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

The Middle Tennessee State University
Ronald E. McNair Post-Baccalaureate Program is a Federal TRiO Program that is funded by the U.S. Department of Education under a $226,105 annual TRiO grant.
Message from the President

Middle Tennessee State University is pleased to be affiliated with the Ronald E. McNair Program. My congratulations go out to the MTSU undergraduates who have participated in the McNair Scholars Program. Their research represents the diligence of students, faculty, and staff members who have joined together to prepare these undergraduates for graduate education. The committed faculty, mentors, and staff of the McNair Scholars Program deserve praise for their role in the students’ achievements.

The release of this journal is a time of celebration since it marks the end of the program’s first funding cycle. Largely due to the successes of mentors and scholars, MTSU’s McNair Scholars Program has received funding from the U.S. Department of Education for another four-year cycle. These funds will provide support for students who might not otherwise have the opportunity to learn about the need for and importance of graduate education, allowing them to gain both insight and skills needed to succeed in advanced studies.

It is with great pride that MTSU publishes this journal. Best wishes go to the fine undergraduate researchers involved in this program as they pursue graduate education and become the role models of tomorrow.

Sidney A. McPhee, President
Middle Tennessee State University
To Our Supporters

A special thank you is extended to the U.S. Department of Education in Washington, D.C., for providing the funds to support Middle Tennessee State University’s McNair Scholars Program. Without these dollars, students deserving a chance to enter graduate programs may not have done so.

Additional thanks go to individuals who have contributed to successes during the first four years:

External Reviewers:
- Dr. Will Nicholas, Retired TRiO Director, University of North Texas
- Ms. Deborah Northcross, McNair Program Director, University of Tennessee-Memphis, Health Science Center

U.S. Department of Education Staff:
- Dr. Linda Byrd-Johnson, TRiO Team Leader, College and University Support Team
- Ms. Deborah Walsh, Program Specialist
- Ms. Lavelle Redmond, Program Specialist
- Ms. Collie Pollack, Program Specialist

On our campus, special recognition goes to Dr. E. Ray Phillips for submitting our first successful McNair proposal as well as Dr. Thomas J. Cheatham and Linda D. Brown for implementing our program. Ms. Brown has been the program coordinator from the beginning. She is committed to the growth and development of an excellent program for the scholars. Ms. Cindy Howell has been the program’s only administrative assistant. She continues to provide care and patience to the scholars in helping them with their everyday needs.

These people, along with members of the Advisory Board and former program staff, are commended for their exemplary service to the program. It is through this group’s collective efforts that MTSU is celebrating another four years of funding. I appreciate everything you have done for MTSU’s McNair Scholars Program.

Sincerely,

L. Diane Miller

L. Diane Miller
Interim Vice Provost for Academic Affairs
Interim Director for McNair Scholars Program
To Our Readers

On behalf of the staff of the McNair Scholars Program at Middle Tennessee State University, we are delighted to share with you the exemplary research efforts of our scholars and their faculty mentors. This journal is a composite of commitment and determination from the students who were our first MTSU McNair Scholars.

We would like to extend heartfelt congratulations to our scholars and our sincere appreciation to the faculty mentors who fostered their academic growth. Many hours of hard work and dedication went into the research presented within this journal. This is an interdisciplinary journal; therefore, each article reflects the style of the discipline represented.

Our scholars are committed to conducting high quality research. The quality of research found within this journal is an example of the next generation of faculty at institutions of higher education. The success of scholars is largely attributed to the mentors’ talents, expertise, and inspiration. We are thankful to have such outstanding participation from them.

The journal was designed, produced, and printed by Publications and Graphics and Printing Services at Middle Tennessee State University. Our sincere appreciation goes out to everyone who helped in the publication process. This volume is a tribute to all of the McNair Scholars and to their faculty mentors for their dedication, professionalism, and accomplishments.

L. Diane Miller
Interim Director

Linda D. Brown
Program Coordinator
Ronald E. McNair Post-baccalaureate Achievement Program
(McNair Scholars Program at MTSU)

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About McNair Scholars and Program

The following information was taken from http://www.ed.gov/offices/OPE/HEP/trio/triohistory.html

History of the Federal TRiO Programs

The history of TRiO is progressive. It began with Upward Bound, which emerged out of the Economic Opportunity Act of 1964 in response to the administration’s War on Poverty. In 1965, Talent Search, the second outreach program, was created as part of the Higher Education Act. In 1968, Student Support Services, which was originally known as Special Services for Disadvantaged Students, was authorized by the Higher Education Amendments and became the third in a series of educational opportunity programs. By the late 1960s, the term “TRiO” was coined to describe these federal programs.

Over the years, the TRiO Programs have been expanded and improved to provide a wider range of services and to reach more students who need assistance. The Higher Education Amendments of 1972 added the fourth program to the TRiO group by authorizing the Educational Opportunity Centers. The 1976 Education Amendments authorized the Training Program for Federal TRiO Programs, initially known as the Training Program for Special Programs Staff and Leadership Personnel. The 1976 Education Amendments authorized the Training Program for Federal TRiO Programs, initially known as the Training Program for Special Programs Staff and Leadership Personnel. Amendments in 1986 added the sixth program, the Ronald E. McNair Post-baccalaureate Achievement Program. Additionally, in 1990, the Department created the Upward Bound Math/Science program to address the need for specific instruction in the fields of math and science. The Upward Bound Math/Science program is administered under the same regulations as the regular Upward Bound program, but it must be applied for separately. The Higher Education Amendments of 1998 authorized the TRiO Dissemination Partnership program to encourage the replication of successful practices of TRiO programs. Finally, the Omnibus Consolidated Appropriations Act of 2001 amended the Student Support Services (SSS) program to permit the use of program funds for direct financial assistance (Grant Aid) for current SSS participants who are receiving Federal Pell Grants.

The legislative requirements for all Federal TRiO Programs can be found in the Higher Education Act of 1965, Title IV, Part A, Subpart 2.

Ronald E. McNair, Ph.D.

Born October 21, 1950, in Lake City, South Carolina, Ronald McNair achieved early success as both a student and an athlete at Carver High School, Lake City, South Carolina. He graduated in 1967 as valedictorian of his high school class. Afterwards, he attended North Carolina A&T State University where he graduated magna cum laude in 1971 earning a B.S. degree in physics. He went on to earn a doctor of philosophy in physics from Massachusetts Institute of Technology (MIT) in 1976, where he specialized in quantum electronics and laser technology. As a student, he performed some of the earliest work on chemical HF/DF and high-pressure CO lasers, publishing path-breaking scientific papers on the subject.

After completing his Ph.D., he began working as a physicist at the Optical Physics Department of Hughes Research Laboratories in Malibu, California, and conducted research on electro-optic laser modulation for satellite-to-satellite space communications.

In January 1978, NASA selected him to enter the astronaut cadre, making him one of the first three Black Americans selected. Dr. McNair died on January 28, 1986, when the Space Shuttle Challenger exploded after launch from the Kennedy Space Center.

MTSU McNair Scholars Program

Middle Tennessee State University Ronald E. McNair Post-baccalaureate Achievement Program is designed to serve first-generation and low-income students as well as students from groups underrepresented in doctoral level studies. Our program encourages talented students to pursue a doctoral degree by providing participants with a mentored research experience, study groups for crucial areas of discipline, and seminars and workshops on topics germane to the pursuit of graduate education. Participants gain experience in presenting their research at professional conferences where they have the opportunity to meet others in their discipline and exchange ideas. Participants attend graduate school fairs and visit university campuses to gain information on the possibilities for future attendance in graduate school.

The MTSU McNair Program comprises academic year and summer research programs. Participants are required to complete a series of assignments and research that prepares them to be choice candidates for graduate schools. The MTSU McNair Scholars Program is funded through a grant from the U.S. Department of Education under the Higher Education Act of 1965, Title IV, Part A, Subpart 2 and Middle Tennessee State University.
The Presence of *Legionella pneumophila* in Biofilms: A Possible Reservoir for the Bacteria in Aquatic Habitats

Nicole M. Clarke
Dr. Anthony Newsome
Department of Biology

*Legionella pneumophila* is a Gram-negative bacterium that is ubiquitous in nature. *Legionella* is also the etiological agent of Legionnaires’ Disease. The bacterium was first identified in 1976 as a result of a mysterious type of pneumonia that caused 32 deaths. Disease outbreaks are often associated with exposure to aerosols generated from air conditioners, plumbing systems, and cooling towers. The purpose of this study was to examine biofilms formed from water samples obtained from cooling towers in various regions of the United States for the presence of *Legionella pneumophila*. Biofilms (mixtures of bacteria, protozoa, and other microorganisms present in water that adhere to an object submerged in a given water sample) may serve as a natural habitat and reservoir for the bacteria in cooling tower systems. We determined the presence of *L. pneumophila* by the use of an antibody-mediated identification system. The use of the Giemsa stain after applying the identification system promoted visualization of the relationship between the antibody reactive bacteria and any interaction with eukaryotic cells within the biofilm.

**Introduction**

In the late summer of 1976, participants at the American Legion Convention in Philadelphia, Pa., developed an unusual type of pneumonia that has subsequently been referred to as “Legionnaire’s Disease.” Months later the etiological agent of this disease was identified as a Gram negative bacterium that could multiply within human cells, and the bacteria was named *Legionella pneumophila* (McDade, 1977; Fraser, 1977). In addition, specialized media (buffered charcoal yeast extract agar) was developed to culture the bacteria from both clinical and environmental sources. Studies of the latter have shown *L. pneumophila* to be widespread in human-made aquatic environments such as cooling towers and plumbing fixtures (Filermans, 1996). Over 30 related species of *Legionella* have also been identified and about half of these species have been linked to human respiratory disease. The initial difficulty in culturing the bacteria in conjunction with its widespread occurrence in certain aquatic environments suggested *L. pneumophila* might benefit from or require interaction with other microorganisms to sustain itself in the environment. In support of this hypothesis, laboratory studies demonstrated that it can multiply in common free-living amoebae in a manner similar to that, which occurs within human cells. It is currently believed that intracellular replication in amoebae are the primary means by which *Legionella pneumophila* and possibly other related species are able to survive and proliferate in aquatic habitats (Fields, 1993). Detection of *Legionella* species in environmental samples is typically based on culture, reaction with fluorescein-labeled antibodies, and most recently polymerase chain reaction. Unfortunately, these methods are not designed to document the association of *Legionella* species with other microorganisms.

The aim of this study was to use techniques that could be applied to the identification of *Legionella* species in environmental samples and determine if the bacteria were closely associated with other microorganisms such as amoebae. For this, an antibody-mediated approach was used. Our system was based on the commercially available and widely used Remel *Legionella* Poly ID Kit, which consisted of a primary antibody to twenty-two *Legionella* species and a secondary fluorescein antibody conjugate. In our study, however, a gold-labeled secondary antibody conjugate was used. This allowed us to then Giemsa stain the specimens, which imparted a red or blue color to non-*Legionella* microorganisms (Reshma et al., 1999), while *Legionella* species stained black as a
result of binding by the gold-labeled secondary antibody.

**Methods**

**Maintenance of Stock Cultures**

*Legionella pneumophila* (AA100) was cultured at 35 C on buffered yeast charcoal extract agar (Becton Dickson, Cockeysville, Md.). The culture was passed onto new media at weekly intervals.

**Formation of Biofilms**

The biofilms were formed by taking 150mL of the cooling tower water sample and placing two slides into a plastic (1.1L) Rubbermaid container. The slides were left at room temperature in the container for five to seven days in order to allow sufficient time for biofilm formation and growth on slides.

**Immunogold Staining**

After being removed from the water sample, the slides were allowed to air dry for a maximum of 10 minutes. The air-dried slides were then fixed in methanol for two minutes. Once the methanol had air dried, 20μL of the primary antibody was added to a designated two-centimeter area of the biofilm slide. The primary antibody was pooled rabbit immune sera to 22 species of *Legionella* obtained from the Remel Legionella Poly-ID Test Kit (Lenexa, Kans.). The slide was placed in a humid chamber formed from a glass petri dish and damp paper towel. The slide was incubated for 45 minutes at 37 C. The slides were removed and rinsed in PBS and in deionized water. Twenty μL of silver enhancement reagent (Goldmark Biologicals, Flemington, N.J.), was next applied for no more than six (6) minutes. The slides were rinsed in deionized water. The slides were next Giemsa stained for 45 minutes and rinsed with deionized water. The slides were allowed to dry overnight and coverslips were then applied using mounting medium.

**Results**

Biofilm formation was examined in 32 cooling tower water samples. In viewing the samples, it was apparent that the degree of biofilm formation varied among the different samples. In some instances, biofilm formation was characterized by the presence of protozoa such as amoebae and sessile ciliates, which at times, were accompanied by bacteria, algae, and diatoms. It was evident that the degree of the colonization by microorganisms was dependent upon the source of water. In other instances, there was little accumulation of cellular material present on the slides. This was likely a reflection of the reduced level of viable cells present in the water sample. In some cases, many of the water sources for this study were treated with biocides that are designed to reduce the viability of cells and inhibit the formation of biofilms. Data on the use and schedule of biocide treatment was not available for this study.

Following immunogold treatment and Giemsa staining, *Legionella* bacteria were observed in some samples. This was evident by bacteria that appeared black in color. Dark color development was a direct result of the gold-labeled conjugate attachment to the primary antibody, which reacts with 22 species of *Legionella*. The use of the silver enhancement treatment made the bacteria visible at a magnification of 400X. When viewed at a magnification of 600X and oil immersion, immunoreactive bacteria were clearly distinguishable from non-reactive bacteria. Studies were also performed using controls in which laboratory cultures of *Legionella pneumophila* were tested using the immunogold staining procedure. With these control cells, *L. pneumophila* stained a dark color while other prokaryotic cells such as *Eschericia coli* failed to be darkly stained following the immunogold treatment. Although present within the biofilm, the *Legionella* species were not closely associated with other cell types such as amoebae. Typically, *Legionella* cells were a component of the biofilm and in proximity to other cells but in no instance were *Legionella* observed to be inside of protozoa such as amoebae. Of the samples examined, immunoreactive bacteria were clearly apparent in 65% of the samples. Other cell types
such as bacteria and protozoa were present in 100% of the samples tested.

Discussion

The results of this study confirm that the use of an antibody based immunogold technique using commercially available antibodies is useful in identifying Legionella pneumophila in biofilms. The water samples from which the biofilms were made came from cooling towers that supplied water to various locations throughout the United States. Since Legionella is a public health concern, this method of identification may be useful in identifying contaminated cooling towers in efforts to control or inhibit biofilms that can harbor Legionella bacteria. A better understanding of the natural history of Legionella species would likely promote improved methods to reduce or eradicate the bacteria in the interest of public health. The techniques described in this report could provide an additional means to document the occurrence of Legionella bacteria in environmental samples. Of additional significance, this technique offers the potential to identify the presence of Legionella bacteria within biofilms and its association with other naturally occurring microorganisms.

Legionella, other bacteria, and protozoa such as amoebae are found in biofilms. The amoeba is significant in the formation of a biofilm because it is the natural host. In: Barbaree, J.M., Breiman, R.F. and Dufour, A.P. (Eds.), Legionelllosis guidelines: best practices for control of Legionella. Houston, Texas.


Acknowledgements
The author wishes to express appreciation to Dr. Anthony Newsome (MTSU Department of Biology) and to The Middle Tennessee State University Ronald E. McNair Scholars Program.
Quantitative Spectrophotometric Methods of Analysis for the Determination of \( \text{Te(OH)}_6 \)

Freneka F. Minter  
Dr. Judith M. Iriarte-Gross  
Department of Chemistry

The purpose of this study is to see if small amounts of telluric acid, \( \text{Te(OH)}_6 \), could be analyzed. There are many methods of analysis in the literature that suggested the determination of \( \text{Te(OH)}_6 \), but these methods are time-consuming and require careful control of the experimental conditions. In alkaline medium, tellurium (VI) absorbs strongly in the ultraviolet region, and a spectrophotometric method is based on this absorption. Using an ultraviolet spectrophotometric method in the determination of \( \text{Te(OH)}_6 \) increases the ease and the speed of the determination of \( \text{Te(OH)}_6 \) concentrations. This study describes a quantitative method for the determination of \( \text{Te(OH)}_6 \), based upon its absorption in the ultraviolet region of the spectrum.

Introduction

Telluric acid, \( \text{Te(OH)}_6 \), has been analyzed using many different techniques. In a paper by Scott and Leonard, it was stated that \( \text{Te(OH)}_6 \) has been investigated using refractometric analysis, acid-base titration, and spectrophotometric methods, are discussed in this paper.

Telluric Acid, \( \text{Te(OH)}_6 \)

Telluric acid is formed by oxidation of powdered tellurium, Te, with chloric acid solution (Equation 1) or oxidation of \( \text{TeO}_2 \) with permanganate in nitric acid (Equation 2). 

\[
\begin{align*}
5\text{Te} + 6\text{HClO}_3 + 12\text{H}_2\text{O} &\rightarrow 5\text{H}_6\text{TeO}_6 + 3\text{Cl}_2 \\
5\text{TeO}_2 + 2\text{KMnO}_4 + 6\text{HNO}_3 + 12\text{H}_2\text{O} &\rightarrow 5\text{H}_6\text{TeO}_6 + 2\text{KNO}_3 + 2\text{Mn(NO}_3)_2
\end{align*}
\]

(1)  

(2)

Telluric acid is a pale yellow crystalline solid. The structure of the octahedron (Figure 1). The large size of the central atom, Te, permits bonding with 6 surrounding OH hydroxy groups. Telluric acid is a weak dibasic acid, which means that it is capable of dissociating two protons \((K_1 \sim 10^{-7}, K_2 \sim 10^{-12})\), and has a low vapor pressure. This compound can be handled in air because of its stability and is also available commercially. Telluric acid is insoluble in most solvents other than water, which prevented the study of the behavior of the NMR chemical shift based on solvent effects. Telluric acid is a fairly strong oxidizing agent, which slowly liberates iodine from potassium iodide and oxidizes hydrochloric and hydrobromic acids on heating. It is readily reduced by hydrazine, hydrogen sulphide, and sulphur dioxide.

The acid has two known crystalline modifications: the \( \alpha \)-form and the \( \beta \)-form. The \( \alpha \)-form, obtained by crystallization from concentrated nitric acid,
HNO$_3$ is cubic, and the unit cell contains 32 molecules. It is transformed to the $\beta$-form upon heating. The stable form, $\beta$-form, is formed at room temperature. It has only 4 molecules in the unit cell. The $\beta$-form separates when solutions of the acid in water or dilute mineral acids are evaporated.\textsuperscript{12}

Telluric acid is a potential sol-gel precursor. The sol-gel process is a process used to form glass and ceramics at room temperature through chemical polymerization.\textsuperscript{13} Sol-gel materials are made by hydrolysis and polycondensation of alkoxides as precursors.\textsuperscript{14} An alkoxide, M(OR)$_x$, is a metal with an alkoxy group attached. Alkoxides, OR, are analogous to hydroxides, OH. The alkoxy, OR, ion is a stronger base than OH and therefore undergoes hydrolysis immediately in water to give ROH and OH. (Equations 3 and 4)

\[
\begin{align*}
M(OR)_x + H_2O &\rightarrow M(OH)_x + xOR \\
Te(OR)_x + H_2O &\rightarrow Te(OH)_x + xOR
\end{align*}
\] (3)  (4)

The properties of the sol-gel products depend upon the following parameters: pH, temperature, solvent, molar ratio of water to alkoxide, and the nature of the alkoxide.\textsuperscript{15,16} If Te(OH)$_6$ is used as the alkoxide intermediate, then the behavior of the Te(OH)$_6$ will affect products produced by the sol-gel process.

One of the most important spectroscopic methods available to the chemist is Nuclear Magnetic Resonance, NMR. This method provides information about the number of each type of atom in the compound. Information regarding the nature of the immediate environment of each type of atom in the compound being investigated is also available from NMR spectroscopy. For example, a proton, $^1H$, NMR spectrum of a compound provides information concerning the number of different types of hydrogens, and the number of hydrogen “neighbors” being observed. Tellurium-125 NMR spectroscopy is a powerful tool for obtaining structural information of tellurium compounds. Tellurium-125 NMR properties of interest are listed in Table 1.

**Table 1:**

<table>
<thead>
<tr>
<th>$^{125}$Te NMR Properties \textsuperscript{17}</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spin (I)</td>
</tr>
<tr>
<td>Natural Abundance</td>
</tr>
<tr>
<td>Frequency (MHz)</td>
</tr>
<tr>
<td>Receptivity ($^1H$)</td>
</tr>
<tr>
<td>Receptivity ($^{13}C$)</td>
</tr>
<tr>
<td>Chemical Shift Range</td>
</tr>
</tbody>
</table>

The relative receptivity of $^{125}$Te with respect to $^1H$ and to $^{13}C$ and its large chemical shift range are some features that make this nucleus attractive for NMR studies. Telluric acid NMR data will be compared to other chemical shift standards, for example, selenium-$^{77}$ NMR and (CH$_3$)$_2$Se, in future research.\textsuperscript{18} Telluric acid is also a potential $^{125}$Te NMR spectroscopy chemical shift reference. An ideal chemical shift reference should be inert, have only one resonance preferably close to one extreme of the chemical shift range, be commercially available and relatively inexpensive, and be readily miscible with most solvents.\textsuperscript{18} This research is needed because there is little information in the literature about $^{125}$Te NMR chemical shift reference compounds.

Telluric acid is a potential $^{125}$Te NMR spectroscopy chemical shift reference because it is stable in air, does not stink like other tellurium compounds, and can be purchased commercially. Telluric acid exhibits one resonance at 713 ppm for a 5 M Te(OH)$_6$ solution (Figure 2). This same resonance was found in a 2.85 M Te(OH)$_6$ solution from previous work.\textsuperscript{8}

**Infrared (IR) Spectroscopy**

Infrared (IR) spectroscopy is another method of analysis primarily used to determine the structure, identity, and quantity of compounds. It is a destructive technique. Infrared spectroscopy identifies active functional groups within a molecule. Infrared spectroscopy measures the vibrational excitation of atoms around...
the bonds that connect them. The position of the absorption lines depends on the types of functional groups present, and the IR spectrum as a whole, is a unique “fingerprint” of the entire molecule. The infrared region extends from approximately 12,500 to 30 cm⁻¹. There are three useful infrared regions: 12,500 to 4000 cm⁻¹, referred to as the near-infrared (near the visible) region, 4000 to 600 cm⁻¹, referred to as the mid infrared (also called vibrational or fundamental IR region) region, and the region from 600 to 30 cm⁻¹, referred to as the far-infrared region. The prefix “infra” meaning “inferior to,” was added to “red” because this particular radiation is adjacent to but slightly lower in energy than red light in the visible spectrum. Infrared spectroscopy is an interesting tool for analyzing tellurium compounds because of the spectral peaks that are displayed at the end of mid IR region and in the far IR region (Table 2).

### Table 2: Spectral Peaks for Specific Tellurium Chemical Bonds

<table>
<thead>
<tr>
<th>Compound</th>
<th>Wavenumber (cm⁻¹)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Te(OH)₆</td>
<td>O-H 3050</td>
</tr>
<tr>
<td>Te(OH)₆</td>
<td>Te-O 650</td>
</tr>
<tr>
<td>Te₂O₄</td>
<td>Te-O 610</td>
</tr>
<tr>
<td>TeO₂</td>
<td>Te-O 650</td>
</tr>
</tbody>
</table>

Ultraviolet Spectrophotometry

The chemistry of tellurium has been neglected in the past, so that relatively few analytic methods for tellurium are known. One of the most important practical methods for determining small quantities of tellurium is the spectrophotometric method using ultraviolet radiation. These methods involve the formation of colored sols. On the basis of different reaction modes, spectrophotometric methods for tellurium can be classified into one of the following groups: (1) the sol method, based upon the reduction of tellurium to their elemental states, and (2) the complex method, based upon the complex formation with inorganic or organic ligands. In both of these methods, tellurium absorbed ultraviolet radiation.

### Methodology

Two hundred milligrams of Te(OH)₆ were added to a 10 mL volumetric flask with distilled H₂O to make the Te(OH)₆ solution. After the Te(OH)₆ had fully dissolved in this solution, the solution was then placed into a 100 mL volumetric flask, and 10 mL of a 6.6 M base (either Ammonium Hydroxide (NH₄OH), Sodium Hydroxide (NaOH), or Potassium Hydroxide (KOH) was added to the volumetric. This solution was mixed by inversion. Distilled H₂O was added to bring the solution up to 100 mL. The solution was mixed by inversion once more and allowed to reach room temperature overnight. After sitting overnight at room temperature, the standard solution was used to prepare a series of dilutions. There were 200 mg of Te(OH)₆ in the standard solution. Dilution concentrations are shown in Table 3.

### Table 3: Dilution Concentrations

<table>
<thead>
<tr>
<th>Concentration of Standard (M)</th>
<th>Volume of Standard (mL)</th>
<th>Concentration of Dilution (M)</th>
<th>Volume of Dilution (mL)</th>
<th>mg of Te(OH)₆ in the Dilution</th>
</tr>
</thead>
<tbody>
<tr>
<td>.0087</td>
<td>3.16</td>
<td>.0011</td>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td>.0087</td>
<td>6.32</td>
<td>.0022</td>
<td>25</td>
<td>50</td>
</tr>
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<td>.0087</td>
<td>9.48</td>
<td>.0033</td>
<td>25</td>
<td>75</td>
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<td>.0087</td>
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<td>.0044</td>
<td>25</td>
<td>100</td>
</tr>
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<td>15.520</td>
<td>.0054</td>
<td>25</td>
<td>125</td>
</tr>
<tr>
<td>.0087</td>
<td>18.680</td>
<td>.0065</td>
<td>25</td>
<td>150</td>
</tr>
<tr>
<td>.0087</td>
<td>21.840</td>
<td>.0076</td>
<td>25</td>
<td>175</td>
</tr>
</tbody>
</table>

These dilutions set overnight before a sample of each one was run on the UV/VIS spectrophotometer.
NMR Sample Preparation
The sample, being analyzed by means of NMR, has to be pure as possible and free of particulate matter and certainly free of any magnetic contaminants. Samples must be in liquid form for this research and must contain a deuterated solvent. The deuterated solvent used in this work was deuterium oxide, D$_2$O. Deuterium oxide, D$_2$O, is a very hygroscopic liquid with a formula weight of 20.03 g/mol. The deuterated solvent, D$_2$O, was used to dissolve polar solutes. A clear, 5 mm NMR tube was filled with enough sample and deuterated solvent to produce a liquid depth of about 2.5 cm. The compound, 3-(trimethylsilyl)-propanesulfonic acid sodium salt, TSP, was used as a reference. The formula for TSP is C$_6$H$_{15}$NaO$_3$S Si and molecular weight is 218.32 g/mol.

IR Sample Preparation
Samples of the precipitate in this research were made by using the potassium bromide, KBr, pellet technique, but instead of using KBr, cesium iodide, CsI, was used. The solid sample was ground using a mortar and pestle and was then incorporated into CsI where it was ground as well, using a mortar and pestle. A small amount of the mixture was put in a Nut and Bolt (NAB) KBr (potassium bromide) Die where pressure was applied to it creating a pellet.

Cesium Iodide (CsI) was used because it becomes a transparent pellet and infrared light can pass through it. Cesium Iodide is useful in the range from 40,000 to 200 cm$^{-1}$, and its reactive index at 2000 cm$^{-1}$ is 1.74. This very useful compound is very hygroscopic, water soluble, and a great infrared material for far infrared studies.

Instrumental
Samples were analyzed using NMR spectroscopy, IR spectroscopy, and UV/VIS spectrophotometry. The NMR spectrophotometer that was used in these studies was a Bruker AC-200 High Resolution Multinuclear FT-NMR (Figure 5). The NMR tubes used in this research were purchased from Wilmad Glass.

Materials
All materials and reagents used in this experiment, unless noted otherwise, were purchased from Aldrich. Telluric acid used for the NMR and UV/VIS spectrophotometric study was purchased from Alfa Aesar. Telluric acid used for titrations was purchased from Aldrich. The NaOH and KOH pellets to make the 1 M base solution were purchased from Fisher.

Results and Conclusions
The results and conclusion were obtained based upon observations and the graphical analysis presented in this paper. The absorbencies and wavelengths of the Te(OH)$_6$ solutions that were analyzed using 6.6 M NH$_4$OH are shown in Table 4.
This data is shown graphically in Figure 8. Based upon this table and figure, the absorbancies and wavelength obtained in this data became constant with the increasing concentration. Figure 9 is a typical calibration curve obtained by graphing the data at the wavelength of 232 cm⁻¹, maintaining the concentration of NH₄OH at 6.6 M, and varying the concentration of the telluric acid solution. By doing this, two data points were omitted. This straight line plot shows that the absorbency of telluric acid in 6.6 M NH₄OH follows the Beer-Lambert’s Law. According to Figure 9, the Beer-Lambert law is followed for the solutions at the wavelength of 232 cm⁻¹ in the determination using NH₄OH solution. For minimum relative error, the concentration range of Te(OH)₆ in NH₄OH solution should be between 75 to 200 mg per 100 mL. Concentrations of Te(OH)₆ lower than 75 mg per 100 mL can be determined, but the relative error will increase as the concentration of the sample to be measured is decreased. By using this method, the concentration of Te in the 1 M precipitate was determined to be .0039 M or 89 mg per 100 mL. The concentration in the 2 M precipitate, based upon this method, was determined to be .0049 M or 112 mg per 100 mL. In conclusion, this method, within the given limits in this paper, can be used to determine Te(OH)₆ in the presence of bases, tellurium dioxide, selenium dioxide, and with other acids.

The absorbencies and wavelengths of the Te(OH)₆ solutions that were analyzed using 6.6 M NaOH are shown in Table 5. This data is shown graphically in Figure 10. Based upon this table and figure, the absorbencies and wavelengths obtained in this data tended to fluctuate. The presence of impurities such as carbonate have been found in previous studies causing the solutions to have greater absorbancies than usual. The analysis of the small amount of crystals that formed in the solution at the bottom of the volumetric flask may provide insight on the nature of possible impurities. Thus, it is difficult to propose the concentration of the 1 M and 2 M precipitates using NaOH as the base.

The absorbencies and wavelengths of the Te(OH)₆ solutions that were analyzed using 6.6 M KOH are shown in Table 6. This data is shown graphically in Figure 11.
Even though the results resemble those using NH₄OH, these results also have characteristics of the results from the method using NaOH. In previous work, the impurities in NaOH solutions were found in the KOH solution.1 Similar to the results from the NH₄OH study, the results from the KOH study were graphed in a calibration curve by graphing the data that had the same wavelength 236 cm⁻¹, maintaining the concentration of KOH at 6.6 M, and varying the concentration of the Te(OH)₆ solutions (Figure 12). By doing this, three data points were omitted because they did not fit on the best fit straight line. The straight line portion of the calibration curve followed the Beer-Lambert’s Law. Based upon the results given for this method, a 1 M and 2 M precipitate both had a wavelength of 234 cm⁻¹, so they did not fit on the calibration curve where the wavelengths are 236 cm⁻¹. The concentration of the 1 M and 2 M precipitate are both more than .0033 M but less than .0044 M because of their absorbencies. In conclusion, as the concentration of telluric acid is increased, the wavelength tends to get longer, and as the concentration of the telluric acid is decreased, the wavelength tends to get shorter.

<table>
<thead>
<tr>
<th>Concentration (M)</th>
<th>Absorbance</th>
<th>Wavelength (cm⁻¹)</th>
</tr>
</thead>
<tbody>
<tr>
<td>.0011</td>
<td>1.4950</td>
<td>230</td>
</tr>
<tr>
<td>.0022</td>
<td>2.2467</td>
<td>232</td>
</tr>
<tr>
<td>.0033</td>
<td>2.3643</td>
<td>234</td>
</tr>
<tr>
<td>.0044</td>
<td>2.3872</td>
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<td>.0054</td>
<td>2.3917</td>
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<td>.0065</td>
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<td>2.4031</td>
<td>236</td>
</tr>
<tr>
<td>.0087</td>
<td>2.4100</td>
<td>236</td>
</tr>
<tr>
<td>1 M Precipitate</td>
<td>2.3677</td>
<td>234</td>
</tr>
<tr>
<td>2 M Precipitate</td>
<td>2.3683</td>
<td>234</td>
</tr>
</tbody>
</table>

**Figure 12:**
**Calibration Curve**

**Future Work**

Future work includes the application of the spectrophotometric method, in this paper, to mixtures of telluric acid with other acids, tellurium dioxide, selenium dioxide, and other precipitates formed from titrations of Te(OH)₅ with various bases. Other future studies consist of the analysis of the precipitate by investigating its solubility, and obtaining ¹H and ¹²⁵Te NMR data of the dissolved precipitate. More IR analysis is planned. Molecular modeling studies using Spartan molecular modeling will be used to design and perform calculations on potential precipitate structures.

**References**


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The web is changing the world. One can order airline tickets, make hotel reservations, buy books, find a job, buy a car, or check a bank balance. All these applications (and thousands of others) have one thing in common—a form. A “form” is an object for collecting information from a user. When the form is submitted, the data is sent to a program running on the web server. This program, called a Common Gateway Interface (CGI) program, may respond (as in the case of a bank balance request) or may record data in a database (as in an airline or hotel reservation) or may take some other action. The point is, there are many, many forms on the web. Building forms and the server-side programs that manage the submitted data is a huge job as well as quite repetitive and routine. As you can imagine, it is a task that is done often and is therefore an excellent candidate for automation. According to a literature and web search, little work has been done on form automation. Only one commercial system, called OmniForm, was found. It uses Optical Character Recognition technology through the use of scanners to convert a hard-copy text form into an online form.

This paper describes a system, called AutoForm, which automates the creation of a web form and the code to process its data. AutoForm takes a text file (or a Microsoft Word file) that uses underlines to indicate an answer slot and creates an HTML file that defines a form which contains input elements where the text file has the underlines. AutoForm also creates the Perl [1] CGI server code to manage the data from this form, thereby automating the entire process. AutoForm can handle several types of input elements including text boxes, multi-line text areas, radio buttons, and check boxes. Related systems will be described in the next section. Then the AutoForm system is described followed by a section describing future work and conclusions.

Related Work

There are many software systems designed to automate processes that are repetitive, routine, and must be done frequently. AutoForm’s goal is to automate the conversion of a text form into a usable online form. Three programs that accomplish tasks related to the AutoForm system are Microsoft (MS) Word (“Save As HTML” option [3]), MS Front Page [4], and a system named OmniForm [2].

When working in the MS Word environment, the process of transforming a regular Word document into an HTML (web-displayable) version is automated. With a Word document open, you can save the file in HTML format by choosing “Save As HTML” from the “File” menu. When this option is chosen, Word takes a copy of the regular Word document and automatically inserts the HTML tags necessary to create a web document that, when displayed by a browser, is formatted much like the original Word document. This is a very useful tool and saves the time required to type in many HTML tags, but it does not support the translation of forms. For example, a set of underscores (underlines) in the Word version of the document which designate an answer field is translated as a set of underscores in the HTML version. The user cannot interact with the resulting web page because Word adds no HTML form tag or input elements. Even if they were added there would be no CGI program specified that would handle the data sent from the resulting form. The “Save As HTML” option is useful for creating static web pages, but not for creating dynamic, interactive web pages.

Microsoft Front Page [4] is a widely-used package for building static web pages especially in the Windows environment. Front Page provides assistance in generating the HTML code for all types of input elements.
and forms. It does not automatically generate the CGI (or ASP) code to manage the data submitted from the forms that it helps the user build.

OmniForm is a commercially available program that translates a hard-copy text form into an interactive form. A scanner reads an actual paper copy of the form, and OmniForm takes the result and inserts HTML-like input elements. The result is an electronic version of the form that can be filled out on a local computer. However, this electronic version of the form cannot be displayed by a web browser, because it is not an HTML version of the form. If the form administrator wanted to make the form available for someone to fill out, they would email the person the electronic version of the form along with a “helper” program. The user must then download and install the helper program on his/her local computer before the form becomes usable. OmniForm has recently added a web hosting service for form administrators to put their forms online, but charges a yearly fee of between $50 (for up to 5 forms) and $180 (for up to 50 forms) per year for its use [2].

The AutoForm System

The system described in this paper, called AutoForm, consists of two major parts: a parsing algorithm to translate the text version of a form into an HTML form, and a CGI program to handle the data that is received when such a form is submitted via the internet. The user is not required to know HTML, Perl, CGI, or any technical material, just how their form should look.

The starting point is a “form” that uses underscores as a place holder for an answer slot in the format of a simple text file or a Microsoft Word document. If the original file is a Word document, simply use the Word “Save as HTML” option under the file menu to convert the Word document to a text file. The resulting file is in HTML format, but as explained earlier, it does not contain an interactive web form. It still contains the underscores that mark the answer slots. Either way, AutoForm starts with a text file containing a form with underscores marking the answer slots.

The first step to translate a text form into a usable online form is to generate the HTML code necessary for the form to be displayed on a web page in such a way that a user may fill it out and submit it online. This is accomplished through the use of a parsing program that takes as input the existing text file version of a form. It is expected that in the text version, an answer field (to be filled in by a user) is designated by a set of one or more underscores. The parsing program traverses the text file looking for sets of underscores. An HTML input text box tag that allows the user to fill in an answer replaces each set of underscores. For consistent appearance between the text and web versions of the form, each HTML text box is designed to be the same length as the number of underscores it is replacing. A required feature of an HTML text box is that it be given a unique name. When a programmer is building a web form from scratch, the name given to a text box is usually associated with the type of answer that a user is expected to enter into the text box. For example, if a user were supposed to enter their favorite color into a particular text box, the programmer would probably give the text box a name like “favColors.” Although it is a simple task for a person to determine the expected answer to a question and to assign its text box an appropriate name, it is difficult for an automated system. Because of this, the parsing program assigns text box names in ascending numerical order based on order of appearance. The text box for the first set of underscores encountered is given the name of “1,” the second is named “2,” and so on. This process of replacing underscores with HTML text boxes is continued until all sets of underscores in the text document have been handled. There is a risk that AutoForm will think a normal underscore, say in a variable name such as First_Name is actually an answer slot. Further, it is possible that AutoForm will not correctly decide what should be text box and what should be a check box or another choice. In all these cases, simple user interaction with a first version of the online form can easily correct the errors. Initially, AutoForm assumes every answer slot is a text box. Next to each such text box in the first version of the constructed online form is a drop-down list. Notice that the user has a chance to say that this is “the start of a radio button group,” “the start of a check box group,” “a member of the current group,” or “not an answer slot.” As the user does in Microsoft Front Page, s/he simply provides information about the structure of the form and does not have to be a web programmer.

All text in the initial file that is not a set of underscores has HTML tags added so it will be properly displayed on a web page. The entire translated document is enclosed inside an HTML form tag, and HTML “Submit” and “Reset” (to remove all answers from the web form) buttons are added to the bottom of the form.

A radio button is an HTML form input element that allows a user to select one (and only one) of several options for a question. A check box allows a user to select zero or more options for a question. Radio buttons and check boxes are extremely common components of online forms, so it is important for AutoForm to handle forms that require them. It does. One of the difficulties in handling questions
with multiple parts is determining the point where one question ends and the next begins. For example, if the question is “What is your gender?” there would naturally be two options (male and female) and therefore two sets of underscores associated with this question. However, the parser has no intelligence and therefore no way of determining what the question is about and that there should be two answer options for it. If the parser could determine this, then instead of replacing the two sets of underscores with text boxes, it would replace them with two radio buttons. Further, the parser does not have the intelligence to determine whether the user should pick one answer option or pick all answer options that apply. If one answer option is to be chosen the parser should supply a set of radio buttons. If the number of selections is variable, the parser should supply a set of check boxes. The problems of knowing how many answer options are available for a particular question and what type of input element is required are easily solved if the user is required to include enough information in the original text file. However, this is a burden on the user requiring knowledge of end-of-question markers and extra typing and formatting. AutoForm allows the user to make these decisions after the first-pass parsing phase is completed by making simple selections from drop-down lists. This approach is as non-obtrusive as possible since the system cannot make these decisions. Another difficulty for the parsing algorithm is related to input elements that are called “text areas.” This is another common feature of many forms, where the answer to a question is expected to be long and may require several lines of writing, such as a comment field. On a regular text form, such a question is usually structured as either several lines of underscores or a large blank space. A proper equivalent answer field for a web form would be an HTML element called a “text area.” This type of answer field is displayed on a web page as a large text box in which the online user can type several lines of text. The current parsing algorithm puts a stipulation on the format of text area questions in the text version of a form so that the proper HTML equivalent can be produced. The stipulation is that an answer field on a text form cannot be designated by a large blank space because the parser will not recognize the blank space as an answer field. The parser only recognizes sets of underscores as answer fields.

Another potential problem is that many text forms have text area questions with answer fields designated by multiple rows of underscores with each row being separated by a carriage return and/or tabs and/or spaces. The intent is to make the text form look more attractive by having the multiple lines of underscores “line up” vertically on the page. This alignment is usually not accomplished by using one long set of underscores and letting the text editor scroll the underscores when the end of a line is reached. The problem created by aligning the rows of underscores is that the parser “sees” each row as an individual answer field and the carriage return and other spacing devices as a new question label. To resolve this problem, the current parsing algorithm is designed to ignore a question label if it contains only white space and join the following set of underscores with the previous set. The result is the desired effect for a text area question: one answer field for one question. A question with three lines of underscores for a user to write a short paragraph is not translated as three HTML text boxes but one HTML text area.

The above solution to text area questions creates another small problem. If the underscores for one question follow the question label and the underscores for the following question precede the question label, the parsing algorithm fails. Such an arrangement may look something like this:

```
Question 1 _____ _____Question 2
```

Because the parser eliminates question labels consisting only of spacing elements, the two answer fields are incorrectly treated as one and “Question 2” loses its answer field in the process. Currently, the form administrator is responsible for ensuring that the text version of a form does not have this sort of mixed underscore placement. A non-obtrusive way of handling this problem is still be investigated.

The parsing program creates an interface for an online user to submit data from a web form, but what happens to the data once it is submitted? That is where the CGI program takes over. The parser designates that the data sent from the online form be sent to a CGI program (through the “action=” form element) where it is then managed by the form administrator. When a form is submitted, the CGI program stores the incoming data to a file in “name=value” pair format, where “name” is the name of the text box and “value” is the input by the user for that text box. This is a good start, but the data is of little use to anyone in this format. The form administrator needs to be able to view data from submitted forms in a convenient and easy manner. To solve this problem, the “View Submitted Form” option was created for AutoForm. Once the form administrator indicates which data s/he would like to view, the CGI program locates the data file (containing the name=value pairs) and the text file version of the online form that was used to send the data. It then “fills in the blanks” by merging the answers.
from the data file into the answer slots (underscores) from the original form and displaying the result on the web browser. The form administrator can then choose to print it, and the result looks as if the form submitter had taken a text version of the form and typed in the answers. This makes it convenient for the user to complete the form online and provides the form administrator with a hard-copy of the form that looks like a completed version of the original text form.

All interactions with AutoForm, for both the form administrator and online user, are done over the web. Once AutoForm is installed on a UNIX server, the form administrator goes to a web page in his/her account to view AutoForm’s menu. From the menu, s/he can choose to translate a new form into an online version or display a submitted form to the browser. Then, depending on the initial menu choice, new online menus are displayed for the administrator to give AutoForm instruction (such as designating which text file to translate or which data file to view).

**Conclusions and Future Work**

Although AutoForm is capable of automating the construction of many online forms, there are still several features that need to be added to make it a robust system. One problem to be dealt with in the future is the ability to update an existing form. Right now if a form administrator wants to change a form (such as to add a new question or change question order) that was previously converted by AutoForm, they must use a different file name for the updated version of the form. This is a result of how information is stored when the form is submitted online. The answers are stored in ascending numerical order. Changing the form will create a problem when the form administrator views forms that were submitted before the change. The change to the answer order results in incorrect placement of answers in the “View Submitted Form” option of AutoForm. For example, suppose that in the original form the first question required the input of a name, but the updated version’s first question required the input of a social security number. When the form administrator views a form submitted with the previous version of the form, the “name” will be in the answer slot where “social security number” is supposed to be. AutoForm has no way to determine that a change has occurred to the original text form when the form administrator changes it and retains the original filename. Since forms are so often changed and it is cumbersome for the form administrator to change the filename of the form each time, a solution needs to be developed. This problem can be solved by having AutoForm store a small database of information about each form. When a change is made to an existing form, AutoForm will associate previously stored data with the version of the text form that produced it. This way AutoForm will be able to display the correct version of a submitted form to the form administrator based on which version of the form was completed online.

AutoForm is also limited in that there is no input validation for the online form. For example, if the question called for the user to enter their age but the user entered an obviously incorrect answer, there is no way for AutoForm to warn the user. Input validation is a fairly common and quite useful feature of online forms, but it is difficult to implement in an automated system. A knowledgeable JavaScript programmer can easily add code to the HTML form to do the error checking.

Currently AutoForm only works in a UNIX environment and the form administrator must be acquainted with UNIX. Since AutoForm is designed to reside on a web server running UNIX, all text form files to be translated, stored, and retrieved must also reside on the UNIX server. The AutoForm menu requires that the administrator designate pathnames where relevant files are located. It is assumed that the form administrator has sufficient knowledge of UNIX to enter these pathnames correctly.

In conclusion, AutoForm is capable of automating the process of translating most simple-text forms into ready-to-use HTML forms and providing server-side code to manage the submitted data. It was developed to support only UNIX web servers and does not provide input data validation for the forms. However it is still in development and has the potential to become a viable application for those who build interactive online forms.

**References**

2. URL: eOmniForm.com - easy forms-based data collection, http://www.eomniform.com/servlet/Login
Every year standardized testing scores are in the headlines of major newspapers around the world. Currently the state, federal, and local policies have used standardized tests for grouping children according to ability levels, determining the quality of educational systems, program evaluation, accountability, and teaching strategies. Unfortunately, decisions are being made solely on a score from these standardized tests, otherwise known as high-stakes testing. People who seem to have a vested interest in the scores are educators, legislators, school boards, business leaders, and local taxpayers. These constituent groups use test results to determine the quality of education the schools are providing for our children. Although there are positive aspects of standardized tests, alternative assessments such as work samples, narrative records, and pictures should also be used to better document student performance. An example of an assessment instrument utilizing these features is the Work Sampling System (Jablon, Marsden, Dichtelmiller and Meisel, 1994). The purpose of the Work Sampling System (WSS) “is to assess and document children’s skills, knowledge, behavior, and accomplishments. It consists of three components; developmental checklists, portfolios, and summary reports” (Meisels, 1993, p. 36).

Focusing on the Curriculum

The pressure to demonstrate accountability through children’s performance on standardized tests changes the content of the curriculum (Kortez, 1988, Frederikson and Collins, 1989; Haladyna, Nolen and Haas, 1991; McGill-Franzen and Allington, 1993). Accountability is beginning to control what teachers actually teach in their classroom. In addition, teachers are beginning to lose their integrity and feel powerless in their own classroom environment. Teachers are facing a dilemma to either ignore the state’s test and do what they think is professionally and responsibly correct, or cave in and teach to the test (Haas, 1991).

Stress

Children express stress in different ways. For example, several qualitative studies demonstrated children’s stressed-related behaviors by complaining of feeling sick, frequently using the restroom, stuttering, nail biting, playing with clothes, wiggling or squirming frequently, chewing on their pencils, twisted their hair (Fleege, Charlesworth, Burts, 1992). Teachers observe first-hand many of these social-emotional behaviors during testing. Test anxiety, or what is sometimes noted as stress, affects children as early as five years old. Honig (1986) defines stress as a nonspecific response of the body to a student demand that exceeds the person’s ability to cope and as a mental state in response to strains or daily hassles. Studies demonstrate these stress-related behaviors during the test-related experience. For example, one study indicated how kindergarteners demonstrated an increase in stress-related behaviors during the testing and a decrease in those behaviors following the testing” (Fleege, Charlesworth, Burts, Hart, 1992).

The Study

Many school districts use standardized tests such as Tennessee Comprehensive Assessment Program (TCAP). Recently, a study was conducted on third grade teachers’ perceptions of the TCAP. The research was taken from four year-round schools. Twenty cross-sectional surveys were distributed to the teachers and 75% (n=14) were returned. The questions on the survey focused on what the teachers observed in the classroom and how they teach their students.

The research questions were 1) Do standardized tests reflect student performance? 2) Are teachers altering...
their curriculum? 3) Are students stressed from taking the TCAP test? In response to the first research question, results demonstrated half of the teachers (n = 7) perceived standardized tests give an accurate measurement of students’ attainment and a little less than half (43%) (n = 6) believed it didn’t give an accurate measurement of student attainment. Only 7% (n = 1) perceived there was no reflection on the test and in the classroom.

In response to my second question, results indicated little less than the majority of the teachers do alter their curriculum toward the test. For example, from the study (43%) (n = 6) alter the content of the curriculum, (71%) (n = 10) develop teaching strategies with the results of the standardized tests. When altering the curriculum, teachers group students according to ability level and use standardized test results in other ways such as providing acceleration or modification opportunities, noting skills deficit, referring to special education, gifted, or remedial programs.

In response to my third research question, teachers commented about their students’ self-esteem. Forty-three percent (n = 6) perceived the test scores don’t affect the students’ self-esteem. However, 57% agreed that the scores do have an effect on the students’ self-esteem. Fifty percent (n = 7) of the responses said it affects their self-esteem in several ways. For example a teacher states, “some are not good test takers or get very anxious before tests and may not do well as they normally do.” She continues to say, “this affects their self-image.” Another teacher states, “if the scores are low, the parent and student will feel more pressure.” She further indicates, “most children feel good after they take the test; however, if they find the test score is low; they begin to doubt themselves.”

Implications

Responses from my research questions indicate some of these teachers do alter their curriculum due to standardized tests results. Altering the curriculum to teach what the test covers limits children’s ability of exploring ideas. Children are sometimes taught there’s only one way of answering a question due to the structure of standardized tests. Children can’t learn to their fullest potential if they are limited to learning only what the test covers. Students need to be in a developmentally appropriate classroom where they can be creative in learning with several possible answers to a question. It’s possible children don’t learn the material covered in the classroom; they just memorize the answers to the questions. Therefore, standardized tests may not be an accurate reflection of their performance level.

Further study is needed regarding how teachers alter the curriculum. For example, classroom observations would provide a better understanding of some teachers curricular choices and practices. Further study is also needed regarding the use of performance based assessment to more accurately identify student outcomes. This study was conducted with only third grade teachers. Another study of teachers from different grade levels would help understand if these results apply only to these third grade teachers or to other grade levels, as well.

Bibliography


New Views on the Molten Sea of Solomon's Temple and Ancient Hebrew Mathematics

A story is told of a great linguist translating various mathematical documents from the Arabic language into Latin. During the process, he comes across a word that makes no sense for describing the cord that stretches across a circle. The word was meaningless in Arabic, but the translator (not a mathematician) did not know that and mistook the word to mean "bosom." And so today, when we refer to the "sine" of an angle, we are perpetuating a mistake made hundreds of years ago. This type of mistake arises from a lack of knowledge of the language from which original texts come, and a misunderstanding of the particular culture's ways of thinking. This may be the case with the ancient Hebrews and their system of mathematics.1

In January of 1984, *The Mathematics Teacher* featured an article titled “An Astounding Revelation on the History of π.”2 This article presented an argument to refute the idea that the ancient Hebrews accepted the primitive value of 3 as the value of π, the ratio of a circle's circumference to its diameter. The article's inspiration came from an Egyptian document written in 1650 BC that records a much better approximation to the value of π, 3.160493827. Supposedly, documenting the idea that the Hebrews accepted 3 as the value of π is following from I Kings 7:23 and II Chronicles 4:2.

And be made the molten sea of ten cubits from brim to brim, round in compass, and the height thereof was five cubits; and a line of thirty cubits did compass it about.

Since Solomon's temple was dedicated about 953 BC, many years after the Egyptians had documented their approximation of π and the Hebrew captivity in Egypt ended after the Egyptian documentation, the Hebrews (being the enslaved artisans and construction work force in Egypt) must have known about this familiar mathematical ratio. The burden of the 1984 article consists in rigorously comparing the two Hebrew words for "line measure" as used in the Kings and Chronicles. However, this article pays no heed to possible distinctions between "line measure" and "curve measure." If within the system of Hebrew mathematics these two ideas are indeed separate and distinct concepts in the ancient Hebrew mind, then there may be grounds to suspect that the passage should be translated exactly and that no system of curve measure is intended. If this is true, then from a mathematical standpoint, the idea that the Hebrews accepted such a crude value of π can be challenged.

There is another aspect of this mystery to consider. If the translation is literal, then the molten sea may not have been circular, but hexagonal; or a hexagon was etched on the lip of the massive basin. This conjecture is made because any circular structure that is 10 units in diameter, can be encompassed by a regular hexagon whose sides are 5 units in length, yielding a perimeter of precisely 30 units (see figure 1). It so happens that the Star of David, the symbol of Israel, is contained within such a shape. The first documented appearance of the Star of David occurs around 600 BC in Palestine, and it is also worthy to note that Solomon's Temple was ravaged by the Babylonians around that time.

Another point of interest that leads us to believe that the Star of David could have decorated this basin comes from the description of the brim. It is described as having a flared brim in the shape of a lily, or being decorated with lilies (see figure 2). Obviously the translation of this verse can lend itself to some very interesting conclusions, but the linguist problems surrounding this verse will be addressed later. However, given the shape and possible uses that will be discussed later, this giant basin could have been the starting point for the symbol that is so commonly used today to represent the Jewish nation. The connection of
the Star of David with the brazen sea gives reason to consider the brazen sea as more than a giant wash bin, but moreover an instrument used in astronomy.

To understand Hebrew mathematics, one must look at the influences of the societies of that day and the impact they had on the Hebrew nation. Very few societies or individuals in history ever on their own “invented the wheel.” As Newton said, his work was the result of “standing on the shoulders of the giants” who had come before him. The societies of the ancient world were no different. Contact made through trade, war, or migration allowed technology, culture, and knowledge to pass from society to society. As seen in the history of Israel, the Hebrews never had the chance to opt for a position of isolationism. Whether they were waging war or living as slaves, the children of Israel had their share of contact with almost every nation of the ancient world.

As with most cultures, both ancient and modern, assimilation into the parent nation and culture is always desired and sought. Around 400 years before Solomon built and dedicated the temple to the LORD, the children of Israel were captives in the land of Egypt. Somewhere in the neighborhood of 800 years after the children of Israel fled Egypt, and 400 years after Solomon built the temple, Nebuchadnezzar and his Babylonian army ransacked the holy temple of God, and carried the children of Israel away into the infamous Babylonian captivity. These two events, the Egyptian and Babylonian captivities, must be considered when understanding the formation of the Hebrew mathematical system.

As mentioned, it is hard to believe that the Hebrews left Egypt with little more than calluses on their hands from building the pyramids. Being the workers that they were, they would have to know and understand the measurements that were being dictated to them to build Egyptian structures correctly. Another reason to believe the Hebrews took with them much of the Egyptian knowledge is that their leader, Moses, who gave them the law from God, and led them for 40 years in the wilderness was raised with an Egyptian education since the daughter of Pharaoh took him in as her own. (Exodus 2:10)
Aside from the Egyptian captivity, there was also the Babylonian captivity. During the Babylonian captivity, the Hebrews faced a society that wished to assimilate them into their own culture. A prominent example of this is recorded in the book of Daniel. In this reference, Daniel and some of his friends become students of the empire where Babylonian culture was forced upon them. Everything from their names to their diets was changed to reflect common Babylonian culture.

Mathematics played a prominent role in ancient Babylon, so to make the Hebrews good Babylonian citizens, it stands to reason that the basics of their Babylonian mathematics were passed on, and we are amazed, thanks to archaeology, to discover how sophisticated this knowledge was.

Given the influences of the surrounding cultures, one must now consider documents written after these influences left their mark on the Hebrew people. There are three main documents that could possibly shed light on this issue. The first two serve as translations of the Hebrew Bible by Jewish scholars while the Talmud serves as a historical document on the culture and philosophy of the nation of Israel. The Latin Vulgate offers little insight into the discussion. The Latin equivalent of the Hebrew has come to us as accurately as possible. The measurements of the Vulgate match those of the original Hebrew Bible, and while no discrepancies or additions appear, nothing useful is to be found either.

However, an interesting situation arises when one consults the Septuagint for the same scripture references that are considered in this paper. First of all, 3 Kingdoms 7: 10-12 must be referenced, and when one reads the passage, one will find that the measurement given for the circumference is 33 cubits as opposed to 30 cubits. All other corresponding measures remain the same. The Septuagint is the only document which records 33 as the measure of the circumference. Even the Latin Vulgate records the measure as 30 cubits. The difference may be in the Greek influence upon the translators of the Septuagint.

The history of the Septuagint includes fewer than a hundred Jewish scholars who over the course of a few hundred years, produced a Greek translation of the Hebrew Bible for all the Hellenistic Jews living in and around Greece. Many parts of the Septuagint are literal translations from the Hebrew language, while other passages are quite dynamic. At the same time, there are many passages from the Hebrew Bible which were deleted, while at the same time, many apocryphal books abound. To answer the question of why the translators changed the measure and as to what they were thinking when they did, one must take into consideration the Greek influence that would be impressed upon the Jewish scholars.

Around the time that the Septuagint was being written, the Greek intellectual giant, Archimedes had set the upper and lower bound of \( \pi \) as being 3 1/7 and 3 10/71. R.B.Y. Scott saw the change because the translators were dealing with two circles, the inner circle of the brazen sea and the outer circle. Scott said that the 10-cubit diameter corresponds to the inner circle while the diameter of the outer circle must be 10 1/3 cubits given that the wall of the basin was a handbreadth thick, and a handbreadth was equal to 1/6 of a cubit. If the outside diameter was indeed 10 1/3 cubits long, then using the “up-to-date” value of \( \pi \) of 3 1/7, the circumference would come out to be about 32.5 cubits which would be rounded up to 33 cubits. There is also the theory that the extra half of the cubit can be found in taking into consideration the width of the brim, which is interpreted to be flared.

Scott’s and Hollenback’s ideas are good, however, the points they make are based on opinion. Scott’s notion that the writers of the Septuagint tried to make the measurements of the brazen sea conform to the value of \( \pi \) is a likely explanation given the liberties that the writers of the Septuagint took in writing many of the other parts of the document. However, these ideas of the mathematics associated with the brazen sea and the possible Greek influence on the composing of the Septuagint offer no explanation to the distinction between “line measure” as opposed to “curve measure.”

The Talmud cannot be used in the same way the Septuagint or the Vulgate is used. On the other hand, the Talmud is a collection of commentaries ranging from daily life to extreme moral circumstances, and it offers a record of life, history, philosophy, and mathematics as was used 300 BC to 500 AD when it was compiled. Although 1 Kings (3 Kingdoms) as used in the Septuagint was written approximately 200 to 300 years before the Talmud, and Solomon’s Temple was built approximately 500 years prior to the writing of Kings, the passages from the Talmud relating to \( \pi \) present a picture of how the ancient Hebrews thought mathematically.

There is a statement from the Talmud that occurs many times and translates as,

“The circumference of a circle is 3 times as long as its diameter.”

Clearly this is idea of \( \pi \) is demonstrated within the scripture that we are considering. With the most basic of mathematical knowledge, most of the educated population knows that the
ratio, π, is not 3. One would say “It is clearly 3.14.” Is it? Through most of one’s secondary school education, when using pencil and paper, one will use the ratio 3.14 to perform any calculations with π. But why not use 3.1415, a much more accurate approximation? Why not use 3.14159265? In the present time, carpenters, metal workers, etc., have the luxury of a calculator to handle tedious decimal places. This was not the case several thousand years ago. Many, including Feldman, have assumed that for the average Hebrew layman worker considered using 3 as the value of π, which was a close enough approximation to get the job done.

However, the subject of interest, the brazen sea, was not the ordinary artifact made by the average Hebrew layman worker. None of the sources considered differentiate between “line measure” and “curve measure.” In order to compare the two words, one must study the works written in ancient Hebrew to get to the roots of the words and their meaning. When one reads the Talmud in Hebrew, there are three words that are used to describe a circle as pointed out in the Mathematics of the Mishnat. In English, these words are translated to “rope,” “thread,” and “roof.” “Roof” pertains to area, so it can be disregarded. The word for “thread” pertains to the straight-line measure from side to side of a circle, whereas the word for “roof” pertains to the circular measure around the outside of the circle. First, it is worthy to note that the Hebrew word for “thread” is used in I Kings 7:23, while at the same time, II Chronicles uses the word for “rope” in chapter 4 verse 2. The original wording in the Hebrew language remains the same except for the word used for “round about,” while the word used in the Talmud for “circumference” is also used in I Kings 7:23. Since the reference in I Kings uses a word which denotes a straight line as opposed to a curve, it could be inferred that the “brim to brim” measure was from one side of the brim to another side six times around which would form a regular hexagon. However, the lack of knowledge of the Hebrew language on the part of the researcher limits the insight that can be gleaned from the verses.

Aside from the linguistics, anyone can understand the general idea of how a structure of its type was used; however, this structure was proportionally different from the run of the mill basin. The functionality and usefulness of this structure comes into question when one considers the girth of the structure, how it would have been used, and other structures around it.

For example, just from the sheer size of the brazen sea, it becomes more of a swimming pool than washbasin. Any Hebrew priest that scaled the 10 feet or more to the rim of the basin (the height of the bronze oxen upon which the brazen sea sat are not given), would be submerged up to their chests or necks, depending on the height of the priest. This is of course assuming that the basin was kept at two-thirds capacity. Given the distaste the Hebrews had for blood and gore, it stands to reason that the priest would have been none too happy when he emerged from the brazen sea covered in blood.

These logistics raise the question of whether the brazen sea was just a large bathtub. II Chronicles 4:6 states that the brazen sea was used for the ceremonial washing of the priests. However, there are many reasons to believe that the brazen sea was not just used in washing, but actually in stargazing. Astronomy played a prominent role in religion because it was of the utmost importance to know exactly the month and day due to observances of fasts and holidays. The huge area of water of the basin would reflect the night sky on a clear night, and the towers beside it would allow someone to look down upon the water’s surface. There is also the question as to the purpose of the “knops” that were cast on the side of the brazen sea when the basin itself was cast (I Kings 7:24). The question remains concerning the lilies (I Kings 7:26), and the true purpose of the two towers (I Kings 7:15). All of these things may, in the future, shed light on the mystery of the brazen sea and possibly the Star of David.

Unfortunately, the lack of knowledge of the ancient Hebrew language thwarts the effort of drawing any concrete conclusions in this paper. One could conclude that there is nothing behind the ancient texts to offer any understanding that the basin was not actually a circular structure, but hexagonal. One could dismiss the scripture of I Kings 7:23 and II Chronicles 4:2 as using the fundamental approximation of π of that day. However, these casual dismissals cannot be substantiated without first exploring the alternate uses of the brazen sea, for if it was indeed used in astronomy, there may be ways to show that it was more than just a big bath tub. Given the historical context in which it was designed and built, the place in which it was put, and the “coincidental” occurrence of the Star of David as a symbol of the nation of Israel around the time of the destruction of the brazen sea leaves this mystery alive and available for future endeavors.

Bibliography


All scripture references taken from the King James Version of the Bible.
Does Spatial Perception Differ by Method of Visualization?

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With the introduction of computer modeling, universities teaching spatial design (landscape architecture, interior design, etc.) need to know how this will change the way they teach and present their courses. With this concept in mind, North Carolina State University (NC State), College of Design (DESIGN) conducted a survey to help determine if spatial perception differed by the method of visualization. The researchers involved with the study collected the original survey data. My area of interest in this pilot study was to reanalyze the original survey data in more detail using more complicated statistical techniques than the initial evaluation, then determine potential trends from the data, and finally use these results to make suggestions for a new survey. I focused on three questions in the original survey: the quality of light, simple vs. complex, and prospect vs. refuge. Each of these questions is related to spatial perception. This analysis shows that for these questions spatial perception differs by method of visualization; therefore, universities teaching spatial design will need to address the issues of these perceptual differences in their curriculum.

Introduction

“Smell the cheese often so you know when it is getting old.” This quote by Spencer Johnson in the book *Who Moved My Cheese?* is especially true in a world of rapidly changing technology. Changes need to be monitored so that people can adapt to them. With the introduction of computer modeling, universities teaching spatial design (landscape architecture, interior design, etc.) need to know how this will change the way they teach and present their courses. With this concept in mind, North Carolina State University (NC State), College of Design (DESIGN) needed to know if spatial perception differed by the method of visualization. NC State, DESIGN compares methods of landscape design visualization, such as traditional viewing (i.e. scale drawings and 3-D models), computer viewing with 3-D computer views, and actual site viewing. The objectives of this research (pilot study) are as follows:

1. To determine if there are significant differences in spatial perception related to the method of representation
2. To determine if there are differences and identify the nature of the difference (i.e. gender, age, years of experience, and highest degree held)
3. To determine why the differences exist (within the scope of the survey)
4. To develop an understanding of how new digital design tools could change design efforts

NC State, DESIGN has conducted a preliminary survey, given to landscape architects with various backgrounds, to analyze the objectives stated above. My area of interest in this pilot study is to reanalyze the original survey data in more detail and use more complicated statistical techniques than the initial evaluation, then determine potential trends from the data, and finally use these results to make suggestions for a new survey, which will be used in future research.

Literature Review

Spatial Design

How does one define “space”? The “feel of a space” is determined by its many components. These spatial components are external, internal, and individual in nature. Although all of the components are interrelated, they all have different meanings.

The external characteristics of a space are derived from the physical

1These objectives are stated in the original paper of North Carolina State University, College of Design, and were reexamined and slightly modified by the author (Raven Neese).
elements of a place. Together these elements give the place a sense of scale, as well as textures and colors. *External space* is like environmental space, the urban scene. Imagine being in the middle of downtown, the extremely tall buildings, the noise of automobiles, and people rushing to get nowhere. How does this make you feel? Now, imagine being on an isolated island with white sandy beaches, transparent aqua-blue water, and the only thing heard is the tides breaking on the beach. How, does this make you feel? In both cases, it is easy to see how the external characteristics of the space help give the individual a specific experience.

The internal characteristics of a space are derived from one’s contextual and personal experience. When visiting a place, we have expectations relating to what the experience will be. For example, landscape architects would not design an industrial building for a major corporation that had a lobby with a tropical scene. This theme of industrialization does not mesh well with a tropical scene. The feelings that are associated with a particular design should also correlate with the activities performed in that confined area. Landscape architects mainly focus on the *internal space*; there are many elements of this spatial component. The play of light, texture, and accessories create the universal theme for a design. Himes (1965) states that “The language of vision is universal and international: it knows no limits of tongue, vocabulary, or grammar, and it can be perceived by the illiterate as well as by the literate” (p. 61). Since visualization is universal, landscape architects then must know if individuals perceive space in the same or different ways.

*Individual space* is the personal bubble that one defines around oneself. It can vary in size depending on the situation and individual. Imagine being at a basketball game that has been sold out. There are people from everywhere to see this event, including yourself. The problem is you cannot enjoy the game because the people around you are so close that your personal space has been invaded; therefore, you cannot focus on what really matters, the game. According to Himes (1965), “The important problem here is not that these behavioral situations exist, but rather to what degree should they be considered in the analysis and design of any particular space” (p. 69). There could be many differences based on the individual’s definition of personal space that could interfere with continuing the design progression.

It is the combination of these *external, internal, and individual* spatial components working together that define the experience of a space. Landscape architects want a better understanding of spatial perception in order to design more effective and more comfortable areas to accommodate the activities within that area.

**Survey Development Process**

Surveys are systems for collecting information on many subjects. There are four phases of the survey development process: planning, developing the survey, obtaining the respondents, and preparing for data collection (Thomas, 1999). Each phase has different decision levels that must be made to proceed to the next phase. The better the survey, the better the results will be in the statistical analysis.

The first phase of the survey development process is planning. The decisions involved with planning include:

1. **Topic identification**
2. **Research questions development**
3. **Participant selection**
4. **Time line scheduling**

One can identify a topic by reading on a broad topic of interest. After brainstorming on the kinds of information that are of interest, one focuses on two or three narrow topics of the research or experiment. Once a particular question becomes evident, the objectives will break up the question(s) into more specific areas. According to Thomas (1999), there are a few guidelines to follow for writing clear objectives:

1. Narrow each objective to one concept or idea
2. Try to avoid using the word and
3. Relate each objective to the research questions
4. Remember that demographic information is not an objective

After writing the research questions and objectives, next select a target group. Target groups (participants) are the people about which information is gathered. The last level of phase one is the time line. The time line is mainly a checklist for the researchers involved to help them keep a schedule. After the planning decisions are made, the second phase of the survey development process is the actual development of the survey. According to Thomas (1999), development involves even more decisions; these include:

- “Items for each of the objectives
- Response options
- Scoring plans
- Demographic items
- Survey format” (p. 13)

Most of a researcher’s time is devoted to the survey development phase. The *items* are responses of the participants. There are many techniques for obtaining responses. For example, open and fixed response, ranking, and rating are a few of the many response options. A coding plan describes how the responses are coded. Demographic items are collected to describe the characteristics of the participants in the study and to provide subgroups for comparisons. A well designed survey format shows the participants that time has been taken in
the preparation of the survey. The survey should always be voluntary and confidential, and this should be stated on every survey.

In phase three, obtaining respondents sounds the easiest but usually is the hardest. In most studies, informed consent forms are needed to obtain permission from the participants. These forms must consist of the following: the nature of the survey, that during any time of the survey/experiment that participants have the right to stop without penalty/sanction, and if working with minors, consent must be obtained from the parent or guardian. These are all part of the ethics of research. Most survey projects will require a gatekeeper letter. A gatekeeper letter is to request permission to obtain access to the participants. A few suggestions include using a business format, spelling the person’s name correctly, and making sure there are no spelling, grammar, syntax, or typographical errors in the letter. The letter should include the following topics: the importance of the study, the time it will take, why the group was selected, how the results will be used, and any contact information for questions and/or concerns (Thomas, 1999, pp. 61-62).

Phase four consists of preparation for data collection. First, a pilot study needs to be done for final revisions to be made. If any changes need to be made on the survey, this is the time. Then, in planning the data collection, knowing how to get in contact with the participants (i.e. email, telephone, fax, etc.) is essential. In addition, one will need to know how to distribute the surveys. Finally, produce the survey (i.e. paper copies, electronic, or web online) to the participants.

The survey development process can be long and hard, but the results are worth the effort. Surveys can make or break the final statistical results, depending on the time devoted in developing the survey and the knowledge of survey development. A bad survey may lead to results that are not as valid and/or reliable. A survey format can have flaws but still be overall good, or a survey format can be perfect but be very wrong for the hypotheses of the study.

Method
Overview
This section will provide information about the original survey conducted by the researchers at NC State, DESIGN.

Participants
Thirty landscape architects (16 female, 13 male, 1 unreported gender) with various backgrounds participated in the survey on a volunteer basis. The participants were students and professionals 19 to 62 years old, with degrees from bachelor to Ph.D. and with 0 to 40 years of experience.

Procedure
The participants were randomly assigned to groups, traditional or computer, by the researchers at NC State, DESIGN. The participants that were in the traditional group viewed the conventional representation, at a scale of one-inch equals twenty feet including a plan, section-elevations, perspective drawings, and a one-inch equals thirty-two feet physical model. The participants that were in the computer group viewed the computer generated virtual reality representation of the same design. The computer-generated images were created by entering the design information into Studio Max 3.0 R2, which rendered hemispherically corrected sequential images on the VisionDome. The 4-meter VisionDome is an immersive, multi-user, single projection virtual reality environment that can accommodate one to ten users at a time. VisionDome users are immersed in a photo-realistic virtual environment, which provides a natural horizontal viewing angle (Holmes, Rice, and Tomlinson, 2000).

According to Holmes, Rice, and Tomlinson (2000),

The mechanism for evaluating the design from all three modes was a questionnaire composed of four sections. Section one (Design Elements) required the [participant] to rate the importance of specific design elements to the character of the design on a scale of one to seven. Section two (Crowding Levels) asked participants to estimate the number of individuals that could be accommodated in the design to create specific levels of crowding. Section three (Paired Adjectives) required [participants] to evaluate the design based on ten paired adjectives. Finally, in section four, as a means to check the completeness of the structured part of the questionnaire in a open response format, [participants] were asked to describe the important characteristics of the design in their own words (p.7).

After the participants viewed their assigned representation group (first view), the groups switched; therefore, the traditional group viewed the computer and the computer group viewed the traditional (second view).

Survey
The participants evaluated the design using three different modes of representation. Holmes, Rice, and Tomlinson (2000) define these different modes as followed:

The overview was presented through representation as on [sic] the overall impression of the design resulting from the viewing
of conventional drawings and the physical model. This overall impression was created through computer-generated representations by a “bird’s eye” fly over and simulated ground level views. The walk-through was a view from a prominent path in the design. The path was indicated in the traditional [model] as a series of arrows on the plan drawing and represented as a virtual walk-through in the computer-generated scene. The panorama, a 360-degree view from a single point in the design, was indicated in the conventional representations as a viewpoint on the plan and in the computer representations as an eye-level 360-degree rotational view (pp. 5-6).

Special care was taken to make sure that the information was consistent between both models in order to control for confounding variables that might arise.

Statistical Analysis

The foundation of beginning the process of statistical analysis is the statistical tests and the corresponding assumptions that need to be used for correct interpretation of the data. I began my analysis by choosing three questions of the survey to focus on: rating the importance of the quality of light, rating the quality of simple versus complex, and rating the quality of prospect versus refuge. My objective in this research is to identify the nature of the differences of viewing (i.e. gender, age, years of experience, and highest degree held), and determine why the differences exist. This was accomplished by breaking down each question into sections. The method of this break down for computer versus traditional (viewing) is as follows for all three questions: a whole without regard to order of viewing, first view (looking individually at overview, panorama, and walk-through), second view (looking individually at overview, panorama, and walk-through) and if there is a difference in either view, then the variables of gender, years of experience, highest degree held, and age are tested for determining the reason for the difference.

Choosing the correct test for data analysis can be tricky, but not having the right test can cause wrong interpretations. Before anything can be done, statistical tests must meet particular assumptions (i.e. normally distributed, independent variables, and constant variances). I chose the F-test, T-test, and Analysis of Variance (ANOVA) for finding differences within the data. The F-test determines if the data has equal or unequal variances. Once that is determined, the T-test is executed accordingly. The T-test determines if there are significant differences between the two independent variables. If there is a significant difference between the two variables, the next step is to determine where the differences occur. The ANOVA was used to test for main effects and interaction of the variables of gender, years of experience, highest degree held, and age. If there is a difference, but not within the variables, then possible trends in the data are examined.

Regression is able to show if trends exist within the data.

Results

The statistical findings of this data are very interesting. For all three questions that were studied, the survey participants answered the questions differently based on their viewing method (computer vs. traditional), and these differences were substantial enough to be considered statistically significant. The survey was relatively complicated, in that the differences in the participants could be caused by several factors, like the order of viewing (first view, second view) or the area viewed (overview, panorama, walk-through). Furthermore, each question could have different results. The significance level of $\alpha = .05$ was used in this research.

For the question of rating the importance of the quality of light, there was a highly significant difference in the second viewing of the computer vs. traditional models, $t(81) = -6.95$, $p = .000$. I then wanted to know whether the differences occurred in the overview, panorama, and/or walk-through. A highly significant difference was found in the perception of the overview area when viewed second by the computer or traditional model participants, $t(25) = 5.069$, $p = .000$. The participants that view the traditional model second after viewing the computer model first rate the importance of the quality of light on average between 1.758 and 4.281 points higher (on a seven point scale) than the participants that view the computer model after viewing the traditional model. Finally, the natures of the differences were studied (i.e. demographic variables of gender, years of experience, degree held, and age) for other causes of the differences. Although a highly significant difference was found in the overview area for the second method viewed, these differences were not due to the demographic variables.

For the question of simple vs. complex, there were similar results. A significant difference was found in the perception of the overview and panorama area when viewed second by either the computer or traditional model participants, $t(28) = 2.134$ and $2.465$, respectively, $p = .042$ and .020, respectively. Participants that view the traditional model second after viewing the computer model rate the quality of simple vs. complex for overview on average between .033 and 1.627 points higher, and the panorama on average between .158 and 1.661 points higher.
(on a five point scale) than the participants that view the computer model second after viewing the traditional model. Again, there were no differences in the responses when examined by the demographic variables.

For the question of rating the quality of prospect vs. refuge, the results were different than those stated above. The participants perceived this question significantly different for the first viewing of the overview area for the computer or traditional models, \( t(28) = 2.673, p = .012 \). Participants that view the traditional model first rate the quality of simple vs. complex on average between .211 and 1.593 points higher (on a five point scale) than the participants that view the computer model first. A significant interaction was found between the highest degree held and the method of visualization (computer vs. traditional), \( F(1, 28), p = .028 \).

Discussion

Survey Suggestions

There are a few survey suggestions that could improve the original survey used in this analysis. Two general suggestions are: before beginning the survey process, know exactly what is wanted from the results, and give most of the time spent in the research process devoted to designing the survey. Additionally, I would also suggest that instead of using a number scale for rating the importance and quality of things use a verbal scale (i.e. “agree” and “disagree”). People usually can relate to a feeling type question rather than a numerical scale. Surveys can make or break the research; therefore, the design of the survey should be thoroughly thought out.

Results’ Implications

The results of the research are interesting. The first two questions (quality of light and simple vs. complex) had differences, but not in the demographic variables. This could imply that the true nature of the differences is the method of visualization (computer or traditional) and the order of viewing (first or second), or demographic variables not studied. This could also imply that there are individual differences that cannot be measured. According to Lord, “There simply is no logical or statistical procedure that can be counted on to make proper allowances for uncontrolled preexisting differences between groups” (Newton and Rudestam, p. 223). The last question (prospect vs. refuge) had differences due to the participants’ highest degree held. The participants with a master’s degree or higher rated the traditional as refuge and the computer as prospect, but the participants with a bachelor’s degree rated both the traditional and the computer the same average rating of three (on a five scale rating). This would imply that either the participants with bachelor degrees are neutral on the quality of prospect vs. refuge or perhaps they do not have a full understanding of the terms.

Each of these questions is related to spatial perception. These results show that spatial perception differs by method of visualization; therefore, universities teaching spatial design will need to address the issues of these perceptual differences in their curriculum.

Future Research

Future research on this topic should include refining the survey instrument, additional statistical analysis on all the questions in the original survey, analyzing new data gathered on the actual site viewing, and then comparing all three viewing methods with the new survey.

References


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Making Changes: 
One Mathematics Teacher’s Transformation

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With the mathematics reform movement currently in progress, many documents are describing a new vision for the role of the mathematics teacher (National Council of Teachers of Mathematics [NCTM], 1991, 2000; National Research Council, 1989, 1990). In reference to this new vision, Clarke (1997) claims that there are two key elements that must be addressed. “First, there is a need for clear descriptions of the role of teachers in such ‘reformed’ classrooms. Second, there is a need for detailed descriptions of the process of teacher change with an emphasis on those factors that exert an influence on that process” (p. 278). One visible reform document, the Professional Standards for Teaching Mathematics (NCTM, 1991), conveys that teachers must be more proficient in:

• selecting mathematical tasks to engage students’ interests and intellect;
• providing opportunities to deepen their understanding of the mathematics being studied and its applications;
• orchestrating classroom discourse in ways that promote the investigation and growth of mathematical ideas;
• seeking, and helping students seek, connections to previous and developing knowledge; and
• guiding individual, small group, and whole-class work (p. 1).

The Principles and Standards for School Mathematics (NCTM, 2000) supports these teacher actions, and places an emphasis on teaching mathematics that is useful in everyday life and in the workplace. Although these expectations may not appear to be unreasonable, how teachers gain expertise in these areas is not always well defined. When teachers enter the classroom, they have already embraced a number of personal experiences as learners of mathematics—ranging from elementary school up through university coursework. In many cases, these experiences have not promoted the practices the Professional Teaching Standards (1991) illustrate. As school districts make attempts to implement mathematics reform or Standards-based curricula, teachers must reflect on whether such proficiencies exist in their own teaching and learning environment and at times, come to terms with their own inadequacies and limitations.

Research Questions

Manouchehri and Goodman (1999) comment that the reform movement visions of teaching place greater demands on teachers than the traditional method of instruction where the teacher dispersed segments of information among the students. In light of these new teacher roles and responsibilities, the researchers were interested in studying a small sample of teachers who were trying to implement reform-based practices in their classroom instruction. Thus, the following major research question emerged:

What factors influence a teacher to teach in a nontraditional manner?

(We will define nontraditional and traditional instruction in the next section.)

In our attempt to answer this question, we also sought out responses to the following three related questions:

• What are a teacher’s conceptions of (a) the teaching and learning of mathematics and (b) the reform movement?
• What elements tend to (a) encourage and/or (b) discourage a teacher to adopt the new visions of teaching?
• How does one’s conceptions “match” one’s practices?

This study was designed to seek answers to the research questions, as they related to a secondary mathematics teacher, and to identify factors that bring about change in the classroom. Thus, a case study design was adopted for this research.
Purpose of Study

The purpose of this qualitative study was to document factors that influenced mathematics teachers to teach in a nontraditional manner. To gain an understanding of a nontraditional teacher's practices, one might observe what occurs in a traditional mathematics classroom. Hiebert (1999) shares one perspective where the traditional classroom places its emphasis on the teacher. There is little regard given to helping students make connections to previous work or to developing a deep conceptual understanding of what they are doing.

In one study, a researcher's observations of a typical mathematics classroom were recorded as follows:

First, answers were given for the previous day's assignment. A brief explanation, sometimes none at all, was given of the new material, and problems were assigned for the next day. The remainder of the class was devoted to students working independently on the homework while the teacher moved about the room answering questions. The most noticeable things about math classes were the repetition of this routine. (Welch, 1978, p. 6)

Although this account was recorded 23 years ago, many would argue that this image of the classroom is very much alive in today's mathematics classrooms.

Now one might ask, “What does the nontraditional mathematics classroom look like?” In describing the ideal mathematics curriculum, the Principles and Standards for School Mathematics (NCTM, 2000) states that “mathematical ideas are linked to and build on one another so that students' understanding and knowledge deepens and their ability to apply mathematics expands” (p. 14). The nontraditional classroom places its emphasis on the student. Students are given more opportunities to develop a profound understanding of mathematical concepts and ideas. There are numerous hands-on activities and lots of real-world applications of mathematics. As said by Gage and Berliner (1992), student-centered teaching “requires constant planning, continuous innovation, a sensitive system of monitoring students' performance, and well-developed skills in maintaining order without being authoritarian” (p. 486). This research attempted to identify teachers who had student-centered classrooms and how they operated in this environment.

As the reform movement continues to be at the center of mathematics education discussions and debates, Clarke (1997) comments on two critical areas from which this movement gains its momentum: “(a) the changing needs of citizens for effective participation in an increasingly technological and global society, and (b) increased research knowledge about the teaching and learning of mathematics” (p. 278).

Today's teachers are being encouraged, and at times forced, to implement technology into their classrooms. In a matter of seconds, a calculator can now perform computations that would have taken days only ten years ago. As computer technology advances, the mathematics community is able to explore mathematical graphs and models in new ways. With the latter point comes the realization that students are not learning the mathematics that they need to learn (Kenney and Silver 1997; Mullis et al. 1997; Beaton et al. 1996). The NCTM (2000) states, “The reasons for this deficiency are many: In some instances, students have not had the opportunity to learn important mathematics. In other instances, the curriculum offered to students does not engage them” (p. 5).

In the nontraditional classroom, students are given every opportunity to learn and discover mathematical concepts on their own. This is an integral part of the reform-based teaching that the researchers were interested in capturing.

As this research project was designed and developed, the researchers concurred with Clarke's (1997) perspectives on the reform movement. The deficiencies noted by the NCTM (2000) need to be addressed and answers sought out as to why more teachers are not engaging in nontraditional instructional practices in their classrooms.

Theoretical Framework

This case study was designed to identify factors that influence nontraditional teaching practices in the mathematics classroom. In trying to classify such aspects, we adopted a framework focused on teacher actions and teacher beliefs and conceptions. Clarke (1997) provided a basis of the framework we used to guide this study. His framework possessed two key categories for the role of the classroom teacher—what the teacher does and her related beliefs about the teaching and learning of mathematics. Both of these areas were critical to this study in trying to understand Ruth and her actions. The researchers will discuss this framework and how it was used to help guide the study in the second paper on the case study of Ruth.

We now will present a brief overview of the methodology used for this study followed by a review of the related literature.

Methodology

“Case studies, by definition, get as close to the subject of interest as they possibly can, partly by means of direct observation in natural settings, partly by their access to subjective factors
Participant

One of the researchers taught a graduate-level course in the spring of 2000 where a component of the course was focused on the mathematics reform movement and how teachers viewed the movement “fitting into” their own classrooms. Thus, the initial study began with a sample of five secondary mathematics teachers, who were students in the course. These teachers taught in four different counties in the Middle Tennessee area and content ranged from general mathematics to geometry. After initial interviews and visits to their respective schools, it was concluded that only one teacher had truly adopted mathematics reform teaching in her classroom instruction. This teacher, Ruth, is the case we are studying.

Ruth is a teacher in a rural school of approximately 350 students. She teaches on the block schedule and her classes consist of one general mathematics and two geometries with students in grades 9-12. The geometry classes became the center of attention by the researchers to her classroom, and the materials that she chose to use in her instruction, that she became the case under intense study. We—as researchers—wanted to find out what prompted her to use such materials and how she used them in her classroom instruction. We also wanted to find out what encouraged her to adopt nontraditional teaching styles and how it affected student learning.

More information and details on Ruth’s background, her conceptions of mathematics, learning mathematics, and instruction of mathematics, as well as her perspectives related to the mathematics reform movement will be found in the second paper on the case study of Ruth.

Role of Researchers and Length of Study

One of the researchers was a faculty member at the university-level, while the other researcher was an undergraduate student completing her degree in mathematics education. Both had agreed to work on this research project as part of the undergraduate’s research study for the summer McNair program at their institution. Both researchers visited Ruth’s classroom, asked Ruth for feedback, and were present at the final open-ended interview. Both researchers were involved in all aspects of the project—from data collection, analysis, and writing of the paper.

This study took place during the spring and summer semesters of the year 2001. While the participant had been involved in earlier interviews and classroom visits by the researchers, the actual teaching episodes the study focused on were in the spring of 2001. The teaching unit, that was the focus of class instruction, was carried out for two weeks—with a block schedule of 90-minute class periods. After the unit was completed, the researchers met with Ruth for an in-depth interview. At this time, we sought out information on why she did certain things as well as her views on the overall success of the unit.

Data Collection Procedures and Analysis

One valuable method of empowering a study design is by triangulation, or the combination of methodologies in the study of the same phenomena (Patton, 1990). Triangulation, as used in this study, refers to the multiple methods of data collected. The researchers used in-depth, open-ended interviews, direct observations of classroom instruction, and written documents such as class handouts, homework, and tests. The data was collected and used to describe what occurred in Ruth’s natural setting–her classroom.

The findings, understandings, and insights that emerge from fieldwork and subsequent analysis are the products of qualitative research (Patton, 1990). Analysis of data from this study was an ongoing process throughout the course of data collection. The researchers coded the data to help search for recurring themes. Once themes were identified, they were used to help identify and support some of the factors involved in making teacher change happen in the classroom. The coding process and analysis of the data will be explained in further detail in the second paper on the case study of Ruth.

Literature Review

Presently, there is a growing body of literature related to the mathematics reform movement. Reform-based instructional methods often present teachers with a major challenge. It is a well-known adage that teachers tend to teach in the same way that they were taught. Thus, changing the instructional practices in one’s classroom is often easier said than done. The NCTM (2000) notes that, “Sometimes the changes made in the name of standards have been superficial or incomplete” (p. 5). Some research sheds light on why reform-based instruction is not being successfully
implemented into today’s schools. Raymond (1997) concluded that “deeply held, traditional beliefs about the nature of mathematics” influence the techniques that a teacher employs even when he/she voices nontraditional beliefs about the way that mathematics should be taught (p. 574). Throughout the course of this study, the researchers grasped the reality of this statement. Early in the study, four of the five teachers expressed acceptance and use of nontraditional methods; but, upon observation, these teachers demonstrated very traditional teaching methods. Sarason (1971) confirms the difficulty of change, “educational changes depend on what teachers do and think—it’s as simple and complex as that” (p. 193).

While reform in the mathematics classroom is extremely difficult, several researchers have documented typical supports for teacher change. As researchers, we wanted to observe how Ruth’s support in changing her classroom “fit into” this body of research. Masingila and Tinto (1998) described seven supports that encourage teachers to change their mathematics classroom: 1. gaining a professional role 2. ensuring staff development experiences 3. involving all teachers 4. risk taking and collaboration 5. experiencing institutional commitment 6. building community support 7. having visible outcomes. (p. 44)

Clarke (1994) also described “ten important principles of professional development,” which highlighted fostering teacher change. One of the most common themes was that teachers need to collaborate with other teachers on how to change their classrooms (Clarke, 1994; Tinto and Masingila, 1997; Hiebert, 1999). This allowed teachers to observe others who were experiencing the same dilemmas and encouraged them to share ideas and activities that worked in their classrooms. Furthermore, changing one’s classroom became easier when the teacher was confident in his/her mathematical abilities. With this assurance comes the confidence to explore along with one’s students.

Where [teachers’] knowledge is more explicit, better connected, and more integrated, they will tend to teach the subject more dynamically, represent it in more varied ways, and encourage and respond fully to student comments and questions. Where their knowledge is limited, they will tend to depend on the text for content, de-emphasize interactive discourse in favor of seatwork assignments, and in general, portray the subject as a collection of static, factual knowledge. (Brophy, 1991, p. 352)

Manouchehri and Goodman (1999) confirmed this statement. They reported one teacher’s comfort with her mathematics content knowledge allowed her to have a more open classroom environment.

In their case study of two teachers working with Standards-based curricula, Manouchehri and Goodman (1999) concluded, “that in the presence of Standards-based curricula the teacher needs to learn and obtain new knowledge about her role in the classroom, re-examine her curriculum and instructional goals in light of the new needs, and re-conceptualize the nature of her interactions with the learners” (p. 22). Our research was interested in studying how one teacher transformed her role in the classroom. Studies have encouraged more in-depth exploration into the role of the mathematics teacher in a nontraditional classroom (e.g. Clarke, 1997; Manouchehri and Goodman, 1999). We hoped that our research—the case of Ruth—would contribute to the body of research on the reform movement and nontraditional classroom instruction.

References


Restoration Art: 
A Transformation of the Relationship 
Between Humans and Nature

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As a greater percentage of the world’s natural resources are being used to support an exponential human population growth and increased consumption and dependence on fossil fuels, the need to return some degree of ecosystemic health to already degraded lands and to mediate the effects of future use on the lands is paramount. Furthermore, recent work in conservation biology has begun to cast doubt on the old rationale that ecosystems can be saved through the creation of preserves and parks. In short, ecosystems in parks are negatively affected by their boundaries and preservation of any area would require preserves to be expanded immensely. Given these two factors, there is increased interest worldwide in the practice of ecological restoration. In the US restoration projects are underway which seek to, for example, reintroduce the prairie ecosystem in the Mid-West and to return the Kissimmee River in Florida to its original meandering course. Such activities have resulted in considerable debate within the philosophical community, especially those interested in environmental ethics. On one end of the spectrum are those opposed to restoration, the preservationists, who argue that restored landscapes are less valuable than their natural counterparts and that restoration is just another manifestation of the desire of humanity for domination and control. At the other end are those in favor of restoration who maintain that, not only is no value lost in the process of restoration, but that value is actually added because restoration has the potential to engender a new relationship between humans and nature. In this presentation, I will demonstrate the overall strength of the latter position and show how redefining restoration in terms of restoration art can augment this strength. Finally, I will offer thoughts toward the creation of ideal standards of restoration art and examine examples of this type of project as they fulfill these criteria.

The main sticking point between these two arguments rests in a disagreement over two underlying assumptions, one following from the other. Preservationists uphold the dichotomy between humans and nature, privileging the latter, and, therefore view science and technology as essentially harmful. In contrast to this, restorationists maintain that man is part of nature, neither having absolute privilege over the other, and that science and technology can be harnessed to serve ecologically minded goals.

For the preservationists, humanity has transcended nature in three vital ways. First, humans, as self-conscious beings, can engage in culture and other goal-directed activities. Second, human’s use of technology exceeds that used by other organisms to such a degree that it is of a categorically different kind. Third, the power that such technology allows us to wield over nature exiles us from the purely natural realm. Then, preservationists reflect on the relationship between humans and nature and argue that humans almost always have a negative impact on any ecosystem they enter because they have an inherent need to dominate and control. To make matters worse, humans have the use of technology, which magnifies these negative effects across the entire Earth. Take for instance the Third Law of Ecology presented by Barry Commoner in The Closing Circle, “Nature knows best. Any major man-made change in a natural ecosystem is likely to be detrimental to that system.” Donald Scherer has characterized this as ecological therapeutic nihilism, referencing the practice in 19th century medicine of withholding treatment because doing nothing caused less harm than intervening. For the preservationists, restoration is just another manifestation of the desire to control nature, and a better prescription would be to do nothing.

The delineation of a stark dualism between humanity and nature is untenable on several grounds. Homo
sapiens are naturally evolved like every other organism on Earth. On the most humble biological basis we are essentially like all other creatures, living, breathing, and transforming our environment. Like all other creatures we are continually immersed in and dependent upon nature throughout our lives. The invention of culture and technology does not allow us to transcend these natural roots. In fact, technology is believed to be the main propelling force behind the evolution of Homo sapiens. The differential survival of Cro-Magnons and Neanderthals, rather than being attributable to any morphological differences, are generally thought to be a result of more prolific and efficient tool use by the Cro-Magnons. Furthermore, many creatures make use of their own technology, such as beavers, ants, and chimpanzees. To put the point briefly, although for any particular attribute, there may be a spectrum on which humans lie on one end and other natural creatures on the other, there is no essential difference between humans and nature.

Such a distinction between man and nature lies at the very root of the ecological crisis. It is, in part, because we feel that we are other than nature, that we do not see problems with using nature to whatever superficial end we may desire. Additionally, the desire to dominate and control nature through technology is based on the idea that nature is other than us, and in fact, opposed to us.

Furthermore, there does not seem to be any reason to hold that technology is essentially bad. Technology is just a means to some goal; it can be bad or good depending upon the goal desired and the state of knowledge in that particular area. It may be true that technology has had many detrimental effects, but is it any wonder given our goals (unending comfort, profit, etc.) and the lack of knowledge to date in many areas (chlorofluorocarbons effect on the ozone, the effect of DDT on bird egg shells)? We will never have 100% certainty for any action that is undertaken; this cannot and should not bind our hands. What restoration is, is a “positive action—an act of faith in the possibility of a mutually beneficial relationship between humans and nature”; the same sort of leap of faith that is required for all action.

Now that I have outlined the major assumptions of the two arguments, I would like to present one of the more prevalent indictments against restoration, namely Robert Eliot’s in his article “Faking Nature.” Eliot argues that even if a restored landscape was identical in every perceivable way to the original, there would still be one difference. Namely, a restored landscape is one that does not have the same historical continuity, as a naturally evolved ecosystem, as the original does. The restored landscape would essentially be a “fake” of the original. Eliot takes his metaphor from painting, where the value of a work does not entirely lie in a particular arrangement of pigment on canvas, but rather on the relationship which the work has to a particular painter in a particular time period. Forged art works are less valuable because they do not have this relationship; the same goes for restoration “fakes” of nature.

This argument is weak on several grounds. First, it is based on the assumption that man is separate from nature (which has already been disputed). If men and/or women are considered as part of nature, then they, too, are artists, so to speak, just as natural evolution is in the creation of ecosystems. Second, Eliot analogizes nature to a painting, when a painting is a static object and nature is a dynamic entity. Since nature is dynamic it is problematic to consider any state of nature as “an original” which can be copied. Frederick Turner points out that in fact nature is, itself, a copy of a copy, in terms of meiosis and sexual reproduction and that “restoration is more in the spirit of the original than preserving it would be.”

Philosophers, like Donald Scherer, have argued that nature is more like a dance piece which is designed to contain improvisation on the part of the performer. For this metaphor, the structure of the piece would come from basic processes of natural evolution while the improvisation would be the particular manifestation of these properties for a given ecosystem, including a few pirouettes on the part of you or I. It is clear that cutting nature off from humans has the potential to cause both to suffer. Nature is deprived of at least one of its potentially most interesting improvisers and humans are denied a role in the performance they were born to dance.

The vision of restoration projects so far may make them appear to be some sort of panacea. However, like most things, restoration is wrought with dangers and pitfalls. As the preservationists maintain, restoration can easily be used as just another tool for domination and control of nature. Projects can be over-managed in an attempt to create a landscape to fit some narrowly defined anthropocentric ideal. Furthermore, many restoration projects have as their standard the return of an ecosystem to the way Europeans may have first encountered it. The problem with defining restoration projects as being successful if they restore an area to the state before human involvement is that it assumes, like the preservationists’ argument, that man and nature are separate. Restoration projects may be designed to exclude human involvement altogether because their impact is viewed as harmful (again falling prey to human/nature dualism). As a last example, restoration projects are geared at rectifying the past and are rarely future-
focused, essentially leaving us to repeat the same mistakes.

Because of these potential problems, I think that it is helpful to redefine restoration in terms of restoration art. Restoration art, like all art, is not easy to define. Restoration artists are artists that are moving out of the gallery and into the landscape, creating works of art on a monumental scale that not only serve as outlets for creative, aesthetic expression but also to return ecological value to damaged landscapes.

Before looking at a few examples of restoration art, I would like to address the promises of ecological restoration art. (1) Restoration artists are not attempting to perfectly recreate some pre-human landscape. Furthermore, in these works the men or women working on these projects are not afraid to leave their mark on nature. They recognize the inevitability of intervention and proceed to act in an ecologically conscious and creative way. (2) It may seem paradoxical at first to think that art is anything other than synonymous with domination and control. However, if you read artists’ accounts of the artistic process, it becomes profoundly clear that this process is a collaborative effort between the artist, his/her ideas, cultural surroundings, and the material with which he-she works. We have probably all heard the anecdote told of Michelangelo and his process of sculpting where he describes the figures which he carves as “screaming to break free from the stone.” Art is, in effect, a process of discovery rather than invention. What good art can do, in part, is to reveal the world in new and profound ways. In a sense what they can do is to facilitate the opening of a space in which nature can more fully “be.” (3) As I pointed out earlier, one of the potential problems with typical restoration projects is that they are almost always focused on amending the past. Such a practice of reciprocity is important; however, restoration art offers the possibility of doing this and much more. Most restoration art projects are also concerned with healing ecosystems, however, they do so in such a way as to not allow the viewer to forgive or forget past damage that has been done. It is essential that restoration projects not just cover up the mistakes of the past, so that these landscapes can continue to be reminders of our past carelessness, which will allow us to critically examine current practices and lead to better judgment in the future. Furthermore, as we continue to learn more about ecology and a suitable, sustainable role for humans in the environment, we can take this knowledge and translate it into practices which will allow us to carry out our actions in the present in such a way as to not cause further ecological damage. (4) Finally, and very briefly, the beauty of restoration art projects is that they offer the rare opportunity to combine means and ends. Not only is the finished project considered a “good,” but the process of getting to that end is good in and of itself. As people work in nature, their understanding of the intricacy, fragility, and complexity of the natural world will engender a greater appreciation for nature, in general.

Due to space constraints, I would like to just take a few lines to gesture towards some of the possible criteria for good restoration art. First, of course, restoration art should make every possible attempt to alleviate as much of the past damage to the land as possible and obviously not cause any more harm. From this it is clear that some sort of ethical norm will need to be developed to lay out the conditions for right and wrong action. This leads to the need for the development of a politics in restoration and a politics of restoration. This may address, for example, the relationship between the community where the artwork is proposed, their needs and desires, and the artists and the scientists that are proposing the project. Restoration projects can be expanded to include the vision of an entire community, with help from artists and scientists.

Putting this rhetoric aside, I would like to examine some actual works of restoration art. The first important figure in the field is Robert Smithson. Smithson, whose works, Spiral Jetty and Broken Circle, are shown in Figures 1.1-1.2, never designated his works as restorative acts. However, his works illustrate one extreme of possible restoration. Smithson’s works do not restore any ecological value to an area, rather they only attempt to return some amount of aesthetic value to the area. This is obviously a very minimal restorative goal, but in some areas where the costs of restoration are prohibitive, this may be the most that can be done.

Mel Chin’s Revival Field, shown in Figure 1.3, is another major piece in the burgeoning area of restoration art. In this piece, Chin has sectioned off a 60 square foot section of the Pig’s Eye landfill, in St. Paul Minnesota with a chain link fence and has planted plants known as hyperaccumulators, plants that remove heavy metals from soils. Chin views his work as a form of sculpture where the actual artwork is hidden from the casual observer, deep in the soil. Overall, Chin’s work is a success; however, the placement of a fence to deter human involvement in the area is an obvious negative feature.

Figures 1.4-1.5 are of a restorative piece proposed by Nancy Holt. Holt’s design includes revegetating the 57 acre, 100 feet high landfill so as to make it suitable habitat for migrating birds and small mammals. Additionally, in the spirit of Stonehenge, Holt proposes to turn the area into a public park complete with astral observatory and other smaller areas for viewing of
the heavenly bodies. Holt’s ideas are very promising, combining restoration with appropriate sustainable human use.

Finally, and perhaps the best work of restoration art to date, is Lluis Vila’s *Clastics*. The company mining the volcano left a large chunk of it missing. Rather than covering up this ecological and aesthetic eyesore (which was probably not possible from a financial point of view), Vila decided to clean up the cut, placing steel support beams and terracing to prevent further erosion. The soil is not suitable for vegetation, but no run-off is affecting the surrounding land. In this way, Vila is left with a stark contrast between the interior redness of the volcano and the surrounding vegetation, which is an appropriate metaphor for human advancement and destruction. While Vila’s work succeeds ecologically and aesthetically, it has the added value of not allowing the viewer to forget the damage inflicted upon the land in the past.

In closing, ecological restoration art holds much promise for transforming the relationship between humans and nature. However, these practices cannot occur in a vacuum. We must critically examine our social and political practices which have lead us to this historical moment, if we are to truly affect the future.

**References**


2. As an aside, setting up such a dichotomy leaves the preservationists in the position of being forced to define nature. The usual definition is that nature is “other” than human. Though hardly a definition, this may lead to the unwanted conclusion that nature does not exist anymore since the influence of humans has pervaded all landscapes (think of global warming, for instance). Such is the case for Bill McKibben in his book *The End of Nature*.


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**Figure 1.1:**

**Figure 1.2:**
Figure 1.3:  
*Revival Field.* Mel Chin. 1990-present.  
Pig’s Eye Landfill, St.Paul, Minnesota.  
Six varieties of hyper accumulator plants,  
chain link fence. 60 square feet.

Figure 1.4:  
*Proposed Site for Sky Mound.*  
Nancy Holt. Hackensack, New Jersey.  
57 acre, 100 feet high landfill.

Figure 1.5:  
*Rendering for Sky Mound.* Nancy Holt.

Figure 1.6:  
*Clastics.* Lluis Vila. Croscat Volcano in the Garrotoxa site.
Experiments are described concerning the excitation of surface guided waves on metal-dielectric thin-film multilayers, and investigations into the possibility of using these multilayers as biochemical sensors are discussed. We make a brief comparison between surface plasmons and surface guided waves. We also discuss theoretically the reflective properties of multilayer thin-films that will allow their use as sensors. Our attempts at fabricating such a sensor necessary for our experiments along with our results are described in great detail.

Introduction

This paper concerns the excitation of surface guided waves on metal-dielectric thin-film multilayers and investigates the possibility of using these multilayers as biochemical sensors. We discuss theoretically the reflective properties of multilayer thin-films that will allow their use as sensors. We also discuss our attempts at fabricating such a sensor necessary for our experiments along with our results.

There are currently a number of commercial sensors based on surface plasmon phenomena [1-4]. Surface plasmons are collective oscillations of electrons on the surface of a metal caused by incident electromagnetic radiation. A plot of reflectivity versus angle of incidence reveals an angle beyond total internal reflection at which the reflectivity drops to a minimum then returns to total internal reflection. At this angle, the incident light is funneled into a surface plasmon. Because the plot is characteristic of the metal film type and thickness, SP sensors utilize the absorption and reflection of electromagnetic radiation on a metal surface with respect to the angle of incidence to sense changes on the surface of the metal. These sensors usually consist of a material with a low index of refraction coupled to a thin metal film. To make similar sensors that are more accurate, we investigate replacing the thin metal film with a multilayer. Our work builds on previous work and uses a theoretical model to guide the design of the multilayers [5]. Our key aim is to show that the predictions of the theory can be realized in practice.

Our work utilizes surface guided wave phenomena rather than surface plasmons. Surface guided waves are not electron oscillations as in a metal. They are instead trapped electromagnetic fields, similar to guided waves in fiber optic cables, whose maximum intensity is peaked just inside the outer layer of the surface and whose strength decreases exponentially with distance away from the surface. The aforementioned waves are characteristic of a given multilayer, thus any shift in the reflectivity minima are the result of a change in the multilayer. In the case of the proposed sensor, the additional change in the multilayer will be the result of the presence of a disease antibody for which the sensor has been designed.

There are specific antibodies that the body creates to counteract various diseases. These antibodies can be isolated in the lab and then chemically treated so that they adhere to a surface. The surface would be a metal for the surface plasmon sensor and the last dielectric layer in our multilayer example. The sensor is then exposed to a sample of blood or plasma from a person being tested for that disease. If the disease entity exists within the blood sample (i.e. the person has that disease), then the disease “molecule” will bind to the antibody creating a layer at the sensor surface. This layer would be detected as a shift in the reflectivity angle. If the disease does not exist in the sample, then there is no binding and consequently no shift in the position of the reflectivity minima.

Theory

The theoretical calculation of the optical reflectivity of a multilayer sample is a problem that has been studied for many years. Early work
attempted to find analytical mathematical expressions for the optical reflectivity; however, with the development of computers the problem was most easily solved numerically. In the work here, we used programs developed previously by Dr. Robertson and Michael May [5]. The programs used a recursive method that began by calculating the reflectivity of the last two interfaces of the multilayer stack. There is a simple expression for the reflectivity of a three medium (two interface) layer. The last two interfaces where then assumed to act as one layer with this reflectivity value and the next interface was then included to determine the reflectivity of the three interface system. This procedure was repeated until the reflectivity for all of the interfaces had been determined. The basic method is described in more detail in reference [6]. The programs that performed the calculations were written in MATLAB.

Based on our model, we developed a design for a multilayer whose surface wave response should prove useful in sensing applications to study experimentally. For our purposes, we decided to use three (3) Ag/Na3AlF6 (Cryolite) bi-layers. With our laser wavelength of 488.0 nm, ideally we needed layers of the following thickness (in nm) beginning with Ag and alternating: 25.0, 300.0, 25.0, 300.0, 25.0, 190.0.

**Experimental Narrative**

The experimental configuration is shown here in Fig. 1. Our laser had a wavelength of 488.0 nm. The beam was filtered through a polaroid, chopped and sent into the prism. The beam reflected from the multilayer onto a photodetector. The signal was lock-in amplified and then recorded using a computer-controlled data acquisition program. The depositions were made via a dimple-boat source resistive heating method.

![Figure 1](image_url)

This section describes in great detail our experience with the experiment. First, we deposited our designated multilayer onto a microscope slide. To attach the glass slide to the prism we used glycerin, which has approximately the same index of refraction as glass, to fill any void between the prism and the glass slide. That is, we put a small drop of glycerin onto the slide (opposite the side with the multilayer) and pressed the slide firmly against the prism. We had to place a “slide holder” on both ends of the slide being careful not to get too close to the area of the multilayer that would be reflecting the laser. We then ran the reflectivity scan. As an initial test, we removed the slide and simply replaced it trying to repeat the slide’s previous orientation, and as we feared the orientation was difficult to repeat, so the reflectivity scan was difficult to repeat. After several failed attempts, we realized that the shifts in the reflectivity minima resulting from the inability to exactly repeat the slide’s orientation would mask any claim that a shift resulted from an additional layer. We then decided that designing and fabricating a makeshift prism holder would be relatively simple. Thus, we decided to deposit directly onto the prism. To test this prism holder, we made a deposition onto a prism and simply placed the prism into the holder. We ran the scan, removed and replaced the prism, and ran the scan again. After eight scans, we concluded that the scan was repeatable enough. However, the reflectivity minima were not exactly in the same position for the each scan. Yet, because the maximum discrepancy was $1/60$ of one degree, we concluded that any significant shift in the minima would not be a result of a disoriented prism.

We deposited the multilayer onto a prism and, due to a time constraint, had to let it remain in the deposition chamber under vacuum overnight. After running the scan seven times, we decided that something had gone wrong with the multilayer; because the scans did not look quite as we knew they should. We cleaned the same prism and again deposited the multilayer. However, upon removing the prism from the vacuum chamber, we noticed that the deposited film was cracked; the film looked like the cracked glaze on pottery but on a much finer scale. Needless to say, it was useless. On our next attempt, the digital readout on the thickness monitor in the evaporator went out just before we finished depositing the last layer of Cryolite. However, the film was again cracked, so it did not matter that the readout had failed. Another attempt yielded the same result. Persisting, we had another go at it. This time, it worked! We ran the scan, and it looked great. With things going well, we had lunch. After lunch, for kicks, we ran the scan again, just to be sure that all was still well, but the scan looked almost flat this time. Over lunch, the multilayer had altered its reflectivity properties. We concluded that because Cryolite is hygroscopic and it was raining that day, the multilayer had literally changed while we were at lunch. This implies that while Cryolite would eventually prove to work for us, it is obviously too unstable to be used in this manner for long-term studies.
To get thinner films of Cryolite, we needed a shorter wavelength laser. We found another laser with a frequency that might be high enough. After running the theory again to get the necessary thicknesses, we attempted another deposition. This scan yielded the results discussed in this paper. While the film was still slightly cracked, it had a nice place near the center that was unblemished. We set the beam to strike the film at that point and the scan looked very nice. We were able to deposit the two additional layers with no more cracking.

For additional data, we attempted another deposition. The film was not cracked. The scan for this film looked nice until the addition of the second additional layer, after which the film cracked. As was the case in several of the other cracked films, we ran the scan anyway. The results were, of course, useless for what we needed. Therefore, we gave it another try. This time the depth monitor went out as we were finishing the second layer of the second bi-layer. So, we made yet another attempt at a deposition. Again, upon the application of the second additional layer, the film cracked. Due to our deadline, we had to give up on collecting more data. The result is that we have only one data set for analysis.

This section describes the details of the one deposition that went well. We deposited onto the prism the three bi-layers (six layers) of the following thickness (in nm): 25.2, 301.1, 24.9, 302.1, 24.9, 190.5. We ran the reflectivity scan, deposited an additional 5.6 nm and then another 5.2 nm of Cryolite onto the multilayer running the reflectivity scan after each deposition.

Entering these thickness data and the wavelength of the laser into the theory gives the plot in Fig. 2(a). The actual reflectivity scan data are shown in Fig. 2(b).

**Conclusion**

The results, as shown, are not conclusive or repeatable enough to sufficiently draw definitive conclusions about the suitability of metal-dielectric layer for sensor elements. Further data are needed. We are confident, however, that more data will show that multilayers can be used as sensors. Future experiments should be conducted with better instruments that are more precise. In addition, we believe that the crazing of the Cryolite was partly due to the small surface area onto which it was deposited, because when we deposited it onto a glass slide, it did not craze, or at least only had crazing near the edges of the large slide which did not interfere with testing. However, when we changed our method to deposit directly onto the prism, which has a much smaller surface area onto which to deposit, the Cryolite crazed almost every time. In the future, the glass slide should perhaps be glued onto the prism using nail polish. This will provide the large surface area needed for the stability of the Cryolite and will still allow a simple prism holder to be used, which allows for repeatable prism orientation. However, the nail polish might affect the vacuum quality, because it will tend to evaporate slowly; never fully allowing the high vacuum that would have otherwise been accomplished. Another approach is to find a better material than Cryolite for the dielectric layers. There are many non-metal materials that can be deposited, however, we are constrained to those that can be deposited by thermal evaporation. This restriction limits our choice of materials significantly; however, a future course of action will be to try these materials experimentally.

**References**

Effect of Phase on Fast Fourier Transforms with Application to Time-Series Photometry

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The reliability of the assumption inherent in a fast Fourier transform, that the phase at time zero for all modes present is zero, is put to test. Using a noise free signal made up of two sinusoidal components with a frequency difference ($\Delta\nu$) between 20 and 60 $\mu$Hz, a phase shift was applied to one of the signals and the results of the fast Fourier transform (FFT) were examined. It was found that phase does indeed affect the FFT results, specifically in cases where the signal is shorter than a critical length of time. Thus phase must be taken into account when using the fast Fourier transform algorithm to analyze signals.

Introduction

Time-series photometry has long been used as a tool in studying the interior properties of pulsating stars. From periodicities in the pulsations such information as mass of the star, rotation rate, magnetic field, luminosity, distance, and atmospheric thickness can be extracted (Nather et al. 1990).

The Whole Earth Telescope (hereafter WET) is an international consortium of astronomers that does time-series photometry with a network of telescopes, distributed in longitude around the globe, to study the interiors of variable white dwarf stars. The advantage of this setup is that one can obtain continuous, uninterrupted by daylight, observations of a particular star for up as long as one is able to secure telescope time. The ultimate product of a WET run is a light curve of many days in length. This light curve is a record of the brightness of a star as a function of time. The precision with which information about the star can be extracted is dependent on how well one can identify which pulsation modes in the temporal spectrum are present (Winget et al. 1991). The example in Figure 1 was created using a simple sine function, $y(t) = \sin(2000\text{Hz} \cdot t)$; note the mode is clearly identifiable in the temporal spectrum.

As mentioned above, the mathematical tool used to convert the light curve into a temporal spectrum is the Fourier transform.

The data reduction process involves creating the temporal spectrum of the light curve and identifying the modes in the spectrum that are dominant. As an example, Figure 1 shows a light curve for a fictitious star that pulsates with a single sinusoidal mode. By applying a Fourier transform to the light curve a temporal spectrum results. The precision with which information about the star can be extracted is dependent on how well one can identify which pulsation modes in the temporal spectrum are present (Winget et al. 1991). The example in Figure 1 was created using a simple sine function, $y(t) = \sin(2000\text{Hz} \cdot t)$; note the mode is clearly identifiable in the temporal spectrum.

As mentioned above, the mathematical tool used to convert the light curve into a temporal spectrum is the Fourier transform.

Figure 1:
Fictitious light curve with the corresponding temporal spectrum.
The fictitious light curve has been cropped and magnified to show detail.
The equation of the signal is $y(t) = \sin(2000\text{Hz} \cdot t)$. 
Fourier transform. When the data are discrete, one can choose between a discrete Fourier Transform (DFT) or a Fast Fourier Transform. When computation of the DFT is involved the number of operations required is \( N^2 \), where \( N \) is the number of points. Implementing the FFT algorithm the number of operations becomes \( N \log_2 N \). This is a significance difference. For example, consider \( N = 100 \) points. For the DFT the number of operations required is \( 100^2 = 10,000 \), whereas the FFT only requires \( 100 \cdot \log_2(100) = 665 \) operations. An excellent presentation of FFT’s is included in Press et. al. (1992).

As mentioned earlier, the goal of the WET collaboration is to resolve the complex pulsations of the star into separate components. In other words, the goal is to extract the individual sine waves, or modes, which contribute to the overall oscillations. The FFT returns values of amplitude of the pulsation modes as a function of frequency. However more than the amplitude and frequency is needed to fully describe a specific mode that is present in a signal.

A sinusoidal signal is fully represented by the following equation, \( y(t) = A \sin(\omega t + \phi) \), where \( A \) is the amplitude, \( \omega \) is the frequency, and \( \phi \) is the phase. Note that the phase of the signal is not explicitly shown in the temporal spectrum, see Figure 1. The FFT algorithm implicitly assumes that all signals start at time zero with a phase of zero. With over one hundred different modes of oscillation possible in a white dwarf star, it is physically incorrect to assume each mode would have a phase of zero. Thus it is impossible to accurately model the pulsations in an actual star if one has no knowledge of the phases associated with each mode.

I have found in my reading of WET analysis of stellar pulsation data, that phase is not addressed. It is my goal to determine if, in the same way that long, multi-site data can improve frequency identification of modes, specific values for phase can be ignored without loss of accuracy in the modeling process. And secondly, what is the critical time-length of a light curve in which phase can be ignored.

Simulations

My analysis begins with the creation of a simple noise free light curve. Because I wanted a quick and efficient way of running and evaluating data, the FFT algorithm in the MATLAB 5.3 software package was used (see Appendix A for script). The interactive nature of the program allowed easy manipulation of the variables so that my time could be spent evaluating different light curves as opposed to software development.

I created noise free signals in the following manner. The amplitudes were set to a specific value and remained unchanged throughout my analysis. The value of the amplitude is arbitrary, but for my test I used a value of 4. The units of the frequency are in radians per second, designated \( \omega \), and are entered in terms of \( \mu \text{Hz} \). White dwarf stars observed by the WET typically pulsate with frequencies ranging between 1000 and 3000 \( \mu \text{Hz} \) (Winget et. al. 1991; Winget et. al. 1994) thus I picked a value of 2000 \( \mu \text{Hz} \) as a representative value for my signal. Because the FFT algorithm uses discrete data as input, I sampled my light curve at 10 second intervals, which is also consistent with typical WET observation (Winget et. al. 1991; Winget et. al. 1994).

Because I wanted to identify a critical length of time for a light curve where specific values for phase can be ignored in mode identification, I varied the length of the light curve, i.e. the number of data points. My initial investigation used values that were in the range of 2000 to 14,000 data points, which at 10 second intervals correspond to 20,000 to 140,000 seconds. (A typical final WET data set lasting many days can have between 50,000 and 100,000 data points, corresponding to 500,000 to 1 million seconds, whereas individual runs can range from 0 to 15,000 points corresponding to up to 150,000 seconds.) Therefore, the values I chose for the length of my artificial light curve are more similar to a single night than a cumulative final data set.

Figure 2 contains an example of one of my simulations. The signal corresponds to \( y(t) = 4 \sin (2\pi \cdot 2000 \mu \text{Hz} \cdot t) \). In this particular example the phase is set to zero and the number of points is 8192, corresponding to 81920 seconds.

![Image](Image)

**Figure 2:**

The temporal spectrum of the signal 

\[ y(t) = 4 \sin (2000 \mu \text{Hz} \cdot t) \].

Note that the peak in the temporal spectrum is not infinitesimally narrow. The spectral resolution is only approximately 20 \( \mu \text{Hz} \), which is the full width of the peak at half-maximum (FWHM). For comparison, Nather et. al. (1990) show that for a 10 day observation run with the WET a spectral resolution of 0.5 \( \mu \text{Hz} \) (FWHM) is possible. The reason for this particular choice as an example is that I wanted mode peaks of sufficiently low resolution that when two sinusoidal signals are combined, the
spectrum would have mode peaks that merge and appear as a single mode. In other words, a light curve created out of two sine waves whose frequencies are separated by a value that is comparable to the resolution of the modes, see Figure 3.

\[
y(t) = 4 \sin(2\pi \cdot 2000\mu Hz \cdot t) + 4 \sin(2\pi \cdot 2020\mu Hz \cdot t).\]

Note that the two peaks are merging into one.

When combining two sinusoidal signals into one light curve, the signals will differ in only two respects; the frequency difference will vary between 20 and 60 \(\mu\)Hz, and the initial phase of one signal relative to the other will vary between 0 and 360 degrees.

Once I created a test case where the two modes were barely unresolved (i.e. the two peaks in the temporal spectrum are almost indistinguishable) I would vary the relative phase of the two signals and observe its influence on mode identification, i.e. could I resolve the two peaks simply by varying the phase.

In total, I ran 108 simulations. Each time a unique light curve was created, and then the FFT algorithm was used to create the resulting temporal spectrum. From the temporal spectrum I quantified the influence of the relative phase on mode identification.

**Analysis**

In each of my simulations I quantified the amplitude of the two peaks in the temporal spectrum and averaged them. I also measured the amplitude of the valley between the two peaks. The ratio of the valley amplitude to the average of the peak amplitude was calculated for each simulation. This ratio was converted to a percentage, and subtracted from 100%. This value represents the degree of resolution which was compared with the cut-off between peaks that are resolved or unresolved. Figure 4 summarizes my results.

Originally I tried to plot the degree of resolution as a function of phase \(\varphi\), frequency difference \(\Delta\omega\), and total run length \(T\). The three-dimensional plot was confusing. I noticed from the run I made with only one sine wave that the width of the mode peak seemed to be inversely proportional to \(T\). I decided then, that I could reduce the complexity of my analysis if I plotted degree of resolution verses phase and the product of \(T \cdot \Delta\omega\), see Figure 4.

The general trend I expected to see was more unresolved spectra for smaller values of \(T \cdot \Delta\omega\), and more resolved spectra for larger values of \(T \cdot \Delta\omega\). Although one might claim to see a slight trend, I believe more data are required.

To look at this in more detail I looked at regions on the graph where one variable remained constant and the other changed. In other word I explored horizontal and vertical projections through the graph in Figure 4 that contained both resolved and unresolved data sets.

Figure 5 shows the temporal spectrums generated by a steady increase in runlength \(T\). This represents a horizontal projection through Figure 4. Note the overall behavior of the peaks to become more resolved as I increased the number of data points, i.e. length of the light curve.

Figure 6 shows the temporal spectrum of a signal as the phase is changed. This represents a vertical projection through Figure 4. Note in this example that the degree of resolution steadily decreases up to a
Figure 5:

Temporal spectrum of the signal

\[ y(t) = 4 \sin(2000\mu\text{Hz} \cdot t + 180) + 4 \sin(2020\mu\text{Hz} \cdot t + 180). \]

The number of data points, length of light curve, increases as you move down and then to the right.

certain point (near the 180-degree phase shift), and then gradually increases again as the phase approaches 360 degrees. This is a critical point! In this one example I have clearly demonstrated that phase can influence mode identification. This implies that ignoring phase behavior can produce inaccurate models.

Also note the length of the light curve; 11,469 data points taken at 10 second intervals gives a time of 114690 seconds. This is approximately 31 hours of observing time. In this amount of time two signals separated by 20 \( \mu\text{Hz} \) might or might not be resolved simply because of a relative differences in phase. To obtain information about stellar properties it is necessary to resolve modes different by only 0.20 \( \mu\text{Hz} \) to 3 \( \mu\text{Hz} \) (Winget et. al. 1994; Kepler et. al. 1995). Thus, scheduling the length of an observing run should take into account the worst case relative phase.

**Summary and Conclusion**

The inherent assumption of the FFT algorithm that the phase for all signals present is zero can be misleading. If two or more signals are relatively close to one another then a phase difference between them could cause the signals to appear unresolved. Apparently in WET observations this difficulty is overcome by the length of the run. My study was unable to confirm this implied assumption due to insufficient test cases. However, this study shows that there is a limit, whether it is the frequency of the signals or the number of points, where the assumption that phase is zero is not justified.

With more studies we hope to quantify the relationship of phase and the FFT. For a particular WET run, if given a difference in frequency to be resolved, we want to be able to confidently determine at what time enough
data points have been collected that any phase difference between the signal components can be justifiably ignored.

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**References**


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**Figure 6:**

The temporal spectrum of the signal

\[ y(t) = 4 \sin(2000\mu\text{Hz} \cdot t + \phi) + 4 \sin(2020\mu\text{Hz} \cdot t + \phi). \]

The phase varies in 45° degree increments from 0° back to 360°.
Appendix A

MATLAB script

% Travis Laurance, Eric Klumpe 8/9/01
% This program uses the fft command to evaluate a time series signal. Two or more signals
% are created that can differ by their frequency, amplitude, and phase. This is done in order to test the effect of
% phase for different values of deltaomegs.
% The signal is created in the program by setting the variables; omega, nn, and deltatime.

% omega is frequency in radians per second (enter in terms of micro-Hz)
deltao = 20;
deltao = deltao*((2*pi)/1000000);
omega = 2000;
omega = omega*((2*pi)/1000000);
omega1 = omega - deltao;
omega2 = omega + deltao;

% amp is amplitude of sine wave
amp = 4;
amp1 = 0;
amp2 = 4;

% phase is phase shift of sine wave
phase = 0*(1/360) * (2*pi);
phase1 = 0*(1/360) * (2*pi);
phase2 = 0*(1/360) * (2*pi);

% nn is the exponent for the number of data points.
nn = 16;
% The percentage of data points used is set by the following two commands.
percent = 100;
fraction = percent/100;

% maxpts sets the number of data points that the fft will process. 6000 data points is an average
% night of observing (i.e. nn = 13 and percent = 75%)
maxpts = fraction*2^nn;

% timemin sets the initial value of time.
timemin = 0;

% deltatime is the interval between each point. Integration times of 10 seconds is
% typical for a WET run.
deltatime = 100.0;

timemax = timemin + deltatime*maxpts;

% time is the variable in the generic equation, y=amplitude*sin(omega*time)
time = timemin:deltatime:timemax;
% signal is the sin wave created from the preceding variables.
signal = amp*sin(omega*time + phase) + amp1*sin(omega1*time + phase1) + amp2*sin(omega2*time + phase2);

% This command introduces a data gap.
% signal(20000:29000) = 0;

% Y = fft(X,n) takes the fast fourier transform of X and stores the data in an array Y. n specifies
% the length of the array Y. If the signal array has more points than n then the points are truncated.
% If the signal array has less points than the array is padded with zeros up to n.
Y = fft(signal,maxpts);

% The above command stores the numbers as complex numbers (x + iy) in the Y array. The following
% command, by taking the complex conjugate, removes the imaginary part.
power = Y.* conj(Y);

% N specifies the length of the array Y.
N=length(Y);

% f is the frequency scale. This command serves to set the scale of the axis for the graph.
% The 2*pi serves to convert the frequency to radians/seconds which are the units of omega.
% The scale factor of (1000000/2/pi) converts the frequency to microHz.
f=(1000000)*(1/N/deltatime)*(0:(maxpts/2));

% The amplitude is the values we want returned from the values of amp, amp1, and amp2. We take
% the square root of the power because earlier we squared the value. Also the quantity is
% divided by maxpts/2 for purposes of scaling. The fft returns values that are off by maxpts/2.
amplitude = sqrt(power(1:((maxpts/2)+1)))/(maxpts/2);

% This command draws the plot of amplitude vs. f.
%plot(time,signal);
plot(f,amplitude);
axis([1900 2100 0 4.2]);

% These commands serve to label the plot.
title('Temporal Spectrum');
xlabel('Frequency (micro-Hz)');
ylabel('Amplitude');
Spatial Strategies in Comprehension

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When will readers use spatial strategies in comprehension? Lakoff and Johnson (1980) proposed that orientational metaphors such as (more is up) can be used as a foundation for an entire system of metaphorical thinking. Two theories that compete with the metaphor hypothesis are spatial paralogic (Desoto, et al. 1965) and markedness (Jones, 1970). The metaphor theory provides a deeper level of understanding. It is important for us to find out if people have an existing comprehension of metaphors and when they actually use this knowledge. A set of experiments on this topic will show what the tasks are that will cause readers to make use of a spatial comprehension schema and what types of consistent spatial strategies readers use.

Introduction

When will readers use spatial strategies in comprehension? This research is essential to find out how people structure their thoughts when completing the tasks of everyday life. It is important to find out how much information people already know and how they utilize this existing information. If we know how everyone comprehends certain information we can then state the reason as to why this occurs, for example, when the participants are given metaphors in a text they will arrange things in a certain order because of them. If the writer that was responsible for writing an instruction manual for building a shelf knew that readers would either read the instructions from the beginning to the end first before starting to put it together or whether they just start and read whenever they get to a hard part, then he would know how to gear the instructions in a way that would make it easy for everyone. This research is a general test of the theory.

Earlier evidence has shown that markedness (Clark 1970), and the metaphor theory (Lakoff and Johnson 1980), have an effect on the types of arrangements people make. When people are given a task to read that uses metaphors they use a certain type of spatial arrangement to process this information. This raises the questions of what this particular task is and what the consistent spatial strategy will be. Lakoff and Johnson (1980) proposed a metaphor theory. They believe “our ordinary conceptual system in terms in which we both think and act, is fundamentally metaphorical in nature.”(p.3). My research is based on this hypothesis. Lakoff and Johnson made strong claims for their theory, for example, they state that “if we are right in suggesting that our conceptual system is largely metaphorical, then the way we think, what we experience, and what we do every day is very much a matter of metaphor.”(p.3). Metaphors have a great influence on thinking and they illustrate this with the example ARGUMENT IS WAR. Some linguistic examples of this metaphor in action are:

- “Your claims are indefensible. He attacked every weak point in my argument. His criticisms were right on target. I demolished his argument. I’ve never won an argument with him. You disagree? Okay, shoot! If you use this strategy, he’ll wipe you out. He shot down all of my arguments.”(p.4)

According to Lakoff and Johnson (1980) people do not just talk as though an argument is war, they also behave that way. The point of arguing is so that each person can fight to prove their opposing points, and if they were not fighting to win the argument then there would really be no sense in arguing, because no one would know how to plan and use strategies to win the argument. The object of it is to win and attack the opposition much like a war.
There are different types of metaphors. Two of the different types that are described in the Lakoff and Johnson book are ontological and orientational metaphors. Ontological metaphors are used to group our experiences as entities or substances. This metaphor structures a person's thinking about the mind and how the events can affect it. With the use of ontological metaphors we can quantify and reason with metaphors. An example of an ontological metaphor is:

“THE MIND IS A BRITTLE OBJECT”

“Her ego is very fragile.
You have to handle him with care since his wife’s death.
He broke under cross-examination.
She is easily crushed.
The experience shattered him.
I’m going to pieces.
His mind snapped. (p.28)”

Orientational metaphors are the focus of my study. These metaphors organize a system of concepts with respect to one another. They are based on experience and give concepts a direction or physical structure of up-down, in-out, front-back, on-off, deep-shallow, and central-peripheral. An example of this type of metaphor is:

“MORE IS UP; LESS IS DOWN”

“The number of books printed each year keeps going up.
His draft number is high.
My income rose last year.
The amount of artistic activity in this state has gone down in the past year.
The number of errors he made is incredibly low.
His income fell last year.
He is underage.
If you’re too hot, turn the heat down. (p.15)

The physical basis described here is if there is more of a substance being added to a container or pile, the level goes up, and if things are taken away it goes down according to Lakoff and Johnson (1980).

Orientational metaphors allow a person to take advantage of their knowledge of the physical world when thinking about abstract information. Dimensions such as fat/thin are easily understood, so there is no need for metaphors to clarify them. On the other hand for a dimension like better/worse, one can benefit from a metaphor to tell the orientation of the words for understanding. If we know “better is up” and “worse is down” we can better grasp the dimension.

The question is how can we test the metaphor theory? People should behave as if they already know them. One way is to give the participants something to arrange on a dimension and see if they do already know these metaphors. Desoto, London and Handel (1965) proposed a theory of spatial paralogic using that method. Their theory says that when words “better” and “worse” are used that the word better appears on top, and worse appears on the bottom. A sample from their experiment is:

“Mantle is better than Mays.
Mays is better than Moskowitz
Mantele is better than Moskowitz
(p.514)”

The first two sentences relate the three items and the last sentence is a true/false question. While people understood this, they wrote the names into boxes on a piece of paper. They tended to go up and down, with better on top. This suggested to Desoto, et al (1965) that better/worse is directly related to up/down.

Jones (1970) argued that Desoto’s results are an artifact. She says that when a blank piece of paper is used, there are a lot of up and down arrangements, but this is due to markedness.

The theory of markedness refers to the way that some adjectives contain presuppositions. Clark (1969) set certain rules that should be used to tell whether or not the adjective is marked. Let’s consider the dimension better/worse. The first rule is that the marked adjective in the pair presupposes something if it is used for comparison. So asking which is worse, presenting or writing a paper, presupposes that both are bad. Asking which is better does not contain a presupposition. This would imply that “worse” is marked and better is not. The second rule is the unmarked member of each pair also serves as the name of the full scale. Consider the dimension long/short. One can tell that long is the unmarked term, because “this board is three feet long” sounds more correct than “this board is three feet short.”

Markedness has a number of implications for comprehension (Clark, 1969). Jones (1970) proposes that one role it plays explains Desoto, et al’s (1965) results. When people write the names on a blank piece of paper, they arrange them as if the unmarked end of the dimension were up. Jones claims that this is a better explanation rather than Desoto et al’s spatial paralogic.

Therefore we have two explanations for the people’s placement of names in these experiments: spatial paralogic and markedness. The problem is that neither explains why particular spatial relationships are as they are, for example, why is the unmarked term on top? I propose that orientational metaphors provide the answer. What does the metaphor add that markedness does not? The metaphor provides an understanding for why things should be spatially arranged in certain ways, but markedness only gives an arbitrary set of rules to follow.

The theory was first put to test by experiment one. Do readers arrange things in a particular order when they
hear arrangements? The participants were given 20 texts such as:

Kerry is better than Jay.
Jay is better than Cameron.
Cameron is better than Ken.

These texts were from the ten dimensions of better-worse, richer-poorer, hotter-colder, deeper-shallower, taller-shorter, noisier-quieter, dirtier-cleaner, bigger-smaller, kinder-crueler, and happier-sadder. Ten of the texts presented the unmarked term from the dimension such as better, and ten of the texts presented the marked term such as worse. The texts were randomized. Participants were given a set of blank 8” by 8” pieces of paper. They were given instructions to only write the names from the texts on the blank paper anywhere on the paper that they would like. There was a separate sheet of blank paper for each text. The participants consisted of 32 introductory psychology students. There were various ages and cultures throughout the study. There was a scale used to score the data that used a number system corresponding with what arrangement they actually made. There were 15 participants that wrote them in order from top to bottom, and only one participant that wrote them in order from bottom to top. There were six that wrote them in order from left to right and one person wrote them in order from right to left. There were three people that appeared to be using the markedness theory. Participants were still writing the names in order and the question made no difference to them. A test of independence was done to compare the results for experiment one and experiment two. By using the chi square \( \chi^2 \) test, \( \chi^2(2, N=68) = 2.21, n.s. \) with \( \chi^2(2, \alpha=.05, \chi^2_{crit}=5.99) \) the results showed that there was no significant difference between the two experiments.

It was time for a new experiment. The question still was yet to be answered of whether there is a task that will cause participants to use a spatial strategy to comprehend the arrangement. Experiment three switched the dimensions in the middle of the text and still asked a question as in experiment two. A sample of this text is shown here:

Jerry is taller than Eric.
Jim is shorter than Jerry.
Who is the tallest?

These texts were from the same dimensions in experiment one and the participants followed the same instructions. The results for this experiment were the same as the first two. The participants wrote them in order form top to bottom and appeared to use very little markedness.

Experiment four was then administered to the introduction to psychology students. They were given a variation of the text in experiment three, but this time the dimension stayed the same throughout the text as so:

Joe is hotter than Chris.
Rob is hotter than Joe.
Who is the hottest?

These texts were from the previous ten dimensions and participants used the same instructions for completing the task. The difference from Experiment three was that participants could not simply write the names in the order read and arrive at a correct ordering according to the dimension being used. They circled the answer to the question at the end. The results for this experiment were similar to those of the other experiments. This time something different started to take place. Some of the participants started using the metaphor theory. When the dimension changed and they were to put the names in order from bottom to top they actually did this. There was still room for perfection in this experiment.

This presented a time for regrouping. The old data was reanalyzed and new ideas were in the works for a way to truly test the theory. The first experiments were not working for a reason and there had to be a way to get participants to do something spatial. At this point we could tell that there was some type of arrangement being used because of the large majority of participants that were writing them in order from top to bottom, but what were they actually doing? With these thoughts in mind experiment five was made. We then decided to give the participants more interesting texts using different scenarios in each one. This also introduced different metaphors that were proven to end up on
the top or on the bottom. The actual dimensions that were used were boosted-depressed, superior-inferior, higher-lower, rational-emotional, alive-dead, dominating-submissive, unbalanced-levelheaded, degrading-uplifting, warm-cold, and healthy-sick. These metaphors were taken from the cognitive psychology website at Berkeley. An example of the new texts is shown here:

The spring weather boosted Jerry’s spirits relative to Eric’s spirits and the spring weather boosted Marcus’s spirits relative to Jerry’s spirits. Whose spirits were boosted the most?

Participants were given two randomized versions of the texts with the dimensions staying the same throughout each one, but the question changed in the second version. Instead of asking “whose spirits were boosted the most?” it would read “whose spirits were boosted the least?” The participants were taken from summer session classes of psychology students. They were of all ages and cultures. They were also given the same instructions as the previous experiments.

Experiment six was used to see if the grids that Desoto, London, and Handel (1965) used in their experiment would make a significant difference. The experiment presented 20 texts from experiment three such as:

Kerry is better than Jay.
Cameron is worse than Jay.
Who is the best?

The participants were read the 20 dimensions and were told they were to only write the names from the texts in any box that was on the paper. The paper had three boxes going up and down and three going left to right with one of those boxes connecting them in the middle. They were also to circle the answer to the question.

At this point the participants have started to use a particular strategy. What we do not know is whether to attribute that to the metaphor theory or something that remains to be seen in these last two experiments. At this time we are in the process of analyzing the data. The analyses of these experiments is ongoing. We are optimistic about the effect the newly designed experiments will have. We must remember the purpose of this research. It is important for us to see if readers use an existing spatial knowledge in reading tasks and when they comprehend things. If someone wants to turn up the volume on their clock/radio do they turn the button forward or backwards to turn it up. How do we know that we should turn it a certain way at all? If we know that people use a certain structure for reading we will then be able to use this information for advancements in the future.

References
Gender Differences in the Relationship between Self-Esteem, Narcissism, Locus of Control, and Aggression

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Fifty-eight college students completed a questionnaire to assess gender differences in the relationship between self-esteem, narcissism, locus of control, and aggression. It was predicted that males would score higher on measures of aggression, particularly physical aggression, than females. It was further hypothesized that low self-esteem, high narcissism, and external locus of control would predict all forms of aggression in males, but that in females, low self-esteem would predict physical aggression, and external locus of control would predict anger and hostility. Preliminary results suggest that males express higher levels of aggression than females, especially physical and verbal aggression. However, the results also suggest that different personality variables predict aggression in males and females. In males, narcissism predicted overall aggression, but there was not a relationship between self-esteem and aggression. In females, low self-esteem significantly predicted overall aggression, and external locus of control predicted hostility, but not anger.

Introduction

The present study examines gender differences in the relationship between self-esteem, narcissism, locus of control, and aggression, in particular physical and verbal aggression, anger, and hostility. In recent decades, high self-esteem has been viewed by American society as a “cure-all” for a wide variety of personal and social problems. Many researchers also believe that high self-esteem is an indicator of good adjustment, thereby making it a desirable and functionally adaptive trait. Furthermore, many counselors, clinicians, and child experts have argued that it is important for children to have high self-esteem and a positive view of themselves. Accordingly, it has been widely asserted that low self-esteem is a cause of violence (Kirschner, 1992; Long, 1990; Oates and Forrest, 1985; Schoenfeld, 1988). Research suggests that people with low self-esteem are particularly prone to aggression, including domestic violence (Paulson, Coombs, and Landsverk, 1990; Russell and Hulson, 1992), child abuse (Culp, Culp, Soulis, and Letts, 1989), homicide (Lowenstein, 1989), and other forms of aggressive behavior. Researchers have argued that individuals may be prompted by their inner self-doubts and self-dislike to behave aggressively toward other people as a way to gain esteem. That is, violence and aggression may serve as tools for self-enhancement or as a way to gain self-esteem.

More recently it has been suggested that people do not automatically possess an inherent motive to maintain self-esteem. Rather, they are motivated to maintain connections with significant people in their lives, and events that lower their self-esteem, or threaten to lower it, may negatively affect those connections (Leary, Tambor, Terdal, and Downs, 1995). Thus, it is not actually low self-esteem that leads to aggressive behavior but the prospect of rejection by significant others. When people do not feel that they will be accepted using socially sanctioned routes, they may try to enhance their social inclusion by using maladaptive actions (Leary, Schreindorfer, and Haupt, 1995). Furthermore, research suggests that although aggressive people are more likely to be rejected, their aggressiveness probably stems from prior rejection (Leary, Schreindorfer et al.).

Due to conflicting data and research regarding the relation between low self-esteem and aggression, other researchers have suggested that the opposite is, in fact, characteristically true (Baumeister, Smart, and Boden, 1996). That is, individuals with high, rather than low, self-esteem are more likely to be aggressive. This view may be more plausible for a number of reasons. First, the motivation to seek self-enhancement appears to be weak or absent among people with low self-esteem, disputing the idea that individuals seek self-enhancement by
means of violence and aggression (Baumeister et al.). Second, persons with low self-esteem may even avoid such supposedly self-enhancing situations due to a general reluctance to change their own views of themselves and in order to avoid disrupting their current state (i.e., ego threat); the same can be shown regarding self-verification. For instance, the quest for opportunities to prove oneself or to raise one’s standing (e.g., picking fights) also mainly appeals to people with high, rather than low, self-esteem (Baumeister at al.). Persons with low self-esteem are more likely to avoid confrontational situations that could result in a further loss of self-esteem. According to Baumeister, aggression results when there is a discrepancy between one’s favorable self-appraisal (i.e., high self-esteem) and a less favorable external appraisal, such as judgment by others.

However, in general, aggressive people form only a subset of high self-esteem individuals—unstable high self-esteem (Bushman and Baumeister, 1998). Kernis, Grannemann, and Barclay (1989) found that people with high, but unstable, self-esteem (i.e., fluctuating with situations) reported the highest tendencies toward hostility and anger; whereas, people with stable high self-esteem reported the lowest. Therefore, high self-esteem may be a heterogeneous category (i.e., composed of many different levels). It has been argued that it is not simply how highly individuals evaluate themselves that determines the degree to which they experience and express aggression but the strength with which they hold these evaluations (Papps and O’Carroll, 1998). Thus, there are many factors that influence how an individual’s self-esteem may actually affect behavior.

Narcissism

Most recently, the relation between unstable high self-esteem and aggression has led to an examination of the relation among narcissism, self-esteem, and aggression. According to the American Psychiatric Association’s (1994) Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) the narcissistic individual demonstrates “a pervasive pattern of grandiosity (in fantasy or behavior), need for admiration, and lack of empathy, beginning by early adulthood and present in a variety of contexts, as indicated by five (or more) of the following: (a) has a grandiose sense of self-importance (e.g., exaggerates achievements and talents, expects to be recognized as superior without commensurate achievements); (b) is preoccupied with fantasies of unlimited success, power, brilliance, beauty, or ideal love; (c) believes that he or she is “special” and unique and can only be understood by, or should associate with, other special or high-status people (or institutions); (d) requires excessive admiration; (e) has a sense of entitlement (i.e., unreasonable expectations of especially favorable treatment or automatic compliance with his or her expectations); (f) is interpersonally exploitative (i.e., takes advantage of others to achieve his or her own ends); (g) lacks empathy: is unwilling to recognize or identify with the feelings and needs of others; (h) is often envious of others or believes that others are envious of him or her; and (i) shows arrogant, haughty behaviors or attitudes” (as cited in Barlow and Durand, 1995, p. 451).

Although narcissism may simply be an extension of self-esteem, narcissistic individuals may be more prone to aggression because they will encounter and be chronically less tolerant of external unfavorable evaluations (Baumeister et al., 1996). The difference between narcissistic individuals and those who simply have high self-esteem is that those with high self-esteem may have well-deserved notions of themselves, whereas narcissists generally have inflated, undeserved self-esteem.

The relation between narcissism and self-esteem has varied substantially from study to study. Some research actually suggests that narcissists are more likely to have low self-esteem than high self-esteem (Kernberg, 1975; Kohut, 1971) because their over-inflated view of the self is simply a cover-up or over-compensation for their actual low self-esteem. The narcissist may also hold a self-love that originated during early development, remaining emotionally invested in this idea, at the same time embodying a less favorable, more developed (and possibly more accurate) self-evaluation. The two contradictory views of the self may simultaneously produce feelings of grandiosity and insecurity (Bushman and Baumeister, 1998).

Some research suggests that narcissism may be related to increased aggression (Bushman and Baumeister, 1998; Papps and O’Carroll, 1998). Although narcissists hold high views of themselves, they may be especially sensitive to insults or ego threats because their views are unfounded. This over-compensation of self-esteem may lead to extreme patterns of rage in the face of unfavorable appraisals. Kernberg (1975) suggests that this rage may be due to patterns that began in response either to parental rejection or to overvaluing by parents that instilled a sense of entitlement. Questionnaire studies have found relationships between narcissism and physical aggressiveness and hostility (Raskin, Novacek, and Hogan, 1991; Wink, 1991). Emmons (1987) linked narcissism to extreme emotional lability and strong reactions, such as anger (a type of aggression) and rage that increase aggressive tendencies. Also, Rhodewalt and Morf (1995) found that when a narcissistic person’s success was followed by failure feedback, he or she
became exceptionally angry. Finally, some research has shown that narcissism correlates with disinhibition and low empathy, both of which are characteristic of aggression (Watson, Grisham, Trotter, and Biderman, 1984).

Locus of Control

Other recent research has examined the relation between locus of control (i.e., the degree of control individuals perceive having over events in their lives) and aggression in children. Individuals who have an external locus of control feel as though they cannot control events in their lives (i.e., outside factors control them); whereas, individuals who have an internal locus of control feel as though they control events in their lives. Osterman, Bjorkqvist, Lagerspetz, Charpentier, Caprara, and Pastorelli (1999) found that verbal, physical, and indirect aggression correlated significantly with external locus of control in a sample of elementary school aged children from Finland and Italy. Also, the correlations between external locus of control and aggression were significantly higher for physical aggression than for indirect aggression. However, locus of control and aggression were unrelated in female children.

Gender Differences in Aggression

Aside from how self-esteem, narcissism, and locus of control are related to aggression, it is important to acknowledge that these factors may interact or separately influence different types of aggression in males and females. Bjorkqvist, Osterman, and Lagerspetz (1992) found that adult males and females develop different types of aggressive behavior throughout their life span. They suggest that males have a tendency toward rational-appearing aggression (i.e., aggression that attempts to appear rational in which aggressive intentions are disguised and are less easy to recognize as aggressive); whereas, females may be more likely to engage in social manipulation or indirect aggression. However, because this research was limited to the workplace, and aggression was measured using the Work Harassment Scale, the results may not generalize to everyday situations. Also, because the study originated in Finland, societal norms may dictate very different norms for aggression in men and women than in the United States.

Although it ultimately depends on how aggression is measured, males generally have been found to be more physically and verbally aggressive than females. It has been suggested that the only type of aggression in which females are equal to males is domestic violence, particularly child abuse (Baumeister et al., 1996).

Rationale for Present Study

Although considerable research over the years has addressed gender differences in physical aggression, the relationship between self-esteem and aggression, and the relationship between narcissism and aggression, most of the research on gender differences and aggression has been limited to physical aggression or has been conducted with children. Also, little is known about the relationship between locus of control and tendencies toward aggression in adults. It is possible that adults who have an internal locus of control versus an external locus of control have different propensities toward aggression. Furthermore, research examining the relationship between narcissism and aggression is so new that the relationship between narcissism and self-esteem, as it relates to different forms of aggression is largely unexplored.

The present study contributes to existing literature by examining self-esteem, narcissistic tendencies, locus of control, and aggressive behavior in male and female undergraduate students. Students completed a demographic questionnaire and questions regarding their self-esteem, narcissistic tendencies, loci of control, and aggressive tendencies to determine whether self-esteem, narcissism, and locus of control differentially predict physical aggression, verbal aggression, anger, and hostility in males and females.

Predictions

The following hypotheses were made regarding the relationship between aggression and self-esteem, narcissism, and locus of control. First, it was hypothesized that males would score higher on the Aggression Questionnaire than females indicating greater aggressive tendencies because males are more physically aggressive. Second, it was predicted that females would demonstrate higher levels of verbal aggression, hostility, and anger than males and less physical aggression compared to other types of aggression. Third, it was predicted that males’ aggression (primarily physical aggression) would be related to low self-esteem, high narcissism, and an external locus of control. For females, it was predicted that low self-esteem would be related to physical aggression, and an external locus of control would be related to anger and hostility. Finally, consistent with the findings from other research, it was thought that there would not be a relationship between narcissism and aggression in females but that there would be one for males.

Method

Participants

Fifty-eight undergraduate college students (25 males; 33 females; M age = 22.05 years; range = 18-36 years) drawn from three general psychology classes offered during Summer Sessions II and IV participated for extra
course credit. The majority of participants were from white middle class backgrounds. An additional participant was excluded from the study because of language barrier difficulties.

**Procedure**

Participants completed a 5-part survey consisting of a demographic questionnaire and 108 questions drawn from (a) The Rosenberg Self-Esteem Scale (Rosenberg, 1965), (b) The Narcissistic Personality Inventory (Raskin and Hall, 1979; Raskin and Terry, 1988), (c) The Locus of Control Inventory (Rotter, 1966), and (d) The Aggression Questionnaire (Buss and Perry, 1992). Prior to completing the questionnaire, participants were given an informed consent form and told that their responses would be anonymous. All questionnaires were group-administered. The entire questionnaire took approximately 20 minutes to complete.

**Survey Instruments**

**Demographic questionnaire.** Participants reported their age, gender, marital status, class status in school, and ethnic background.

**The Rosenberg Self-Esteem Scale.** Self-esteem was measured using the Rosenberg Self-Esteem Scale (Rosenberg, 1965), a 10-item scale on which items are answered on a 4-point scale, ranging from “strongly agree” to “strongly disagree” (e.g., “On the whole, I am satisfied with myself.”). Questions 1, 3, 4, 7, and 10 are scored such that “strongly agree” (“SA”) or “agree” (“A”) responses are equal to “1,” and “strongly disagree” (“SD”) or “disagree” (“D”) are scored as “0.” Questions 2, 5, 6, 8, and 9 are scored such that “SD” and “D” responses are equal to “1,” and “SA” or “A” responses are equal to “0.” Responses are summed to create a global self-esteem score, with higher scores corresponding to higher self-esteem (possible range of scores = 0-10). The entire questionnaire can be found in Appendix A.

**The Narcissistic Personality Inventory.** Narcissism was measured using the Narcissistic Personality Inventory (NPI) (Raskin and Hall, 1979; Raskin and Terry). The inventory contains 40 true/false items which assess 7 components of narcissism: (a) authority (8 items); (b) self-sufficiency (7 items); (c) superiority (4 items); (d) exhibitionism (7 items); (e) exploitativeness (5 items); (f) vanity (3 items); and (g) entitlement (6 items). Each “false” response is scored as “0,” and each “true” response is scored as “1.” Higher scores are indicative of greater narcissism (possible range of scores: 0-40). The entire NPI can be found in Appendix B.

**Locus of Control Inventory.** Locus of control was measured using Rotter’s (1966) Locus of Control Inventory. The extent to which an individual possesses internal or external reinforcement beliefs is measured using a true or false format (e.g., “The success I have is largely a matter of chance.”). For each of the 29 items on the scale (only 23 are scored; 6 are filler items), participants choose either statement “a” or “b” as it applies to them. An individual’s score is the number of “external” statements chosen (possible range of scores: 0-23). Higher scores indicate an external locus of control; whereas lower scores are suggestive of an internal locus of control. The Locus of Control Inventory can be found in Appendix C.

**The Aggression Questionnaire.** Aggression was measured using the Aggression Questionnaire (AQ) (Buss and Perry, 1992), which assesses physical and verbal aggression (representing the behavioral component of aggression), anger, and hostility (representing the affective and cognitive components of aggression). The AQ consists of 29 items: (a) 9 physical aggression items (e.g., “If somebody hits me, I hit back.”); (b) 5 verbal aggression items (e.g., “I often find myself disagreeing with people.”); (c) 7 anger items (e.g., “I flare up quickly but get over it quickly.”); and (d) 8 hostility items (e.g., “I wonder why sometimes I feel so bitter about things.”). Each item is rated on a scale of 1 (extremely uncharacteristic of me) to 5 (extremely characteristic of me). A participant’s overall aggression score is the total of these ratings (possible range: 29-145). The AQ can be found in Appendix D.

**Preliminary Results**

**Gender Differences in Aggression**

To test the prediction that males would score higher on the AQ than females, a series of t-tests were conducted to compare the overall aggressive tendencies of males and females, as well as gender differences for physical aggression, verbal aggression, anger, and hostility. As predicted, males (M = 77.91, SD = 13.93) scored significantly higher on the AQ than females (M = 61.13, SD = 14.06), t(51) = 4.32, p < .05, indicating higher overall levels of aggression for males. This difference was largely the result of significant gender differences for physical aggression (males: M = 24.35, SD = 8.18; females: M = 15.70, SD = 5.66), t(51) = 4.55, and verbal aggression (males: M = 15.83, SD = 2.87; females: M = 12.00, SD = 2.82), t(51) = 4.86, p < .05. There were no significant gender differences for anger and hostility although males had a tendency to score higher than females on these two subscales as well. Thus the hypothesis that females would demonstrate higher levels of verbal aggression, anger, and hostility than males was not supported.

As predicted, females demonstrated lower physical aggression, relative to verbal aggression, anger, and hostility. The mean response for physical aggression represented 33%
of the possible range for physical aggression; whereas the mean for verbal aggression was 48%, the mean for anger was 43%, and the mean for hostility was 46%. Thus, females were more likely to report engaging in verbal aggression, anger, and hostility than to report engaging in physical aggression.

Relationship Between Self-Esteem, Narcissism, Locus of Control, and Aggression for Males

A series of correlational analyses were used to test the hypothesis that males’ aggression (i.e., scores on the AQ) would be predicted by low self-esteem, high narcissism, and an external locus of control. Total aggression was not correlated with self-esteem, $r (23) = -.15$, or locus of control, $r (19) = -.05$, but was correlated with narcissism, $r (21) = .37$, $p = .05$. Thus, higher narcissism scores significantly predicted higher aggression scores for males. In particular, overall aggression was significantly predicted by the narcissistic characteristics of self-sufficiency, $r (21) = .38$, vanity, $r (21) = .65$, and entitlement, $r (21) = .48$, $p < .05$.

Relationship Between Self-Esteem, Narcissism, Locus of Control, and Aggression for Females

A series of correlational analyses were conducted to test the hypothesis that low self-esteem predicts physical aggression and that an external locus of control predicts anger and hostility in females. First, there was not a significant correlation between self-esteem and physical aggression, $r (30) = -.14$, but there was a significant negative correlation between self-esteem and overall aggression, $r (30) = -.30$, $p = .05$. Furthermore, both anger and hostility were negatively correlated with self-esteem, $r (30) > -.30$, $p < .05$. That is, females who reported lower self-esteem also scored higher on the AQ in general and in particular on the anger and hostility subscales of the AQ; physical aggression was not related to low self-esteem.

There was a positive correlation between locus of control (i.e., higher locus of control scores are indicative of an external locus of control) and hostility, $r (24) = .54$, $p < .05$, but not between locus of control and anger, $r (24) = .03$. Thus, hostility in females was predicted by an external locus of control orientation although anger was not. Additional analyses suggested that overall aggression in females was related to external locus of control, $r (24) = .38$, $p < .05$. Finally, as predicted, there was not a relationship between narcissism and overall aggression in females, $r (27) = -.05$.

Discussion

The present study examined gender differences in the relationship between self-esteem, narcissism, locus of control, and aggression. It was predicted that males would score higher on the AQ than females, and preliminary results suggest that males did, in fact, score significantly higher than females on the AQ, indicating higher overall aggression levels. This difference can be largely accounted for by measures of physical and verbal aggression. Males also tended to score higher on measures of anger and hostility than females.

It was also hypothesized that females would engage in more verbal aggression, anger, and hostility than physical aggression. As predicted, females did report a greater tendency to engage in verbal aggression, hostility, and anger; physical aggression was the least reported type of displayed aggression.

It was also predicted that high aggression in males would be characteristic of individuals with low self-esteem, high narcissism, and external loci of control. This hypothesis differs from that of Baumeister and his colleagues. Baumeister has suggested that high self-esteem predicts aggression; whereas, traditional social psychology research has implicated low self-esteem. However, preliminary results indicate no relationship between self-esteem and aggression in males or between locus of control and aggression. However, narcissism scores significantly correlated with aggression scores; males with high narcissism scores also attained high aggression scores. The components of narcissism represented by self-sufficiency, vanity, and entitlement particularly correlated with aggression in males. Interestingly, although self-esteem was not related to aggression, self-esteem was related to narcissism. Males who expressed greater narcissism also scored higher on the Rosenberg Self-Esteem Scale. This finding partially replicates the works of Baumeister and his colleagues who found that narcissists also express high self-esteem (although their self-esteem is unstable) but differs regarding the relationship between self-esteem, narcissism, and aggression.

It was hypothesized that, in females, low self-esteem would predict physical aggression. Furthermore, anger and hostility could be predicted by external locus of control. Although there was no significant correlation between self-esteem and physical aggression, there was a significant negative correlation between self-esteem and the subscales of anger and hostility. This finding is interesting because it suggests that low self-esteem may differentially impact aggressive tendencies in males and females. Certainly, this finding differs from that found by Baumeister and his colleagues.

Finally, the present study examined the relationship between locus of control and aggression. It was thought that the degree to which an individual feels in control of events in his or her life would influence aggressive behav-
ior. It was predicted that having an external locus of control might lead individuals to engage in more aggressive types of behaviors. Specifically, it was thought that females who have an external locus of control may express more hostility and anger in their responses on the Aggression Questionnaire. Preliminary results suggest that although external locus of control was not significantly correlated with anger, it was significantly correlated with hostility. Additionally, further analyses suggest that external locus of control is correlated with overall aggression in females.

The final prediction concerned the relationship between narcissism and overall aggression. Research by others has demonstrated a clear relationship between narcissism and aggression for males but not for females. The present study replicated that finding. Preliminary results indicate no significant relationship between stable and unstable high self-esteem—one that will also distinguish those with high self-esteem from those with low self-esteem and to test the hypothesis that high self-esteem is a desirable trait that low self-esteem is more indicative of aggressive tendencies, particularly anger and hostility, than high self-esteem.

It has been suggested that differences in aggression in males and females stem from societal manipulations of acceptable behavior for both genders. Although it is not considered unacceptable for males to manifest physical and verbal aggression, society looks down upon such displays by females. Not only could this account for the higher frequencies of reported physical and verbal aggression by males but also for the large number of instances of anger and hostility expressed by females. It may be that females feel comparable levels of aggression but have been socialized not to express it directly, resulting in greater levels of hostility and anger.

It will be important to determine why there was not a relationship between self-esteem and aggression in males in the present study. One possibility lies with the scales that were used to assess aggression and self-esteem. The Rosenberg Self-Esteem Scale, although widely used, is a very short and simple scale. As a result, it is possible that it ignores or takes for granted relevant differences that might have changed the outcome of the present study. Furthermore, this scale was constructed with the assumption that high self-esteem is a desirable trait to have. Thus, it is possible that the questions are biased in such a way that the scores lean to the high side of self-esteem.

Past research has not been conclusive regarding the relationship between high or low self-esteem and aggression. Baumeister and his colleagues (1996, 1998) are adamant that high self-esteem leads to aggression because those with high self-esteem are more likely to engage in aggressive acts to convince themselves their high self-esteem is well deserved. However, it seems to be more accepted that those with low self-esteem are prompted by self-dislike to gain esteem from others by behaving aggressively (Kirschner, 1992; Long, 1990; Oates et al., 1985; Schoenfeld, 1988). However, Leary and his colleagues (1995) suggest that it is not self-esteem that predicts aggression but the prospect of rejection by significant others. Thus far, the present study has not found a relationship between high or low self-esteem and aggression in males, suggesting that a fear of rejection may in fact be a sound indicator of aggression (although this was not assessed in the present study). However, findings for females suggest that low self-esteem is more indicative of aggressive tendencies, particularly anger and hostility, than high self-esteem.

References


**Endnotes**

1. Participants’ scores on one or more of the four scales were omitted from analysis if participants failed to respond to items on a scale. Five participants’ narcissism scores were excluded, 12 participants’ locus of control scores were excluded, and 5 participants’ aggression scores were excluded due to unanswered or ambiguously answered items.
# Appendix A
## Rosenberg Self-Esteem Scale

**Instructions:** Below is a list of statements dealing with your general feelings about yourself. For each statement, if you strongly agree, circle SA. If you agree with the statement, circle A. If you disagree, circle D. If you strongly disagree, circle SD.

<table>
<thead>
<tr>
<th>Number</th>
<th>Statement</th>
<th>SA</th>
<th>A</th>
<th>D</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>On the whole, I am satisfied with myself.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>At times I think I am no good at all.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>I feel that I have a number of good qualities.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>I am able to do things as well as most other people.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>I feel I do not have much to be proud of.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>I certainly feel useless at times.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>I feel that I'm a person of worth, at least on an equal plane with others.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>I wish I could have more respect for myself.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td>All in all, I am inclined to feel that I am a failure.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.</td>
<td>I take a positive attitude toward myself.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note:** For items 1, 3, 4, 7, and 10, SA or A responses = 1 and SD or D responses = 0. For items 2, 5, 6, 8, and 9, SD or D responses = 1 and SA or A responses = 0. Higher scores reflect higher self-esteem (range: 0-10).

# Appendix B
## The Narcissistic Personality Inventory

**Instructions:** For each item, indicate whether the item is characteristic of you (true) or uncharacteristic of you (false).

<table>
<thead>
<tr>
<th>Number</th>
<th>Statement</th>
<th>T</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>I have a natural talent for influencing people.</td>
<td>T</td>
<td>F</td>
</tr>
<tr>
<td>2.</td>
<td>Modesty doesn't become me.</td>
<td>T</td>
<td>F</td>
</tr>
<tr>
<td>3.</td>
<td>I would do almost anything on a dare.</td>
<td>T</td>
<td>F</td>
</tr>
<tr>
<td>4.</td>
<td>I know that I am good because everyone keeps telling me so.</td>
<td>T</td>
<td>F</td>
</tr>
<tr>
<td>5.</td>
<td>If I ruled the world, it would be a much better place.</td>
<td>T</td>
<td>F</td>
</tr>
<tr>
<td>6.</td>
<td>I can usually talk my way out of anything.</td>
<td>T</td>
<td>F</td>
</tr>
<tr>
<td>7.</td>
<td>I like to be the center of attention.</td>
<td>T</td>
<td>F</td>
</tr>
<tr>
<td>8.</td>
<td>I will be a success.</td>
<td>T</td>
<td>F</td>
</tr>
<tr>
<td>9.</td>
<td>I think I am a special person.</td>
<td>T</td>
<td>F</td>
</tr>
<tr>
<td>10.</td>
<td>I see myself as a good leader.</td>
<td>T</td>
<td>F</td>
</tr>
<tr>
<td>11.</td>
<td>I am assertive.</td>
<td>T</td>
<td>F</td>
</tr>
<tr>
<td>12.</td>
<td>I like to have authority over other people.</td>
<td>T</td>
<td>F</td>
</tr>
<tr>
<td>13.</td>
<td>I find it easy to manipulate people.</td>
<td>T</td>
<td>F</td>
</tr>
<tr>
<td>14.</td>
<td>I insist upon getting the respect that is due me.</td>
<td>T</td>
<td>F</td>
</tr>
<tr>
<td>15.</td>
<td>I like to display my body.</td>
<td>T</td>
<td>F</td>
</tr>
<tr>
<td>16.</td>
<td>I can read people like a book.</td>
<td>T</td>
<td>F</td>
</tr>
<tr>
<td>17.</td>
<td>I like to take responsibility for making decisions.</td>
<td>T</td>
<td>F</td>
</tr>
<tr>
<td>18.</td>
<td>I want to amount to something in the eyes of the world.</td>
<td>T</td>
<td>F</td>
</tr>
<tr>
<td>19.</td>
<td>I like to look at my body.</td>
<td>T</td>
<td>F</td>
</tr>
<tr>
<td>20.</td>
<td>I am apt to show off if I get the chance.</td>
<td>T</td>
<td>F</td>
</tr>
<tr>
<td>21.</td>
<td>I always know what I am doing.</td>
<td>T</td>
<td>F</td>
</tr>
<tr>
<td>22.</td>
<td>I rarely depend on anyone else to get things done.</td>
<td>T</td>
<td>F</td>
</tr>
</tbody>
</table>
23. Everybody likes to hear my stories. (5) T F
24. I expect a great deal from other people. (7) T F
25. I will never be satisfied until I get all that I deserve. (6) T F
26. I like to be complimented. (3) T F
27. I have a strong will to power. (7) T F
28. I like to start new fads and fashions. (4) T F
29. I like to look at myself in the mirror. (6) T F
30. I really like to be the center of attention. (4) T F
31. I live my life in any way I want to. (2) T F
32. People always seem to recognize my authority. (1) T F
33. I would prefer to be a leader. (1) T F
34. I am going to be a great person. (2) T F
35. I can make anybody believe anything I want them to. (5) T F
36. I am a born leader. (1) T F
37. I wish somebody would someday write my biography. (3) T F
38. I get upset when people don’t notice how I look when I go out in public. (4) T F
39. I am more capable than other people. (2) T F
40. I am an extraordinary person. (2) T F

Note: The numbers in parentheses represent the seven components of narcissism (1 = authority; 2 = self-sufficiency; 3 = superiority; 4 = exhibitionism; 5 = exploitativeness; 6 = vanity; 7 = entitlement). Eight items measure authority; seven items measure self-sufficiency; four items measure superiority; seven items measure exhibitionism; five items measure exploitativeness; three items measure vanity; and six items measure entitlement. Each “false” response is scored as “0,” and each “true” response is scored as “1.” Higher scores are indicative of greater narcissism (possible range: 0-40).

Appendix C
Locus of Control Scale

Instructions: For each question, circle the answer (a or b) that you most closely identify with.

1. a. Children get into trouble because their parents punish them too much.
   b. The trouble with most children nowadays is that their parents are too easy with them.

2. a. Many of the unhappy things in people’s lives are partly due to bad luck.
   b. People’s misfortunes result from the mistakes they make.

3. a. One of the major reasons why we have wars is because people don’t take enough interest in politics.
   b. There will always be wars, no matter how hard people try to prevent them.

4. a. In the long run, people get the respect they deserve in this world.
   b. Unfortunately, an individual’s worth often passes unrecognized no matter how hard he tries.

5. a. The idea that teachers are unfair to students is nonsense.
   b. Most students don’t realize the extent to which their grades are influenced by accidental happenings.

6. a. Without the right breaks, one cannot be an effective leader.
   b. Capable people who fail to become leaders have not taken advantage of their opportunities.
7. a. No matter how hard you try, some people just don't like you.
   b. People who can't get others to like them don't understand how to get along with others.

8. a. Heredity plays the major role in determining one's personality.
   b. It is one's experiences in life which determine what they're like.

9. a. I have often found that what is going to happen will happen.
   b. Trusting to fate has never turned out as well for me as making a decision to take a definite course of action.

10. a. In the case of the well prepared student, there is rarely if ever such a thing as an unfair test.
    b. Many times exam questions tend to be so unrelated to course work that studying is really useless.

11. a. Becoming a success is a matter of hard work; luck has little or nothing to do with it.
    b. Getting a good job depends mainly on being in the right place at the right time.

12. a. The average citizen can have an influence in government decisions.
    b. This world is run by the few people in power, and there is not much the little guy can do about it.

13. a. When I make plans, I am almost certain that I can make them work.
    b. It is not always wise to plan too far ahead because many things turn out to be a matter of good or bad fortune anyhow.

14. a. There are certain people who are just no good.
    b. There is some good in everybody.

15. a. In my case, getting what I want has little or nothing to do with luck.
    b. Many times, we might just as well decide what to do by flipping a coin.

16. a. Who gets to be the boss often depends on who was lucky enough to be in the right place first.
    b. Getting people to do the right thing depends upon ability, luck has little or nothing to do with it.

17. a. As far as world affairs are concerned, most of us are the victims of forces we can neither understand, nor control.
    b. By taking an active part in political and social affairs, the people can control world events.

18. a. Most people don't realize the extent to which their lives are controlled by accidental happenings.
    b. There really is no such thing as "luck."

19. a. One should always be willing to admit mistakes.
    b. It is usually best to cover up one's mistakes.

20. a. It is hard to know whether or not a person really likes you.
    b. How many friends you have depends upon how nice a person you are.

21. a. In the long run, the bad things that happen to us are balanced by the good ones.
    b. Most misfortunes are the result of lack of ability, ignorance, laziness, or all three.

22. a. With enough effort, we can wipe out political corruption.
    b. It is difficult for people to have much control over the things politicians do in office.

23. a. Sometimes I can't understand how teachers arrive at the grades they give.
    b. There is a direct connection between how hard I study and the grades I get.
24. a. A good leader expects people to decide for themselves what they should do.
   b. A good leader makes it clear to everybody what their jobs are.

25. a. Many times I feel that I have little influence over the things that happen to me.
   b. It is impossible for me to believe that chance or luck plays an important role in my life.

26. a. People are lonely because they don’t try to be friendly.
   b. There’s not much use in trying too hard to please people; if they like you, they like you.

27. a. There is too much emphasis on athletics in high school.
   b. Team sports are an excellent way to build character.

28. a. What happens to me is my own doing.
   b. Sometimes I feel that I don’t have enough control over the direction my life is taking.

29. a. Most of the time, I can’t understand why politicians behave the way they do.
   b. In the long run, the people are responsible for bad government on a national as well as on a local level.

Note: An individual’s score on the scale is the number of underlined items chosen. Items 1, 8, 11, 19, 24, and 27 are filler items and are not scored. Possible scores range from 0 to 23.

Appendix D
The Aggression Questionnaire

Instructions: Rate each of the following items on a scale of 1 (extremely uncharacteristic of me) to 5 (extremely characteristic of me).

___ 1. Once in a while I can’t control the urge to strike another person.
___ 2. Given enough provocation, I may hit another person.
___ 3. If somebody hits me, I hit back.
___ 4. I get into fights a little more than the average person.
___ 5. If I have to resort to violence to protect my rights, I will.
___ 6. There are people who pushed me so far that we came to blows.
___ 7. I can think of no good reason for ever hitting a person.
___ 8. I have threatened people I know.
___ 9. I have become so mad that I have broken things.
___10. I tell my friends openly when I disagree with them.
___11. I often find myself disagreeing with people.
___12. When people annoy me, I may tell them what I think of them.
___13. I can’t help getting into arguments when people disagree with me.
___14. My friends say that I’m somewhat argumentative.
___15. I flare up quickly but get over it quickly.
___16. When frustrated, I let my irritation show.
___17. I sometimes feel like a powder keg ready to explode.
___18. I am an even-tempered person.
___19. Some of my friends think I’m a hothead.
___20. Sometimes I fly off the handle for no good reason.
21. I have trouble controlling my temper.
22. I am sometimes eaten up with jealousy.
23. At times, I feel I have gotten a raw deal out of life.
24. Other people always seem to get the breaks.
25. I wonder why sometimes I feel so bitter about things.
26. I know that “friends” talk about me behind my back.
27. I am suspicious of overly friendly strangers.
28. I sometimes feel that people are laughing at me behind my back.
29. When people are especially nice, I wonder what they want.

**Note:** Items 7 and 18 are reverse scored. Items 1-9 measure physical aggression. Items 10-14 measure verbal aggression. Items 15-21 measure anger. Items 22-29 measure hostility. Higher scores reflect higher levels of aggression (possible range = 29-145).
Self-Efficacy as a Predictor of Outcome: Development of a Brief Questionnaire

Literature Review

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Department of Psychology

Self-efficacy theory, which is defined as individuals’ expectations about their ability to engage in or execute a given behavior, was introduced by Albert Bandura in 1977. Self-efficacy is not a global trait that operates independently of context; efficacy expectations vary depending on the task and context an individual faces (Strecher, DeVellis, Becker and Rosenstock, 1986). In self-efficacy theory, “people’s beliefs in their capabilities to manage environmental demands affect the courses of action they choose to pursue, how much effort they put forth in a given endeavor, how long they persevere in the face of obstacles and failure experiences, how much anxiety they experience in coping with stressors and the level of accomplishments they realize” (Bandura, 1995, p. 179). People will attempt situations within their self-perceived capabilities, but will avoid situations that they feel exceed their current abilities (Bandura, 1977). Self-efficacy affects not only choice of behavioral settings but also interpretation of the settings. Self-efficacy theory has proven to be useful in treatments aimed at initiating and maintaining behavior change in fields as diverse as smoking cessation and contraceptive use (Strecher et al., 1986).

According to Strecher (1986), efficacy expectations vary along dimensions of magnitude, strength and generality. Magnitude refers to the ordering of tasks by difficulty level. People who have low-magnitude expectations feel that they can perform only the simpler of a series of tasks, while those with high magnitude expectations feel that they can perform even the most difficult tasks in a series. Strength refers to a judgement of how certain one is of one’s ability to perform a specific task. The third dimension, generality, concerns the extent to which efficacy expectations about a particular situation generalize to other situations (Strecher, 1986).

Self-efficacy stems from information created from direct and mediated experience (Bandura, 1977). Judgement of one’s own self-efficacy arises from interpretation and assessment of four major sources of information. The first source of information, referred to as performance accomplishments, has to do with one’s assessment of mastery over a task of some difficulty. Performance accomplishments are the most reliable source of efficacy expectations since mastery of a task involves development of skills and coping mechanisms useful in dealing with the task (Strecher, 1986). A second source of efficacy information is vicarious experience. Observation of other’s success or failure at a given task allows individuals to determine whether or not they will be successful. Verbal persuasion, the third source of efficacy information, has to do with suggestions from other people that a task can or cannot be mastered. The fourth and final source of information is one’s physiological state, which provides efficacy information because people are more likely to expect failure “when they are very tense and viscerally agitated” (Strecher, 1986, p. 76). Of the four sources of information which constitute an assessment of one’s self-efficacy, performance accomplishments are held to be the most reliable since they have to do with one’s own actions.

Although the sources of efficacy provide an individual with useful information, it is one’s own appraisal of events that influences perceived self-efficacy. According to Bandura (1977), a distinction must be drawn between information from environmental events and information that is processed and transformed by the individual. “Information is attended to, weighted and interpreted in ways that mediate its impact on efficacy expectations” (Strecher, 1986, p. 76). Certain individuals may focus on positive aspects of an experience while others focus on the negative. An individual with low self-efficacy is likely to focus more on the negative aspects of an experience and see these negative
aspects as important whereas someone with high self-efficacy will accurately monitor the positive and negative aspects but view the positive ones as more important. Central to one’s appraisal of an experience is the interpretation of that experience. Self-efficacy is enhanced when an achievement is performance based and not dependent on chance or temporary factors (Strecher, 1986).

While self-efficacy is an internal, cognitive assessment of one’s capabilities in a given situation, it is not independent of environmental cues or influences. People partly judge their efficacy through social comparison making vicarious information a useful source of efficacy information (Bandura, 1995). Various studies have demonstrated the effects of bogus performance feedback on perceived self-efficacy. An example of the way in which one’s environment affects perceptions of self-efficacy is provided by Marlatt and colleagues (Marlatt, Baer and Quigley, 1995) when describing the decision of a small boy to swim in a restricted pool on a very hot day. Perceptions of self-efficacy are applied to the situation as the boy might assess his confidence about his ability to resist the urge to dive in, his confidence in his ability to cool off without diving in, or to dive in without getting caught. These judgements of self-efficacy are relative to factors such as the heat of the day, the coolness of the pond, the size of the sign that restricts pool use and the social norms for this kind of activity. The situation is complicated by the boy seeing three of his friends playing in the water and experiencing no negative consequences. This is equivalent to a positive outcome expectation. Even more likely, the boy could observe others present who do not jump in, but heed the sign that provides the vicarious information (Marlatt, Baer and Quigley, 1995). This illustration is useful because it demonstrates a decision-making process where self-efficacy to perform or resist a given activity is assessed by the individual, and suggests that the individual is not isolated from cues outside of his own body.

Marlatt and Gordon (1985) propose five kinds of self-efficacy as they relate to addictions and involve the different stages of committing to change, maintaining change, and preventing relapse. These stages are identified as resistance self-efficacy, harm-reduction self-efficacy, action self-efficacy, and maintenance self-efficacy which is differentiated into coping self-efficacy and recovery self-efficacy. Resistance self-efficacy has to do with the individual’s belief that he or she can avoid use prior to first use. Risk reduction self-efficacy has to do with reducing one’s risk by reducing intake following initial use of the drug. Action self-efficacy has to do with the decision and commitment to change; this change being either abstinence or controlled use of the drug. Within coping self-efficacy there are five major situations that have been identified as presenting a substantial relapse risk for recovering alcoholics. These are negative emotional states, negative physical states, positive emotional states, testing personal control, urge and temptations, interpersonal conflict, social pressure to drink, and positive emotional states (Marlatt and Gordon, 1985). This paper will focus primarily on coping and resistance self-efficacy which involve individuals’ belief or confidence in their ability to succeed in the task before them and their ability to recover from a failure experience.

Measuring Self-Efficacy

Several scales have been developed in recent years to measure the concept of self-efficacy. Self-efficacy scales do not measure skills; they measure what people believe they can do under varied circumstances with the skills they possess which often leads to an assessment of the particular skills required by the task (Bandura, 1986). Self-efficacy beliefs related to substance abuse have been measured using clients’ self-ratings about perceived personal ability to resist an urge to use a drug in a particular situation (Whittinghill, Whittinghill and Loesch, 2000). Self-efficacy scales for drug use vary from single items to scales with 100 items or more. The most common scale for assessing coping self-efficacy measures strength of confidence to avoid substance use in specific situations (Marlatt, Baer and Quigley, 1995). Domain self-efficacy scales have been found to predict better than global tests, suggesting that self-efficacy is not a global concept (Bandura, 1986). In domain scales, the items assess a general level of competence at each aspect of a domain (Bandura, 1986). Thus, for example, individuals are asked if they feel they can resist the urge to drink when they are upset emotionally, as opposed to a general question of whether or not they can resist the urge to drink, period. Negative affect (unpleasant emotions), testing personal control, and social pressure are the three areas where people report feeling that they are most likely to relapse (Pare, 1999). Domain scales of self-efficacy are useful because they reveal subtle differences between one’s perceived self-efficacy in different areas. One may be highly efficacious in one particular area such as while experiencing positive affect, but highly ineffectual in another area such as during experience of negative affect. An adequate self-efficacy measure requires a detailed assessment of the magnitude, generality, and strength of efficacy expectations (Bandura, 1977).

The first self-efficacy scales developed centered on smoking cessation and ability to avoid relapse to smoking. One such scale, The Smoking
Self-Efficacy Questionnaire (SEQ) is a 17-item, self-report questionnaire designed to measure efficacy expectations for resisting the urge to smoke in high risk-situations was found to be useful (Colletti, Supnick and Payne, 1985). In the SEQ, subjects are first asked to indicate whether the urge to smoke in a situation described can be resisted. Responding “no” to an item is scored as a confidence rating of zero. However, if a subject responds “yes” indicating that they can resist the urge to smoke in a given situation, then confidence to resist is rated on a scale from 10-100 where 100 indicates absolute certainty that they can refrain. Thus, the confidence ratings reflect the strength of the self-efficacy judgement. The SEQ appears to be an internally consistent and moderately reliable instrument (Colletti, et.al., 1985). It was shown to have predictive validity at one-month follow-up and discriminant validity, ensuring that the SEQ measures self efficacy expectations and not variance accounted for by unrelated factors such as age or number of years smoking (Colletti, et.al., 1985). The Situational Confidence Questionnaire (SCQ; Annis, 1982) consists of 100 items covering eight domains of difficulty experienced by alcoholics in terms of heavy drinking or relapse. Respondents are asked to imagine themselves in each situation and rate their level of confidence in their ability to resist the urge to drink heavily in that situation. The instrument yields an overall efficacy rating as well as a rating for each of the eight categories of relapse situations. In order to determine the validity of the instrument, Miller, Emerson and Todt (1989) compared the SCQ scores of two groups—one group was considered long-term sober (sober for one year) and one who was short-term sober (in the process of completing treatment program)—hypothesizing that these two groups should yield different scores. For seven of the eight subscales, higher self-efficacy was demonstrated in the responses of the long-term sober group. The sub-scales—Negative Emotional states, Testing Personal Control, and Social Pressure to Drink accounted for most of the variance. The SCQ demonstrated adequate construct and predictive validity (Miller, et. al., 1989).

A 100-item self report questionnaire called the Inventory of Drinking Situations (IDS) has been developed (Annis, 1982) to assess drinking within the eight categories of relapse situations identified in the work of Marlatt and Gordon: unpleasant emotions, physical discomfort, pleasant emotions, testing personal control, urges and temptations, conflict with others, social pressure to drink, and pleasant times with others. Good reliability, content, and external validity have been reported for the IDS subscales (Annis, Graham and Davis, 1987).

The Drug Taking Confidence Questionnaire (DTCQ; Annis and Martin, 1985) is a 50-item self report questionnaire developed to assess situation-specific coping self efficacy for use of a particular substance of abuse. The questionnaire is designed for the individual in that the drug that he or she is addicted to is implemented into each item (e.g. cocaine, alcohol, heroin, cannabis, etc.). Respondents report how confident they are that they could resist the urge to drink heavily or engage in any use of a particular drug in each of the 50 situations on a 6-point scale ranging from 0-100 where 0 is not at all confident and 100 is very confident. The DTCQ was found to be reliable and demonstrated good construct, convergent, and discriminant validity (Sklar, Annis and Turner, 1997).

The Drinking Self Efficacy Questionnaire (DSEQ; Young, Oei and Crook, 1991) is a 35-item self report questionnaire in which subjects rate 35 situations using a 1-6 scale which ranges from “I am very sure I would drink” (1) to “I am very sure I would not drink” (6). In a study determining the validity of the instrument, three areas of potential relapse risk were identified among the sample of adolescents—self efficacy in situations of social pressure, self efficacy in situations of opportunistic drinking, and self efficacy in situations characterized by a need for emotional relief. The DSEQ demonstrated high internal consistency, predictive validity and reliability. It also demonstrated good utility both in predicting consumption and in discriminating between problem and non-problem drinkers (Young, et. al., 1991).

The Alcohol Abstinence Self Efficacy Scale (AASE; DiClemente, Carbonari, Montgomery and Hughes, 1994) is a 20-item self report measure designed to assess self efficacy applied to alcohol abstinence. Abstinence efficacy is assessed on a 5-point scale of confidence to abstain from alcohol across 20 different high-risk situations. The AASE differs from other scales of self-efficacy in that it only measures five of the eight potential relapse risk situations and is noted for its brevity. The AASE was found to be a reliable and valid measure of abstinence efficacy with no substantial gender differences in scores. The creators of the scale contend that the five-item subscales appear to capture major dimensions of relapse and determinant categories as studied by Marlatt and Gordon (DiClemente et. al., 1994).

Self-Efficacy: Descriptive or Cause of Behavior?

Several researchers have disputed the usefulness of self-efficacy theory for different reasons. Irving Kirsch (1986) proposes that self-efficacy is similar to and not distinct from other theories used to describe human
behavior. Kirsch compares self-efficacy to an individual's level of aspiration, arguing that the measurement of self-efficacy is actually a measurement of one's level of aspiration. He argues that self-efficacy is a concept that is not distinct from Rotter's locus of control or Atkinson's theory of motivation. Kirsch argues that because these terms existed in the literature prior to 1977, the concept of self-efficacy introduced by Bandura was not a novel term, nor did it describe a new concept.

Bandura (1995) argues that the terms are distinct from the concept of self-efficacy. Perceived self-efficacy and locus of control are different concepts representing different phenomena. He explains that perceived self-efficacy is concerned with people's beliefs about their capabilities to produce certain performances, while locus of control, a global trait, refers to people's beliefs about whether the outcomes they experience are dependent on their actions or are the result of fate, chance, or luck. Self-efficacy theorists reject the trait approach to human behavior, in favor of specific judgements of capability that vary across realms of activity, task demands, and situational circumstances (Bandura, 1995). To illustrate the distinction, an individual may realize that a certain outcome is controlled by factors that are internal as opposed to external, which means that he has an internal locus of control. However, he can also conclude that because personally, he lacks the skills necessary to control this outcome, others may be successful in mastering the task but he may still fail. Hence, while self-efficacy and locus of control bear some relation, the terms are definitely distinct.

Self-efficacy can also be distinguished from motivation. An individual can be extremely motivated to perform a given task and yet if he or she lacks the skills or capabilities necessary to perform that task, he or she will ultimately fail. On the other hand, one can possess the skills necessary to perform a task and lack sufficient motivation to do so. One study which demonstrated this was conducted by Kelly, Myers and Brown (2000) who wanted to examine relationships between 12-step attendance and abstinence. The authors believed that coping factors, self-efficacy, and motivation would mediate the relationship between 12-step attendance and successful outcome or abstinence. The results indicated that motivation was the only factor that mediated this relationship. This finding does not discount self-efficacy theory as an explanation for behavior, but reminds researchers and clinicians: one can be successful at a given task only when one is motivated to do so. Therefore, self-efficacy and motivation must be two separate entities, due to the fact that an individual must have one (motivation) before the second (self-efficacy) can be of any use.

Another concept that has been thought to be interchangeable with self-efficacy is that of outcome expectations. Individuals' outcome expectations have to do with whether they believe that they will be rewarded or punished for their actions. Bandura (1995) argues that self-efficacy is distinct from outcome expectations in that behavior is motivated by more than a desire for reward or an avoidance of punishment. He points out that people often fail to repeat rewarded acts and continue to perform acts that have been punished and suggests that reward/punishment theories of behavior do not explain differences among individuals.

The issue of self-efficacy as a cause of behavior as opposed to merely a descriptive of it has been the subject of considerable debate. Hawkins (1995) acknowledges that several studies have suggested that it holds predictive validity, yet argues that self-efficacy is not a true cause of behavior, but rather, a descriptive metaphor. He suggests that it merely describes behavior, but does not cause it. Hawkins feels that while self-efficacy “correlates” well in the short term, the fact that it fails to predict behavior in the long term demonstrates its lack of causality. Bandura (1986) proposes that the usefulness of self-efficacy in so many diverse domains suggests causality. According to Bandura, the domains of psychological functioning to which the theory has been applied are remarkably diverse encompassing everything from affective reactions of stress and depression to athletic feats and career choice. Self-efficacy has been studied under laboratory conditions and in controlled field studies where external validity could be implied (Bandura, 1986). The findings obtained from studies of diverse populations, methodologies, and assessment measures demonstrate the causal linkage: “postulated determinants alter self-percepts of efficacy and self-efficacy, in turn, affects action” (Bandura, 1986, pg 360).

Self-Efficacy in Various Studies

As Bandura pointed out in his defense of the causality of self-efficacy theory, various researchers from different domains have found self-efficacy to be a useful concept. Studies have been conducted using self-efficacy as a predictor, mediator, or mechanism for change in studies as diverse as nicotine addiction to pain during childbirth to recovery from rape (Carmody, 1992; DiClemente, 1981; Manning and Wright, 1983; Regehr, Cadell and Jansen, 1999). In an early study on self-efficacy conducted by Manning and Wright (1983), 52 pregnant women made self-efficacy judgements before and during labor and then reported in post delivery
Another study that lends support to self-efficacy theory is one conducted by Regehr and colleagues in which self-efficacy and locus of control were examined in relation to their effect on symptoms of depression and post-traumatic stress following rape or attempted rape. Seventy-one women who had been victims of rape or attempted rape in their adult lives participated in the study. The study’s results confirmed that those women with higher levels of self-efficacy showed lower rates of depression and post-traumatic stress symptoms (Regehr et al., 1999).

Several studies have been conducted in the area of self-efficacy as it relates to nicotine addiction and cessation of cigarette smoking. DiClemente (1981) attempted to determine if the theory of self-efficacy proposed by Bandura could be applied to successful maintenance of smoking cessation. Sixty three subjects who had recently quit smoking by three different means were assessed on self-efficacy at approximately four weeks after cessation, and again at five-month follow-up. Results confirmed the hypothesis that those who were abstaining at five-month follow-up were those who had higher self-efficacy following smoking cessation. Those with lower self-efficacy four weeks after cessation had relapsed.

Another researcher, Carmody, (1992) attests to the usefulness of the self-efficacy construct in preventing relapse in the treatment of nicotine addiction. In his commentary on future directions of relapse prevention, he points out several studies that have provided empirical support for self-efficacy theory where self-efficacy expectations were found to be highly related to maintenance of abstinence and movement through stages of change as well as cessation of smoking itself. While Carmody proposes that relapse prevention centered around the concept of self-efficacy needs further support, he supports it as a promising theory worthy of further study.

Recently, researchers have begun to attest to the usefulness of self-efficacy in relapse prevention for addictions other than nicotine (Annis, 1990; Annis and Davis, 1991; Bandura, 1999; Whittinghill, Rudenga and Loesch, 2000). Prevention of relapse to substance abuse and predictors of possible risk factors to relapse are necessary given the high relapse rate of former substance users. Relapse rates are said to be as high as 50% to 90% for most addictions (Marlatt and Gordon, 1985). Given the limited utility of traditional solutions to improving long term treatment outcome, there has been much interest in recent years in exploring the treatment implications of different theories of addiction as these relate to the relapse process. One of the most influential theoretical frameworks that has been applied to the problem of relapse is the cognitive-social learning approach, specifically self-efficacy theory. Empirical findings on a range of addictive behaviors support the relationship between self-efficacy ratings and treatment outcome (Annis, 1990). In a model of relapse prevention proposed by Annis and Davis (1991), based on self-efficacy theory, it is proposed that when a former substance abuser enters a high risk situation for drinking, a process of cognitive appraisal of past experiences is set in motion which culminates in a judgement, or efficacy expectation, by the client of his or her ability to cope with the situation and this judgement of personal efficacy determines whether or not drinking takes place. There is now strong empirical support, as Annis and colleague suggests, of the power of self-efficacy judgements in predicting drinking behavior and relapse to drug use (Allsop et. al., 2000; Brown et. al, 1998; Burling and Reily, 1989; Coon et. al., 1998; Harmon, 1993; Pare, 1999; Ritz and Watzl, 1983; Rychtarik et. al., 1991; Sadowski et. al., 1993; Sitharthan and Kavanaugh, 1990; Solomon and Annis, 1990).

One of the earliest studies concerning self-efficacy as a predictor of relapse risk was conducted by Rist and Watzl (1983) using an all female population. In this study, 145 alcoholic women were assessed at pre and post treatment for alcohol addiction centered around social skills training. Assessments taken before treatment included the subjects assessment of their relapse risk (self-efficacy), specific assertiveness, their assessment of the discomfort they would feel in refraining, and general assertiveness. These measures were also taken following treatment. Treatment outcome was assessed in individual interviews three and eighteen months after discharge. Results indicated that in fact, patient assessment of self-efficacy to avoid drinking in certain situations or (relapse risk) predicted abstinence at three months as did specific assertiveness. At eighteen-month follow-up, however, neither self-efficacy nor specific assertiveness was a significant predictor of relapse.

Another early study conducted by Fromme, Kivlahan, and Marlatt (1986) did not lend support to self-efficacy theory. The primary goal of this study was to determine whether completion of a skills training program would predict drinking patterns in high risk drinkers. Secondly, the study attempted to determine if self-efficacy would increase as a result of treatment, thus
producing the end result of changes in drinking behavior. Forty three college students at the University of Washington completed the eight-week program and were assessed on their outcome expectancies as well as self-efficacy prior to intervention, after the program and at four-month follow-up. Neither outcome expectancies, nor self-efficacy showed any significant change as a result of the program. It should be noted that participants in the study were mildly to moderately dependent on alcohol. Studies demonstrating a significant relationship between self-efficacy and treatment outcome usually employ subjects who are moderately to severely dependent on alcohol. Secondly, the fact that they were college students who may view excessive drinking in social situations as acceptable may have affected the findings.

A study conducted by Burling and Reily (1989) lends support to self-efficacy as a predictor of treatment outcome. This study attempted to examine the effect of self-efficacy on many aspects of treatment and treatment outcome. Several questions were addressed, the first one being whether alcoholics differed from drug abusers with respect to self-efficacy. Secondly, it was hypothesized that self-efficacy would increase during treatment and that inpatients with high self-efficacy at the end of treatment would exhibit less relapse and better functioning than those with low self-efficacy. A third hypothesis was that follow-up self-efficacy ratings should be lower for patients who relapsed, and that possibly, patients who relapsed could predict the circumstances of their relapse episode. Self-efficacy ratings were assessed before, during, and following treatment at six months. Results confirmed the hypothesis that self-efficacy increased during treatment and those patients with higher self-efficacy at six-month follow-up were more likely to be abstaining. High self-efficacy, at the end of treatment, however, was not found to be predictive of positive treatment outcome at follow-up. The various substance abuse groups did not differ with respect to self-efficacy ratings. Contrary to beliefs, patients with lower self-efficacy at intake remained in treatment longer and had a more positive discharge. Patients with high self-efficacy at intake were more likely to leave without completing treatment. Those with lower self-efficacy at intake experienced a greater increase in self-efficacy during treatment and those who experienced greater in treatment change had higher abstinence rates at follow-up. A possible explanation for the fact that high self-efficacy at intake did not predict positive treatment outcome could be that patients who felt extremely confident in their ability to abstain underestimated the difficulty of the task and had less willingness to expend effort to acquire the skills necessary to cope with problem behavior.

Another study which lends support to self-efficacy theory was conducted by Sadowski, Long and Jenkins (1993). This study addressed the belief that change in self-referent thought during treatment is the best predictor of treatment outcome. It was hypothesized that self-efficacy would be negatively correlated to drug use. Subjects were 1,291 students from 91 randomly selected classes at Auburn State University who returned completed surveys. It was hypothesized that attendance at substance abuse programs would be higher among students who had attended treatment for drug abuse. It was also hypothesized that among students who had attended treatment for substance abuse, self-efficacy would be lower for those currently using and higher among those who abstained. This hypothesis was supported for every drug (marijuana, cocaine, hashish, tranquilizers, stimulants, and other non-prescription drugs) except alcohol. It was found that self-efficacy was only a predictor of behavior when students had received treatment and it was not a significant predictor for those students who had not received treatment. The findings of the present study support the belief that treatment promotes the development of self-schemas in which substance control is salient thereby effecting in self-efficacy. A proposed reason for the non-significant correlation found between alcohol and self-efficacy was that within a college sample, alcohol use may not be viewed as negatively as other substances.

While previous studies focused on the use of self efficacy in predicting treatment outcome where treatment focused on abstinence as its goal, a study conducted by Sitharthan and Kavanaugh (1990) looked at the link between self-efficacy and outcome in a program for controlled drinking. This study attempted to determine if certain biographical variables, severity of alcohol problems, consumption level during the program (since it was not abstinence based), and post treatment self-efficacy level would predict drinking outcome in a controlled drinking program. In such a program, treatment was centered around clients lessening their drinking habits in order to reduce harm, as opposed to abstinence as the goal. Because this program aimed at controlled drinking and not abstinence, treatment outcome was measured in days abstinent per week with two to four drinks being the targeted goal depending on the sex of the client. There were 60 subjects, 40 men and 20 women, who upon entrance to the program, were interviewed to determine history of problem drinking and biographical variables. Two questionnaires assessed alcohol dependence during this period and a self-efficacy for drinking control scale was administered. These were
again administered at six-month follow-up. A record of consumption of alcohol by each client was kept throughout the program. The results were positive. Consumption of alcohol dropped. There was an increase in the number of abstinent days per week. Self-efficacy rose during and after treatment. Severity of alcohol problems, consumption during the program, and post treatment self-efficacy level were significant predictors of the amount of alcohol consumed during the follow-up period with self-efficacy and drinking during program being the strongest predictors. A self-efficacy assessment at post treatment significantly predicted consumption over the next six months.

A study conducted by Solomon and Annis (1990) was designed to address the debate concerning whether self-efficacy and outcome expectancies for drinking are independent of one another or interact to produce certain outcomes. While self-efficacy has been held to be a better predictor of behavior, with outcome expectancy contributing only small predictions, researchers have found significant correlations between the two. Three models of behavior have been proposed to explain the relationship between self-efficacy and outcome expectancies. The first, self-efficacy theory, says that efficacy expectancies are the better predictors of future drinking behavior and that outcome expectancies add little to the prediction of future drinking behavior. The second, expanded self-efficacy theory, proposes that some combination of self-efficacy and outcome expectancies may be a better predictor than either of the two alone. In the third, personal efficacy model, a relationship is proposed between outcome expectancies, efficacy expectancies, valence, and performance. If the value of any one of these factors is zero, behavior will not change. The Solomon and Annis study was conducted to determine which one of these theories would hold true empirically. One hundred male alcoholics were administered measures of self-efficacy and outcome expectancies at intake and three months following treatment. The results indicated that outcome expectancies were not predictive of post treatment consumption of alcohol. No evidence was found to support the proposition of a relationship between outcome expectancies, efficacy expectations, valence, and performance. With regard to expanded efficacy theory, efficacy and outcome expectancies were found to be only weakly related. However, the findings were consistent with Bandura’s theory of self-efficacy in which it is proposed that outcome expectancies may not add to the prediction of behavior. Drinking related self-efficacy assessed at intake was found to be strongly associated with level of alcohol consumption on drinking occasions at follow-up. No relation was observed between clients’ outcome expectancies and drinking at follow-up.

In a study by Rychtarik, Prue, Rapp, and King (1991), the role of self-efficacy in predicting relapse at twelve month follow-up was examined. The study consisted of 87 male alcoholics who were assessed on self-efficacy at intake and discharge. The drinking status of these males was assessed several times during the twelve-month interval. Results indicated a significant increase in self-efficacy from intake to discharge and showed that lower self-efficacy at intake was in fact predictive of relapse while discharge self-efficacy was not predictive at six or twelve months. Individuals who were high in self-efficacy at intake showed the greatest resistance to relapse over time. Mayer and Koeningsmark-Sayer (1991) investigated the theory that post treatment self-efficacy would be predictive of lapse/relapse. It was hypothesized that those with lower self-efficacy at the end of treatment would lapse or relapse in fewer days than those with higher self-efficacy. Eighty subjects (49 males, 31 females) were assessed on self-efficacy at pre-treatment, post treatment and at three-month follow-up. The researchers stated that three months was used as the interval because most subjects relapse within three months and self-efficacy is most predictive at this time. Subjects were given the Inventory of Drinking Situations and at pre treatment and at post treatment they were given the Situational Confidence Questionnaire (Annis, 1982). It was hypothesized that pre-treatment IDS scores would correlate more with lapse/relapse than post treatment SCQ scores. It was found that subjects who had lower self-efficacy on certain categories of the SCQ had more days until first lapse, revealing an opposite relationship than the one hypothesized. A possible explanation of the findings was that the subjects experience a type of post-treatment denial following treatment and do not accept the rehabilitation process. Post-treatment denial relates more to an addict who feels that he or she does not have to take certain cautionary steps in the rehabilitation process.

In a study conducted by Harmon (1993), an investigation was conducted applying the theory of self-efficacy to outcome for cocaine addicts. The study attempted to investigate whether expectancies for cocaine use and self-efficacy assessed at pre and post treatment would predict aftercare compliance. Aftercare compliance was defined as remaining in the aftercare program following discharge and refraining from cocaine use or use of other substances during this time. The author hypothesized that cocaine expectancies and self-efficacy would predict outcome over demographic variables; that cocaine expectancies and
The study consisted of 142 male veterans, mostly African American, aged 21-66 years. Assessments were given at intake to measure substance use dependence and background variables. The Cocaine Expectancy Questionnaire (CEQ) and a modified version of the Situational Confidence Questionnaire (SCQ) were given at pre and post treatment. Results revealed changes in self-efficacy as well as cocaine expectancies during treatment, confirming the third hypothesis and disconfirming the fourth (that cocaine expectancies would remain stable). Both self-efficacy and cocaine expectancies were useful in the prediction of aftercare compliance: as separate variables. However, the combined power of self-efficacy with expectancies did not significantly improve predictive utility over either alone. This disconfirmed the second hypothesis. The first hypothesis was also disconfirmed because cocaine expectancies and self-efficacy did not predict aftercare compliance over demographic variables. This study supports the theory that self-efficacy is separate and distinct from outcome expectancies, and it provides some support for self-efficacy as a predictor of outcome, but it leaves room for question concerning the prediction of self-efficacy over other variables.

In a study conducted by Brown, Carello, Vik and Porter (1998), the relationship between alcohol expectancies and self-efficacy during a four-week relapse prevention program was investigated. The authors hypothesized that both alcohol expectancies and self-efficacy would change during treatment with positive alcohol expectancies decreasing and self-efficacy increasing over the four weeks. They hypothesized that those subjects with lower self-efficacy at admission would show greater decreases in alcohol expectancies during treatment. One hundred and one veterans were admitted to treatment (ninety-nine men and two women). They were assessed for alcohol dependency, alcohol expectancies, and self-efficacy two days following admission to treatment and immediately following treatment. Results confirmed all three hypotheses. Positive alcohol expectancies decreased during treatment whereas self-efficacy increased. These two were inversely correlated among subjects at admission with those people low in self-efficacy, high in alcohol expectancies, and vice versa. Also confirmed was the hypothesis that those with lower self-efficacy at intake demonstrated greater decreases in alcohol expectancies than those with high self-efficacy at intake.

In a study looking at predominantly crack cocaine users, researchers (Coon, Pena and Illich, 1998) investigated whether self-efficacy increases during treatment and whether self-efficacy is higher among abstainers than relapses at follow-up. The study assessed the validity of a four-item phone interview derived from the Alcohol Abstinence Self-Efficacy Scale (AASE), selected for its brevity. One hundred and eighty-six subjects were given a modified version of the AASE at admission, discharge, and one-month follow-up. The AASE was modified so that the questions centered around drugs other than alcohol. The modified 20-item version was given at admission and discharge, with the four-item version used at one-month follow-up. Responses on the four specific items used at follow-up were compared to the full item scale at admission and discharge. The results confirmed findings in other studies. Self-efficacy increased during treatment and continued to increase at one-month follow-up. Subjects with higher self-efficacy at follow-up were abstaining while those with lower self-efficacy had relapsed. The four-item version of the AASE was found to be very useful.
have a better outcome because of a greater change in self-efficacy than someone who entered with high self-efficacy and changed less. Lastly, the study wanted to determine which domain of self-efficacy would predict outcome. Specifically, it was hypothesized that increased self-efficacy concerning negative emotional states would predict outcome. Subjects participating in Relapse Prevention aftercare were expected to have better outcomes and days abstinent than the Alcoholics Anonymous aftercare and reference group, which received no additional aftercare following standard treatment. The population for study consisted of 102 adult male and female clients who underwent treatment at three different treatment centers. Following treatment, subjects were given the option to attend aftercare. Those who chose not to attend aftercare were still assessed following treatment and at six-month follow-up and served as a reference group. Those who chose aftercare were randomly assigned to two groups, Relapse Prevention aftercare or traditional Alcoholics Anonymous 12-step aftercare. Measurements given at intake assessed dependence, addiction severity, substance use behavior, psychological disorders, and cognitive functioning. The Alcohol and Drug Use self-efficacy scale was administered at intake, discharge, following aftercare, and at six-month follow-up. Outcome measures assessed days of abstinence and latency to lapse and relapse at six-month follow-up. Self-efficacy increased significantly from pre aftercare to six-month follow-up in only one domain of self-efficacy—situations involving emotional states. No group differences were found. The hypothesis was not supported that self-efficacy would be higher (would increase more) in the Relapse Prevention aftercare group. The second hypothesis that higher levels of self-efficacy would be associated with improved functioning at six-month follow-up, was supported. High pre and post aftercare efficacy levels predicted better functioning at the follow-up with pre aftercare self-efficacy constituting the best predictor. Both pre and post aftercare self-efficacy predicted latency to lapse and latency to relapse.

A study conducted by Florentine and Hillhouse (2000) provided empirical support for the Addicted Self Model of recovery, which is similar to social-cognitive theory in some of its concepts, but dissimilar in describing the process of change. The Addicted Self Model assumes that among those who are dependent on drugs and/or alcohol, continued use of the drug will lead to failed attempts to control drug use, which then leads to lowered self-efficacy. Lowered self-efficacy, in turn, leads to an individual viewing himself or herself as addicted, hence “the addicted self” title, and having heightened negative expectancies about the use of alcohol or drugs. In order to lend support to this theory, the following hypotheses were tested: controlled drinking or drug use would lead to lowered self-efficacy; lower self-efficacy would be associated with higher negative expectancies and higher negative expectancies would lead to abstinence acceptance. It was hypothesized that while negative expectancies would predict abstinence acceptance, it wouldn’t necessarily predict level of alcohol or drug use at follow-up. A prospective longitudinal study of clients entering all metropolitan L.A. county out-patient drug free programs was conducted. Four hundred and seventeen respondents completed intake interviews and 356 (85%) completed follow-up interviews eight months later. Controlled use self-efficacy was assessed as well as negative expectancies associated with continued alcohol and drug use. Abstinence acceptance and relapse severity (at follow-up) were also assessed. Results supported all hypotheses thus lending support to the Addicted Self Model.

In another study conducted by Kelly, Myers and Brown (2000), self-efficacy was investigated as one of three possible mediators between 12-step attendance and positive outcome. The purpose of the study was primarily to determine whether or not 12-step attendance predicted substance use in the six months following discharge. Secondly, the study was designed to determine whether 12-step attendance created increases in motivation, coping strategies, and self-efficacy at three months and substance use in the following three months. Ninety-nine adolescents aged 14-18 were assessed with interviews at intake, and three and six months following discharge. Most were polysubstance abusers. Because adolescents differ developmentally and cognitively from adults and because they are likely to have shorter abuse histories, they are a unique and distinct population for study. Results indicated that 12-step attendance (post discharge) did predict abstinence with abstainers attending approximately twice as many twelve step meetings. Abstinence focused coping, self-efficacy, and motivation for abstinence together significantly mediated the relationship between 12-step attendance during the first three months and substance use outcome in the second three months post discharge. However, when analyzed separately, only motivation mediated the relationship. Attendance at 12-step meetings was significantly related to motivation for abstinence, which in turn predicted substance use outcome in the following three months.

Allsop, Saunders and Phillips (2000) conducted a study which investigated factors influencing the relapse process. It was hypothesized that post treatment self-efficacy, cognitive functioning, level of depen-
dence on alcohol, levels of pre-treatment drinking, and major depression would all predict treatment outcome. High levels of self-efficacy immediately following treatment and at six and twelve month follow-up were hypothesized to be predictive of better outcome with longer time until lapse or relapse. Poor cognitive functioning was hypothesized to predict poor outcomes and shorter time until lapse or relapse because it was thought that individuals with poorer cognitive functioning would be less able to employ coping strategies learned in treatment. High levels of dependence on alcohol and high levels of pre-treatment drinking were hypothesized to be associated with fewer days until lapse or relapse. Higher levels of depression were thought to be associated with poorer outcome. Sixty male subjects from Scotland aged 21-60 years who were highly dependent on alcohol were assessed 10-14 days following entrance into the program, immediately following treatment, and again at six and twelve month follow-up. They were given instruments designed to measure their self-efficacy, level of dependence on alcohol, level of depression, and cognitive functioning. Results revealed that post treatment self-efficacy and pre-treatment cognitive functioning had effects on outcome at six month follow-up only. Neither level of alcohol dependence, nor depression scores were found to predict outcome at six and twelve month follow-up.

In summary, several researchers have found self-efficacy to be predictive of outcome (Allsop et al., 2000; Brown et al., 1998; Burling and Reily, 1989; Coon et al., 1998; Harmon, 1993; Pare, 1999; Ritz and Watzl, 1983; Rychtarik et al., 1991; Sadowski et al., 1993; Solomon and Annis, 1990) while others have not found self-efficacy to be predictive of outcome (Fromme et al., 1986; Kelly et al., 2000; Mayer et al., 1991; Powell and Dawe, 1993). From the literature reviewed, several conclusions have emerged. First, self-efficacy has been found to be a better predictor of outcome in the short term (Ritz and Watzl, 1983; Allsop et al., 2000). Secondly, self-efficacy has been found to be a better predictor when subjects are moderately to heavily dependent on alcohol (Fromme et al., 1986). Self-efficacy at pre-treatment has been found to be a better predictor than self-efficacy at post treatment (Burling and Reily, 1989; Pare, 1999).

To explain this, certain researchers have proposed a possible ceiling effect of self-efficacy at post treatment which makes post treatment self-efficacy less predictive (Rychtarik, 1991). One study described a post treatment denial, a refusal to accept the rehabilitation process, as an explanation for why post treatment self-efficacy is sometimes not predictive of outcome (Mayer et al., 1991). Other researchers have found that change in self-efficacy during treatment is what is predictive of outcome (Burling and Reily, 1989). It has been found that self-efficacy is predictive of outcome not only in programs centered around abstinence as their goal, but in controlled drinking programs as well (Sitharthan and Kavanaugh, 1990). Finally, it has been found that individuals who are more aware of their vulnerabilities are more likely to have better outcomes than those who have unrealistically high self-efficacy at intake (Powell and Dawe, 1993).

The purpose of the present archival data study is to identify the questions on a brief self-efficacy scale developed by Hamilton (1985) that are the best predictors of sobriety. Sobriety data were collected from five to ten years ago from a sample of recovering substance abusers that had been treated for their addiction. We want to determine which questions best predict current relapse and from this, we will develop a ten-item questionnaire that has strong predictive validity.

References


preliminary scale development and validation. Behavioral Assessment, 7, 249-260.


Anxiety and Cocaine Use

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The purpose of this study was to examine temporal relationships between anxiety and cocaine use. While anxiety in recovering addicts has been noted in treatment and recovery, temporal relationships between anxiety and cocaine use have not been determined. It has been assumed that anxiety in recovery cocaine addicts was precipitated by the drug. Archival data coded from client histories of anxiety and substance use/abuse were used to determine age of onset of each to allow delineation of relationships between anxiety and cocaine use/abuse.

Anxiety

Anxiety has been defined as an unpleasant emotional state or condition characterized by subjective feelings of tension, apprehension, nervousness, and worry, and by activation or arousal of the autonomic nervous system (Spielberger, 1995). Spielberger (1977) refines this definition by identifying two types of anxiety: state and trait. State anxiety is defined as the experience of anxiety as an unpleasant condition whereas trait anxiety refers to relatively stable individual differences in state anxiety-proneness. This approach assumes that the more trait anxiety an individual has, the more likely they are to experience state anxiety.

The primary instrument used to measure anxiety has been the State-Trait Anxiety Inventory (STAI; Spielberger, 1983a). Currently in its second revision, this 40 question self-report questionnaire has been used in more than 2,000 published studies (Spielberger, 1983b). Test-retest reliabilities for Form Y of the STAI (the most current version) have been reported to range from .65 to .86 for the T-anxiety scale (trait anxiety) and from .16 to .62 for the S-anxiety scale (state anxiety) (Spielberger, 1983a). Low test-retest reliabilities for the S-anxiety scale are understandable, given that a valid measure of state anxiety should reflect the influences of unique situational factors that participants experience at each time of testing. Although there are other methods of evaluating anxiety, including self-reported experiences of panic attacks, the STAI remains the primary measure of anxiety evaluation.

Anxiety as Sequelae of Cocaine Use

It is known that persons who use mood-altering substances frequently report excessive anxiety. Washton and Golds (1984), while attempting to assess the consequences of cocaine use on health and functioning, found that 50% of cocaine users experience panic attacks. This contrasts with the finding by Klerman, Weissman, Ouellette, Johnson, and Greenwald (1991) that 1.6% of the general population experience such attacks. The comorbidity of cocaine use and anxiety is so well established that the DSM-IV (1994) includes cocaine-induced anxiety disorder as a diagnostic category.

The impaired functioning theory is based on the assumption that cocaine use precipitates anxiety (Newcomb and Bentler, 1988; Vaillant and Milofsky, 1982; Zucker and Gomberg, 1986). The mechanism of impairment is cocaine-induced pharmacological alteration of physiological chemistry which makes the user more susceptible to the experience of anxiety. This theory has found much support. Cocaine use predating the experience of anxiety has been reported in both case-study and community sample literature.

Aronson and Craig (1986) treated three patients whose anxiety disorders had been precipitated by the use of cocaine. Mr. A, Ms. B, and Mr. C had all used cocaine prior to their experiences of anxiety and despite cessation of use continued to be plagued by anxiety attacks. Louie, Lannon, and Ketter (1989) describe 10 patients whose cocaine use predated their panic disorders. Louie, Lannon, Rutzick, Brown, Lewis, and Jones (1996) describe a study in which phone calls
were solicited from cocaine users by way of a major metropolitan newspaper. From approximately 400 calls, 95 callers were identified who developed panic attacks after significant cocaine use and whose panic persisted after cessation of use.

Geracioti and Post (1991) describe another patient, Mr. A., who was in treatment for experiencing daily panic attacks. He first began to experience panic attacks three to four hours after the use of a small amount of cocaine and had reportedly used cocaine only twice before. The case of Geracioti and Post’s Mr. A. suggests that onset of panic disorder can be precipitated by even occasional use of cocaine.

Cocaine Use as Sequelae of Anxiety

Theories based on the assumption that anxiety leads to cocaine use include the self-medication theory (Khantzia and Treece, 1985) and the self-derogation theory (Kaplan, 1975, 1996). The self-medication theory assumes that people who experience anxiety begin using drugs in an attempt to alleviate discomfort. They might use cocaine to pharmacologically treat their anxiety. This approach to self-medication would seem reasonable since research (Estroff, 1987) has found that cocaine may have anxiolytic properties.

The self-derogation theory also assumes anxiety leads people to use cocaine. Kaplan (1996) posits a reciprocal relationship between self-attitudes and deviant behavior in that distressed persons use drugs to attempt to restore a sense of self that had previously been damaged (perhaps by their experiences of anxiety). Although Estroff and Gold (1986) suggest that people with preexisting psychiatric disorders use cocaine to self-medicate, they did not reference empirical literature supporting the self-medication theory. Anthony, Allen, and Petronis (1989) have proposed that more research should be done to explore panic attacks occurring prior to cocaine use.

Etiology/Chronology

Theories assuming the relationship of comorbid anxiety and cocaine use have typically fallen into those supporting cocaine’s precipitation of anxiety and those supposing anxiety leads to cocaine use. In examining the etiology of comorbid anxiety and cocaine use, the concept of temporal causality has been used as the primary means of implying causation. Temporal causality is an assumption that when one condition is present before another, and when those two conditions occur together frequently, the first condition is thought to have caused the second condition. For comorbid anxiety and cocaine use, it would be assumed that if anxiety preceded cocaine use, then the anxiety may have contributed to the cocaine use and, conversely, if cocaine use preceded experiences of anxiety, the substance use had precipitated the anxiety.

The construct of temporal causality has been the focus of much debate since it does not take into account confounding variables which could be responsible for an observed relationship. It is, however, the only way to objectively evaluate a cause-effect relationship between cocaine use and anxiety within the confines of modern ethical practices. Controlling either variable for humans is unethical. This is why temporal causality has been used in supporting research for most theories explaining comorbid anxiety and cocaine use.

Temporal causality has lent support to the impaired functioning theory. Many studies have been published in which cocaine use was found to predate the onset of anxiety (Aronson and Craig, 1986; Louie, Lannon, and Ketter, 1989; Louie et. al., 1996; Geracioti and Post, 1991). No articles have been published which report that anxiety predates cocaine use. This is not to say that anxiety does not predate cocaine use; only that no studies have demonstrated it yet.

Although the theories explaining the relationship between comorbid anxiety and cocaine use assume opposite temporal causalities, they are not necessarily mutually exclusive. As with most observable comorbid relationships, it is possible that in certain cases each theory can be correct. The case may be that preexisting anxiety can lead to cocaine use and that cocaine use can precipitate anxiety. In such a scenario, were an empirical study done to assess the onset of both anxiety and cocaine use, a bimodal distribution would be found. Also, in this case, it would be logical to assume that each group might consist of different people with varying life-course trajectories. And were this to be true, therapies with each group might have varying effects.

The present study was designed as a preliminary empirical investigation into the etiology of comorbid anxiety and cocaine use. Archival data from self report histories of anxiety and substance use/abuse of chemically dependent residential patients were used to determine age of onset of both anxiety and cocaine use. Comparison of times of onset of each permit determination of temporal relationships between anxiety and cocaine use.

Methods

Subjects

Archival data from a consecutive sample of 81 residential patients in an alcohol and drug treatment program were used in the present study. After detoxification, each patient was administered a packet containing a three-page questionnaire assessing,
among other things, their history of panic anxiety, drug use, and selected childhood experiences. Of 81 subjects for whom data were available, only the 24 who reported having used cocaine and experienced escalating anxiety were utilized in the present study. This sample of 24 was predominately female (n = 16) and Caucasian (n = 20) with an average age of 34.8 (SD = 8.75).

**Instruments and Procedures**

Each patient completed a questionnaire that asked age at onset of anxiety, frequencies of anxiety experiences (including phobias, obsessions, compulsions) over time and anxiety eliciting events such as nightmares, fears of going to school, learning problems, and bullying. The final page of the questionnaire asked the patient to list all mood-altering substances used, age at first use, and pattern of use over time. The self-reported histories were coded for age of first use of cocaine, age at which cocaine use escalated, age at first experience of anxiety, and age at escalation of anxiety. This study utilized the subset of archival data completed by clients who reported both cocaine use and experience of anxiety. Age at first cocaine use and age at escalation of anxiety (rather than first experience of anxiety) were used to divide subjects into three groups. The rationale for using age at escalation of anxiety rather than first experience of anxiety was because the former includes anxiety experiences over time and across intensity.

**Results**

Patients’ self-reports of age of first cocaine use and age at which anxiety began to escalate were used to divide participants into three groups: 1) those who used cocaine prior to the age at which their anxiety began to escalate, 2) those who experienced escalating anxiety and initial cocaine use at the same age, and 3) those who experienced escalating anxiety prior to use of cocaine. Of the 24 patients who had experienced both escalating anxiety and cocaine use, 1 had used cocaine prior to their experience of escalating anxiety, 4 reported escalating anxiety and cocaine use at the same age, and 19 experienced escalated anxiety prior to cocaine use. A comparison of life-course trajectories across groups was not possible because only one patient fit within the “cocaine first” group. The majority of patients reported experiencing anxiety prior to cocaine use. Descriptive information on the “anxiety first” group is presented.

**Descriptions of “Anxiety First” Group**

Of the “anxiety first” patients, 84% were Caucasian and 63% were female. The average age was 34.8 years with a standard deviation of 9 years. A diagnosis of ADHD had been given to 10.5% of the “anxiety first” patients. The mean and modal score for first experience of anxiety was 12 years (SD = 5.41). The average age that patients began experiencing escalating anxiety was 13.47 (SD = 4.88). Table 1 describes patients’ life events at time of first experience of anxiety.

Table 2 presents information on frequencies of childhood anxiety eliciting events such as nightmares, phobias, obsessions or compulsions, fears of going to school, learning problems, and bullying. Patients were asked about the amount of anxiety felt during family conflicts. Their responses can be found in Table 3. More than half (57.9%) of patients rated their caregivers’ disciplining and quality of childhood below 5 on a 1-10 Likert scale where 1 was “appropriate” and 10 was “abuse.” Of the patient group who experienced escalation of anxiety before cocaine use, 50% reported that their parents had had problems with anxiety or depression. Patients in this group also reported that 42.1% of their mothers and 84.2% of their fathers smoked while the patients were growing up.

Information regarding patients’ experience of anxiety over the past six months can be found in Table 4. It should be noted that 26.3% of patients described their experiences of anxiety as “seldom” over the past six months. Patients’ age of first and escalating use of drugs can be found in Table 5.

**Discussion**

In the present study it was found that 19 of 24 patients experienced escalating anxiety prior to cocaine use, and 1 patient first used cocaine prior to the age at which their anxiety escalated. Since there have been no findings of this type reported in prior literature, more research in this area is warranted. The fact that 10.5% of the “anxiety first” group had a previous diagnosis of ADHD seems meaningful in the context of this study. It has been found that persons with an ADHD diagnosis are at higher risk for cocaine use (McCance-Katz and Kosten, 1998). Also of note, the endorsement of experiences of phobias (68.4%) and obsessions/compulsions (73.7%) in childhood for the “anxiety first” group warrants further investigation to determine the characteristics of these experiences.

While this set of archival data provides much information about temporal sequencing of anxiety and cocaine use, many questions remain unanswered. Because of the small sample used in the present study and the inclusion of a single patient in the “cocaine first” group, it was impossible to compare the life-course-trajectories of each group. Consequently, whether the “anxiety first” and “cocaine first” groups are qualitatively different from each other remains to be assessed. Additional exploration of the cocaine/anxiety relationship would be better
served by a standardized measure of anxiety.

A subsequent study is currently underway in which temporal sequencing of anxiety and cocaine use/abuse will be explored with a larger sample and with more standardized measures. The Spielberger STAI is being used to assess both state and trait anxiety within patients. A more simplified version of the questionnaire used in the present study has been developed and is currently being completed by patients.

The seminal issue addressed in this research is the differences in life-course-trajectories between “anxiety first” and “cocaine first” patients. Although the small number of “cocaine first” subjects precluded analysis of between group variables in the present study, a subsequent study is underway to allow for such consideration. Life-course-trajectories of patients are being assessed and differences between groups will be analyzed to determine if differences exist between patients who use cocaine prior to onset of anxiety and those who experience anxiety prior to cocaine use.

References


Table 1:
Percentage of Patients Reporting the Following Life Events at First Experience of Anxiety

<table>
<thead>
<tr>
<th>Life Event</th>
<th>Percentage of Subjects Reporting the following:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relationship Issues</td>
<td>0.0%</td>
</tr>
<tr>
<td>None</td>
<td>5.3%</td>
</tr>
<tr>
<td>Abuse</td>
<td>5.3%</td>
</tr>
<tr>
<td>Physical Illness or Pregnancy</td>
<td>10.5%</td>
</tr>
<tr>
<td>Existential Tumult</td>
<td>10.5%</td>
</tr>
<tr>
<td>School-Related Problems</td>
<td>15.8%</td>
</tr>
<tr>
<td>Family of Origin Issues</td>
<td>36.8%</td>
</tr>
</tbody>
</table>

Table 2:
Mean Frequencies of Anxiety-Causing Events in Childhood

<table>
<thead>
<tr>
<th>Event</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Never</td>
</tr>
<tr>
<td>Night terrors or nightmares</td>
<td>0.0%</td>
</tr>
<tr>
<td>Obsessions/compulsions</td>
<td>26.3%</td>
</tr>
<tr>
<td>Fear of going to school</td>
<td>57.9%</td>
</tr>
<tr>
<td>Learning problems</td>
<td>57.9%</td>
</tr>
<tr>
<td>Phobias</td>
<td>31.6%</td>
</tr>
<tr>
<td>Bullied</td>
<td>47.4%</td>
</tr>
</tbody>
</table>

Table 3:
Likert Scale Responses of Amount of Anxiety Felt During Family Conflicts in Childhood
(0 being “no anxiety”, 10 being “very anxious”)

<table>
<thead>
<tr>
<th>Level of Anxiety</th>
<th>Percentage of Patients Reporting</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>5.3%</td>
</tr>
<tr>
<td>1</td>
<td>5.3%</td>
</tr>
<tr>
<td>2</td>
<td>5.3%</td>
</tr>
<tr>
<td>3</td>
<td>5.3%</td>
</tr>
<tr>
<td>4</td>
<td>0.0%</td>
</tr>
<tr>
<td>5</td>
<td>0.0%</td>
</tr>
<tr>
<td>6</td>
<td>21.1%</td>
</tr>
<tr>
<td>8</td>
<td>15.8%</td>
</tr>
<tr>
<td>9</td>
<td>15.8%</td>
</tr>
<tr>
<td>10</td>
<td>15.8%</td>
</tr>
</tbody>
</table>
Table 4:  
Frequency of Anxiety or Panic Over Past Six Months

<table>
<thead>
<tr>
<th>Response</th>
<th>Percentage of Patients Reporting</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>0.0%</td>
</tr>
<tr>
<td>Seldom</td>
<td>26.3%</td>
</tr>
<tr>
<td>Weekly</td>
<td>15.8%</td>
</tr>
<tr>
<td>Two to three (per week)</td>
<td>31.6%</td>
</tr>
<tr>
<td>Daily</td>
<td>15.8%</td>
</tr>
<tr>
<td>Several times (per day)</td>
<td>10.5%</td>
</tr>
</tbody>
</table>

Table 5:  
Age at First and Escalating Use of Drugs

<table>
<thead>
<tr>
<th>Drug</th>
<th>First Use</th>
<th>Escalation Use</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean Age</td>
<td>Mean Age</td>
</tr>
<tr>
<td></td>
<td>X</td>
<td>SD</td>
</tr>
<tr>
<td>Caffeine</td>
<td>13.54</td>
<td>7.05</td>
</tr>
<tr>
<td>Alcohol</td>
<td>16.21</td>
<td>6.27</td>
</tr>
<tr>
<td>Marijuana</td>
<td>17.86</td>
<td>9.33</td>
</tr>
<tr>
<td>Opiates</td>
<td>18.67</td>
<td>8.46</td>
</tr>
<tr>
<td>Sedatives</td>
<td>18.70</td>
<td>4.47</td>
</tr>
<tr>
<td>Hallucinogens</td>
<td>19.73</td>
<td>7.08</td>
</tr>
<tr>
<td>Amphetamines</td>
<td>21.45</td>
<td>12.75</td>
</tr>
<tr>
<td>Cocaine</td>
<td>24.74</td>
<td>9.08</td>
</tr>
</tbody>
</table>
This paper examines the lyrics of nine traditional Cuban ballads. Through textual comparison and analysis, it is shown that although each song uses a “language of love” that is perhaps universally recognizable, the song lyrics also reveal a deeper complexity of meaning in which love translates into other sensitivities, and overt meanings are obscured. Four extensions of the standard notion of “lover” are considered and compared: the lover as woman, the lover as place, the lover as political figure, the lover as supreme being, and the lover as ethnic collective. It is argued that all make similar use of the ballad medium and its expected symbols and imagery, yet with a range of expressive functions that challenge the notion of love ballad as a form of simplistic romantic expression.

The use of song as a form of direct address to one’s beloved is certainly the most straightforward use of the ballad medium. In this section, we look at two songs that make extensive use of such expression: “Chan Chan” and “Tomando Té.” Both the Spanish and English are given in parallel text for easy comparison. In the following songs as well as throughout the paper, portions of special relevance to our topic are given in bold italics.

Extensions of “Lover” in Cuban Lyrics

The Cuban ballad is tied as intimately to the people who sing it as it is to the cultural contexts in which it emerged and in which it is sung. As lyric and song, it recalls both the form and content of the Spanish romancero of the fifteenth and sixteenth centuries, yet bears the unique markings of Caribbean experience. A key difference is reflected in use of language: the romancero typically avoided metaphor, personification, and symbol, yet the Cuban ballad embraces such elements (Smith 1996: viii). Indeed, the use of double-entendre is as common in Cuban song as it is in Caribbean daily life. It compels the ballad to reach beyond trite gesticulations of love, desire, and longing. As a result, the basic notion of “lover”—the central element of the love ballad—emerges as an entity much more complex than a human object of desire.

In this paper, we examine four ways in which the notion of “lover” may be extended from a human (usually female) object of desire to a place, a political figure, the Supreme Being, as well as an entire ethnicity.

The “Lover” as Woman

In his book Caribbean Currents, Manuel (1995: 237) addresses the use of song to express feelings of love, specifically as a way of speaking to the heart of a lover:

Throughout the Caribbean as throughout the world, love and male-female relationships have always been favorite song topics… Caribbean men, especially in the Spanish-speaking areas, often use songs to convey their feelings, singing softly in a lover’s ear, playing a romantic record over and over for a beloved woman, or even giving a sweetheart a chosen recording.
At first glance, these songs appear to be quite different in theme. The first, “Chan-Chan,” directly addresses a woman lover, using a set of images that clearly reflect feelings of love and sexual desire. The second, “Tomando Té,” at first glance, appears to proclaim the joy of drinking tea. On second glance, however, the lyrics of “Tomando Té” might also be interpreted as directly addressing a woman as well. The title “Tomando té” is a double-entendre; although it can mean “drinking tea” (tomando té), it can also be understood as a “taking you” (tomándote), because in Spanish the words for tea and you are spelled slightly differently, but pronounced virtually the same: té and te. Any minute difference in pronunciation between tomando té and tomándote would almost definitely be leveled in a metered form of expression such as a song. When “Tomando Té” is interpreted in this sense, it becomes quite different. The song simultaneously proclaims the medicinal value of drinking tea and provokes the listener with a more suggestive meaning that lies just below the surface. Then, in the last three verses of the song, ambiguity is resolved. The lines “Cuando te tome en casa” and “En efecto te tome” can only be read one way. In the end, the suggestive meaning is validated.

**Chan Chan**
-Máximo Francisco Repilado Muñoz
De Alto Cedro voy para Marcane
Llego a Cueto voy para Mayari
De Alto Cedro voy para Marcane
Llego a Cueto voy para Mayari

**Del cariño que te tengo**
No te lo puedo negar
Se me sale la babita
Yo no lo puedo evitar.

**Cuando Juanica y Chan Chan**
en el Mar cernían arena
Como sacudía el jibe
A Chan Chan le daba pena
Limpia el camino de pajas
Que yo me quiero sentar
En aquel tronco que veo
Casi no puedo llegar.

**Tomando Té**
No puedo tomar café
porque el café me quita el sueño
sólo puedo tomar té
porque tomando té me duermo
Es la lógica del té
hierba tan medicinal!

que estaría todo el día
que estaría todo el día
tomando té
tomando té

El doctor que a mi me ve
Exclama con mucha guasa
Que yo sólo sanaré
Cuando te tome en la casa

En efecto te tome
Y tan dulce lo sentí!

**Chan Chan**
I’m going from Alto Cedro to Marcane
Then from Cueto, I’m going to Mayari.

**Drinking Tea [?]**
I cannot drink coffee
because it keeps me awake
I can only drink tea
because by drinking tea I fall asleep
It’s the logic of tea
What a medicinal Herb!

I’d be the whole day.
I’d be the whole day.
drinking tea
drinking tea.

The doctor who sees me
ironically says
that I’ll only get better
if I’d drink tea at home

En efecto te tome
Y tan dulce lo sentí!
The “Lover” as Place

Cuban traditional songs adapt the amorous language and images prevalent in “Chan-Chan” and “Tomando Té” to express nostalgia for a place, as we see Siboney and Andalucía.

Both Siboney and Andalucía are places: Siboney is a Cuban town and Andalucía is a region of Spain. When hearing “Siboney” and “Andalucía,” a listener who was not aware of these facts could easily identify these songs as ballads sung to women, especially since these songs are sung in the second person, suggesting a human object. Except for a few depersonifying words such as “suelo” and “tierra” in “Andalucía,” both songs may as well be songs to women with real physical characteristics and sexual allure. The title “Andalucía” is strongly suggestive of a woman’s name. Notice in the lyrics that many of the images and metaphors—body parts, the night, and a wish that the addressed might come soon—are similar to those used in “Chan Chan” and “Tomando Té.” Most significantly, they personify the place as a female lover.

---

**Siboney**

*—Enesto Lecuona*

Siboney, 
yo te quiero, yo me muero por tu amor
Siboney, en tu boca 
la miel puso su dulzor
Ven a mí, 
que te quiero y que todo tesoro eres tú 
para mí
Siboney, alarrullo de 
la palma pienso en ti
Siboney, de mis sueños, 
si no oyes la que ja de mi voz.
Siboney, si no vienes me moriré de amor.
Siboney, de mis sueños, 
espero con ansia en mi caney,
porque tú eres el sueño de mi amor,
Oye el eco de mi canto de cristal
No se pierda por entre el rudo maníqual.

---

**Siboney**

Siboney, I love you, I would die for your love.
Siboney, your lips are as sweet as honey.

**Come to me,**

because I love you and you are a treasure to me
Siboney, the sweet lullaby of the palms makes me think of you.
Siboney, you are in my dreams when you are not near.
Siboney, if you don’t come to me, I shall die brokenhearted.
Siboney of my dreams
I will await you anxiously in my hut, for you are my dream of love, Siboney.
Hear the echo of my tender cry.
Don’t get lost on your way through the jungle.

---

**Andalucía**

*—Ernesto Lecuona*

Andalucía, 
suelo encantador
la flor de amor 
quién vino a ti jamás te olvidará
feliz será!
Tus cármenes grandinos de ilusión 
donde las fontanas cantan murmurando su pasión.
Andalucía, 
tierra de pasión
mi corazón
De amores embriagado suspiro con tu aliento perfumado se embriago
Tus noches dan encanto al corazón
No hay tierra más primorosa que Andalucía 
tierra de alegría y de amor. 
donde las flores perfuman y las mujeres son flores de amor
Andalucía, flor de amor.

---

**Andalucía**

Andalucía, enchanting land,
flower of love,
he who comes to you will never forget you, and will always be happy!
Your red-brown land of fantasy where the springs sing, murmuring their passion.
Andalucía, land of passion, my heart.
Euphoric with love I sigh;
With your perfumed breath you enraptured me.
Your nights give enchantment to the heart.
No land is more beautiful than Andalucía,
Land of joy and of love where the flowers are fragrant and the women are flowers of love.
Andalucia, flower of love.
The “Lover” as Political Figure

In Cuba the names “Comandante” and “Caballo Viejo” are well-known to Cubans. The “Comandante” (Commander) is Che Guevara, a revolutionary killed following the takeover of 1959, and “Caballo Viejo” (Old Horse) is Fidel Castro himself, the long-standing president of Cuba, who demands the total allegiance of his people. The following two songs “¡Hasta siempre! Comandante” and “El Caballo Viejo” conform to the ballad format. Although their images bear the added heft of political statement, they still ring with desire that is thoroughly personified.

The similarities and differences in these two songs and the previously mentioned are many. In “¡Hasta Siempre! Comandante,” Che Guevara is directly addressed, whereas in “El Caballo Viejo,” Fidel Castro is sung about in the third person. Use of the third person may be a gesture of respect; in any case, it gives the song a strongly legendary tone. In all regards, both are songs of love. The first is a promise of love to the lost hero, and the second is a fable of how the old horse (Castro) found his mare, which presumably represents the Cuban people to whom he has committed his life.

In both songs, interestingly, the lyrics are sung not by an “I” as in the songs previously examined, but rather by a collective “we.” This perspective seems consistent with the fervent solidarity reinforced by all state institutions in communist Cuba. It also includes the listener in the song, such that the listener is essentially “trapped” in the singer’s political viewpoint, whether he or she likes it or not.

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### El Caballo Viejo

**- Simon Díaz**

| Es una poesía que habla de un caballo viejo que se encuentra libre por el amor. Cuando el amor llega así de esta manera, uno no se da cuenta de que un corazón amarrado, cuando le sueltan las riendas, se convierte en un caballo desbocado. Si un potro lozano se encuentra con el viejo, su corazón se libera. Este poema habla de la liberación del amor y la resistencia a las ataduras. |

| El Old Horse

| When love comes like this, in this way, one does not even realize it. The meadow becomes green again, the blossoms flourish and the rope is blown. | If the old horse finds a vigorous young mare, his chest is unleashed, he gets unbridled. And cannot be controlled by the bit, nor by a fake rein.  |

| Cuando el amor llega así de esta manera, uno no se da ni cuenta que un corazón amarrado, cuando le sueltan las riendas, se convierte en un caballo desbocado. Si un potro lozano se encuentra con el viejo, su corazón se libera. Este poema habla de la liberación del amor y la resistencia a las ataduras. |

| When love comes like this, in this way, it is not one's fault. Love has neither schedule, nor date on the calendar. When desires come together, they set the horse free, for he is old and tired. They don’t even realize that when a tied heart is released from its reins, it turns wild.  |

### Cuando las ganas se juntan

| Cuando el amor llega así de esta manera, uno no tiene la culpa. Quererse no tiene horario, ni fecha en el calendario. Cuando las ganas se juntan, caballo le dan sabana porque está viejo y cansao. Y sale por la mañana con su pasito apurao. A verse con su potranca que lo tiene embarrascao. |

| When desires come together, they set the horse free, for he is old and tired. And he leaves in the morning with his fast pace. To be seen with his young mare that has him crazy. |

| El potro da tiempo al tiempo porque le sobra la edad. El caballo viejo no puede perder la flor que le dan. Porque después de esta vida, no hay otra oportunidad. Cuando el amor llega así, llega así, de esta manera. |

| The colt bides his time, for he has plenty of it. But the old horse cannot lose the flower they give him. Because after this life, there is no other chance. When love comes like this, it comes like this, in this way. |
The “Lover” as Supreme Deity

A striking nevertheless subtle detail of the following song “Inpaz” is its ambiguous use of the possessive adjective su, which in Spanish has several meanings, including “you,” “him,” or “her.” The exact meaning is usually clarified by context. In the absence of such context, the adjective is polysemic. If we choose to translate the pronoun as “you,” then su is a form of respect, as when addressing someone higher, like a higher power. If “him,” then it could refer indirectly to a masculine deity—God (recall the use of third person in “Caballo Viejo,” above). If “her,” it could refer to a woman lover.

The resonating impact of this song is in its first and final verses: “¿Quién me va a quitar esta vaguedad?”—a plaguing, unanswered question. The words “tremble” and “great torment” are immediately reminiscent of the Biblical torment of Job, summed up neatly in Job 3: 20-25:

Why is light given to those in misery, and light to the bitter of soul,

to those who long for death that does not come,

who search for it more than hidden treasure,

who are filled with gladness and rejoice when they reach the grave?

Why is life given to a man whose way is hidden, whom God has hedged in?

For sighing comes to me instead of food; my groans pour out like water.

A similar line of questioning is found in Isaiah 63: 11-13:

Where is he who set his holy spirit among them,

who sent his glorious arm of power to be at Moses’ right hand,

who divided the waters before them,

to gain for himself everlasting renown, who led them through the depths?

The answer to these questions is, of course, the Almighty. This also seems to be the case in “Inpaz.” In addition to the spiritual intention evoked by these lyrics, the images and language are boldly physical, such as “intimacy” and the gender-ambiguous “breast.” These elements, as well as the never-identified object of the song, move together with images of love, desire, and impatience to express a deeper, more intricate passion.
Lover as “Racial Object”

Ballads sung to women often voice internalized racial perceptions, as evidenced in the following two songs:

Negra bembón
Thick-lipped Black [Woman]
-Arcaño

You passed by me yesterday, mulata, and glared at me contemptuously with your self-consuming conceit you put me down for my color.... Because you’ve Ironed your kinky hair and you’ve got a bit less color, you think you’re the queen of the house.

But the truth is more glaring, that you don’t know what you are, you’re a thick-lipped black, just like me.

These two songs describe a dark, mysterious woman: a mulata. They also reveal a brooding racial negativity. In “Negra Bembón,” we find reference to stereotypical physical characteristics associated with black people, such as “thick lips” and “kinky hair.” The song also calls attention to intra-racial status or social standing within the black community; specifically, the narrator is angry because the mulata of whom he sings is contemptuous and conceited, and disdains those she perceives as below her social status, simply because of her lighter skin. The phrase “queen of the house” could refer both to her occupational position within a household—traditionally black slaves or household helpers with lighter skin asserted and often achieved a privileged status over those of darker skin—as well as to her asserted position within the black culture. This song is an anti-ballad; the narrator addresses the woman as an object of desire, yet feels contempt at having been regarded by her with contempt rather than having the desire returned, and therefore he aims to debase her pride.

The song “María la O” is also sung to a mulata, this one described as “wretched.” A likely interpretation of this song is that the mulata mentioned in the opening verse as well as in the chorus sings about herself and how she has been cheated on by her lover. The self-denial and self-hatred that results from this infidelity resounds with a racial note: she was jilted because of her color, and that is something she has no hope of changing, hence the mortal despair. This

1Mulata (“mulatta,” in English), usually signifies a woman of racial mixture, usually of black and white. It may also be used to describe a woman who is dark-completed.
interpretation is consistent with Manuel (1995: 236) regarding the objectification of race in Latin music:

In Latin music, the woman beloved by the song’s narrator, if racially identified at all, is typically described as morena (“dark,” “mulatto”) or negra—seldom as white or blond. But aside from the ambiguity of negra (a common term of endearment meaning either “negress” or “dark-eyed one”), one might ask whether such references indicate a profound racial attitude, a purely aesthetic preference for dark women, or merely a conventional and superficial stereotype of such women as being exotic and sexy (236).

In the case of the previous two songs, the racial references come across as ambivalent, at once admiring the uniqueness of the mulata and condemning it.

**Conclusion**

This research has attempted to show that the traditional Cuban love ballad is not sung only to women, but also to places, political figures, higher beings, and racial groups as a whole. All the songs examined in this paper have at least one thing in common: adherence to a love ballad model. This model is characterized by use of second person (“you”), which gives the idea that a song is being addressed directly and intimately to one person; and also by use of more or less frank language and images referring to love, longing, desire, infidelity, sex, rejection, broken-heartedness, self-pity, and many others. Why this model and its attendant language and imagery recur across such a broad range of expressions is unclear and perhaps not a question worth asking. Much more interesting is the use of the ballad medium to express intense feelings about issues much broader than love—both overtly and covertly—and the apparent masking of meanings by the ballad medium itself.

This “masking of meanings” has special relevance in modern-day Cuba, which is, for all intents and purposes, a totalitarian state in which free expression is all but nonexistent. Moses (2000: 11) notes a tendency toward double-entendre almost as a way of life among contemporary Cubans:

The spoken language in Cuba is multi-layered, since meanings must often be conveyed through careful chosen words. Those who trust each other develop a cryptic, elliptical way of talking which is referred to as ‘speaking Chinese.’

This is not to say, however, that the usage of cryptic meanings and double-entendres is an effect of post-revolutionary Cuba. As we have seen, it is much more likely that the usage of “language of love” in songs that are not actually ballads is in fact a fundamental part of Cuban cultural expression.

**References**


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