58359 M-1 cm-1). When methylated, the ICT was reduced to 350 nm (ε = 81846 M-1 cm-1), respectively 1 (Graph 1).

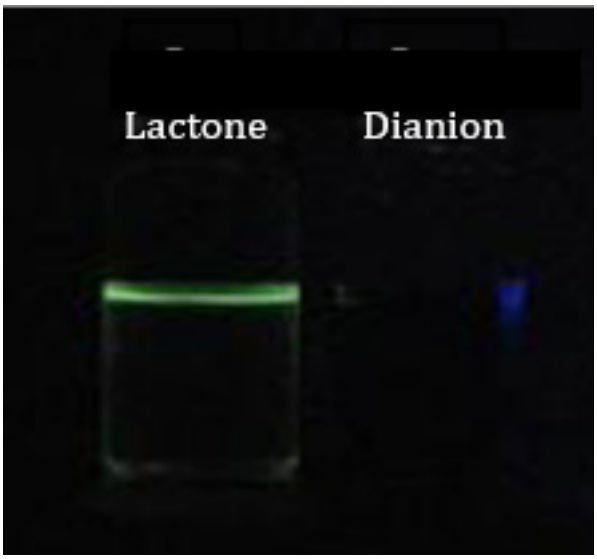


Scheme 2. This is the switching pathway when pH is used as an external stimulus.

We also examined the nitro molecular switch by fluorescence spectroscopy. The closed planar lactone switch was compared to the ring-opened states. This lactone was observed to have a faint green luminescence, respectively, when irradiated with a UV lamp (Picture 1). Upon addition of the base luminescence was immediately attenuated and could be rapidly restored with an

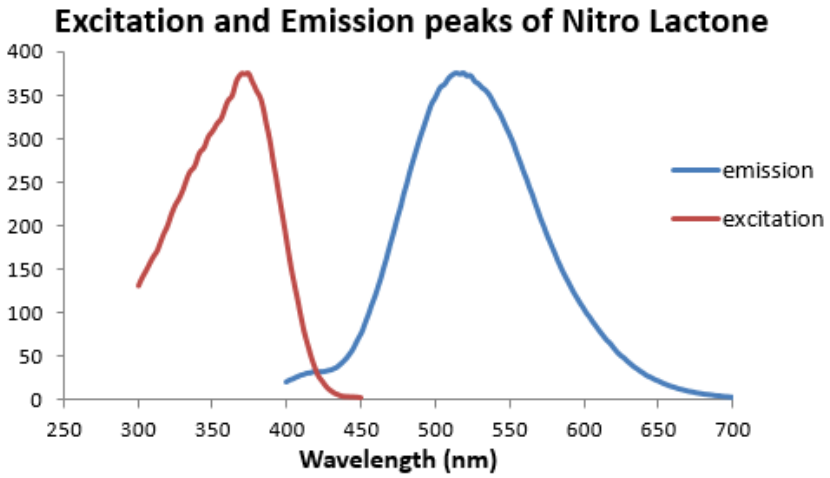


Graph 1. Electronic absorption spectra of the nitro lactone, dianion and methyl ester [1].



Picture 1. On the left, closed nitro compound and on the right, ring-opened nitro compound

addition of acid. The nitro lactone emitted at 515 nm (kex = 370 nm). After addition of the base, the lactone no longer emitted at the previous excitation wavelength 1 (Graph 2).



Graph 2. Normalized fluorescence of nitro lactone dissolved in acetonitrile. No emission was observed for the dianion1.

Conclusion

We synthesized, characterized, and reversibly opened and closed this nitro lactone with pH as a stimulus. Through the use of UV-Vis and fluorescence spectroscopy we observed a difference between the ring-open and ring-closed states of this biaryl lactone. With the molecule "tethered," we observed an increase in ICT and fluorescence. As hypothesized with the molecule in the ring-open conformation, the ICT attenuated and lacked luminescence. This molecule has proven itself a good starting point for molecular machines and has sparked ideas for further studies.

Gold Nanoparticles from Methanobactin

by:
Kao Zoua Yang
Advisor: Dr. Marcus McEllistrem

Abstract

Methanobactin is a biological molecule secreted by methanotrophic bacteria (that is, bacteria that live on methane gas). Methanobactin's role is to bind, reduce, and chaperone Cu2+ ions from the environment back inside the bacterium. In addition to copper, methanobactin has been shown to bind a wide variety of metals and in some cases to reduce them. There are two types of methanobactin: SB2 and OB3b. Our research project involves the study of OB3b methanobactin's chemistry with gold, namely the reduction of Au3+ to Au0 (that is, reducing gold ions to gold atoms). The gold atoms then combine to form gold nanoparticles. With appropriate concentrations of the gold and methanobactin, nanoparticles of various sizes (and to some extent, shapes) are produced in water at room temperature. My article will provide evidence for the reduction of gold ions and the formation of gold nanoparticles.

Background

Nanomaterials have allowed the world to develop and fabricate many of today's devices, equipment, clothing, and even food. These materials are often comprised of nanoparticles, particles on the 1-100 nanometer scale. Some examples for nanoparticle applications include a drug delivery system, quantum dots in solar cells, and lithium-ion batteries.

Methanotrophs

Methanotrophs are a living biological organism. They are prokaryotes (no cell nucleus) that metabolize methane as a source of food. They can be found in freshwater and marine sediments, wetlands, groundwater, and rice paddies where a large amount of methane is produced. Methanotrophs are referred to as methane-oxidizing bacteria. Methanotrophs have been found to contain enzymes known as monooxygenases (MMOs); there are two MMO types that associate with the organism. One is soluble MMO (sMMO) and the second is particulate MMO (pMMO) (Behling, Hartsel, Lewis, DiSpirito, Choi, Masterson, Veglia and Gallagher 2008: 12604). Specifically with pMMO, copper in the environment has an important role in regulation and catalysis. Methanotrophs attract or bring copper into the organism by secretion of a poly-peptide called methanobactin (mb).

Methanobactin

Methanobactin (mb) is a naturally occurring copper-binding and reducing peptide secreted by methanotrophs. Methanobactin is used by methanotrophs to "traffic" copper into the organism because of its strong attraction to copper (Kim, Graham, DiSpirito, Alterman, Galeva, Larive, Asunskis, and Sherwood 2004: 1613). Methanobactin, however, can be bound to many other metal ions too, but does not necessarily reduce these. Metals ions that methanobactin had bonded and reduced include Copper (Cu2+), Silver (Ag+), Gold (Au3+), Platinum (Pt2+), Palladium (Pd2+), Rhodium (Rh2+), and possibly Mercury (Hg2+).

Motivation

Gold nanoparticle research is an important area in Materials Science; however problems with reproducibility and effective size and/or shape control present problems. Our research addresses those problems and perhaps allows us to control them to our specifications. It has produced more desirable results, and it will drive and benefit research in gold nanoparticle applications.

Methanotrophs exhibit interesting properties, such as the ability to oxidize methane into methanol (fuel). That ability alone attracts the interest of the fuel industries. An understanding of methanobactin's role in the reaction as a reducing agent and ligand can improve research and support the interests of the fuel industries.

Structure of mb

The OB3b mb structure contains two oxazolone rings (Fig. 1) while the SB2 mb structure contains one oxazolone ring, one imidazole ring, and a sulfate group (Fig. 2). The rings present in both structures play a key part in the binding and reducing of copper ions in the organism. The structure in itself is complex.

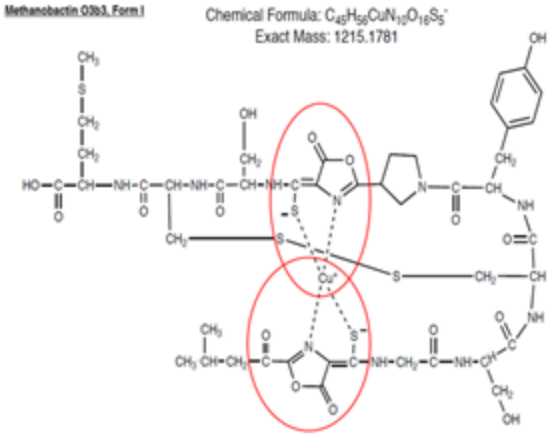


Figure 1: OB3b mb structure. The red circle areas indicate the two oxazolone rings.

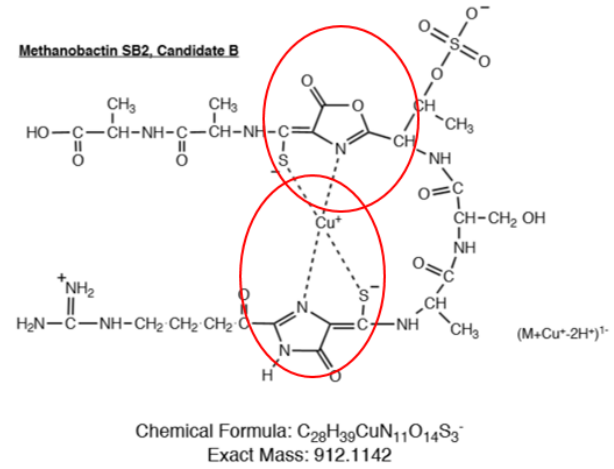


Figure 2: SB2 mb structure. The red circle areas indicate the oxazolone ring and imidazole ring.

Source: Dr. Warren Gallagher, Department of Chemistry, University of Wisconsin-Eau Claire, used with permission.

Experimental

Instrumentation

Ultraviolet-visible Spectroscopy (Cary 50 Bio UV) was used to obtain the spectra of samples. Properties scanned were absorbance versus the wavelength. The wavelength range set by the instrument was recorded at the 300-700nm. The sensitivity of the instrument required that our experiments employ relatively low concentrations of mb in order to get proper results (<1000μM).

Transmission Electron Microscopy (JEOL 2010 200 kV) was used to observe and characterize the nanoparticles. With TEM resolution, nanoparticles in the three to five nanometers were observable. TEM allowed us to confirm nanoparticle size distribution, uniformity, and shape variations. All samples were prepped onto 3mm copper grids (Refer to TEM preparations section for more details).

Methanobactin

Two strains of methanobactin were used in our research, SB2 mb and OB3b mb. The SB2 mb was prepped fresh from powder source and provided by Dr. Alan DiSpirito (Iowa State University). Bulk methanobactin solution was mixed with deionized water. The bulk sample's concentration was set to 1000μM. After the fresh bulk methanobactin solution was created, a large portion was stored in the freezer to stop decomposition. The remaining sample was used for experimentation where the concentration would be adjusted to the experiments' specifications.

The OB3b mb sample was prepped fresh from powder source and received by Dr. Warren Gallagher (University of Wisconsin-Eau Claire). The bulk sample was also mixed with deionized water to a final concentration of 1000μM. The same protocol was followed in storing the bulk methanobactin solution.

The bulk methanobactin solution was stored in the freezer to preserve its efficiency and stop decomposition. The methanobactin solution used per experiment was generally less than 1ml, and depending on how experiments ran, only a small volume of methanobactin solution was kept at room temperature for experimentation.

SB2 mb Solution Preparation

Gold solution was created from HAuCl4 and dissolved in deionized water and set to a constant 10,000μM concentration. SB2 methanobactin was also dissolved in deionized water with appropriate volumes to achieve the desired concentrations. The optimal concentration range of mb used was within 100μM-25μM concentrations. With the desired concentration of mb, the ratio of gold to methanobactin and the appropriate volumes combination of both set, the gold and mb solutions were mixed together. The concentration of mb used depended on the time it took to produce gold nanoparticles.

OB3b mb Solution Preparation

In a fashion similar to the SB2 method, gold solution prepped exactly the same way, except that the mb was a different strain. The concentrations of methanobactin used were 1000μM, 500μM, 250μM, 100μM, and 75μM. The volume of the methanobactin and gold solution were then adjusted for the desired ratio. The gold concentration again remained constant at 10,000μM. The process of combination followed the same protocol as the SB2 mb method. Below is a visual representation of the chemical process of reducing the Au3+ to Au0.

Figure 3: Reducing Au^{3+} to Au^{0}.

TEM Grid Preparations

Initial experiments were prepped using Copper TEM Grids (TED Pella Part Number 01890-F 15-25nm Lacey Carbon Formbar Coating non-continuous) and (TED Pella Part Number 01843-F 15-25nm continuous carbon 300 mesh). Final experiments used Gold TEM Grids (TED Pella Part Number 01843G-F 15-25nm 300 mesh).

After sample prep, appropriate combination, and the initiation of the particle production, we waited for the solution to reach a cranberry color. After the color was reached, immediate preparation of the sample was performed. A dispensable glass pipet was used to extract the sample and approximately 1-2 drops were placed on the grids. With the pH experiment, the reaction was allowed to continue for 48 hours followed by an immediate TEM grid preparation.

Results

A ratio experiment was used to test optimal gold nanoparticle production or a successful reaction. The ratios that were determined best were done with gold to methanobactin ratios at 2:1, 5:1, 6:1, and 10:1 (Table 1). In order to obtain the desired ratio, the concentration of gold and methanobactin was controlled along with volumes. Appropriate control of solution conditions allowed us to start nanoparticle formation. Gold nanoparticle generation was initiated with a measured combination of the Au and mb solutions. From there, the time dependence of gold nanoparticle generation varied with the concentration of methanobactin. All samples' total Au/mb volume were measured to give 1000µL.

Experiment Number	Individual solution Concentrations	Individual Solution Volumes	Ratio	Final mb Concentration
1	100µM mb and 10,000µM Au	1ml mb and 0.02ml Au	2:1	98µM
2	100µM mb and 100µM Au	0.2ml mb and 1ml Au	5:1	16.7µM
3	100µM mb and 10,000µM Au	1ml mb and 0.05ml Au	5:1	95µM
4	25µM mb and 1000µM Au	1ml mb and 0.15ml Au	5:1	22.5µM
5	25µM mb and 1000µM Au	1ml mb and 0.15ml Au	6:1	21.7µM
6	25µM mb and 1000µM Au	1ml mb and 0.25ml Au	10:1	20µM

Table 1: List of experiments with different ratios of samples that produced particles. The last two columns of Ratio and Final mb Concentration show that with different ratios you can still end up with roughly the same final mb concentrations and still produce particles (excluding experiment number 2).

Concentration Effect on OB3b-Kinetics

We also experimented with OB3b mb at various levels of concentration (1000μM, 500μM, 250μM, 100μM and 75μM). From the different concentrations we concluded that as the concentration decreased from 1mM, the kinetics also changed; that is, the time it took to produce gold nanoparticles changed. The particle production state could also be observed by the cranberry color. Table 2 and Figure 4 below portray the results from the kinetic experiment of varying concentrations.

Concentration (μM)	Gold to mb Ratio	Time for Nanoparticles to form
1000	5:1	1-3 minutes
500	5:1	5-48 minutes
250	5:1	15 minutes
100	5:1	80+ minutes
75	5:1	3+ hours

Table 2: Kinetic study of decreasing concentration versus time for nanoparticles to form.

Data

Gold nanoparticles' presence in the solution could be determined by the wavelength peak appearing on a spectrum scan from UV-Vis (see Figures 5, 6, and 7). As seen from the graphs, gold nanoparticles typically peaked at around 540nm (Fig. 4). The spectrum graphs are plotted on an "Absorbance vs Wavelength" axis. Absorbance here corresponds to the sample's color intensity and concentration within the solution. Higher concentrations of mb will give higher absorbance readings in the spectrum.

TEM imaging and analysis was used to determine the relationship between concentration and particle size. Fig. 8 and 9 show images of a 25μM SB2 mb sample and 100μM SB2 mb sample. Fig. 8 has a magnification of 500,000X and Figure 9 has a magnification of 250,000X. Figure 8 gives nanoparticle diameter ranges in the order of ~5-25nm where Figure 9 gives nanoparticles diameter ranging in ~5-30nm range.

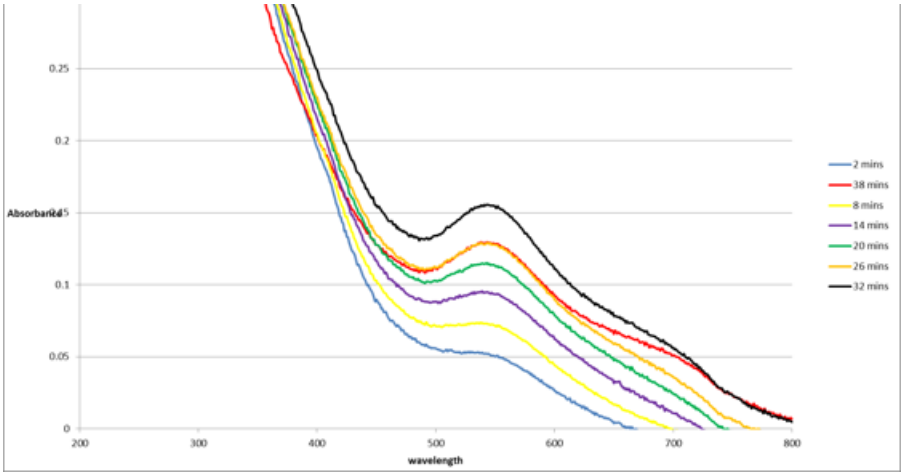


Figure 4: A kinetic scan (UV-Vis) was used to track the progress of the peak of 500μM OB3b mb after initiating particle production. The graph shown here gives the scans at the corresponding time (minutes) which has an increment of 6 minutes.

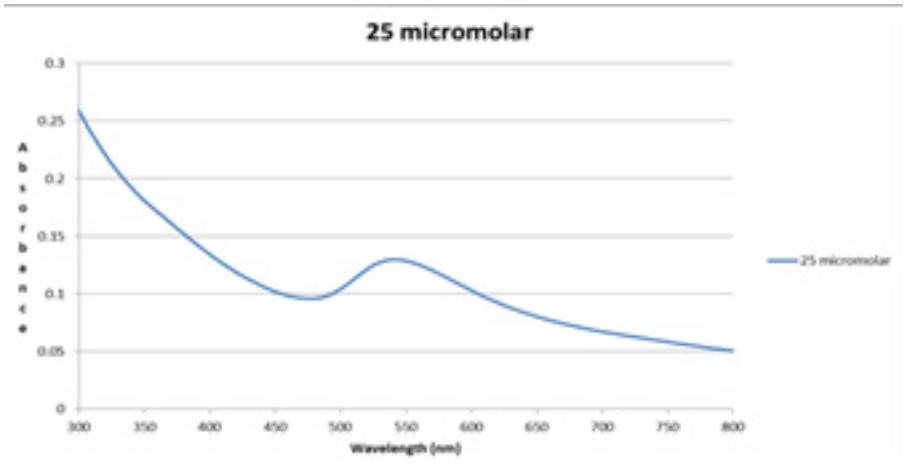


Figure 5: UV-Vis spectrum of 5:1 ratio 25μM SB2 sample.

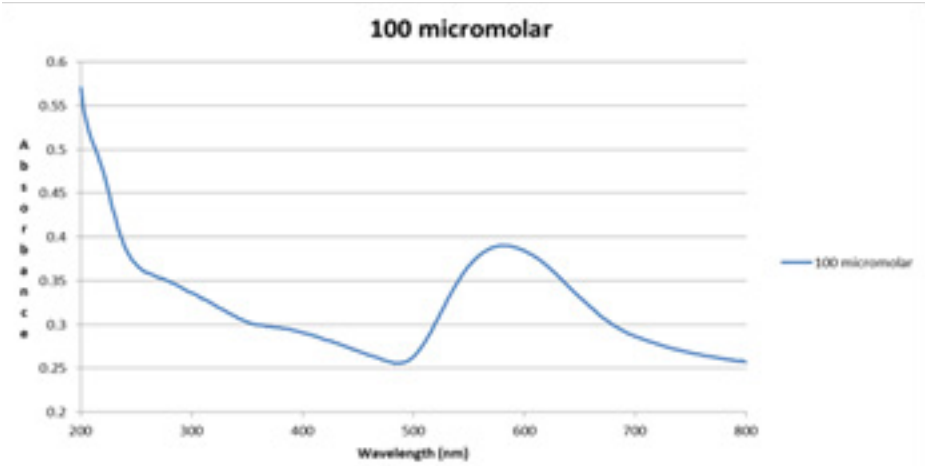


Figure 6: UV-Vis spectrum of 5:1 ratio 100μM SB2 sample.

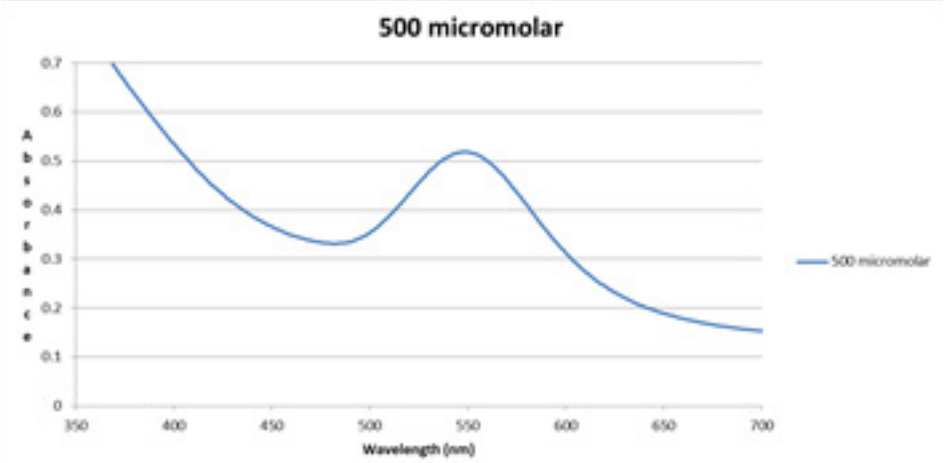


Figure 7: 500μM OB3b mb sample

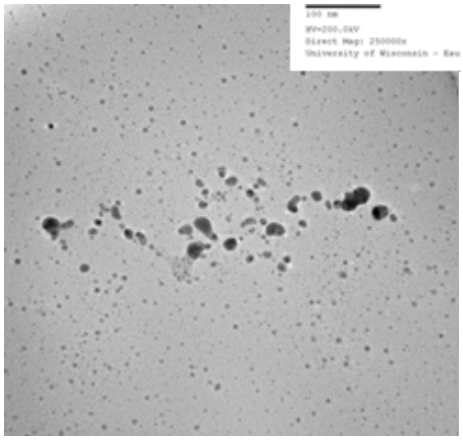


Figure 8: 25μM SB2 mb

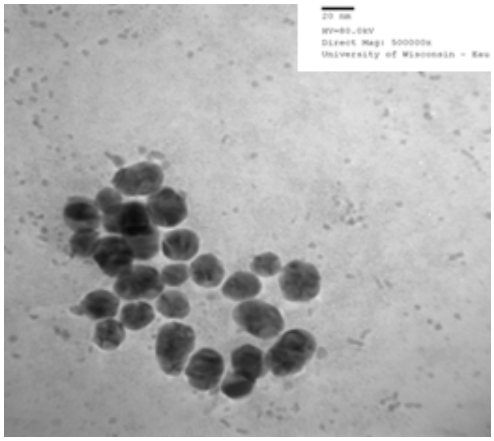


Figure 9: 100μM SB2 mb

Figures 10 and 11 show a shape variation from particle growth. The sample comes from 100μM OB3b mb sample, but it also occurs in the 25μM OB3b mb sample. Here the shape variation was only observed in the OB3b mb strain. The experiments were allowed to continue reacting for 48 hours, then preparation onto grids followed.

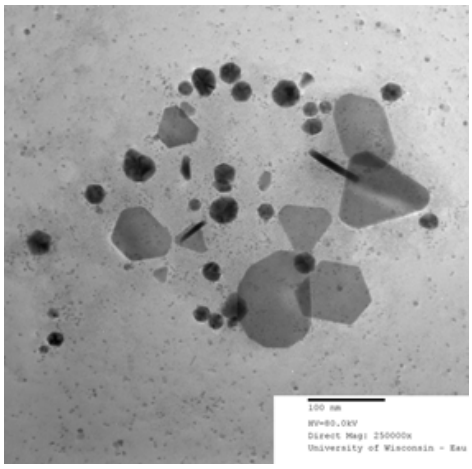


Figure 10: 100μM OB3b mb sample at 250,000X magnification

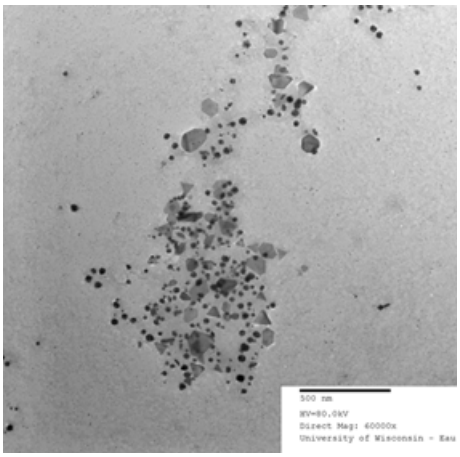


Figure 11: 100μM OB3b mb sample at 60,000 magnification

Discussion

We successfully produced gold nanoparticles with solutions of gold and methanobactin. Our results showed that a gold-to-methanobactin ratio of 5:1 reliably produced gold nanoparticles. Beyond reliable nanoparticle production, we also found that the kinetics of nanoparticle production was predominately controlled by the methanobactin concentration. If we consider the overall reaction sequence to be

$$mb_{(aq)} + Au^{3+}_{(aq)} \longrightarrow [mb{:}Au]_{complex} \longrightarrow Au^{0} \longrightarrow Au$$

then the kinetics of the first step appears to dominate the overall process's kinetics. Further, at an Au/mb ratio of 5, Au3+ is in excess, so the kinetic dependence on methanobactin is not surprising. What is unexpected, however, is that mb is apparently capable of reducing multiple Au3+ ions.

The presence of gold nanoparticles was determined from UV-Vis spectroscopy. Figures 4, 5, and 6 show plots with peaks in the mid to high-500 nm range. The peak indicates the presence of gold nanoparticles. Typically, our gold nanoparticles showed peaks at the 540nm point (see Figure 4). Depending on the solution concentration and kinetics, the peak position varied as much as 50nm. Figure 6 gives a higher absorbance level than the 25μM mb and 100μM mb samples due to the higher concentration of mb. This holds true for the 25μM mb and 100μM mb, where 100μM has a higher peak, thus giving us the trend of more gold nanoparticles with higher concentrations of methanobactin.

Preparing the TEM grid for the 100μM OB3b mb sample 48 hours after initiating particle production showed larger gold particles in the TEM image with varying shapes that included spheres, rods, and plates (triangular and polygonal). In contrast, times of 5 minutes with all other samples that had reached particle production would only generate spherical shapes. We concluded that the time allowed for the reaction determined the shape variance.

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The Three Kongs: Americans' Values and Audiences' Technological Preferences

by:
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Advisors: Dr. Joel Pace and
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Looking at the three most notable renditions of the film *King Kong*, from 1933, 1976, and 2005, I have hypothesized that a connection exists among technology/shot length, historical context, suturing, and facial recognition/sympathy in regards to Kong's portrayal and idealization. I posit that he represents something different in each time period and that technology/shot length, along with the other factors, determined how each director decided what role his Kong would play and how he likely provided an outlet for popular social opinion in each version. Each of the three films focuses on a similar story arc, but the presentation and the sympathies differ vastly from one to another. To grasp this interpretation one can start with the historical context of each film in relation to its Kong.

During the filming of the original *King Kong*, released in 1933, the Great Depression lay at its worst point. *King Kong* took place primarily on Skull Island, a fictional location where dinosaurs and other large extinct creatures still existed and thrived. The last thing people in 1933 wanted to think about when going to a film was the dire economic state of the U.S. As a result, the film transported the audience to somewhere exciting and larger than life. King Kong represented the Other, that unexplainable force that had caused the nation to crumble financially. On top of that, Kong abducted Ann Darrow, a young helpless beauty who fell prey to the Other. The abduction narrative lay fresh in the minds of the '33 public as the tragedy of the Lindberg baby abduction received wide publicity. The average shot length (ASL) for the 1933 King Kong was 6.8 seconds, quite a bit longer than the 2005 rendition at 2.7 seconds. This means that the 1933 version dwelt on a shot for an average of four seconds longer before making a cut. As film technology has progressed through the years, so has the ability to make increasingly quicker cuts and edits. Thus, this long shot length constituted less of a deliberate decision and more of a technological limit. The director, Merian Cooper, made Kong a true monster. However, even if he had wanted to push the audience (through cinematography) toward sympathizing with the beast, my research has shown this would have proven next to impossible.

Little, Jones and Debriene's journal article in *Philosophical Transactions* (2011) discusses the importance of the face in conveying emotion. Even from infancy, humans can recognize a face and pick up cues from it. We readily draw conclusions about personality attributes, appearance, emotional states, and preferences of complete strangers based on facial cues alone. This said, in 1933, in order to shoot a close-up of Kong's face, the prop designers had to create a giant separate bust. What they could do with this bust proved very limited, since an entire crew was needed to control its movements off screen with wires. Even though the shots had to be much longer, almost none of the camera time focused on Kong's face. Even in the scenes that solely feature Kong and Ann, such as the scene in which Kong takes Ann to his lair, we only see Kong from a far removed over-the-shoulder perspective. In contrast, when we see Ann, the audience more often than not sees only her face. We view her expressions and can clearly grasp her emotions; this increases the intensity with which we identify with her. This relates to a strategy directors

use to gain audience investment in their films. As viewers, we obviously recognize that what we see on the screen is not real, but rather acting and special effects. Yet we still suspend our disbelief and enjoy the world of the story. In order for that to happen effectively, we need to "suture" into the film through a character or several characters. We use that character as a surrogate for ourselves in order to make the story more personal, and thereby, give us a reason to care. Suturing requires that the character posess likable traits, ones that we can identify with or wish we posessed ourselves. In Cooper's Kong, we are encouraged to suture in with Ann Darrow, a woman down on her luck, starving and unemployed. Her plight mirrored what many people either experienced or feared in the Depression, so the tie was fairly direct to the viewer. Her attractivness, along with her unassuming yet brave nature, make her positive and relatable. Once the film set her up as the viewer's surrogate, the audience would begin to see things the way she does and sympathize with her character. Ann's desires become our desires, and obviously, she does not desire Kong. The time's limited editing technology meant cuts took place deliberately and at times important to the viewer; hence, many cuts went to Ann's face instead of to Kong's.

Reflecting social context, this film proved immensely popular in 1933; moviegoers lined up around the block to get a seat in the theater. The film's narrative portrays a terrifying monster that originates on a mysterious island far removed from civilization, and yet he manages to abduct and adversely affect the lives of innocent Americans. Kong functions as a massive scapegoat for the Depression and the Lindberg abductor all rolled into one. Cooper in part had limited technology and social historical context to thank for his immense success, not to mention the talented actress Fay Wray who played Ann. Her convincing and identifiable performance allowed the audience to suture in with her as their surrogate, a mechanism that drove distaste for Kong.

In the 1970s another director, John Guillerman, decided to resurrect the Kong myth. Aware, however, of the status of the original classic, Guillerman wanted to make a film that differed enough from the original so as to discourage comparison. In 1975 the environmental movement was in full swing. Many people concerned themselves with the rights of endangered species and the negative effects of oil drilling. Not accidentally, Guillerman depicted in his film, released in 1976, a greedy oil company's expedition to an unknown island to drill for oil. While on the island, company agents meet a giant ape, which they end up bringing back to the States for the profits it can bring them.

Made over 40 years after the original, this film's cutting and editing benefit from better technology and the shot lengths proved shorter. The audience sees Kong's face much more frequently than in 1933, and consequently sympathizes more with the ape. In addition, the female lead, this time named Dwan, develops a connection with Kong and stands up for him to the very end. Just two years before the production of the 1976 Kong, the robbery and hostage crisis at the Kreditbanken in Stockholm, Sweden brought the effects of the "Stockholm Syndrome" into the public's consciousness. The situation between Dwan and Kong seems to follow a similar formula: though the audience follows Dwan's lead and feels for the ape, it could turn untrusting if it related film events to Stockholm. On top of that, the technology still failed to render Kong's face naturally; this impeded viewers ability to read its cues and feel identification. Thus, this film gets caught up making Kong the embodiment of an endangered species and a symbol for better environmental practices, yet the technology did not allow it to create a believable and tragic monster. The viewers' surrogate, Dwan, comes off as a fairly flat character. She first appears drifting at sea and seems both impulsive and naive. Suturing more readily takes place with the lead male, who has very little interaction with Kong.

Bearing the name of a classic and enjoying massive hype, this film had a tremendous opening, clearing much more money than it cost to make. The collective reviews of the film, however, have labeled it an embarrassment to the King Kong franchise. Guillerman attempted to go beyond his technological means, and even with more cuts available to him, he failed to make

Kong the hero he wanted to create.

In 2005 Peter Jackson decided to face the original head-on and remake the masterpiece. Doing extensive research on the original, Jackson engages his film in a dialogue with Cooper's--making references to and even mimicing some of the original's most famous lines. In most cases, instead of doing shot for shot, Jackson used the 1933 Kong as a meta commentary on his version. For example, in the original, Jack and Ann engage in a dialogue while looking out over the water from the steamboat. Jack treats Ann with disdain, mentioning that a woman doesn't belong on the ship. This reflected attitudes from the '30s time period. In Jackson's version, the crew appears practicing a scene for the movie they will shoot on the island. Ann and Baxter, the egomaniac actor who will star alongside Ann on the island, re-enact the 1933 scene line for line while Denham films and Jack admires Ann's acting. Jackson uses techniques such as this in order to infuse the 1933 classic throughout his remake in an endearing, yet not overpowering manner. This contrasts with Guillarman's attempts to avoid a botched remake by swerving as far away from the original plot as possible while all the time still calling his film *King Kong*. It becomes obvious which method proved more successful.

In 2005 the U.S. faced a growing recession, and money once again became a major issue. The 2005 *Kong* is set in 1933, with very overt depictions of the Great Depression. This can be looked at as a way for contemporary viewers to face where they came from and acknowledge that things can and have been far worse in past generations. Another large concern of the turn of the 21st century (and still today) involves immigration. Many illegal aliens enter the country and tensions over what should be done about it run high. The narrative of Jackson's *King Kong* reverses the original's somewhat: Kong is happy in his own environment, but forced into the U.S. where Americans instantly put him in captivity. The immigrants to the U.S. often face desperate and awful situations in their own countries, but many Americans try to force these immigrants out and back into their own version of captivity. This film not only uses the background of The Depression, but it also brings to mind immigration issues, all with enough of a guise to not offend the audience.

One glaring difference takes Jackson's *Kong* in an entirely new direction: Jackson makes Kong the film's tragic hero and he does so very successfully. An initial problem for this new direction arose out of the ape's having to climb a building in New York. In 1933 the Empire State building stood tallest in New York, and was viewed as the mecca of commerce and industrial brilliance. Having King Kong climb and conquer such a building back then conjured up a foreign power's getting on top of the heart of our country. Thus, shooting Kong down made the U.S. triumphant and provided a release of viewers' anxiety. In 1976 Kong climbed the World Trade Center. Once again, in that year, the two towers played a role similar role to the public as the 1933 Empire State. Jackson faced a predicament. He wanted the audience to sympathize with Kong, and yet having him climb a building and get shot at with planes would too closely recall the tragedy of 9/11. By going back to the original time period, before the towers were even built, Jackson avoids the comparison, and the fact that we know from the original where the narrative is heading, Kong's climbing of the Empire State building presents no anxiety and leaves us open to sympathize with him.

Even before we see Kong on screen for the first time, a connection begins to develop between our surrogate, Ann, and the ape. Though Ann play acts her screams of anguish, they signal future pain and possible danger. This turns into a call that results in a response as Kong roars back, adding to his humanistic and compassionate qualities, though at that point in the film it may just seem scary. Jackson also reconstructs the famous scene in which Kong takes Ann to his lair. The cinematography and theme are the original's exact opposite. Instead of looking at Kong from afar, as in the 1933 version, we see his face just as frequently as Ann's. On top of that,

the 21st century technology enables facial motion capture; hence, a human actor performs all of Kong's facial expressions, effectively humanizing him and allowing the audience to finally see Kong as the hero, one they genuinely hope will prevail. Jackson dwells on Kong and Ann, many times shown equally with very minimal cutting. Also Ann, our surrogate, openly accepts Kong as her object of desire, making it easier to follow suit as the viewer. Jackson dwells on Kong's face often, a face that realistically registers sadness or fear, solidifying the bond between audience and ape. Jackson achieves this through technology and strategic shot length. The ASL for the 2005 *Kong* is essentially half that of 1933. Jackson frequently utilizes exciting action sequences to keep things contemporary; he cuts very frequently, giving the audience a familiar pace, but also intersperses these with scenes where the shots take longer and gain that much more of an effect.

Jackson's transformation of this familiar ape culminates in the scene where Kong, finally brought to his knees, perishes. Called The Fall of Kong, this scene takes place in all three renditions, and occurs in just about the same way in all three—the planes and the fall itself. However, whereas the two earlier films incited varying degrees of triumph and relief, Jackson's scene brings the viewers a profound sadness, frightened by Kong's realistic expression and the helplessness of our surrogate, Ann. This scene again drives home the formula I have proposed—a combination of strategic dwelling shots, clever avoidance of the terrorism angle, and an excellent performance by our surrogate to lead us to the final intended emotion.

Early on in my research, I had proposed that older films had much longer shot lengths, and thus the depth of these films was probably greater, allowing viewers to connect with the characters and take in each frame with more detail. Looking at the three *Kongs* as an example of shot length and how it changed over time with more and more cuts, I have discovered that longer shots did not lead to more depth, i.e., greater character development and more pleasing composition. In 1933 shots lasted much longer that in 2005, and yet the 2005 version accomplishes a real connection with Kong, using a combination of new technology and strategic camera dwelling. Undoubtedly, new technology plays a significant role; the '76 version proves that just having more dominion over shot length does not render viewers' identification with the subject. Technology and quicker cutting do not subtract from films' quality, as I had first suspected, but rather they open another door for directors to go in whichever direction they choose, for example, binding films to social and historical issues. Directors, if they so choose, have the power to make people think critically and potentially even nudge audiences in a direction of social change.

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Comparison of Geophysical Techniques for Soil Texture Estimation

by:
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Abstract

Soil texture provides an important parameter for agricultural, environmental, and geotechnical applications. This study investigates the potential of geophysical techniques to improve soil texture estimation over small field areas. Data were acquired across an 11 acre field site composed of primarily coarse-grained soils. Soil samples from 27 boreholes across the field were analyzed using a soil sieve. To determine if the geophysical data could be used to improve soil texture estimation, the sand fraction was estimated by geostatistical software using ordinary kriging of one-half of the soil texture points and using co-kriging of the sand fraction and geophysical data. The geophysical data do not change the large-scale patterns observed in the sand fraction, but they do help to constrain interpolation between borehole measurements. To quantify the improvement in soil texture estimation when geophysical datum are included, the root mean squared errors (RMSE) of the sand fraction estimates from the geophysical data were compared to the true sand measurements from selected borehole locations. The RMSE resulting from this comparison show that incorporating the geophysical data into sand estimation only slightly increased the accuracy of the estimation.

Introduction

Soil texture, defined loosely as the fraction of sand, silt, and clay-sized particles in a given area, is an important parameter for agricultural, environmental, and geotechnical applications. The spatial distribution of soil texture is often quite variable, both laterally and vertically, and conventional methods of measuring soil texture are time consuming and limited to point measurements that cannot usually capture the natural heterogeneity of a given property. This study investigates the potential of several near-surface geophysical techniques for improving soil texture estimation. When compared to soil sampling, geophysical data can be acquired quickly and with high resolution over large areas, which can provide much better spatial coverage, at a lower cost, than conventional soil mapping techniques. During data collection, ground penetrating radar, electromagnetic induction, and magnetic susceptibility respond to the inherent electromagnetic properties of silt and clay particles. This sensitivity allows for calculation of the relative percent sand, over the entire field area. Soil samples acquired in conjunction with the geophysical data establish absolute values of percent sand at the borehole locations. Using the relative sand values over the entire field and the absolute sand values from select locations, statistical software can compute a soil texture map for the entire field area.

Data Acquisition

This experiment was conducted at an agricultural research station near Spooner, Wisconsin. Data were acquired across an 11 acre field site composed of primarily coarse-grained soils. Measurements of soil texture were collected in 27 boreholes to a depth of 46 cm with a vertical

sampling increment of approximately 8 cm. Using a soil map, borehole locations were selected at intervals that allowed sufficient sampling of the different soil types across the site. High-resolution geophysical data were acquired in six traverses across the field (Figure 1). The geophysical techniques used were electromagnetic induction, magnetic susceptibility, and ground-penetrating radar (GPR) with 500 MHz antennas (Figures 2 and 3).

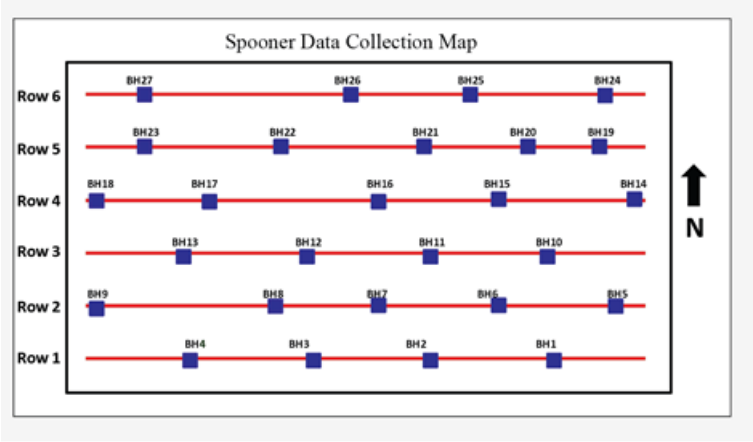

Figure 1: Soil data were acquired in 27 boreholes, while geophysical data were acquired along the six horizontal traverses shown. Schematic is not to scale.

Figure 2: GPR data were acquired using a PulseEkko Pro system. The antennae were mounted on a sled and pulled along each traverse.

Figure 3: A Geonics EM 38 was used to collect electrical conductivity and magnetic susceptibility data.

Soil samples from each borehole were analyzed to determine the sand and gravel fraction (hereafter referred to as sand fraction) using a soil sieve (a set of screens used to separate different grain sizes from a soil sample). Additional soil texture analysis is underway to determine the distribution of fines (silt and clay) within each sample. However, for this project, soil texture was simply quantified as the coarse-grained soil fraction. A map of the sand fraction across the site was generated using kriging, a statistical computation in which measurements from known locations are used to interpolate values between datum points, of the average sand fraction in each borehole from 0 to 46 cm depth (Figure 4). The soil texture across the site is predominantly coarse-grained (all samples were more than 50% coarse-grained soil), but significant variations in the sand fraction occur in some areas of the site.

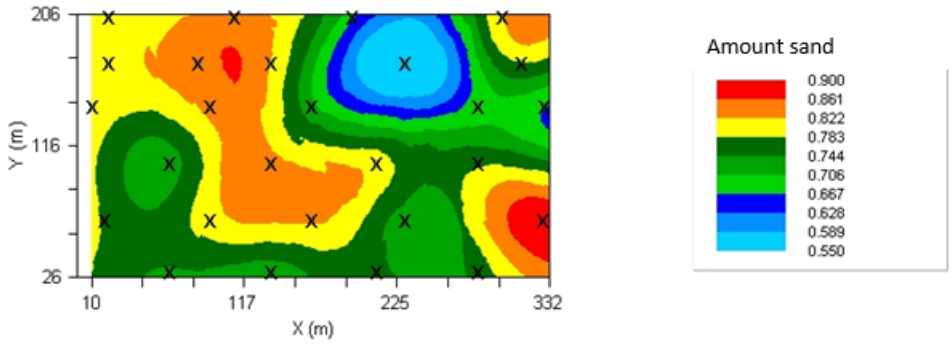

Figure 4: The fraction of sand was mapped across the site using borehole data from 0 to 46 cm depth. Sand sized grains are defined as those larger than the standard 200 sieve.

Maps of the geophysical data appear as Figures 5a-5d. While each of the geophysical data sets shows some similar patterns (i.e., a contrast in properties between the northern and southern halves of the site), the data from the different techniques do not, overall, appear to be very similar. These maps only show relative soil texture differences across the field and are not corrected with absolute soil texture measurements from the borehole locations. The differences in data sets are not surprising, as most of these techniques are sensitive to slightly different soil properties. Ground penetrating radar data serves a dual purpose in this experiment. GPR data can be used to estimate the soil water content (volume of water in a given sample). It is also analyzed for amplitude, or the strength of the signal between the two transmitting antennae. The signal quickly deteriorates in the presence of silt and clay, which is naturally conductive. Therefore, weak amplitude indicates more silt and clay and a lower sand fraction. Electromagnetic induction techniques were used to measure electrical conductivity (EC), which is primarily influenced by the same soil parameters as GPR amplitude. The EC and ground penetrating radar amplitude data were expected to show similar patterns; the lack of similarity in these data sets may indicate that GPR amplitude is more sensitive to changes in antenna coupling (contact with the ground) than to soil properties. Magnetic susceptibility is influenced by the prevalence of magnetic minerals in the soil, which at this site, is expected to depend primarily on the amount of silt and clay. Note that areas in red are associated with sandier areas, while cool colors are associated with increased silts and clays.

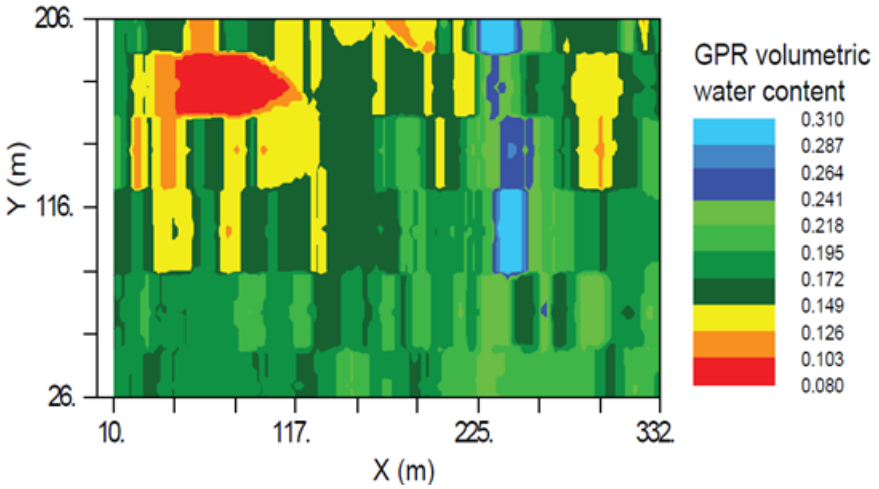

Figure 5a: Volumetric water content measurements from GPR groundwave travel time data. Scale ranges from 8% to 31% water in the soil.

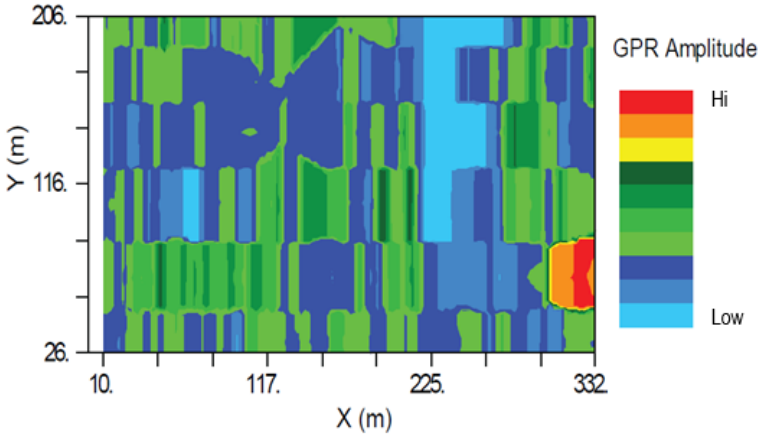

Figure 5b: GPR groundwave amplitude is output on a relative, site specific scale. The pattern of groundwave amplitude fluctuation is most critical for this project. Amplitude increases in sandy areas, and decreases with poor contact with the ground.

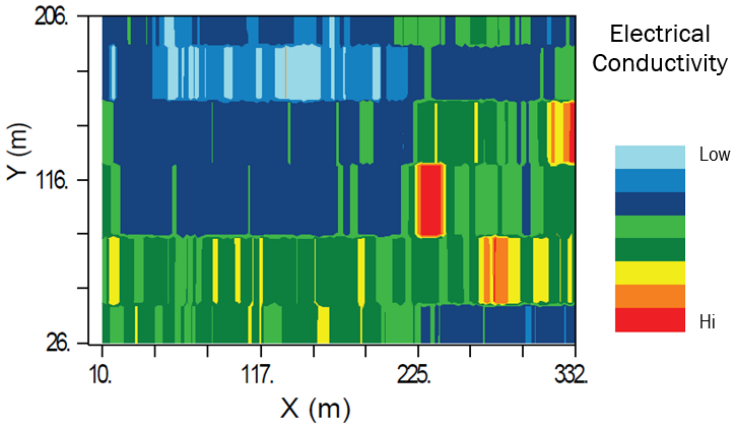

Figure 5c: Electrical conductivity increases with silt and clay rich soils. Like groundwave amplitude, the electrical conductivity measurements are relative, and the data pattern is most useful in interpretation.

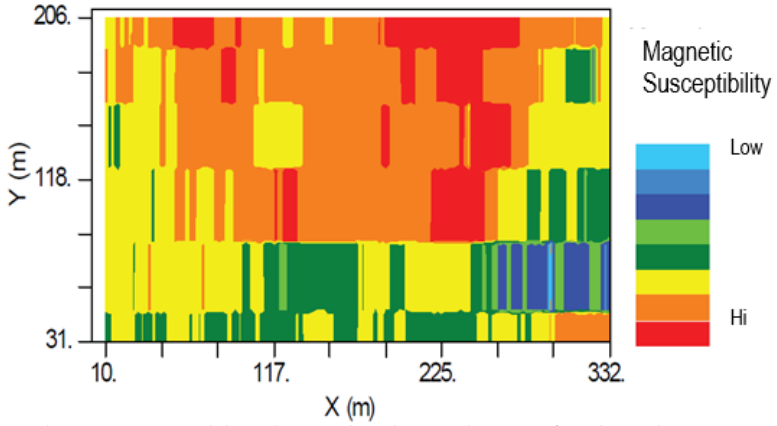

Figure 5d: Magnetic susceptibility values are also relative and site-specific. These values increase with a prevalence of magnetic minerals in the soil, which are typically associated with fine grains.

Comparison of Spatial Variability: Soil Texture and Geophysical Data

Experimental semi-variograms (hereafter referred to simply as variograms) were generated for each data set using GS+ geostatistical software. The experimental variogram (γ) relates the variability of measurements to the distance between them and is calculated as follows,

$$\gamma(h) = \frac{1}{2N(h)} \sum_{i=1}^{N(h)} [v(x_i) - v(x_i + h)]^2 \quad \text{(Rubin 2003)}$$

where h is the distance between two measurements (the lag distance), N(h) is the number of pairs of measurements separated by a distance h, and v(xi) is a measurement taken at location xi. Using GS+, variogram models were fit to the experimental variograms. The parameters used in the models are the sill (the variogram value (γ) at which γ ceases to increase with increasing h), the correlation length (denotes the average distance over which correlations can be observed), and the nugget (measures the very small-scale variability). The type of variogram model describes the shape of the variogram as the variability increases from the nugget to the sill. The expected model will show little variability between measurements in close proximity, and increasing variability as the distance between two measurements increases.

Figure 6 shows the variograms calculated for the sand fraction for different depth intervals. The variogram value is the average variability at a given lag distance (distance between two points that are being compared). The variogram models are fit to the data points to better illustrate them. This figure shows that soil texture samples in close proximity have a higher correlation than samples taken at a greater distance apart. The variograms of sand fraction from 0-8, 0-15, and 0-23 cm are all very similar, suggesting that sand fraction variability does not change significantly over the 0-23 cm interval. This depth interval is also approximately equal to the plowing depth, so it is likely that the soil is relatively uniform over this depth. The variograms from 0-30 and 0-38 cm show considerably higher variability at lower distances, which may indicate natural soil heterogeneity beneath the plowed zone. The last interval, from 0-46 cm, shows intermediate variability.

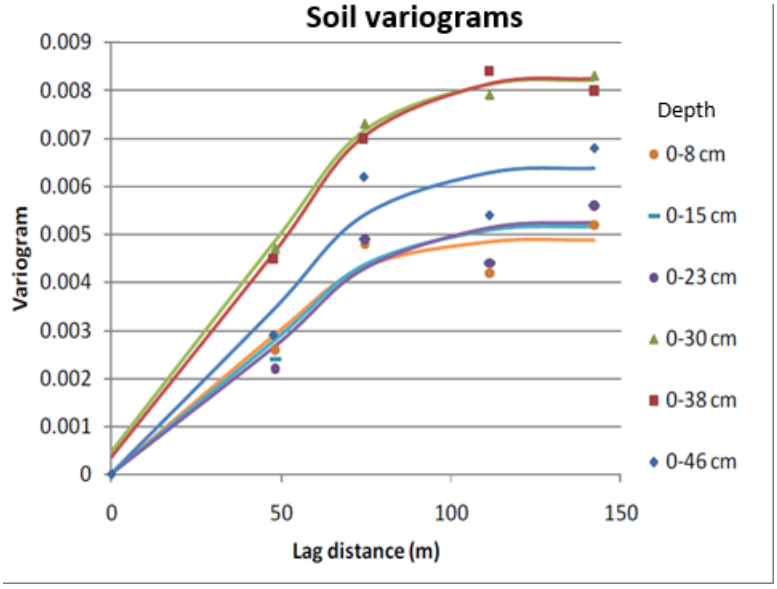

Figure 6: Variograms of the sand fraction were calculated for each depth interval.

Figure 7 shows the normalized variograms (calculated by dividing the sample by its variance, or sill value) of soil water content, GPR amplitude, and the sand fraction. This figure shows that both soil water content and ground penetrating radar amplitude have less correlation than soil texture. The high variability observed in the GPR data may reflect the heterogeneity of soil water content caused by variable evapotranspiration across the field, as well as variability in soil water content caused by differences in soil texture. Amplitude data may show high variability due to their sensitivity to a variety of different parameters, including antenna connection with the ground, which is partially dependent on vegetative cover.

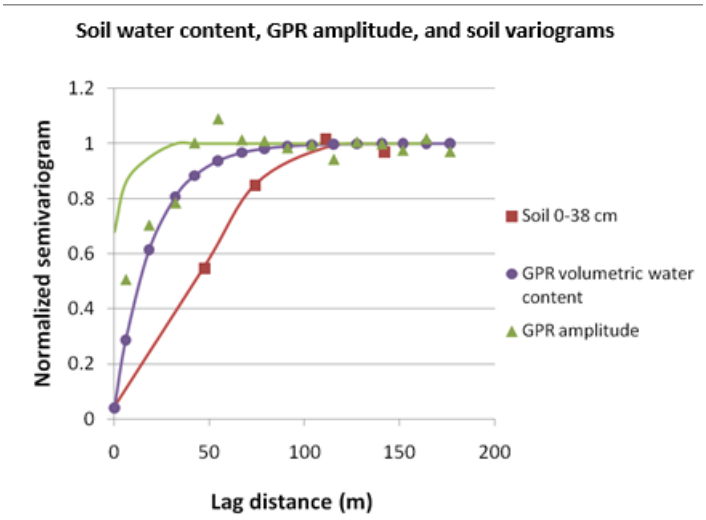

Figure 7: Normalized variograms for soil water content, GPR amplitude, and soil texture.

Figure 8 shows the normalized variograms (synonymous with semivariogram) of EC, magnetic susceptibility, and the sand fraction. This plot shows that EC and magnetic susceptibility generally have greater spatial correlation than soil texture, especially at lag distances of 50-100 m. The greater spatial correlation of these geophysical data may reflect the greater sampling depths of these techniques, some of which may extend into the shallow bedrock at this site. The bedrock is expected to have more uniform physical properties than the soil, so geophysical measurements influenced by the bedrock may show less variability.

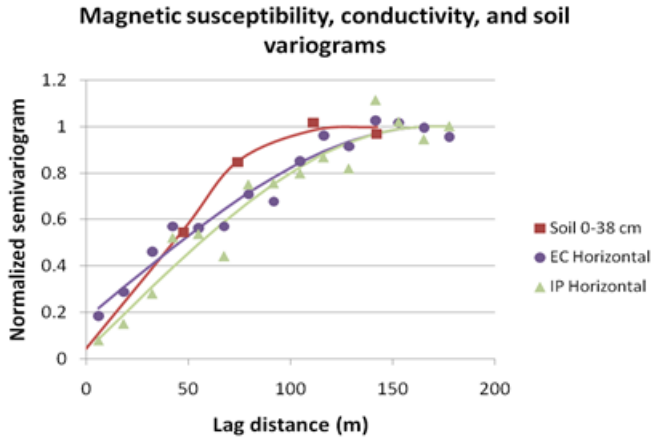

Figure 8: Normalized variograms for electrical conductivity, magnetic susceptibility, and soil texture.

Estimation of Soil Texture Using Geophysical Data

To determine if the geophysical data could be used to improve soil texture estimation, the sand fraction was estimated using co-kriging of the soil texture measurements and geophysical data. To test this method, half of the sand fraction measurements were removed from the data file; the measurements removed were chosen so that the remaining measurements would offer the best possible spatial coverage of the field. Figure 9a shows the new sand fraction estimates from ordinary kriging of only half of the soil texture measurements. Figures 9b – 9e show sand fraction estimates generated using co-kriging of soil texture and geophysical measurements. Borehole sample locations used in the kriging calculations are marked by an X.

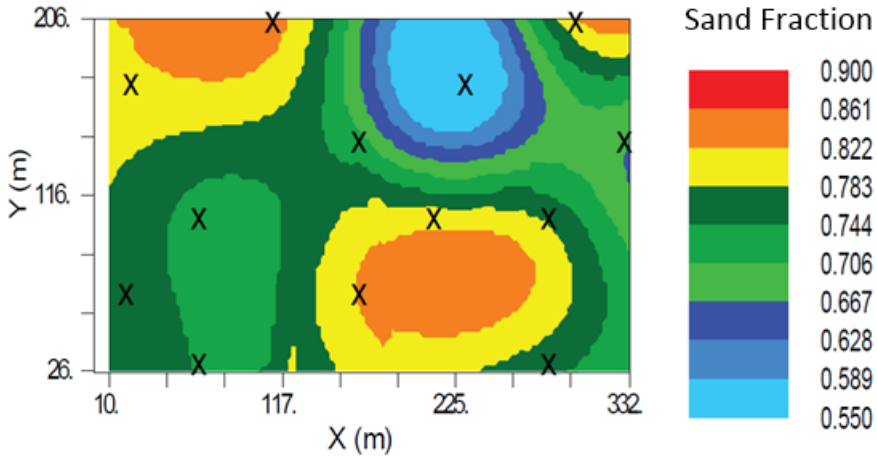

Figure 9a: Sand fraction estimates from ordinary kriging of sand fraction measurements, ranging from 55% to 90% sand.

Figures 9a-9e show the maps of sand fraction generated using ordinary kriging of only soil data, and co-kriging of soil data and geophysical data are very similar. The geophysical data do not change the large-scale patterns observed in the sand fraction data, but do help to constrain interpolation between sand fraction measurements. To quantify the improvement in soil texture estimation when geophysical data are included, the sand fraction estimates from kriging were compared to the sand fraction measurements at the borehole locations omitted from the data used in kriging. The root mean squared errors (RMSE) resulting from this comparison ap-

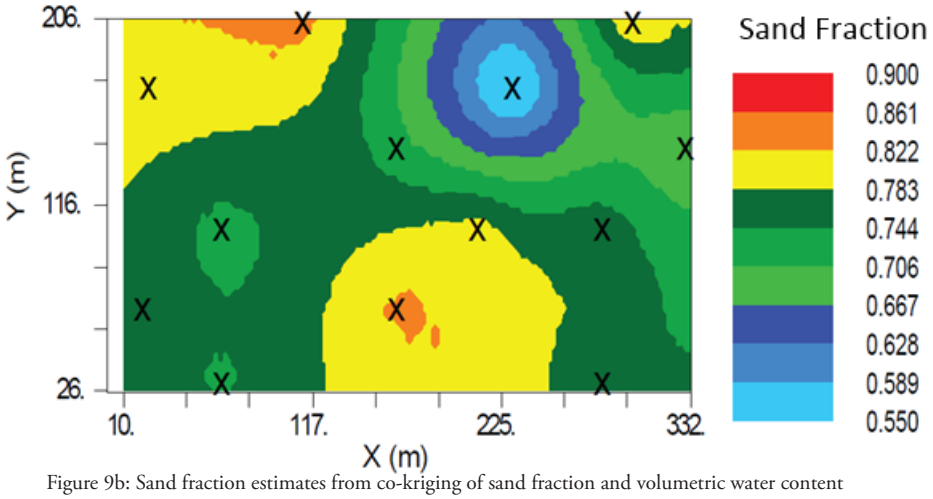

Figure 9b: Sand fraction estimates from co-kriging of sand fraction and volumetric water content measurements.

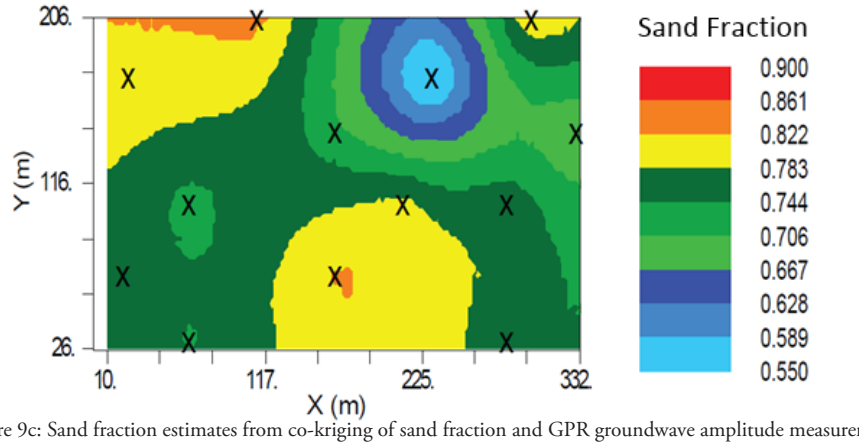

Figure 9c: Sand fraction estimates from co-kriging of sand fraction and GPR groundwave amplitude measurements.

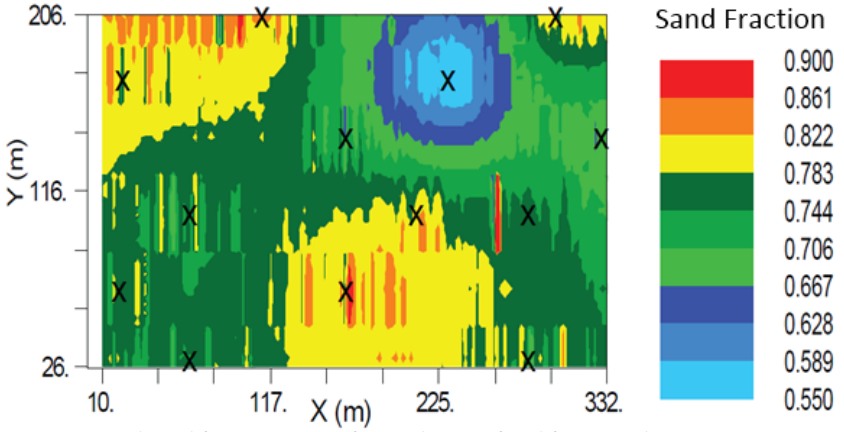

Figure 9d: Sand fraction estimates from co-kriging of sand fraction and EC measurements.

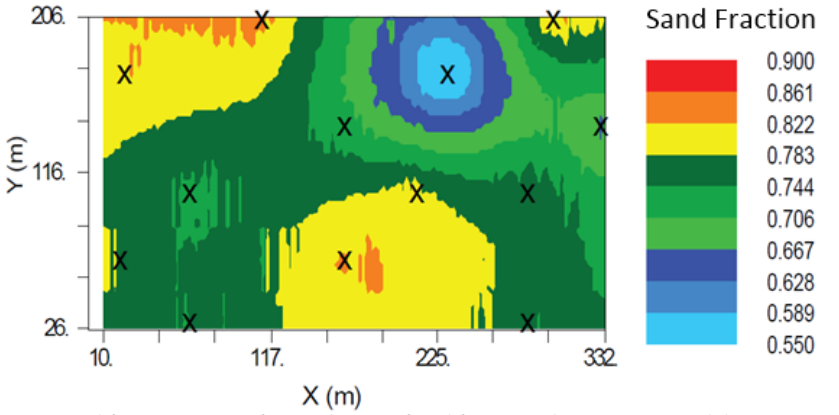

Figure 9e: Sand fraction estimates from co-kriging of sand fraction and magnetic susceptibility measurements.

pear in Table 1, which shows that incorporating the geophysical data into sand fraction estimation caused only a minor reduction in RMSE. This modest improvement may be due to the relatively large number of sand fraction data points still remaining in the data subset, or more likely, it may reflect the different sampling depths of the geophysical data and sand fraction measurements. Additional analyses using a data subset with fewer sand fraction sampling points and estimating sand fraction over a depth interval that better matches the geophysical sampling depth are underway.

RMSE from ordinary kriging of sand fraction	**0.073**
RMSE from co-kriging of sand fraction and soil water content	0.063
RMSE from co-kriging of sand fraction and GPR amplitude	0.063
RMSE from co-kriging of sand fraction and electrical conductivity	0.064
RMSE from co-kriging of sand fraction and magnetic susceptibility	0.064

Table 1: RMSE between estimated and measured sand fraction values for sampling locations not included in the kriging calculations.

Conclusions

This experiment shows that the spatial correlations of geophysical data and soil texture are different, but that incorporating geophysical data into soil texture estimation can slightly improve the accuracy of these estimates. Variograms of GPR data (soil water content and ground-wave amplitude) generally show higher spatial variability than soil texture variograms calculated over the approximate sampling depth of the GPR data; the higher variability of GPR data may reflect their dependence on factors other than soil texture (e.g. changes in water content). EC and magnetic susceptibility data showed more spatial correlation than GPR or soil texture data, but this could be due to the greater sampling depth of the EC and magnetic susceptibility data. All geophysical techniques showed approximately the same reduction in RMSE when geophysical data were used in soil texture estimation, indicating that each technique is responding to some parameters related to soil texture. Further analysis is needed to determine which geophysical technique is most effective when fewer soil samples are acquired and when sand fraction estimation is performed only over the vertical interval relevant to the geophysical sampling depth.

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Student Consensus

by:
Brittany R. Henn
Advisor: Dr. April Bleske-Rechek

Abstract

Researchers tested the assumption that students' postings on *RateMyProfessors.com* reflect students' emotions rather than objective appraisals of the instruction. Under that assumption, student ratings of an instructor should vary widely, and only by aggregating many students' responses, should consensus about an instructor be reached. Researchers recorded ratings from the web site for approximately 370 instructors from a single midwestern university. Data suggest that *RateMyProfessors.com* has student consensus in its ratings, which are similar to reliable, valid Student Evaluations of Instruction provided by institutions themselves.

Introduction

Software engineer John Swapcenski created *RateMyProfessors.com* in 1999 as a tool for students to rate, and comment on, their instructors. Students generally use the web site to plan course schedules for upcoming semesters, but they can rate their instructors, on a one-to-five rating scale, for multiple criteria: helpfulness (how approachable/nice a professor is, willingness to help inside/outside of class); clarity (how well the instructor teaches the material, how easy they are to understand); easiness (how easy it is get an 'A', how much work the class involves); rater interest (rater's interest in the subject prior to the course); and attractiveness. Averaged together, the helpfulness and clarity ratings calculate each instructor's overall quality rating.

Researchers most often compare *RateMyProfessors.com* to Student Evaluations of Instruction. While little research exists for *RateMyProfessors.com*, the most researched method of evaluating college instruction is the Student Evaluation of Instruction (SEI). Institutions currently use SEIs to improve instructor quality as well as to make decisions in promotion and tenure. Past research shows that SEIs are reliable and stable in regard to the actual ratings obtained, valid when compared with student learning, multidimensional in what they assess, useful in improving instruction, and minimally affected by various course, teacher, or student characteristics that could potentially bias results (Coladarci and Kornfield, 2007). At most institutions results from SEIs are the most important factor in determining teaching effectiveness, while students remain generally unaware of how much weight their opinions carry on these evaluations. (Yining and Hoshower, 2003).

Research comparing *RateMyProfessors.com* with SEIs shows that a few instances exist where the two different systems of evaluation are similar. Coladarci and Kornfeld (2007) completed a study comparing *RateMyProfessors.com* ratings with SEI ratings; they found that on nearly every level they compared, *RateMyProfessors.com* and SEIs had correlated ratings.

Many researchers have criticisms of the validity of the ratings on *RateMyProfessors.com*. One popular criticism is that students value the easiness of the instructor over actual quality. Multiple studies imply that a bias exists towards students rewarding instructors based on attractiveness or easiness instead of instruction quality. This assumption has many possible explanations. It may

be true that students reward instructors who give out many 'A's. Possibly high quality instructors make it easier for students to learn; therefore the students rate them higher in easiness because they facilitated learning better than other instructors (Michels and Bleske-Rechek, 2010).

Another criticism of *RateMyProfessors.com* is that students only use the web site to 'rant' or 'rave' about instructors. Davison and Price state: "The onus is on the student to log in, register and take the time to post a rating on a particular instructor. This process lends itself to bias, with students who either loved or hated an instructor more likely to post" (2009, 52). Research in SEIs show that students agree on their judgments of an instructor (Aleamoni, 1987). If students only use *RateMyProfessors.com* to 'rant' or to 'rave', then analysis of the data should produce a bimodal distribution; however, Michels and Bleske-Rechek (2010) found a near-normal distribution for ratings at a specific university. In addition, if students only use the web site to 'rant' or to 'rave', it should take a high number of ratings to find consensus among students. The current study focuses on finding student rating consensus to support the validity of the web site and its similarity to standard SEIs.

Method

Researchers selected approximately 370 instructors with ten or more ratings, from the total number of professors at a single midwestern university. For each instructor, researchers recorded, from *RateMyProfessors.com*, each rating for quality, helpfulness, clarity, easiness, and rater interest. From this researchers calculated descriptive statistics (mean, standard deviation, and variance) for each criterion. Then, an overarching dataset was created that included instructor name, number of student raters, number of courses taught, department, and the descriptive statistics previously calculated.

Results

The majority of instructors examined had between 10 and 20 ratings although the number ranged as high as 110. The average instructor had a mean quality rating of 3.54 and a standard deviation of 0.885 (variance = 0.78). This resembles previous studies in that ratings tend to be positive overall and distributed normally. Results show no association between the number of students and degree of variance around the mean quality rating [as shown in Figure 1]. Additionally, the number of student raters produced no association with the degree of variance around the mean easiness rating [Figure 2]. Therefore, student consensus about instructors was similar regardless of the number of raters a particular instructor had. Similarly, Figure 3 illustrates that instructors with very high, or very low, mean quality ratings showed much lower levels of degree of variance around the mean. This means that students tended to agree on high and low quality teachers, whereas more discrepancies appeared when instructors received an 'average' rating.

Discussion

The researchers had hypothesized that student consensus could be found in the ratings given for individual instructors on *RateMyProfessors.com*. Past research has shown that Student Evaluations of Instruction are reliable and stable, and students tend to agree on the quality and effectiveness of an instructor. *RateMyProfessors.com,* dismissed as invalid by many authors such as Davison and Price (2009), in fact shows student consensus on ratings. Regardless of the number of raters a given instructor had, relatively similar degrees of variance were found. This supports the hypothesis that *RateMyProfessors.com* has a similar amount of consensus as found in SEIs. Researchers of the current study also found very low degrees of variance for instructors who were rated high, or low, in quality and instructors that were rated low in quality.

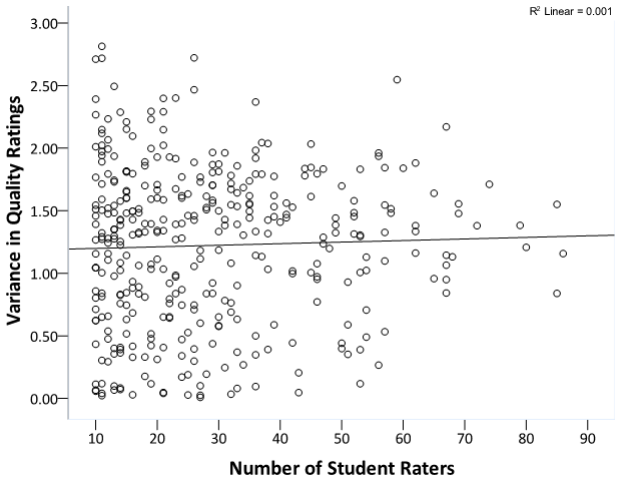
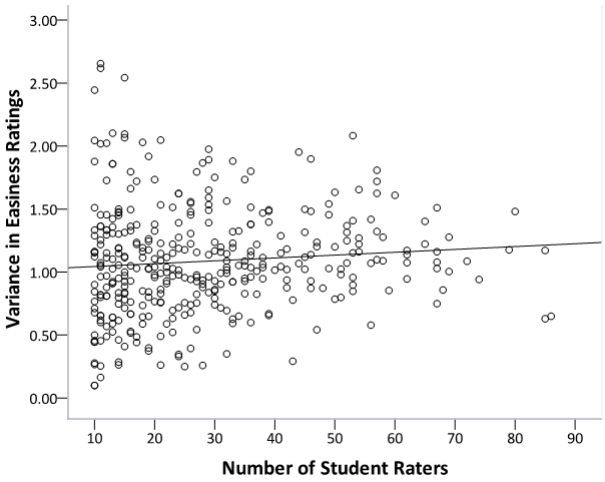


Figure 1: Variance in quality ratings according to number of student raters

Figure 2: Variance in easiness ratings according to number of student raters



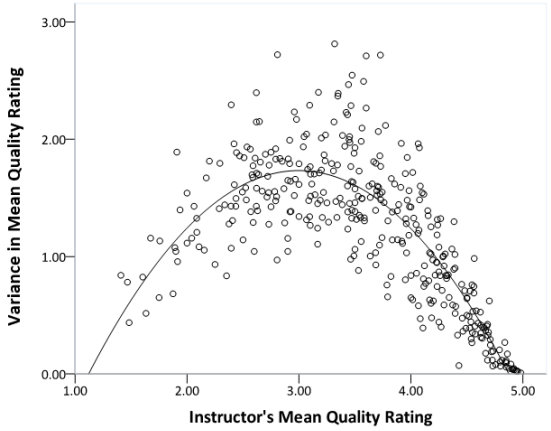


Figure 3: Variance in mean quality ratings

Our findings support taking *RateMyProfessors.com* ratings as seriously as SEIs. Further research should include replications of our methodology at other universities to ensure the applicability of external validity. A direct comparison between ratings on *RateMyProfessors.com* and SEIs given by the institution would be helpful in finding just how reliable *RateMyProfessors.com* seems to be when contrasted with Student Evaluations of Instruction.

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Assessing Differences in School Resource Officers' Perceptions of Cyberbullying

by:
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Advisor: Dr. Justin Patchin
and Dr. Sameer Hinduja

Abstract

Using data collected from 509 school resource officers (SRO) from across the United States, this paper evaluates how important SROs believe it is for law enforcement to respond in several cyberbullying scenarios. We hypothesized that female SROs, SROs who have children under age 18, and SROs who have earned at least a four-year degree would report a greater law enforcement responsibility than their counterparts. Results, however, largely failed to uncover statistically significant differences among SROs based on these characteristics. We discuss the possible explanations for this finding and implications for the role of law enforcement in dealing with nontraditional forms of adolescent deviance.

Introduction

Cyberbullying is a growing phenomenon that has attracted the attention of parents, scholars, and governments in recent years. This phenomenon is facilitated by young people having more opportunities to access new technologies, computers, and the Internet to enhance their everyday lives. Adolescents can use many technologies such as email, instant messaging, texting, blogs, social networking sites, video and photo sharing sites, massively multiplayer online role-playing games (MMORPGs), and interactive video games to carry out electronic harassment (Bhat, 2008; Erdur-Baker, 2010; Hinduja & Patchin, 2010; Hinduja & Patchin, 2011; Patchin & Hinduja, 2010c; Smith, Mahdavi, Carvalho, Fisher, Russell, & Tippett, 2007; Subrahmanyam & Greenfield, 2008; Vandebosch & Van Cleemput, 2009).

Cyberbullying incidents can occur in almost any place where access to information and communication technologies (ICTs) exist. For example, technology is so sophisticated that many adolescents can communicate and interact with their friends at school and carry on the same communication at home. Since school is one of the places where cyberbullying can occur, this creates a growing concern for all school professionals and a new responsibility for school resource officers (SROs) across the United States. Unfortunately, little research to date has identified how SROs respond to incidents of cyberbullying among adolescents.

This research will describe the current state of how SROs approach incidents of cyberbullying. First, we summarize what is known about cyberbullying. Second, we discuss SRO's responsibilities in schools. Third, we discuss gender differences to understand how the gender of an SRO might influence how he or she deals with incidents of cyberbullying. Fourth, we discuss current research findings. Finally, we offer guidance for future empirical research on this issue.

Cyberbullying

Cyberbullying Defined

To date, no consensus exists on the definition of cyberbullying. Some researchers and authors prefer a concise and reasonably comprehensive definition that includes the most relevant elements. For example, Hinduja and Patchin (2009:5) defined cyberbullying as "willful and repeated harm inflicted through the use of computers, cell phones, and other electronic devices." However, Smith, Mahdavi, Carvalho, Fisher, Russell, and Tippett prefer a descriptive definition. They refer to cyberbullying as, "An aggressive, intentional act carried out by a group or individual, using electronic forms of contact, repeatedly and over time against a victim who cannot easily defend him or herself (2007:376)." Although no consensus exists on the definition of cyberbullying, nevertheless, the above definitions contain similarities. These include using technology to bully another person (e.g., computer, cell phone, or other electronic device), causing harm to another person (i.e., psychologically, emotionally, or socially), and repeating the action (e.g., duplicating digital content, such as emails, pictures or videos,) (Hinduja & Patchin, 2010; Patchin & Hinduja, 2010b; Patchin & Hinduja, 2011).

Who Does Cyberbullying Harm?

The term cyberbullying is commonly associated with adolescents on one side of the communication exchanging rude or insulting content to adolescents on the other side of the communication through deliberate, repeated, and hurtful behavior over time (Hinduja & Patchin, 2010; Hinduja & Patchin, 2009; Patchin & Hinduja, 2010c; Patchin & Hinduja, 2011; Vandebosch & Van Cleemput, 2008). While using rude or insulting communication is not illegal because of First Amendment protections, cyberbullying can cross the line into harassment (Hinduja & Patchin, 2008a). Cyberbullying typically harms the adolescent target of the communication; that victim may have had to live with excruciating psychological, emotional, and social wounds (Hinduja & Patchin, 2008a; Hinduja & Patchin, 2009).

Since 2002, by using a variety of quantitative and qualitative methodologies, Patchin and Hinduja (2011) have conducted seven research projects that have included more than 12,000 adolescents from over 80 schools. Patchin and Hinduja concluded that the seven research projects present a meaningful illustration of adolescents who either have been cyberbullied, or have cyberbullied others, at some point in their lifetimes.

The results of those studies indicate that the proportion of youths who have been cyberbullied ranges from 18.8% to 40.6%—with an average of 27.3%—although, a recent study in spring 2010 puts the proportion of youths who have experienced cyberbullying at 21%. This means that about one out of every five youths will experience cyberbullying at some point in life. Conversely, the rates were slightly lower for the proportion of youths who admit to cyberbullying others. The rates for this group range from about 11% to 20%, with an average of 16.8%. This average means that about one out of every six adolescents has cyberbullied someone at some point in life (Patchin & Hinduja, 2011).

Instruments Used to Cyberbully

The devices capable of carrying out cyberbullying behaviors include computers, cell phones, personal digital assistants (PDAs), cameras, video game consoles, and other hand-held devices. Some arenas in which cyberbullying can occur are email, instant messaging, text messaging, chat rooms, and blogging. Email (e.g., Gmail) is a casual form of written communication that enables adolescents to write, store, send, and receive mail electronically. Email can be abused,

however. For example, a student receives an email from an unknown person threatening to kill him or her after school. Instant messaging (e.g., Hotmail's Instant Messenger) also allows two or more people to communicate, but in a synchronous exchange of private messages. Text messaging is a fast and effective way to use cell phones or PDAs to send out messages, even those that can be hurtful and embarrassing to somebody. For example, a female student sends another female student a text message that calls her a slut; this might then be forwarded to the whole class. A 'chat room' (e.g., True.com), another instrument which can be used to cyberbully others, allows synchronous conversations with one or more persons. Blogging (e.g., Blogster) is an individual's virtual journal created and stored on the Internet. It also can be used to cyberbully others; for example, an adolescent can take an embarrassing picture of a victim and post it on his or her blog for other classmates and friends to rate and judge the victim.

As mentioned above, cyberbullying has become an issue across the United States because of the advances in ICTs. This creates new problems for school personnel and creates the need for them to find strategies to address this phenomenon. SROs stand at the frontlines of identifying and responding to incidents of cyberbullying.

School Resource Officers (SROs)

Roles of SRO

The relationship between law enforcement and schools in the U.S. has been under discussion over the last 40 years (Lambert & McGinty, 2002). Historically, the job description of SROs has been spontaneous and undefined. SROs were assigned jobs such as security guard or disciplinarian for students by the principal at respective schools. However, in 1973, the Advisory Commission on Criminal Standards and Goals issued a set of recommendations encouraging SROs to teach classes, counsel students, and serve as a resource for law-related issues (Lambert & McGinty, 2002). Today, an SRO's job description has clearer definition to embrace the primary purpose of providing a variety of services at school for students, faculty, and staff (Lambert & McGinty, 2002). All SRO programs are funded by the federal government through the Community Oriented Policing Services (COPS) program (Lambert & McGinty, 2002; Paynter, 1999).

The SRO's job description continues to attract ongoing debate in many U.S. school districts. Lambert and McGinty (2002) developed a survey instrument that included the perceived importance of various personal characteristics, skills, knowledge items, and job tasks that might be preferred in an SRO. The respondents in their study included 161 principals, 159 SROs, and 57 law enforcement administrators. These respondents rated the importance of each item from 1 (not at all important) to 5 (extremely important). The most desired personal characteristics reported were honesty, a good role model, willingness to work with young people, and reliability. Skills items such as work with school administrators and crisis intervention were reported. Respondents gave highest importance, for the knowledge items, to knowledge of the law, the physical layout of the school building, and police procedures. The highest rated job task item included assisting the principal, upon request, in the investigation of thefts, fights, and drug problems.

Lambert and McGinty's (2002) results also indicated that principals are primarily concerned with SROs keeping the school safe on a day-to-day basis. In contrast, SROs find it difficult to be merely law enforcement officers when the Advisory Commission on Criminal Standards and Goals recommended their teaching and counseling students as well. Likewise, SROs imagine themselves performing a broader job, one that focuses more on the job functions beyond the traditional security guard role. Furthermore, Lambert and McGinty (2002) suggested that the SRO role should progress towards that of a school and community resource, rather than simply a security guard.

While the Advisory Commission on Criminal Standards and Goals suggested that

SROs teach classes, counsel students, and serve as a resource for law-related issues, the National Association of School Resource Officers (NASRO) similarly suggested SROs use a triad concept in schools, whereby SROs are assigned jobs as teachers of law-related education, counselors on law-related issues, and law enforcement officers (Lambert & McGinty, 2002; Paynter, 1999). The triad concept illustrates a recent definition of the SRO as a full-time law enforcement officer assigned to public schools to provide a variety of services for students, faculty, and staff (Lambert & McGinty, 2002). Furthermore, SROs should serve as resources for law-related issues because they can bring the school and community together (Lambert & McGinty, 2002). SROs can also work closely with the community by providing information to citizens about the school's activities in regard to recent issues.

An SRO's roles as a teacher, counselor, and law enforcement officer are essential to creating effective safety strategies for schools. As teachers in classrooms, SROs can educate students about law related issues, such as their rights and responsibilities under the law (Lambert & McGinty, 2002; Paynter, 1999). As counselors, SROs can build positive relations with students at the grade school level, which can continue at the middle and high school levels. SROs can also help at-risk students and address cyberbullying problems by referring students to the appropriate community resources. When SROs enforce the law, they can identify potential cyberbullying problems that may violate the law and suggest solutions, or they can make an arrest when appropriate.

The role of an SRO changes as the use of ICT at school grows. SROs face increasing responsibilities as teachers, counselors, and law enforcement officers. These responsibilities also require the SROs to tackle issues by developing strategies to identify and respond to incidents of cyberbullying. This article's next section explores how men and women differ in the way they perceive situations and respond to cyberbullying incidents.

Gender and SRO Perspectives on Cyberbullying

How do Men and Women Differ in the Way They Perceive Situations?

Little research to date discusses how the gender of a SRO may have an effect on how he or she will respond to incidents of cyberbullying among adolescents. However, the present literature on gender differences can help in understanding how men and women might respond differently to such situations. Stalans and Finn (2000) examined the contextual features of battering to determine if the gender of responding officers affected their decisions to arrest the aggressor or refer the battered woman to a shelter. Stalans and Finn concluded that male and female officers did not differ on arrest rates; however, female officers proved more likely than male officers to refer the battered woman to a shelter (2000). Stalans and Finn (2000) suggested that female officers showed more empathy toward the battered woman and were more likely to blame the man as the aggressor.

Pohl, Bender, and Lachmann (2005) used the autobiographical memory (AM) instrument, which measures self-continuity, communication skills, and behaviors, to explore the social skill differences between men and women; they predicted that women are more empathetic, and have more emotional responses to other persons' needs than men. This emotionality may allow women to understand and appreciate specific situations and to act accordingly by choosing the appropriate behavior (Eagly & Johannesen-Schmidt, 2001). In that study, the authors predicted that men would be more assertive than women because men can more effectively influence and negotiate with others. This ability might allow men to express themselves and their rights in an appropriate manner so as to not violate the rights of others (Eagly & Johannesen-Schmidt, 2001).

Because women showed more empathy than men and men showed more assertiveness

than women, we hypothesized that the female SROs would rate the scenarios of cyberbullying higher than male SROs (See Table 1). We speculated that female SROs would prove more likely to understand, and appreciate the specific cyberbullying scenarios, and to assign a higher need for law enforcement intervention to the scenarios.

SRO with Children Under the Age 18

How Much Do SROs Understand the ICTs Used by Children Under the Age 18?

To date, little research exists on how well SROs understand the ICTs used by children under age 18. Nevertheless, we speculate that SROs are knowledgeable individuals who are up-to-date with current ICTs. We believe that SROs are educated professionals who have probably encountered at least one cyberbullying case through a misuse of ICTs by students at their respective schools. SROs' experience should help shape their understanding of how ICT misuse can pose a potential threat to students. This at least may make them attentive to the issues that can develop from misusing ICTs.

Furthermore, we speculate that SROs who are themselves parents will be involved in their children's lives by allocating time for family activities. In addition, we believe that SROs who are parents should be more interested in the ICT used by their children because they have experi-

Educational Attainment by SROs

Scenario	Male SROs (Mean)	Female SROs (Mean)	Stat. Sig.
A male student receives an email from an unknown person threatening to kill him at school tomorrow.	9.11	9.18	.775
A female student receives a text message from another student saying that she is a slut.	4.26	4.11	.692
A student creates a web page making fun of the school principal.	4.11	3.96	.710
A teacher confiscates a cell phone from a student in class and wants to determine if it contains any information that is in violation of school policy.	2.58	1.55	.006
A parent calls the police department to report that her son is being cyberbullied by another youth in their neighborhood.	7.71	8.06	.257
A student creates a Facebook Fan Page called "Give Mary a Wedgie Day." Mary is a student at a school in your jurisdiction.	5.63	6.05	.309
A female student, Jenny, covertly takes a picture of another female student, Margaret, in her underwear in the girl's locker room, and posts it on "HotorNot.com" without permission. This site allows the rest of the student body to rate or judge Margaret's physical appearance.	8.86	9.19	.132
A male student reveals another student's sexual orientation (without permission) via Twitter to the rest of the student body.	5.56	6.09	.246
A parent calls to report that her son has a naked image of a female student from his school on his cell phone.	8.32	8.43	.726

Table 1: Results for Gender and SRO perspectives on Cyberbullying, using Independent-Samples t-Test. Scale ranges from 0 to 10 (how much of a role law enforcement should play in investigating or responding to the incident and reflects 0 = no law enforcement role/responsibility and 10 = very important/significant law enforcement role/responsibility.)

ence or training in dealing with the misuse of ICTs. Therefore, we hypothesize that SROs who have children under age 18 will more highly rate the need for law enforcement intervention in the scenarios of cyberbullying (See Table 2).

Scenario	SROs without Children (Mean	SROs with Children (Mean)	Stat. Sig.
A male student receives an email from an unknown person threatening to kill him at school tomorrow.	9.06	9.14	.745
A female student receives a text message from another student saying that she is a slut.	3.97	4.33	.312
A student creates a web page making fun of the school principal.	4.15	4.04	.759
A teacher confiscates a cell phone from a student in class and wants to determine if it contains any information that is in violation of school policy.	2.36	2.37	.977
A parent calls the police department to report that her son is being cyberbullied by another youth in their neighborhood.	7.76	7.81	.854
A student creates a Facebook Fan Page called "Give Mary a Wedgie Day." Mary is a student at a school in your jurisdiction.	5.48	5.84	.348
A female student, Jenny, covertly takes a picture of another female student, Margaret, in her underwear in the girl's locker room, and posts it on "HotorNot.com" without permission. This site allows the rest of the student body to rate or judge Margaret's physical appearance.	8.86	8.98	.605
A male student reveals another student's sexual orientation (without permission) via Twitter to the rest of the student body.	6.01	5.62	.359
A parent calls to report that her son has a naked image of a female student from his school on his cell phone.	8.32	8.36	.893

Table 2: Results for SROs with Children under Age 18, using Independent Samples t-Test. (Scale range represents how much of a role law enforcement should play in investigating or responding to the incident with 0 = no law enforcement role/responsibility and 10 = very important/significant law enforcement role/responsibility.)

Does a Higher Education Affect SROs Awareness of Cyberbullying?

The change in emphasis from law enforcement and crime fighting to community policing has modified the SRO role in ways that require additional education. Arguments that favor a bachelor's as the minimum degree standard assert that a changing and complex police role requires a college education (e.g., Baro & Burlingame, 1999; Krimmel, 1996; Roberg & Bonn, 2004). Research has suggested that officers with four-year college degrees make better ethical choices and have fewer complaints filed against them than officers without such degrees

(e.g. Paoline III & Terrill, 2007; Truxillo, Bennett, & Collins, 1998). Research also suggests that officers with a four-year college education possess better communication skills, knowledge of the law, and greater flexibility to accept change over their less-well-educated counterparts (Baro & Burlingame, 1999). Similarly, in Krimmel's (1996) study on officers' self-reported performance, the four-year college educated officers rated higher on knowledge of departmental rules, use of safety practices, and ability to accept change than officers lacking a four-year college degree.

Based on that research, we assume three things: that SROs with at least a four-year degree will be more likely to communicate better with students, will have better knowledge of the laws pertaining to deviant behaviors, and will prove more flexible in finding solutions to the problems they encounter. Therefore, we hypothesize that SROs with at least a four-year college education will rate the scenarios on cyberbullying higher than their counterparts will (See Table 3).

Method

During the summer of 2010, we queried SROs about their experiences dealing with cyberbullying. Officers were invited to participate if members of the National Association of School Resource Officers (NASRO). NASRO members received an email invitation to anonymously complete an online survey. Participants were invited to add an email address at the end of the survey, and five of the addresses were randomly selected to receive a $50 Amazon.com gift card. At the time, NASRO included over 6,000 registered members, although it is unclear what proportion of members were sworn officers. (Membership includes researchers, administrators,

Scenario	Less Than 4 Year Degree (Mean)	At Least 4 Year Degree (Mean)	Stat. Sig.
A male student receives an email from an unknown person threatening to kill him at school tomorrow.	9.31	8.93	.072
A female student receives a text message from another student saying that she is a slut.	4.24	4.21	.932
A student creates a web page making fun of the school principal.	4.43	3.66	.023
A teacher confiscates a cell phone from a student in class and wants to determine if it contains any information that is in violation of school policy.	2.75	1.88	.011
A parent calls the police department to report that her son is being cyberbullied by another youth in their neighborhood.	8.00	7.57	.113
A student creates a Facebook Fan Page called "Give Mary a Wedgie Day." Mary is a student at a school in your jurisdiction.	5.66	5.82	.487
A female student, Jenny, covertly takes a picture of another female student, Margaret, in her underwear in the girl's locker room, and posts it on "HotorNot.com" without permission. This site allows the rest of the student body to rate or judge Margaret's physical appearance.	8.99	8.88	.607
A male student reveals another student's sexual orientation (without permission) via Twitter to the rest of the student body.	6.16	5.22	.036
A parent calls to report that her son has a naked image of a female student from his school on his cell phone.	8.40	8.28	.946

Table 3: Results for Educational attainment by SRO, using Independent Samples t-Test. (Scale range represents how much of a role law enforcement should play in investigating or responding to the incident with 0 = no law enforcement role/responsibility and 10 = very important/significant law enforcement role/responsibility.)

and others who are not practicing school resource officers). Overall, 509 respondents started the survey with two thirds (339) completing it.

In addition to asking officers to report any involvement in investigating cyberbullying, we asked survey-takers to rate, on a scale of 0 to10, the extent to which law enforcement should play a significant role in several different cyberbullying scenarios. As outlined above, the purpose of this study was to reference gender, status as a parent, and educational attainment as predictors of how school officers would respond to various cyberbullying incidents.

Results

We first learned that the vast majority of the respondents (95%) viewed cyberbullying as a serious problem warranting the response of law enforcement. A majority of survey respondents (87%) also had "sometimes" or "often" dealt with a cyberbullying case. Among our SRO respondents, over 70% reported investigating at least one cyberbullying incident during the previous school year. Additionally, the average number of cyberbullying incidents investigated by respondents in the previous school year was 13. This nontrivial number (4,407 cases among 339 SROs) illustrates the pervasiveness of the problem.

To test the three hypotheses, we conducted independent samples t-tests. The first hypothesis (that female SROs would rate the scenarios of cyberbullying higher than male SROs) was partially supported. As noted in Table 1, for most situations, female SROs did place a higher responsibility on law enforcement than male SROs; however, the only scenario that showed any significant association between male and female SROs was the cell phone scenario ("A teacher confiscates a cell phone from a student in class and wants to determine if it contains any information that is in violation of school policy" ($p = .006$)).

The second hypothesis stated that SROs who had children under the age 18 would rate the scenarios of cyberbullying higher than their counterparts. That hypothesis was also partially supported. According to Table 2, the SROs who had children under age 18 rated most of the scenarios higher than their co-respondents; however, the results produced no significant association between the SROs who have children under the age of 18 and those who did not.

The third hypothesis stated that SROs with at least a four-year college education would rate the scenarios on cyberbullying higher than their counterparts. This hypothesis was not supported; in fact, the opposite of what we predicted proved true. In Table 3, the results indicate that SROs who have less than a four-year degree rated the scenarios (except for the Facebook Fan Page scenario) higher than their counterparts. The results also produced three statistically significant scenarios: the web page ["A student creates a web page making fun of the school principal" ($p = .023$)], the cell phone ["A teacher confiscates a cell phone from a student in class and wants to determine if it contains any information that is in violation of school policy" ($p = . 011$)], and the Twitter ["A male student reveals another student's sexual orientation (without permission) via Twitter to the rest of the student body" ($p = .036$)].

The results also revealed what SROs perceive as promising or ineffective when dealing with cyberbullying. The promising approaches that could be used to prevent cyberbullying included "Getting parents on board right away," "Mediation and counseling," "Having a clear policy and following it consistently," "The most effective means of ending cyberbullying were education and sound policy," and "Sitting down with all the parties and working out a solution and talking about potential consequences." What were identified as ineffectual included "Lecturing kids doesn't seem to be too effective," "There is no proven action that will work on all kids. Some have no fear of consequences," "…advised of criminal harassment law and given report # for court. Did not stop the bullying," and "None have worked well, kids do not care about laws yet, parents are the same."

Discussion

The results showed some consistency with our hypotheses. In the first hypothesis the female SROs rated most scenarios higher than their male counterparts; hence, our hypothesis about gender and SROs' perspectives on cyberbullying was partially supported. The female SROs had higher ratings on the email, parent reports that son is being cyberbullied, Facebook Fan Page, HotorNot.com, Twitter, and parent reports that son is taking naked image scenarios. For example, female SROs (M = 9.19) were more likely than male SROs (M = 9.11) to believe that "A male student receives an email from an unknown person threatening to kill him at school tomorrow," warrants a greater law enforcement responsibility; however, both groups placed a high law enforcement responsibility on the incident. Additionally, the female SROs placed a moderate to high law enforcement responsibility on the scenarios for which they had higher ratings. In contrast, male SROs had higher ratings on the text message, web page, and cell phone confiscation scenarios. For example, male SROs (M = 2.58) were more likely than female SROs (M = 1.55) to believe that "A teacher confiscates a cell phone from a student in class and wants to determine if it contains any information that is in violation of school policy," warrants a greater law enforcement responsibility; however, both male and female SROs rated this scenario as a low concern that warrants the response of law enforcement. In addition to the cell phone confiscation scenario, the male and female SROs also placed a low concern that warrants the response of law enforcement on the text message (M = 4.26, Male; M = 4.11, Female) and web page (M = 4.11, Male; M = 3.96, Female) scenarios.

The only scenario that was statistically significant under this characteristic was the cell phone confiscation scenario ($p = .006$). We believe that the statistical significance found here related to female SROs placing less responsibility on law enforcement to respond to the cyberbullying incident because it was a privacy based situation. Perhaps male and female SROs differ in their perspectives on privacy situations. Female SROs may believe that a teacher should not look through a student's cell phone because it may contain personal information, or they may believe that this incident could be resolved through school intervention.

For the second hypothesis, the SROs who had children under the age 18 had higher ratings than their co-respondents on most scenarios including the email, text message, cell phone confiscation, parent reports that son is being cyberbullied, Facebook Fan Page, HotorNot.com, and parent reports that son is taking naked image scenarios. For example, SROs who had children (M = 7.81) were more likely than their counterparts (M = 7.76) to report that "A parent calls the police department to report that her son is being cyberbullied by another youth in their neighborhood," warrants a greater law enforcement responsibility; however, both groups placed a moderate responsibility on law enforcement to intervene in that situation. There were also two scenarios where SROs who did not have children under the age of 18 had higher ratings than their counterparts: the web page and Twitter scenarios. For example, SROs who did not have children under the age of 18 (M = 4.15) were more likely than their counterparts (M = 4.04) to report that "A student creates a web page making fun of the school principal," warrants a higher law enforcement responsibility; however, both groups assigned a low responsibility for law enforcement to intervene in that scenario.

We found no statistically significant association between SROs who had children under age 18 and those who did not have children under age 18. Perhaps, the children of the SROs might have been too young to operate the ICTs. Moreover, perhaps SROs who were parents had a weak parent-child relationship. They may have invested less time with their children and were less aware of the ICTs used by their children. Another explanation could be that SROs who did not have children under age 18 were younger, more up-to-date with the current cyberbullying

phenomenon, had more time to investigate the cyberbullying incidents, and placed a greater law enforcement responsibility on combating cyberbullying. Conversely, the SROs with children may have been older individuals who had fewer experiences with cyberbullying incidents and were not up-to-date with this current phenomenon.

The results for SROs educational attainment were unexpected. These findings contradicted our hypothesis because the SROs who attained at least a four-year degree rated almost all of the scenarios lower than the SROs who held less than a four-year degree. For example, the SROs who attained at least a four-year degree (M = 5.22) were less likely than their co-respondents (M = 6.16) to report that "A male students reveals another student's sexual orientation (without permission) via Twitter to the rest of the student body," warrants a greater law enforcement responsibility; however, both groups rated the scenario as a moderate law enforcement responsibility. Perhaps, the SROs who had less than a four-year degree had less education on ethics and law; hence, they used less discretion on rating the scenarios. In contrast, the SROs who had attained at least a four-year degree had more education; therefore, they were able to make better ethical decisions, had better knowledge of the law, and were more flexible about accepting change in adverse decision-making situations.

The results also revealed three statistical significances in this area, including the web page ($p = .023$), cell phone confiscation ($p = .011$), and Twitter ($p = .036$) situations. We found that the SROs with at least a four-year degree (M = 3.66) were less likely than their counterparts (M = 4.43) to report that "A student creates a web page making fun of the school principal," warrants a greater law enforcement responsibility. Although making fun of the school principal is unethical, it is not, however, as important as, say, threatening to physically harm the principal. For the cell phone confiscation scenario, we determined that the SROs with at least a four-year degree (M = 1.88) were less likely than their co-respondents (M = 2.75) to believe that "A teacher confiscates a cell phone from a student in class and wants to determine if it contains any information that is in violation of school policy," warrants a greater law enforcement responsibility because a law may not exist that prohibits school teachers from carrying out this act in the SRO's reporting state. Lastly, we found that the SROs with at least a four-year degree (M = 5.22) were less likely than their counterparts (M = 6.16) to report that "A male student reveals another student's sexual orientation (without permission) via Twitter to the rest of the student body," warrants a greater law enforcement responsibility. Although unethical, this incident may not violate cyberbullying law of the SRO's present state.

Directions for Future Research

Our results indicate a need for more research into the demographic differences associated with perceptions of law enforcement's role. For example, we want to know if male and female SROs differ in their perspectives on what the role of law enforcement should be when responding to cyberbullying situations. As we mentioned earlier, about 6,000 SROs received the survey but only 509 (8%) responded and two thirds of those (5.65%) completed it. This indicates we need a larger size sample to yield more reliable results.

We suggest that SROs need more educational and training programs focused on law, procedures, and responsibility. Perhaps, these should be a national requirement for all SROs. Additionally, we support a requirement that SROs address the cyberbullying issues with students and parents at school assemblies and parent-teacher meetings. SROs should also rally parents to push for legislation against cyberbullying because the laws need to catch up with the technology that facilitates the spread of the offenses. Lastly, law enforcement officers need to be proactive and passionate about preventing cyberbullying. In some instances, police officers are involuntarily assigned the position of SRO, one for which they may have no interest, education, or training.

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Bacterial Degradation of Methyl Red Under Carbon Deficient Conditions

by:
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Introduction

Azo dyes--synthetic dyes used for the production of cosmetics, pharmaceuticals, food and textiles--contain at least one double nitrogen (N=N) bond and aromatic rings within their respective structures. Dyes are categorized by the number of azo bonds present within the compound and these can range from single to multiple azo bonds. The color of the dye results from the connection of the azo bonds between the aromatic rings, and the structure of the molecule is referred to as the chromophore (Nigam et al. 1995). The breaking of the chromophore constitutes the first step in dye degradation, which results in the formation of two aromatic amines (Costa-Ferreira et al. 2006).

Azo dyes, produced to withstand fading, have accumulated within some waterways into which dye effluents are discharged. The most obvious result of the discharge of effluents with higher azo dye concentrations is the change in water color within the waterway environment. Understanding consequences of azo dyes in the environment warrants further study; this would help explain biochemical effects on the ecosystem, and possibly to also reveal remediation strategies. Though the fate of these dyes remain largely unknown, a study involving breakdown of the dyes under anaerobic conditions revealed the formation of aromatic amines with potentially carcinogenic effects (Chung et al. 2000). Chung's findings lead readers to infer that effluent from production sites that utilize azo dyes requires remediation, a method(s) capable of efficiently removing the harmful constituents that lie within the wastewater.

Currently different techniques are employed to remove azo dyes from wastewater: coagulation/flocculation, membrane filtration, and advanced oxidation processes (AOP). The limitations of these techniques make them particularly unattractive to manufacturers: they require a high energy demand, and thus incur high costs for the company (especially AOP). In addition, the residual sludge from the flocculation and membrane filtration processes contains azo dye constituents that pose a biohazard and also require further treatment and safe disposal. The ability to degrade azo dyes without the presence of additional nutrient sources rarely occurs (Nigam et al. 1995).

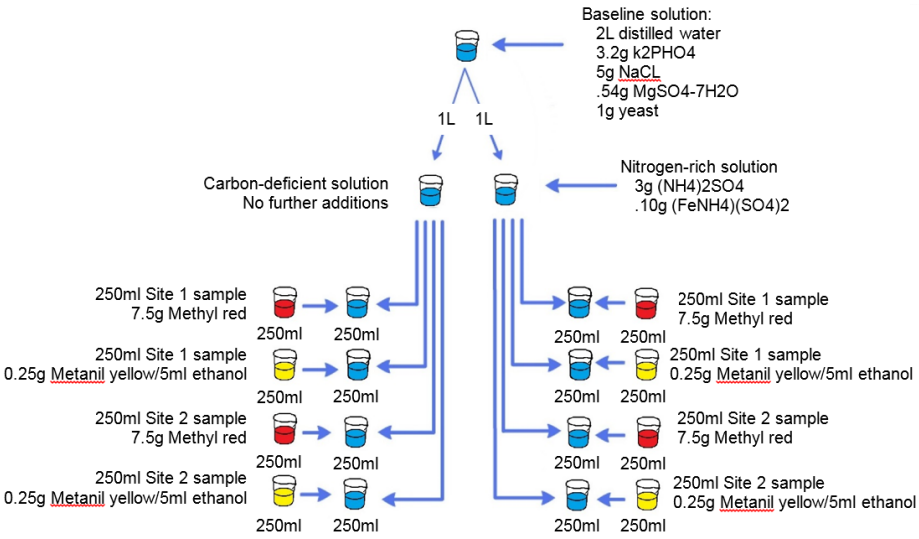
Finding bacteria that could accomplish the degradation process would be especially beneficial, as it would not only address azo dye removal, but also reduce the overall amount of waste that requires disposal. A bacteria capable of consuming azo dye waste products could provide a more cost-effective form of azo dye remediation. The focus of this study is to observe whether bacteria found downstream of paper mill effluent can completely degrade the azo dyes without additional nutrient sources.

Materials and Method:

Collection and Preparation of Samples

Samples of paper mill effluent were taken at two sites on the Wisconsin River--one in Brokaw, WI and the other in Wausau, WI—at approximately 100 yards downstream from paper mills. Nalgene bottles (n=2) were used to collect water, sediment, and biofilms from the shoreline of the river at each site. Figure 1 presents the preparation of test samples.

Figure 1: Preparation of test samples



(a) Site-Sample Solutions

Step One: solutions were prepared by adding 3.2 grams (g) of K2HPO4, 5 g of NaCl, .54 g of MgSO4-7H2O and 1 g of yeast extract to two liters of distilled water. After these solutes were added, the solution was divided into two one-liter aliquots.

Step Two: one liter of the solution was set aside for the carbon source and required no additional components. The remaining solution received 3 g (NH4)2SO4 and .10 g of (FeNH4)(SO4)2 to create a nitrogen source.

Step Three: the two sources were each divided into four 250 milliliter (ml) aliquots. Each sample had 250 ml of the site sample added to them and 7.5 milligrams (mg) of methyl red (n = 4) and metanil yellow (.025 g dye/5 ml ethanol; n = 4) added to them, respectively. Both solutions were stored under stationary conditions at room temperature and unexposed to light sources. Solutions were observed daily for decolorization.

(b) Bacteria Isolation on Columbia Blood Agar and Methyl Red Agar

The spread-plate technique was used to transfer sampled site solutions to Columbia Blood Agar (CBA). Bacterial growth was observed and colonies were isolated based on different morphological characteristics (size, shape, color). Isolated bacteria were individually transferred to methyl red agar (MRA) in order to observe their ability to decolorize the dye.

(c) Carbon Deficient Sources

A carbon deficient source was used to observe bacteria's ability to proliferate without additional carbon sources. Forty milliliters of 10X salts [solution constituents described below] was added to 360 ml distilled H2O and 0.2 g of Casamino Acids and then divided into two 200-ml aliquots. Solutions were autoclaved and each solution had 2-ml of 100X MgSO4 and two 200-microliters (µl) of 1000X iron [solution constituents described below] added. Three milliliters of methyl red dye (.025 g/5 mL ethanol) were added to one solution, while the other solution remained dye-free.

10X salts solution (500 ml) consisted of five hundred milliliters of distilled water, 15 mg of (NH4)2SO4, 8 g of K2HPO4, and 12.5 g of NaCl.

1000X iron solution (10 ml) consisted of .10 ml distilled water, and 5 mg Fe(SO4)

(d) Inoculation of Carbon Deficient Source

Two test tubes were utilized for each sample (n=2) observed. One tube contained the dye and the remained as a dye-free control sample. One milliliter of each solution was placed in separate test tubes. A sample colony of bacteria was aseptically inoculated into individual test tubes. Test tubes were stored under stationary conditions--at room temperature--and unexposed to light.

(e) Transfer of Bacteria to Sequential Test Tubes: Aerobic Conditions

The bacteria were incubated for 24-36 hours in test tubes, and if proliferation was observed, they were transferred to new test tubes. One milliter of sterile dye and dye-free solutions were each placed into autoclaved test tubes. Ten microliters of each sample were serially transferred to dye and dye-free solutions, respectively.

(f) Transfer of Bacteria to Sequential Test Tubes: Anaerobic Conditions

Bacteria were transferred into the dye and control solutions. Samples were covered with an overlay of mineral oil to maintain anaerobic conditions. All samples were observed on a daily basis for growth and dye degradation.

Developments

(a) Carbon and Nitrogen Source

In five weeks, color change was observed in one flask containing methyl red dye as a carbon source. This solution was used to obtain bacteria for further testing of dye degradation. Decolorization of the solution containing dye as the nitrogen source site sample was not observed.

(b) Bacteria Isolation on Columbia Blood Agar and Methyl Red Agar

Solution from the carbon source, transferred to CBA, resulted in colonies that were distinguished by mucoidal/nonmucoidal properties, color, and other morphological features. The morphologically distinct colonies transferred to MRA resulted in nine colonies observed to decolorize MRA. These samples were used to determine the bacteria's ability to decolorize methyl red under carbon deficient conditions.

(c) Decolorization within Carbon Deficient Conditions: Aerobic Conditions

The initial transfer of two separate bacteria, F2 and G2, displayed decolorization of samples within 72 hours. However, sequential transfers to dye solutions did not display decolorization and appeared to darken in color. Within seventeen days, black precipitate formed at the bottoms of the tubes. The darkening of the solution, and the black precipitate, could have resulted from unviable cells, perhaps due to dye toxicity. Tubes that did not contain dyes displayed proliferation of bacteria, perhaps as a result of the bacteria being autotrophic in nature. Thus, even though bacteria proliferated, they proved incapable of degrading azo dyes under aerobic conditions. Previous studies have asserted that, under aerobic conditions, azo dye degrading bacteria must have a specific enzyme for degradation. This enzyme, azoreductase, is highly specific to the substrate that it degrades, and functions under aerobic conditions (Stolz 2001). Although this

process does occur, it is highly unlikely for azo dye reduction to take place under aerobic conditions (Pandey et al. 2007). Observing the inability to decolorize samples under aerobic conditions, we concluded that F2 and G2 do not contain the azoreductase enzyme.

(d) Decolorization within Carbon Deficient Conditions: Anaerobic Conditions

The initial transfer of G2 and F2 displayed dye decolorization within 48 hours. In addition, bacteria proliferation was observed within tubes that did not contain dye. Unlike the case of the aerobic conditions, sequential transfers of bacteria to new media resulted in decolorization of the dye. These results resembled findings that azo dye decolorization is more readily accomplished under anaerobic conditions (Stolz 2001). In future, we will subject the solutions to aerobic conditions. These anaerobic-aerobic techniques will be performed to try to mineralize the aromatic amines that result from the breakage of the azo bond (Adadeyo et al. 2004).

By mineralizing the compound, the toxic components will reduce to a non-toxic compound.

Conclusion

Although it is highly unlikely for bacteria to degrade azo dyes without additional nutrient sources, four bacterial species have been observed to degrade methyl red using the dye as the sole carbon source (Pandey et al. 2007). And, though we have observed two species able to decolorize methyl red, this study requires additional observation to determine whether or not the aromatic amines have been reduced. By doing this, we determine G2 and F2s' ability as azo dye degradation agents.

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Genesis

by:
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Introduction

Many people claim unfamiliarity with graphic novels, much less with graphic novels as a literary medium. They ask, "Is that like a comic book?" While knowing that a comic book is relatively short, typically around 21 pages (many of which are advertisements) a comic book is also part of a series; it can't exist without the one subsequent, or the one previous.

A graphic novel, on the other hand, has length, contains no ads, is self-contained, and typically includes more serious subject matter than comic books because it need not answer to advertisers or censor itself for young audiences. Many times, graphic novels can be compilations of limited run comic series, such as *Watchmen* or *The Dark Knight Returns*. In those cases the original comics are released periodically and then collected into a larger format that is, unlike regular comics, reprinted for years and years. Some, however, like my *Genesis*, which is the subject of this paper, or Brian Azzarello's *Joker* appear as a single book released at one time.

Prototypes

Graphic novels as we know them today have only existed since the 1970s. Some of the modern graphic novels' predecessors include *The Adventures of Tintin in the Land of the Soviets* which Le Petit Vingtieme published in 1930 (Tintinologist 2009). Some fans consider this one of the very first graphic novels, although it initially appeared as a collection of comic strips. Arnold Drake and Leslie Waller's *It Rhymes with Lust* (1950) was touted as a Picto-Fiction; it chronicled a manipulative redhead's adventures in a Pittsburgh-like steel mining town in the expanding U.S. (Phipps 2007). Arnold Drake, the main author of *Lust*, has frequently asserted that it was the first graphic novel, although others dispute this claim (Phipps 2007). Another prototypical graphic novel is *Blackmark* (1971), which resembles many contemporary graphic novels but has large portions of prose, as well as narrative and speech bubbles—details that set *Blackmark* apart from modern graphic novels. And while many argue that it is the first graphic novel, others maintain that, while groundbreaking, this work falls short of criteria typically central to a modern graphic novel (Lander 2002).

The term "graphic novel" first appeared in 1978 on the paperback edition of Will Eisner's *A Contract with God and Other Tenement Stories* (Will Eisner Studios). Of these early examples, this book most closely resembles modern graphic novels, and many scholars and enthusiasts commonly acknowledge it as the first. *Contract* opened the door for followers of this new genre because it contained juxtaposed elements that pushed the envelope of visual storytelling at the time. Not a single cape or mask appeared in any of these four stories—an unusual abscence for a comic book in that time period.

Medium Transitions and Legitimacy

Graphic novels "hit their stride" in the 1980s when the medium began to align with, and influence, movie production in Hollywood. The film adaptation of Alan Moore's *Watchmen* appeared in Spring 2009, even though Moore had written it in 1986 and 1987. Another Alan Moore graphic novel, *V for Vendetta,* was written between 1982 and 1985, but the film did not come out until 2005. Two less well known graphic novels written by Moore, *From Hell* and *The League of Extraordinary Gentlemen*, received little critical acclaim as films. These disappointments forced Moore away from movie reproductions of his work because the films strayed so far from his original source material (Johnston 2005). Similarly, *The Dark Knight Returns*, by Frank Miller, written in 1986, provided much of the visual and script material for the movie *The Dark Knight* which Warner Brothers released in 2008.

Maus, published between 1980 and 1991, won its author Art Spiegelman a Pulitzer Prize for its depiction, via anthropomorphic figures, of the Holocaust. This marked the transition of graphic novels into "real literature." *Sandman: A Midsummer's Night Dream*, by Neil Gaiman and Charles Vess, remains the only graphic novel to win a World Fantasy Award for Best Short Fiction, rather than in the 'Special Award Professional' category where 'comics' are traditionally recognized (Gaiman N.D.; World Fantasy Board N.D.).

The emergence of graphic novels, and comic books, as legitimate, even respected, forms of literature undoubtedly reflects their ever-increasing use as source material for movies. In his column "Come in Alone," Warren Ellis writes:

> It's the belief of several of my peers that the way forward, to attach the potential (as opposed to actual present-day) audience for comics, is to do superheroes really well for a major corporation who [sic.] can force them into the cultural spotlight and into new sales venues. … creating a new boom in the comics business. …These are not stupid people who are saying this. These are smart people who have nothing but the best intentions for the medium as a whole (Ellis 2000, N.P.).

A decade ago Ellis predicted, but did not explain, the symbiosis that would develop between graphic novels and movies. This relationship works because graphic novels are ready-made storyboards for movies. The setting, dialogue, narrative, and character design is all there. When adapting a graphic novel, movie producers have an enriched starting point, an advantage in their work. Conversely, movies then push graphic novels into the spotlight, which reinforces the latter's standing as a literary medium.

Producing *Genesis*

The graphic novel *Genesis*, my first, drew much from the guidance of academic mentors Dr. Joel Pace and Jon Loomis, but the overall experience was admittedly both solitary and lonely. It came to life over most of the summer and fall of 2009 in my room, at my desk, with pencils and pens. At times I felt like I'd jumped in way over my head. As Warren Ellis notes: "We all enter comics on our own. Moving into the fictional world of a graphic novel is not a group pursuit. It is the act of one reader, with one copy of one comic. We all come in alone" (Ellis 1999, N.P.).

As Ellis says, we all come in alone, and that, I feel, perfectly describes the process of creating *Genesis*. The title of my graphic novel, *Genesis*, with biblical connotations only slightly intended, signifies the beginning in a couple of ways: in my path as a writer, and in the characters' lives in the story as well. *Genesis*' plot revolves around a twenty-something college student readying himself for the next chapter in life, whatever that might be. Along the way, the protagonist finds himself caught up in many mishaps beyond his control, all of which result from his acting the Good Samaritan.

Genesis developed from a short story I wrote for a creative writing course, but more importantly from true, but bizarre, events that transpired at the drive-through window of a Burger King in St. Paul, Minnesota. Since that start, the novelized version has grown into a full length piece that looks almost nothing like the original. In between those two stages an outline helped me collect my thoughts, shuffle possibilities around, and pile them in at the right places.

From the outline I moved to storyboarding, rough thumbnail sketches of each panel and scene (Figure 1). A panel is a single box of illustration, and a scene a collection of panels that happen sequentially. To these I added many notes—some about dialogue, some about setting and movement. These storyboards proved handy references when I drew the panels: I always had a sketch of what was supposed to come next, and what I had originally wanted the panel to look like. Oftentimes the panel ended up looking nothing like the original storyboard because I would think of something different or have trouble drawing exactly what I had envisioned. Sometimes I cut out, or added, new panels because the narrative warranted more, or because too many panels appeared in the original storyboard.

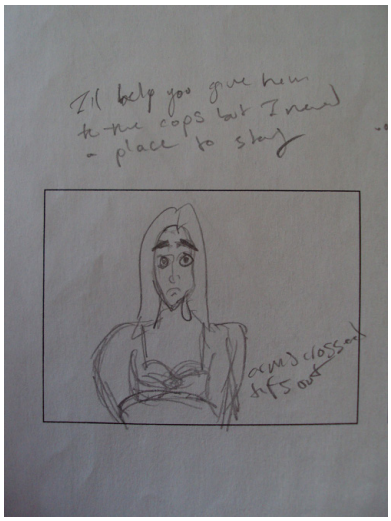

Figure 1: Panel from *Genesis* Storyboard

To aid my drawing, I took pictures of almost every storyboard. I biked all around town, (Eau Claire, WI) to find scene locations for the book. While Eau Claire residents, when looking through *Genesis* might identify some places in the novel, I did take artistic license transforming almost everything, so many places don't exactly resemble their prototypes.

With the outline of the story, and the storyboard, I produced a tentative script. However, this remained liquid the whole time. I never had a concrete script: even when I made my final pages I changed dialogue, either because I found it too wordy or decided the character wouldn't say that. Writing a graphic novel proved very different from the kind of writing I was used to: my other work employs long descriptions of setting and detail, but in *Genesis* the illustrations had to say those things. Thus, I cut the dialogue down to concise, very phonetic verbiage suitable for tight little speech bubbles. Also, the dialogue had to "speak" for itself; since I couldn't describe a person's accent or use of dialect, the dialogue had to show it. Much slang, with phonetic spelling, appears in *Genesis*, although I did allow myself leeway with description inside the narrative boxes.

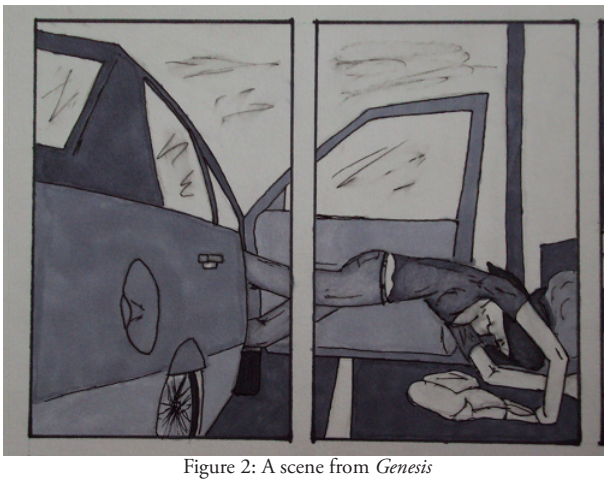
Figure 2: A scene from *Genesis*

Generally when I write, I envision the story becoming a movie: I see scenes in my head and write down what I see. This capability greatly assisted me to complete storyboards and sketches, but when it came to page layout and paneling things took a different turn.

Page layout was tricky. I wanted to lead the reader easily through the story without breaking it up. However, I also wanted to do this more

creatively than a sequential plot, which unfolds box after box after box. As a result, no two pages have exactly the same layout. I used a very wide variety of panel sizes as well, though all of them are rectangular. My "mental-movies" equate page layout with cutting film. I had to figure out where the scene needed to stop, in order to give the reader the most important moment in time.

When I had laid the page out based on the storyboards, I put pencil to page. First, I made a light sketch like that in the storyboard panel, to gauge the fit of everything that belonged in the novel's panel. Following this fast and painless process, I filled in the sketches with a darker pencil, a crucial point in the process and the most labor intensive and time consuming step. I burned through many erasers during this time, eliminating sketches as well as mistakes. Keeping lines very clean and simple made future processes easier and quicker. The photographs I had taken of the area helped greatly, making the process quicker than I think it would have been otherwise. As I am no artist, I took any advantage I could to draw the panels. New scenes emerged out of combinations of different photographs. Drawing won as the most difficult and frustrating of the parts of *Genesis*.

Penciling became the most rewarding and satisfying portion of the process, especially when pages came together as a whole. When I was done, I could stare at the page, at the created scene and follow the story that I had written. A very cool feeling.

Inking followed penciling. Inking makes images permanent leaving no room for error. At first it was nerve wracking, but I found inking enjoyable and rather interesting, though inking made my wrist ache from holding my hand steady to create smooth lines. Another rewarding experience, inking made everything pop out and look even better. To ink, I didn't use any special tool, just a black Uniball Vision pen that flowed effortlessly. The true black color of the ink added great depth to the illustrations and I used the ink for shadow and emphasis. Movement is difficult to show in the graphic novel format. What I did to draw and ink movement in a single panel was outline the drawing several times. That made it seem more than one object appeared there, which gives the illusion that the object is moving.

What I created with my pencils and ink was a big color by numbers, a reasonable project for a person of underdeveloped artistic abilities. *Genesis* uses a gray scale, versus a full color palate, because I envisioned it printed in black and white. This makes production cheaper all around; I didn't have to buy as many markers and I didn't need colored prints. I couldn't recall the last time I'd ever sat down for hours at a time just to color, to relax, and just focus on one thing instead of the million I think about at any given moment during a normal day. I used only three markers, each a different cool, as opposed to warm, shade of gray, and I also used a blending marker to create additional shades and tinted white space.

Figure 3: Images of *Genesis*' protagonist in penciling, inking, and full gray scale stages.

I took a high resolution picture of each finished page to import into my computer; from this I transferred it to the school's computers which include Adobe Photoshop and Adobe Illustrator software. The images' file sizes were very large; every time I saved them in a new program it made a duplicate copy, resulting in using a ton of hard drive space. Using Adobe Illustrator, I created speech bubbles and narrative boxes on top of the pages and entered the dialogue and narrative for each page.

I want to interest a publisher in *Genesis* for distribution throughout the region. Before that can happen I must produce several markups on my own. These markups will be full length, full sized drafts of the novel that I can then send to publishing agents, as well as give to friends who wish to read what I've created. As this is my first foray into the genre, my expectations for *Genesis* are reasonable. I don't expect to see it flying off local bookshelves or climbing the *New York Times* Bestseller list, yet it would simply be nice to have several self-published copies to hold as mementos of the project.

In summary, producing *Genesis* caused me to run the gamut of emotions from love, hate, and anger, to frustration, elation, and happiness. But, in the end, nothing substitutes seeing it come to fruition. This eye opening experience gave me a wealth of knowledge: I know the effort it takes to put a graphic novel together by oneself, and with many projects in mind for the future, all based again on my own short stories, I intend to have a partner, an illustrator for those books. I would not have gotten as much out of the experience had I only written *Genesis*, but I will say it is a lot for one person to handle. Next time I'll ignore Ellis; I won't go it alone!

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The Socially Influential Power of Commercially Successful Musicals *West Side Story* and *In the Heights*: the Good, the Bad, and the Work Left to Be Done

by:
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Despite their glamorous appeal and powerhouse entertainment value, commercially successful "Broadway" musicals are more than just fun and games. "Broadway" musicals have immense power to influence American society, for better or worse. *West Side Story* (1957) and *In the Heights* (2008) are two "Broadway" musicals with similar subject matter and soaring critical acclaim. Separated by more than 50 years, these shows demonstrate positive and negative social influence in the realm of ethnic diversity. *West Side Story* has had a lasting impact on the image of Puerto Ricans in the United States, while *In the Heights* exposes audiences to more true-to-life portrayals of Latino life. Despite the passing of more than 50 years, as well as several landmark changes in American society, audience reactions to *In the Heights* indicate lasting misconceptions about Latinos. With time, and continued dedication to challenging stereotypes and misconceptions, rather than perpetuating them, "Broadway" musicals will come to play a more integral role in American society and the way Americans think about contemporary social issues.

"Broadway" musicals or commercially successful musicals, have significant power to influence society. These productions reach vast numbers of people in New York City and across the country, with performances, as well as dissemination of music, scripts, study materials, books, film versions, and promotional appearances. Unlike other entertainment media, such as television and film, "Broadway" musicals combine spoken dialogue, music, dance, and spectacle, while focusing viewers on a specific story for a specific length of viewing time. Television and movies can in rare instances incorporate these elements all together, but audiences are less "captive" to the performance. Changing channels in your own living room or walking out of a movie you paid ten dollars for may prove easier than leaving a "Broadway" musical production. Tickets for "Broadway" musicals are significantly more expensive than television viewing or a night at the movies, and are often highly sought after. Some "Broadway" musicals feature actors and actresses who have already become famous on television and in films, so in addition to already beloved "Broadway" performers, these other actors create an even higher level of attraction. Current ticket prices for "Broadway" musicals such as *The Lion King* and *Mary Poppins* run between $30 and $130 or more.[1]

The influential social power of "Broadway" musicals lies in their ability to entertain audiences and to engage them in social discourse. Many "Broadway" musicals reference, sometimes more subtly or more blatantly than others, controversial social issues that are difficult to approach in everyday life because of misunderstandings and fear. A theatre production allows viewers social safety in relationship to controversial social issues. As viewers, they are (usually) not required to participate directly in the social discourse playing out onstage. Rather, they can survey, individually or with a fellow theatre-goer, and formulate opinions and perspectives without pressure to engage directly in discourse that may be controversial. Removing pressure to engage directly allows viewers to learn and develop social understandings in a non-threatening environment, and such

[1] www.ticketmaster.com, copyright 1999-2010.

an environment could free them of some of the fear that may otherwise hold them back from participating in social discourse in everyday life. Once viewers have experienced a "Broadway" musical and have gained a better understanding of a contemporary social issue, they may also be able to use their viewing experience as a gateway to breech related social issues in their everyday lives.

"Broadway" musicals possess great power to influence American society, but this power can be positive as well as negative. In order to positively influence society, musicals must challenge or reject stereotypes that fuel misperceptions and get in the way of positive social discourse. Despite good intentions, too many products of American entertainment media perpetuate stereotypes. Some stereotypes, or archetypes, can help audiences relate to characters and situations; others can damage the image of a person or group of people. The musical *West Side Story* shows the influential power of "Broadway" musicals and the negative effects they can have on American society. *In the Heights*, separated by more than 50 years from *West Side Story*, demonstrates some of the positive influential effects of musicals, but still shows signs of lasting misperceptions about Latinos in the U.S. Musicals such as *In the Heights* show a move on "Broadway" towards more true-to-life portrayals of people and issues in America and the growing importance of exposing significant social issues onstage.

West Side Story was originally based on a 1949 American play about a modified Romeo and Juliet conflict between Catholics and Jews after World War II. Early on, the idea of basing the musical on opposing religious groups was left behind because of flagging contemporary resonance, and the project stalled until creators Arthur Laurents and Leonard Bernstein came upon a newspaper article about gang warfare in New York City. In the article, Puerto Ricans took center stage in the conflict and the urgency of the situation was attractive for a contemporary musical storyline.[2] Frances Negrón-Muntaner explains in her article about *West Side Story* and Puerto Rican identity discourse that despite the relevancy of the dramatic concept overall, critics and creators alike agree the musical was never meant to be about Puerto Ricans. Regardless, the Puerto Rican gang in the story drew negative attention from the very beginning. When Laurents and Bernstein began to seek others to join their creative team, lyricist Steven Sondheim initially refused to take part in the project because he admittedly knew nothing of Puerto Rican life.[3] Such a statement from just one of the creators, all of whom hailed from Jewish-American backgrounds, is distressing in comparison to the length at which Puerto Ricans are represented in *West Side Story.* To his credit, Bernstein has written about preparing for the show with research into Puerto Rican culture in New York, but the extent to which his research found its way into the production remains in question.[4] What is unfortunate, Negrón-Muntaner points out, is that despite the lack of truthfulness in *West Side Story,* its portrayal of Puerto Rican people and communities has become a "name brand" for Puerto Rican culture, a name brand that has found its way—for better or worse—into the perspectives of both Puerto Ricans and non-Puerto Ricans.

In the original "Broadway" cast production, the principal Puerto Rican characters in *West Side Story*, except for Anita, were played by white American actors. The use of white actors reflects not only the lack—or absence—of Puerto Rican artists on "Broadway" at the time, but also a sense of caution on the creators' part about presenting racial "others" onstage. Using white actors to embody the interracial love story between Tony and Maria may have resulted in a more socially comfortable viewing experience for audiences.[5] In this way, the viewing experience did allow viewers social safety, but it sheltered them from their fear of an ethnic group, not

[2] Negrón-Muntaner, Frances. "Feeling Pretty: West Side Story and Puerto Rican Identity Discourses." Social Text 18.2 (2000): 90.

[3] Ibid., 84.

[4] Ibid.

[5] Ibid., 91-92.

from fear of an idea. Carol Lawrence played Maria, and George Chakiris played Bernardo. The script describes Maria and Bernardo in convergence with already established stereotypes about Puerto Ricans. The script explains that Maria is "an extremely lovely, extremely young girl… an enthusiastic, obedient child, with the temper, stubborn strength and awareness of a woman."[6] Negrón-Muntaner links this description to a viriginal Latina persona vulnerable to victimization.[7] The script details Bernardo as "handsome, proud, fluid, [with] a chip on his sardonic shoulder."[8] These adjectives are confluent with prescribed stereotypes of Latino male criminality and sexuality.[9] Anita's personality dovetail's on Bernardo's. She is "a Puerto Rican girl with loose hair and slightly flashy clothes…[she] is knowing, sexual, sharp."[10] This description conjures the same embodiment of sexuality as well as the infamous Latina "spit-fire".

Due to the nature of the conflict between the Jets and the Sharks, the Puerto Rican teens are often the butt of insults and mockery. At the beginning of Act One, the Jets and the Sharks make their first appearances; after some of them have scuffled, a police officer shows up. He obviously favors the white gang, and joins them in their hatred towards the Puerto Rican teens. After greeting both gangs and inquiring about the scuffle, he says "Boy, what you Puerto Ricans have done to this neighborhood...[The officer explains the need for the white gang's cooperation in order to keep the peace in the neighborhood so that he can keep his job. After the Sharks are dismissed, continues]... If I don't put down the roughhouse, I get put down…So you buddy boys are gonna play ball with me. I gotta put up with them and so do you. You're gonna make nice with them PRs from now on."[11] This treatment of the Puerto Rican teens fits the nature of the conflict in the musical, but it also indirectly puts Puerto Ricans down and makes them out to be deserving of negative stereotypes. At the conclusion of the musical, after the rumble and Bernardo's death, Anita ventures into the night to speak to Tony on Maria's behalf. Anita must face the Jet gang at the drugstore in order to get to Tony's hiding place in the cellar. As she tries to make her way to the cellar door, the Jets ridicule her and block her way. They prattle mockingly in Spanish and force her to act subordinately as she tries to calmly move past them. Eventually the situation escalates and the Jets close in on Anita, screaming insults such as "Bernardo's tramp!", "Bernardo's pig","lyin'Spic", "Gold tooth!", and "Garlic mouth!"[12] The Jets shove Anita in a corner and are about to attack when the owner of the drugstore returns and stops them. It is clear what would have happened had he not appeared. This frightening scene violently perpetuates stereotypes about Latino sexuality and it validates the forcing of another ethnic group to act subordinately. Scenes such as this may fit into a musical like *West Side Story,* but the stereotypical implications have a greater and more lasting impact than the scene's dramatic value.

The manner in which the Puerto Rican characters were portrayed onstage only furthers the stereotypes they represent. The original Broadway cast recording of *West Side Story* gives evidence to the controversial Puerto Rican accent Carol Lawrence applied to the character Maria. The accents found in musical numbers such as "Tonight" and "One hand, one heart" were poorly executed and made an overly simplistic mockery of Puerto Ricans and their language.[13] The character Anita has attracted particular controversy because of the "America" musical number. At a gathering of the Shark women, Anita chides the other girls for talking incessantly about their old home in Puerto Rico. After Rosalia expounds on the beauty of the island at the beginning

[6] Richards, Stanley. "West Side Story." Ten Great Musicals of the American Theatre. Radnor, PA: Chilton Book Company, 1973. 361.

[7] Negrón-Muntaner, "Feeling Pretty", 83.

[8] Richards, "West Side Story", 352.

[9] Negrón-Muntaner, "Feeling Pretty", 85.

[10] Richards, "West Side Story," 361.

[11] Ibid., 353-354.

[12] Ibid., 407-408.

[13] Negrón-Muntaner, "Feeling Pretty", 91.

of the musical number, Anita mimics her, singing "Puerto Rico, you ugly island, island of tropic diseases. Always the hurricanes blowing, always the population growing, and the money owing, and the babies crying, and the bullets flying. I like the island Manhattan, smoke on your pipe and put that in!"[14] The sarcastic manner in which Anita sings these contentious words indicates her dislike for her homeland. Indeed, as the musical number continues she meets all of her friends' lauds of Puerto Rico with equally matched attacks. This musical number, while explaining some of the possible reasons Puerto Ricans might have left the island to come to New York, also clearly denounces Puerto Rico in favor of the United States. In an interview with National Public Radio, Rita Moreno, the Puerto Rican actress who played Anita in the 1961 film version of the musical, shared her fear of performing the original words to the "America" number. Moreno worried about the reaction the musical number would draw from Puerto Rican audiences, and whether they would blame her for denouncing her birthplace. The words to the number were altered to lessen their offensive effect, but Moreno still reported nagging feelings of her failure to represent her people in a positive light.[15]

Dependence on stereotypes in entertainment media will always be a reality, and in some cases stereotypes can be put to good use. But in *West Side Story*, the stereotypes of Puerto Ricans are not challenged. In actuality, the Puerto Ricans are ridiculed and mocked in the script and the characters act predictably in congruence with their respective stereotypes. Maria falls naively into forbidden love, instigates conflict between the two gangs, then wishes to run away to escape the consequences. Bernardo resorts to violence to solve the problems of his gang and to protect his sister Maria, but is later murdered. Anita, after preparing herself for a sexual rendezvous with Bernardo, must face the victimizing Jet gang to try to save Tony. But upon learning of Bernardo's death, she is left in a heartbroken rage and reprimands Maria's naïve behavior. The superficiality of these characters does not allow for a better understanding of who they are. They serve the drama and the initial intentions of the musical, but this intended purpose does not supersede the lasting impact their images had and still have on America's perceptions of Puerto Ricans.

The 1950s were a tumultuous time in American race relations, especially for African-Americans, and it is no surprise that an American musical of the same time period would poorly represent Puerto Ricans. The events of the Civil Rights movement show plainly the abundance of prejudice, fear, and resistance to change that was seeping through American ideology in the 1950s.[16] These harmful sentiments, aimed at a racial group that had already been present in American society for a century or more, surely translated to an ethnic group that had even less exposure in the United States. In the same interview with National Public Radio, Rita Moreno explained the difficulty she had as an actress in New York City and the way she faced unceasing racial prejudice in show business and in everyday life.[17] This begs the question: given the state of race relations in the U.S. in the 1950s, and the non-mimetic intentions of the musical, could *West Side Story* have done a better job representing Puerto Ricans? Exposing American audiences to some semblance of Puerto Rican life in the 1950s must have been important to asserting the development of multicultural America, and in any case Puerto Ricans should not have been excluded from the subject matter of musical theatre productions or any entertainment media. However, for creators Bernstein and Laurents, investing in more familiar subject matter or spending more time in research could have resulted in less damaging approaches to *West Side Story*.

There seems to have been little forethought about Puerto Ricans' reaction to *West Side Story*; though there was likely little concern about their presence in "Broadway" audiences. Some

[14] Richards, "West Side Story," 372.

[15] *Acclaimed Actress Rita Moreno on Life, Longevity in the Arts*, dir. Michel Martin, National Public Radio, 2007.

[16] Bruce J. Dierenfield, "The Jim Crow South and Origins of the Movement," The Civil Rights Movement: Revised Edition (Edinburgh Gate: Pearson Education Limited, 2008).

[17] Martin, *Rita Moreno*.

Puerto Ricans may not have seen the musical until the film version in 1961.[18] But would *West Side Story* still work if the Puerto Rican Sharks were replaced with another group of teens? Or would the switch only serve to stamp another ethnic group with a "brand name"? Contemporary revivals could give West Side Story new meaning by refocusing audiences on the larger, over-arching themes such as racism, police brutality, and violence. These re-mountings, based on better understandings of discourse on racial and ethnic issues in American society, and the creative freedom to insert any cultural groups and settings into the story, have the potential to reorient audiences to what has been a highly controversial as well as critically acclaimed production.

Fast forward more than 50 years when *In the Heights* (2008) moved to "Broadway" status and won a Tony award for Best Musical. The story was meant to showcase a Latino community and was conceived of and composed by a young Latino-American. Nearly all of the actors in the original Broadway cast were of Latino background, and no white American characters appear in the story. Like *West Side Story*, *In the Heights* broaches significant social issues such as ethnic identity, gentrification, and the need for quality education, all of which impact Latinos and other ethnic groups in the U.S. However, the characters who convey the story are not stereotypes, but rather, archetypes, and their personae help audiences relate to what is happening onstage. More importantly, and perhaps not surprisingly, the characters are relatable across racial and ethnic boundaries and show alignment with American ideals, which is certainly a factor in the success of this production. Without question, the relatability of the characters stems from the social reality of assimilation in the United States. Many of the characters show some move towards Americanization, whether it be the way they dress, or the nature of their ambitions.

Relatable archetypes can also help encourage social change outside of the theatre. In an essay on Chicano theater, authors Bruce-Novoa and Valantin describe how socially progressive Chicano theaters in the U.S. effectively move audiences to social action long after the curtain has fallen.[19] The term Chicano refers to a social movement that began in the 1950s and advocated for the empowerment of Mexican people in the United States.[20] Since then, Chicano theatres have developed across the country and provide platforms for the exploration of social issues, as well as opportunities for Latino actors, playwrights, producers, and theatre technicians. The authors acknowledge stereotypes as valuable tools for relating to audiences, writing that despite negative connotations, common stereotypes or archetypes allow audiences to relate and sympathize with characters and their ambitions. When audiences can see themselves in the characters onstage and align with their perspectives, they may be more likely to connect to the overarching themes and messages encapsulated in the story. The challenge is to create relatable characters who are shown to be aligned with accepted social and cultural traditions: characters whom audience members view as "us" grouping, rather than as "them." When audiences feel they can relate to the characters as "us," they may be more likely to accept challenges to make changes in their own lives. When characters oppose cultural and social traditions, audiences can become alienated and may resist consideration of ideas put forth onstage.[21] This approach to stereotypes seems to permeate American entertainment media more often than the superficial approach found in *West Side Story*, though the extent to which audiences are challenged to social change varies significantly.

The recognizable personae embodied in the characters in *In the Heights* help audiences quickly relate to, and sympathize with, them. Not surprisingly, the qualities that make these characters most attractive are congruent with the most traditional of American ideals such as individu-

[18] Negrón-Muntaner, "Feeling Pretty," 83.

[19] Bruce-Novoa, John D. and David Valentin, "Revolutionizing the Popular Image: Essay on Chicano Theatre," Latin American Literary Review 5.10 (1977).

[20] Levinson, David and Melvin Ember, "Mexicans," American Immigrant Cultures, vol. 2 (New York City: Simon and Schuster Macmillan, 1997).

[21] Bruce-Novoa and Valentin, "Revolutionizing the Popular Image," 43-45.

alism, hard work, friendship, and the importance of the family structure. For example, the female lead Nina embodies an "ambitious girl" persona. Throughout her life she has worked towards her goal of attending college, and her determination and level-headed attitude have helped her achieve this goal. Nina is well liked in her neighborhood and is a positive role model for others. But, she is thrown off course when she loses her scholarship and must overcome challenges to reconcile her relationship with her disappointed parents and to find a way to return to school. The male lead Usnavi embodies a "good guy" persona. An attractive young adult, Usnavi runs a relatively successful bodega in his neighborhood, plays a positive role model for his younger cousin, takes care of his abuela, offers comic relief to others, and despite his good intentions, has bad luck with women. The characters Nina and Usnavi both show alignment with American ideals such as hard work, individual determination, and the importance of family. Ironically, the characters who embody these ideals are not white Americans, but rather Latino Americans. This reality demonstrates a key difference between *West Side Story* and *In the Heights*. Latino characters once portrayed as unwelcome outsiders who were ridiculed and mocked by white American characters, now embody American ideals in conflict with white Americans (a theme which receives only indirect treatment within the story).

Actually, the tables are turned in *In the Heights*. The absence of and lack of concern for white American characters, the tight-knit nature of the Latino community, and the abundant use of Spanish places white American viewers in an outsider position at first, but also offers them an opportunity to be part of a minority ethnic group. Though the Latino characters embody recognizable archetypes that make them relatable across racial and ethnic boundaries, the absence of white American characters prevents white American viewers from feeling completely a part of the community onstage. The archetypes encourage mutual understanding and commonality, but a white American still does not belong. Additionally, the musical spotlights a Latino neighborhood in New York City. Not all viewers have experienced a community in which everyone is of a similar ethnic or racial background and in which family ties, lifelong friendships, and family-owned businesses form the basis of the community's functioning. Though communities such as these draw admiration, not all viewers will have experienced the same sense of fitting into and serving their neighborhood. Granted, no matter what the nature of a "Broadway" musical, not all viewers will feel a part of the community onstage. But in comparison to the way *West Side Story* encouraged separation and fear of another ethnic group, *In the Heights* encourages viewers to learn and appreciate another ethnic group while building a sense of commonality through archetypes and common American ideals.

The use of Spanish in *In the Heights* draws particular interest, partly because of its power to put viewers in an outsider position, but also because of its power to show the importance of maintaining one's first language as a way to maintain one's identity. One of the primary themes of the show is the struggle to maintain one's identity while seeking success in the United States, and upholding the Spanish language becomes one of the ways the characters face this challenge. *West Side Story* also has instances of Spanish, mostly in the form of single words and short phrases. These instances have little power to alienate audiences, as most of them occur in familiar situations in which the words are recognizable or can be deduced based on what is happening. In this case, Spanish serves only to add novelty, and helps solidify the Puerto Rican's role as a group of ethnic "others." Moreover, the poor execution of Spanish accents previously discussed further negates the well-intentioned utilization of Spanish in this musical.

Spanish words and phrases are interspersed with high frequency in the dialogue and music of *In the Heights*. For example, the recurring catch phrase and theme in the show is "Paciencia y fay" or "Patience and faith". As part of my research, I was privileged to attend two performances of this musical in July of 2008, just months after the show gained "Broadway" status and won

a Tony Award. I am familiar with bits and pieces of the Spanish language, and would have fared well at a production of *West Side Story,* but as an audience member at *In the Heights* I found myself lost in a long thread of Spanish words and phrases that ran through nearly all of the dialogue and music. Similar to my experience viewing the film version of *West Side Story*, I could relate to situations happening onstage and could deduce what the Spanish might mean, but I felt more lost and that I was missing out on part of the story. On the other hand, one musical number during the opening of the second act helped solidify the importance of the Spanish language to the community onstage and in reality. The beginning of act two opens at dawn, after the neighborhood's annual Fourth of July celebration. In the midst of the chaos caused by a power outage the previous night, Nina and Benny have reconciled their troubled relationship and have spent the night together. They emerge on Benny's fire escape as the sun comes up. Nina has been teaching Benny some Spanish words as a way to help him fit in better with her family. It is implied earlier in the musical that Benny does not belong to the Latino community, though his ethnic background remains in question. (This implied interracial or interethnic relationship ironically mirrors the central conflict in *West Side Story.*) On the fire escape, Nina tests Benny on words such as esquina, tienda, and bombilla. As the song progresses, Benny asks desperately how to say words such as "call me," "blue," "love me," and "embrace me."[22] The number ends as other members of the community emerge from their apartments to begin the day, all relieved by the passing of the chaotic night.

The "Sunrise" number shows the importance of the Spanish language in the Latino community in *In the Heights*. Benny's struggle to learn words and phrases in order to please his love interest's family indicates the connective and inclusive role of the language in the community and within families. It also provides an unexpected and subtle opportunity for the audience to learn Spanish. Whether this was an intention of the number remains unclear, but conscientious viewers will take the opportunity to experience being part of a linguistic minority and to appreciate the importance of language in a community.

In the Heights shows the progress that has been made on "Broadway" and in American ideology since the time of *West Side Story*; however, reviews of *In the Heights* reveal perceptions about the Latino community that clearly indicate that the job is not yet finished. In an interview on *The Today Show*, Lin Manuel-Miranda shared that the musical had enjoyed great success in the Latino community, but white American viewers found the show too idealistic and not true to life. Miranda says "…It was very funny to read the English reviews and the Spanish reviews of *In the Heights*…the English reviews said 'This was great but it's a really unrealistic view of the neighborhood' and the Spanish reviews were 'This was really great and finally a realistic view of our neighborhoods.'" Miranda mentioned white audience's lasting perceptions about Latinos living in communities wracked with gang violence and drugs, and though he acknowledged the reality of such communities for Latinos and other ethnic groups in the United States, he asserted that not all Latinos live this way and that he hoped the show will lead others to that same realization.[23]

When the musical first appeared on "Broadway" in March 2008, *New York Times* theater critic Charles Isherwood wrote a review embedded with subtle hints of lasting misperceptions of Latinos in the United States. He described the character Vanessa as "all legs and voice", and described actors' portrayals as "generously seasoned with plenty of sugar and spice."[24] These comments subtly hint at the same stereotypes of Latino sexuality and "spit-fire" personas that have permeated American culture since the 1950s. Isherwood's review is positive in nature but reflects a superficial and seemingly popular understanding of Latinos. Whether his writing reflects his

[22] Sh-K-Boom Records Inc, In the Heights Original Broadway Cast Recording and Lyrics, New York City, 2008.

[23] The Today Show."We the People" online series. 2009. Accessed 08/01/10 http://today.msnbc.msn.com/id/26184891#31397530.

[24] Isherwood, Charles. "The View from Uptown: American Dreaming to a Latin Beat." The New York Times online, 2008. Accessed 08/01/10.

own views of Latinos or a desire to relate to readers' views of Latinos, it shows the need for better social understanding and the importance of dismantling misperceptions.

Where will "Broadway" musicals go from here? Their power to entertain and to influence has remained constant over time and has demonstrated positive and negative effects on American society. The beloved musical *West Side Story* demonstrates how a "Broadway" production can have lasting negative effects on the image of an ethnic group in the United States. *In the Heights* shows a much more positive treatment of a similar ethnic group, and provides an example of how a "Broadway" musical can challenge misperceptions and positively influence society in the realm of ethnic diversity. The question remains: if producers continue to harness the socially influential power of "Broadway" musical productions while dedicating themselves to challenging stereotypes and misperceptions, will audiences continue to dedicate their time and money to filling seats at these productions? Entertainment has always been at the heart of this American art form, and if this remains so, audiences will need little other enticement to walk down the "Great White Way".

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Correlates of Academic Achievement Motivation Among Underrepresented College Students

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Abstract

The purpose of this study is to determine the relationship between socioeconomic status, perceived social support, perceived discrimination, and ethnic group identification on the academic achievement motivation of underrepresented (i.e., minority, low income, and first generation) college students. Psychological scales will be used to profile students' perceived social support, perceived discrimination, and his or her ethnic group identification. The students' socioeconomic status will also be reported and recorded. Self-efficacy, intrinsic value, and self-regulated learning will be measured through psychological scales to identify the motivational processes of academic achievement. Additionally, participants' GPAs will supply another measure of academic achievement and motivation. We expect to observe that high socioeconomic status and high perceived social support will be positively associated with academic achievement motivation, and that high ethnic group identification and high perceived discrimination will be negatively associated with academic achievement motivation. This research adds pertinent knowledge to the field of psychology about the academic achievement motivation of underrepresented students.

Introduction

According to the National Center for Education Statistics (2010), the percentage distribution of students enrolled in degree-granting institutions by race/ethnicity from fall 1976 through fall 2009 shows distinctly low percentages of Black, Hispanic, Asian/Pacific islander, American Indian/Alaska Native students enrolled in degree-granting institutions compared to White students. The National Center for Education Statistics (2010) also published reports that higher percentages of Asian/Pacific Islander and White 4th-graders and 8th-graders scored at or above proficient on the 2005 National Assessment of Educational Progress reading assessment than did American Indian/Alaska Native, Black and Hispanic students at the same grade levels. It is evident that a gap exists between minority and non-minority students as far as attending and achieving in school. Academic achievement and motivation among minority and non-minority students need to be examined in order to understand and address the discrepancy between the two groups.

Countless variables relate to a student's academic achievement motivation. In an effort to understand academic achievement motivation across various factors, we have identified four factors that have all been found to independently hold a relationship to academic achievement motivation in order to find a more multidimensional model. We have included socioeconomic status (SES), perceived social support, ethnic identity and perceived discrimination as factors relating to academic achievement motivation. These variables were selected for the present study because previous research has shown them to be significantly related to academic achievement motivation. Our intent is to determine the relationship between SES, perceived social support, ethnic identity and perceived discrimination on the academic achievement motivation of underrepresented (i.e., minority, low income, and first generation) college students.

Socioeconomic status

Sirin (2005, 417) found a medium to strong socioeconomic status-achievement relation in a meta-analytic review of research. That work displayed that the academic achievement of a student is strongly influenced by parents' location in the socioeconomic structure (Sirin 2005, 438). Specifically, social capital and resources at home are indirectly and directly provided to children through family socioeconomic status, which sets a student up for better academic performance (Sirin 2005, 438). According to Coley (2002, 5-6), beginning kindergarteners in higher socioeconomic groups are more likely to be proficient in reading and mathematics than kindergarteners in lower socioeconomic groups. In the fall of kindergarten, higher socioeconomic status predicts higher initial reading achievement and more rapid reading growth per month for students (Aikens and Barbarin 2008, 243). Family context best explains the differences among socioeconomic status in kindergartener's initial reading achievement, whereas schools and neighborhoods best explain the differences in socioeconomic status in kindergarteners' rates of monthly reading growth (Aikens and Barbarin 2008, 247). Furthermore, simply attending a school where the average socioeconomic status of the student body is low can impair learning and achievement. As Palardy (2008, 36) discovered, receiving an education in low social class schools (low mean socioeconomic status of students in attendance) can be harmful to students' learning. Students attending low social class schools experience less favorable learning conditions in comparison to students attending high social class schools (Palardy 2008, 36). In particular, students who attend schools where the mean socioeconomic status of students in attendance is low typically started school with lower achievement and learned less across four years of high school than students attending schools with a high mean socioeconomic status of students (Palardy 2008, 37). Academic achievement is the ultimate goal, however, that cannot be attained or measured if a student is not even enrolled. The National Center for Educational Statistics (2010) reported that from 1970 through 2009, the percentage of high school dropouts among people ages 16 to 24 years old increased as family income quartile decreased.

Perceived social support

Parental involvement has a direct and positive effect on grades among high school students, but does not indirectly have an effect on grades through homework (Fehrmann, Keith, and Reimers 1987, 333). In addition, since spending time on homework predicts higher grades, parental involvement that centers around encouraging students to spend more time on homework could indirectly lead to higher grades (Fehrmann, Keith, and Reimers 1987, 335). Parental social support is a significant predictor of college grade point average, whereas social support from friends and romantic partners does not significantly predict grade point average (Cutrona et al. 1994, 376). Parental support as a predictor of grade point average was significant even across a heterogeneous group of college students (Cutrona *et al.* 1994, 375). A study that employed the Multidimensional Perceived Social Support Scale found that total level of social support emerged as a significant independent predictor of academic achievement for college students (DeBernard, Spielmans, and Julka 2004, 9). The number and quality of a student's attachments to others and to key institutions improves the likelihood that he or she will finish school (Marcus and Sanders-Reio 2001, 437). Secure family attachment promotes the social and academic competence required to achieve in school (Marcus and Sanders-Reio 2001, 437). The structure and stability of family, a higher number and quality of family connections to formal education, and knowing peers enrolled in school are all connections that enhance the chances a student will graduate (Marcus and Sanders-Reio, 2001, 437). Parents who read to a student at home, provide a space for educational activities, and ask questions about school engage in home-based involvement activities, which relate strongly to preschool classroom competencies such as motivation, attention,

task persistence, reception of vocabulary skills, and low conduct problems (Fantuzzo *et al.* 2004, 474). Overall, parental school involvement promotes achievement by increasing social capital (i.e., skills and information that help students succeed) and social control (i.e., communicating appropriate school behavior for students) (Hill and Taylor 2004, 162).

Ethnic identity

There is a divide in the literature regarding the relationship between ethnic identity and academic achievement. Some research points to ethnic identity as negatively correlated to academic achievement while other research notes that ethnic identity is positively related to academic achievement.

Ethnic identity as a barrier to achievement

As Fordham (1988, 58) noted, in order to achieve mobility and dodge stigma, some Black Americans undertake attitudes, behaviors, and characteristics that are "un-Black," or not typically attributed to Black Americans or to the Black community. In an effort to excel academically, Black Americans are encouraged to push their children to display behaviors and attitudes that are uncharacteristic of the Black community, which means dissociating with ethnic identity (Fordham 1988, 82). Grade point average among 9th and 12th grade alienated students (low levels of racial centrality, private regard, and public regard) was significantly higher in comparison to idealized students (high levels of racial centrality, private regard, and public regard) (Harper and Tuckman 2006, 395-396). Research also shows that priming for race and the stereotypes related to an ethnic group's intellectual ability among African Americans depresses their standardized test performance in comparison to White participants (Steele and Aronson 1995, 808). When conditions are created to alleviate the stereotype threat, performance improves among African Americans, which equates the two groups if differences in SAT scores are controlled (Steele and Aronson 1995, 808). Even students of color who identify highly with academics are more likely to withdraw from school, but Caucasian students' identity does not significantly influence withdrawal rates (Osborne and Walker 2006, 563).

Ethnic identity as a motivator for achievement

Researchers found that holding high centrality, strong group pride, and positive beliefs about society's views of African Americans all relate to more positive beliefs regarding academics, meaning that ethnic identification functions as motivation (Chavous, *et al*. 2003, 1086). Furthermore, more research found that adolescents' ethnic identity holds a positive relationship to school achievement and engagement (Taylor *et al.* 1994, 21). Gender differences have been found as well for ethnic identity. For boys, racial centrality is positively associated to school performance and attitudes of school importance (Chavous *et al.* 2008, 650).

Perceived discrimination

Members of lower status groups are more likely to report that they have been victims of personal discrimination on the basis of ethnicity compared to members of higher status groups (Major *et al*. 2002, 273). Also, for low-status groups, more ingroup identification is related to greater perceived discrimination than it is for high-status groups (Major *et al.* 2002, 273). If members of low-status groups endorse the ideology of individual mobility, they are less likely to think negative outcomes from high status group members are due to discrimination (Major *et al.* 2002, 280). For both Black and White students, lower feelings of discrimination play a part in higher college performance (Nettles, Thoeny, and Gosman 1986, 306). Overall, African American students have significantly lower academic integration ("students' perceptions about

the availability and attitudes of faculty with regard to providing informal and formal contact to discuss school work or career plans"), feel less like their university is nondiscriminatory, are less satisfied with their university, face more interfering problems, and possess worse study habits in comparison to White students (Nettles, Thoeny, and Gosman 1986, 309). Also, Black students have significantly lower cumulative college grade point averages, high school grade point averages, composite SAT scores, and socioeconomic status compared to White students (Nettles, Thoeny, and Gosman 1986, 302). When African American students are more aware of discrimination, they perceive academic achievement to be less important and are therefore less engaged in their schoolwork (Taylor *et al.* 1994, 21). Experiences of discrimination that African-American adolescents encounter by peers and teachers are potential threats and risks to academic motivation (Wong, Eccles, and Sameroff 2003, 1221). Across genders, lower 8th grade achievement was related to more reports of classroom and peer discrimination (Chavous *et al.* 2008, 648). In relation to discrimination, individuals high in stigma consciousness do not typically undertake opportunities to invalidate the stereotypes about their group (Pinel 1999, 126).

A relation between discrimination and ethnic identity has also been found. For African-Americans, possessing ethnic identity acts as a promotive and protective factor because the identification compensates for and buffers against the influence of discrimination (Wong, Eccles, and Sameroff 2003, 1223). Gender differences exist in this case as well. Higher racial centrality in boys acts as a protective factor for grade point average and importance of school since higher racial centrality is related to less risk for the negative influence of classroom discrimination (Chavous et al. 2008, 637). Girls with higher centrality are shielded from the negative influence of peer discrimination on school importance and academic self-concept (Chavous et al. 2008, 637).

Self-efficacy, self-regulated learning and intrinsic value

Self-efficacy, self-regulated learning, and intrinsic value have been shown to relate to academic attainment and even hold interrelationships. Self-efficacy is an individual's belief about his or her capabilities to produce a certain level of performance (Bandura 1994, 1). As cited by Zimmerman (1990, 4), metacognitively, motivationally, and behaviorally active students who put forth these characteristics into their own learning are students who self-regulate their learning. Additionally, self-regulated students respond to feedback about the effectiveness of their learning and hold self-perceptions of academic accomplishment (Zimmerman 1990, 5). An individual is intrinsically motivated when the performance of an activity is done for the purpose of its inherent satisfaction, not for separate consequences such as rewards (Ryan and Deci 2000, 56). Self-efficacy and intrinsic value are positively associated with student cognitive engagement and academic performance (Pintrich and De Groot 1990, 37). Although intrinsic value does not have a direct effect on academic performance, it is strongly related to self-regulated learning (Pintrich and De Groot 1990, 37). Initiative, intrinsic motivation, and personal responsibility are all characteristics of students who achieve particular academic success (Zimmerman & Martinez-Pons, 1988; Zimmerman 1990, 14). Self-efficacy and goals setting, when combined together, contribute to academic achievement (Zimmerman, Bandura, and Martinez-Pons 1992, 674).

Current Research

In sum, higher socioeconomic status and greater social support are related to higher academic achievement motivation. Discrimination is linked to lower academic achievement motivation. The literature is divided on the correlates of ethnic identity with academic achievement motivation. In order to study our predictor variables, we disseminated an online survey via *Qualtrics* to undergraduate students at the University of Wisconsin-Eau Claire that contained

valid and reliable psychological scales previously used and published by other researchers. Based on a review of the literature, we hypothesize that high socioeconomic status and high perceived social support will be positively associated with academic achievement motivation, and that high ethnic group identification and high perceived discrimination will be negatively associated with academic achievement motivation.

Method

Participants

A total of 242 (86 male, 322 female, 2 other) undergraduate students enrolled at the University of Wisconsin-Eau Claire completed the survey (per Green 1991).

Materials

Participants completed a questionnaire online via *Qualtrics*. The questions were a mix of multiple choice, free response, and Likert rating scales. The questionnaire included demographic questions and free response or multiple-choice questions about socioeconomic status. Additionally, the questionnaire requested ratings regarding participants' feelings about certain statements and provided a slider scale for participants to estimate their cumulative grade point average.

Measures

Ethnic Identity. The four item Ethnic Group Identification scale was used in which participants had a choice in ranking from 1-7 (Major *et al.* 2002).

Perceived Discrimination. The three-item scale measured perceived discrimination and the participant could pick from 1-7 for ranking each statement (Pinel 1999).

Stigma Consciousness. The ten-item Stigma Consciousness Questionnaire was employed and participants could rank from 0-6 for each of the statements (Pinel 1999).

Socioeconomic Status. A five-item scale was used. Three multiple choice questions and two free response questions make up the scale. For the purposes of initial *t*-tests and the regression analysis, we only utilized the question that asked about estimated annual household income.

Perceived Social Support. The twelve-item Multidimensional Scale of Perceived Social Support was used and the rankings ranged from 1-7 (Zimet *et al.* 1988).

Self-Efficacy. The nine-item Self-Efficacy Scale was employed with rankings from 1-7 (Pintrich amd De Groot 1990).

Intrinsic Value. The nine-item Intrinsic Value Scale was utilized with rankings from 1-7 (Pintrich and De Groot 1990).

Self-Regulated Learning. The nine-item Self-Regulation Scale was used with rankings from 1-7 (Pintrich and De Groot 1990).

Grade Point Average. A slider scale ranging from 0.0-4.0 appeared at the end of the survey for students to estimate their cumulative grade point averages.

Procedure

Participants began the online survey by reading the informed consent page and agreeing to participate in the study. Students completed the questionnaire in lieu of extra credit for other psychology courses at the University of Wisconsin-Eau Claire or simply as a volunteer. A few multiple choice questions regarding their gender, country and state/province of origin, college/university attended, year in school and ethnicity were presented. Next, participants responded to a four-item scale regarding the strength of their ethnic identification. These questions provided a seven-point scale for them to choose the extent to which they agreed with the statements. Ex-

amples from this set are: "How important is your ethnicity to your identity?" and "How often do you think of yourself as a member of your ethnic group?" The next page presented a three-item scale regarding the extent to which they feel they have been discriminated against based on their ethnic identity, which was once again presented on a seven-point rating scale. Examples of two of these statements are: "Your ethnic group is discriminated against" and "The average person belonging to your ethnic group is discriminated against." Subsequently, participants responded on a seven-point scale regarding the extent to which they agreed with a ten-item scale that represents stigma consciousness. Statements such as: "I never worry that my behaviors will be viewed as stereotypical of people of my ethnic background" and "Stereotypes about people of my ethnic background have not affected me personally" appeared. After that, they were presented with three standard multiple choice questions regarding household income and the highest levels of education of their parents and/or guardians. Also, they were asked to report the occupations of their parents and/or guardians via text entry. Next, participants rated the extent to which they agreed on a twelve-item, seven-point scale regarding their perceived social support. Examples of two of these statements are: "I can talk about my problems with my family" and "I have a special person who is a real source of comfort to me." The next three pages of the survey presented statements that once again had to be rated on a seven-point scale that were centered around self-efficacy, intrinsic value, and self-regulated learning. The nine-item scale regarding self-efficacy had statements such as: "Compared with other students in class, I expect to do well" and "My study skills are excellent compared with others in my classes." The nine-item scale regarding intrinsic value presented statements such as: "I prefer class work that is challenging so I can learn new things" and "Even when I do poorly on a test, I try to learn from my mistakes." The nine-item scale regarding self-regulation included statements such as "I ask myself questions to make sure I know the material I have been studying" and "I work hard to get a good grade even when I don't like a class." Finally, students were asked to estimate their cumulative GPA on a slider scale ranging from 0.0 to 4.0. First semester freshman were asked to calculate their high school cumulative GPAs and noted the distinction. A debriefing page and an evidence of participation slip followed the survey.

Results

Reliability of Scales

Overall, our psychological scales demonstrated great reliability: Racial identity ($\alpha = .75$), perceived discrimination ($\alpha = .93$), stigma consciousness ($\alpha = .76$), income (single-item measure), perceived social support ($\alpha = .94$), self-efficacy ($\alpha = .94$), intrinsic value ($\alpha = .91$), and self-regulated learning ($\alpha = .71$).

Group Differences Between Minorities and Non-Minorities

A *t*-test determined the difference in means for the predictor and moderator variables between minorities and non-minorities. Compared to non-minorities, minorities scored higher on racial identity, $t(397) = -4.33$, $p < .001$, perceived discrimination, $t(397) = -13.88$, $p < .001$, and stigma consciousness, $t(385) = -5.82$, $p < .001$. Non-minorities scored higher than minorities on social support, $t(383) = 3.07$, $p < .01$, income, $t(380) = 8.32$, $p < .01$, self-efficacy $t(382) = 2.08$, $p < .05$, and GPA $t(375) = 5.88$, $p < .001$. Table 1 highlights the comparisons between groups. No differences appeared in scores between minorities and non-minorities on the intrinsic value or self-regulation measures.

Table 1: Group Differences Between Minorities and Non-Minorities

Variable	Minorities		Non-Minorities	t	df	sig.
Racial Identity	5.32(1.21)	>	4.64(1.11)	-4.33	397	***
Discrimination	3.78(1.44)	>	1.84(.90)	-13.88	397	***
Stigma Consciousness	4.03(.91)	>	3.27(.93)	-5.82	385	***
Social Support	5.51(1.12)	<	5.98(1.07)	3.07	383	**
Income	3.03(2.24)	<	5.67(2.24)	8.32	380	***
Self-Efficacy	5.09(1.08)	<	5.38(.95)	2.08	382	*
Intrinsic Value	5.49(.87)	=	5.46(.91)	-0.24	380	*ns*
Self-Regulation	4.50(.75)	=	4.63(.79)	1.13	378	*ns*
GPA	3.10(.43)	<	3.45(.41)	5.88	375	***

Note: $p < .05$ *, $p < .01$ **, $p < .001$ ***

Correlations

We conducted bivariate correlational analyses to determine which variables significantly associated with one another for our two groups, minorities and non-minorities. Table 2 charts the correlations between variables for non-minorities. Discrimination is positively associated with stigma consciousness for non-minorities, $r(328) = .27$, $p < .01$. Racial identity is positively associated with social support for non-minorities, $r(327) = .15$, $p < .01$. Discrimination is negatively associated with social support for non-minorities, $r(327) = -.12$, $p < .05$. Discrimination is positively associated with stigma consciousness for non-minorities, $r(328) = .27$, $p < .01$. Discrimination is negatively associated with self-efficacy for non-minorities, $r(326) = -.14$, $p < .01$. Stigma consciousness is negatively associated with self-efficacy for non-minorities, $r(326) = -.12$, $p < .05$. Social support is positively associated with self-efficacy for non-minorities, $r(326) = .28$, $p < .01$. Discrimination is positively associated with intrinsic value for non-minorities, $r(325) = -.14$, $p < .05$. Stigma consciousness is positively associated with intrinsic value for non-minorities, $r(325) = -.12$, $p < .05$. Social support is positively associated with intrinsic value for non-minorities, $r(325) = .27$, $p < .01$. Self-efficacy is positively associated with intrinsic value for non-minorities, $r(324) = .60$, $p < .01$. Stigma consciousness is negatively associated with self-regulation for non-minorities, $r(323) = -.17$, $p < .01$. Social support is positively associated with self-regulation for non-minorities, $r(323) = .26$, $p < .01$. Self-efficacy is positively associated with self-regulation for non-minorities, $r(322) = .61$, $p < .01$. Intrinsic value is positively associated with self-regulation for non-minorities, $r(322) = .57$, $p < .01$. Stigma consciousness is negatively associated with income for non-minorities, $r(323) = -.14$, $p < .05$. Social support is positively associated with income for non-minorities, $r(323) = .23$, $p < .05$. Social support is positively associated with GPA for non-minorities, $r(320) = .13$, $p < .05$. Self-efficacy is positively associated with GPA for non-minorities, $r(319) = .33$, $p < .01$. Intrinsic value is positively associated with GPA for

non-minorities, r(319) = .13, p < .05. Self-regulation is positively associated with GPA for non-minorities, r(319) = .28, p < .01. Table 3 charts the correlations between variables for minorities. Discrimination was positively associated with stigma consciousness for minorities, r(59) = .45, p < .01. Discrimination was negatively associated with self-efficacy for minorities, r(58) = -.29, p < .05. Social support was positively associated with self-efficacy for minorities, r(58) = .29, p < .05. Social support was positively associated with intrinsic value for minorities, r(57) = .27, p < .05. Self-efficacy was positively associated with intrinsic value for minorities, r(57) = .63, p < .01. Discrimination was negatively associated with self-regulation for minorities, r(57) = -.36, p < .01. Stigma consciousness was negatively associated with self-regulation for minorities, r(57) = -.29, p < .05. Social support was positively associated with self-regulation for minorities, r(57) = .27, p < .05. Self-efficacy was positively associated with self-regulation for minorities, r(57) = .77, p < .01. Intrinsic value was positively associated with self-regulation for minorities, r(57) = .66, p < .01. Intrinsic value was negatively associated with income for minorities, r(57) = -.41, p < .01. Self-regulation was negatively associated with income for minorities, r(57) = -.28, p < .05. Discrimination was negatively associated with GPA for minorities, r(57) = -.28, p < .05. Self-efficacy was positively associated with GPA for minorities, r(57) = .46, p < .01. Intrinsic value was positively associated with GPA for minorities, r(57) = .37, p < .01. Self-regulation was positively associated with GPA for minorities, r(57) = .46, p < .01.

Table 2 Correlations for Non-Minorities

Variable	Discrimination	Stigma Consciousness	Social Support	Self-Efficacy	Intrinsic Value	Self-Regulation	Income	GPA
Racial Identity								
Pearson Correlation	-.005	-.006	.149**	.089	.027	-.062	.106	.006
Sig. (2-tailed)	.933	.908	.007	.108	.624	.267	.058	.240
N	338	328	327	326	325	323	323	320
Discrimination								
Pearson Correlation		.266**	-.115*	-.144**	-.142*	-.108	-.094	-.079
Sig. (2-tailed)		.000	.038	.009	.010	.052	.091	.161
N		328	327	326	325	323	323	320
Stigma Consciousness								
Pearson Correlation			-.050	-.116*	-.123*	-.169**	-.137*	-.076
Sig. (2-tailed)			.369	.036	.027	.002	.014	.177
N			327	326	325	323	323	320
Social Support								
Pearson Correlation				.279**	.265**	.258**	.228*	.127*
Sig. (2-tailed)				.000	.000	.000	.000	.023
N				326	325	323	323	320
Self-Efficacy								
Pearson Correlation					.598**	.609**	.078	.328**
Sig. (2-tailed)					.000	.000	.162	.000
N					324	322	322	319
Intrinsic Value								
Pearson Correlation						.565**	.014	.133*
Sig. (2-tailed)						.000	.806	.017
N						322	321	319
Self-Regulation								
Pearson Correlation							.074	.275**
Sig. (2-tailed)							.186	.000
N							319	319
Income								
Pearson Correlation								.072
Sig. (2-tailed)								.203
N								316

Note: p < .05 *, p < .01 **, p < .001 ***

Table 3 Correlations for Minorities

Variable	Discrimination	Stigma Consciousness	Social Support	Self-Efficacy	Intrinsic Value	Self-Regulation	Income	GPA
Racial Identity								
Pearson Correlation	.165	.162	.106	-.062	.149	-.174	-.101	-.050
Sig. (2-tailed)	.203	.220	.430	.643	.270	.196	.446	.712
N	61	59	58	58	57	57	59	57
Discrimination								
Pearson Correlation		.448**	-.078	-.286*	-.160	-.361**	.041	-.282*
Sig. (2-tailed)		.000	.561	.030	.235	.006	.758	.033
N		59	58	58	57	57	59	57
Stigma Consciousness								
Pearson Correlation			-.081	-.408	-.181	-.292*	-.016	-.105
Sig. (2-tailed)			.547	.001	.179	.028	.903	.437
N			58	58	57	57	59	57
Social Support								
Pearson Correlation				.285*	.266*	.267*	.025	.082
Sig. (2-tailed)				.030	.046	.045	.855	.544
N				58	57	57	58	57
Self-Efficacy								
Pearson Correlation					.634**	.765**	-.114	.462**
Sig. (2-tailed)					.000	.000	.393	.000
N					57	57	58	57
Intrinsic Value								
Pearson Correlation						.656**	-.413**	.373**
Sig. (2-tailed)						.000	.001	.004
N						57	57	57
Self-Regulation								
Pearson Correlation							-.275*	.463**
Sig. (2-tailed)							.039	.000
N							57	57
Income								
Pearson Correlation								-.186
Sig. (2-tailed)								.166
N								57

Note: p < .05 *, p < .01 **, p < .001 ***

Regression Analysis

We submitted our data to a multiple regression with racial identity, perceived discrimination, stigma consciousness, perceived social support, income, self-efficacy, intrinsic value, and self-regulation variables as predictors of GPA. Self-efficacy and self-regulated learning variables emerged as significant predictors of GPA. Together, self-efficacy (β = .13, p < .001) and self-regulated learning (β = .09, p < .05) accounted for 19.4% of the variance in GPA (R2 = .19; F(9, 360) = 10.86, p < .001). Racial identity, perceived discrimination, stigma consciousness, perceived social support, and intrinsic value were nonsignificant predictors of GPA. Figure 1 displays a visual model of the variables and their significance in predicting GPA.

Discussion

Minorities identified more with race, perceived more discrimination, and were more conscious of stigma in comparison to non-minorities. Non-minorities had more perceived social support, higher family income, higher self-efficacy, and higher GPAs in comparison to minorities. In relation to our initial hypotheses, a few were supported with correlational data. High socioeconomic status was positively associated with intrinsic value and self-regulation for minorities. High socioeconomic status was not significantly associated with academic achievement motivation for non-minorities. High perceived social support was positively associated with self-efficacy, intrinsic

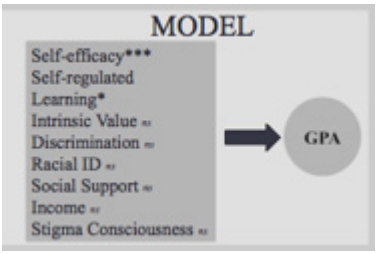

Figure 1. Model for regression analysis. Note: p < .05 *, p < .01 **, p < .001 ***

value, and self-regulation for minorities, and for non-minorities the same variables were found to be significant along with GPA. Ethnic group identification was not significantly associated with academic achievement motivation for either minorities or non-minorities, which leaves us unable to contribute to the divided literature. Perceived discrimination was negatively associated with GPA, self-efficacy, and self-regulation for minorities, but just self-efficacy and intrinsic value for non-minorities. Regression analyses indicated that self-efficacy and self-regulated learning were significant predictors of GPA.

We found it especially interesting that both minorities and non-minorities had significant and positive correlations between discrimination and stigma consciousness. In order to analyze the similarity, we brainstormed possible alternative explanations for the similar correlations. First, the thought occurred to us that low-income, first generation students would be in the non-minority group and could have reported high discrimination and stigma consciousness. We used BadgerCare (2012) to determine the annual income for a family of four that lies below 130% of the Wisconsin poverty level. We pulled students who fit the criteria of estimating less than $30,000 as annual income and first-generation status. Only five students fit these criteria, which would not have altered our data, so this explanation was ruled out. Second, we compared the correlation coefficients between males and females, but these were not significant, so gender was not confounding our findings either. Future analyses will seek other explanations for the similarity in discrimination and stigma consciousness correlations between minorities and non-minorities.

Limitations

First, the data in our study are based on an uneven distribution of groups. We had a high number of non-minority participants as well as a high number of female participants. The University of Wisconsin-Eau Claire men-to-women ratio is 7-to-10; therefore, we expected to receive more female participants. In addition, only 797 of 11,330 students at the university consider themselves as multicultural, so it was inevitable that we would have a large number of non-minority participants.

Second, we were not able to employ a random sample. We disseminated our survey primarily to Psychology 100 students (entry-level, introduction course). In order to gain a representative size sample of minorities students, we also targeted organizations on campus that generally have larger numbers of minority students as members. Specifically, we sent our survey to groups such as the Office of Multicultural Affairs and TRiO programs (Student Support Services and McNair).

Third, our data were correlational, so causational inferences cannot be made, which is why we plan to conduct path analyses in the near future. Path analyses will allow us to determine indirect and direct paths of statistical influence, which are the closest type of interpretations to causational statements available for correlational data.

Future Research

While our data contribute to the literature, we will further evaluate our model with conditional process modeling (Hayes, 2012) to evaluate moderated mediation (i.e., direct and indirect effects). Future research will consider other indicators of academic success, such as college retention or graduation rates. Since our first-year students were likely reporting their final high school GPA and all students may have a tendency to overestimate their GPA, future studies will seek confidential permission to access students' academic records. Finally, our research looks at a cross-section of students across four or more years of college, so future research could employ a balanced group size cross-sectional design or a longitudinal design. A longitudinal design would allow researchers to analyze the influences on minority and non-minority academic achievement across the college years.

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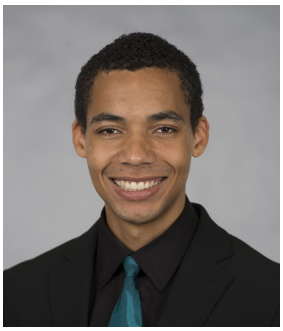

Novel Ionic Liquid Crystals Based on Nitrile Functionalized Imidazolium

by:
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Dr. Laurent Douce (Université de Strasbourg)

Abstract

Ionic liquids and liquid crystals have both received extensive study, yielding a plethora of useful applications. The confluence of these two fields offers the opportunity to synthesize a class of materials capable of displaying the useful properties of ionic liquids and liquid crystals to varying degrees. A typical approach to synthesis involves bonding a rigid organic cation, commonly the imidazolium ring, to a long and flexible aliphatic chain. The resulting molecule maintains its ionic character and contains a rigid-flexible antagonistic pair leading to mesomorphic ordering. With this foundation, we proceeded to generate and fully characterize fifteen ionic liquid crystals exhibiting an imidazolium ring functionalized with a nitrile moiety. Furthermore, the effect of the anion selection on the stability and ordering of the liquid crystal phase was explored. These ionic molecules will be used to prepare mesomorphic complexes via nitrile coordination on transition metals in order to obtain more functional materials (luminescent, magnetic, catalytic).

Introduction

Ionic liquids have become increasingly popular over the past several years as researchers continue to discover ways to apply their unique combination of useful properties. These properties include high chemical and thermal stability, a wide electrochemical window, high ionic conductivity, extremely low volatility, and catalysis.[1] The allure of ionic liquids also results from their ability to be carefully manipulated. By changing the cation, anion, or both, chemical and physical properties can adjust to fit a variety of specific needs. Liquid crystals, more familiar as they are found in a multitude of devices we use every day, play an important role in cellular biology. A liquid crystal is characterized by macroscopic ordering and fluidity, and two classes of liquid crystals exist.[2] Thermotropic temperature dependent liquid crystals transition from solid to liquid crystal to isotropic liquid as temperature increases. They are typically comprised of molecules with a rigid aromatic head or center unit and a fluid alkyl tail. Lyotropic liquid crystals change phases depending on the concentration of the liquid crystal in solution. These liquid crystals are comprised of molecules containing a hydrophilic and hydrophobic antagonistic pair.[3] The high degree of control we can exert over the liquid crystal supramolecular structure and the wide variety of liquid crystals allows them to serve a multitude of functions. These range from uses in liquid crystal displays to detergents to gene therapy and drug delivery.[4]

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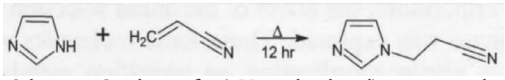
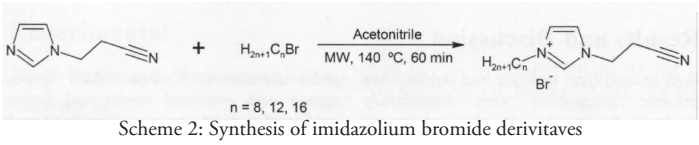
While both ionic liquids and liquid crystals are useful individually, combining the properties of both in a single compound opens up new potential applications—for example, the use of imidazolium-based ionic liquid crystals to display the smectic A phase in dyesensitized solar cells. An effective electrolyte, the lamellar macroscopic structure of the compound has also been shown to have a beneficial effect on photoconversion efficiency.[5] With the field of ionic liquid crystals still largely unexplored, we endeavoured to make our own foray.

This research sought to synthesize a range of ionic liquid compounds and extensively characterize each one to identify those compounds that also showed liquid crystalline character. We decided to employ the imidazolium ion as the foundation from which we would construct organic cations. Ionic compounds containing a cation based on the imidazolium unit have been well characterized and consistently satisfy the conditions for classification as ionic liquids.[6] To complement our imidazolium cations, we elected to use five different anions commonly used in ionic liquid synthesis: bromide (Br-), chloride (CJ-), thiocyanate (SCN-), tetrafluoroborate (BF4-), and hexafluorophosphate (PF6).



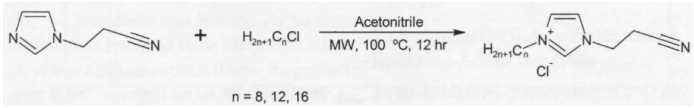
Scheme 1: Synthesis of 3-(1H-imidazol-1-yl)propanenitrile

The first step of the project was to functionalize imidazole with a cyanoethyl side chain (Scheme 1). The reaction ran for 12 hours overnight and resulted in a nearly quantitative yield. Thin film chromatography and proton nuclear magnetic resonance (NMR) spectroscopy confirmed that all the imidazole had been reacted and that only the desired product remained. With the success of the first reaction, we proceeded to alkylate the imidazole with a bromoalkane (Scheme 2). In addition to functionalizing the imidazole with a carbon chain, the bromoalkylation resulted in the formation of the imidazolium cation with bromide as the anion. Two more imidazolium bromides, one with a side chain of 12 carbons and one with 16 carbons, were synthesized by replacing 1-bromooctane with the appropriate bromoalkane in the previous procedure. All bromoalkylation reactions resulted in yields that were nearly quantitative. These reactions are typically completed by refluxing the reaction over a period of at least 12 hours. Thus, microwave synthesis proved to be an extremely efficient method for the production of alkylated imidazolium bromide compounds.



Scheme 2: Synthesis of imidazolium bromide derivitaves

Alkylation of the imidazole can also be completed with a chloroalkane to yield an imidazolium chloride product (Scheme 3). Because of the success seen with the bromoalkylation procedure, we proceeded to follow the same synthetic method, but with a chloroalkane in place of a bromoalkane. The result was disconcerting, as TLC and proton NMR spectroscopy clearly indicated the presence of two imidazolium products. The desired product was successfully isolated via column chromatography, but the percent yield was unsatisfactory. The two imidazolium products had nearly the same polarity, and the separation proved difficult and protracted. We suspected that the decomposition of the cyanoethyl imidazole had occurred prior to alkylation and hypothesized that a significant decrease in reaction temperature would prevent the formation of the second imidazolium. This procedure still required the use of column chromatography; however, the process was substantially easier as the



Scheme 3: Synthesis of imidazolium chloride derivitaves

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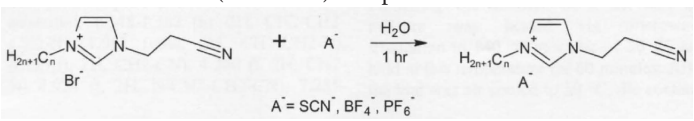
product only needed to be isolated from residual cyanoethyl imidazole. The decrease in reaction temperature from 140 °C to 110 °C resulted in only one imidazolium product, but the reaction time had to be increased by 13 hours in order to obtain an appreciable yield. Moreover, even after 14 hours, a considerable amount of cyanoethyl imidazole remained unreacted.

The remaining nine imidazolium compounds containing either the BF4-, PF6-, or SCN anion were readily synthesized via anion metathesis (Scheme 4). All products were obtained with a yield greater than 80%, and seven of the nine anion metathesis reactions produced yields that were quantitative.



Scheme 4: Anion metathesis of imidazolium bromides

Results and Discussion

Both imidazolium bromide and imidazolium chloride compounds were successfully synthesized with the aid of a microwave reactor. The bromide imidazolium synthetic method proved facile and delivered excellent yields, while the synthesis of chloride imidazolium required careful attention to reaction conditions and produced only adequate results. We expect that satisfactory yields of the imidazolium chlorides could be obtained by further optimizing the reaction temperature and time.

Using three cyanoethyl imidazolium-based cations containing an aliphatic chain or either 8, 12, or 16 carbons and pairing each cation with one of five different anions, a total of 15 compounds were synthesized successfully. These products were all characterized initially with thin layer chromatography and proton NMR spectroscopy. After all products were synthesized, carbon NMR spectroscopy, infrared spectroscopy (IR spectroscopy), thermal gravimetric analysis (TGA), differential scanning calorimetry (DSC), and elemental analysis (EA) were utilized. Polarizing optical microscopy (POM) was also used on several compounds for the qualitative study of liquid crystal phase transitions. Carbon NMR spectra agreed with predicted results and further confirmed the chemical identity of each product. Every IR spectra displayed the distinctive nitrile absorption peak around 2260 - 2220 cm-1 (Figure 1). This was particularly important as we

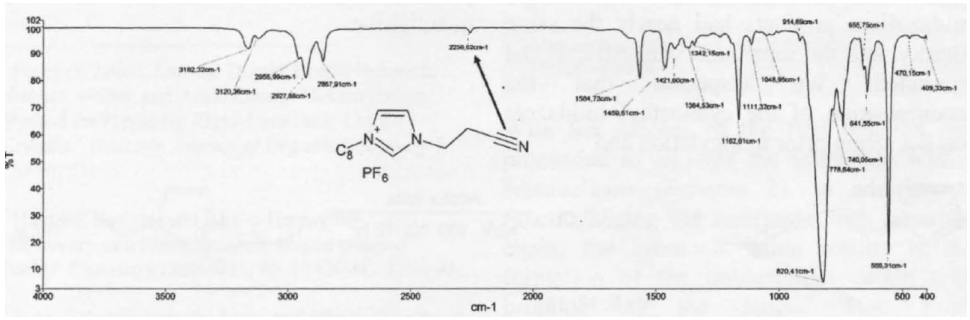


Figure 1: FTIR characteristic nitrile stretch at 2256 cm-1

needed to ensure that the decomposition of the cyanoethyl imidazole had not occurred during the alkylation step. TGA was used to determine the purity of the products. The TGA thermal curve for each product strongly indicated the presence of a single compound; however, a number of samples contained water up to 10% of the total weight. The hygroscopic nature of the products was also clearly visible from analysis of the IR spectra. Imidazolium with an aliphatic chain of 8

or 12 and a bromide or chloride counterion proved to be the most hygroscopic species. To obtain IR spectra and TGA thermal curves free of water contamination, all products were dried under strong vacuum at 50 oc for 24 hours. DSC was crucial in determining the liquid crystal phase transition temperatures and allowed us to discover intermediate phases that would be difficult to see via POM. Finally, EA was used to verify the purity of the compound.

Experimental

3-(1H-imidazol-1-yl)propanenitrile (Scheme 1)

Imidazole (20.9 g, 0.307 mol) and acrylonitrile (24m, 0.37 mol) were stirred and refluxed at 95 °C in a round-bottom flask overnight. The reaction mixture was placed on a rotary evaporator to remove excess acrylonitrile. Afterwards, the product was dried overnight under vacuum, and a clear, yellow-tinted liquid was obtained (36.808 g, 99%).

1H NMR (300 MHz, CDC13): 8 = 2.82 (t, 2H, CH2-CN), 4.278 (t, 2H, N-CH2), 7.026- 7.126 (s, 2H, N-CH-CH-N), 7.595 (s, lH, NCH- N). 13C NMR (75 MHz, CDC13):

1-(2-cyanoethyl)-3-octyl-1H-imidazol-3-ium bromide (Scheme 2)

3-(1H-imidazol-1-yl)propanenitrile (2.500 g, 0.206 mol), 1-bromooctane (7.45 ml, 0.0310 mol), and acetonitrile (5 ml, 0.0957 mol) were added to a 30 ml microwave vial. Following the addition of a stir bar, the mixture was heated via microwave irradiation to 140 °C at a rate of 30 W, and held at this temperature for 60 minutes. After the vial was air cooled to 50 °C, the contents were transferred to a round bottom flask. The mixture was dissolved in a minimum of dichloromethane, and a large excess of ether was added to precipitate the product out of solution. After chilling for two hours at -20 °C, the precipitate was isolated via vacuum filtration and washed three times with ether. A yellow solid was obtained after the product was dried overnight under vacuum (7.47 g, 98%).

1H NMR (300 MHz, CDC13): 8 = 0.900 (t, 3H, CH3 aliphatic), 1.272 (m, 8H, CH2 aliphatic), 1.348-1.362 (m, 2H, CH2-CH2- CH2-N), 1.951 (quin, 2H, CH2-CH2-N), 3.369 (t, 2H, CH2-CN), 4.260 (t, 2H, CH2- N) 4.924 (t, 2H, N-CH2-CH2-CN), 7.285- 7.82 (m, 2 x 1H, N-CH-CH-N), 10.563 (s, 1H, N-CH-N). 13C NMR (75 MHz, CDC13):

1-(2-cyanoethyl)-3-dodecyi-1H-imidazol- 3-ium bromide

3-(1H-imidazol-1-yl)propanenitrile (2.495 g, 0.206 mol), 1-bromododecane (5.35 ml, 0.0309 mol), and acetonitrile (5 ml, 0.0957 mol) were added to a 30 ml microwave vial. Following the addition of a stir bar, the mixture was heated via microwave irradiation to 140 °C at a rate of 30 W, and held at this temperature for 60 minutes. After the vial was air cooled to 50 °C, the contents were transferred to a round-bottom flask. The mixture was dissolved in a minimum of dichloromethane, and a large excess of ether was added to precipitate the product out of solution. After chilling for two hours at -20 °C, the product was isolated via vacuum filtration and washed three times with ether. A powdery white solid was obtained after the product was dried overnight under vacuum (6.30 g, 97%).

1H NMR (300 MHz, CDC13): 8 = 0.897 (t, 3H, CH3 aliphatic), 1.275 (m, 16H, CH2 aliphatic), 1.363-1.376 (m, 2H, CH2-CH2- CH2-N), 1.968 (quin, 2H, CH2-CH2-N), 3.366 (t, 2H, CH2-CN), 4.264 (t, 2H, CH2- N) 4.928 (t, 2H, N-CH2-CH2-CN), 7.262-7.693 (m, 2 x 1H, N-CH-CH-N), 10.741 (s, 1H, N-CH-N). 13C NMR (75 MHz, CDC13):

1-(2-cyanoethyl)-3-hexadecyi-1H-imidazol-3-ium bromide

3-(1H-imidazol-1-yl)propanenitrile (2.509 g, 0.0207 mol), 1-bromohexadecane (9.45 ml, 0.0309 mol), and acetonitrile (5 ml, 0.0957 mol) were added to a 30 ml microwave vial. Following the addition of a stir bar, the mixture was heated via microwave irradiation to 140 °C at a rate of 30 W, and held at this temperature for 60 minutes. After the vial was air cooled to 50 °C, the contents were transferred to a round-bottom flask. The mixture was dissolved in a minimum of dichloromethane, and a large excess of ether was added to precipitate the product out of solution. After chilling for two hours at -20 °C, the product was isolated via vacuum filtration and washed three times with ether. A powdery white solid was obtained after the product was dried overnight under vacuum (8.76 g, 99%).

lH NMR (300 MHz, CDCI3): 8 = 0.887 (t, 3H, CH3 aliphatic), 1.263 (m, 24H, CH2 aliphatic), 1.341-1.360 (m, 2H, CH2-CH2-CH2-N), 1.963 (quin, 2H, CH2-CH2-N), 3.339 (t, 2H, CH2-CN), 4.255 (t, 2H, CH2-N) 4.903 (t, 2H, N-CH2-CH2-CN), 7.268-7.596 (m, 2 x 1H, N-CH .. CH-N), 10.784 (s, 1H, N-CH-N). 13C NMR (75 MHz, CDCI3):

1-(2-cyanoethyl)-3-octyl-1H-imidazol-3-ium chloride (Scheme 3)

3-(1H-imidazol-1-yl)propanenitrile (2.516 g, 0.208 mol), 1-chlorooctane (5.30 ml, 0.0312 mol), and acetonitrile (5 ml, 0.0957 mol) were added to a 30 ml microwave vial. Following the addition of a stir bar, the mixture was heated via microwave irradiation to 110 °C at a rate of 20 W, and held at this temperature for 14 hours. After the vial was air cooled to 50 °C, the contents were transferred to a round-bottom flask. The mixture was dissolved in a minimum of dichloromethane, and a large excess of ether was added to precipitate the product out of solution. After chilling for two hours at -20 °C, the precipitate was collected via vacuum filtration and washed three times with ether. Column chromatography (silica gel, dichloromethane, methanol) was used to isolate the desired product. After drying overnight under vacuum, a clear, yellow liquid was yielded (1.93 g, 34%).

1H NMR (300 MHz, CDCI3): 8 = 0.881 (t,3H, CH3 aliphatic), 1.267 (m, 8H, CH2 aliphatic), 1.339-1.353 (m, 2H, CH2-CH2- CH2-N), 1.937 (quin, 2H, CH2-CH2-N), 3.376 (t, 2H, CH2-CN), 4.248 (t, 2H, CH2-N) 4.925 (t, 2H, N-CH2-CH2-CN), 7.259-7.800 (m, 2 x 1H, N-CH-CH-N), 10.846 (s, 1H, N-CH-N). 13C NMR (75 MHz, CDCI3):

1-(2-cyanoethyl)-3-dodecyi-1 H-imidazol-3-ium chloride

3-(1H-imidazol-1-yl)propanenitrile (2.507 g, 0.0207 mol), 1-chlorododecane (7.40 ml, 0.0313 mol), and acetonitrile (5 ml, 0.0957 mol) were added to a 30 ml microwave vial. Following the addition of a stir bar, the mixture was heated via microwave irradiation to 110 °C at a rate of 20 W, and held at this temperature for 14 hours. After the vial was air cooled to 50 °C, the contents were transferred to a round-bottom flask. The mixture was dissolved in a minimum of dichloromethane, and a large excess of ether was added to precipitate the product out of solution. After chilling for two hours at -20 °C, the precipitate was collected via vacuum filtration and washed three times with ether. Column chromatography (silica gel, dichloromethane, methanol) was used to isolate the desired product. After drying overnight under vacuum, a slightly yellow solid was obtained (3.09 g, 46%).

1H NMR (300 MHz, CDCI3): 8 = 0.884 (t, 3H, CH3 aliphatic), 1.261 (m, 16H, CH2 aliphatic), 1.342-1.356 (m, 2H, CH2-CH2-CH2-N), 1.942 (quin, 2H, CH2-CH2-N), 3.362 (t, 2H, CH2-CN), 4.244 (t, 2H, CH2-N) 4.9~6 (t, 2H, N-CH2-CH2-CN), 7.242-7.676 (m, 2 x 1H, N-CH-CH-N), 10.957 (s, 1H, N-CH-N). 13C NMR (75 MHz, CDCI3):

1-(2-cyanoethyl)-3-hexadecyi-1H-imidazol-3-ium chloride

3-(1H-imidazol-1-yl)propanenitrile (2.500 g, 0.0206 mol), 1-chlorohexadecane (9.40 ml, 0.0312 .mol), and acetonitrile (5 ml, 0.0957 mol) were added to a 30 ml microwave vial. Following the addition of a stir bar, the mixture was heated via microwave irradiation to 110 °C at a rate of 20 W, and held at this temperature for 14 hours. After the vial was air cooled to 50 °C, the contents were transferred to a round-bottom flask. The mixture was dissolved in a minimum of dichloromethane, and a large excess of ether was added to precipitate the product out of solution. After chilling for two hours at -20 °C, the precipitate was collected via vacuum filtration and washed three times with ether. The collected solid was dissolved in dichloromethane, and the precipitation and vacuum filtration process was repeated. The product was dried overnight under vacuum and white solid was obtained (4.06 g, 52%).

1H NMR (300 MHz, CDC13): 8 = 0.885 (t, 3H, CH3 aliphatic), 1.260 (m, 24H, CH2 aliphatic), 1.347-1.360 (m, 2H, CH2-CH2-CH2-N), 1.947 (quin, 2H, CH2-CH2-N), 3.352 (t, 2H, CH2-CN), 4.241 (t, 2H, CH2-N) 4.913 (t, 2H, N-CH2-CH2-CN), 7.222-7.603 (m, 2 x 1H, N-CH-CH-N), 11.043 (s, 1H, N-CH-N). 13C NMR (75 MHz, CDCI3):

General procedure for anion exchange (Scheme 4)

1-(2-cyanoethyl)-3-octyl-1H-imidazol-3-ium bromide, 1-(2-cyanoethyl)-3-dodecyl-1H-imidazol- 3-ium bromide, or 1-(2- cyanoethyl)-3-hexadecyl-1H-imidazol-3-ium bromide was dissolved in a minimum of water (10 ml) and a solution of the complimentary salt dissolved in water (4mL) was added via pipette. The solution was left to stir for 60 minutes. The precipitate was filtered off and washed three times with cold water.

1-(2-cyanoethyl)-3-octyl-1H-imidazol-3-ium thiocyanate

The general procedure was followed without the need for filtration. 1-(2-cyanoethyl)-3-octyi-1H-imidazol-3-ium bromide (0.509 g, 16.2 mmol) and potassium thiocyanate (0.327 g, 33.6 mmol) yielded a clear liquid (0.311 g, 65%).

1H NMR (300 MHz, CDCI3): 8 = 0.885 (t, 3H, CH3 aliphatic), 1.279 (m, 8H, CH2 aliphatic), 1.334-1.359 (m, 2H, CH2-CH2-CH2-N), 1.966 (quin, 2H, CH2-CH2-N), 3.299 (t, 2H, CH2-CN), 4.302 (t, 2H, CH2-N) 4.822 (t, 2H, N-CH2-CH2-CN), 7.345-7.742 (m, 2 x lH, N-CH-CH-N), 9.626 (s, 1H, N-CH-N). 13C NMR (75 MHz, CDCI3):

1-(2-cyanoethyl)-3-dodecyl-1H-imidazol-3-ium thiocyanate

The general procedure was followed without the need for filtration. 1-(2-cyanoethyl)-3-dodecyl-1H-imidazol-3-ium bromide (0.477g, 12.9 mmol) and potassium thiocyanate (0.223 g, 23.9 mmol) yielded a white solid (0.421 g, 94%).

1H NMR (300 MHz, CDC13): 8 = 0.888 (t, 3H, CH3 aliphatic), 1.267 (m, 16H, CH2 aliphatic), 1.343-1.360 (m, 2H, CH2-CH2-CH2-N), 1.983 (quin, 2H, CH2-CH2-N), 3.296 (t, 2H, CH2-CN), 4.299 (t, 2H, CH2-N) 4.823 (t, 2H, N-CH2-CH2-CN), 7.275-7.588 (m, 2 x 1H, N-CH-CH-N), 9.894 (s, 1H, N-CH-N). 13C NMR (75 MHz, CDCI3):

1-(2-cyanoethyl)-3-hexadecyi-1H-imidazol-3-ium thiocyanate

The general procedure was followed using 1-(2-cyanoethyl)-3-hexadecyl-1H-imidazol-3-ium bromide (0.506 g, 11.9 mmol) and potassium thiocyanate (0.231 g, 23.8 mmol) to yield a white solid (0.411 g, 85%).

1H NMR (300 MHz, CDC13): 8 = 0.884 (t, 3H, CH3 aliphatic), 1.259 (m, 24H,

CH2 aliphatic), 1.347-1.359 (m, 2H, CH2-CH2-CH2-N), 1.968 (quin, 2H, CH2-CH2-N), 3.290 (t, 2H, CH2-CN), 4.301 (t, 2H, CH2-N) 4.816 (t, 2H, N-CH2-CH2-CN), 7.312-7.668 (m, 2 x 1H, N-CH-CH-N), 9.676 (s, 1H, N-CH-N). 13C NMR (75 MHz, CDCI3):

1-(2-cyanoethyl)-3-octyl-1H-imidazol-3-ium tetrafluorborate

The general procedure was followed without the need for filtration. 1-(2-cyanoethyl)-3-octyl-1H-imidazol-3-ium bromide (0.493 g, 15.7 mmol) and potassium tetrafluoroborate (0.394 g, 31 .3 mmol) yielded a clear liquid (0.331 g, 66%).

lH NMR (300 MHz, CDC13): 8 = 0.882 (t, 3H, CH3 aliphatic), 1.270 (m, 8H, CH2 aliphatic), 1.327-1.344 (m, 2H, CH2-CH2-CH2-N), 1.904 (quin, 2H, CH2-CH2-N), 3.091 (t, 2H, CH2-CN), 4.193 (t, 2H, CH2-N) 4.594 (t, 2H, N-CH2-CH2-CN), 7.299-7.608 (m, 2 x 1 H, N-CH-CH-N), 8.961 (s, 1H, N-CH-N). 13C NMR (75 MHz, CDCI3):

1-(2-cyanoethyl)-3-dodecyl-1H-imidazol-3-ium tertafluoroborate

The general procedure was followed using 1-(2-cyanoethyl)-3-dodecyl-1H-imidazol-3-ium bromide (0.495 g, 13.4 mmol) and potassium thiocyanate (0.334 g, 26.5 mmol) to yield a white solid (0.491 g, 97%).

1H NMR (300 MHz, CDCI3): 8 = 0.887 (t, 3H, CH3 aliphatic), 1.264 (m, 16H, CH2 aliphatic), 1.345-1.359 (m, 2H, CH2-CH2-CH2-N), 1.932 (quin, 2H, CH2-CH2-N), 3.113 (t, 2H, CH2-CN), 4.213 (t, 2H, CH2-N) 4.622 (t, 2H, N-CH2-CH2-CN), 7.272-7.560 (m, 2 x 1H, N-CH-CH-N), 9.117 (s, lH, N-CH-N). 13C NMR (75 MHz, CDCI3):

1-(2-cyanoethyl)-3-hexadecyi-1H-imidazol-3-ium tetrafluoroborate

The general procedure was followed using 1-(2-cyanoethyl)-3-hexadecyl-1H-imidazol-3-ium bromide (0.501 g, 11.7 mmol) and potassium tetrafluoroborate (0.308 g, 24.5 mmol) to yield a white solid (0.445 g, 88%).

1H NMR (300 MHz, CDCI3): 8 = 0.886 (t, 3H, CH3 aliphatic), 1.260 (m, 24H, CH2 aliphatic), 1.336-1.352 (m, 2H, CH2-CH2-CH2-N), 1.918 (quin, 2H, CH2-CH2-N), 3.097 (t, 2H, CH2-CN), 4.203 (t, 2H, CH2-N) 4.605 (t, 2H, N-CH2-CH2-CN), 7.264-7.566 (m, 2 x lH, N-CH-CH-N), 9.012 (s, 1H, N-CH-N). 13C NMR (75 MHz, CDCI3):

1-(2-cyanoethyl)-3-octyl-1H-imidazol-3-ium hexafluorophosphate

The general procedure was followed using 1-(2-cyanoethyl)-3-octyl-1H-imidazol-3-ium bromide (0.481 g, 15.3 mmol) and potassium tetrafluoroborate (0.586 g, 31.8 mmol) to yield a clear liquid (0.547 g, 72.7%).

1H NMR (300 MHz, CDC13): 8 = 0.871 (t, 3H, CH3 aliphatic), 1.259 (m, 8H, CH2 aliphatic), 1.311-1.332 (m, 2H, CH2-CH2-CH2-N), 1.874 (quin, 2H, CH2-CH2-N), 3.007 (t, 2H, CH2-CN), 4.146 (t, 2H, CH2-N) 4.489 (t, 2H, N-CH2-CH2-CN), 7.307-7.502 (m, 2 x 1H, N-CH-CH-N), 8.569 (s, 1H, N-CH-N). 13C NMR (75 MHz, CDCI3):

1-(2-cyanoethyl)-3-dodecyi-1H-imidazol-3-ium hexafluorophosphate

The general procedure was followed using 1-(2-cyanoethyl)-3-dodecyl-1H-imidazol-3-ium bromide (0.486 g, 13.1 mmol) and potassium thiocyanate (0.486 g, 26.5 mmol) to yield a white solid (0.486 g, 85%).

1H NMR (300 MHz, CDCI3): 8 = 0.884 (t, 3H, CH3 aliphatic), 1.260 (m, 16H, CH2 aliphatic), 1.329-1.342 (m, 2H, CH2-CH2-CH2-N), 1.894 (quin, 2H, CH2-CH2-N), 3.028 (t, 2H, CH2-CN), 4.168 (t, 2H, CH2-N) 4.524 (t, 2H, N-CH2-CH2-CN), 7.282-7.508 (m, 2 x 1H, N-CH-CH-N), 8.655 (s, 1H, N-CH-N). 13C NMR (75 MHz, CDCI3):

1-(2-cyanoethyl)-3-hexadecyl-1H-imidazol-3-ium hexafluorophosphate

The general procedure was followed using 1-(2-cyanoethyl)-3-hexadecyi-1H-imidazol-3-ium bromide (0.481 g, 11.3 mmol) and potassium hexaflurophosphate (0.430 g, 23.4mmol) to yield a white solid (0.440 g, 80%).

1H NMR (300 MHz, CDCI3): 8 = 0.886 (t, 3H, CH3 aliphatic), 1.260 (m, 24H, CH2 aliphatic), 1.326-1.341 (m, 2H, CH2-CH2-CH2-N), 1.895 (quin, 2H, CH2-CH2-N), 3.024 (t, 2H, CH2-CN), 4.164 (t, 2H, CH2-N) 4.518 (t, 2H, N-CH2-CH2-CN), 7.281-7.511 (m, 2 x 1H, N-CH-CH-N), 8.631 (s, 1H, N-CH-N). 13C NMR (75 MHz, CDCI3):

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Linguistic Analysis of Well-Being

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Abstract

To understand how well-being affects people's thinking patterns and word choice, this study analyzed participants' scores on the *Psychological Well-Being Scale* (Ryff, 1989) and assigned participants to write about their daily lives. Writings were analyzed using the *Linguistic Inquiry and Word Count* program which counts word frequency and categorizes them. An analysis of variance indicated that participants with a low well-being score used significantly more first person singular pronouns ("I" and "me") and negative emotion words than participants with a high well-being score who used significantly more first person plural pronouns ("we," "us," and "our") and positive emotion words. This suggests that participants with a lower well-being have more negative and self-involved thoughts, and those with a higher well-being have more positive and socially involved thoughts.

Linguistic Analysis of Well-Being

The discipline of psychology has often focused on the negative, at-risk, aspects of human behavior. In 1998, Martin Seligman, then President of the American Psychological Association, challenged psychology to focus less on negative aspects of life and deliberately explore optimism, courage, and focus on the patients' future (Seligman, 1999). Seligman's speech launched 'positive psychology' and resulted in a notable increase in the number of studies aimed at exploring the 'positive' elements within human psychology.

Many studies attest to the benefits high well-being and positive outlook bestow on other aspects of life. King, Hicks, Krull, and Del Gaiso (2006) found that subjects' experience of positive mood correlated strongly and positively with their reports of living meaningful lives. Other research found that individuals who exhibit a positive affect had better physical health, a lower morbidity rate, and decreased pain symptoms (Cohen and Pressman, 2006).

The famous "nun study" of Danner, Snowdon, and Friesen (2001) examined U.S. nuns' (all born before 1917) autobiographical essays written in their late teens or early 20s, and coded these for use of positive, negative, and neutral emotion words. Their results showed a strong positive correlation between longevity and the expression of positive emotion words in the early diaries. The women who frequently used positive terms lived a mean of 10.7 years longer.

On the opposite end of the well-being continuum, negative mood is associated with lower levels of meaning in life (King et al., 2006). Additionally, Cohen and Pressman (2006) found that negative affect was correlated with poorer overall health and that negative emotions suppress the immune system and increase an individual's risk of disease.

To assess positive and negative well-being, this study employs the *Psychological Well-Being Scale* (PWBS, created by Carol Ryff (1989)), which can be used to create an overall well-being score. Its six subscales consist of (a) level of autonomy (self-determination, independence, evaluation of yourself by your own standards); (b) environmental mastery (creating suitable

environments for yourself, successful aging); (c) personal growth (self-actualization, openness to experience, continued growth); (d) positive relations with others (warm, trusting interpersonal relations); (e) purpose in life (sense of directedness, setting goals); and (f) self-acceptance. The scale is theoretically grounded and has been used therapeutically to create the well-being theory, which encourages patients to introspect and gain skills allowing them to attend to the positive aspects in their lives (Fava and Tomba, 2009).

Language, a vast component in our everyday lives, employs powerful indicators of a person's emotional, physical, and mental state (Junghaenel, Smyth and Santer, 2008). Psychoanalytic theories stress the importance of words and thoughts in creating change in a person's life. For example, Slatcher, Vazire, and Pennebaker (2008) found that use of positive emotion words served as an indicator of relationship satisfaction and stability. In cognitive-behavioral therapy, one technique encourages patients to change negative thoughts and words to more neutral thoughts and words. This study looks at the words we use to see if word choice can provide insight into well-being.

The *Linguistic Inquiry and Word Count* (LIWC) program created by Pennebaker, Chung, Ireland, Gonzales, and Booth (2007) analyzes word files by categorizing individual words and giving an output of the percentages of words in each category. According to Tausczik and Pennebaker (2010), the program arose out of the need to analyze simple text for psychological variables. Researchers have used the LIWC program for a wide variety of purposes. The program has compared Beatles' and Paul McCartney's lyrics and analyzed terrorists' writings (Wapner, 2008, October 13). When assessing external validity, Pennebaker *et al*. (2007) found support because judge's ratings and LIWC scales highly correlated.

This current study focuses on first person singular pronouns (I, me, mine) and first person plural pronouns (we, us, our). Simmons, Chambless, and Gordon (2008) studied family members of people with psychiatric illnesses. They found that relatives' hostility and criticism positively correlated with use of first person singular pronouns and negatively correlated with first person plural pronoun use. In addition, Rude, Gortner, and Pennebaker (2004) found that people who scored mild depression or higher on the *Beck Depression Inventory* used more negative words and the word "I" more than people who had never been depressed.

The second focus of this study lies with positive and negative emotion words. Tausczik and Pennebaker (2010) stated that the more emotion words a person uses, the more pronouns they use, so the variables are complementary. Additionally they stated that a greater use of emotion word correlates with engagement in the topic that has a person's attention.

In 1994, Pennebaker created a manual that gave readers tips about running a writing study. The current study took advantage of suggestions for participants' writing instructions, amount of time to write, and the numbers of days to engage participants in writing.

This study combines a traditional focus on negative issues with the new positive psychology paradigm. The findings from this study contribute to understanding the relationship between high and low well-being levels and words (specifically pronouns and emotion words). This could have implications for linguists, psychologists, and therapists.

I hypothesized that participants with low well-being scores use more self-referential words including "I" and "me" than participants with high well-being scores who will use more social words like "we," "us," and "our." Additionally, participants with a low well-being score will use more negative emotion words than those with a high well-being score, who will use more positive emotion words.

Method

Participants

Participants were recruited via Facebook, and through introductory psychology and English courses at a mid-sized public university in the upper Midwest. As incentive, participants could receive extra credit and also enter a random drawing for two $20 gift certificates. Seventy-six participants (58 women and 18 men) completed the PWBS and took part in four days of writing; their ages ranged from 18 to 51 with 92% falling between 18 and 24 years of age. One participant had a first language other than English. Seventy-three participants classified their ethnicity as white, two said they were Asian, and one declined to identify race/ethnicity.

After completing the PWBS, participants split into three groups according to well-being (high, medium, and low). The medium well-being group was excluded from the analysis because comparison between individuals would include some who were more similar than different. The final participant total was 46 participants (36 women and 10 men), 23 in the high well-being condition and 23 in the low well-being condition. Of these, 96% were between the ages of 18 and 24 with the range from 18 to 38. The same first language and ethnicity characteristics still applied, but with 43 participants classifying themselves as white.

Materials

The online survey system *Qualtrics* was used for the data collection portion of the study. Participants consented to participate by clicking the "Next" button on the Qualtrics screen. They then, on Day One, completed the PWBS survey; on the four following days they typed their essays into a text entry form.

The PWBS (taken on Day One) consisted of 84 questions, to which participants responded by choosing their agreement level from 1 (strongly disagree) to 6 (strongly agree) on a Likert scale. Researchers computed responses and summed the subscale scores for an overall measure of well-being. Scores could range from 14 to 84 on each of the six subscales with an overall score from 84-494. The visual binning command in *SPSS* was used to separate individuals into high, medium, and low levels groups.

Researchers initially spellchecked participants' essays in *Microsoft Word* 2007. *The Linguistic Inquiry and Word Count* (LIWC) program analyzed text files by counting word frequency and outputting a percentage of words used. LIWC categorizes words into four major divisions (linguistic processes, psychological processes, personal concerns, and spoken categories), each of which are broken into smaller categories. Average word count on Days One, Two, Three, and Four were 361, 354, 332, and 292, respectively. Pertinent variables in this study were first person singular pronouns, first person plural pronouns, positive emotion words, and negative emotion words.

Procedure

The study took five days and participants followed a link to *Qualtrics* for each part of the study. They completed the PWBS on the first day and were assigned to write about their daily life on four consecutive days. This included writing about family, friends, school, or anything exciting or frustrating. They were instructed to write continuously for at least 10 minutes in a quiet environment conducive to uninterrupted participation. Participants were explicitly instructed to complete the assignment honesty and freely. They were cautioned that if their emotional condition became troublesome, they could withdraw from the study. Additionally, they were informed that they could avail themselves of University Counseling Center staff, whose number was provided in

case of distress. In order to track individuals throughout the days, participants entered their email addresses. Essays were loaded into the LIWC program for analysis. Researchers assigned participants a case number and participant identifying information, such as their email, was removed from the data analysis file. Sample size was adequate for analysis. In addition, participants received class credit according to the number of days they completed, but were only eligible for the gift cards if they completed all five days.

Results

A 4 (writing days 1 through 4) x 2 (low and high well-being) mixed-design analysis of variance (*ANOVA*) was used to examine percentage of words devoted to first person singular, first person plural, positive emotion, and negative emotion words. Partial eta squared was used to compute the effect size. The between subjects factor was the well-being level and the within subjects factor was the day on which the writing occured.

No differences in well-being level appeared as a function of gender, age, ethnicity, or first language. On the PWBS, positive relations with others scores ranged from 41 to 84, autonomy scores from 37 to 80, environmental mastery scores from 42 to 81, personal growth scores from 46 to 84, purpose in life scores from 44 to 84, and self-acceptance from 38 to 83. The total PWBS scores ranged from 283 to 488.

	High Well-being		Low Well-Being	
Variable	Mean	SD	Mean	SD
First Person Singular Pronouns	8.70	.36	10.30	.36
First Person Plural Pronouns	0.82	.11	.50	.11
Positive Emotion Words	4.56	.21	3.94	.21
Negative Emotion Words	1.39	.13	1.84	.13

Table 1: Mean percentage of words used by level of well-being.

Table 1 displays the mean percentages of words used. The means show that individuals with a high well-being scored higher on first person plural pronouns and positive emotion words whereas those with a low well-being scored higher on first person singular pronouns and negative emotion words.

For first person singular pronoun use, the results indicated a significant effect of well-being, $F(1, 44) = 10.10$, $p = .003$, $np2 = .19$. There was neither a significant main effect of days, $F(3, 132) = 1.24$, $p = .297$, nor was an interaction present, $F(6, 132) = .844$, $p = .472$. Figure 1 shows a 95% confidence interval of the mean score for the well-being groups as they relate to first person singular pronoun use.

Results indicated that for first person plural pronoun use, there was a significant effect

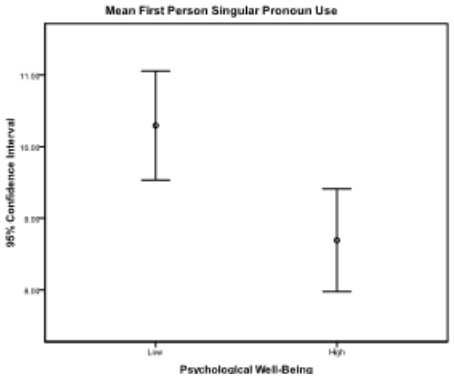

Figure 1: Significant effect between low and high well-being participant's mean first person singluar pronoun use.

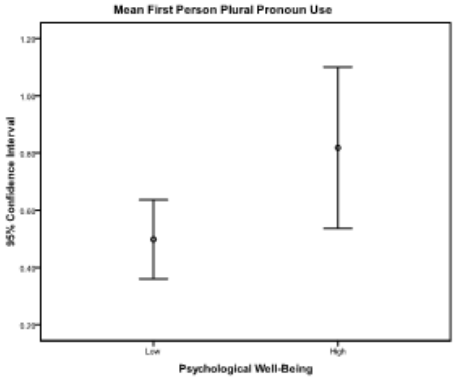

Figure 2. Significant difference between low and high well-being groups in mean first person plural pronoun use.

for well-being, F(1, 44) = .458, p = .040, np2 = .092. However, there was no significant effect for days, F(3, 132) = .611, p = .609, but a significant interaction between the two, F(3, 132) = 3.355, p = .021, np2 = .071. Figure 2 illustrates the relationship between the means for each well-being group in the number of first person plural pronouns used.

In terms of positive emotion word use, there was a significant effect of well-being, F(1, 44) = 4.320, p = .044, np2 = .089. There was no significant effect of day, F(3, 132) = 1.783, p = .153 or interaction F(3, 132) = .507, p = .678 between the day and well-being. Figure 3 demonstrates a confidence interval of positive emotion word use when comparing the means of the high and low well-being groups.

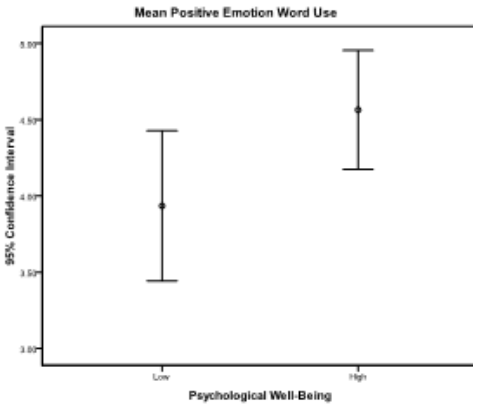

Figure 3: The high-well being group used significantly more positive emotion words than the low well-being group.

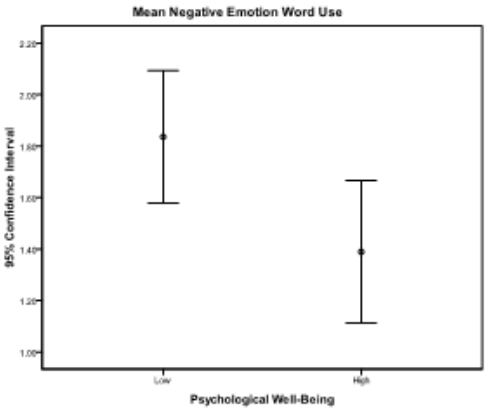

Figure 4: The low well-being group used significantly more negative emotion words than the high well-being group.

Finally, negative emotion word use results indicated that there was a significant main effect of well-being, F(1, 44) = 5.993, p = .018, np2 = .120 but no significant main effect for days, F(3, 132) = 1.395, p = .247. The interaction of days and well-being was also non-significant, F(3, 132) = .692, p = .559. Figure 4 exhibits an error-bar graph of the means for each well-being group when using negative emotion words.

Discussion

Findings proved consistent with the hypotheses. Results indicated that participants with a lower level of well-being did use significantly more first person singular pronouns, with a small to moderate effect size, than the higher well-being group. Stirman and Pennebaker (2000) found that poets who eventually committed suicide used more first person singular pronouns than did formerly and currently depressed participants (Rude, *et al.*, 2004). This suggests that participants with lower well-being (i.e. those who are suicidal and depressed) may be more self-involved (and ruminate over how daily life topics apply to themselves) than persons with higher well-being.

Additionally, participants who ranked high in well-being used more first person plural pronouns, suggesting that they could be more socially involved. Alfred Adler theorized that community concern (*Gemeinschaftsgefühl*) shows psychological health (Hillman, 1988). Usage of more "we" and "us" words coincides with this social interest theory.

The second hypothesis was also supported: participants with a higher level of well-being used more positive words compared to participants with a lower well-being score. Also, those participants who showed lower well-being used a significantly higher number of negative emotion

words. This suggests that participants with higher well-being have more positive thoughts. This confirms the need for therapeutic techniques that focus on changing thought patterns, such as those seen in cognitive-behavioral therapy.

This study may be limited by the few number of first person plural pronouns that participants actually used. Although the word count across all four days averaged a respectable 335, the mean first person plural use was less than 1 for both well-being groups. In addition, the mean for the well-being groups in terms of negative word use lay between 1 and 2; hence a larger word size would increase validity. Another limitation common to any text-analysis programs is the assumption that words issue in a straightforward manner; this excludes the detection of sarcasm and some slang terms.

Future research might contrast different personality types and explore how they pertain to the different LIWC variables (i.e., ascertain if a correlation exists between introversion and use of fewer social process words and positive emotion words). Also, the U.S. is an individualistic society, so running this study in a different culture might result in different first person singular and plural pronoun use, especially in collectivist societies.

In conclusion, a correlation exists between a person's level of well-being and his or her word choice. Individuals with a higher level of well-being may have different thought patterns contributing to a more positive and socially aware outlook. When focusing on negative well-being, one might overlook the strengths (social caring) that are expressed by those with a higher level of well-being. This study provides data to support notions that word use and thought patterns are different for those with high and low well-being. This reinforces the need for Martin Seligman's "positive psychology."

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Racialization of Gender Among Hmong-American Undergraduates

by:
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Abstract

Hmong-American college students live in a multi-cultural environment that shapes their perception of their gender identities and roles. The objective of this project is to emphasize critical analysis (such as Delgado and Stefancic 2012) when assessing minority experiences in the United States, in this case Hmong-American experiences. In particular, the project draws upon critical perspectives to analyze the contributions of race and gender to social constructions of gender discourse. Findings suggest that race and gender are experienced differently within White public spaces (WPS) and Hmong public spaces (HPS). These experiences shape the ways in which Hmong men and women perform gender.

Hmong in Diaspora & Hmong-American

Hmong people are an indigenous group from the mountains of southern China. There are numerous theories of Hmong origins, but the majority of scholars agree that the Hmong were in China before the Chinese empire was established around 2000-2500 B.C. (Cha 2010; Yang 2009). As a result of Chinese political pressures, many Hmong people migrated into Vietnam and Laos. Due to some Hmong groups' political affiliations with France and the United States during the Vietnam War, many Hmong communities sought political refuge in Thailand. Many Hmong still live in Laos, Vietnam and China today (Yang 2009).

Within Laos, Vietnam and China, the Hmong are classified as hill tribe indigenous groups; however, like similar ethnic groups, many now live in the cities of those countries. Those living in the United States, France, Australia, and Thailand have been received as refugees (Hillmer 2010). Since 1976, the lives of Hmong refugee families have been intricately tied to the assimilative institutions and policies of the nation states in which they settled and the social and cultural practices associated with those institutional frameworks.

In the United States today, the Hmong-American population consists of refugees, immigrants, and native-U.S. born citizens. According to the 2010 Census, about 260,000 persons of Hmong origin were counted in the 50 U.S. states, the District of Columbia and Puerto Rico. Approximately 49,000 live in Wisconsin, making Wisconsin the third largest Hmong population in the U.S. behind California and Minnesota (Pfeifer *et al.* 2012). The concentrated nature of the Hmong population in the upper Midwest has driven the educational, medical, social-service and welfare, and legal institutions in these areas to interact intensively with Hmong-Americans. These interactions impact the ways in which Hmong-Americans experience and understand their lives and the relationships they have with the people they encounter in these institutions and the society at large.

Background: Theoretical Problems

This project emphasizes critical analysis to develop and employ an intersectional approach when assessing minority experiences in the United States, in this case Hmong-American experiences. In particular, it focuses on the ways in which gender and race intersect in Hmong-American identity formations.

Hmong-American college students live in a multi-cultural environment that shapes their perception of their racial and gender identities and roles. Hmong-American undergraduates have been exposed to an educational system that has very different cultural expectations than historical or traditional Hmong norms and practices. Scholars suggest that reasons for these differences in cultural expectations are related to their migration and transition into an industrialized society, and/or different educational and economic opportunities and contexts (Lo, 2002; Lee, *et al*. 2009; Long, 2008). Scholars also argue that these new environments put social pressure on Hmong-Americans in terms of different gender norms, the disruption of traditional practices, and intergenerational conflicts related to social identities and relationships among Hmong-Americans (Lo, 2002; Moua, 2003; Tatman, 2004). In all these studies, the focus tends to lie with the tensions assimilative pressures in U.S. society cause, and the differences from, and conflict with, the cultural ideas and practices of Hmong communities and people.

While these scholars point to tensions arising from the encounter between traditional Hmong culture and modern industrial society, I would like here to offer a critique of understanding assimilation divorced from the social suffering it generates. In particular, I focus on the important connection racial hierarchies have with how Hmong-Americans experience and address conflicts around gender. Hmong people living in America have very different experiences from White people living in America. Additionally, Hmong-American men have different expectations and social pressures in comparison to Hmong-American women. Considering both racial and gender experiences will contribute to understanding social suffering in its institutional context and will provide a better analysis of Hmong-American experiences than evaluations of traits and behaviors from a cultural determinist approach.

We look at how the experience of gender is shaped by other discourses of identity (such as race). How might a Hmong female college student's sense of her own gender-related obligations and responsibilities be shaped not just by the discourses of gender in U.S. society generally, but also by discourses that racialize Hmong people in the United States? Would this sense of a gendered self be different from that of a White female college student? I argue that the stigmas and hierarchies attached to race shape how different racialized groups experience gender.

Hmong-Americans' lives are constantly influenced by racialization and the hierarchical dynamics that affect Asian Americans in the United States. Historically, the construction of race in the United States is rooted in colonialism and theories of unilineal evolution in early scientific explanations of race (Schultz & Lavenda 2009). These historical ideas continue to operate in institutions as a way to racialize and exclude minority people from power. Edward Said (1985) suggests that contemporary European ways of imagining non-European identity are "orientalist." Rooted in colonialism and imperialism, orientalist ways of "knowing" objectify the experiences and identities of people seen as Europe's "Others." Said argues that representations of other cultures, societies, and histories are linked with power and knowledge production (Said 1985). This relationship influences the ways in which dominant European ideologies create social hierarchy even after colonialism. Even liberal theory, which asserts the universal equality of all humans, has been shown to be Eurocentric in its assumptions about what makes the "universal subject" (Tong 2013). In this case, the universal subject is the middle-class European male.

Fern Johnson (2000) in *Speaking Culturally* points out that these historical discourses often categorized Asian Americans as "(a) foreigners, (b) the model minority, and (c) sexually exotic" (199). In light of Said's argument, Johnson's observations suggest that even while these stereotypes may sometimes be seen as desirable, they actually cause damage. Such damage occurs in objectifying Hmong memories in ways that do not recognize the reality of Hmong experiences. Furthermore, Johnson (2000) argues that Southeast Asian Americans have a complex history since the Vietnam War. Refugees have been 'Blackened' and gendered as low-income communities of color (Lee 2008). By being 'blackened', as Lee (2008) suggests, Hmong-Americans are racialized and separated from the model minority ideologies. As a result, orientialist and racializing discourses impact how gender is conceptualized, and these discourses play a major role in how Hmong-Americans navigate and experience education inequities (DePouw 2012).

In analyzing the discourse of gendering, we suggest that differences exist between Hmong conceptions of Hmong femininity and White conceptions of Hmong femininity. Additionally, liberal conceptions of gender (White conceptions of femininity) that, even though they are supposedly universal and emphasize universal equality, still see gender difference through racial terms. Moreover, Tong (2013) and hooks (1995) emphasize the Eurocentrism of liberal feminism in which White feminists approach women of color through a position of power that normalizes Whiteness. The liberal conception of femininity is racialized because liberal ideologies are influenced by the discourses of orientalism and racialization highlighted by Said (1985), hooks (1995), Johnson (2000), Lee (2008), and DePouw (2012).

As a result of the different conceptions of femininity, Hmong-Americans develop a second lens through which they view both Hmong and White notions of gender. White conceptions of Hmong femininity as oppressed, when internalized by Hmong women, lead them to perceive White femininity as liberated and Hmong femininity as oppressed. Thus, this discourse places Hmong women in a position of valorizing White gender ideals while seeing their own gendered identity as oppressed. This is especially true for Hmong women who, in seeking ways to critique Hmong patriarchy, find the language of liberalism as a useful articulation.

An intersectional approach focused on the racialization of gender is also valuable in making sense of complicated issues surrounding identity (Lee and Vaught 2003). Lee's and Vaught's work suggests that Hmong-American high school females find themselves embracing Whiteness in reaction to gender domination and rejecting Whiteness in resistance to racial domination. This creates a contradictory situation for young Hmong-American women. In order to further analyze this contradiction, our project critically explores how racialization and gender ideologies influence the ways gender plays out in private and public spaces.

Theoretical Approach, Methodologies and Participants

To explore the experiences of Hmong-American students, I first looked at how they think about and experience race and gender, and then used Critical Race Theory (CRT) as a framework to understand the broader patterns of their experiences.

In *Critical Race Theory: An Introduction*, Richard Delgado and Jean Stefancic (2012) discuss intersectionality, the theory that a group forms its identity via recognizing the diversity of experiences rather than adopting a universal shared experience. They also discuss anti-essentialism, the recognition that a heterogeneous understanding of race and gender helps critique overgeneralizing groups of people. Our research utilized intersectionality and anti-essentialism as key mechanisms for critical analysis. Delgado and Stefancic's use of these two terms allows for a critical analysis of how race and gender impact the socio-cultural dynamics of how gender plays out.

Additionally, in exploring these concepts we recognize that identities develop through processes. Stuart Hall (1990) suggests "identity [is] a 'production', which is never complete,

always in process, and always constituted within, not outside, representation" (222). Furthermore, we employed Judith Butler's (1990) theory of performativity to see how the process of gendered identity formation also constitutes a performance of gendered identity. Performativity holds that identity (including race and gender) is not an innate essence located in the individual; rather, he or she creates it through the performance of social and cultural practices (Butler 1990).

To gather data on race and gender, I generated an online survey and conducted multiple interviews with participants. The *Qualtrics* survey explored how participants identified and experienced race and gender differently in different spaces or contexts. To organize these different contexts, we focused on the survey's findings on identity and roles in relation to private and public spaces. Within public spaces more broadly, we distinguished between White public spaces (WPS) and Hmong public spaces (HPS).

Anthropologist Jane Hill uses language as a means to discuss how spaces are socially constructed in relation to race. Hill (1998) identifies WPS as a predominant space where Whiteness is normalized through the insistence on English as the dominant language and the policing of the linguistic practices of those coded as non-native speakers of English.

In our project, I identified educational spaces and the general community as WPS because these places exhibit similar pressures of White normalization—i.e., White conceptions of universal femininity, and White conceptions of Hmong femininity as an inferior, oppressed kind of femininity that needs liberation in order to turn it into universal femininity. Although not directly addressed in the survey, these spaces were indirectly linked to the kinds of relationships.

Home: Please rate the following.

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
I was given household responsibilities while growing up.	○	○	○	○	○
I was recognized for my contributions in the home.	○	○	○	○	○
I was recognized for my schoolwork in the home.	○	○	○	○	○

Education: Please rate the following.

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
I feel that my educational abilities are high compared to other gender.	○	○	○	○	○
I feel that my educational abilities are high compared to other racialized groups.	○	○	○	○	○
I feel that I am able to succeed in higher education because of my gender.	○	○	○	○	○
I feel that I am able to succeed in higher education because of my race.	○	○	○	○	○

Figure A

A total of 38 participants took part—8 men and 30 women—and all participants were identified as Hmong-American college students from Wisconsin, Minnesota, or California. Participants received an opportunity to voluntarily participate in a follow-up interview, and with these eight (five women and three men) I conducted personal interviews.

Community: Please rate the following.

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
My gender sometimes presents challenges to my ability to work in the Hmong community.					
My race sometimes presents challenges to my ability to work in the Hmong community.					
My race sometimes presents challenges to my ability to work in the general community.					
I feel that the community welcomes my service because of my gender.					

Figure B

Public Space: Please rate the following.

	No	Alone	In a Group
I feel comfortable going to a doctor's appointment.			
I feel comfortable visiting the post office.			
I feel comfortable visiting government offices on official business.			

Figure C

Results & Analysis

Whether the questions directly or indirectly identified race or gender, participants' responses implied the spaces in which people understand and experience gender and race in particular ways. A direct survey question showed a pattern that participants experienced and discussed race and gender differently depending on the particular spaces. Figure D shows three graphs that indicate how participants' gender and race identity created certain challenges differently in each space. Within HPS, 71% of the participants indicated that their gender sometimes presented challenges to their ability to work in the Hmong community, while only 31% agreed that race sometimes presented challenges to their ability to work in the Hmong community. This emphasizes how HPS was mostly perceived as a challenge for gender identity. In comparison, 61% of the participants indicated that race sometimes presented challenges to their ability to work in the general community. This shows the race was seen as a more prominent challenge within WPS but less in HPS.

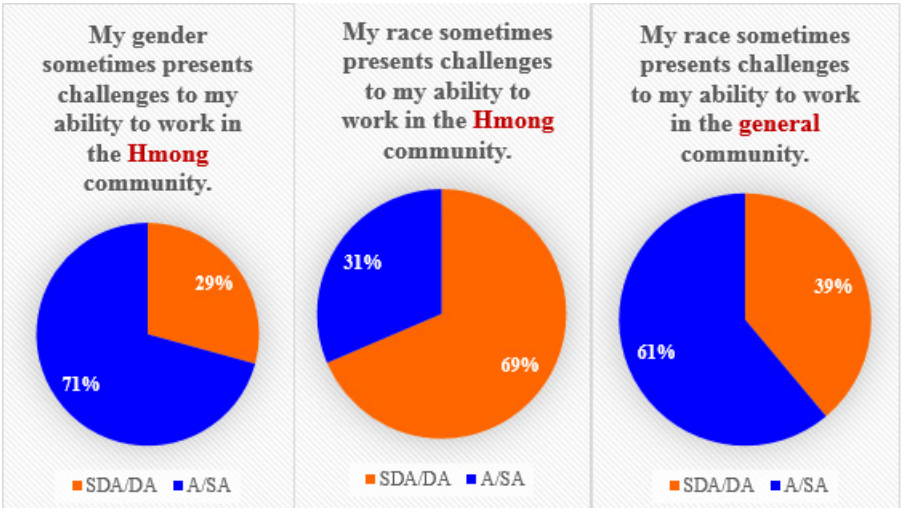

Figure D

Key: Strongly Disagree (SDA), Disagree (DA), Strongly Agree (SA), Agree (A).

I interviewed the follow-up volunteers (5 women and 3 men) regarding their relationships and interactions in each type of space. A majority of the women participants shared that within their home, there was often a discussion of gender inequality. Nag,[1] a female participant shared, "I don't want to be a part of the Hmong community because it's just not as equal for women as the mainstream." Pajyeeb similarly agreed with Nag. Her explanation for rejecting Hmong was the fact that "it's easier to be a girl at school, because there's more equality here."

In addition, Pajyeeb shared her thoughts on her interracial relationship. She commented that she chooses her partner because "he is not Hmong." Pajyeeb commented on how she does not want to marry a Hmong guy because she does not want to marry into a traditional Hmong family. She justified her decision by saying that "… most traditional families they, I feel like they just kind of test you all the time. That gets old and it's, it is not something that I want to deal with. Imagine, waking up and know that, 'oh my mother-in-law is going to test me on something today. What is it?'…" Pajyeeb also commented that her boyfriend's mother, who is White, will not respond the same way. Her explanation is, "it is because she's American. And of course they don't share the same things. They don't really share the same cultural value as us. I know she will understand. But I guess that's just not her personality."

The experiences that both Pajyeeb and Nag shared suggest the intersectionality of race and gender; however, they have not developed a consciousness that allows them to analyze their experiences in terms of race. This is shown through the ways they described their relationships by using words such as "culture" or "personality" instead. Ngo (2013) utilized the term "culture consciousness" to discuss Hmong immigrant leaders' analysis of the dichotomy between cultural essentialism and cultural hybridity. Ngo's intent was to emphasize a critical, anti-essentialist conception of culture that community leaders use for social critique and political strategy, including anti-racist and anti-essentialist ones (2013: 963). Ngo used culture as a strategic way to talk about race. In contrast, Pajyeeb's used the idea of culture in an essentialist way, as an attempt to talk about race and gender without actually naming them. In this case, "culture" becames an alibi for the ways in which Hmong tradition is racialized and gendered.

On the other hand, Peter argued, "in my family there's no gender inequality because we only have one daughter and the rest are sons." Another participant, Thomas, was surprisingly open in commenting, "my mother and sisters washes the dishes and dad and I watch the chickens. That's just how things are." Interestingly, the male participants challenged Orientalist and racialized stereotypes that Hmong culture is "backward" and not liberating, but they also did not offer alternative ways to critique gender hierarchies in Hmong communities.

This limited critique of patriarchy within HPS usually comes from those participants who may not be thinking about race in relation to gender. A common trend shows that in order to understand how they performed racialized gender roles, male participants tended to be aware of race but needed to develop gender consciousness, while female participants understood gender but needed to develop race consciousness in order to understand how they performed racialized gender. This means that (1) both race and gender consciousness need to be developed in order for men and women to understand the dynamics of race and gender in contemporary U.S. society, and (2) in order to understand how Hmong college students experience race and gender, we need to see race and gender as connected to and inseparable from each other.

Identities are gendered in certain ways by being racialized, and racialized in certain ways by being gendered. The idea of a woman as more desirable/eligible for marriage after acquiring a degree is an example that illustrates how her gender identity is racialized. This transformation of a woman's status from "degree-less" to "with-a-degree" enhances her gender status. The added status of a degree is a form of racialization, since the degree is tied to Whiteness. Thus, her gender

[1] All names of participants are pseudonyms

identity is racialized and given a racial meaning that enhances her status. Furthermore, by being a Hmong woman, she is "Whitened" and given "model minority" status in relation to male Hmong youth who are "Blackened" by broader racial discourses (see, e.g., Vang and Schein 2010).

So far, our findings appear to confirm Lee's argument. Moving beyond Lee's observations of embracing Whiteness in resistance to gender domination and rejecting Whiteness in resistance to racial domination, our findings suggest that participants who critically think about race have developed strategies to negotiate this contradiction. In comparison, these participants who consciously consider race recognize that their upbringing creates a reality in which they experience Lee's paradox. In addition, they recognize that race plays a major role in how they have experienced gender in each space (both HPS and WPS). These participants' experiences suggest that they can move beyond this contradiction by using race-consciousness as a tool to explain and negotiate their gender performance in each space.

For example, Nkauj See shared that between her home, the Hmong community, and the broader community (e.g., at school setting, work) she felt a shift in gender performance that she continuously has to negotiate. She commented that she lives in a "split world"—within the White world (WPS) gender can be performed according to liberal norms, and in the Hmong world (HPS) gender can be performed according to Hmong gender norms. As identified by Nkauj See, Hmong gender norms are that men generate income, make decisions, and mediate between the public and private spaces, while women make household decisions and negotiate relationships within private spaces. Moreover, Nkauj See recognized that she often had to shift gender performance between both worlds to feel like she belonged.

In terms of racial dynamics, Nkauj See pointed out that her recognition of race created a change in how she saw herself interact with other races within WPS. She shared that:

> White people are part of my cultural experiences, so it wasn't difficult to build interpersonal relationships. I find it weird now that I'm a lot older. I can see how I act with White people differently. I feel that now I'm more closed off where I don't really talk to [White people] as much as anymore. Just because I feel like, you feel so aware of all these little racism type, microaggressions that like now it is just a little bit harder.

Nkauj See recognized that her participation in women's activist groups provided tools for her to critique Hmong patriarchy. Interestingly, she expressed an awareness that her involvement within these activist groups derived from liberal ideologies. Most youth activist groups are tied to a liberal understanding of social equality, which influences how gender is constructed. Such activism has an affiliation with Whiteness since liberalism is associated with Whiteness. Nkauj See recognized that liberalism is recognized as Whiteness and White culture, which are rejected within HPS, and pointed out that Hmong-American women, including herself, who resist gender domination used liberalism as a critique of Hmong patriarchy. She was aware that when this is seen as a critique of Hmong culture, the critique is rejected within HPS. This rejection then causes Hmong-American women to "embrace Whiteness".

Nkauj See's acknowledgment of the racialized gender discourse helped her to recognize that she has to figure out a way to perform gender differently in each space so she will not meet rejection. Within her home and Hmong communities, she is expected to complete domestic chores such as cooking or washing the dishes to be considered a good daughter. To show respect towards and maintain her relationships with her family members, Nkauj See continued to perform gender in this way. On the other hand, she used liberal activist critiques to challenge gender norms within HPS.

Nkauj See also recognized that the different ways in which gender is performed impacts both HPS and WPS. She suggested:

> If you are a woman, it takes women, where we have to prove ourselves worthy of our job. If we don't then people are going to step all over you… especially if you are women of color or Hmong woman, even though we have the trail of fitting the model minority, since we don't play that leadership role, we are not given opportunities to play the leadership position in the Hmong community (HPS).

HPS norms do not prepare Nkauj See for female leadership in WPS, but being a woman of color is also an obstacle for her to be a leader in WPS. She continued to refer back to how the racialization of Hmong-Americans shapes the way she performed gender roles in WPS. She recognized that she had to become something else within each space. Nkauj See used race consciousness to help her analyze this paradox.

Another participant, Iab, recognized how western ideologies have contributed to the way she interacted with the Hmong community. Iab expressed: "The ways in which Hmong community makes sense of Hmong gender equality, is something that I cannot participate in. Hmong community does not make the space for me to participate in Hmong community."

This observation shows her consciousness that within HPS no room exists for her to use her adopted liberal critiques. Iab admitted that she had a difficult time participating comfortably in Hmong private contexts because of "Whiteness." This recognition allowed Iab to push her participation within these spaces. "I don't participate, but I do care about it depending on the different situations. Whose responsibilities it is to watch my grandma? Eventually it comes down to being my mom's responsibilities, which is not fair. This in turn affects my mom." Iab argued that this shows unequal gender expectations within Hmong communities that immediately impact her life. As a result she wanted to challenge and engage in this conversation. Within WPS, Iab also recognized a shift in how she participated with people of different racial groups (White and Hmong). She pointed out that in college, race consciousness made her aware of her alienation:

> I don't really have White friends anymore. I don't know how to enter the conversation with them. It is just really weird. In high school, everyone got together and talk. When you are in college its just lecture. When you get to talk to people you only have to talk before or after. It's just five minutes; I don't feel like having a relationship with them. I've gone on research trips with my White peers, but it's just really awkward to talk to them. And even after, we would see each other but we wouldn't say much after the event. Like, I would see them and say hi, but they would just say hi back and then that would be the end of the conversation. A Hmong person is more likely to ask me to go to a party with them in comparison to a White person. It was really weird. It just never happened in college. My Hmong friends from high school, they invite me right away in comparison to White friends from high school.

Iab continuously searched for ways to connect to Hmong community and she envied those who can "live in two worlds." In addition to this search for connection, Iab also recognized that her gender changed the way she engaged with the Hmong community.

> My family does not do Hmong in the same way. My dad does not have the same status and recognition in our clan family. In compared to Phooj because his father has specific social status that he can engage in the Hmong activities. Maybe it is because of my gender that I don't have to engage in the same way that my boyfriend does."

Iab had a gender critique of Hmong spaces and a race critique of White spaces, but the racialized nature of her gender critique alienated her from the conversations and relationships she wanted to pursue in Hmong spaces. Iab's recognition of this was clear from her comments that for herself, she used her awareness of race to negotiate and cope with this race-related conflict between ideas of gender within each space.

Both of these participants' experiences suggest that race can be a useful perspective to understand and explain how racialized gender is performed within these spaces.

Conclusion

Within WPS there exists an underlying, liberal idea that everyone is equal, and our research suggests that this ideal influences how gender equality is conceptualized in HPS and how gender inequality is discussed in private spaces.

Although all participants experienced the phenomenon of race, these findings suggest that HPS is a place where race is not talked about. We hold general assumptions about what would happen if a Hmong person discussed race in public: (1) the fear of being marginalized as too radical, and (2) the fear that discussing race draws attention to notions of Hmong cultural inferiority. However, evidence in this paper suggests that adopting an intersectional consciousness of both race and gender will aid men and women in understanding the dynamics of race and gender. In addition, in order to understand how Hmong college students experience race and gender, we need to see race and gender as connected to and inseparable from each other.

These conditions prevent a direct discussion of race, but race can be addressed indirectly through the discussion of gender in HPS when Hmong-American women offer criticisms of Hmong gender relations. Relating to Lee's research, the ways in which gender and race is discussed in each space may explain how Hmong-American women fall into the situation of embracing Whiteness in resistance to gender domination, but rejecting Whiteness in resistance to racial domination. Furthermore, our findings suggested that anti-essentialism and intersectional analysis of race and gender consciousness provide male and female participants ways to resist this dichotomy.

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