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Featured Scholar
It is my pleasure to recognize the significant achievements of the students who participated in the McNair Scholars Program during the 2004-2005 academic year. Under the careful guidance and support of their faculty mentors, these MU undergraduates worked tirelessly to produce the important work featured in this publication. The diverse topics and writing styles represent the variety of disciplines and provide for a rich and interesting reading experience. Although the entire papers of only seven scholars can be presented in this interdisciplinary journal, the work of all the participants listed within this publication, is appreciated and to be commended. While the areas the scholars chose to explore are very different, they share a common passion and enthusiasm for discovery and excellence that embodies the goals and mission of the program. Their hard work and dedication truly honor the memory of astronaut and scientist, Dr. Ronald E. McNair.

A University-wide effort, the McNair program attracts students and faculty mentors from a variety of academic departments and fields of inquiry. Over the past sixteen years, students have had the opportunity to learn about the importance and excitement of earning a graduate degree, while gaining both the insight and skills that will enable them to excel. The faculty mentors, students and program staff collaborate in their efforts to ensure the preparation for and placement into graduate programs.

Having served as a faculty mentor and a guest presenter for the MU McNair Scholars Program, I have had the opportunity to become very acquainted with the program and witness its continued growth and success. We are proud to showcase the work of these talented beginning researchers, in this, the thirteenth edition of the MU McNair Journal. Our best wishes go out to this remarkable group of students as they begin the transition into the next phase of their academic journey.

Pamela Benoit, PhD
Interim Dean, Graduate School
Background
College students who are considering study beyond the baccalaureate level realize their dreams through the McNair Scholars Program at the University of Missouri-Columbia (MU). MU was one of the original fourteen universities selected to develop a program established by the U.S. Department of Education and named for astronaut and Challenger crew member Ronald E. McNair. The purpose of the program is to provide enriching experiences that prepare eligible students for doctoral study.

Program Elements
One of the most exciting aspects of the McNair Scholars Program is the opportunity for junior or senior undergraduate students to participate in research experiences. McNair Scholars conduct research and engage in other scholarly activities with faculty mentors from the areas in which they hope to pursue graduate study. These research internships are either for the academic year or for the summer session and are under the supervision of faculty mentors. For academic year internships, students work a minimum of ten hours per week during the fall and winter semesters. Summer interns work full-time for eight weeks.

McNair Scholars also attend professional conferences with their mentors, go to graduate school fairs, prepare for graduate school entrance exams, receive guidance through the graduate school application process and obtain information on securing fellowships, graduate assistantships, and loans. Participants learn about graduate school life, advanced library skills, and effective ways to present their work. At the completion of the research internships at MU, McNair Scholars make formal presentations of their research to faculty and peers at the McNair Scholars Conference and submit papers summarizing their work. Students who participated as juniors the previous year continue in the program during their senior year for graduate school placement and to further develop their skills.

Eligibility
Participants must meet grade point average standards; be U.S. citizens or permanent residents; and qualify as either a first generation college student with an income level established by the U.S. Department of Education, or a member of a group that is underrepresented in graduate education.

All students who wish to be involved submit an application to the program. A committee composed of faculty members and representatives from both the graduate dean’s office and the McNair Scholars Program selects participants and approves faculty mentors. Research internships are offered to those students who are juniors or seniors and are identified as having the greatest potential for pursuing doctoral studies.
Melanie is a senior from Perryville, MO who is majoring in Biochemistry. She is a recipient of the Excellence Award, Bright Flight and the Granville M. Smith scholarship and is member of the Phi Kappa Phi Honor Society and the National Society of Collegiate Scholars. In addition to her academic organizations, Melanie volunteers for the Mid-Missouri Crisis Hotline. After graduation next May, she plans to pursue a PhD in Genetic Counseling.

Introduction

Autism is a complex disease characterized by impairment of social interaction, language, behavior, and cognitive functions. One in every 1000 children are afflicted, with the disorder three to four times more likely in boys than girls. An even larger number of individuals show some features of autism but do not meet the full diagnostic criteria according to the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV). The DSM-IV describes autistic behavior on the presence of at least 6 of 12 symptoms related to impairment in social interaction, verbal and nonverbal communication deficits, restricted interests, and repetitive behaviors. While these symptoms are normally present by the age of three, children with autism show great variation in their clinical presentation. This variability suggests that multiple genes are necessary for the manifestation of autism. It is this same heterogeneity that has made understanding of the neurobiology of autism a difficult puzzle.

Our research team consists of neuroradiologist, Dr. Dale Vaslow, radiation physicist, Dr. Evan Boote, geneticist, Dr. Judith Miles, research/computer specialist, Nicole Takahashi, and biochemistry major and McNair scholar, Melanie Evans. With our combined expertise, we propose to correlate brain structure with biochemical findings via Magnetic Resonance Spectroscopy. We will also examine the MRS data in terms of laterality differences within our study subjects compared to normal controls.

Literature Review

■ General

In the last 15 years, numerous neuroimaging studies examined the brain anatomy of autistic patients in order to identify structural neurological abnormalities, but the disorder affects so many abilities and behaviors that almost every brain region has been considered as a possible site of dysfunction and results have been flooded with limited replications and even contradictory findings. When studying such a heterogeneous syndrome as autism, it is particularly important to limit the number of experimental variables in the study by retaining as homogenous a population of subjects as possible. Previous studies conducted by Miles et al. have approached this dilemma of a natural heterogeneity within autism by defining two homogenous autism subgroups: essential and complex. This was done by observing physical features that are present in a consistent proportion of autism populations. Complex autism is defined on the basis of generalized dysmorphology, microcephaly, and the presence of major brain malformations. This group appears to have autism as a result of some general insult during early development. Patients that are nondysmorphic, not microcephalic, and have had an MRI showing no structural abnormalities are diagnosed with essential autism.

■ Magnetic Resonance Spectroscopy

While neuroimaging has been the technique of choice for the study of autism, hydrogen proton magnetic resonance spectroscopy is beginning to be utilized. To the best of our knowledge, prior MRS studies of autism have not attempted to reduce the heterogeneity of the population included in the manner described above. In vivo MRS is the only noninvasive
A handful of studies using proton MRS have been conducted on autistic individuals. One study reported a reduction of NAA in the cerebellum, possibly indicating a reduction of Purkinje and granule cells. Otsuka et al. replicated these findings, but also found that NAA levels appeared normal in the medial temporal cortex (hippocampus-amygdala region). Hisaoka et al. found significantly lower NAA in the temporal regions (Brodmann’s areas 41 and 42), suggesting low density or dysfunction of neurons in Brodmann’s areas, which might relate to the disturbances of the sensory speech center (Wernicke’s area). Hashimoto et al. found no abnormalities in right parietal cortex, but observed an increase in the NAA/Cho ratio, with age in early childhood, in both autistics and controls up to age 8 years. A more recent article published by Sokol et al. reported an association between choline/creatine ratios and the severity of autism. An increase in choline suggests increased cellular proliferation, membrane degradation, or membrane turnover.

### Clinical and Structural Correlates

One consideration in this study is the experimental design in the choice of brain regions to investigate. There is evidence supporting temporal lobe dysfunction in autism, as suggested by research on autistics with epilepsy and non-autistic epileptics. Up to a quarter of people affected with autism also suffer from epilepsy, and some forms of temporal lobe epilepsy can mirror autistic symptoms. Landau and Kellfner and Deonna reported that a malformation of the temporal lobe resulted in loss of language as well as seizures, both common symptoms of autism. A more recent epilepsy study by Besag demonstrated an association between temporal lobe tubers and autism. Hoon and Reiss described a classic case of autism associated with a unilateral temporal lobe tumor and seizures. An interesting case was reported by Bachevalier of monkeys with temporal lobe lesions showing autism-like behavior, including avoidance of social contact and demonstration of stereotyped locomotor activity. Lesions in the amygdala and hippocampus in monkeys also produced some features of behavior similar to those seen in autism. MRI studies have shown that the parieto-temporal lobe as a whole is larger in autistic patients. The amygdala may also be larger while the hippocampus findings are conflicting. These studies, in addition to that of MRS studies, lead us to believe that the temporal region is an important region to analyze.

Several neuropathological studies have found low Purkinje and granular cell count in the cerebellar hemispheres in autism, and the reduced cerebellar NAA levels reported in the previously mentioned MRS studies are consistent with this finding. The cerebellum is one of the most consistent abnormal structures in the autistic brain, and is thus a focus of our study.

Although it is unclear whether frontal lobes are structurally abnormal in autism, there is some evidence that they are involved in the neurological impairment. A study of cerebellar blood flow patterns in children using SPECT indicates delayed frontal maturation in childhood autism, which is consistent with the clinical data and cognitive performance of autistic children. Two studies report absence of normal frontal negative potentials associated with auditory attention and visual attention are absent in autism.

The above MRS studies of autism are restricted to select localized regions of the brain. In order to simultaneously study multiple regions, this study uses a multivoxel proton MRS as the neuroimaging method. Multivoxel technique allows a number of voxels to be positioned in the brain. Previous MRS studies have typically been performed on only one or two single voxel volumes. The current generation of hardware and software allow interrogation of a larger number of voxels simultaneously. However, the more voxels of interest (VOIs) formed the longer the scan time. Due to restrictions of cost and time, we have chosen to limit this study to the temporal lobe, cerebellum, parietal lobe, basal ganglia, and frontal lobe, based on previous neuroimaging findings. As will be detailed later, symmetric left/right volumes of interest were identified on each.

### Neurochemical Lateralization

Laterality is the demonstration by cerebral dominance in which there is preferential use and superior functioning of either the left or right side of the brain. The concepts of cerebral dominance and hemispheric asymmetry have been studied since the 19th century and it is well accepted that the two halves of the human brain are structurally and functionally different. Normal lateralization typically involves a left-hemisphere dominance for

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**Table 1: Major Metabolites of MRS Spectra**

<table>
<thead>
<tr>
<th>Metabolite</th>
<th>Function in MRS</th>
<th>Changes in metabolite</th>
</tr>
</thead>
<tbody>
<tr>
<td>N-acetyl-aspartate (NAA)</td>
<td>Made exclusively in the mitochondria of neurons, has been hypothesized to be a marker of neuronal and axonal viability and density</td>
<td>↓ NAA = neuronal or axonal damage</td>
</tr>
<tr>
<td></td>
<td></td>
<td>↑ NAA = neuronal or axonal recovery</td>
</tr>
<tr>
<td>Total Creatine</td>
<td>Reliable marker of intact brain “energy metabolism” Most stable cerebral metabolite – used as internal reference</td>
<td>↓ Cr = energy deficit</td>
</tr>
</tbody>
</table>
language and motor skills and right-hemisphere dominance for spatial processing. Autism is believed to be a left-hemisphere dysfunction syndrome because children with autism have deficits in language, analytical processing, and cognitive functions, all of which are attributed to the left-hemisphere. Likewise, children with autism show little disturbance in visual-spatial abilities and perception of musical stimuli, both processes attributed to the right-hemisphere. While many studies have been conducted on structural and functional asymmetries of both normal and autistic individuals, studies on neurochemical asymmetries are limited and none have been reported in autistic individuals. One study by Jayasundar utilized MRS imaging to investigate neurochemical lateralization in normal individuals and found a significant lateralization in the distribution of metabolites; more specifically, a right-shift in thalamus and frontal regions and a left-shift in cerebellum and parietal regions. This project will be one of the first to analyze MRS data for neurochemical laterality in autistic individuals.

**Methodology**

■ Subjects

Eleven autistic and seven control patients scheduled for brain MRI scans at the University of Missouri-Columbia Children’s Hospital were recruited for additional MRS studies under an IRB. To optimize sample homogeneity, the subjects were matched for age (4.6 yrs ± 1.4), normal brain MRI, normal EEG, normal head circumference (0.40 SD ± 1.4), no history of regression, and similar IQs (83 ± 17). Of the eleven subjects with autism, ten were male, eight were diagnosed with essential autism, and three were diagnosed with complex autism.

■ Procedure

To begin to examine laterality in autism, Magnetic Resonance Spectroscopy (MRS) was selected as a suitable technique because it is non-invasive and measures important neurologic metabolites. Subjects were examined using a Siemens Symphony 1.5 Tesla magnetic resonance imaging system and automated metabolite analysis package. Magnetic Resonance Spectroscopy data were acquired using a spin-echo chemical shift imaging sequence with an echo time of 30 milliseconds, a repetition time of 1500 milliseconds and averaging 4 signal acquisitions. Bilaterally symmetrical volumes of interest (VOIs) were aligned in the sagittal plane from the frontal lobes and angled back toward the cerebellum (Fig. 1). Depending upon the size of the subject, this resulted in approximately three by five voxels for a total of 15 voxels sampled for spectroscopic data. The volume represented by each individual voxel in the chemical shift image was approximately 0.8 cc. Automated analysis of the spectroscopic data to determine the area under metabolite peaks was performed on a separate workstation (Fig. 2 and Fig. 3). The area of a metabolite peak is proportional to the concentration of that metabolite in the individual voxel volume. The focus of the study was directed at two major resonances: N-acetyl-aspartate (NAA), which is present almost exclusively in neurons and neuronal processes and is considered a marker of axonal integrity, and choline (Cho) which is a marker of cell membrane proliferation, turnover, or disruption. Creatine (Cr) is used as an internal standard. Because of variations in the signal calibration and acquisition of spectroscopy data by the magnetic resonance imaging system, this internal standard is used for reporting results. In reporting metabolites as ratios of areas under the peaks with respect to Cr, individual and daily variations are reduced.

■ Data Analysis

Metabolic ratios of NAA/Cr and Cho/Cr were determined for each volume of interest (VOI) in the frontal, temporal, parietal, basal ganglia, and cerebellar regions. The ratios within these VOIs were averaged, and the differences between left and right brains were expressed as left/right asymmetry ratios. These ratios were studied using a repeated measures analysis of variance and a t-test for independent samples.
Results

No significant differences for NAA/Cho (p=ns) or NAA/Cr (p=0.09). However, a statistically significant increase was found for Cho/Cr (p=0.02) in the brains of autistic subjects. This difference in choline between autistic subjects and controls was not significant for select brain regions, but was significant for the combined regions. Though the difference in NAA/Cr between autistic subject and controls was not statistically significant (p = 0.09), larger sample sizes may yield a significant difference.

The combined group of essential and non-essential shows no significant difference in metabolites in each of the five regions of interest. We observed a right-shift in the ratio of Cho/Cr in the cerebellum (p=0.05). The results of the t-test for the cerebellum are summarized in Table 2. This is preliminary evidence that choline levels may be increased in subjects diagnosed with essential autism compared to those with complex autism.

Table 2: P-values of Cho/Cr Ratios by Subgroup in the Cerebellum

<table>
<thead>
<tr>
<th>Subject</th>
<th>Average Right Cerebellar Cho/Cr</th>
<th>Average Left Cerebellar Cho/Cr</th>
<th>R/L Cerebellar Cho/Cr</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>ES1</td>
<td>0.680</td>
<td>0.520</td>
<td>1.308</td>
<td></td>
</tr>
<tr>
<td>ES2</td>
<td>0.600</td>
<td>0.490</td>
<td>1.265</td>
<td></td>
</tr>
<tr>
<td>ES3</td>
<td>0.670</td>
<td>0.605</td>
<td>1.107</td>
<td></td>
</tr>
<tr>
<td>ES4</td>
<td>0.600</td>
<td>0.570</td>
<td>1.053</td>
<td></td>
</tr>
<tr>
<td>CX1</td>
<td>0.535</td>
<td>0.670</td>
<td>0.799</td>
<td></td>
</tr>
<tr>
<td>CX2</td>
<td>0.727</td>
<td>1.750</td>
<td>0.415</td>
<td></td>
</tr>
<tr>
<td>CX3</td>
<td>0.537</td>
<td>2.173</td>
<td>0.247</td>
<td></td>
</tr>
<tr>
<td>CN1</td>
<td>0.617</td>
<td>0.740</td>
<td>0.833</td>
<td></td>
</tr>
<tr>
<td>CN2</td>
<td>0.637</td>
<td>0.550</td>
<td>1.156</td>
<td>ns</td>
</tr>
<tr>
<td>CN3</td>
<td>0.644</td>
<td>0.852</td>
<td>0.756</td>
<td></td>
</tr>
</tbody>
</table>

ES = Essential autism, CX = Complex autism, CN = Control subject, ns = not significant

Discussion

An overall increase in choline was found in the brains of patients with autism compared to control subjects, and a potential right-shift of cerebellar choline in patients with essential autism. As shown in Table 1, the choline peak in MR spectra is generated by free choline and phosphocholine, components of membrane synthesis, and glycerophosphocholine, a breakdown product of the degradation of membrane phosphatidylcholine. Increased choline has been associated with accelerated degradation of membranes and/or an increase in number of glial cells. This finding of elevated choline is consistent with that of Sokol et al., who stated that autism may involve a disruption of cell membrane phosphatidylcholine with expression of breakdown product glycerophosphocholine. Since choline is also considered a marker of cellular membrane turnover, elevated choline may suggest an increase in cellular proliferation. This would be consistent with data showing increased brain volume in young autistic children. Increased choline has also been associated with the presence of tumors, demyelination, Alzheimer’s disease, and general brain trauma. With so many possible interpretations of these results, more controlled MRS studies must be conducted.

The fact that the right-shift of choline in the cerebellum was only observed in the essential autism subgroup stresses how vital it is to have homogeneous subject populations in any autism study. Autism has a natural heterogeneity, and to attempt to control for it, study groups should be made as homogeneous as possible, taking into account the diagnosis of essential or complex autism.

These results should be interpreted with caution, considering they are based on an extremely small sample size. However, it is promising that even with a small sample, statistically significant results were still obtained. Larger samples of autistic patients diagnosed with essential autism may shed more light on the meaning of an elevated choline level. However, this exploratory study suggests that MRS can be an important tool to study brain laterality in autism.

References

Introduction

Voters are concerned with specific issues in society that affect which political candidate they vote for at the polls during elections. For instance, a voter may vote as an advocate for abortion rights, leading them to vote for the pro-choice candidate. In an attempt to capture votes and win elections, political parties attempt to appeal to voters by speaking to these issues of concern. Over time, Republican and Democratic parties have developed an association with certain issues, in effect “owning” issues in the minds of voters. Petrocik (1996) defines issue ownership as a reputation for being “better able to ‘handle’ [a problem] than his opponent.” Voters develop a perception of a party’s issue competencies, believing that one party is better at addressing certain issues than the other party. According to Petrocik, Benoit, and Hansen (2003), parties campaign mostly about the issues that they “own,” especially when the issue is of great concern to voters. These factors combine to form the framework for the intricate relationship between political parties, their campaigns, and voters.

Literature Review

This research aims to make significant gains towards the previous research that has been conducted in the past on Petrocik’s theory of issue ownership by seeking to determine whether parties do empirically own certain issues according to the public’s perceptions. Petrocik’s theory predicts a political campaign effect when a candidate successfully frames the vote choice as a decision to be made in terms of problems facing the country that he is better able to “handle” than his opponent. [2] For instance, if a Democrat purposefully emphasizes the issue of health care, which Petrocik believes is thought by most voters to be better handled by Democrats, this may make health care more salient among voters, and the Democrat should benefit as a result. Likewise, if a Republican focuses on the issue of taxes, which is traditionally perceived as better handled by Republicans, the Republican should benefit if taxes become more important to voters.

Previous research has been conducted in the realm of issue ownership theory, including whether or not voter perceptions do differ between parties (Democratic and Republican) on issue competencies and whether candidates emphasize some issues in systemic ways. [2] Petrocik (1996) applied his theory to presidential elections, affirming that perceptions do differ and that candidates do systematically shape their campaigns based on the concept of issue ownership. Through content analysis of news reports, voter opinion polls over a decade, and actual voting results, Petrocik found that candidates do emphasize specific issues in their campaigns and that the outcomes of elections are a reflection of the issue concerns of voters.

He also discusses the existence of performance issues. Major current events can “provide one party with a ‘lease’—short-term ownership—of a performance issue” (Petrocik, 1996). For instance, if the incumbent party has difficulties with an issue (e.g. high inflation or unemployment), “the challenger acquires an advantage, a performance-based ownership of the issue, from his irrefutable demonstration that the incumbent party cannot handle the job” (Petrocik, 1996). So, voters’ perceptions of a political party’s performance in the White House determines which party has a (short-term) advantage on these issues.
Petrocik’s research, which included a case study of the 1980 presidential election, established the grounds for his theory, revealing that candidates generally emphasize issues that the public considers better handled by their particular party. He incorporated voters’ perceptions spanning a decade, leaving room for opinions to be collected over a broader span of time, revealing possible trends and changes.

Later research also found that issue ownership theory influences the content of candidates’ TV spot ads and acceptance speeches in presidential campaigns and that a strong relationship exists between candidate issue emphasis, issue importance among voters, and the vote. [3] Petrocik, Benoit, and Hansen (2003) found that both Democratic and Republican candidates emphasize issues which their own party is believed to own in both television spots and acceptance speeches. Their study was the first to measure the issues emphasized by presidential candidates in their campaign messages. The study’s findings established a relationship between candidate issue emphasis and voter perception of party issue ownership. They also found a strong correlation between not only the issue content of the campaign and the issue agenda of the electorate, but also the issue agenda of the electorate and the vote. Another significant finding revealed that the news media does not appear to influence the issue concerns of voters, showing neither correlation between campaign issue emphases and the issue content of the media nor the media’s issue content and the varying issue concerns of voters.

Benoit and Hansen (2004) analyzed political party issue ownership patterns in primary and general presidential debates, supporting the theory. This study also revealed a shift in issue discussion over time, as Democratic-owned issue discussion has increased over time and Republican-owned issue discussion has decreased. Benoit and Hansen speculate that this is a result of adapting debate messages to voters. This study’s findings are very significant in supporting the importance of a longitudinal study on voter public opinion, as it suggests that a longitudinal analysis may be very revealing in the research into issue ownership theory.

The results of this research could contribute significantly to the research previously conducted, as well as potentially being useful in the campaigning strategies of the two parties. No studies over public opinions spanning several years have been conducted to analyze the trends and shifts that exist in the perception patterns of issue ownership. It is highly probable that long-term public opinion trends in issues are found to favor specific parties and that these trends have shifted over time, leading the research towards answering a question not posed in previous research. Aside from the opportunity to contribute to past research, any findings could also influence political campaigning. Political candidates rely on public opinion as a source in developing their campaign strategies. If this research can add another dimension to the work of Petrocik and others in the theory of issue ownership, the theory could be used even more practically as a resource candidates can exploit in their campaign messages. [1]

Though significant research has been conducted, the theory leaves room to expand. Since Petrocik introduced his theory of issue ownership, some significant research into the area has been conducted. However, the theory is relatively young and allows researchers room to expand on its findings. A longitudinal study over public opinions regarding a party’s ability to handle a specific issue would make significant headway into the theory.

**Purpose and Hypotheses**

We know that the candidate messages and news coverage tend to emphasize the issues that the two major political parties are assumed to own. However, we have no longitudinal evidence for the key assumption of issue ownership theory: that voters believe these parties have different issue handling competencies.

The proposed research expands on the previous research by longitudinally analyzing voters’ perceptions of which candidates are better able to handle specific issues from the years 1970 to 2004. This empirical data should reveal whether Democrats or Republicans empirically own a number of issues. Also, the research should determine through trend-analysis whether issue ownership patterns have shifted between the years 1970 and 2004, and if so, how. In order to test this, I pose the following hypotheses and research questions:

**H1:** Voters report that the Democratic and Republican parties own different issues.

**H2:** Whether the two major political parties own specific issues between the years 1970-2004. Petrocik does not provide explicit criteria for determining whether an issue is consistently owned by one political party or leased (a performance issue that is expected to vary). I decided to apply a criterion of 90%. If a party owns 90% of the polls on a particular issue, that party is considered to own that issue. If polls reveal that parties do own issues over time, I pose the following two research questions to delineate between the issues owned by the Democratic and Republican parties.

**RQ1:** Which issues are owned by the Democratic Party?

**RQ2:** Which issues are owned by the Republican Party?

In order to investigate the degree to which parties own specific issues, I also pose a third research question to determine how much each party owns an issue.

**RQ3:** What is the average margin of ownership for each issue?

The second hypothesis determines whether some issues are not empirically owned by parties, but rather are subject to other performance-related factors. These are issues in which no party wins 90% of an issue’s polls, failing to achieve this study’s established threshold. This hypothesis expands on Petrocik’s (1996) concept of performance issues.

**H2:** Some issues are performance issues (not clearly owned by one party or the other).

If this hypothesis is supported, I pose a fourth research question to determine which issues can be classified as performance issues.

**RQ4:** Which issues are performance issues?

Though Petrocik and others have conducted research in the realm of issue ownership theory, their research has consisted mostly of media content analysis and the presence of issue ownership in campaigns. The proposed research takes a different direction, focusing more on public opinion poll analysis of voters and seeking to define possible variations in which political parties own which issues since 1970. The research is significant in its potential to point out these possible ownership changes.
and discover variables affecting why voters associate certain issues with a particular party. This potential discovery could dramatically affect the relationship between candidates and voters by providing them both further insight into political campaigns and election outcomes, with regard to the issues.

Methodology

This research will provide empirical evidence for patterns of issue ownership and shifts in issue ownership patterns over time. In other words, this research will identify which political party is believed to own a series of issues based on public perceptions, as expressed in public opinion poll data, as well as which issues are regarded as performance issues.

The method for gathering the data is searching and downloading pertinent information from public opinion polls through Lexis-Nexis, using the academic reference search engine to access the polls of the Roper Center for Public Opinion Research database. The time period being researched spans from the years 1970 to 2004. The year 1970 was determined by the availability of polls for this research’s selected public issues.

Polls are identified as relevant based on the intersection of two sets of specific keywords. The first set of keywords focuses on the way poll conductors frame their questions about issue ownership perceptions:

- better job handling
- more likely to improve
- better job dealing with
- better job on
- to deal with
- best job of
- better job controlling
- make the right decisions about

The second set of keywords concentrates on the issue topics being analyzed. Those words, grouped by issue, are:

- education
- jobs, employment, unemployment
- environment
- poverty, poor
- Social Security, elderly
- health care, Medicare
- economy, inflation, cost of living
- crime, drugs
- foreign policy, military, national defense, terrorism
- taxes
- federal budget, deficit, government spending
- abortion

Although voters have been questioned about other public issues, these issues are some of the most heavily polled; therefore, the data collected should provide the most useful data.

Following the data collection, the selected polls will be organized by date and issue into a Microsoft© Excel spreadsheet. The trends in the data will then be analyzed to discover possible shifts in the public’s opinion of which political party is perceived to better handle each issue. To aid in the analysis process, each issue will be charted using Excel. This will be utilized in order to provide a visual graphic of any shifts to complement the quantitative data.

This method should provide data compelling enough to either confirm or refute my proposed hypotheses that longitudinal analysis reveals that parties own certain issues and that some issues are performance issues. By organizing the data and analyzing annual public opinion poll results, this information will be identifiable.

Findings

Over 1000 polls were gathered using the Lexis-Nexis search engine. The number of polls available for each issue varied from a lowest number of 35 (poverty) and a highest number of 138 (economy). The latest available year for the polls of these issues was 1970, thus limiting the longitudinal analysis to that far back. Not all issues had polls available that far back, however. For example, the budget/deficit issue polls were not available until 1984. Though the majority of the issues had poll data leading up to 2004, the poll data for three issues was not available past 1994 (inflation), 1998 (poverty), and 2002 (crime). Furthermore, polls were not conducted systematically over time. Although it would have been cleaner if the polls on a given issue had been conducted on a consistent basis (e.g., every six months), they appear to be taken at random.

A significant amount of data was gathered despite these limitations in poll availability. Table 1 summarizes the collected data. Hypotheses 1 and 2 were both supported. Voters reported that Democrats and Republicans own different issues, so hypothesis 1 was confirmed. Using the 90% threshold to determine issue ownership over time, seven (7) issues are owned by one of the two parties. The data provided an answer to research question 1, as the Democrats own six (6) issues—abortion, education, environment, health care, poverty, and social security. The party owns four (4) of these issues outright (abortion, environment, poverty, and social security), winning 100% of the polls on each issue. They won 91% of education polls and 98% of health care polls. Research question 2 was also answered with the Republicans owning only one (1) issue (defense), with 99% of the polls.

Table 1: Summary statistics of number of polls gathered through Lexis-Nexis and number of polls owned by Republicans and Democrats

<table>
<thead>
<tr>
<th>Issue</th>
<th>First poll date</th>
<th>Last poll date</th>
<th>No. of polls (R)</th>
<th>No. of polls (D)</th>
<th>Percent</th>
<th>Dem</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abortion</td>
<td>Nov. 83</td>
<td>Jan. 04</td>
<td>0</td>
<td>36</td>
<td>100%</td>
<td></td>
</tr>
<tr>
<td>Budget, deficit</td>
<td>Feb. 84</td>
<td>Jan. 04</td>
<td>46</td>
<td>24</td>
<td>34%</td>
<td></td>
</tr>
<tr>
<td>Crime</td>
<td>Jan. 70</td>
<td>Oct. 02</td>
<td>75</td>
<td>27</td>
<td>26%</td>
<td></td>
</tr>
<tr>
<td>Defense</td>
<td>Oct. 79</td>
<td>Dec. 04</td>
<td>90</td>
<td>1</td>
<td>1%</td>
<td></td>
</tr>
<tr>
<td>Economy</td>
<td>Aug. 70</td>
<td>Dec. 04</td>
<td>62</td>
<td>70</td>
<td>53%</td>
<td></td>
</tr>
<tr>
<td>Education</td>
<td>Aug. 70</td>
<td>Jul. 04</td>
<td>0</td>
<td>87</td>
<td>93%</td>
<td></td>
</tr>
<tr>
<td>Environment</td>
<td>Oct. 81</td>
<td>Jul. 04</td>
<td>0</td>
<td>87</td>
<td>100%</td>
<td></td>
</tr>
<tr>
<td>Health care</td>
<td>Aug. 70</td>
<td>Dec. 04</td>
<td>2</td>
<td>118</td>
<td>98%</td>
<td></td>
</tr>
<tr>
<td>Inflation</td>
<td>Jan. 70</td>
<td>Nov. 94</td>
<td>44</td>
<td>10</td>
<td>19%</td>
<td></td>
</tr>
<tr>
<td>Poverty</td>
<td>Sept. 83</td>
<td>Aug. 98</td>
<td>0</td>
<td>35</td>
<td>100%</td>
<td></td>
</tr>
<tr>
<td>Social Security</td>
<td>Nov. 81</td>
<td>Dec. 04</td>
<td>0</td>
<td>101</td>
<td>100%</td>
<td></td>
</tr>
<tr>
<td>Taxes</td>
<td>Jul. 74</td>
<td>Mar. 04</td>
<td>56</td>
<td>31</td>
<td>36%</td>
<td></td>
</tr>
<tr>
<td>Unemployment</td>
<td>Apr. 71</td>
<td>Sept. 04</td>
<td>7</td>
<td>49</td>
<td>88%</td>
<td></td>
</tr>
</tbody>
</table>

Also of note, for some polls on certain issues the Democrats and Republicans had equal poll percentages. For example, on the issue of crime, six (6) polls resulted in ties, so only 102 of the 108 total polls show a preference for one political party in Table 1.
In response to research question 3, the average margin of ownership varies for each issue. The margins are summarized in Table 2. The average margins of ownership for Democrats is 9.1% for abortion, 13% for education, 24.4% for environment, 20.7% for health care, 43% for poverty, and 14.9% for social security. The average margin of ownership for Republicans is 29.9% for defense. In short, the two political parties do not get the same advantage on every issue they own (for Democrats, their margin among voters varies from 9.1-43%).

Table 2: Summary statistics of average overall percentage for Republicans and Democrats on each issue and percentage margin of ownership

<table>
<thead>
<tr>
<th>Issue</th>
<th>Avg. overall % (R)</th>
<th>Avg. overall % (D)</th>
<th>Own. Margin %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abortion</td>
<td>274</td>
<td>36.5</td>
<td>9.1</td>
</tr>
<tr>
<td>Budget, deficit</td>
<td>36.4</td>
<td>33.1</td>
<td>3</td>
</tr>
<tr>
<td>Crime</td>
<td>32.1</td>
<td>27.6</td>
<td>4.5</td>
</tr>
<tr>
<td>Defense</td>
<td>53.2</td>
<td>23.3</td>
<td>29.9</td>
</tr>
<tr>
<td>Economy</td>
<td>36.6</td>
<td>37</td>
<td>0.4</td>
</tr>
<tr>
<td>Education</td>
<td>29.2</td>
<td>42.2</td>
<td>13</td>
</tr>
<tr>
<td>Environment</td>
<td>21.6</td>
<td>46</td>
<td>24.4</td>
</tr>
<tr>
<td>Health care</td>
<td>25.5</td>
<td>46.2</td>
<td>20.7</td>
</tr>
<tr>
<td>Inflation</td>
<td>38.1</td>
<td>28.5</td>
<td>9.6</td>
</tr>
<tr>
<td>Poverty</td>
<td>17.5</td>
<td>60.5</td>
<td>43</td>
</tr>
<tr>
<td>Social Security</td>
<td>30.2</td>
<td>45.1</td>
<td>14.9</td>
</tr>
<tr>
<td>Taxes</td>
<td>38.8</td>
<td>35.3</td>
<td>3.5</td>
</tr>
<tr>
<td>Unemployment</td>
<td>30.8</td>
<td>44.7</td>
<td>13.9</td>
</tr>
</tbody>
</table>

Hypothesis 2, which states that some issues are performance issues, is also confirmed. Of the 13 issues, the Democrats won the majority of the polls on eight (8) issues—abortion, economy, education, environment, health care, poverty, social security, and unemployment; and the Republicans won the majority of polls on five (5) issues—budget/deficit, crime, national defense, inflation, and taxes. However, not all of the issues were owned by a party. Polls shift frequently enough on six (6) of the issues that neither of the parties achieves 90% of the poll results. Thus, these issues—budget/deficit, crime, economy, inflation, taxes, and unemployment—are classified as performance issues. For example, the Democratic Party won 86% of unemployment polls and 51% of economy polls, and the Republican Party won 66% of the budget/deficit polls, 69% of the crime polls, 82% of the inflation polls, and 62% of the taxes polls. Although each party won the majority of the polls on these issues, they failed to meet the 90% standard adopted here to define issue ownership.

The gathered data was also organized to analyze the average poll percentages for Democrats and Republicans in each issue, as displayed in Table 2. These percentages were computed to determine the average margin of ownership on the issues each party owns. The degrees of issue ownership varied among the issues and parties based on their poll percentages. As mentioned above, the Democrats owned four (4) issues outright, whereas the Republicans owned none of the 13 issues outright. The parties combined to own seven (7) issues, winning 90% of the polls, whereas the remaining issues shifted from one party to another with more frequency.

Excel charts graphed of all 13 issues’ poll data provide a visual of these various ownership degrees. Figure 1 shows the trends in economy polls, which is a much tighter issue that has shifted frequently over time between Democrats and Republicans.

**Figure 1:** The economy performance issue, which shifted ownership between parties over time. The Democrats win the majority of the polls by the narrow margin of 70 to 62 polls.

**Conclusion**

This research confirms the basic tenets of issue ownership theory. It shows that there is a fair amount of consistency in ownership of some issues and delineates between owned issues and performance issues. According to public opinion polls, of 13 major issues, the Democratic Party owns six (6) issues, and the Republican Party owns one (1). The remaining six (6) issues are performance issues. Given a party’s tendency to campaign mostly on issues they are perceived to own, this type of longitudinal analysis can help us better understand the relationship between political parties, issues, and voters.

In the future, further research should be conducted on the longitudinal relationship between the issues analyzed and the performance of political parties on these issues over time. For instance, in years when Democrats are perceived as better able to handle inflation, is there a Democratic president in office performing well on inflation. Or, is there a Republican president in office not performing well on inflation.

Also, it would be interesting to see a study on the longitudinal relationship between the most important issues to voters during elections and whether or not the election winners own more of these issues.

**References**


Jered D. Wisdom
Movements, Resource Selection, and Intraspecific Interactions of the Eastern Cottontail Rabbit
Joshua Millspaugh, PhD, Mentor
Department of Fisheries & Wildlife

Jered is a senior from Sikeston, MO who is majoring in Fisheries and Wildlife. He is a member and has held positions in the MU Student Chapter of the Wildlife Society and the School of Natural Resources STUCO. Jered has received scholarships from several conservation organizations including The Rocky Mountain Elk Foundation and Quail Unlimited. His research and work with the Missouri Department of Conservation has inspired him to pursue a graduate degree in the study of large mammals.

Introduction

Since the flood of 1993 managers have made efforts to establish forests in parts of the Missouri River floodplain to reestablish native oak species, afforest former agricultural lands, improve wildlife habitat, and establish agroforestry practices. Wildlife damage, however, has been hampering the success of these efforts through herbivory. During the winter, due to a lack of succulent green vegetation, the eastern cottontail rabbit (Sylvilagus floridanus) will prune, bark, or girdle the stems’ base which kills or damages the trees (Geis 1954).

The eastern cottontail rabbit can be found over the eastern two-thirds of the United States (Schwartz and Schwartz 1995). It is known as a habitat generalist because it occupies and forages in a variety of cover types (Chapman et al. 1980, Bond et al. 2002, Swihart and Yahner 1982). The cottontail does however prefer open brushy or forest-border habitat (Mankin and Warren 2001, Schwartz and Schwartz 1995). Generally, the cottontail requires an area with adequate cover such as brush piles, dense vegetation, or old fencerows nearby to protect it. Evidence shows that abundance of suitable cover may be more important than food supply in habitat selection (Bond et al. 2002). Home range for the eastern cottontail can depend upon many variables such as location, sex, season, cover and food availability (Schwartz and Schwartz 1995, Cowan and Bell 1986, Bond et al. 2002, Althoff 1997).

There has been a reported regular pattern of dominance between males and between females but, there is no dominance between the sexes (Schwartz and Schwartz 1995, Cowan and Bell 1986). It has not been reported that there is social competition for food among cottontails but a female will defend the area around her nest site (Cowan and Bell 1986). Breeding and nesting in Missouri generally begins in mid-February and goes through September, but it can be delayed if the winter is exceptionally harsh (Schwartz and Schwartz 1995).

The cottontail prefers to forage on succulent green vegetation, but its availability is related to seasonality. Generally, bluegrass, wheat, and white clover are preferred, but red clover, Korean lespedeza, small and common crabgrass, timothy, common chess, some sedges, forbs and cultivated plants are also adequate. As long as snow is absent dried forbs and grasses, some berries, winter wheat, and rye are chosen in the winter. If snow or ice have these foods covered or availability is low then buds, twigs, bark, and sprouts of shrubs, vines, and trees will be relied upon in the cottontail’s diet. It is possible for rabbits to subsist on woody plants, but it is not healthy (Schwartz and Schwartz 1995).

The objectives were to determine core area and home range of the eastern cottontail rabbit. We also wanted to establish which resources were selected at large and fine scales in the Missouri River floodplain by the rabbits. Additional objectives were to assess intraspecific interactions between the cottontails and suggest techniques to alleviate winter herbivory damage in agroforestry systems.

Study Area

The study was at Plowboy Bend Conservation Area (2,617 acres) (Secs. 24 and 25, T 47 N, R 14 W; Moniteau County) managed by the Missouri Department of Conservation, approximately five miles northeast of Jamestown, Missouri. Plowboy is open to public use for outdoor recreation and is adjacent to the Missouri River. The majority of the area consists
of agriculture fields, grasslands, and young cottonwood/willow stands. Three 40-acre fields or the redtop, no redtop, and control fields made up the study area. All of which were adjoining so rabbit movement was permitted between fields. Oak seedlings (*Quercus bicolor, Q. palustris*) were planted in the redtop field and no redtop field, while there were not any oak seedlings planted in the control field. In addition to oak trees, redtop grass (*Agrostis gigantea*) was planted originally to assess the responses of oaks to different ground vegetation in the field designated as the redtop field. The no redtop field and control were not planted in a cover crop, but colonized by local vegetation such as johnsongrass, smartweed, pigweed, Asters, and other coarse weeds (Swearingin et al. 2004).

### Methods

In the winter of 2004-2005, 20 Tomahawk cat/rabbit model 606 live-traps were set in each of three 40-acre fields. Traps were placed at a rate of 2 per acre in a grid configuration in a randomly selected quarter section of each of the three 40-acre fields. Rows were spaced 200 feet apart, and within each row traps were spaced 183 feet apart. Our goal was to have at least 8 rabbits per field collared. Each trap was wrapped in dark roofing paper to protect the cottontails from the elements and to help minimize stress (Swihart and Yahner 1982). Each trap was baited with a combination of lettuce, celery, cabbage, and rabbit feed pellets. If temperatures were expected to fall below 15° F, the traps were closed. Following animal care and use protocol, captured rabbits were placed in a dark pillow case to help minimize stress. For each attached collar we recorded collar frequency, date and time the collar was applied, and if the rabbit was captured at the same location more than once it was assumed that there was some interaction occurring. This protocol of going to the next nearest rabbit was repeated until all were located. The first rabbit chosen to locate during each session was chosen randomly, so that the location sequence was not repeated for each session. Once a rabbit was located we recorded date, time, collar frequency, habitat on large scale or field type such as control or redtop and on a fine scale or vegetation type such as johnsongrass and redtop grass. There were six large scale categories; redtop, no redtop, control, wooded areas, agriculture fields, and miscellaneous open areas. There were ten fine scale vegetation types; johnsongrass, redtop grass, smartweed, pigweed, sunflowers, soybeans, corn, trees, barren, and coarse weeds. UTM coordinates, a compass bearing, and estimated distance to each rabbit based on signal strength was also recorded. From these data we were able to estimate UTM locations by using the following equations (Roberts et al. 2004):

\[
\text{New UTMN} = \text{Old UTMN} + (\cos(\text{bearing})) \times (\text{dist.})
\]

\[
\text{New UTME} = \text{Old UTME} + (\sin(\text{bearing})) \times (\text{dist.})
\]

### Statistical Analysis

Exact UTMs enabled us to calculate home range and core area by running the UTMs in the computer program CALHOME (Millspaugh 2004). The Adaptive Kernel method for estimating home range was utilized and a 95\% and 50\% contour was used for each home range (Millspaugh 2004). ANOVA single factor tests were used to compare home range and core area estimators of adult male, juvenile male, adult female, and juvenile female rabbits (Larsen 2003). All data were entered into a database where average values and values of adult male, juvenile male, adult female, and juvenile female rabbits’ home ranges and core areas could be calculated.

Habitat selection data were analyzed using the resource selection program RESELECT. Within this program the Neu et al. method was used to determine what habitats were selected or avoided. Bailey confidence intervals were selected over the binomial intervals because Bailey intervals are more accurate when using the Neu et al. method (Millspaugh 2004). P-values less than 0.05 denote a significant selection or avoidance of a habitat type (Millspaugh 2004).

UTMs also enabled us to assess when a rabbit was within 40 meters of another rabbit. The exact UTMs and observation times were entered into Arc Map. Through Arc Map a query for each rabbit was conducted of other rabbits found within 40 meters of the rabbit under analysis. Then another query could be conducted that located the other rabbits within 40 meters at approximately the same time. These results were then entered into a spreadsheet. In the spreadsheet average values and instances of adult male, juvenile male, adult female, and juvenile female rabbits’ interactions could be calculated.

### Results

During the winter of 2004-2005, we captured 41 rabbits (21 adult males, 10 adult females, 5 juvenile males, 5 juvenile females). Of these rabbits we collected 1163 locations from late December to early April. Predation was a major cause of mortality within the study area and this coupled with young small rabbits escaping the radio collar limited our sample size. However, at least 20 locations were collected from 24 individuals. Most of our sample consisted of adult males and females (Table 1).

<table>
<thead>
<tr>
<th>Number of rabbits</th>
<th>Age and gender</th>
<th>Field captured</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Adult Female</td>
<td>control</td>
</tr>
<tr>
<td>4</td>
<td>Adult Male</td>
<td>control</td>
</tr>
<tr>
<td>1</td>
<td>Juvenile Female</td>
<td>control</td>
</tr>
<tr>
<td>1</td>
<td>Juvenile Male</td>
<td>control</td>
</tr>
<tr>
<td>2</td>
<td>Adult Female</td>
<td>no redtop</td>
</tr>
<tr>
<td>3</td>
<td>Adult Male</td>
<td>no redtop</td>
</tr>
<tr>
<td>1</td>
<td>Juvenile Female</td>
<td>no redtop</td>
</tr>
<tr>
<td>3</td>
<td>Juvenile Male</td>
<td>no redtop</td>
</tr>
<tr>
<td>2</td>
<td>Adult Female</td>
<td>redtop</td>
</tr>
<tr>
<td>3</td>
<td>Adult Male</td>
<td>redtop</td>
</tr>
<tr>
<td>1</td>
<td>Juvenile Female</td>
<td>redtop</td>
</tr>
</tbody>
</table>

**Table 1.** Rabbits with >20 locations, their age, gender, and field in which they were trapped.
We observed variability in rabbit movement when comparing rabbits by age and gender. The cottontails’ home range (95%) was significantly larger than its core area (50%) (P<0.001) (Table 2). Adult male home range that averaged 11.60 ha was significantly larger than the juvenile male (P<0.02) home range which averaged 6.34 ha and adult female (P<0.001) home range which averaged 3.75 ha (Table 1, Figure 1). Adult males also had the largest core area (50%) (P<0.02) that averaged 1.77 ha. Additionally the adult male core area 1.77 ha was significantly larger (P<0.02) than the adult female core area that averaged 0.44 ha. The juvenile male core area that averaged 0.70 ha was also significantly larger (P<0.01) than the adult female core area (Table 1, Figure 2).

Adult male cottontails were often found within 40 meters of other rabbits no matter the age or gender. It could not be determined whether interactions among juveniles were different or similar to adults. For example, it was undetermined whether juvenile females interacted significantly more with juvenile males rather than juvenile females. This is probably due to the small sample size (Table 1). Therefore the ages were combined to simply compare males and females. Females were found with males significantly more (P< 0.0001) often than with other females (Figure 3). Additionally, females were with males significantly more (P<0.01) frequently than males were with other males. Females have limited interactions with other females; in fact males interact significantly more (P<0.01) among themselves than females interact among other females. Overall the most interactions occurred between females and males, while the fewest interactions occurred between females and other females (Table 3).

At the large scale or field type, cottontail rabbits significantly preferred (P<0.0001) the no redtop and control fields. The agricultural, forested, miscellaneous, and redtop fields were all significantly avoided (P<0.0001). Several rabbits utilized a sunflower field that was not harvested through the months of January-March at night, which was considered a crop field.

At the fine scale or vegetation type the cottontails significantly preferred (P<0.0001) johnsongrass, course weeds, and smartweed. Redtop grass, pigweed, sunflowers, soybeans, corn, trees, and barren areas were all significantly avoided (P<0.0001). As previously mentioned the sunflower field containing sunflowers and pigweed was utilized at night by many rabbits throughout January-March.
**Discussion**

Bond et al. (2001) found evidence in Mississippi that movement rates did not differ by year or gender, but that movement rates changed between day and night as well as by season. Our research only looked at one winter but the results do indicate that movements differ by gender. Availability of resources and harsher winters may be reasons for movement differences observed in our Central Missouri study versus Bond et al. (2001) in Mississippi. Bond et al. (2002) also found that males preferred woody patches during the day, while females chose grassy areas and both chose grassy areas at night. Our study, however, found that forested areas were avoided by all rabbits. There is a consensus that in general, cottontail rabbits move little during the day and mostly move at night (Bond et al. 2002). Our findings agree with the consensus and one explanation for this is to minimize the risk of predation.

Althoff et al. (1997) found in Pennsylvania that male cottontails’ habitat selection preferences were nearly identical to females in old-fields and shrublands for daytime use. It was also discovered that form location in winter and summer were in areas associated with higher cover densities than areas in fall and spring. Bond et al. (2002) in Mississippi found that the cottontails are generalists at the small spatial scale or microhabitat. Althoff et al. (1997) however, found that the cottontails are generalists at a larger scale or macro habitat. We cannot describe the rabbits’ actions in seasons except winter, but males and females did have similar habitat selection preferences just as Althoff et al. (1997) described.

It has been found that home range overlap occurs often in cottontails. Some evidence shows that distance is associated with the distance of nest sites due to nest defense. It has been noticed that there is little or no female home range overlap while females are nesting (Bruch and Chapman 1983, Marsden and Holler 1964, Chapman et al. 1980). Haugen (1942) suggested that competition between females for nest sites could even limit populations. Schwartz and Schwartz (1995) claims that the dominant male’s home range will usually encompass the superior habitat. Our research also indicates these same scenarios. Females had very little home range overlap, while almost every male’s home range was overlapping with other males’ home ranges.

**Management Implications**

This research was conducted during the winter, which is when cottontail rabbits’ herbivory damage is most likely to occur. In order to minimize the occurrence of herbivory damage managers should create a buffer that is 680 meters wide around the forest regeneration site. The buffer should have all preferred vegetation that is tall and dense removed because it is suitable rabbit habitat. This buffer width was calculated as twice the width of the adult male home range which was the most extensive between the different ages and genders. This buffer could be an agricultural field left fallow during the winter months.

The forest regeneration site should also have all tall and dense vegetation removed from within it. A cover crop such as redtop grass could be planted on site so that all rabbit preferred habitat is removed. Alternatively, the regeneration site could be thoroughly mowed, which would produce similar results.

Much of this research took place during the Missouri Department of Conservation’s prescribed rabbit season, but no rabbits were ever harvested by hunters in this study. Therefore, encouraging hunter harvest would also help minimize herbivory because the season is held prior to the typically harsher winter months of late January and February.

Additionally, the construction of exclosures around individual trees could minimize herbivory from rabbits. This would eliminate direct access to the trees by wildlife that damage the trees in their search for food during winter.

**Literature Cited**


Carmen Washington

Pregnancy Intention and Social Well-Being

Marjorie Sable, DrPH, MSW, Mentor
School of Social Work

Unintended pregnancy has been identified as a public health problem because of its health, social, and economic consequences. These consequences include abortion, the socio-economic impact of childbearing on young, unmarried women, health behaviors associated with unintended pregnancy, health consequences to the mother, and consequences to the child (Brown & Eisenberg, 1995).

Despite efforts to address unintended pregnancy and widespread availability of family planning, the rate of unintended pregnancy is higher in the U.S. than those of other industrial countries (Brown & Eisenberg, 1995). Healthy People 2010 (the U.S. Department of Health and Human Services’ public health goals for the nation) specified a health objective to increase the proportion of pregnancies that are intended to 70 percent (U.S. Department of Health and Human Services, 2000).

Currently, nearly 50 percent of all pregnancies are classified as unintended, and approximately 48 percent of all women ages 15 to 44 have experienced at least one unintended pregnancy (Henshaw, 1998). Unintended pregnancy is defined as a pregnancy that had not been intended at the time conception occurred and is further classified as mistimed or unwanted. Mistimed conceptions are those that were wanted by the woman at some time, but which occurred sooner than they were wanted. Unwanted conceptions are those that occurred when the woman did not want to have any (more) pregnancies at all (Brown & Eisenberg, 1995). Approximately 25 percent of unintended pregnancies are identified as unwanted; and the remainder is classified as mistimed (Brown & Eisenberg, 1995).

Factors Contributing to Unintended Pregnancies

Women with unintended pregnancies represent all socioeconomic status, marital status, and age groups. However the incidence of unintended pregnancy is higher among low-income, unmarried, and young women (Brown & Eisenberg, 1995). Poverty plays a major role in unintended pregnancy. Seventy-five percent of the pregnancies to women with incomes that are below 100 percent of the federal poverty level are unintended (Forrest, 1994). Marital status is strongly related to whether a pregnancy is unintended. Eighty-eight percent of pregnancies to never married women and 65 percent of pregnancies to formerly married women were unintended (Forrest, 1994). Pregnancies during the teen years are most likely to be classified as unintended. For example, in 1982, 82 percent of pregnancies by teenagers aged 15-19 were unintended (Brown & Eisenberg, 1995). In 1994 there were 781,000 pregnancies among adolescent women younger than 19 years of age in the United States; approximately 78 percent of those pregnancies were unintended (Henshaw, 1998). Similarly, among women over the age of 40, 77 percent of their pregnancies were unintended (Brown & Eisenberg, 1995).

Unintended pregnancy rates are higher among African-American women than among White women. Seventy-two percent of pregnancies and 51 percent of births to African-American women are unintended compared to 43 percent of pregnancies and 27 percent of births for White women (Henshaw, 1998).

Unintended pregnancy is also higher among some subgroups than for the nation as a whole. These include homeless women, teenagers who drop out of school, and women who are heavy
abusers of alcohol and illegal drugs (Brown & Eisenberg, 1995). Lack of social support is also a contributing factor to unintended pregnancies. Social support consist of two subgroups: (1) the perception that there is a sufficient number of available others to whom one can turn in time of need, and (2) a degree of satisfaction with the available support (Vaux, 1998). A study conducted in Harare, Zimbabwe showed that women who are unmarried (single/divorced/widowed), or in a relationship where the quality is reported poor have higher rates of unintended pregnancy (Mbizvo et al., 1997).

Why is Unintended Pregnancy a Problem?

Unintended pregnancy has a significant impact on medical, economic, and social issues for women. It was estimated that 3.5 million unintended pregnancies cost approximately 13 billion dollars in medical expenditures (Moser & Bachrach, 1996). Some of the consequences associated with unintended pregnancy include abortion (Brown & Eisenberg, 1995), inadequate prenatal care (Sable & Wilkinson, 1998), and socioeconomic problems which include inadequate financial security and low educational attainment (Brown & Eisenberg, 1995).

Abortion. The most significant medical consequence of unintended pregnancy is abortion, with 50 percent of unintended pregnancies resulting in abortion (Brown & Eisenberg, 1995). For centuries abortions have been performed globally whether legally or illegally. With the 1973 Supreme Court ruling Roe v. Wade abortions became legalized in the United States. However, there are medical and economical risks associated with abortions. Despite the fact that medical risks associated with legal abortions in the United States are far less than those associated with pregnancy and childbirth, there are still risks associated with the procedure (Brown & Eisenberg, 1995). The maternal mortality associated with childbirth is more than 10 times that of induced abortion (Council on Scientific Affairs, American Medical Association, 1992). However risk associated with illegal abortions include hemorrhage, cervical injury, and death because of poorly performed procedures and inadequately trained healthcare providers (Brown & Eisenberg, 1995). Economic risk associated with abortions is generated as a result of the Hyde Amendment. This amendment prohibits federal funds to be used for abortion services (Klima, 1998). As a result the ability of poor women to obtain legal abortion services is limited.

Inadequate prenatal care. There is substantial evidence of a relationship between unintended pregnancy and inadequate participation in prenatal care. Women who have mistimed or unwanted pregnancies tend to initiate prenatal care later in pregnancy and receive less adequate care than women who have intended pregnancies (Brown & Eisenberg, 1995; Sable & Wilkinson, 1998). Women with an unwanted pregnancy are 1.8 to 2.9 times more likely to begin care after the first trimester, and women with a mistimed pregnancy are 1.4 and 2.6 times more likely to begin care after the first trimester when compared to women who intended the conception (DePersio et al., 1994; Kost et al., 1994; Pamuk and Mosher, 1988).

Health Behaviors. In addition to initiating prenatal care later in pregnancy, women with unintended pregnancies are more likely to use tobacco and alcohol (Brown & Eisenberg, 1995). Women with unwanted or mistimed conceptions are 30 percent more likely to smoke than a woman with intended conceptions (DePersio et al., 1994). Although studies do not support a direct link between unintended pregnancies and low birth weight, the fact that women with unintended pregnancies have a higher rate of substance use contributes to low birth weight. Smoking retards fetal growth; the birth weight of infants born to smokers is reduced by 150 to 320 grams (Chomitz et al., 1995). Alcohol abuse during pregnancy is related to a series of congenital malformations described as fetal alcohol syndrome (Chomitz et al., 1995).

Child Outcomes. There has been some research demonstrating an association between unintended pregnancy and child outcomes. For example, one study found that high parity (used as a proxy for unintended pregnancy) predicted lower levels of child attachment security (Miller, Feldman & Pasta, 2002), and another found that lower levels of pregnancy acceptance predicted lower levels of child attachment security (Ispa, Sable, Porter & Csizmadia, 2005). Baydar (1995) found that mistimed and unwanted children under age two had significantly higher scores on the fearfulness scale and significantly lower scores on a positive affect scale than children who were wanted. They also had less positive relationships with their mothers. Lower self-esteem may also be a consequence of unintended pregnancy. This study also found that mistimed and unwanted children between one and two years of age received fewer opportunities for skill development than wanted children. In the follow-up among preschoolers, unwanted children received significantly lower levels of developmental resources than wanted children. Mistimed children received fewer opportunities for skill development than wanted children but more opportunities for skill development than unwanted children.

Socioeconomic Issues. As a result of the majority of unintended pregnancies consisting of young, unmarried, and low-income women, unintended pregnancy diminishes socioeconomic well-being and promotes the cycle of poverty. Young mothers with unintended pregnancies are less likely to complete high school and to attend college (Brown & Eisenberg, 1995). Young mothers are also more likely to be unmarried. In addition, having a large family size places greater demands on a family’s economic assets. Studies have shown that younger mothers tend to have more children than do women who delay childbearing (Moore, 1992). As a result of fewer years of schooling, larger families, and lower likelihood of being married, young mothers acquire less work experience, have lower wages and earnings, and are more likely to live in poverty (Brown & Eisenberg, 1995). These mothers are also more likely to depend on welfare receipt (Brown & Eisenberg, 1995).

Loneliness, Psychosocial Well-Being and Pregnancy Intentions

There is little published research examining the relationship between a woman’s pregnancy intention with loneliness and social support. In a study conducted on loneliness among pregnant teenagers the researcher suggested that loneliness could lead to sexual relationships and pregnancy as a means to fulfilling an unmet emotional need (Klein, 2001). Other studies have looked at a woman’s social support and perceived loneliness during pregnancy and after pregnancy, but none have looked at the relationship between loneliness and pregnancy intention. One study examined psychosocial factors related to unintended pregnancy among a sample of pregnant African American women (Orr and Miller, 1997). The researchers found that women who
reported unwanted pregnancies had higher levels of exposure to stressors than women who reported intended pregnancies. Women with unwanted pregnancies were also more likely to have higher scores on the CES-D depression scale, lower levels of support from the baby’s father, and more likely to report that they were not at all satisfied with life.

The current study examines the relationship between pregnancy intention and social well-being. Specifically, it examines whether women with unintended pregnancies are more likely to be lonely, lack social support, or have family relationship problems than women who report that their pregnancies were intended. Understanding the factors associated with unintended pregnancy is important in order to identify areas to target for developing effective interventions to reduce unintended pregnancy.

Methods

■ Subjects

Participants for this study were recruited among pregnant women receiving prenatal care at three sites: the Women, Infants, and Children (WIC) Program at the Columbia/Boone County Health Department, the Family Health Center, and the University of Missouri hospital prenatal clinic. We surveyed a total of 72 women between the ages of 18 to 36 years (mean age of 24 years).

Table 1 reports frequency data on the participants’ marital status, education level, race, ethnicity, health insurance, and birth control method. The majority of the participants (58.3%) were single. More than 50 percent of the participants had some college or more. The majority of the participants were White (69.4%) compared to the 29.4% non-White participants. Most (75%) of the participants were Medicaid recipients and 73.6 percent of the participants were not using a birth control method at the time of conception.

Table 1. Characteristics of the Study Sample.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marital Status</td>
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<td></td>
</tr>
<tr>
<td>Single</td>
<td>42</td>
<td>58.3%</td>
</tr>
<tr>
<td>Married</td>
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<tr>
<td>Divorced</td>
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<td>Education level</td>
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<tr>
<td>Completed College</td>
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<td>16.7%</td>
</tr>
<tr>
<td>Graduate Education</td>
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<td>5.6%</td>
</tr>
<tr>
<td>Race</td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>50</td>
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<tr>
<td>Black</td>
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<tr>
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<td>1.4%</td>
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<tr>
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<td>8.3%</td>
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<td>None</td>
<td>53</td>
<td>73.6%</td>
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<tr>
<td>Birth Control Pill</td>
<td>11</td>
<td>15.3%</td>
</tr>
<tr>
<td>Condom</td>
<td>3</td>
<td>4.2%</td>
</tr>
<tr>
<td>Foam or Diaphragm</td>
<td>1</td>
<td>1.4%</td>
</tr>
<tr>
<td>Patch</td>
<td>4</td>
<td>5.6%</td>
</tr>
</tbody>
</table>

■ Procedures

Participants were surveyed at a WIC clinic, a health center for low-income patients, and a hospital prenatal clinic. Participants were recruited from the WIC clinic once a month on the day that nutrition classes were conducted for prenatal and breast-feeding women. Before the class started the researcher informed the participants about the purpose of the study, the requirements, amount of time involved, and the incentive. A $5 gift card to Wal-Mart was offered as an incentive to participate in the study. Participants at the health center were recruited by the nurses before their appointment and then directed to the researcher after the appointment. Participants at the hospital prenatal clinic were recruited by distributing fliers with an overview of the study’s purpose and the incentive to women in the waiting room.

Participants were given a consent form to read and the interviewer gave an overview of the significant points in the consent form such as needing to be at least 18 years old, and if not, needing parental consent, the information would be kept confidential, that their name would not be associated with their responses, that they could terminate the interview, and at the end of the survey they would receive a $5 Wal-Mart gift card. The participants also filled out a form for potential follow-up that asked for their name, address, phone number, date of birth, their physician’s name, and the week of pregnancy they were in. Once the participants completed the survey they filled out identification information (name, address, social security number) which was used for the receipt, and were given the Wal-Mart gift card. This study was approved by the University of Missouri Institutional Review Board.

■ Survey Instrument

The questionnaires were read to the participants and filled out by the interviewer in order to avoid literacy barriers. The first section of the questionnaire asked for demographic information such as the participant’s age, marital status, who they live with, if they rent or own their home, their highest grade completed, their ethnicity, the number of times pregnant, the number of live births, when they began prenatal care, their type of health insurance, and if they were using a birth control method at the time of conception.

The second section of the questionnaire used eight items to measure pregnancy intention. Two of the questions are from the National Survey of Family Growth (London, 1995). Six of the questions were previously used by MU researchers studying Early Head Start programs (Ispa, Sable, Porter, & Csizmadia, 2005). To measure pregnancy intention, participants were asked to think back to the time that they became pregnant and to select the best response: 1 = I did want to become pregnant before that time, 2 = I wanted to become pregnant at that time, 3 = I did not want to become pregnant at that time but wanted a child at some time in the future, 4 = I did not want to become pregnant at that time or any time in the future. Responses 1 and 2 were classified as an intended pregnancy and responses 3 and 4 were classified as an unintended pregnancy. The unintended pregnancies further classified as a mistimed pregnancy (response 3) or an unwanted pregnancy (response 4). Figure 1 illustrates that 41.7 percent of the pregnancies were intended, and that among the unintended pregnancies, 52.8 percent were mistimed and 5.6 percent were unwanted.
The third section of the questionnaire was the 20-item Revised UCLA Loneliness Scale (Russell & Cutrona, 1980) designed to measure perceived loneliness. Participants were asked to respond to statements such as “I feel in tune with the people around me”, using a 4 point Likert-type scale where 1= Never, 2= Rarely, 3= Sometimes, and 4= Often. The remainder of the questionnaire measured social support. The fourth section used a 12-item scale from the Multidimensional Scale of Perceived Social Support (MSPSS) (Zimet et al., 1994). Participants were asked to respond to statements such as “I get the emotional help and support I need from my family,” and “There is a special person in my life who cares about my feelings.” Responses were on a 7-point Likert-type scale from 1-7, where 1= Very strongly disagree and 7= Very strongly agree. The participants referred to the responses on the flash card and selected a number that corresponded with their answer. The MSPSS has three subscales: the Family Support Subscale, the Friend Support Subscale, and the Significant Other Support Subscale.

The fifth section of the questionnaire used a 25-item scale from the Index of Family Relations (IFR) (Hudson, 1994). Participants were asked to answer questions such as “I feel like a stranger in my family”, and “My family is a real source of comfort to me”. Responses were on a Likert-type scale of 1-7, where 1= None of the time and 7= All of the time.

For the pregnancy intention questions and for all of the scaled items, participants were given a flash card for each section with responses that corresponded with the participant’s answer (e.g., 1= Never, 2= Rarely, 3= Sometimes, and 4= Often). This allowed them to listen to the question and respond according to the answers on their flash cards.

**Data Analysis**

Descriptive statistics were calculated for the demographic variables. Pearson correlation coefficients were calculated to examine the correlations between three of the pregnancy intention/acceptance variables (“to what extent was your pregnancy on purpose?”, “how glad are you to be having this baby?”, and “to what extent did you feel that your baby would fill an emptiness/space in your life?”) and the three scales (IFR, MSPSS, and the Revised UCLA Loneliness Scale). Mean scores, standard deviations and independent t-tests were computed to compare the scores on the scales by pregnancy intention.

**Results**

Table 2 illustrates the correlations between three of the pregnancy acceptance variables with the three scales (IFR, MSPSS, and UCLA Revised Loneliness). The extent to which a woman’s pregnancy was “on purpose” was positively correlated with the Social Support Scale (MSPSS) (r=0.275, p<0.05), indicating that the more a woman’s pregnancy was on purpose, the higher was her level of social support. This variable was not significantly correlated with the Index of Family Relations or the Perceived Loneliness Scale. The extent to which a woman reported being glad to be having the baby was significantly correlated with all three scales. This variable was negatively correlated with the Index of Family relations (r=-0.307, p<0.01) indicating that the happier she was to be having the baby, the fewer family problems she reported. Similarly, the happier she was to be having the baby, the lower was her perceived loneliness score (r=-0.403, p<0.01). Happiness was positively correlated with social support (r=0.341, p<0.01) indicating that the happier a woman was to be having the baby, the higher was her reported level of social support.

<table>
<thead>
<tr>
<th>Variable Description</th>
<th>Index of Family Relations</th>
<th>Social Support Scale</th>
<th>Loneliness Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>To what extent was this pregnancy on purpose?</td>
<td>-0.169</td>
<td>0.275*</td>
<td>-0.218</td>
</tr>
<tr>
<td>How glad are you to be having this baby?</td>
<td>-0.307**</td>
<td>0.341**</td>
<td>-0.403**</td>
</tr>
<tr>
<td>To what extent did you feel that your baby would fill an emptiness (space) in your life?</td>
<td>-0.01</td>
<td>-0.036</td>
<td>0.321**</td>
</tr>
</tbody>
</table>

*p < 0.05, **p < 0.01

Table 3 presents the mean scores and standard deviations for the different scales and subscales by pregnancy intention. Our results indicated that unintended pregnancy was not significantly associated with perceived loneliness as measured by the Revised UCLA Loneliness Scale or family relationship problems as measured by the Index of Family Relations. Using the MSPSS and its three subscales to measure social support, we found that unintended pregnancy was significantly associated with less social support overall (t=2.37, 69df, p<.05) and with two of the social support subscales. Specifically, women whose pregnancies were unintended had lower mean scores on the Family Support Subscale (t=2.24, 67df, p<.05) and on the Significant Other Subscale (t=2.76, 67df, p<.01) than women whose pregnancies were intended, indicating lower levels of social support among women with unintended pregnancies.
For developing effective interventions to reduce unintended pregnancies, understanding the factors associated with unintended pregnancy is important. Programs that increase social support, reduce loneliness, and address family relationship problems might be effective; such programs would include early intervention to increase self-esteem and social support among girls, especially before they reach their reproductive years. Further research is needed to develop and evaluate psychosocial interventions to reduce unintended pregnancy and to make recommendations for specific practice interventions to increase social well-being for women whose pregnancies are unintended.

### Discussion

The goal of this study was to examine whether women with unintended pregnancies are more likely to be lonely, lack social support, or have family relationship problems than women who report that their pregnancies were intended. We found that unintended pregnancy is associated with some of these measures of social well-being. In this sample of pregnant women, there is a significant difference in the levels of social support when comparing women with unintended pregnancies and women with intended pregnancies. Specifically, those with unintended pregnancies had significantly lower levels of overall social support, family support, and significant other support compared with women with intended pregnancies. We can only hypothesize about causality. It is possible that the unintended pregnancy itself resulted in diminished social support. It is also possible, however, that diminished social support contributes in a manner not yet understood to the occurrence of an unintended pregnancy.

Measures of pregnancy acceptance or happiness about being pregnant were associated with some measures of social well-being. Our findings indicate that women who expressed that their pregnancies were “on purpose” have higher levels of social support and women who expressed happiness to be having a baby have lower levels of family relationship problems, lower levels of loneliness, and higher levels of social support. Also, women who expressed higher levels of agreement that the baby would fill a void in their life had higher levels of loneliness.

The findings from this study indicate that there are psychosocial factors associated with unintended pregnancy, although we could not determine whether these factors were precursors or consequences of the unintended pregnancy. The availability of contraceptives alone has not been, and will not be, sufficient to reduce the high level of unintended pregnancies. Understanding the factors associated with unintended pregnancy is important in order to identify areas to target for developing effective interventions to reduce unintended pregnancy. Social work and public health interventions could be devised to address psychosocial factors shown to be associated with unintended pregnancy. Programs that increase social support, reduce loneliness, and address family relationship problems might be effective; such programs would include early intervention to increase self-esteem and social support among girls, especially before they reach their reproductive years. Further research is needed to develop and evaluate psychosocial interventions to reduce unintended pregnancy and to make recommendations for specific practice interventions to increase social well-being for women whose pregnancies are unintended.

### References


Introduction

“Macromolecular protein complexes have an important role in most cellular processes such as protein transport and cell division ...”

These protein complexes consist of a large number of different proteins, each playing a specific role in an organism. If any element of the protein complex is missing, then it may not be able to perform its duty satisfactorily. To understand the biological function of such a protein complex, a detailed study of all the components must be done and this is where proteomics comes into application. Proteomics, an increasingly powerful field in the area of molecular cell biology, is the study of proteins and their functions. Proteomics seeks to identify all of the proteins in cellular processes and this proves to be highly beneficial for diagnostic and therapeutic purposes. In order to identify a protein the structural composition (peptide sequencing) must be known. The technology of mass spectrometry not only helps to identify the structure but also determines the post-translational modifications (chemical changes to proteins).

Mass spectrometry measures the mass-to-charge ratio (m/z) of ionized molecules thereby determining the molecular weight, which is then used to identify the molecule since this property is unique to all molecules or atoms.

In the current research the protein, Cytochrome-C (Cy-C) is known. The structure of the protein will be studied using mass spectrometry. The purpose of this research is to study the structure of Cytochrome-C before and after post-translational modification by 4-hydroxy-2-nonenal (4HNE, structure shown below). “4HNE is the most prevalent toxic lipid peroxidation product formed during oxidative stress. It exerts its cytotoxicity mainly by the modification of intracellular proteins.”

4HNE-modified proteins have been detected in degenerative disorders and this suggests that it may play a role in the onset of these diseases. This study will investigate how 4HNE interacts with Cy-C. Cytochrome C is a protein which plays a role in cellular respiration and apoptosis.

Cy-C also plays an important role in photosynthetic processes and in anaerobic dark processes of bacteria such as nitrate and sulfate reduction. Cy-C is a small heme protein in the inner membrane of the mitochondrion. It is a soluble protein, unlike other cytochromes and is an essential component of the electron transfer chain. It is capable of undergoing oxidation and reduction, and does not bind to the oxygen.

Literature Review

In the definitive chromatographic work done by Wagner and co-workers, strong cation exchange (SCX) was used in the first dimension and reversed phase high performance liquid chromatography (RP-HPLC) in the second dimension. In the study the sum of proteins identified after separation by SCX chromatography was more than in strong anion chromatography (SAX). Also more proteins were identified after a separation by 2-dimensional HPLC (2D-HPLC) than 1-dimensional (1D-HPLC). In a study by Haojie and Yonlong on the structure of Cy-C, 9

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Atim Enyenihi

Protein Structure by Mass Spectrometry

Michael Greenlie, PhD, Mentor
Department of Chemistry

American Chemical Society and Tripos Scholar
Atim, is a senior Chemistry and Spanish major who is originally from Nigeria. She is a member of the Alpha Chi Sigma professional chemistry fraternity, the National Society of Collegiate Scholars and has studied abroad in Mexico and Spain. This summer she participated in the University of North Carolina Summer Research Program and performed research in the area of Analytical Chemistry. Following graduation, Atim hopes to pursue a doctorate in Chemistry.
produce the ions necessary for mass analysis. SCX separates on atmospheric pressure chemical ionization (APCI) will be used. Two ionization methods, electrospray ionization (ESI) and reversed phase liquid chromatography (RP-HPLC) will be used. Two ionization methods, electrospray ionization (ESI) and atmospheric pressure chemical ionization (APCI) will be used to produce the ions necessary for mass analysis. SCX separates on the basis of charge and RPLC removes the buffer from the SCX step. These steps are outlined in figure 1.

Protein Digestion with trypsin

After protein purification, the first step is to convert the protein into a set of peptides using a sequence specific protease: trypsin, Lys-C, Asp-N or Glu-C. This is because peptides contain two to fifty amino acid residues with low molecular weight while proteins contain more than fifty amino acid residues and often have a large molecular weight. In order to identify a protein, “sequence information is needed and the mass spectrometer is most efficient at obtaining sequence information from peptides that are up to ~20 residues long, rather than from whole proteins.” Trypsin is the protease often used, to convert the proteins to peptides because it “specifically cleaves proteins on the carboxy-terminal side of arginine and lysine residues.”

Separation Method

High performance liquid chromatography (HPLC) is the method of choice for protein and peptide analysis. This is due to “its sensitivity, adaptability to accurate quantitative determination, suitability for separating nonvolatile species or thermally fragile ones...” Reversed phase liquid chromatography (RP-HPLC), which separates on the basis of hydrophobicity and removes buffers is a popular method of choice. Ion-exchange chromatography is the most commonly practiced chromatographic method for protein purification “due to its ease of use and scale-up capabilities.”

Ionization method

The first step in the mass spectrometric analysis of organic compounds is the production of gas phase ions. The ionization method commonly used is ESI. In ESI, analytes are ionized at atmospheric pressure directly from a flowing liquid stream, and the ions thereby produced are then directed into the mass spectrometer. Liquid from either an infusion pump or HPLC effluent enters into the atmospheric pressure ionization source through a capillary under a high voltage. The high electric field at the tip of the needle causes the solution to disintegrate into an aerosol plume of very small electrically charged droplets, and this process is referred to as electrospray. Another ionization method the APCI, is employed for high flow rates. It normally requires a neumatically assisted nebulizer to promote the formation of uniform small droplets.

Methods

The first step in mass analysis involves the production of gas phase particles. In order to do this, the protein (Cy-C) must first be digested with trypsin to form peptides followed by a (2-D) chromatographic separation. The peptides can then be ionized and finally introduced into the mass spectrometer. For 2-D chromatography, strong cation exchange (SCX) and reversed phase liquid chromatography (RPLC) were used. Two ionization methods, electrospray ionization (ESI) and atmospheric pressure chemical ionization (APCI) were used to produce ions necessary for mass analysis. 32 Karat software was used for the HPLC instrument operation and Finigan Excalibur software for operation of the mass spectrometer.

Materials

A Thermo Finnigan TSQ 7000 Triple Quadruple Mass Spectrometer with a P400 quatiunary pump, SCM 1000 vacuunn degasser, AS5000 auto sampler, and a UV6000 LP photodiode array detector is used for this study. The instrument is calibrated and tuned with MRFA tetrapeptide and myoglobin mixture. The electrospray potential is 4500V. Strong cation exchange column (SCX); reversed phase high performance liquid chromatography (RP-HPLC) column; Beckman 126P HPLC with an auto sampler and diode array detector; and Fisher FS60 sonicator are used for liquid chromatography. Milli-Q water purification system with resistivity of 18.2mΩ.cm at 25°C and total organic carbon (TOC) of 4 ppb is used to produce HPLC quality water. Crystalline ammonium phosphate dibasic (granular, ACS grade); sodium chloride (ACS grade) and sodium perchlorate monohydrate (HPLC grade) were ordered from Fisher Scientific. The protein, cytochrome-C equine heart assay was from Aldrich Chemical and the TPCK treated enzyme, trypsin, was from Fisher-Scientific.

Digestion with Trypsin

2.813 mg/ml concentrated Cytochrome C (Cy-C) was diluted to 1ml/mg in a buffer of pH 8, consisting of 50mM Tris HCl, and 1mM CaCl2. 0.5µg trypsin was added to 500 µl buffer and vortexed to mix properly. The solution was incubated at 37°C for 2 hours.
4 hours and 25 µL of 1M HCl was added to stop the reaction. A color change from red to pale yellow indicated the presence of peptides and not proteins. The digested protein was kept in a freezer at -70°C.

**Mobile Phase Preparation (Instrument equilibration)**

In a 1000 ml graduated cylinder, 500 ml solution of mobile phase A and mobile phase B were prepared. Mobile phase A consisted of 400 ml acetonitrile (C<sub>2</sub>H<sub>3</sub>N) and 100 ml HPLC grade water and 0.1% trifluoroacetic acid (C<sub>2</sub>H<sub>3</sub>F<sub>2</sub>O<sub>2</sub> or TFA). Mobile phase B was prepared with 500 ml Milli-Q H<sub>2</sub>O and 0.1% trifluoroacetic acid. 200-1000 µl Finn pipet was used to add the TFA. The pipet tips were autoclaved prior to usage. The mobile phases A and B were put in 500 ml bottles to be vacuumed and degassed. For degassing, a Fisher FS60 sonicator and a vacuum pump were used for 5 minutes. The solutions were then used to equilibrate the C-18 reversed-phase column.

**Solution Preparation**

For SCX, buffer A contained 8Mm (NH4)<sub>2</sub>HPO<sub>4</sub> and 5% acetonitrile (C<sub>2</sub>H<sub>3</sub>N or ACN) in H<sub>2</sub>O. Buffer B contained 0.4M NaCl, 8Mm (NH4)<sub>2</sub>HPO<sub>4</sub> and 5% ACN/H<sub>2</sub>O. Approximately 400 ml buffer A was prepared with 33.33 ml (NH4)<sub>2</sub>HPO<sub>4</sub>, 20 ml ACN and 347 ml H<sub>2</sub>O. For buffer B contained 33.33 ml NH4)<sub>2</sub>HPO<sub>4</sub>, 20 ml ACN, 50 ml NaCl and 307 ml H<sub>2</sub>0.

<table>
<thead>
<tr>
<th>A (ml)</th>
<th>B (ml)</th>
</tr>
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<tbody>
<tr>
<td>(NH&lt;sub&gt;4&lt;/sub&gt;)&lt;sub&gt;2&lt;/sub&gt;HPO&lt;sub&gt;4&lt;/sub&gt;</td>
<td>33.33</td>
</tr>
<tr>
<td>NaCl</td>
<td>40</td>
</tr>
<tr>
<td>C&lt;sub&gt;2&lt;/sub&gt;H&lt;sub&gt;3&lt;/sub&gt;N</td>
<td>20</td>
</tr>
<tr>
<td>H&lt;sub&gt;2&lt;/sub&gt;O</td>
<td>347</td>
</tr>
</tbody>
</table>

Table 1: SCX Mobile phase composition

For RP-HPLC solvent A contained 400 ml H<sub>2</sub>O and 0.2ml 0.1% TFA and B contained 200ml of 80% ACN, 0.2ml 0.1% TFA and 200ml H<sub>2</sub>O (table 2).

<table>
<thead>
<tr>
<th>A (ml)</th>
<th>B (ml)</th>
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<tbody>
<tr>
<td>C&lt;sub&gt;2&lt;/sub&gt;H&lt;sub&gt;3&lt;/sub&gt;N</td>
<td>200</td>
</tr>
<tr>
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<tr>
<td>TFA</td>
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Table 2: RP-HPLC mobile phase composition

<table>
<thead>
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<th>Flow rate (ml/min)</th>
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<th>B%</th>
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<td>100</td>
<td>0</td>
</tr>
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<tr>
<td>50</td>
<td>1</td>
<td>60</td>
<td>40</td>
</tr>
</tbody>
</table>

Table 3: RP-HPLC gradient programming

**Fig. 2.** The peaks in the tryptic map of Cytochrome C at 215 nm were identified by RP-HPLC. Column: C<sub>18</sub> reversed-phase column 4.6 x 150mm, 5-µm particle size, 300 x pore size.

**Fig. 3.** ESI Ion chromatogram

**Fig. 4.** APCI Ion chromatogram
Discussion

RP-HPLC separates better than SCX. Using this method approximately eleven peptides were identified. In figure 2 the peaks are resolved with good resolution, relatively low retention times and no peak broadening. ESI was superior over APCI because it identified more peptides and with better resolution, sharp peaks as figure 3 shows. ESI identified about 26 peptides and 15 of them are well resolved. On the other hand, APCI identified approximately 24 peptides and only 3 of them were well resolved in figure 4. Therefore for the study of how Cytochrome-C interacts with 4-HNE, RP-HPLC in combination with ESI, proves to be a good method.

References

**Introduction**

Two forces converged that led to my interest in a study of the images of African Americans in the Pictures of the Year archive. One was my personal interest in this coverage, specifically by newspapers. As a working journalist for more than 25 years I have experienced what it’s like to be a minority on a staff trying to increase minority coverage by the paper or news agency for which I was working. The second force was the introduction of the digital archive—a format specifically designed for ease of use by students, professionals and researchers. Suddenly thousands of images representing 60 years of photojournalism were available for perusal and study. With the interest and the available data, I set out to learn more about the particulars of coverage of African Americans at the contest level, which, I felt, would probably be noticeably different than the work done at the level of daily journalism.

What is known today as the Pictures of the Year International photography contest was begun in 1943 as “The First Annual Fifty Print Exhibition of Spot News and Feature Pictures” by Clifton C. Edom, then a professor at the University of Missouri School of Journalism with the expressed purposes to “pay tribute” to the good work of American newspaper photographers, bring them together in and “to compile and preserve, as a result of this contest, a collection of the best in current, home-front press pictures.” (Milios, 2003) Through the work of Masters students Randy Olson in 1983 and Matt Milios in 2003, a digital archive for the contest was created, making the thousands of images accessible “for the education and inspiration of students, professionals and anyone else with an interest in photojournalism.” (p. 6)

The archive, however, is not a comprehensive or even consistent catalogue of the contests. A conversation with Olson in 2004 revealed that there has been no primary standard for selection of images for display or publication of images from the contest. (Olson, 2004)

The selections were based on anything from the photograph’s status as a winning entry or the current contest director’s personal interest in a photograph to a photographer’s personal solicitation for inclusion.

The Pictures of the Year archive spans six decades, through many changes in or lack of philosophies in photojournalistic coverage. From its inception it has been designed to recognize the best of photojournalism, but how well does this work serve as coverage of minority communities, specifically the African American community? Have the changes in the industry, including increased hiring of Black photojournalists and increased awareness of the need to expand news content, influenced the types of photographs that win in the contest?

**Literature Review**

Mainstream media, with its predominantly white ownership, staffs and content, have been challenged on several occasions to increase the amount and better the quality of coverage of minority communities. In 1947 the Hutchins Commission challenged the press to provide coverage that was more consistent with the true racial make-up of the country. In 1967 The National Advisory Commission on Civil Disorders was formed by President Johnson to study the causes of the more than 100 race riots in the country that year. The role of the press...
was specifically examined by that commission (also known as the Kerner Commission.) They found the media had failed to cover racial problems in the country, and that its white majority perspective was unfair and detrimental to race relations in the United States. It charged the media to “publish newspapers and produce programs that recognize the existence and activities of the Negro, both as a Negro and as part of the community.”

(Cropp, Frisby, 2003) At the time of the report only one percent of shows Blacks in a limited light, usually negative or problematic. (Martindale, 1987) Stereotypical coverage of African Americans represented a large portion of coverage in these papers. The void in the mainstream media became very clear following the 1968 assassination of Civil Rights leader, the Rev. Dr. Martin Luther King Jr., when newsrooms were clearly seeing how their coverage of the Civil Rights movement was hurt by its lack of minority news people. But still little changed. A third major push was the 1978 challenge by the American Society of Newspaper Editors (ASNE) for its members to increase diversity amongst news staffs to match that of the audience it covered by the year 2000. (p. 4) Many media companies finally responded to this call, most of them seeing the initiative now as a business imperative designed to make their product more attractive to minority readers rather than a moral imperative of doing the right thing.

In the preface of her book Picturing Us, editor and curator Deborah Willis talks of the importance of photography in the African American culture—from its effects on self-image and identity to its importance in the history of Black Americans.

Many studies have been done on the portrayed image of African Americans in newspapers, magazines and advertisements. The archive, however, is a relatively new entity and my study is one of few that have been conducted from data in the POYI archive. I have purposely limited my reviews to works of a past few decades, which includes studies based on the archive and more recent studies or work based on images of African Americans in the media.

In 1983 Sentman conducted an analysis of African American coverage in editorial content, the covers and advertisements of 416 issues of Life magazine from 1937-72 at five-year intervals. (Sentman, 1983) She found that Black coverage as a percent of total coverage increased little over its life, from 0.6 percent in 1937 to its high of 2.7 percent in 1972. But because Sentman studied the magazine at five-year intervals, her study has been criticized because of the content that was missed in the remaining 27 years.

In her study she noted earlier studies of coverage of Blacks in the media, notably Stempel’s “Visibility of Blacks in News and News-Picture Magazines” (1971); Lambert’s “Negro Exposure in Look’s Editorial Content” (1964); Colle’s “Negro Image in the Mass Media” (1968) and Click’s “Comparison of Editorial Content of Ebony magazine, 1967 and 1974.” (1975). According to Sentman, the studies showed small steps in increased visibility of Blacks in news coverage, television, motion pictures and advertisements.

Martindale’s research on general news coverage of Black Americans analyzed the content from four U.S. daily newspapers (the Chicago Tribune, The New York Times, the Boston Globe and the Atlanta Constitution) and found stereotypical coverage of Blacks represented a large portion of coverage in these papers. (Martindale, 1987) Stereotypical coverage of African Americans shows Blacks in a limited light, usually negative or problematic.

The content measured was not limited to photographs; rather she measured any newspaper item that concerned, involved or affected Blacks except sports items. She chose newspapers she described as “resource-rich, influential papers which might have been expected to take a lead in correcting some of the coverage inadequacies that journalists acknowledged during the 1960s.” (p. 4) The newspapers also represented different African American populations in different parts of the country.

In addition to four main content categories, Martindale also divided the time frame into three eras: pre-Civil Rights Movement, Civil Rights and the modern era. The reasoning behind the divisions was to see how or if coverage changed based on the political strength and social condition of African Americans in each era. The years studied were 1950-53, 1963-68 and 1972-80.

The results showed that in the 1950s stereotypical coverage (defined as coverage showing Blacks as criminals, entertainers or sports figures) represented 47% of coverage by the papers. During the 1960s coverage Civil Rights coverage dominated, with much content of Blacks as protestors (a high of 26% in The New York Times and low of 9% in the Chicago Tribune.) In the 1970s stereotypical coverage rose, though not to pre-Civil Rights levels, and the majority of coverage within the category was of entertainers, not criminals. The largest percentage of content in this era was of Blacks as politicians. This category was virtually non-existent in the 1950s part of the study. While Martindale concluded that the drop in criminal images was likely a sign of stereotypes lessen, she added that images of Blacks as protestors during the 1960s might actually carry connotations similar to that of Black criminals.

Lester and Smith built on the research of Sentman and Martindale by analyzing African American picture content in Life, Time and Newsweek magazines. (Lester, Smith, 1990) Their 1989 study of 11 sampled years from 1937-1988 found an increase in visibility of African Americans during that time and attributed the progress to both the Civil Rights Movement and efforts made in response to the 1968 Kerner Commission report. Their study found that coverage of African Americans did increase over time and though content of the categories showed mixed results, Lester and Smith concluded that rising numbers in non-stereotypical categories show that there was an increased sensitivity on the part of newspaper editors to show African Americans as equal members of society.

A 1994 follow-up study of four newspapers by Lester showed an increase in coverage but also an increase in stereotypical images from 1937-1990. (Lester, 1994) Using The New York Times, the Chicago Tribune, the New Orleans Times-Picayune and the San Francisco Chronicle, and criteria similar to the Lester and Smith study, Lester found that 5.7% of the images from all the papers were of African Americans and that 49.9% of those images were of a stereotypical nature. In Chicago and San Francisco this was created by a rise in sports coverage, and an increase in crime-related images in The New York Times. All four papers published more photos of African Americans over the course of the three time periods (pre-Civil Rights, Civil Rights and Modern Eras) and showed similar trends in most subject categories. Lester found that the modern era showed a move away from the more negative racial stereotypes and in most subject areas African Americans were shown as “equal, productive members of
society” (p. 391). Comparing the two studies, Lester concluded that the newspapers focused more extensively on sports compared to the magazines and the magazines more extensively on social problems compared to the newspapers.

Research based on the POY archive, as mentioned before, is less plentiful due to the newness of the archive. However, the research is nonetheless significant.

In 1993 Hagaman analyzed the use of conventionalization in the making of sports photographs. (Hagaman, 2001) Her research examined photographic style based on the 1,521 entries in sports feature categories in the 1989 POY contest. She found a high degree of standardization in the style of photography across several different categories, including images of winning, losing, fans, pain, officials and coaches. She found the images to have a common, simple, repetitive nature and that sports feature images (non-action photographs) are based on a repertoire of known, workable images that provide for a very efficient but uncreative way of working. Due to limitations built into the industry (deadlines, preconceived ideas of photo editors, etc.) photographers rarely stray from this known way of working, therefore rarely produce images that say or show something new. The images that win in this category are often simply a “better version of a standard picture” or a photo with a twist or “second element that produces a clever or unexpected variation on a standard type.

For his 2003 master’s thesis Yung Soo Kim did a content analysis of images of the September 11th terrorist attacks. (Kim, 2003) The contest for publication year 2001 included three special categories for news and feature photos from the attacks. More than 2,000 photographs were entered, from journalists representing newspapers, magazines, wire services and photography agencies. Kim studied 667 photos, 328 from the news category and a selection of 339 (one third) of the feature category, dropping the picture story category.

His results showed a high level of conventionalization among the images. More than 94 percent of the images could be categorized into one of four main themes: event, aftermath, firefighters and Muslim world (the remaining images were catalogued as “other.”) Images of the attacks and the reaction to them made up 57.6 percent of the 667 images. Most of the photographs of damage from the attacks were of the World Trade Center, with only 6.3 percent coming from the Pentagon attack. Thirty six percent of the event images were of people’s reactions to the attack. Astonishment/fear images accounted for 83.3 percent of the feature event images. Evacuation photographs accounted for 37.7 percent of the news event images. Kim concludes that both the damage and reaction photographers shape the perception of a “challenged America.” (p.47) Images of firefighters, though totaling just 8.8 percent of all images, were said to help shape a pro-America perspective through the men’s “bravery” and ‘sacrifice’.

The most recent study of archive images is the 2004 Greenwood and Smith study of conventionalization of winning feature photography. (Greenwood, Smith, 2004) The study analyzed 100 images from twelve years at five-year intervals, from 1945-2000, categorizing them as everyday life, children, animals or special occasions. Their results showed that there is a high degree of conventionalization in winning feature photographs, supporting the conventionalization results found by Hagaman and Kim. Most of the winning images depict everyday life situations, followed by the children category. Combined, those two categories account for 72 percent of winning feature photographs. The study also found that judges of the contest are awarding prizes to images that go beyond the conventional and to a broader range of categories.

The journalism industry’s record with regards to coverage of minority communities is and has been poor and many different agencies have acknowledged the need for change. Studies and books within the industry substantiate the claims from the Kerner Commission and ASNE in regards to both quality and quantity of that content. Magazines and newspapers continue to rely on stereotypical or easy ways to cover the Black community instead of working for the kind of quality coverage that shows African Americans as full citizens in society.

Studies of images within the POY archive are new and have not yet scratched the surface of the archive’s research potential. The studies that have been done have added to our understanding of the power of photography and the methods and means of making images at the professional level.

A study of the images of African Americans among winning entries in POY contest would add to the understanding of the coverage of and the quality of images of Blacks in the archive and would be consistent with past research.

Methodology

The unit of analysis was the “image” with an image being an individually numbered entry in the archive. There are nearly 35,000 images in the archive, with many of them containing more than one photograph, such as picture stories or sequences, so the total number of pictures is higher than the number of images.

The first step was to select the images having African Americans anywhere in the pictures. The task was to determine a sub group of the archive that was both manageable and an accurate reflection of the collection. Determining whether a person in the photography was African American was a judgment call based largely on Negroid physical features. Other information about the nationality or ethnicity of the subjects was gleaned from caption information, which usually provided information such as location of the photograph, what the situation was and the names of persons photographed. If a subject in a photograph had a Hispanic surname, he/she was not selected for the data set. If a photograph contained no supporting information to help determine if it met the data set criteria, it was eliminated from consideration. The first edit resulted in 4,538 photographs.

The data set was then narrowed to include only winning images (first, second, third, honorable mention and special recognition awards.) An award-winning image indicates that the judges felt the photograph excelled in its category. Since the objective of the research was to assess the quantity and quality of newspaper images in the archive, all magazine and special category images were eliminated. To more accurately examine the kinds of images newspaper photojournalists are asked to make on a daily basis, all multiple picture categories (picture stories, sequence sets, portfolio and special award categories) were eliminated. This yielded a data set of 294 images from single picture categories (news, sports, features, portrait), the categories most consistent with daily assignments the professional newspaper photojournalist handles. The possibility of missing key events or features was avoided by the fact that every year of the competition was assessed.

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Findings and Discussion

<table>
<thead>
<tr>
<th>Category</th>
<th>Number of Winners</th>
</tr>
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<tbody>
<tr>
<td>Sports</td>
<td>128</td>
</tr>
<tr>
<td>Crime</td>
<td>46</td>
</tr>
<tr>
<td>Social Commentary</td>
<td>36</td>
</tr>
<tr>
<td>Everyday Life</td>
<td>21</td>
</tr>
<tr>
<td>Business</td>
<td>16</td>
</tr>
<tr>
<td>Portrait</td>
<td>12</td>
</tr>
<tr>
<td>Entertainment</td>
<td>11</td>
</tr>
<tr>
<td>Education</td>
<td>10</td>
</tr>
<tr>
<td>Religion</td>
<td>10</td>
</tr>
<tr>
<td>Accident</td>
<td>4</td>
</tr>
<tr>
<td>TOTAL</td>
<td>294</td>
</tr>
</tbody>
</table>

Consistent with past studies, stereotypical images dominate the data set. There has been a steady increase in the quantity of African American images over the course of the contest, but the quality of coverage in the single-picture newspaper categories is still overwhelmingly stereotypical in nature, giving newspaper readers a limited record of African-American life. One must look at other aspects of the archive, such as picture story categories and the magazine division, if they wish to see a more balanced view.

Nearly 75% of the images (210 of 294) fall into stereotypical coverage categories: 45% in sports, 16% in crime and 12% in social commentary. What the data set lacks is the everyday life images (7%) that serve to counterbalance these negative images or stereotypical coverage. This is likely more a fault of the archive as a record of a photojournalism contest and the limitations of that contest.

Without the sports images African Americans are typically shown as criminals or victims of crime or as victims of racism, poverty, drug abuse, homelessness, domestic abuse and unemployment. Sports photography is considered stereotypical coverage in part because the coverage of African Americans is by default rather than by conscious decision. At least one major media company—Gannett—has gone so far as to say that, due to the large percentage of Blacks in the major sporting events, coverage of Blacks in sports is skewed to the point where it is insignificant to diversifying overall coverage. Gannett no longer considers most sports coverage as coverage of African Americans:

“While it can be difficult to mainstream (the appropriate incorporation of minority sources) game stories, enterprise, columns and fan panels offer opportunities to add minority faces and voices. Remember: Athletes playing in games and selected groups such as all-area teams do not constitute mainstreaming.”

There are few photographs that show Blacks as students, business people, in positions of power, as heroes, as caregivers or just being happy. Again, this is most likely a reflection of the kinds of images that traditionally do not win in this annual contest. The study did find 16 images of African Americans in business settings (5%) and 21 images in Everyday Life (7%). Two other categories
that are considered stereotypical—religion and entertainment—showed relatively low numbers, 3% and 4% respectively. If sports were not considered, the percentages among the other categories are fairly even, with a spread of just 15 percentage points from lowest (accident, 1%) to highest (crime, 16%).

There were no more than two winning images per year in the first 13 contests (nine images, eight in sports.) Winning photographs start to significantly increase in the 1956 contest year, roughly coinciding with the start of the Civil Rights era and an overall increase of awareness of Blacks and Black issues. Since 1956 trend lines show an overall increase in winning images, with most of the images being made in 1986 and after. From 1956-1978 the wins are more diverse, with winning images in each of the 10 content categories. Twenty-three percent of the images (69) were made in this time period. However there are only three images in the Social Commentary category despite these years being the heart of the Civil Rights era.

Many significant photographs were made during the Civil Rights Era though very few were honored in the contest year they were made, often because the works weren’t seen as until years after they were made. Flip Schulke made many of the significant images of the time, including extensive coverage of Dr. Martin Luther King Jr., but they were not recognized as award-winning images until 1994 when they won a specialty award, the Kodak Crystal Eagle. (The Kodak Crystal Eagle Award was established to honor photojournalists whose work has raised public awareness and changed the way people act or feel about a socially significant topic.)

The number of winning entries with African American faces remained in the single digits until 1986, when there was a tremendous spike in the number of Awards of Merit given by the judges in all categories. More than 180 awards were given in single picture newspaper categories that year, 29 of the images contained African Americans. This unusual spike in awards was due to the large increase of entries as the contest switched from print submissions to slides. A similar spike occurred in 1996 when the contest again switched formats. (Kuykendall, 2005)

There is significant increase in African American visibility in the past two decades. The majority of winning images have been made in the last 18 contests (64% — 187 of 294.) In 1986 there were winning images in all but two categories (Accident and Education.) Since then at least three categories are represented in each year. It is during this time period that 29 of the 36 (81%) of all social commentary images were made. That category is second only to sports for winning images (76%, 59%) in that time frame. Crime follows closely with 30 of that category’s 46 images made since 1986 (65%). There are 10 separate years in which there are no winning images, the last being 1979.

Coverage of African Americans is shown to be geographically diverse with winning images being made by more than 130 newspapers representing 34 states and the District of Columbia. No one newspaper has more than nine award winning images of African Americans in the data set (Miami Herald.) Newspapers in Florida have produced the most with 35, 15 of those images were sports related. California papers had the next largest total—34, also with 15 sports related images.

There are several characteristics relevant to single-image categories and the contest that must be noted. First of all, entries to the Pictures of the Year contest are voluntarily submitted,
usually by the photographer who made the image. Consequently the images entered do not necessarily reflect all of the best work done during the year throughout the industry.

Secondly, the objective of winning in a contest is not congruent with daily photographic coverage. As Mendelson (1999) has found, novelty plays an important role in winning in a contest, yet novelty is hard to achieve on a daily basis. Daily photojournalistic assignments are routine and redundant in nature, leaving little room for creativity. The assignments are made within a very small time frame, allowing little time to explore an assignment in depth. These routine images are not entered into the contest because it is known that photographic expectations are high and these routine images are often the first to be eliminated in judging. Nancy Lee, a former POY contest judge, said, “The pictures we skipped (eliminated) were ones we felt we had seen before.” (Mendelson, 1999) Greater flexibility of subject matter and more time is afforded to multiple-picture, long term assignments.

Few contest winners are based on their possible historical significance, or that significance may not be obvious at the time of the judging. The standards that apply to choosing a winner in a contest (such as novelty, strong composition, news content, graphic design elements, etc.) occur less frequently in the repetition of daily assignments. Making a photograph that combines the elements of good photography with the elements that will set that picture apart from hundreds of others can be as much a matter of luck as hard work and occurs infrequently. Maria Mann, another former judge, put it this way: “…you can see that all of those pictures [that won in sports] are completely different than what you would classically take to get winning sports pictures. You can have the best baseball or football, a classic picture very well executed and admirably done, but there again, I think that’s specifically where we were looking for something new.” (Mendelson, 1999)

**Conclusions**

As a study and measure of daily journalistic images, this study compliments and is consistent with previous studies. It shows the growth in quantity of coverage of the African American community, from one sports image in 1943 to a high of 31 winning images in 1996. The first decade of the contest gives an extremely limited view of African Americans (seven images, six of them in sports) but that view broadened greatly after 1958, when there are more images in more of the categories. After 1956 winning images fairly consistently appear in at least three categories each year. The largest proportion of images were made in 1986 and after, with 64% (187 of 294) of the images being made in that time period.

The quality of coverage is dominated by stereotypical images, with 75% falling in sports, crime and social commentary. Sports imagery accounts for nearly half of the photographs at 45%. The elimination of sports from consideration would significantly even out coverage of the community, providing a smaller number of images but a more diverse representation of the community. At least one media company has taken this approach as a way of increasing the coverage of minority communities.

Single-image categories generally do not provide opportunities for in-depth coverage of a topic and this study further supports that. The archive does provide opportunities for further study in multiple picture categories, both in newspapers and magazines.

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Olson, Randy, Interview, Sept. 22, 2004


**Footnotes**

1 Not all of the images studied can be found in the archive since the archive does not include all entries from every category. This study is important, however, because it does examine images submitted to the contest.

2 Special categories are often used when there is an event that contest officials know will produce a large number of images, such as presidential election coverage and large disasters.

3 NEWS WATCH, a weekly newsletter produced by the Gannett Corporate News Department, 2005.
Background/Literature Review

GDP-mannose dehydrogenase (GMD), encoded by the algD gene, is a crucial enzyme in the biosynthetic pathway of alginate, a protective exopolysaccharide produced by the pathogenic bacterium *Pseudomonas aeruginosa*. Infection by *P. aeruginosa* is common and debilitating in patients with impaired immune defenses. Cystic fibrosis patients are particularly susceptible to infection as their condition results in cellular damage and the buildup of mucus for which the bacterium has a high binding affinity [1].

Once chronic infection by *P. aeruginosa* has occurred, it is extremely difficult to eliminate the bacteria, which cause damage leading to respiratory failure. Bacterial colonies aggregate in the mucus of patients and form a protective biofilm, primarily made up of alginate [2]. The alginate biofilm offers protection from the host immune response and antibiotics, which are unable to penetrate to the bacteria. The use of broad spectrum antibiotics can select for *P. aeruginosa* as its inherent resistance gives it an advantage over infectious organisms that may otherwise hold a competitive advantage. Even intense treatment with somewhat effective antibiotics rarely succeeds in eradicating the infection [1].

Excessive inflammation is a typical immune response of cystic fibrosis patients with *P. aeruginosa* infections. It is believed that this prolonged inflammation, which is ineffective in eradicating the bacterial infection, causes more serious damage to the host than the bacteria. It has been observed that immunosuppressive agents, which reduce this inflammatory response, can improve the condition of cystic fibrosis patients [1].

The alginate secreted by *P. aeruginosa* is a linear copolymer of β-D-mannuronic acid and α-L-guluronic acid [3]. Alginate is produced from fructose-6-P by a seven step biosynthetic pathway. The majority of the genes encoding the enzymes involved in this pathway are arranged into an operon in which algD, which encodes GMD, is the first gene. The algD promoter controls the expression of the rest of the alginate genes arranged in the operon [2]. The bifunctional enzyme encoded by algA exhibits phosphomannose isomerase activity as it converts fructose-6-P to mannose-6-P. Following this, phosphomannomutase, encoded by algC, converts mannose-6-P to mannose-1-P. The third step in the pathway requires the bifunctional algA enzyme to exhibit GDP-mannose pyrophosphorylase activity to replace the phosphate on C-1 with a GDP nucleotide, creating GDP-mannose. The four-electron oxidation of GDP-mannose to GDP-mannuronic acid by GMD is the fourth step in this pathway. The next step polymerizes this molecule to form β-mannuronic acid. After this, C-5 polymannuronan epimerase, encoded by algG, converts mannose-6-P to mannose-1-P. The polysaccharide continues to grow until the mature heteropolymer alginate is formed from the epimerization and acetylation of the original mannuronic acid homopolymer [3]. This alginate biofilm secreted by mucoid *P. aeruginosa* greatly increases the virulence of the bacteria by providing a thick physical shell between the cell and antibiotic and phagocytic attacks and by allowing the bacteria to better form colonies and associations with host cells that offer further protection [1].

GMD is part of a small group of NAD+-dependent enzymes that catalyze the four-electron oxidation of an alcohol to an acid. Glyceraldehyde 3-phosphate dehydrogenase, which
performs its reaction by way of cysteine residues forming a thiohemiacetal intermediate, has served as the general model for these four-electron-transfer dehydrogenases [4]. UDP-glucose dehydrogenase (UDPGDH) is a nucleotide-sugar dehydrogenase quite similar to GMD. In pathogenic bacteria such as Streptococcus pneumoniae type 3 and group A streptococci, UDPGDH synthesizes UDP-glucuronic acid from UDP-glucose. This glucuronic acid, much like the mannuronic acid produced by GMD, is used in the construction of an antiphagocytic polysaccharide shell [5]. This hyaluronate shell, composed of alternating glucuronic acid and N-acetylglucosamine residues, is required for virulence, allowing the bacteria to evade the immune system response [6]. Enzymatic studies of UDPGDH have shown that the reaction catalyzed by the enzyme follows a bi-uni-bi uni-bi ping-pong binding scheme in which an active site cysteine is crucial for catalysis [6]. UDP-glucose is first oxidized to an aldehyde with the binding and reduction of the first NAD+ molecule to the enzyme and subsequent release of the product NADH. The sulfur on cysteine then forms a thiohemiacetal intermediate by forming a bond with the substrate at the C-6 position. The reduction of a second NAD+ to NADH converts the thiohemiacetal to a thioester, which it is then believed water converts to UDP-glucuronic acid with the release of the substrate by UDPGDH [5].

The conversion of a nucleotide-sugar to an acid used in the construction of a protective polysaccharide shell provides GMD and UDPGDH with a marked similarity in their catalytic roles. It has therefore been proposed that GMD follows a catalytic mechanism very similar to that of UDPGDH. Initial velocity kinetic studies of GMD have been shown to be consistent with a bi-uni-bi uni-bi ping-pong mechanism like that believed to be employed by UDPGDH, in which the nucleotide sugar binds, NAD+ binds, NADH is released, a second NAD+ binds, the second NADH is released, and finally the acid product from the initial substrate is released [2]. A significant 22% amino acid sequence similarity between P. aeruginosa GMD and S. pyogenes UDPGDH and significant similarities in the crystal structures of GMD and UDPGDH, found as tetrameric and dimeric respectively, further indicates significant similarity in structure and thus function of these two enzymes [3]. In addition, mutation of an active site cysteine, C268, to a serine residue shows a 95% loss in enzyme activity, which is significant but not as great a loss as expected in an essential catalytic residue, leaving the possibility of an alternative pathway open [7].

Although similarities with UDPGDH are evident, studies of other four-electron-transfer dehydrogenases have yielded results that suggest alternative pathways that do not involve thio-intermediates. Mutation of conserved active site cysteine residues in histidinol dehydrogenase (HDDH) to serine and alanine residues show little change in enzyme activity [4]. If cysteine is not acting as an active site nucleophile in catalysis, then the accepted thio-intermediate paradigm of glyceraldehyde-3-phosphate exhibited by other enzyme family members such as UDPGDH may well not apply to GMD.

To gain a complete understanding of enzyme function, the structure must be well understood. The quaternary structure provides significant information on the binding of substrates and effectors to the enzyme, significantly influencing enzyme activity. Previous studies of GMD have offered conflicting data on the quaternary structure of the enzyme. Some kinetic studies of cooperativity in GMD have yielded Hill coefficients consistent with a hexameric enzyme, which has also been observed using gel filtration, although other kinetic data has shown varying levels of cooperativity suggesting different oligomeric states [2]. Dynamic light-scattering measurements were found to be more suggestive of a trimer [2]. The crystal structure of GMD shows a tetramer, which is consistent with additional size-exclusion column chromatography data [3]. These inconsistencies in quaternary structure data suggest the possibility that GMD can interconvert between different oligomeric states under varying conditions. An example of such an occurrence can be found in porphobilinogen synthase (PBGS). This enzyme was found to have conflicting data that characterized it as primarily hexameric and octameric by techniques of analytical centrifugation, gel filtration, and native gel electrophoresis [8]. PBGS also exhibited protein concentration-dependent specific activity, which may also account for the variance in activity seen in GMD. It is proposed that the concentration-dependent specific activity of PBGS is the result of equilibrium between a more active octameric form of the enzyme and a less active hexameric form [8].

An improved understanding of the quaternary structure of GMD may help to resolve inconsistent kinetic data on the activity of the enzyme. As the committed step in the biosynthesis of alginate, and with no analogue in the human body, inhibition of GMD is seen as an attractive candidate for developing antibiotics effective in combating infection by P. aeruginosa [2]. Preventing alginate biosynthesis would leave the bacteria vulnerable to conventional anti-pathogenic strategies. The elimination of this chronic and often fatal respiratory pathogen would significantly improve the quality of life of patients, particularly cystic fibrosis patients in whom P. aeruginosa infection is most common [1].

**Methodology**

This research is an attempt to better determine the effect of protein concentration and presence of bound ligands on the quaternary structure of wild-type GDP-mannose dehydrogenase (GMD).

AlgD, the gene from which GMD was expressed, was cloned from P. aeruginosa, and placed into a plasmid also containing the gene for ampicillin resistance. This plasmid was stored in JM109 E. coli cells at -80°C to protect against degradation. Plasmid DNA was extracted and purified from JM109 cells by use of the Stratagene Plasmid Miniprep Kit. The plasmid was then transformed into BL21(DE3) competent cells to allow for overexpression of AlgD. Plasmid was introduced to the cells by heat shock at 42°C. Cells were then incubated in SOC media before being allowed to incubate on an agar plate containing LB media and ampicillin to select only for those bacteria that have taken up the plasmid. After one day of incubation, an individual colony was selected from the plate and then grown at 37°C in a 6L batch of 25g/L LB media and 100µg/mL ampicillin. When the optical absorbance of the cells at 600nm reaches 0.6, GMD overexpression was induced by the addition of 0.42mM IPTG. This absorbance and all spectrophotometric measurements were made using a Cary 50 spectrophotometer. Overexpression was checked by performing gel electrophoresis on the cells before and after induction by IPTG and checking against a standard of pure GMD. The induced cells were harvested by centrifugation and stored at -80°C.
GMD was purified from the harvested cells by a previously established purification protocol. Frozen cells were thawed and resuspended in 50mM Tris acetate buffer at pH 7.6. In order to lyse the cell, remove contaminants and stabilize the protein, the following components were added to the cell solution: 0.2µg/g cell paste of lysozyme to lyse the cells, 10µg/mL DNase I to digest DNA in the cells, 0.5mM TLCK and PMSF to inhibit protein digestion, 2mM Ca^{2+}, 2mM Mg^{2+} and 1mM DTT to further stabilize protein. Following an hour of incubation at 37°C, this solution was then sonicated to further lyse the cells. Centrifugation allows for the disposal of unwanted cell components from the sample. 5mg/g cell paste protamine sulfate dissolved in water was added to the supernatant dropwise over ice. The nucleic acids precipitated out of solution by protamine sulfate were then removed via centrifugation. This was followed by a heat treatment step in which 1M Tris acetate pH 5.0 equal to 50% of the total purification volume was added to the supernatant and then incubated at 57.5°C for 10 minutes before another centrifugation. Acetone equal to 45% of the total purification volume was then added to the supernatant, causing the protein to precipitate out of solution. After another centrifugation, the pellet was resuspended in 100mM triethanolamine, 2mM DTT and left stirring at 4°C overnight. This solution was centrifuged a final time. The supernatant was loaded on a Pharmacia Superdex 200 gel filtration column equilibrated in 50mM Tris acetate pH 7.6, 1mM DTT, 100mM NaCl and 10% glycerol.

After allowing size-exclusion chromatography to take place overnight, collected fractions were analyzed to determine where the protein was located. An elution profile was created by observing the fraction number and volume versus the concentration of protein as determined by absorbance at 280nm. Molecular weight was determined by comparison to the elution profiles of protein standards of known molecular weights calibrated on the column. Purity of the protein was checked by performing an SDS PAGE on samples from each step in the purification and comparing to a standard of pure GMD.

Following fraction pooling, the concentration of protein was determined by Bradford analysis. An excess of Coomassie Blue G-250 dye was added to a sample of the protein. The dye binds protein and shifts its absorbance maximum from 465nm to 595nm. Absorbance of the unknown at 595nm was compared to standards of a known protein concentration.

The volume of the pooled fractions was then split, half to be analyzed with pre-bound ligands present in the protein, and the other half to be analyzed after dialysis to strip the enzyme of ligands. The presence of ligands bound to the protein was determined by HPLC, looking for peaks at times the ligands had been removed from the protein. After this, the protein was concentrated to 5mg/mL and then 50mg/mL in the same fashion as the undialyzed protein.

Each sample of protein, dialyzed and undialyzed, was run over the Superdex 200 gel filtration column and analyzed in the same manner as during purification to determine the molecular weight and oligomeric state of the enzyme under each condition. Kinetic studies were then performed on each sample of enzyme in order to determine changes in activity, binding affinity and cooperativity. The basic assay was a 1mL solution consisting of 0.125mg GMD, 7.5% glycerol, 1mM DTT in 50mM Tris acetate pH 8 buffer. NAD+ concentrations ranging from 0.025mM to 5mM were added to the sample to observe changes in specific activity with respect to substrate concentration. Finally, 0.1mM GDPmannose was added to activate the reaction. The reaction was monitored by measuring the change in absorbance at 340nm (at which the product NADH absorbs light) over ten minutes. This set of titrations was repeated twice with the addition of 10µM and 100µM GMP, an allosteric inhibitor of GMD. This was done to observe any changes in the allosteric binding site of the enzyme that may occur with changes in concentration or bound ligands. All activities were determined from the slope of the reaction during steady-state conditions. Data showing substrate inhibition were fit to the following equation:

\[
v = \frac{V_{max} A}{(K_m + A + K_A)}
\]

Data not showing any substrate inhibition were fit to the Hill equation:

\[
v = \frac{(V_{max} A^n)}{(K_{m,n} + A^n)}
\]

where \(V_{max}\) is the maximum velocity of the reaction, \(K_m\) is the Michaelis constant representing binding affinity for the variable substrate, \(A\) is the substrate concentration, \(K_i\) is the inhibition constant, and \(n\) is the degree to which multiple ligands bind to the same protein influence each other.

Dynamic light scattering data was collected using a DynaPro 99 Molecular Sizing Instrument. Prior to measurement, all samples were diluted to 0.5mg/mL to avoid overloading the sensitive instrument. Additionally, all samples were centrifuged at 15,000rpm for 10 minutes to remove dust and other contaminants that would interfere with dynamic light scattering measurements. Samples were then filtered through a 0.2µm Microfilter prior to reading. Dynamics software was used to measure the hydrodynamic radius and calculate the molecular weight and polydispersity of the sample.

Molecular weight data from size exclusion chromatography was obtained using the same Superdex 200 gel filtration column used in purification. A standard curve from 12.4 to 200kDa was created using cytochrome C, carbonic anhydrase, bovine serum albumin, alcohol dehydrogenase and β-amylose. Blue dextran was used to determine the void volume of the column. Approximately 15mg of protein from each sample was loaded onto the column and allowed to elute into a fraction collector overnight. Fractions were analyzed as before by measuring absorbance at 280nm. The center of the absorbance peak was taken as the elution volume of the protein, and was then fit to the standard curve to determine the molecular weight of the sample.
## Results

Kinetic studies of GMD (Fig. 1) demonstrated little cooperativity between the subunits of the enzyme. Hill coefficients ranged from 0.9 to 2.6, with no observable trend for this variance. Hill coefficients greater than 2.0 suggest a minimum of two GMD subunits interacting during catalysis, although little information beyond this dimer minimum was determined.

Uninhibited apoenzyme demonstrated lower substrate affinity for NAD$^+$ than the corresponding undialyzed enzyme. Inhibition studies showed decreasing maximum velocity as concentrations of the allosteric inhibitor, GMP, were increased. Interestingly, this inhibition of velocity was only observed with apoenzyme and not with undialyzed enzyme. Additionally, higher concentrations of GMP increased substrate affinity. An exception to this can be seen with 54mg/mL GMD in the presence of 100µM GMP, which shows a lower substrate affinity than at lower GMP concentrations. However, a high degree of error is associated with this value, making its significance questionable.

### Table 1: Kinetics and Inhibition of GMD

<table>
<thead>
<tr>
<th>Enzyme Concentration (mg/mL)</th>
<th>[GMP] (µM)</th>
<th>Vmax (µM)</th>
<th>Km (µM)</th>
<th>Hill Coefficient</th>
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<tr>
<td>5.4</td>
<td>0</td>
<td>0.25±0.01</td>
<td>580±30</td>
<td>1.7±0.1</td>
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<tr>
<td>5.4</td>
<td>10</td>
<td>0.25±0.02</td>
<td>530±80</td>
<td>1.5±0.2</td>
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<td>5.4</td>
<td>100</td>
<td>0.25±0.01</td>
<td>270±30</td>
<td>1.8±0.2</td>
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<tr>
<td>54</td>
<td>0</td>
<td>0.40±0.01</td>
<td>560±40</td>
<td>1.7±0.2</td>
</tr>
<tr>
<td>54</td>
<td>10</td>
<td>0.38±0.02</td>
<td>410±60</td>
<td>1.7±0.3</td>
</tr>
<tr>
<td>54</td>
<td>100</td>
<td>0.40±0.06</td>
<td>1000±400</td>
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<tr>
<td>apo6.2</td>
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<tr>
<td>apo6.2</td>
<td>10</td>
<td>0.28±0.01</td>
<td>910±50</td>
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<tr>
<td>apo6.2</td>
<td>100</td>
<td>0.19±0.01</td>
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<tr>
<td>apo48</td>
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<tr>
<td>apo48</td>
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<td>100</td>
<td>0.27±0.02</td>
<td>720±90</td>
<td>1.5±0.2</td>
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Dynamic light scattering measurements (Fig. 2) found all samples of GMD to be approximately trimers, with molecular weights ranging from 125.3 to 149.7kDa (monomeric GMD is 47kDa). However, there is a large degree of error associated with dynamic light scattering, and even small variance in the measured hydrodynamic radius can equate to significant error in the calculated molecular weight of a sample.

### Table 2: Dynamic Light Scattering Measurements

<table>
<thead>
<tr>
<th>Enzyme Concentration (mg/mL)</th>
<th>Rh (nm)</th>
<th>MW (kDa)</th>
<th>Subunits</th>
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<tr>
<td>5.4</td>
<td>4.7±0.2</td>
<td>125.3±12.8</td>
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<td>54</td>
<td>4.8±0.6</td>
<td>128.8±37.1</td>
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<tr>
<td>apo6.2</td>
<td>4.9±0.2</td>
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<tr>
<td>apo48</td>
<td>5.1±0.5</td>
<td>149.7±34.9</td>
<td>3.2</td>
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Discussion

The low cooperativity exhibited by GMD during kinetics and inhibition studies does little to clarify the nature of the oligomeric state of this enzyme under varying conditions. While some samples had cooperativity indicative of at least a dimeric enzyme, most showed no cooperativity. This does not suggest that the enzyme does not consist of multiple subunits, but merely that interactions between these subunits were not observed under the conditions of these experiments.

High concentrations of the GMD inhibitor, GMP, were found to increase the affinity of the enzyme for substrate NAD$^+$, while only decreasing the maximum velocity of apoenzyme. Additionally, the substrate affinity of uninhibited apo enzyme was found to be lower than that for undialyzed enzyme. These discrepancies are likely the result of the ligands pre-bound to undialyzed GMD. It is possible that pre-bound ligands may block or minimize the inhibitory effect of GMP while increasing substrate affinity as a result of conformational changes induced by ligand binding.

Dynamic light scattering measurements found all samples to be approximately trimeric. However, a large degree of error was associated with these measurements. This likely stems from the extreme sensitivity of the instruments used in this experiment, which can be thrown off by the presence of trace amounts of dust or other contaminants in a sample. Instrumental sensitivity also prompted the dilution of all samples to approximately 0.5mg/mL prior to measurement. Although dilution and measurement were performed quickly, a rapid interconversion between different quaternary structures could account for the similarity in measurements between samples.

Size-exclusion chromatography presented the most promising avenue of oligomeric state characterization. Samples at lower concentrations (5.4 and 6.2mg/mL) were calculated to elute as dimers, while more highly concentrated samples (54 and 48mg/mL) eluted as trimers. This suggests that GMD undergoes a concentration-dependent interconversion between quaternary structures, with higher concentrations of the enzyme prompting the formation of a larger oligomer.

Although data on the oligomeric structure of GMD currently remains conflicting and ambiguous, this study has provided some intriguing areas of exploration for further research. More extensive size-exclusion chromatography studies may help to clarify any interconversion between different quaternary structures. Future studies should utilize alternate methods of molecular weight determination such as native polyacrylamide gel electrophoresis and analytical ultracentrifugation.

Additionally, further changes in enzyme concentration, as well
as a broad range of pHs and temperatures used in purification methods, storage and measurement, should be studied in order to gain a broader range of data on the oligomeric state of GMD.

References

### 2004-2005 Research Topics

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<td>A Comparison of Spatial and Temporal Distribution of Prehistoric Pottery in Dunklin County, Missouri</td>
<td>Michael O’Brien</td>
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<td>Ryan Beumer</td>
<td>Agricultural Economics</td>
<td>How Burning Affects the Levels of Phosphorus Lost to Water Sheds by Way of Sediment and Surface Runoff</td>
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Back row: Jamaal Glenn, Scott Winton, Jenny Flatt, Ryan Beumer, Gerald Cole, Mark McClendon, Vicki Curby (Director)
Second row: Charles Smarr, NaTashua Davis (Assistant Director), Michael Talley, Karen Mitchell, Venita Cooper, Atim Enyenihi, Jeremy Bloss (Student Services Advisor)
First row: Neville Miller, Colby Bestgen, Chris Walters, Tiffany Butler, Carmen Washington, Sarah Evola, Melanie Evans, Darlene Dixon (Program Assistant)
Not pictured: Jered Wisdom
While this was advantageous, perhaps the most important also placed me on par with more advanced graduate students. Over the cohort with whom I entered graduate school, but experiences not only provided me with a distinct advantage and prepare a research manuscript for publication. These research project, present research at a professional conference, of opportunistic doors have since been built and opened.

The McNair program provided opportunities to conduct a research project, present research at a professional conference, and prepare a research manuscript for publication. These experiences not only provided me with a distinct advantage over the cohort with whom I entered graduate school, but also placed me on par with more advanced graduate students. While this was advantageous, perhaps the most important benefit stemming from my McNair experience was the opportunity to interact one-on-one with my McNair mentor. Through our collaboration, I developed a reputation with my mentor and among other faculty members as an ambitious and industrious student worthy of their precious time, attention, and resources. As a result, I benefited from numerous fellowships, assistantships, and teaching and research opportunities that served to further enhance my qualifications as I progressed toward a career in academia.

Aside from the obvious challenges associated with ambitious academic dreams, all doctoral students enviable must navigate challenging personal circumstances while maintaining their commitment toward long-term educational objectives. As a line in my favorite poem reads: “A goal is only as worthy as the effort that is required to achieve it.” In my case, the 5 years spent positioning myself financially to attend college was certainly a test of determination, but my greatest challenge was maintaining (or regaining, to be more precise) my focus after my wife, Irina, was murdered just hours after I had written the first paragraph of my dissertation and 7 months before I had planned to complete my doctoral program. We had met in a class at MU as undergraduates, and for the next 6 years we were inseparable as best friends and mutual sources of inspiration while our academic pursuits paralleled one another. Despite incomprehensible devastation, my resilient character was ultimately undeterred and I earned a Ph.D. in 2004, following a one year delay.

I am currently an assistant professor at the University of Kentucky, where I have the privilege of paying forward the opportunities that the McNair program afforded me by facilitating students’ ability to fully capitalize on their potential. The University of Kentucky does not have a McNair program, but I quickly developed a reputation as one who voluntarily invests a great deal of time providing research opportunities to ambitious undergraduate students. My desire to work independently with these students is a direct result of the benefits I have enjoyed stemming from my McNair experience, and one of my goals for the students I work with, like the McNair program, is to introduce, encourage, and prepare them for the opportunities of graduate education.

Attending graduate school, and entering a doctoral program specifically, is not a decision to be taken lightly – more than half of all students who begin a doctoral program never earn a doctoral degree. Among those who have earned doctoral degrees, most would agree that a resilient character predicts success in a doctoral program better than any measure of intelligence. For this reason, McNair Scholars, who epitomize resiliency through their quest for excellence in spite of pedigrees that place them at a disadvantage, are particularly well suited for the doctoral journey. Make no mistake, the road is long and winding, with some obstacles likely to be encountered along the way, but with persistence dreams can be achieved!
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