McNair Scholars Research Journal

Volume 6 - Spring 2010

Featuring research of Boise State McNair Summer Research Fellows
### Boise State University McNair Scholars

#### Class of 2004

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<td>Chris Mathias</td>
<td>Criminal Justice</td>
<td>Vermont Law/Northeastern U.</td>
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#### Class of 2005

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<tr>
<td>Juan Berrocal</td>
<td>Electrical Engineering</td>
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<tr>
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<td>Communication</td>
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<td>Katey Irwin</td>
<td>Biology</td>
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<td>Jennifer Jenkins</td>
<td>Social Science</td>
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<tr>
<td>Megan Jensen</td>
<td>Art - Printmaking</td>
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<td>Josh Redden</td>
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<td>Irene Ruiz</td>
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<td>Deborah Allen</td>
<td>Social Science</td>
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<td>Lorena Alvarez</td>
<td>Psychology</td>
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<td>Columbia University</td>
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<tr>
<td>Luis Rosado</td>
<td>Exercise Science</td>
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MESSAGE FROM PRESIDENT BOB KUSTRA

It is with real pleasure that I write to introduce this sixth volume of the *McNair Scholars Research Journal*. The papers contained in this volume represent a remarkable breadth of scholarship that encompasses some of the best of what Boise State University has to offer. The Scholars, their faculty mentors, the staff of the McNair Program, and all of us at Boise State are justifiably proud of this work.

Congratulations to all of the 2010 McNair Scholars for your achievements over the past year. In particular, I want to acknowledge the hard work and accomplishments of the senior Scholars whose research is represented in the papers in this publication. McNair scholars work with faculty mentors who are committed to the rigors of scholarship—a working relationship that both students and faculty describe as unique and beneficial. I also want to recognize and thank all of the faculty mentors who have worked with our McNair Scholars. It is your patience, guidance, and encouragement that facilitates the transformation of these students into scholars.

The Ronald E. McNair Post-Baccalaureate Achievement Program honors the memory and achievement of the late Dr. Ronald E. McNair, a physicist and NASA astronaut. Its goal is to encourage undergraduates from underrepresented backgrounds to emulate the academic and professional accomplishments of Dr. McNair by facilitating their pursuit of doctoral degrees and academic careers in teaching and research. The McNair Scholars Research Journal is evidence that the McNair Program provides a valuable opportunity for these students to explore research on significant issues as they prepare for graduate school. Students also have access to venues such as conferences and journals where they can present their original projects.

The research presented here signals the arrival of a new group of rising scholars who will carry their talents, enthusiasm, and hard work ahead into graduate programs here and across the country. I hope that you will continue to aspire, achieve, and pursue your dreams.

Again, congratulations and best wishes.

Warm Regards,

Bob Kustra
We are very pleased to present our sixth issue of the Boise State McNair Scholars Research Journal. This journal introduces a group of scholars from Boise State whose numerous undergraduate accomplishments culminate with its publication. The collective excellence of these eleven articles is a testament to the scholarly habits of each of these scholars and to the support provided by a growing list of faculty mentors. The journal represents the first published piece for many McNair Scholars and is the final component of preparation the program provides to them as undergraduates at Boise State.

The McNair Program at Boise State strives to create meaningful academic experiences that will enable our students to succeed at the next level. The research component for McNair Scholars has two specific goals: First, to engage students in the research enterprise at the undergraduate level, so they develop the analytical and methodological skills, academic sophistication, and confidence that will make them successful students in graduate school. Second, to provide students a unique opportunity to publish their undergraduate research, so the scholars gain an early understanding of the critical role that publishing will play in their academic careers. In this respect, the McNair Scholars Research Journal is a key component in the preparation of our scholars for careers in research and teaching.

The research contained here is the culmination of work that for most of these scholars began in August of 2008 with the bulk of the research conducted in the summer of 2009. The scholars worked many hours in seminars with staff, with faculty mentors and each other in order to put together strong research projects. Their impressive achievements are the result of these very important collaborative efforts. Our McNair Scholars’ research continues to translate to high levels of success for our program so we find it most fitting that it culminates in recognition of their work through this journal. We are especially proud of how these students have grown as researchers and scholars.

As in the past, we need to extend deep appreciation to Memo Cordova who provides invaluable research guidance to McNair Scholars; to Meredith Grubbs who, besides doing scores of other things, helps us with every aspect of putting our journal together; and to faculty mentors, on whose expertise we deeply rely for all research to come to fruition.
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*The Boise State McNair Scholars Program is supported by a $225,000 annual grant from the US Department of Education TRiO Programs.*
Representing Propositional Logic Connectives
With Modular Polynomials

Shawn Davis: McNair Scholar
Dr. Andrés Caicedo: Mentor
Mathematics

Abstract

This paper explores the relationship between \( n \)-valued propositional logic connectives and modular polynomials. Namely the representing of logic connectives using modular polynomials. The case for \( n = 2 \) is explored and a method is developed for finding the coefficients of the unique polynomial that represents any given binary logic connective. Examples are then given for using the modular polynomial representations of connectives to determine the validity of propositional arguments. A similar procedure is shown for when \( n = 3 \) and an evaluation of the axioms of Łukasiewicz’s 3-valued logic is given using modular polynomials. The general case is explored to determine for which values of \( n \) the representation holds. It is then shown that \( \text{mod } n \) polynomial functions are sufficient for representing any \( n \)-valued logic connective if and only if \( n \) is prime.

1 Introduction

Mathematics and logic have a deep-rooted relationship with one another. Gottfried Wilhelm Leibniz explored this relationship in the 17th century [9][4]. George Boole published his Laws of Thought in the 19th century which further cemented the relationship between mathematics and logic [3][4].

This paper will focus on exploring the relationship between \( n \)-valued propositional logic and base \( n \) modular arithmetic. More specifically it will be concerned with polynomial functions in \( \mathbb{Z}_n \) that represent \( n \)-valued propositional logic connectives. The ultimate aim of this paper is to show that there exists a unique modular polynomial function for representing any \( n \)-valued propositional logic connective when \( n \) is prime.

The following abbreviations will be used for discussing propositional logics: ‘TRUE’, ‘FALSE’, and ‘INDIFFERENT’ will be represented by \( T \), \( F \), and \( I \) respectively. Common operators will be as follows: ‘AND’-\( \wedge \), ‘XOR’-\( \text{xor} \), ‘NOT’-\( \neg \), ‘OR’-\( \lor \), ‘IF...THEN’-\( \rightarrow \), and ‘IFF’-\( \leftrightarrow \).

2 General Propositional Logic Structure

Logical systems are composed of a syntactic element and a semantic element. For this paper, the syntax for an \( n \)-valued propositional logic will employ lower case letters with or without subscripts as variables, symbols for connectives of all arities, commas, and parentheses. Let \( \Sigma_n \) be the set composed of these elements for a given \( n \)-valued propositional logic. A finite string of symbols from \( \Sigma_n \) is allowable, or a well-formed formula (wff), if and only if it conforms to the following rules:

1. All variables are wffs.
2. If \( f \) is a symbol for a \( k \)-ary connective and \( w_1, w_2, \ldots, w_k \) are wffs then \( f(w_1, w_2, \ldots, w_k) \) is a wff.

Let \( L_n \) be the set of all allowable strings from \( \Sigma_n \).

Let \( V_n \) be a set of size \( n \). \( V_n \) is the set of truth values of the logic. Further \( V_n \) contains two distinguished symbols, \( T \) and \( F \), that represent truth and falsehood respectively.

The semantics of the logic assign meaning to the symbols for connectives. This meaning is determined based on how the connective behaves under certain valuations of the propositional variables. A valuation is a map, \( v \), from the set of propositional variables to \( V_n \). Thus the semantics is defined by specifying how to extend each valuation \( v \) so it is a map from all of \( L_n \) to \( V_n \). This is done by interpreting each \( k \)-ary connective, \( f \), as a function, \( \hat{f} : V_n^k \rightarrow V_n \) such that:

\[ v(f(p_1, \ldots, p_k)) = \hat{f}(v(p_1), \ldots, v(p_k)) \]

This extends each valuation \( v \) from all of \( L_n \) to \( V_n \)[1][5][11].
3 2-Valued Structures

The structure for 2-valued propositional logic will employ \( \Sigma_2, \mathcal{L}_2, \) and \( V_2 = \{ F, T \} \). For example, the valuations of the binary operators, \((p \land q) \in \mathcal{L}_2\) and \((p \oplus q) \in \mathcal{L}_2\) are presented in tabular form:

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>( p \land q )</th>
<th>( p \oplus q )</th>
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<tr>
<td></td>
<td></td>
<td>T</td>
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Throughout the paper juxtaposition may be used in place of \( \land \).

4 Representation of 2-Valued Propositional Logic Connectives Using Mod 2 Polynomials

**Lemma 4.1** (Fermat). \( p^n \equiv p \mod n \) when \( n \) is prime. \( \square \)

**Theorem 4.2.** For any prime \( n \) and any polynomial \( P \in \mathbb{Z}_n[x_1, x_2, \ldots, x_k] \), there is a unique polynomial \( \hat{P} \) such that:

1. For all \( m_1, \ldots, m_k \in \mathbb{Z}_n \), \( P(m_1, \ldots, m_k) = \hat{P}(m_1, \ldots, m_k) \)
2. The degree of any \( x_i \) in any monomial in \( \hat{P} \) is smaller than \( n \).

**Proof.** Let \( P \) be an arbitrary polynomial in \( \mathbb{Z}_n[x_1, x_2, \ldots, x_k] \) where \( n \) is prime. Let \( m_i \) represent the degree of the variable \( x_i \) with \( 1 \leq i \leq k \). If \( 0 < m_i < n \) then there is nothing to prove. If \( m_i > n \) then by lemma 4.1

\[
x_i^{m_i} = x_i^{m_i - n} \equiv x_i^{m_i - n + 1} \mod n.
\]

Now if \( 0 < m_i - n + 1 < n \) then set \( m_i - n + 1 \) as the value of \( m_i \) and we are done, else repeat this \( j \) times such that \( 0 < m_i - j(n - 1) < n \) at which point set \( m_i = j(n - 1) \) as the value of \( m_i \). Performing this reduction for all monomials in \( P \) yields \( \hat{P} \) such that satisfies (1) and (2).

Let \( P \) be an arbitrary polynomial in \( \mathbb{Z}_n[x_1, x_2, \ldots, x_k] \) where \( n \) is prime. Note that \( \mathbb{Z}_n[x_1, x_2, \ldots, x_k] \) is an integral domain, since \( \mathbb{Z}_n \) is a field when \( n \) is prime. \( \square \)

Consider polynomials in \( \mathbb{Z}_2[p, q] \). These polynomials have the reduced form \( c_1pq + c_2p + c_3q + c_4 \) by Theorem 4.2. Call this general reduced form \( P_2(p, q) \). Accounting for the four possible value combinations of \( p \) and \( q \) and substituting these values into the polynomial \( P_2 \) yields four linear equations:

\[
\begin{align*}
P_2(1, 1) &= c_1 + c_2 + c_3 + c_4 \\
P_2(1, 0) &= c_2 + c_4 \\
P_2(0, 1) &= c_3 + c_4 \\
P_2(0, 0) &= c_4.
\end{align*}
\]

Setting up these equations into a linear system in matrix form gives us:

\[
\begin{bmatrix}
1 & 1 & 1 & 1 \\
0 & 1 & 0 & 1 \\
0 & 0 & 1 & 1 \\
0 & 0 & 0 & 1
\end{bmatrix}
\]
Since this matrix is triangular without zeros along the diagonal it is invertible and therefore spans \( \mathbb{Z}_2^4 \), the four-dimensional vector space with elements from \( \mathbb{Z}_2 \). This tells us that the coefficients of \( P_2 \) span \( \mathbb{Z}_2^4 \), so there is a polynomial representation for all the vectors of \( \mathbb{Z}_2^4 \) for the given valuations of \( p \) and \( q \).

**Theorem 4.3.** For any binary connective in \( \mathcal{L}_2 \), there is a unique polynomial in \( \mathbb{Z}_2[p, q] \) that represents this connective.

**Proof.** To show that there is a polynomial in \( \mathbb{Z}_2[p, q] \) that can represent any binary connective of \( \mathcal{L}_2 \), it needs to be shown that the valuation of all connectives can be represented by a fourth dimensional vector. Further it must be shown that this vector can be mapped onto a vector in \( \mathbb{Z}_2^4 \). Define \( h : \mathcal{V}_2 \rightarrow \{0, 1\} \) such that \( h(F) = 0 \) and \( h(T) = 1 \). Let \( \ast \in \mathcal{L}_2 \) be an arbitrary binary connective. Define vector \( \mathbf{v} \) such that \( v_i \) is the \( i \)th entry of \( \mathbf{v} \) and each \( v_i \) is the valuation, \( g \), of \( \ast \) such that \( v_1 = g(T \ast T) \), \( v_2 = g(T \ast F) \), \( v_3 = g(F \ast T) \) and \( v_4 = g(F \ast F) \). Taking \( h_2(\mathbf{v}) \) gives a vector in \( \mathbb{Z}_2^4 \) and from above the coefficients of \( P_2 \in \mathbb{Z}_2[p, q] \) span \( \mathbb{Z}_2^4 \), so there is a unique set of coefficients for a polynomial in \( \mathbb{Z}_2[p, q] \) that represents the connective \( \ast \). Let \( P_\ast(p, q) \in \mathbb{Z}_2[p, q] \) be the polynomial that represents the connective \( \ast \). From Theorem 4.2, the reduced form of \( P_\ast \) is unique. Since \( \ast \) was an arbitrary binary connective, there exists a unique polynomial representation for all the binary connectives of \( \mathcal{L}_2 \). \( \square \)

The proof for the existence of polynomial representations for 2-valued propositional connectives of any arity is proved in the general case in section 9.

To find the representative polynomial of a binary connective we can use the linear system from above to find the coefficients of the polynomial. For example, to find the polynomial that represents the material conditional \((\rightarrow)\) of propositional logic we would row reduce the following:

\[
\begin{bmatrix}
1 & 1 & 1 & 1 & 1 \\
0 & 1 & 0 & 1 & 0 \\
0 & 0 & 1 & 1 & 1 \\
0 & 0 & 0 & 1 & 1
\end{bmatrix} \sim \begin{bmatrix}
1 & 0 & 0 & 0 & 1 \\
0 & 1 & 0 & 0 & 1 \\
0 & 0 & 1 & 0 & 0 \\
0 & 0 & 0 & 1 & 1
\end{bmatrix}
\]

This shows that the representative polynomial for \( p \rightarrow q \) is \( h(p)h(q) + h(p) + 1 \) where \( h \) is the mapping from \( \mathcal{V}_2 \) to \( \{0, 1\} \). Here \( \sim \) symbolizes that the two matrices are row equivalent.

## 5 Evaluating 2-Valued Propositional Logic Arguments Using Base 2 Modular Arithmetic

An argument in propositional logic is a set of premises that are taken to support a given conclusion [2]. For \( p_i, q \in \mathcal{L}_2 \), an argument with \( k \) premises can be symbolized as \((p_1 \land p_2 \land \ldots \land p_k) \rightarrow q\). The argument is said to be valid if and only if whenever all the premises are true the conclusion is also true. Another way to say this is that \((p_1 \land p_2 \land \ldots \land p_k) \rightarrow q\) is a tautology [11]. An element in \( \mathcal{L}_2 \) is a tautology if it is true on all possible truth values. By Theorem 4.2 and section 4, there is a unique polynomial representation for tautologies in \( \mathcal{L}_2 \). This can be determined using the method from the end of section 4:

\[
\begin{bmatrix}
1 & 1 & 1 & 1 & 1 \\
0 & 1 & 0 & 1 & 1 \\
0 & 0 & 1 & 1 & 1 \\
0 & 0 & 0 & 1 & 1
\end{bmatrix} \sim \begin{bmatrix}
1 & 0 & 0 & 0 & 0 \\
0 & 1 & 0 & 0 & 0 \\
0 & 0 & 1 & 0 & 0 \\
0 & 0 & 0 & 1 & 1
\end{bmatrix}
\]

Thus the polynomial representation of tautologies is the constant 1.

So to determine if an argument is valid using its polynomial representation, find the polynomial representation of the argument and reduce the resulting polynomial. The argument is valid if and only if the polynomial reduces to 1. Take for example *Modus Ponens*:

\[
\begin{align*}
1. & \quad p \rightarrow q \\
2. & \quad p \\
\therefore & \quad q.
\end{align*}
\]

Using the symbolic representation, this becomes:

\[
[(p \rightarrow q) \land p] \rightarrow q.
\]

Finding the representative polynomial of 3 gives

\[
[(p \times q + p + 1) \times p] \times q + [(p \times q + p + 1) \times p] + 1
\]

which simplifies via Theorem 4.2 to
\[
p^2 \times q^2 + p^2 \times q + p \times q + p^2 \times q + p^2 + p + 1 \\
= 4 \times p \times q + 2 \times p + 1 \\
= 1
\]  
(5)

The simplification of equation 5 to ‘1’ shows that the argument is a tautology and therefore \textit{Modus Ponens} is valid.

Now consider the fallacy of affirming the consequent:

1. \( p \rightarrow q \)
2. \( q \)
∴ \( p \).

Symbolizing this argument and finding the representative polynomial gives

\[
[(p \times q + p + 1) \times q] \times p + (p \times q + p + 1) \times q + 1 \\
= p^2 \times q^2 + p^2 \times q + p \times q + p \times q^2 + p \times q + q + 1 \\
= 5 \times p \times q + q + 1 \\
= p \times q + q + 1.
\]  
(7)

So equation 7 simplifies to \( p \times q + q + 1 \). Since this is not a tautology, affirming the consequent is invalid.

\section{6 3-Valued Structures}

The structure for 3-valued propositional logic will employ \( \Sigma_3, \mathcal{L}_3 \), and \( V_3 = \{F, I, T\} \). In \( V_3 \), I represents indifferent or undefined.

The structure for base 3 modular arithmetic is as follows: \{0,1,2,+,×,0,1\}. The tables for + and × are:

\[
\begin{array}{c|ccc}
+ & 0 & 1 & 2 \\
\hline
0 & 0 & 1 & 2 \\
1 & 1 & 2 & 0 \\
2 & 2 & 0 & 1 \\
\end{array} \\
\begin{array}{c|ccc}
\times & 0 & 1 & 2 \\
\hline
0 & 0 & 0 & 0 \\
1 & 0 & 1 & 2 \\
2 & 1 & 2 & 1 \\
\end{array}
\]

\section{7 Representation of 3-Valued Propositional Logic Connectives Using Mod 3 Polynomials}

Polynomials in \( \mathbb{Z}_3[p,q] \) have the reduced form via Theorem 4.2:

\[
c_1 \times p^2 \times q^2 + c_2 \times p^2 \times q + c_3 \times p^2 + c_4 \times p \times q^2 \\
+ c_5 \times p \times q + c_6 \times p + c_7 \times q^2 + c_8 \times q + c_9.
\]  
(8)

Call this polynomial \( P_3(p,q) \). Accounting for the nine possible value combinations of \( p \) and \( q \) and substituting these values into the polynomial \( P_3 \) yields nine linear equations. Using the method from section 4 to create a linear system for the coefficients of \( P_3 \) yields the matrix

\[
\begin{bmatrix}
1 & 2 & 1 & 2 & 1 & 2 & 1 & 2 & 1 \\
1 & 1 & 2 & 2 & 1 & 1 & 1 \\
0 & 0 & 1 & 0 & 0 & 2 & 0 & 0 & 1 \\
1 & 2 & 1 & 1 & 2 & 1 & 2 & 1 \\
1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \\
0 & 0 & 1 & 0 & 0 & 1 & 0 & 0 & 1 \\
0 & 0 & 0 & 0 & 0 & 0 & 1 & 2 & 1 \\
0 & 0 & 0 & 0 & 0 & 0 & 1 & 1 & 1 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1
\end{bmatrix}
\]

which has the inverse:
So the coefficients of $P_3$ span $\mathbb{Z}_9^3$. A similar proof to the one presented in Theorem 4.3 shows that for any binary connective in $\mathcal{L}_3$, there is a unique polynomial in $\mathbb{Z}_3[p,q]$ that represents this connective. Further the method for finding the coefficients of these polynomials as outlined in section 4 can be extended into the $n = 3$ case.

8 Łukasiewicz 3-Valued Axioms

The 3-valued propositional logic employed by Łukasiewicz used the operators, expressed in Polish notation, $C$ and $N$ [12]. For the notation used in this paper these operators become $\rightarrow$ and $\neg$ respectively. The truth tables for these operators are as follows:

<table>
<thead>
<tr>
<th>$p$</th>
<th>$q$</th>
<th>$p \rightarrow q$</th>
<th>$\neg p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$T$</td>
<td>$T$</td>
<td>$T$</td>
<td>$F$</td>
</tr>
<tr>
<td>$T$</td>
<td>$I$</td>
<td>$T$</td>
<td>$F$</td>
</tr>
<tr>
<td>$I$</td>
<td>$T$</td>
<td>$T$</td>
<td>$I$</td>
</tr>
<tr>
<td>$I$</td>
<td>$I$</td>
<td>$T$</td>
<td>$I$</td>
</tr>
<tr>
<td>$I$</td>
<td>$F$</td>
<td>$I$</td>
<td>$I$</td>
</tr>
<tr>
<td>$F$</td>
<td>$T$</td>
<td>$T$</td>
<td>$T$</td>
</tr>
<tr>
<td>$F$</td>
<td>$I$</td>
<td>$T$</td>
<td>$T$</td>
</tr>
<tr>
<td>$F$</td>
<td>$F$</td>
<td>$T$</td>
<td>$T$</td>
</tr>
</tbody>
</table>

Applying $h : V_3 \rightarrow \{0, 1, 2\}$ to the valuations of these operators such that $h(F) = 0$, $h(I) = 1$, and $h(T) = 2$ and entering them into vectors gives:

$$
\begin{bmatrix}
2 \\
1 \\
0 \\
2 \\
1 \\
2 \\
0 \\
2 \\
2 \\
2 \\
0 \\
1 \\
1 \\
0 \\
2 \\
1 \\
2 \\
2 \\
2
\end{bmatrix}
\begin{bmatrix}
0 \\
0 \\
1 \\
1 \\
2 \\
1 \\
0 \\
1 \\
2 \\
1 \\
0 \\
1 \\
2 \\
1 \\
0 \\
1 \\
2 \\
2
\end{bmatrix}
$$

Augmenting the coefficient matrix from section 7 with these vectors and row reducing gives the coefficients for the polynomial functions that represent these operators.

$$
\begin{bmatrix}
1 & 2 & 1 & 2 & 1 & 2 & 1 & 2 & 1 & 2 & 0 \\
1 & 1 & 1 & 2 & 2 & 1 & 1 & 1 & 1 & 1 & 1 \\
0 & 0 & 1 & 0 & 0 & 2 & 0 & 0 & 1 & 0 & 0 \\
1 & 2 & 1 & 1 & 2 & 1 & 1 & 2 & 1 & 2 & 1 \\
1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 2 & 1 \\
0 & 0 & 1 & 0 & 0 & 1 & 0 & 0 & 1 & 1 & 1 \\
0 & 0 & 0 & 0 & 0 & 0 & 1 & 2 & 1 & 2 & 2 \\
0 & 0 & 0 & 0 & 0 & 0 & 1 & 1 & 1 & 2 & 2 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 2
\end{bmatrix}
\sim
\begin{bmatrix}
1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 2 & 0 \\
0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 2 & 0 \\
0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 2 & 0 \\
1 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 2 & 0 \\
0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 1 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 2 & 2
\end{bmatrix}
$$

From this $(p \rightarrow q)$ is represented by the polynomial $2 \times h_3(p)^2 \times h_3(q)^2 + 2 \times h_3(p)^2 \times h_3(q) + 2 \times h_3(p) \times h_3(q)^2 + h_3(p) \times h_3(q) + 2 \times h_3(p) + 2$ and $(\neg p)$ is represented by the polynomial $2 \times h_3(p) + h_3(p)$.

Łukasiewicz employed four axioms for his logic:

5
Ax1: \( p \rightarrow (q \rightarrow p) \)
Ax2: \( (p \rightarrow q) \rightarrow [(q \rightarrow r) \rightarrow (p \rightarrow r)] \)
Ax3: \( (\neg p \rightarrow \neg q) \rightarrow (q \rightarrow p) \)
Ax4: \( ((p \rightarrow \neg p) \rightarrow p) \rightarrow p \)

Being axioms all four should be tautologies. Finding the representative polynomials for these axioms and reducing the polynomials using Theorem 4.2 yields a single 2 for all four axioms (See Appendix). To verify that 2 is indeed the unique polynomial that represents tautologies row reduce the following matrix:

\[
\begin{bmatrix}
1 & 2 & 1 & 2 & 1 & 2 & 1 & 2 & 1 & 2 \\
1 & 1 & 1 & 2 & 2 & 1 & 1 & 1 & 2 \\
0 & 0 & 1 & 0 & 0 & 2 & 0 & 0 & 1 & 2 \\
1 & 2 & 1 & 1 & 2 & 1 & 1 & 2 & 1 & 2 \\
1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 2 & 2 \\
0 & 0 & 1 & 0 & 0 & 1 & 0 & 0 & 1 & 2 \\
0 & 0 & 0 & 0 & 0 & 0 & 1 & 2 & 1 & 2 \\
0 & 0 & 0 & 0 & 0 & 0 & 1 & 1 & 1 & 2 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \\
\end{bmatrix}
\sim
\begin{bmatrix}
1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \\
\end{bmatrix}
\]

Thus 2 is the polynomial that represents tautologies which means that the axioms all simplify to tautologies as expected.

### 9 Determining which values of \( n \) allow for polynomial representations of logical connectives

Let \( P_n \) represent the reduced general form of \( \mathbb{Z}_n[p,q] \). For base \( n \) modular arithmetic, the structure will be \{0,1,..,n-1\}, +, \times, 0, 1\}. Let \( L_n \) map \( \mathbb{Z}_n \) to \( \mathbb{Z}_n[p,q] \) and \( h_n \) be a function that maps \{F, I_1, I_2, ..., I_{n-2}, T\} to \{0,1,2,..,n-1\} such that \( h_n(F) = 0, h_n(I_1) = 1, h_n(I_2) = 2, ..., h_n(I_{n-2}) = n-2, h_n(T) = n-1 \). To examine whether or not \( n \) is viable for a given structure, two cases where \( n \) is composite and \( n \) is prime will be examined.

The method from sections 4 and 7 will be used to set up a linear system for the coefficients of \( P_n \). The rows will be formed by setting the values of \( p \) and \( q \) in the following way:

\[
\begin{align*}
(p &= n-1, q = n-1) \\
(p &= n-1, q = n-2) \\
\vdots \\
(p &= n-1, q = 1) \\
(p &= n-2, q = n-1) \\
\vdots \\
(p &= 1, q = 1) \\
(p &= n-1, q = 0) \\
(p &= n-2, q = 0) \\
\vdots \\
(p &= 1, q = 0) \\
(p &= 0, q = n-1) \\
\vdots \\
(p &= 0, q = 0)
\end{align*}
\]

The columns will represent the following powers of \( p \) and \( q \):

\[
p^{n-1}q^{n-1} \quad p^{n-1}q^{n-2} \quad ... \quad p^{n-1}q^1 \quad p^{n-2}q^{n-1} \quad ... \quad p^1q^1 \quad p^{n-1}q^0 \quad ... \quad p^1q^0 \quad p^0q^{n-1} \quad ... \quad p^0q^0
\]

Call the matrix constructed to these specifications \( C_2 \).

**Theorem 9.1** (Case when \( n \) is composite). When \( n \) is a composite number \( \mathbb{Z}_n[p,q] \) is insufficient to represent all the connectives of \( n \)-valued propositional logic.
Proof. Consider an \( n \)-valued propositional logic. Let \( n \) be a composite number such that \( n = i \times j \) where \( i \) and \( j \) are integers. From section 9 this can be translated into a base \( n \) polynomial function with a coefficient matrix \( C_2 \). There is a row in \( C_2 \) such that \( p = i \) and \( q = 0 \). Multiplying this row by \( k \) yields a row that is linearly dependent with the row made when \( p = 0 \) and \( q = 0 \). These two rows are shown below.

\[
(p = i, q = 0) \quad \begin{bmatrix} 0 & 0 & \ldots & 0 & p^{n-1} & p^{n-2} & \ldots & i^1 & 0 & \ldots & 1 \end{bmatrix}
\]

Multiplying this row by \( k \) gives:

\[
\begin{bmatrix} 0 & 0 & \ldots & 0 & k \end{bmatrix}.
\]

When \( (p = 0, q = 0) \)

\[
\begin{bmatrix} 0 & 0 & \ldots & 0 & 0 \end{bmatrix}.
\]

Since \( C_2 \) contains at least two rows that are linearly dependent \( C_2 \) does not span \( \mathbb{Z}_n^2 \) and therefore cannot span all possible binary connectives of \( \mathcal{L}_n \). This means that the base \( n \) polynomial is insufficient for representing all binary connectives and therefore insufficient for representing all the connectives of \( n \)-valued propositional logic.

\[ \square \]

**Theorem 9.2** (Case when \( n \) is prime). When \( n \) is a prime number, \( \mathbb{Z}_n[x_1, x_2, \ldots, x_k] \) is sufficient to represent any \( k \)-ary connective of \( n \)-valued propositional logic.

**Proof.** Let \( n \) be prime. This will be a proof by induction on the coefficient matrices constructed from the \( k \)-variate polynomial in \( \mathbb{Z}_n[x_1, x_2, \ldots, x_k] \). The base case will be \( k = 2 \). First, though, consider the following lemma.

**Lemma 9.3.** Let \( C_k \) represent the coefficient matrix for the generalized polynomial \( P(x_1, \ldots, x_k) \in \mathbb{Z}_n[x_1, \ldots, x_k] \). If \( C_k \) is invertible then there is a representative polynomial in \( \mathbb{Z}_n[x_1, \ldots, x_k] \) for all \( k \)-ary connectives in \( \mathcal{L}_n \).

**Proof.** This follows from an extension of theorem 4.3. If it can be shown that the valuation for any \( k \)-ary connective can be represented by a vector in \( \mathbb{Z}_n^{(n^k)} \), then, assuming \( C_k \) is invertible such that it spans \( \mathbb{Z}_n^{(n^k)} \), there is a representative polynomial in \( \mathbb{Z}_n[x_1, \ldots, x_k] \) for all \( k \)-ary connectives. Let \( f \) be the symbol for an arbitrary \( k \)-ary connective in \( \Sigma_n \) and the vector \( \vec{v} \) be such that its entries are the valuations of \( f \) for all possible combinations of valuations for \( x_1, x_2, \ldots, x_k \). Thus \( |\vec{v}| = n^k \). Now let \( h : V_n \rightarrow \{0, 1, 2, \ldots, n - 1\} \) be a one-to-one and onto function. So \( h(\vec{v}) \in \mathbb{Z}_n^{(n^k)} \).

From lemma 9.3, to show that a representative polynomial exists for any given \( k \)-ary connective it will be sufficient to show that \( C_k \), the coefficient matrix of \( k \) variables, is invertible.

Set \( m = n^2 \) and assume for contradiction that there exists a non-trivial vector \( \vec{x} \in \mathbb{Z}_n^m \) such that \( C_2 \cdot \vec{x} = \vec{0} \). Let \( x_i \) denote the \( i^{th} \) element of \( \vec{x} \). Note that \( x_m = 0 \), since the \( m^{th} \) row of \( C_2 \) is

\[
\begin{bmatrix} 0 & 0 & \ldots & 0 & 1 \end{bmatrix}.
\]

So the \( m^{th} \) row of \( C_2 \) multiplied by \( \vec{x} \) equals 0 and thus \( x_m = 0 \).

Now consider the \( m - (n - 1) \) through \( m - 1 \) rows which take the form:

\[
\begin{bmatrix}
0 & 0 & \ldots & 0 & (n - 1)^{n-1} & (n - 1)^{n-2} & \ldots & (n - 1)^1 & (n - 1)^0 \\
0 & 0 & \ldots & 0 & (n - 2)^{n-1} & (n - 2)^{n-2} & \ldots & (n - 2)^1 & (n - 2)^0 \\
\vdots & \vdots & \ddots & \vdots & \vdots & \vdots & \ddots & \vdots & \vdots \\
0 & 0 & \ldots & 0 & 2^{n-1} & 2^{n-2} & \ldots & 2^1 & 2^0 \\
0 & 0 & \ldots & 0 & 1^{n-1} & 1^{n-2} & \ldots & 1^1 & 1^0 \\
\end{bmatrix}
\]

Since the first \( m - n \) columns are zero and \( x_m \) is also zero, the columns of interest are \( m - n + 1 \) through \( m - 1 \). These entries form an \( (n - 1) \times (n - 1) \) matrix of the form:

\[
\begin{bmatrix}
(n - 1)^{n-1} & (n - 1)^{n-2} & \ldots & (n - 1)^1 \\
(n - 2)^{n-1} & (n - 2)^{n-2} & \ldots & (n - 2)^1 \\
\vdots & \vdots & \ddots & \vdots \\
2^{n-1} & 2^{n-2} & \ldots & 2^1 \\
1^{n-1} & 1^{n-2} & \ldots & 1^1 \\
\end{bmatrix}
\]

Call this matrix \( A_2 \). Now define a matrix \( B_2 \) with the form:
(n - 1) \cdot \begin{bmatrix}
(n - 1)^{n-1} & (n - 2)^{n-1} & \ldots & 1^{n-1} \\
(n - 1)^1 & (n - 2)^1 & \ldots & 1^1 \\
(n - 1)^2 & (n - 2)^2 & \ldots & 1^2 \\
\vdots & \vdots & \ddots & \vdots \\
(n - 1)^{n-3} & (n - 2)^{n-3} & \ldots & 1^{n-3} \\
(n - 1)^{n-2} & (n - 2)^{n-2} & \ldots & 1^{n-2}
\end{bmatrix}

\textbf{Lemma 9.4.} Let } n \text{ be a prime. For } S = \sum_{i=1}^{n-1} i^r \mod n \text{, if } (n - 1) \mid r \text{ then } S \equiv 0 \mod n. \text{ If } (n - 1) \mid r \text{ then } S \equiv (n - 1) \mod n. [6]

When multiplying } B_2 \cdot A_2 \text{ each entry is } \sum_{i=1}^{n-1} i^r \mod n. \text{ If necessary } r \text{ can be reduced by using lemma 4.1 until } 1 \leq r < n. \text{ For example, the multiplication of the } 1^{st} \text{ row of } B_2 \text{ with the } (n - 1)^{th} \text{ column of } A_2 \text{ would be } \sum_{i=1}^{n-1} i^{n+1} = \sum_{i=1}^{n-1} i^2. \text{ The entry can be determined using lemma 9.4. Note that once } r \text{ has been reduced the only case when } (n - 1) \mid r \text{ is when } r = (n - 1). \text{ It is only the case that } r = (n - 1) \text{ along the diagonal of the resulting matrix. So } B_2 \cdot A_2 \text{ takes the form:}

(n - 1) \cdot \begin{bmatrix}
(n - 1) & 0 & \ldots & 0 \\
0 & (n - 1) & \ddots & \vdots \\
\vdots & \ddots & \ddots & 0 \\
0 & \ldots & 0 & (n - 1)
\end{bmatrix} = I_{n-1}

where } I_{n-1} \text{ is the } (n - 1) \times (n - 1) \text{ identity matrix. This follows because } (n - 1)^2 = n^2 - 2n + 1 \equiv 1 \mod n. \text{ This means that } A_2 \text{ is invertible and for the equation } A_2 \cdot \vec{v} = \vec{0}, \vec{v} = \vec{0}. \text{ For the case at hand this means that } x_{m-n+1} \text{ through } x_{m-1} \text{ are equal to } 0. \text{ Similarly for rows } m - 2n + 2 \text{ through } m - n \text{ in } C_2, \text{ because } A_2 \text{ occurs in columns } m - 2n + 2 \text{ through } m - n. \text{ To illustrate here is the binary coefficient matrix for } P_3:

\begin{bmatrix}
1 & 2 & 2 & 1 & 1 & 2 & 1 & 2 & 1 \\
1 & 1 & 2 & 1 & 1 & 1 & 1 & 1 & 1 \\
1 & 2 & 1 & 2 & 1 & 1 & 1 & 2 & 1 \\
1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \\
0 & 0 & 0 & 0 & 1 & 2 & 0 & 0 & 1 \\
0 & 0 & 0 & 0 & 1 & 1 & 0 & 0 & 1 \\
0 & 0 & 0 & 0 & 0 & 1 & 2 & 1 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 1 & 1 & 1 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1
\end{bmatrix}

Therefore } x_{m-2n+2} \text{ through } x_{m-n} \text{ are also all equal to } 0.\text{ This leaves only the first } m - 2n + 1 \text{ rows and columns which can be partitioned into the following form:}

\begin{bmatrix}
(n - 1)^{n-1} \cdot A_2 & (n - 1)^{n-2} \cdot A_2 & \ldots & (n - 1)^1 \cdot A_2 \\
(n - 2)^{n-1} \cdot A_2 & (n - 2)^{n-2} \cdot A_2 & \ldots & (n - 2)^1 \cdot A_2 \\
\vdots & \vdots & \ddots & \vdots \\
2^n-1 \cdot A_2 & 2^{n-2} \cdot A_2 & \ldots & 2^1 \cdot A_2 \\
1^{n-1} \cdot A_2 & 1^{n-2} \cdot A_2 & \ldots & 1^1 \cdot A_2
\end{bmatrix}

Notice that the scalar multiples of } A_2 \text{ are exactly the entries of } A_2. \text{ Therefore it has the following inverse:}

(n - 1) \cdot \begin{bmatrix}
(n - 1)^{n-1} \cdot B_2 & (n - 2)^{n-1} \cdot B_2 & \ldots & 1^{n-1} \cdot B_2 \\
(n - 1)^1 \cdot B_2 & (n - 2)^1 \cdot B_2 & \ldots & 1^1 \cdot B_2 \\
(n - 1)^2 \cdot B_2 & (n - 2)^2 \cdot B_2 & \ldots & 1^2 \cdot B_2 \\
\vdots & \vdots & \ddots & \vdots \\
(n - 1)^{n-3} \cdot B_2 & (n - 2)^{n-3} \cdot B_2 & \ldots & 1^{n-3} \cdot B_2 \\
(n - 1)^{n-2} \cdot B_2 & (n - 2)^{n-2} \cdot B_2 & \ldots & 1^{n-2} \cdot B_2
\end{bmatrix}

This follows because } A_2 \cdot B_2 = I_{n-1} \text{ and the scalars ensure that all the entries except those along the diagonal are zero (from lemma 9.4). Also from lemma 9.4 the scalars down the diagonal are all } n - 1 \text{ so that when multiplied by the
scalar on the inverse, $B_2$, simplifies to 1. So the resulting matrix is a partitioned diagonal matrix with $I_{n-1}$ along the diagonal which is itself the identity matrix.

Thus, $x_1$ through $x_{m-2n+1}$ are all equal to 0. This means that $\bar{x}$ is trivial and therefore $C_2 \cdot \bar{x} = \bar{0}$ has only the trivial solution. From this it follows that $C_2$ is invertible [7].

Since $C_2$ is invertible when $n$ is prime, $\mathbb{Z}_n[p,q]$ is sufficient for representing all binary connectives in $\mathcal{L}_n$ by lemma 9.3.

Assume that $C_k$, the coeffecient matrix of $k$ variables, is invertible. Consider the coefficient matrix of $k + 1$ variables, $C_{k+1}$. It can be constructed such that it has the following form:

\[
\begin{bmatrix}
(n-1)^{n-1} \cdot C_k & (n-1)^{n-2} \cdot C_k & \ldots & (n-1)^1 \cdot C_k & C_k \\
(n-2)^{n-1} \cdot C_k & (n-2)^{n-2} \cdot C_k & \ldots & (n-2)^1 \cdot C_k & C_k \\
\vdots & \vdots & \ddots & \vdots & \vdots \\
2^{n-1} \cdot C_k & 2^{n-2} \cdot C_k & \ldots & 2^1 \cdot C_k & C_k \\
1^{n-1} \cdot C_k & 1^{n-2} \cdot C_k & \ldots & 1^1 \cdot C_k & C_k \\
0^{n-1} \cdot C_k & 0^{n-2} \cdot C_k & \ldots & 0^1 \cdot C_k & C_k
\end{bmatrix}
\]

For example take $C_2$ and $C_3$ when $n = 2$:

\[
C_2 = \begin{bmatrix}
1 & 1 & 1 & 1 \\
0 & 1 & 0 & 1 \\
0 & 0 & 1 & 1 \\
0 & 0 & 0 & 1
\end{bmatrix}
\]

\[
C_3 = \begin{bmatrix}
1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \\
0 & 1 & 0 & 1 & 0 & 1 & 1 & 0 \\
0 & 0 & 1 & 0 & 1 & 0 & 1 & 0 \\
0 & 0 & 0 & 0 & 1 & 1 & 1 & 1 \\
0 & 0 & 0 & 0 & 1 & 0 & 1 & 1 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0
\end{bmatrix}
\]

Assume for contradiction that there is a non-trivial vector $\bar{x}$ such that $C_{k+1} \cdot \bar{x} = \bar{0}$. Notice that the last $n^k$ entries of $\bar{x}$ are zero since $C_k$ is invertible and is the only non-zero partition for the final $n^k$ rows of $C_{k+1}$. Let $A_{k+1}$ be the first $n^{k+1} - n^k$ rows and columns of $C_{k+1}$. $A_{k+1}$ is a partitioned matrix of $C_k$ with scalar multiples from $A_2$ and so has the following inverse:

\[
(n - 1) \cdot C_k^{-1} 
\]

\[
\begin{bmatrix}
(n-1)^{n-1} \cdot C_k^{-1} & (n-2)^{n-1} \cdot C_k^{-1} & \ldots & 1^{n-1} \cdot C_k^{-1} \\
(n-1)^{n-2} \cdot C_k^{-1} & (n-2)^{n-2} \cdot C_k^{-1} & \ldots & 1^{n-2} \cdot C_k^{-1} \\
\vdots & \vdots & \ddots & \vdots \\
(n-1)^1 \cdot C_k^{-1} & (n-2)^1 \cdot C_k^{-1} & \ldots & 1^1 \cdot C_k^{-1} \\
(n-1)^0 \cdot C_k^{-1} & (n-2)^0 \cdot C_k^{-1} & \ldots & 1^0 \cdot C_k^{-1}
\end{bmatrix}
\]

This means that $\bar{x} = \bar{0}$ and so $C_{k+1}$ is invertible.

Therefore $n$-valued propositional connectives of all arities can be represented by a polynomial in $\mathbb{Z}_n[x_1, x_2, \ldots]$ if $n$ is prime.

Therefore from Theorems 9.1 and 9.2, all connectives of $\mathcal{L}_n$ can be represented by modular polynomials if and only if $n$ is prime.

References


Appendix

\[
\text{LoMat} := \begin{pmatrix}
1 & 2 & 1 & 2 & 1 & 2 & 1 & 2 & 1 \\
1 & 1 & 1 & 2 & 2 & 2 & 1 & 1 & 1 \\
0 & 0 & 1 & 0 & 0 & 2 & 0 & 0 & 1 \\
1 & 2 & 1 & 1 & 2 & 1 & 1 & 2 & 1 \\
1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \\
0 & 0 & 1 & 0 & 0 & 1 & 0 & 0 & 1 \\
0 & 0 & 0 & 0 & 0 & 1 & 2 & 1 \\
0 & 0 & 0 & 0 & 0 & 0 & 1 & 1 & 1 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1
\end{pmatrix}
\]

\[
\text{LoMat3} := '<<|>|'(\text{LoMat3}, '<<|>|'(2, 1, 0, 2, 2, 1, 2, 2, 2))
\]
LoMat3C :=
\[
\begin{bmatrix}
1 & 2 & 1 & 2 & 1 & 2 & 1 & 2 & 1 & 2 \\
1 & 1 & 1 & 2 & 2 & 2 & 1 & 1 & 1 & 1 \\
0 & 0 & 1 & 0 & 0 & 2 & 0 & 0 & 1 & 0 \\
1 & 2 & 1 & 1 & 2 & 1 & 2 & 1 & 2 & 0 \\
1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 2 \\
0 & 0 & 1 & 0 & 0 & 1 & 0 & 0 & 1 & 1 \\
0 & 0 & 0 & 0 & 0 & 0 & 1 & 2 & 1 & 2 \\
0 & 0 & 0 & 0 & 0 & 0 & 1 & 1 & 1 & 2 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 2
\end{bmatrix}
\]

C := (p, q) ↦ 2p^2q^2 + 2p^2q + 2pq^2 + pq + 2p + 2

LoMat3N :=
\[
\begin{bmatrix}
1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0
\end{bmatrix}
\]

N := p ↦ 2p + 2

> weakSimp := proc(expr, list)
local i, j, deg, simp, varList;
deg:=degree(expr);
simp:=expand(expr);
varList:=list;
if nops(varList)=0 then
    return "varList is empty";
end if;
for i from 1 to nops(varList) do
    simp:=(add(coeff(simp,varList[i],n)*varList[i]^(abs((n mod 2)-2)),n=1..deg) +coeff(simp,varList[i],0)) mod 3;
end do;
return expand(simp) mod 3;
end proc:

\[
Ax1 := C(p, C(q, p))
\]

\[
Ax2 := C(C(p, q), C(C(q, r), C(p, r)))
\]

\[
Ax3 := C(C(N(p), N(q)), C(q, p))
\]

\[
Ax4 := C(C(C(p, N(p)), p), p)
\]

weakSimp(Ax1,[p,q])

2

weakSimp(Ax2,[p,q,r])

2

weakSimp(Ax3,[p,q])

2

weakSimp(Ax4,[p])

2
Perceptions of Discrimination: An Analysis of Four National Surveys of Latinos; Findings from the Pew Hispanic Center/Kaiser Family Foundation National Survey of Latinos

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Abstract

Objective: Throughout the history of the United States different legal measures have resulted in efforts to deal with immigration issues, and some have resulted in adverse consequences for Latinos in particular. Massive immigration from 1850-1920 arose the historic distrust and suspicion of Anglos toward Mexicans and tended to evoke various kinds of repressive acts, excluding Mexican Americans from political participation (Garcia and de la Garza 1977). After the 9/11 attacks Latinos reported a heightened level of perceived discrimination as well as fear of deportation, even among U.S. Citizens. Methods: Using multiple-regression analysis this study analyzes four datasets of National Survey of Latinos\textsuperscript{1} for years 2002, 2004, 2006, and 2007. Individual factors such as gender, citizenship, income level, and marital status were used to determine the impact on perceptions of discrimination among Latinos. Significance: Reasonable perceptions of discrimination, a lack of political trust and sporadic political participation for Latinos suggest troubling prospects for the future of race relations, the American political system, and the entire essence of democracy.

Introduction

Quantitative restrictions, border patrols, work permits, economic needs tests, wage parity requirements, raids, and repatriation among others have been part of the efforts to restrict immigration (Gradstein and Shiff, 2004). The justification of these measures is first derived from labor shortages, economic hardship, the perceived threat from immigrants, or when states' legislatures are perceived to be overly responsive to minority groups (Hero and Colbert, 2001). These types of measures and other events often influence public opinion, public response, and so much as trust in the government (Michelson, 2001). In addition, an absence of socialization and familiarity with American political processes help explain why Latinos are less politically knowledgeable and involved as native born people (Nicholson, Pantoja, and Segura, 2006).

Mexicans first found themselves in a state of political vulnerability and powerlessness after the loss of land and identity in the ratification of the Treaty of Guadalupe Hidalgo (Takaki 2008). One million Mexicans immigrated to the United States between 1850 and 1920 as a result of U.S. built railroads in Mexico, the Mexican Revolution (1910-1917), and other push-pull social and economic factors (Espinosa, 2007; Ngai, 2004). In the 1920s Mexicans were enumerated as a separate race and deportation statutes were put in place. “The possibility of sweeps, detainment, interrogation, and deportation spread apprehension among Mexicans and loomed as perhaps the single greatest indicator that Mexicans did not belong” (Ngai, 2004). In 1924 the Johnson-Reed Act was the nation’s first comprehensive restriction law. This act drew a new racial and ethnic map based on new categories and hierarchies of difference. “The nation was racially and spatially reimagined; immigration restriction produced the illegal alien as new legal and political subject (Ngai, 2004).” The repatriation of over 400,000 Mexicans in the early 1930s was a racial expulsion program exceeded in scale only by the Native American removals of the 19th century (Ngai, 2004).

In 1942, due to labor shortages caused by World War II, the U.S. government established the Bracero program, under which Mexico sent workers to the U.S. as temporary laborers. This program encouraged illegal entry for Mexicans economic refuge and other interests. From 1949 to 1954 over one million undocumented immigrants

\textsuperscript{1} The Pew Hispanic Center bears no responsibility for the interpretations offered, or conclusions made based on analysis of the Pew Hispanic Center National Survey of Latinos.
entered the United States. Pressured to address the massive immigration rates the U.S. Immigration and Naturalization Service (INS) conducted Operation Wetback (1954). Operation Wetback was a massive enforcement effort aimed at apprehending and deporting undocumented Mexicans in the southwest. According to Commissioner General Joseph M. Swing the “alarmingly ever-increasing flood tide” of undocumented migrants from Mexico constituted “an actual invasion of the U.S.” Between 1953 and 1955 801,069 immigrants were apprehended.

The Mexican American civil rights movement was at its peak from 1965-1975. Mexican Americans accepted the legitimacy and necessity of following the political process and committed themselves to developing the resources required to deal effectively in the political arena (Garcia and de la Garza, 1977). These efforts generated the establishment of grassroots organizations such as the Mexican American Legal and Education Fund and League of Latin American Citizens.

In the state of California in 1986 a proposition passed making English the official language; in 1998 Proposition 227 eliminated bilingual education in public schools; and in 1994 Proposition 187 denied social services to undocumented immigrants. In reaction to the anti-Latino atmosphere, Mexican Americans became more concerned about racism and discrimination (Michelson, 2003). Immigrants, undocumented and authorized Latinos were alarmed by the threatened enactment of House of Representatives' Bill 4437: “Border Protection, Antiterrorism, and Illegal Immigration Control of 2005.” The dynamics of the marches in protest of HR 4437 were in many ways prefigured by events that occurred in California as a response to Proposition 187 (Milkmam, 2006).

The legacy of discrimination and prejudice is a major part of the context in which today’s generation of Latinos still experiences. The effects of racial exclusion and discrimination continue to influence social and political outcomes (Blank, Dabady, and Citro, 2004). Cumulative discrimination is defined as the dynamic concept that captures systematic processes occurring over time and across domains. The effects of cumulative discrimination can be transmitted through organizations and social structures of society; the ways in which discrimination effects are transmitted across domains and over generations often depend on the social organization (Blank, Dabady, and Citro, 2004).

I intend to expand the knowledge about the role that current and past discrimination may play in shaping American society. It is important to recognize three aspects of the discrimination process. They are: 1) the effects of discrimination may cumulate across generations and throughout history, 2) the effects of discrimination may cumulate over time through the course of an individual’s life across different domains, and 3) the effects of discrimination may cumulate over time through the course of an individual’s life sequentially within any one domain (Blank, Dabady, and Citro, 2004). Immigration policies with adverse consequences for racial and ethnic minorities may affect the diversity of American communities. Mistreatment of Latinos has impacted their sense of belonging in America and their ties to their national origin. The intent of this study is to sharpen the concept of discrimination and factors that affect the perception of its existence.

The social environment that surrounds Latinos makes certain aspects of their identity more significant than others according to Social Identity Theory. Social environments that foster adverse consequences for racial minorities help shape the identity of Latinos on an individual level affecting their political trust. It is acculturation that is corrosive of political trust for Latinos of Mexican descent, and trust in government impacts both government effectiveness and individual political behavior (Michelson, 2003). It is also important to recognize generational effects. For example, third-generation Mexican Americans are more acculturated according to socioeconomic status and linguistic measures and are more pessimistic about the political system than first and second generation Mexican Americans. Whether these suggestions also pertain to Latinos of other origins has not been tested.

Literature review

While some studies suggest that larger percentages of a minority group in a given population promotes interracial contact and cultural literacy others suggest that it promotes conflict, hostility, and tension (Oliver and Wong, 2003; Dixon and Rosenbaum, 2004; Wenzel, 2006). Other literature on behavioral contact finds that contact between majority and minority populations significantly reduces prejudicial attitudes and opinions about minorities and minority based policies (Stein, Post, and Rinden, 2000). MacKuen (1981) finds evidence that direct experiences influence individual’s political concerns (as cited by Michelson, 2001). Michelson also finds that recently naturalized Mexican American voters are significantly more concerned with racism and discrimination than native-born Mexican American voters or non-naturalized Mexicans (2003); however, she does not address undocumented Mexican Americans. According to Michelson the heightened sensitivity was due to the political atmosphere of the Chicago area when the survey was taken. Events and the sequence of events often influence public opinion; trust in the government, and political behavior (Hero, 2005; Michelson, 2001). Perceptions of discrimination among Latinos motivate public opinion towards immigration and bilingual education, and collective action toward immigration.
according to Gabriel Sanchez’s analysis of the 1999 National Survey of Latinos. Not only does discrimination have
a negative effect on health, but it is also a source of chronic stress among Hispanics (R. Cardarelli, K. Cardarelli,
and Chiapa, 2007).

Methodology

According to Blank, Dabady, and Citro, longitudinal and repeated cross-sectional data illuminate trends
and changes in patterns of racially discriminatory attitudes and behaviors toward Latinos. Perceived discrimination
may over/under report discrimination assessed by other methods. The guiding question of this study is to identify
what social factors influence Latinos’ perception of discrimination.

This research was conducted as a panel design. The data sources are the Pew Hispanic Center/Kaiser
Family Foundation 2002 National Survey of Latinos, Pew Hispanic Center/Kaiser Family Foundation 2004 National
and Pew Hispanic Center 2007 National Survey of Latinos. The 2002 survey focused on attitudes and experiences
of Latinos on a wide variety of topics, 2004 focused on politics and civic participation, 2006 focused on the
immigration debate, and the 2007 survey focused on illegal immigration.

For the National Survey of Latinos (NSL) in 2002 interviews were conducted by telephone for 67 days
among a nationally representative sample of 2,929 adults, 18 years and older, who were selected at random.
Although observations include non-Hispanics, these observations were not be used because variation cannot be
measured when compared to the National Survey of Latinos for 2004, 2006, and 2007. In 2004 the sample design
employed a highly stratified disproportionate Random Digit Dialing sample of the 48 contiguous states, according to
the Pew Hispanic Center. The 2004 survey interviews were conducted by telephone for 48 days among a nationally
representative sample of 2,288 Latino adults, 18 years and older. Unlike 2004, the 2006 survey results were
weighted to better represent the distribution of adults throughout the United States. The 2006 survey and 2007
survey interviews were conducted by telephone for a one month period; the survey was drawn through Random
Digit Dialing. The surveys were conducted among nationally represented samples of 2,000 Hispanics adults, 18
years and older.

I used multiple regression analysis to test which independent variables were statistically significant. The
dependent variable is derived from the following question asked in each survey: “In general, do you think
discrimination against Latinos is a major problem, minor problem, or not a problem in preventing Latinos from
succeeding in America?” The independent variables are income, birthplace, years living in the U.S., U.S.
citizenship, employment status, partisanship, marital status, educational level, and gender. By using Multiple
Regression Analysis I determined which independent variables explain variation in the dependent variable.
My hypotheses for this study are as follows:

Hypotheses

1. All other things being equal, an increase in income leads to a decrease in the perception of
discrimination preventing Latinos from succeeding in America.
2. All other things being equal, respondents born outside the United States will be more likely to believe
perceived discrimination prevents Latinos from succeeding in America than respondents born in the U.S.
3. All other things being equal, respondents of U.S. citizenship are less likely to perceive discrimination
preventing Latinos from succeeding in America than non-citizens.
4. All other things being equal, having full-time employment leads to a decreased perception of
discrimination preventing Latinos from succeeding in America than respondents who did not report
having a full-time job.
5. All other things being equal, respondents reporting as Republicans are less likely to perceive
discrimination as preventing Latinos from succeeding in America than non-Republicans.
6. All other things being equal, respondents who are single are more likely to believe perceived
discrimination prevents Latinos from succeeding in America than respondents who are not single.
7. All other things being equal, an increase in education level leads to a decrease in the belief that
perceived discrimination prevents Latinos from succeeding in America.

2 As titled by the Pew Hispanic Center
8. All other things being equal, women are more likely to believe perceived discrimination prevents Latinos from succeeding in America.

Formula

\[ Y = a + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + b_5x_5 + b_6x_6 + b_7x_7 + b_8x_8 + e \]

**Y** = Discrimination effect on preventing Latinos from succeeding in America  
**a** = constant  
**b_1** = Income level  
**b_2** = Birthplace  
**b_3** = U.S. Citizenship  
**b_4** = Employment Status  
**b_5** = Partisanship  
**b_6** = Marital Status  
**b_7** = Educational Level  
**b_8** = Gender  
**e** = Error

Limitations

I did not address discrimination against non-Hispanics or any policies intended to alleviate discrimination. There is no data that addresses who the respondent believed committed act(s) of discrimination preventing Latinos from succeeding in America. There may be error in the term definition and concept understanding of discrimination among respondents. I did not measure discrimination, but the reports on levels of perceived discrimination against Latinos, keeping them from succeeding in America. The survey captured self-reported evidence on perceptions that are not validated. I cannot identify how much of any past outcome is due to discrimination or how much past discrimination may be affecting current outcomes.

Findings

![Figure 1. Statistical significance & null hypothesis](image)

\*p \leq 0.05
As shown in Figure 1, Total Annual Income was a statistically significant in every survey. In 2004 Place of birth, Citizenship, and Employment were statistically significant predictors in addition to Total Annual Income. The independent variables explained 11.2% of the variation in the dependent variables for 2004. This was dramatically different to the surveys in 2002 (0.06%), 2006 (2.7%), and 2007 (2.1%). As shown in figure 2 the beta weight rankings for each survey were consistent with the t scores in Figure 1.

Although all the surveys were completed by the Kaiser Family Foundation/Pew Hispanic Center I analyzed each survey coding to identify disparities between survey years that might have affected the survey results from one year to another. By options, I refer to the options listed on the coding manual after each question. By coding, I refer to the methodology of each survey.

The options and coding for Total Annual Income were the same for all survey years, and in each survey year Total Annual Income was a significant factor. Place of birth and Citizenship were both significant in 2004. In 2007 place of birth options were listed differently than other survey years. In 2002, 2004, and 2006 U.S. was listed first and coded as 1 followed by Puerto Rico which was coded as 2. In 2007 Puerto Rico was coded 1, and the United States was coded 2.

The question structure, options, and coding were the same for Place of birth and Citizenship in 2004 as in the 2002 National Survey of Latinos. Yet, in 2002 neither Place of birth nor Citizenship were significant. In 2006, Education was significant and it too shared the same question structure, options, and coding as all three other surveys.

In 2007 place of birth options were listed differently than other survey years. In 2002, 2004, and 2006 U.S. was listed first and coded as 1 followed by Puerto Rico which was coded as 2. In 2007 Puerto Rico was coded 1, and the United States was coded 2.

Citizenship varied from 2002 and 2004 to 2006 and 2007. In 2002 and 2004 the question was “Now we would like to ask you about U.S. Citizenship. Are you…?” The options listed were “A U.S. Citizen, Currently applying for citizenship, Planning to apply for citizenship, and Not planning to become a citizen.” In 2006 and 2007 the question was worded differently: “Are you a citizen of the United States?” with options of “yes or no.” As previously mentioned Citizenship was only significant in 2004.

The survey question for Employment was worded the same in 2002 and 2004, but the options differed. The question structure and options were completely different in 2006 and again in 2007.

The question structure for Marital Status was the same in every survey year. The only difference was in one of the options. In 2002, 2004, and 2006 “Living with a partner” was coded as 2, whereas in 2007 “Have a partner” was coded as 2.

By options, I refer to the options listed on the coding manual after each question. By coding, I refer to the methodology of each survey.
The predominant finding from these regression analyses is that the respondent’s income level matters greatly for the perception of discrimination. This statistically significant variable is conspicuous despite coding, question wording, and option differences across the surveys. Employment and educational level are also generally important.

**Discussion**

Differences in question structure, options, and coding did not appear to have statistically significant effects in the survey results. The results were independent of the surveys’ differences. The question structure, options, and coding remained the same for the Dependent Variable and the general focus of the independent variable remained more important than the minor differences from one survey to another.

The surveys revealed interesting factors that affected the perception discrimination as it prevents Latinos from succeeding in America. With 2004 explaining variation to a much greater degree than 2002, 2006, and 2007, I was left with questioning the reasons for these results. According to Michelson (2001), extensive media attention to an issue can increase its perceived national importance, and Latinos are aware of the political world and react to changes in that environment. The survey conducted in 2002 addressed a wide variety of topics and the 2004 survey’s primary focus was politics and civic participation. The 2006 National Survey of Latinos: The Immigration Debate contained new questions about the immigration debate, and followed the congressional votes on the immigration question. The Pew Hispanic Center 2007 National Survey of Latinos was conducted during a period of increased local- and state-level legislative actions, and increased enforcement measures in reaction of the illegal immigration debates. This survey included new questions regarding fears of deportation.

The general focus and new questions in each survey do not appear to influence the explained variation in each survey. The consistency of Total Annual Income as a significant factor is ever present. It is important to consider the national mood and level of media coverage, and how it may have affected Latino public opinion and their perceptions of discrimination. The 2002 survey followed the 9/11 attacks; this event followed a report of a heightened level of perceived discrimination among Latinos as well as fear of deportation, even among U.S. Citizens. The presidential election debates of 2004 may have had sway the American national mood and ultimately the Latino reaction to perceive discrimination at a higher extent than in 2002, 2006, or 2007. Arguably the events following the 9/11 attacks such as the attention to immigration in the 2004 U.S. presidential debates may have led to the creation of House of Representatives’ Bill 4437. This bill was proposed to criminalize any knowledge of undocumented persons residing in the United States without immediate reporting to INS as well as antiterrorism. The threatened enactment of Bill 4437 caused alarm throughout the United States especially in Latino communities. In 2006 over five million opponents of Bill 4437 set out to march the streets in protest.

**Conclusion**

The general trend among Latinos and their perceptions of discrimination as a major problem in preventing Latinos from succeeding in America exists with Total Annual Income as a consistent factor. The analysis suggests that increased levels of perceived discrimination are correlated with shifts in national mood. However, the analysis also suggests that a perception of discrimination always exists in respondents with lower total annual incomes. A state’s racial and ethnic composition is an important factor in shaping policy outcomes (Hero 2001). In addition to a state’s composition we also have to consider political participation among racial and ethnic minorities. This is significant with the increased Latino population expected to compose 25% of the total U.S. population by 2042. Reasonable perceptions of discrimination, a lack of political trust and sporadic political participation for Latinos suggest troubling prospects for the future of race relations, the American political system, and the entire essence of democracy.
References


Identifying Student Perceptions:
The Effect of Parent-Child Relationships on Attitudes towards Academic Abilities

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Multi-Ethnic Studies

Abstract
This study expands on research that identifies the many negative effects poor parent-child relationships can have on children by examining how these disadvantages continue into children’s young-adult lives and influence attitudes and confidence levels towards success. This study will focus on young-adult, college students and will specifically consider their attitudes and confidence levels towards achieving self-defined, academic success. The purpose of this research is to determine if participants with weak parent-child relationship face more academic disadvantages due to lower levels of confidence and development of derogatory attitudes towards their capability to achieve in order to identify potential educational disparities related to family background. Twenty-two face-to-face interviews were completed with college students from a Northwestern University in which questions about family background and academic attitudes were asked. Findings indicated the converse of the hypothesis to be true showing that students with the weakest parent-child relationships exhibited the highest levels of confidence in their ability to achieve academic success on their own without any outside influences.

Introduction
The first higher education institutions in the United States were founded in the 17th century emulating English objectives of educating upper-class gentlemen. It was not until two decades later in the 19th century that women and minority groups were even given consideration for admittance to institutions of higher education, but the education of this demographic was still seen by wealthy, white men as, not only unnecessary, but unwanted and threatening to societal continuity (Solomon 1986). These ideologies may have dissipated over the last two decades, but this has done little to amend educational disparities between minority and majority classes from high school graduation rates to enrollment in and graduation from universities.

Educational limitations have shifted from overt regulatory methods to more covert, economic stratification (Haycock 2006). “Today, our highest-achieving low-income students actually go directly on to college at rates about the same as our lowest-achieving students from wealthy families” (U.S. Department of Education 1992). With the astronomical rise of educational costs, students from low socio-economic backgrounds are being confronted with the greatest barriers to higher education. Statistics provided by the U.S. Bureau of the Census (2006) indicate that four times more Blacks and Hispanics live below the poverty level than Whites and an overwhelming portion of all ethnicities that live below the poverty level are from single-mother homes.

The expansive research available on educational disparities makes it impossible to refute the facts that socio-economic status in the United States has come to play a detrimental role in creating higher-education opportunities and that minority groups and women in single-mother situations make up the majority of low-income households confronted with these hurdles. Statistics from 2006 show that 75 percent of students from the highest income bracket obtain a bachelor’s degree by the age of 24 compared to nine percent of low-income students who will obtain the same degree by the age of 24. For that nine percent it is imperative to consider if the hurdles they have overcome then land them on a level playing field or if they continue to face disparate challenges. Research shows that as diminutive as the statistics are for low-income students to go on to college, the percentage of students who persist to graduation can drop by more than half those numbers. The reasons for this attrition are many, ranging from economic challenges to knowledge of navigating the educational and financial aid system to lack of motivation and support (Haycock 2006).

Bernard Weiner, a cognitive psychologist, has done extensive research into attitudes and motivations of college students that affect academic success. Through his studies, Weiner (1976) identified a correlation between
academic motivation and attribution of academic success to internal or external factors. The internal/external attribution is referred to by Weiner as “locus of responsibility.” An internal attribution indicates association of success or failure to factors within oneself, for instance, work ethic or lack of intelligence. An external attribution is present when success or failure is attributed to factors outside of oneself, for example, hard tests or mean teachers. Both internal and external attributions can be identified as stable, remaining static throughout life changes, or unstable, shifting from external to internal attribution as life situations vary (Weiner 1972). Stable attributions have a greater effect on confidence levels than unstable attributions because they are perceived as constant. For example, if a student has an internal stable attribution that his grades are a result of his hours of long study, then every time he gets a good grade on a test his levels of confidence will increase because he believes that study and grades will always provide the same outcome (Weiner 1976).

Through Weiner’s application of these theories to academic success he concludes that, “the attribution process appears to be a significant determinant of learning and performance in the classroom,” (Weiner 1972: 214). In his continued research, Weiner (1996) identifies an internal, stable attribution as a characteristic possessed by the most successful students, success being identified by high grades and levels of achievement. If an internal attribution is the most indicative of academic success then it is imperative to consider what factors play foundational roles in its construction. For example, it is important to question if the type of environment children are raised in and the type family relationships they have affect what type of attribution they will display in their adult lives as they pursue higher education. Addressing these questions can provide insight into possible disadvantages between family backgrounds and attitude development that can ensure academic success.

The present study will look specifically at the construction of these academic attitudes with the goal of understanding how family backgrounds and relationships, specifically parent-child relationships, have the ability to perpetuate educational success or disadvantage. Research on the effects of parent-child relationships on children’s health and well-being is extensive. Associations have been found between the strength of parent-child bonds and well-being (Bucx and Van Wel 2008), personality development (Trumpeter et al. 2008), and even levels of physical distress during invasive cancer treatments (Penner et al. 2008). Research has also shown that poor parent-child relationships are negatively correlated to physical health habits (Toda et al. 2008), mental health, healthy self-development (Trumpeter et al. 2008), and self-worth (Verschueren and Marcoen 2002).

Despite extensive research available showing the many ways poor parent-child relationships affect children negatively, there is limited information available that explores possible disadvantages children carry into adulthood due to development of lower confidence and self-esteem levels. There is even less research currently available that examines how the effects of parent-child relationships relate to the development of attitudes and characteristics that will be displayed when children move into young-adulthood. This research will explore if students from poor parent-child backgrounds are more likely to develop attitudes that work against their success, how students at this developmental stage define their relationships with their parents, and if, and how they view it affecting their educational goals and ability to attain them.

Present study

The purpose of this study is to evaluate the diversity of definitions of academic success and ideal parent-child relationships across ethnicity, gender, and varying strengths of parent-child relationships and identify any correlation between expressed satisfaction with parent-child relationships and self-confidence and motivational attitudes towards abilities to achieve academic goals. This information was obtained via face-to-face interviews and questionnaires with college students between the ages of 18 and 25. This demographic was chosen because this is the developmental stage in young adults found to have the biggest shift in relationships between parents and children (Bucx and Van Wel 2008). The advantage of using an interview technique for this study was that it allowed participants to self-define academic success and ideal parent-child relationships and rate them based on their own expectations of these concepts.

The first research question addressed was how participants define college success. I hypothesized that participant’s from higher socio-economic backgrounds would be more likely to take their education for granted, and in doing so, would exhibit lower academic standards by not relating college success to high grades and extremely hard work. The second research question addressed was what participants believe their parents’ roles should be in their child’s college education. I hypothesized that the expectations of participant’s with good parent-child relationships would be higher and more demanding, based on their life experiences and what they have come to expect. The third research question addressed was if participants believe that relationships with parents can affect college success. I hypothesized that college students would not make a connection between their relationships with their parents and their ability to achieve academic success because of the autonomous stage they are at in their lives.
The fourth research question addressed was if participants believe they can achieve their definition of success if they do not have their current relationship with their parents. I hypothesized that participants with strong parent-child relationships would be more likely to attribute their success to their own abilities and show higher levels of confidence towards achieving academic success (e.g., self-efficacy), even without their relationship with their parents.

Method

Participants

Participants consisted of 22 undergraduate students between the ages of 18-25, (M=22.9) at a Northwestern University. Participant were 11 males and 11 females and consisted of two freshman, eight sophomores, five juniors, and seven seniors representing a diversity of majors across the university. The ethnic diversity consisted of one Romanian, one Sudanese, one Korean, one Bosnian, three Filipinos, four Latinos, and 11 Caucasians. All Caucasian and three Latino participants were born in the United States with all remaining participants born in their native countries. Out of the 22 participants, eight are first generation college students, five have one parent who obtained a bachelor’s degree or higher, and nine reported that both parents have received a bachelor’s degree or higher.

Materials and procedure

Participants were recruited via fliers hung up and handed out around high-traffic areas on the university campus as well as emailed to acquaintances to be passed onto interested parties. Willing participants contacted the interviewer via the university email address supplied on the fliers and upon receipt of an email, a response was sent from the interviewer requesting age, gender, and ethnicity to assure compliance to demographic guidelines after which an interview date and time was set.

Participants reported to the Psychology Research Center on campus for their interview and consent forms were obtained showing voluntary participation and permission to audio record interviews. The purpose of the study was explained as analyzing how academic motivational factors are affected by challenges in college; however, information was not given regarding the hypothesized correlation of academic attitudes to the strength of parent-child relationships to avoid bias in answers. The introduction included a brief summary explaining the challenges in the interviewer’s academic background in order to create a relaxed environment in which participants would feel comfortable relating their own challenges. Interviews lasted an average of forty minutes and were followed by a short online questionnaire including demographic information. Interviews were audio recorded to be transcribed at a later date.

Interview. The interview consisted of 25 open-ended questions regarding the participant’s academic paths, attitudes towards college success, relationships with parents, and the perceived effects of parent-child relationships on achieving academic success. The interview questions were presented in two categories; the first 15 questions related to participant’s academic history and goals and the last 10 questions shifted to family relationships. The entire interview protocol is included in Appendix A.

Questionnaire. The questionnaire consisted of demographic questions about the participant’s income and education levels of their parents. It also contained questions such as: Are grades a matter of luck? If I do well on a test is it because I studied hard? These questions enable identification of whether participants relate their academic abilities and success to their own efforts (internal attribution) or to the factors outside of their control (external attribution).

Data analysis

Preliminary data analyses included dividing participants into three groups based on their responses to the questions, “What is your definition of an ideal parent-child relationship?” and “How do your parents compare to that ideal?” The three groups consisted of positive parent-child relationships, neutral parent-child relationships, and negative parent-child relationships. Ten participants responded that their parents met or came close to their definition of an ideal relationship, and were placed in the group “positive parent-child relationships”. Six
Participants expressed pleasure with their parent’s efforts, but also expressed disappointment in their failure to meet key roles in their definition of an ideal relationship, and were placed in the category “neutral parent-child relationships.” Seven participants responded that their parents have in no way met their needs or filled their expectation of an ideal relationship, and were placed in the group “negative parent-child relationships.” All participant responses to the first research question were taken from the data and placed into one document separated into the positive, neutral, and negative participant groups. This process was repeated for the remaining three research questions and answers were compared side by side based on participant’s categories allowing the evaluation of similar ideologies within and across groups.

**Results**

This section presents the research findings in four categories which represent the four research questions being focused on. Examining the results individually, by research question, will afford the opportunity to focus on variance of responses between the positive, neutral, and negative parent-child relationship groups. For each research question, participant responses will be compared within and across the three groups to determine if shared attitudes are present either across and/or within the groups.

**Definitions of academic success**

Across the positive, neutral, and negative parent-child relationship groups no significant differences in defining academic success were found. Answers included varying combinations of several common ideologies including: efforts resulting in good grades, high grades coupled with social development, such as participation in campus activities, and a holistic view of progression towards an end goal of obtaining a successful career. A participant in the positive group stated, “You come to college to branch out find yourself and gain the knowledge you need for a future career.” A participant in the neutral group stated, “Success in college is understanding yourself and where you can go from there. It’s only opening the next door.” A participant in the negative group stated, “If I can get through this semester and if I can actually retain what I learn and know I can use it for the rest of my life, that would be success for me, that is success… really learning.” The similarities in participant responses across parent-child-relationship groups are more indicative of participation in a shared academic culture.

**Expectations of parents’ roles in college**

The second research question examined whether college students’ expectations for the role parents should play in their children’s college education varied based on participants’ parent-child relationship quality. Across the positive, neutral, and negative groups all participants agreed that it is the parents’ responsibility to: play an active role in their child’s education while still allowing them the autonomy to make their own life decisions, teach their child about the processes necessary to attend college, be a main source of encouragement and support, and provide a fall back during challenging times. A participant in the positive group stated, “Support them, give them advice as in what’s going to benefit them in the future but don’t really make the decision for them.” A participant in the neutral group stated, “Encouraging… turn someone to not only get education but to find education and find out what it really is.” A participant from the negative group stated, “Support thing again… like I support you in what you want to do, I’m here if you need me, and I’ll do whatever I can to help you.”

It is interesting to note that the majority of participants failed to relate financial support to the initial question, but with a follow up question resoundingly agreed that it is a large and very important part of the parents’ role to either provide a portion of funding or aid their child in finding sources of funding. Like the results of the first question the similarities in participant responses across groups is more indicative of participation in a shared academic culture.

**Perceptions of parent’s roles in academic success**

Participants across all three parent-child relationship groups expressed a shared belief that the quality of students’ relationships with their parents play an important role in their ability to be successful but variance in answers emerged as participants elaborated on their reasoning for this belief.

Participants in the positive parent-child relationship group expressed the influence of parents as vital to academic success due to their provision of family support and providing a fallback in times of struggle. One
Several participants expressed high levels of confidence towards achieving success with their own abilities. One participant stated, “I think, definitely, if you have a good relationship with your parents it helps a lot and it’s nice to have that net to fall back on.” Relating to the ways in which their strong relationships with their parents have benefitted them, participants in the positive parent-child relationship group expressed the ability of good relationships with parents to reduce life challenges and decrease the stress of facing problems on their own. For example, one participant commented, “It gives them more of a challenge if they don’t have a good relationship with their parents usually they have more problems in their life, I guess, the more stress, because they don’t have the support.” Another participant stated, “For someone like myself whose grown up in a good family situation and church it’s important to have that interaction, reassurance from your parents.” In relation to their own experiences, this group made positive connections with the ways they have benefited from a strong relationship with their own parents and their current success in college.

Participants in the neutral parent-child relationship group expressed that parents have an influence on academic success, but that the ultimate defining factor would be dependent on the student’s internal motivation. For example after answering yes to the initial question, one of the participants said, “It has to come from inside, it has to be intrinsic, it has to be internal drive to do well in school. There’s only so much that parents can do to help their kids.” This group expressed that parents’ ability to affect the academic success of their children is due to the drive and motivation they encourage and foster through providing support and a stable environment. One participant stated, “People that have a strong support system in their family have a better chance. Having a support group is helpful and if your parents are there for your support then you have a lot more capability to be successful.”

Participant responses from the negative parent-child relationship group contrasted responses from the positive and neutral groups by relating to the negative correlation between the disadvantages of not having a strong relationship with parents and the ability to succeed. The negative group expressed the derogatory affect poor parent-child relationships have as creating feelings and attitudes of worthlessness and lack of confidence. For example one participant stated, “I accepted mediocrity because I felt like I wasn’t worth anything more… that definitely derived from my relationship with my parents.”

The capacity to complete college was not only expressed as dependant on internal confidence but also related to challenges on time and monetary capabilities, for example, parents’ disappointment in students not working longer hours and making more money coupled with constant pressures to do so and lack of financial aid from parents. One participant related the tension between himself and his father over the economic situation of being a student when he said, “I can’t work as much as I want to and it makes him upset that I can’t make my insurance payment every month.” One participant related the reasons his parents thought he shouldn’t attend college when he said, “We can’t afford it and you have to be able to support yourself when you get out of high school. We’re not going to support you.” This is an example of how participants with the weakest parent-child relationships viewed the effects parents have on their child’s ability to succeed as negative and creating further challenges.

**Academic self-efficacy**

The fourth research question examined if strong parent-child relationships tend to cause higher levels of self-esteem would participants with the strongest parent-child relationships display the highest levels of confidence in being able to achieve academic success on their own regardless of outside forces? Responses to this question provided the greatest variance between the three groups.

The positive parent-child relationship group expressed the lowest levels of confidence in their ability to succeed academically without the relationship they have with their parents. One participant stated, “I probably wouldn’t even be here. I wouldn’t have any motivation to be.” The relationships between these participants and their parents were expressed as a necessity for the development of motivation to even attend college or be successful in life. Another participant stated, “I probably could, but I probably wouldn’t. I mean it’s possible that I could, but I don’t think I would be as pushed to do well.” This group displayed an external locus of control in expressing that their relationship with their parents is more a driving force for their desire to attend and do well in college than their own internal drive and motivation. These results contradict the expected findings of this research that the group with the strongest parent-child relationships would develop the highest levels of self-worth (Verschueren & Marcoen, 2002) and as a byproduct would develop the highest levels of confidence in their own abilities to achieve academic success.

The neutral parent-child relationship group displayed greater variance in their responses to this question. Several participants expressed high levels of confidence towards achieving success with their own abilities. One participant stated, “I believe I can, I believe that you can do anything you want just as long as you put the effort into it.” The majority of responses, however; showed more similarities to the doubts expressed by the positive group, for example, “In order to achieve… I don’t think that I would have met that mark without that support group.”
Participants expressed that they may be able to succeed despite the lack of a relationship with their parents, but challenges would have taken longer to overcome and the process would have been more difficult. This group displays a somewhat balanced locus of control by expressing that they could still achieve success, but the relationship with their parents is important to them in excelling in their education. One participant stated, “I think I could. There might be a few times where I hit a low point and I might stay down there a little bit longer” Although there is an increase in confidence compared to the responses from the positive group responses are still far from the high levels of confidence expected from this group.

It was assumed that in accordance with previous research the negative parent-child relationship group would display lower levels of self-esteem and confidence in their own abilities as is typical of children lacking strong parent-child relationships (Verschueren & Marcoen, 2002). Conversely this group displayed the strongest feelings of determination and internal drive, that no matter whether a strong relationship existed with a parent or not they would succeed and achieve their goals. One participant stated, “I really think that’s my own success, that’s my own.” Another participant stated, “I’ll do it no matter what!” This group displayed high levels of confidence in their abilities and even a determination derived from feelings of failures in their parental relationships to prove their worth and abilities, exemplified by one participant who stated, “For me I turned their negative nonsupport into a driving force to make me, showing them that I can be something, that I am a worthy human being.”

**Discussion**

The results from this study indicate the converse of the two major hypothesis of this research that: 1) students would not be aware of effects parent-child relationships have on academic success, and 2) that participants with the stronger parent-child relationships would exhibit the highest levels of academic self-efficacy and as a result also express the highest levels of confidence in their abilities to achieve their goals regardless of outside influences. The results show that all participants not only expressed an awareness of a causal relationship between their relationships with their parents and their ability to achieve success, but were also able to articulate how this relationship functioned. Participants with the strongest parent-child relationships saw the benefits received from this: encouragement, support, guidance, and even financial back-up, as such a crucial part of their academic success that they exhibited severe lack of confidence in their ability to obtain their academic goals without their relationships with their parents. This shows that the strength of parent-child relationships plays an important role in the development of attitudes towards academic success.

Looking at the four main research questions, we see that the way participants define success and what role they think parents should play in their child’s college education have a low association, if any, with the strength of their relationships with their parents and may have a stronger association with the cultural environment and expectations that college students share. The common attitude expressed that parents should provide support and encouragement while allowing their child the freedom to make their own decisions is indicative of participants’ shift into young adulthood and the desire to be seen as autonomous adults while being afforded the freedom to make their own mistakes and learn from them (Bucx and Van Wel 2008).

Although the negative parent-child relationship group expressed strong feelings that their relationships with their parents do not affect their ability to succeed, we must consider that their high levels of determination and drive may be more related to their relationships with their parents than participants are aware of. These levels of determination may have developed as a means of proving others wrong or proving their own worth to counteract disappointments in their relationships with their parents and lack of support and encouragement that has been available in their lives. This is exemplified in one participant’s expression of her motivation, “A lot of it is to prove to him that this isn’t a joke, that college degrees are a serious thing. They’re not just something where, ah well! You’re just going back to school.” Based on attitudes expressed by participants, it is also necessary to acknowledge that these levels of determination may be driven, in some part, by a desire to avoid being stuck in the same lifestyles as their parents.

The negative parent-child relationship group displays an internal locus of control by attributing their ability to succeed in college solely to their own abilities and not to any outside forces, especially relationships with their parents. This type of an internal locus of control was found to be a characteristic of students reaching high levels of academic success (Weiner 1972) suggesting that although the majority of participants in this group were from single-parent or low-income backgrounds, demographics underrepresented at the college level, they held attitudes that would be beneficial in assuring their success in college. This indicates that the small percentages of this demographic that continue to college are using the disadvantages from their family backgrounds in motivational ways as determination to achieve their academic goals. This does not minimize the variety of other challenges faced by these students that will play a role in their likelihood to continue to graduation. Although participants in this
group do not have the ideal relationship they would like with their parents they are supplementing their lack of parental support with support from other types of relationships, which the majority of participants in this group stated were intimate partners.

Conclusion

The results of this research indicate that family background and the strength of parent-child relationships children grow up with do have an effect on attitudes and confidence levels necessary to achieve success in adulthood. This indicates that when educational attributes and disadvantages are being discussed it is imperative to consider student’s family backgrounds and their quality of relationships with their parents to fully understand all the factors influencing academic potential. Educators must understand that, though college students are adults and acting autonomously, their attitudes and characteristics are still a product of the benefits or disadvantages provided by their quality of home life and relationships with their parents.

This knowledge can provide ways for educators to better understand, identify, and aid student’s with particular challenges, for example, providing students who do not have a strong relationship with their parent’s more encouragement and mentorship. This research also provides an opportunity for parents and children alike to gain an awareness of how the quality of their relationships will affect children’s future goals and abilities. Raising awareness in parents can provide opportunities to encourage them to provide relationships that will lead their children to greater, future achievement.

Acknowledgements

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References


Appendix A

1. Tell me about the life events that have led to you going to college.
2. How old were you when you started college?
3. Did you go straight from high school to college?
4. When you were in high school and preparing to apply for college who helped you figure out what the process was for applying and choosing a major?
5. Where there any major influences as far as why you chose your major?
6. What was your parents’ role in encouraging you to go to college?
7. What do you think had a bigger affect on you going to college, your own desire or the expectations of other that you go?
8. What challenges have you had to overcome in order to go to college?
9. How have they affected your determination to do well in school?
10. Who do you talk to about those challenges?
11. What does success in college mean to you?
12. How do you think you are doing on that scale?
13. So what do you think your role is as the student in being successful?
14. What is an ideal parent-child relationship to you?
15. How does that compare to the relationship you have with your parents?
16. How often do you talk to your parents?
17. What do you talk about?
18. Is there anything you don’t feel comfortable disclosing to them?
19. What do you think a parent’s role should be in their child’s college education?
20. How do your parents compare to that?
21. Do the relationships that college students have with their parents affect their ability to be successful?
22. If you didn’t have the relationship you do with your parents could you achieve your definition of success you explained to me earlier?
Dissemination and Implementation of Alternative Treatment Methods into Idaho’s Unipolar Mood Disorder Treatment

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Social Sciences

Abstract

Research has documented the effects of some alternative methods on mood: exercise (Legrand & Heuze, 2007), diet (Appleton et al., 2007) and supplementation with micronutrients such as iron (Beard et al., 2005), fatty acids (Nemets et al., 2002) and St. John’s wort (Mulrow, 2005), for example, have all demonstrated an ability to positively affect mood. It is unknown to what extent this research has been disseminated or implemented into practice. 

Procedure: Mental health care practitioners (n = 306) in Idaho were randomly surveyed. Items measuring knowledge and use of the following three methods were asked: exercise, diet, supplementation. Results: Sixty-eight percent of respondents had encountered exercise as a mood disorder treatment option in professional discussion within the last 2 years, 44.7% had encountered dietary methods and 46.5% had encountered supplemental methods in the same context. Sixty-six percent (n=204) of respondents indicated that they used exercise methods to treat mood disorders, 35% (n=108) reported using dietary measures and 19% (n=60) reported using supplemental methods. Specific types of exercise, dietary and supplemental methods used—e.g. yoga, St. John’s wort, etc—are also discussed. Conclusions: The use of some alternative methods for the treatment of mood disorders is common in mental health care practitioners.

Introduction

Although life expectancy in the United States is relatively high when compared with the rest of the world, the quality of the average American life has been called into question through a body of research that illustrates a growing trend of mental disorder prevalence in the population. National numbers indicate that between 6.6 and 11.9% of the general population suffers from a mood disorder, 85% of which are severe enough to affect the individual’s life negatively on a daily basis (Baumeister & Harter, 2007). In addition, Ohayon (2006) reported that 5.2% of participants in a nationwide study had a diagnosable major depressive disorder. This trend is also seen on an international scale and is expected to continue; in a worldwide predictive model, Murray and Lopez (1997) forecast that by 2020 unipolar major depression will be second only to ischemic heart disease as the leading causes of disability adjusted life years.

The mental health of Idahoans—the population base for the present study—follows national trends; the 2007 Behavior Risk Factor Surveillance System (BRFSS) conducted in Idaho revealed that 35% of respondents (n=5618) reported that at least one day in the last 30 days their mental health was “not good.” Additionally, the mean number of “not good” days out of the last 30, in those that reported any “not good” days, was 9.3 (Idaho Department of Health and Welfare).

These high rates of mood disorders have not gone unnoticed; between 1987 and 1997, use of antidepressants and outpatient care for the treatment of depression more than doubled (Olfson, 2002). Researchers have also noted the issue, and an abundance of mental health treatment related research has surfaced. Some of this research indicates that nutrition, supplements and exercise, traditionally unutilized in the mental health care field, can be effective methods for treating unipolar depression and anxiety disorders (Broocks et al., 1998; Kane, 1998; Kaplan, Crawford, Field & Simpson, 2007; Mulrow & Egger, 2008; Sanchez-Villegas et al., 2007; Woo et al., 2006). However, it is unknown whether or not this research has been implemented into mental health practitioners’ training, repertoire or practice. Below, we will discuss extant research on these important potential treatments of unipolar mood disorders.
Exercise and mood disorders

An increasing amount of research indicates that exercise-based methods can be effectively used in the treatment of patients suffering from unipolar depression and anxiety. For instance, multiple studies indicate that aerobic exercise is better than placebo and can be comparable to psychotropic medications when treating depression and anxiety (Allan, Manbar, & Morris, 2002; Broocks et al., 1998; Kaplan et al., 2007; Legrand & Heuze, 2007). In addition, in clinical samples, although producing a less rapid response than antidepressant medication, aerobic exercise was found to produce significantly lower relapse rates in women whose experimental group received it as part of their depression treatment plans (Allan et al., 2002). Much less work has been done on the effects of exercise on depression and anxiety in children, but in a systematic review of sixteen studies conducted through the Cochran Database researchers concluded that there was at least a small effect in favor of exercise when compared with placebo (Nordheim & Hagan, 2006).

Nutrition, diet and mood disorders

A relationship has been found between nutrient intake and psychological health (Kaplan et al., 2007; Kolata, 1982; Woo et al., 2006). This is not surprising as certain vitamins and minerals have long been known to affect brain functionality (Kaplan et al., 2007; Kolata, 1982), but their possible use as mood disorder treatment has spurred more research as of late. This profusion is evident when considering the more than six randomized controlled studies and five case studies, performed in the last decade, that evaluate formulas of anywhere from 2 to 36 vitamins and minerals producing documented influence on mood and behavior in populations ranging from bipolar adults to unruly children (Kaplan et al., 2007). Various formulas were found to decrease violent and antisocial incidents (Gesch, Hammon, Hampson, Eves & Crowder, 2002), others were found to reduce stress (Carroll, Ring, Suter & Willemsen, 2000) and still others were found to stabilize the behavior and moods of bipolar participants (Popper, 2001; Simmons, 2002).

Additionally, much research argues that diet in a larger context may also be important. Various studies argue that carbohydrate (Dye, Lluch & Blundell, 2000; Halyburton et al., 2007; Lloyd, Green & Rogers, 1994) and fat intake (Brinkworth et al., 2009) can alter mood in predictable ways that could be appropriate for mood disorder treatment. In a 2009 study, Appleton and colleagues found that even specific foods have can have effects of mood; depressed mood was inversely related to the intake of specific foods such as fish, raw fruits and vegetables and even cake (2007).

Supplemental methods for mood disorders

Dietary supplements such as Saint John’s Wort (Kane 1998; Mulrow et al., 1998), B Vitamins (Godfrey et al., 1990; Goggans, 1984; Kane, 1998), and omega fatty acids (Kaplan et al., 2007; Sanchez-Villegas et al., 2007) have now accrued a significant literature base assessing their value as possible treatment options for patients suffering from unipolar depression and anxiety. This research is not without conflict. Saint John’s Wort, for example, was evaluated in the Cochran Database of Systematic Reviews with mixed results: using 37 randomized double blind studies researchers concluded that “St. John’s Wort may be effective for treating mild to moderate depression, although the data are not fully convincing” (Mulrow, Berner, & Egger, 2005, p.2).

Utilization of exercise and nutrition-based treatment programs

With the increasing amount of literature surrounding exercise and nutritional mechanisms for altering mood and behavior, it is also important to note current popularity levels of such methods. Utilization of nutritional supplements and dietary mechanisms, classified as complementary and alternative medicine (CAM), has become more popular in recent decades. This is true both in practitioner and patient populations. A meta-analysis examining trends in the amount of coverage CAM received in top medical journals from 1965 until 1999 reported that, while it had near invisibility at first, it had a “steadily expanding presence toward the end of the period examined” (Winnick, 2007, p. 384). Notably, high rates of interest in CAM methods and high perceptions of its usefulness have been recorded in general health practitioners and medical students (Anderson & Anderson, 1987; Furnham, 1993; Wharton & Lewith, 1986). In addition, a study of the general population not only indicated popularity growth, but also CAM’s specific popularity as mental health treatment (Kessler et al., 2001). Specifically, Kessler and colleagues found that CAM methods were utilized more for anxiety and depression than for any other illnesses.
The above discussion of existing research makes it apparent that exercise and nutritional methods are routinely discussed as possible treatment options for depression and anxiety in literature. It is, however, harder to assess to what degree this literature had been disseminated into practitioner populations and implemented into practices. Therefore, the present study seeks to answer the following research questions:

RQ1: Are Idaho’s mental health practitioners aware of and have they implemented nutrition, supplemental and exercise methods into their treatment of patients suffering from unipolar mood disorders?

RQ2: What indicators (e.g., age, months in practice, county of practice, and perceived efficacy) are good predictors of high and low dissemination and implementation levels?

Method

Instrument development

A self-report format survey was constructed for a sample of mental health practitioners. The survey contained a mixture of open and closed ended questions totaling 16. Pilot testing indicated a 10-15 minute response time was average. The questionnaire contained (1) demographic items (age, state of practice, county of practice); (2) professional items (occupational license, months in practice, do you treat patients suffering from unipolar depression and/or anxiety); (3) dissemination evaluation; (4) implementation evaluation and (5) attitudes toward efficacy. The last three items were asked in regards to the following three alternative methods: nutrition, supplements and exercise.

Dissemination for the above three treatment methods was evaluated based on two Yes or No questions: The first inquired about the respondents recent-in the last two years-exposure to each method in literature or other professional discussion. The second asked respondents to report any training they had completed that instructed them in the use any of the three methods as treatment for unipolar mood disorders.

Implementation was likewise assessed for each of the three treatment methods through three questions. The first had a Yes or No response format: When treating patients for unipolar depression and/or anxiety disorders do you use any (one of the three treatment methods) as part of their treatment? If Yes was selected then the questionnaire asked the respondent to list the specific subtype of method used. For example, if a respondent reported using exercise as a treatment method, they would then identify “yoga” or “any-patients choice” as subtypes. Subtype identification was open ended. The last implementation question asked the respondent to indicate how frequently he/she refers patients suffering from unipolar depression and/or anxiety disorders to health professionals who specialize in nutrition, supplement use and/or exercise. Here a five-point Likert scale from never to always was used.

Because some research indicates that efficacy is the most important perception effecting use of complementary and alternative forms of medicine, respondents were asked the following Yes or No question with regards to the three treatment options: Do you think that (insert method name) CAN BE EFFECTIVELY USED in the treatment of unipolar depression and/or anxiety disorders?

Procedure

On May 14, 2009 data for 3236 eligible participants was taken from the Idaho Bureau of Occupational Licenses webpage. The following licenses were considered eligible: psychologist (PSY), licensed professional counselor (LPC), licensed marriage and family therapist (LMFT), licensed clinical social worker (LCSW) and licensed clinical professional counselor (LCPC). After removing duplicates, incomplete addresses and expired licenses, 2544 candidates were left. A paper format of the survey was mailed to a random sample of 1500 of the 2544 candidates. Return postage and a cover letter were included.
Results

Participants

Three hundred and six surveys were returned. Fifty respondents (16%) indicated that they did not currently treat unipolar mood disorders; they were instructed to leave the rest of the survey blank. The mean age of the sample was 49.6 years (SD = 10.73). Of the 188 respondents who disclosed their license type, the type was as follows: 15.4% LPC, 5.9% LMFT, 13.3% PSY, 36.1% LCSW, 29.3% LCPC. The mean months in practice, considering all license types, was 170.96 months (SD = 119.99). Two hundred and twenty six respondents reported an Idaho county as their location of practice. A wide variety of counties were represented. Using the Profile of Rural Idaho developed through the Idaho Department of Commerce and Labor, the urban/rural designation of respondent’s county of practice is shown below in Table 1.

Table 1. Respondents’ County of Practice using the Profile of Rural Idaho Designations

<table>
<thead>
<tr>
<th>County Category</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open country</td>
<td>19</td>
<td>8.4</td>
</tr>
<tr>
<td>Rural Center</td>
<td>19</td>
<td>8.4</td>
</tr>
<tr>
<td>Commuting</td>
<td>1</td>
<td>.4</td>
</tr>
<tr>
<td>Urban</td>
<td>187</td>
<td>82.7</td>
</tr>
</tbody>
</table>

Dissemination

Most respondents (67.6%) indicated that they had encountered exercise as a treatment option for unipolar mood disorders in literature or other professional discussion within the last two years. The most commonly encountered exercise treatment method was walking (21.5%), followed by yoga (17.2%) and aerobic exercise (16.8%). Additionally, 44.7% of respondents indicated that they had encountered nutritional programs as a treatment option for unipolar mood disorders and 46.5% indicated that they had encountered supplements in the same context.

Table 2. Number and Percent of All Practitioners Who Reported Encounters with Listed Methods

<table>
<thead>
<tr>
<th>Encounters</th>
<th>n</th>
<th>%</th>
<th>Encounters</th>
<th>n</th>
<th>%</th>
<th>Encounters</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walking</td>
<td>55</td>
<td>21.5</td>
<td>Saint John’s Wort</td>
<td>46</td>
<td>17.9</td>
<td>Generally Balanced Diet</td>
<td>43</td>
<td>16.7</td>
</tr>
<tr>
<td>Yoga</td>
<td>44</td>
<td>17.2</td>
<td>Omega Fatty Acids</td>
<td>43</td>
<td>16.8</td>
<td>Macronutrient Intake</td>
<td>7</td>
<td>2.7</td>
</tr>
<tr>
<td>Aerobic</td>
<td>43</td>
<td>16.8</td>
<td>B Vitamins</td>
<td>36</td>
<td>14.1</td>
<td>Specific Foods***</td>
<td>5</td>
<td>2.0</td>
</tr>
<tr>
<td>Anaerobic</td>
<td>22</td>
<td>12.7</td>
<td>Vitamin D</td>
<td>7</td>
<td>2.7</td>
<td>Diabetic/Glycemic Index</td>
<td>3</td>
<td>1.2</td>
</tr>
<tr>
<td>Patients choice</td>
<td>16</td>
<td>9.2</td>
<td>Other herbs*</td>
<td>5</td>
<td>2.0</td>
<td>Vegan Diet</td>
<td>1</td>
<td>.4</td>
</tr>
<tr>
<td>Meditation</td>
<td>5</td>
<td>2.9</td>
<td>Minerals (Ca, Fe, Mg)</td>
<td>4</td>
<td>1.6</td>
<td>Mediterranean Diet</td>
<td>1</td>
<td>.4</td>
</tr>
<tr>
<td>Martial Arts</td>
<td>4</td>
<td>2.3</td>
<td>Sam-e</td>
<td>4</td>
<td>1.6</td>
<td>Vegetarian Diet</td>
<td>1</td>
<td>.4</td>
</tr>
<tr>
<td>Cycling</td>
<td>2</td>
<td>1.2</td>
<td>Melatonin</td>
<td>3</td>
<td>1.2</td>
<td>Juice Plus Diet</td>
<td>1</td>
<td>.4</td>
</tr>
<tr>
<td>Swimming</td>
<td>2</td>
<td>1.2</td>
<td>5-HTP</td>
<td>3</td>
<td>1.2</td>
<td>Alli Diet</td>
<td>1</td>
<td>.4</td>
</tr>
<tr>
<td>Horseback Riding</td>
<td>1</td>
<td>.6</td>
<td>Multivitamin</td>
<td>2</td>
<td>.8</td>
<td>Blood Type Diet</td>
<td>1</td>
<td>.4</td>
</tr>
<tr>
<td>Gardening</td>
<td>1</td>
<td>.6</td>
<td>Miscellaneous**</td>
<td>2</td>
<td>.8</td>
<td>Food Sense Program</td>
<td>1</td>
<td>.4</td>
</tr>
</tbody>
</table>

Categories of nutritional and exercise interventions are grouped according to unifying themes: e.g., The “Macronutrient Intake” group includes diets that manipulate the intake of carbohydrates, fats or protein. *Other herbs: kava kava, ginseng, valerian root;**Miscellaneous: L-tyrosine, phenylalanine;***Specific Foods: low caffeine diet, low sugar diet, gluten free diet, Feingold’s diet.
None of the demographic characteristics measured predicted practitioner encounters with exercise, nutrition or supplement based treatment methods: No significant relationships were found when chi squared tests of independence were calculated comparing The Profile of Rural Idaho’s urban-rural designation of a practitioner’s county of practice and encounters with nutritional supplements ($\chi^2 (3, N=225)=2.13$), nutritional programs ($\chi^2 (3, N=224)=1.34$) or exercise ($\chi^2 (3, N=225)=2.78$). A chi squared test of independence comparing license type and encounters with nutritional supplements as treatment options for unipolar mood disorders found a significant interaction ($\chi^2 (6, N=187)=16.01, p<.05$); psychologists were more likely to have encountered supplements. Similarly, when comparing license type and encounters with exercise methods of treatment a marginally significant trend was found ($\chi^2 (6, N=187)=11.97, p=.06$); psychologists were more likely to have encountered exercise. But, when comparing license type and encounters with nutritional programs no significant relationship was found ($\chi^2 (6, N=186)=4.59, p<.05$). A multiple linear regression was calculated predicting encounters with the three treatment methods by age ($F (3, 239) =.70$) and months in practice ($F(3, 242) = 1.65$); neither equation was significant.

Table 3. Number & Percent Encounters with Listed Methods by Practitioner License Type

<table>
<thead>
<tr>
<th>License</th>
<th>Exercise</th>
<th></th>
<th>Nutrition</th>
<th></th>
<th>Supplement</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>N</td>
<td>%</td>
<td>N</td>
</tr>
<tr>
<td>PSYC</td>
<td>23</td>
<td>92</td>
<td>14</td>
<td>56</td>
<td>20</td>
</tr>
<tr>
<td>MFT</td>
<td>7</td>
<td>63.6</td>
<td>4</td>
<td>36.4</td>
<td>3</td>
</tr>
<tr>
<td>LCSW</td>
<td>47</td>
<td>71.2</td>
<td>29</td>
<td>44.6</td>
<td>29</td>
</tr>
<tr>
<td>LPC</td>
<td>19</td>
<td>65.5</td>
<td>11</td>
<td>37.9</td>
<td>11</td>
</tr>
<tr>
<td>LCPC</td>
<td>30</td>
<td>55.6</td>
<td>24</td>
<td>44</td>
<td>24</td>
</tr>
</tbody>
</table>

Note: PSYC = psychologist, MFT = marriage and family therapist, LCSW = licensed clinical social worker, LPC = licensed professional counselor, LCPC = licensed clinical professional counselor.

Additionally, 44.7% of the 255 respondents who answered the item considering training in alternative techniques reported training in the use of exercise as a treatment method; 26.6% reported training in nutritional programs and 17.1% reported training in the use of supplements. Table 4 provides a breakdown of specific methods in which practitioners reported training.

Table 4. Practitioners’ Self Reported Training in Alternative Methods

<table>
<thead>
<tr>
<th>Exercise</th>
<th>n</th>
<th>%</th>
<th>Nutrition</th>
<th>N</th>
<th>%</th>
<th>Supplements</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aerobic</td>
<td>40</td>
<td>15.7</td>
<td>Generally Balanced Diet</td>
<td>29</td>
<td>11.3</td>
<td>Omega Fatty Acids</td>
<td>22</td>
<td>8.6</td>
</tr>
<tr>
<td>Walking</td>
<td>43</td>
<td>16.9</td>
<td>Macronutrient Intake</td>
<td>8</td>
<td>3</td>
<td>Saint John’s Wort</td>
<td>20</td>
<td>7.8</td>
</tr>
<tr>
<td>Yoga/Meditation</td>
<td>37</td>
<td>14.5</td>
<td>Miscellaneous Diet***</td>
<td>4</td>
<td>1.6</td>
<td>B Vitamins</td>
<td>11</td>
<td>4.3</td>
</tr>
<tr>
<td>Anaerobic</td>
<td>14</td>
<td>5.5</td>
<td>Specific Foods ****</td>
<td>4</td>
<td>1.6</td>
<td>Other herbs*</td>
<td>5</td>
<td>1.9</td>
</tr>
<tr>
<td>Patients choice</td>
<td>7</td>
<td>2.7</td>
<td>Diabetic/Glycemic Index</td>
<td>1</td>
<td>.4</td>
<td>Minerals (Ca and Mg)</td>
<td>3</td>
<td>1.2</td>
</tr>
<tr>
<td>Martial Arts</td>
<td>4</td>
<td>1.6</td>
<td>Intuitive Eating</td>
<td>1</td>
<td>.4</td>
<td>Other Vitamins (D &amp; E)</td>
<td>3</td>
<td>1.2</td>
</tr>
<tr>
<td>Movement Therapy</td>
<td>4</td>
<td>1.6</td>
<td>Mediterranean Diet</td>
<td>1</td>
<td>.4</td>
<td>Miscellaneous**</td>
<td>2</td>
<td>.8</td>
</tr>
</tbody>
</table>

Categories of nutritional and exercise interventions are grouped according to unifying themes. e.g., The “Macronutrient Intake” group includes diets that manipulate the intake of carbohydrates, fats or protein. *Other herbs: kava kava, skull cap, Bach flower, valerian root. **Miscellaneous: 5HTP, phenylalanine. ***Specific Foods: complex carbohydrate limitations, raw foods diet, Juice Plus diet, vegan. ****Miscellaneous Diet: Weight Watchers, Alli Diet, Blood Type Diet, MediFast diet, Solution program, three seasons diet.
Implementation

In response to a question asking practitioners if they used exercise as an element of treatment (yes/no) 66% of respondents (n=204) answered “yes”. One hundred and eight or 35% of practitioners answered “yes” when asked if they used any sort of nutritional program while 19% (n = 60) answered “yes” to the same question about nutritional supplement use in their practice. These numbers were confirmed when use was measured by the stages of change scale. Use on the stages of change scale consisted of all respondents self rating a 4—“I have just begun to implement this method into my practice” or a 5 “I already use this method and have measures in place to maintain its use”: exercise 67% (n = 207), nutritional programs 39% (n = 121), supplements 20% (n = 63). Specific exercises, nutritional and supplemental methods implemented by respondents are displayed in Table 5.

Table 5. Practitioner use of Alternative Techniques for the Treatment of Clients with Unipolar Mood Disorders

<table>
<thead>
<tr>
<th>Exercise</th>
<th>n</th>
<th>%</th>
<th>Nutrition</th>
<th>N</th>
<th>%</th>
<th>Supplement</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walking</td>
<td>118</td>
<td>47</td>
<td>Balanced Diet</td>
<td>77</td>
<td>31</td>
<td>B Vitamins</td>
<td>31</td>
<td>13</td>
</tr>
<tr>
<td>Patients Choice</td>
<td>70</td>
<td>28</td>
<td>Macronutrient Intake</td>
<td>23</td>
<td>9</td>
<td>Omega Fatty Acids</td>
<td>28</td>
<td>12</td>
</tr>
<tr>
<td>Yoga or Meditation</td>
<td>59</td>
<td>24</td>
<td>Specific Foods*</td>
<td>14</td>
<td>6</td>
<td>Miscellaneous***</td>
<td>17</td>
<td>7</td>
</tr>
<tr>
<td>Aerobic</td>
<td>55</td>
<td>22</td>
<td>Miscellaneous**</td>
<td>8</td>
<td>3</td>
<td>Saint John’s wort</td>
<td>16</td>
<td>7</td>
</tr>
<tr>
<td>Anaerobic</td>
<td>23</td>
<td>9</td>
<td>Weight Watchers</td>
<td>5</td>
<td>2</td>
<td>Melatonin</td>
<td>10</td>
<td>4</td>
</tr>
<tr>
<td>Outdoor exercise</td>
<td>6</td>
<td>2</td>
<td>Diabetic/Glycemic</td>
<td>3</td>
<td>1</td>
<td>Vitamin D</td>
<td>7</td>
<td>3</td>
</tr>
</tbody>
</table>

Categories of nutritional and exercise interventions are grouped according to unifying themes: e.g., The “Macronutrient Intake” group includes diets that manipulate the intake of carbohydrates, fats or protein. *Specific Foods: caffeine limitations, Juice Plus, low sugar regimens, increased water intake, organic foods diet; Miscellaneous nutrition**: Blood Type Diet, Food Sense Program, Nutri-Systems, The New You Diet, the Seale Harris Diet, Ultra Mind Diet, Unstack Diet & Solution Program; Miscellaneous supplements***: valerian root (2), kava kava (2), Sam-e (4), multivitamins (4), vitamin E (2), amino acids, glucosamine & vitamin C.

Ninety-nine percent of the 249 practitioners who answered the item, answered “yes” when asked if they believed that exercise can be effectively used to treat unipolar mood disorders; 93% of the 236 practitioners who responded to the item indicated “yes” when asked the same question regarding nutritional methods and 82% of the 222 practitioners who responded to the item indicated “yes” in regards to supplemental methods. When comparing practitioners’ implementation of exercise methods on the stages of change scale and a practitioners belief that exercise was an effective, a significant interaction was found ($\chi^2 (4, N = 244) = 33.656, p<.05$): Those who believed that exercise could be used as an effective treatment for unipolar mood disorders were more likely to use exercise in their practices. This relationship was also significant when considering efficacy beliefs about and use the use of nutritional methods ($\chi^2 (10, N = 226) = 41.78, p<.05$) and supplements ($\chi^2 (5, N = 214) = 36.252, p<.05$).
Implementation, as measured with the stages of change model, is displayed below in Graph 1.

### Graph 1. Practitioner Stages of Change Scores by Percent

<table>
<thead>
<tr>
<th>Percent of Practitioners</th>
<th>Supplements</th>
<th>Nutritional Methods</th>
<th>Exercise</th>
</tr>
</thead>
<tbody>
<tr>
<td>I am not familiar</td>
<td>25</td>
<td>8.5</td>
<td>8.5</td>
</tr>
<tr>
<td>I am not interested</td>
<td>8.5</td>
<td>16.9</td>
<td>17.5</td>
</tr>
<tr>
<td>Considering</td>
<td>17.5</td>
<td>4.1</td>
<td>17.5</td>
</tr>
<tr>
<td>Just began to implement</td>
<td>29.3</td>
<td>31.7</td>
<td>67.6</td>
</tr>
<tr>
<td>Already use</td>
<td>31.7</td>
<td>5.6</td>
<td>15.2</td>
</tr>
</tbody>
</table>

**Discussion**

**Dissemination**

Approximately 68% of the practitioners sampled indicated that they had encountered exercise as a treatment option for unipolar mood disorders in professional literature or discussion within the last two years. Nutritional and supplemental methods enjoyed dissemination rates near 45%. These numbers indicate that a large number of mental health practitioners are aware of these alternative techniques. Additionally, no difference that was found between the dissemination levels of different age groups, counties of practice or months in practice. This indicates that the dissemination of research considering alternative treatment methods is not affected by urban/rural designations that may or may not affect ideology.

Dissemination was found to differ based on license type; practitioners who were licensed as psychologists were more likely to have encountered both supplemental and exercise methods for the treatment of unipolar mood disorders in the last two years. This difference may be a result of educational discrepancies between the two groups. Although this study did not measure education levels, the license of psychologist in state of Idaho requires a doctoral degree (Idaho.gov/IBOL). All other licenses included in this study require only 60 credit hours of graduate education—equivalent to two years of post bachelors degree study (Idaho.gov/IBOL). While more research is needed to verify this connection, it seems a likely scenario that an increase in length of study would result in a broader scope of knowledge.

**Implementation**

Mental health practitioner use of exercise methods for the treatment of unipolar mood disorders was measured at 66%, roughly equivalent to its dissemination rate of 68% within the last two years. This one-to-one ratio between recent dissemination and implementation is not seen in either nutritional or supplemental methods. While nutritional methods were recently disseminated into 44.7% of the practitioner sample, only 35-39% had implemented them into practice. This gap between knowledge and use widens again as only 19-20% of practitioners utilize supplemental methods while 46.5% claim to have encountered them in the last two years alone in professional discussion. These discrepancies between knowledge and use of supplemental and nutritional methods may be influenced by practitioners’ beliefs about efficacy, implementation power and scope of practice concerns.

**Perceived efficacy.** In this study, perceptions of efficacy regarding each of the three alternative methods were significantly related to the use of each respective method. Both use and perceptions of efficacy were highest for
exercise methods, second highest for nutritional methods and supplemental methods had the lowest perceived efficacy and the lowest implementation levels. These perceptions of efficacy may be influenced by agreement or disputes in literature. As the introduction of this paper displays, research regarding the efficacy of nutritional and supplemental treatment methods are not without conflict. This is generally untrue of exercise research. While research does dispute the amount and intensity of exercise needed to positively influence the psyche (Dunn, et al., 2001; Lawlor & Hopker, 2000; North, et al., 1990; Stein, 1992; Stitch, 1999), disputes about the efficacy of exercise as a general strategy are rarely found (Callaghan, 2004).

Academia’s confidence in the efficacy of exercise may translate into higher efficacy rates in the practitioner population, while the unsure nature of literature considering nutrition and supplemental methods may result in lower perceived efficacy rates for these treatments. The influence of indecisive literature on perceived efficacy of nutritional and supplemental methods may be illustrated by the number of practitioners who did not answer the efficacy question regarding these methods: Of the practitioners asked the efficacy question, only 8 did not respond in regards to exercise, 21 did not respond in regards to nutritional programs and 35 did not respond in regards to supplemental methods.

It is evident that perceived efficacy effects implementation, however, the results of this study show large gaps between the perceived efficacy and implementation rates. Supplemental methods were perceived as effective by 82% of those who answered the item but only 19-20% of respondents use supplemental methods. Similarly, nutritional methods were regarded as effective by 93% of respondents but only used by 35-39%. These gaps refute the notion that perceived efficacy is the most important determinate for implementation (Furnham, 1993). Other possible explanations are discussed below.

Implementation power. Regardless of a methods perceived efficacy, it must be implementable to enjoy widespread use. Gold et al. argue (2006), that this barrier became more significant in the 1990s when the evidence-based medical movement was widely adopted into the mental health field. These researchers propose that this switch in acceptance of only tightly controlled randomized clinical trials caused internal validity to be valued higher than external validity. This shift morphed the majority of research into efficacy based with only very few studies that focused on a treatments implementation and dissemination power (Sussman, Valente, Rohrbach, Skara & Pentz, 2006).

This low implementation power may be particularly relevant when considering the many variations in diet discussed in the literature and the unregulated dosage issues that plague research on supplemental methods. Currently, granting agencies are recognizing the barrier that low implementation power posses and are again stating the need to tailor treatments to clinical practice realities (Addis, 2002). Organizations such as the Substance Abuse and Mental Health Services Administration (SAMHSA), the National Institute on Drug Abuse and the American Psychological Association (APA) have structured programs designed to disseminate research outlining evidence-based practices in ways that are implementable for practitioners. SAMHSA, for example, provides free “Toolkits” that contain workbooks, tips for implementation and evaluation methods (Gold et al., 2006).

Training and scope of practice concerns. Training, which works to eliminate providers’ lack of confidence and skills, plays an important role in the implementation of new treatments (Addis 2002; Corrigan, Steiner, McCracken, Blaser & Barr, 2001; French 1996). Forty-five percent of respondents indicated that they had received some type of training in exercise based practices for the treatment of mood disorders, 27% indicated the same for training in nutritional methods and 17% had some type of training in supplemental techniques. These numbers correspond much better than efficacy rates to the reported use rates for both nutritional methods (35-39%) and supplemental methods (19-20%), indicating that training may be an important factor in implementation. Additionally, scope of practice concerns may influence implementation rates: Although respondents were not directly questioned on this topic, many practitioners used the comments section of the survey to express the concern that the discussed methods especially the use of supplements were beyond their scope of practice and were more appropriate for medical doctors.

Conclusions

It appears that demographic characteristics such as age, months in practice and county of practice do not play a role in the dissemination or implementation of exercise, nutritional and supplemental methods of treatment for unipolar mood disorders. Perceived efficacy and training in each of the three methods, however, do play
important roles in their implementation. Further research should consider other barriers such as implementation power and scope of practice concerns.

Acknowledgements

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References


Critical Literacy:  
Changing the World through the Word

Martha S. Mendoza: McNair Scholar  
Dr. Alicia Garza: Mentor

Bilingual Education

Abstract

This study analyzes the role that children’s literature plays in acquiring critical tools and deconstructing the internalized sense of worthlessness and oppression that Latinos living in poverty might experience. The goal is to provide literacy spaces and critical tools for both, teachers and students from marginalized and oppressed backgrounds, as Paulo Freire and Donaldo Macedo suggest, to become aware of one’s reality and act upon our world. This intends to engage students in dialogue and reflection, in order to critically analyze and understand issues of social, economic and political injustice and inequities; and deconstruct their internalized sense of worthlessness and oppression. The outcome of the study is to provide bilingual educators with literature resources, such as a collection of literature in Spanish and reflection suggestions, aimed to promote action, transformation and social justice within a community of learners.

At a young age, I succumbed to the messages posed at my schools, by the mass media, and in the community at large, which led me to believe that I had less value than my White counterparts. I was convinced that for me to succeed, I had to give up my identity. I was made to feel like a second-class citizen because of my socioeconomic status and my Spanish language and because I lived in a run-down community (p. 118).

−Margarita Berta-Ávila, 2003

Introduction and Review of Literature

Margarita Berta-Ávila’s experience as a Latina growing up in the United States is similar to that of many young Latinos in this country. Sixty one percent of Latino children that live in poverty (reported by the National Center for Children in Poverty in 2007) might experience the same internalized sense of oppression such as Margarita Berta-Ávila, as a result of the social, historical and political marginalization that Latinos have encountered in the United States. In regards to issues of race, class, culture and language, some Latinos have been conditioned to believe that they lack the power and voice to claim a just and equitable standard of living. This sense of worthlessness and hopelessness can be defined as internalized oppression, which affects individuals who have been socially and politically alienated, excluded and discriminated. As Mahan (2002, p. 49) states:

If SG [subordinated groups] members begin to believe that they have no control over their lives and lack the capacity for autonomy, they may begin to show the passive behavior known as learned helplessness. If they experience shame due to being viewed as second-class citizens or less than real Americans, SG members may, in a paradoxical manner, simultaneously believe and not believe that they are inferior. PMA [persons of Mexican ancestry] may even become ashamed of being identified with the Mexican ethnic group (p. 296).

According to existing research, some students from Latino communities have been led to believe that they are helpless, inferior and powerless upon their life and reality (Berta-Ávila, 2003; Mahan, 2002). Stereotypes portrayed in the media and society at large have contributed to negative self-perceptions and lack of confidence in some Latino children: “Those at the receiving end of prejudice can experience physical and psychological harm, and over time, they internalize and act on negative perceptions about themselves and other members of their own group”
(qtd. in Padilla, 2004, p. 15-16). Ada (2003) claims that living in poverty may be another factor contributing to the sense of hopelessness that some Latinos experience:

Because some Latinos live in conditions of extreme economic poverty, they suffer from the social illnesses that plague our economically deprived neighborhoods, where people might not see hope of a better future and might internalize a sense of worthlessness society projects unto them (p. 52).

As a result of living under such social, economic and political stressors, some Latino children may become passive and oblivious to injustices and inequities in their lives. For some Latino children, this leads them to believe that what they experience is a product of their predestined fate. And at this point, they run the risk of conforming to an oppressive reality. The illustration below (Figure 1) describes the issue of internalized oppression as a spiral which confines marginalized individuals into a perpetual cycle of injustice, internalized oppression and conformity.

![Figure 1](image-url)

The question that we must ask ourselves as educators, is how can we break this cycle of oppression? As Berta-Ávila (2003, p. 120-1) has observed “This false consciousness produces passive, non-critical students. Within this passivity, Xicanas/Xicanos [Chicanas/Chicanos] do not question injustices or inequalities they experience as individuals or as a community.” How can educators guide Latino students to acquire a critical view of their world? Most important, how can educators guide Latino students to challenge the existing structures of inequality and oppression that subordinate them, in order to deconstruct their internalized sense of oppression?

One approach is a transformative and critical pedagogy, where children are informed about their human rights and given the necessary tools to demand them. When literacy is viewed as a critical stance, it becomes a process that precedes words, and stresses the importance of acquiring the skills to decode, encode and recode the world. As Freire and Macedo (1987) propose, literacy is an approach to attain “a critical reading of reality” (p. 36), by reading the world within words, in order to understand it and transform it. Reading the world means to understand how human practices and social, political and economic systems influence and manipulate history, language, culture, and society to accentuate privilege for some and take away the humanity of many. The written word is a tool that can be used to explore and critically analyze the world. Thus, the act of reading the word and the world can serve as an instrument to guide students to challenge existing structures of inequality and oppression. Freire (1970, p. 47) explains that “To surmount the situation of oppression, people must first critically recognize its causes, so that through transforming action they can create a new situation, one which makes possible the pursuit of a fuller humanity.”

Critical literacy goes beyond critically analyzing and understanding texts. It is a process that works with the written language in order to bring to light social injustices and inequities that take place in the world. Besides reading the written word, this approach to literacy focuses on leading students to “recognize various tensions and enable them to deal effectively with them” (Freire & Macedo, 1987, p. 49) by providing them with spaces for dialogue to understand and critically interpret their reading of the world. Within these spaces, students have the opportunity to challenge their reality and explore new alternatives for transforming it. Shor and Pari (1999) suggest:
Critical literacy thus challenges the status quo in an effort to discover alternative paths for social and self-development. This kind of literacy – words rethinking worlds, self dissenting in society – connects the political and the personal, the public and the private, the global and the local, the economic and the pedagogical, for reinventing our lives and for promoting justice in place of inequity. (p. 1)

The reading of the word and the world can take place through powerful texts that address or portray concerns that affect the lives and self-perceptions of some Latino students. As educators, it is our ethical duty “to intervene in challenging students to critically engage with their world so they can act upon it and on it” (Freire & Macedo, 1995, p. 10). This being said, as educators it is crucial that we talk about issues of social inequity and injustice in order to guide our students to learn and reflect about them, so that they can identify the issues that oppress them and decide to act on them (Shor, 1992). Critical literacy is a pedagogical tool that empowers and encourages students from oppressed backgrounds to believe in their own power and voice.

Critical literacy challenges the status quo. When educators present marginalized children with powerful literature and guide them through dialogue and reflection, they have the opportunity to discover a new path to breaking free from the cycle of internalized oppression (Figure 2). The model on the left illustrates how critical literacy intercepts the cycle of internalized oppression, to create a path of critical consciousness and transformation. Educators and Latino students can engage in dialogue and reflection about topics of social injustice and oppression by analyzing literature that connects to the students’ lives and reality. Research has identified children’s literature as a powerful way to “stir our emotions and create recognition of our collective humanity and of our potential to create history” (Furumoto, 2008, p.79). When the texts, stories and characters relate to students’ cultural backgrounds and more important, to their experiences in the world, students have the opportunity to engage in dialogue that addresses situations of social injustice and inequity. In addition, through such connections with the literature, students also find examples and “models for what they can do when faced with difficult life situations, the need to make a moral decision, the necessity to make a choice, or the opportunity to make their own decisions and thus create their own path” (Ada, 2003, p.10).

**Purpose**

A dialogue with Macedo, Freire (1995) explains the need for the oppressed to “develop the necessary critical tools that will enable them to read their world so they can apprehend the globality of their reality and choose what world they want for themselves” (Freire & Macedo, 1995). The purpose of this study is to create a literacy curriculum resource in Spanish for bilingual educators, so that they make use of critical tools that can enable students to read both the word and the world. This curriculum resource promotes dialogue and reflection about selected children’s literature in Spanish that portrays issues of social inequity and injustice.
It is impossible to think, however, of overcoming oppression, discrimination, passivity, or pure rebellion without first acquiring a critical comprehension of history in which these intercultural relations take place in a dialectical form. Thus, they are contradictory and part of a historical process. Second, we cannot think of overcoming oppression without political pedagogical projects that point to the transformation of the reinvention of the world (Freire & Macedo, 1995, p. 13).

The goal of this curriculum resource is to create a space for dialogue and reflection in order for students to:
- Critically analyze and understand issues of social, economic and political injustice and inequities.
- Deconstruct internalized sense of worthlessness and oppression.
- Create a space for alternative paths for self-growth.
- Promote action, transformation and social justice within a community of learners.

The questions then, are: what children’s literature in Spanish can be used to create a space for dialogue and reflection about issues of social inequity and injustice in the lives of Latino students? And, how can educators engage students on a critical reading of their world by using these pieces of literature?

**Methodology**

In order to create a critical literacy curriculum resource for educators, I collected thirty children’s books in Spanish, which I selected and analyzed using criteria inspired by the concept of critical literacy. A search of databases, libraries, and publishers was used to locate the assortment of children’s literature. One database in particular, The Barahona Center at California State University San Marcos, is dedicated to study books in Spanish for children and adolescents, and has an extensive database of resources. An author, Isabel Schon, has published three volumes of the series *Recommended Books in Spanish for Children and Young Adults* since from 1991 through 2004, which was a very helpful resource. Lastly, two publishers (Ediciones Ekaré and Children’s Book Press) have collections of works that focus on sociopolitical issues and the promotion of social justice. The following criteria were used to select the appropriated books for this study:

<table>
<thead>
<tr>
<th>Plot &amp; Theme</th>
<th>The plot and theme portray social, economic and political issues, such as oppression, poverty, abuse and exploitation. “The social climate needs to be honestly portrayed in a way that is understandable to children without being overwhelming” (Galda &amp; Cullinan, 2006, p. 242).</th>
</tr>
</thead>
<tbody>
<tr>
<td>Language</td>
<td>Comprehensible and authentic. “Look for language that is true to the characters but is not overwhelmingly archaic or full of dialect” (Galda &amp; Cullinan, 2006, p. 243). Accurate within the story’s background/context. Enriching language.</td>
</tr>
<tr>
<td>Presence of conflict</td>
<td>Besides making a story interesting, the presence of conflict gives children the opportunity to understand and be aware of the issues, its causes and its consequences. Thus, providing an example and guidance on how to engage in praxis to confront such conflicts.</td>
</tr>
<tr>
<td>Message</td>
<td>Author’s message goes beyond the words. The message helps the reader learn about a problem in society or in his/her own life. In addition motivates the reader to reflect and act upon such problem.</td>
</tr>
<tr>
<td>Illustrations</td>
<td>Accurately represent the literary and cultural content. “People of the culture are not all portrayed the same, but as individuals” (Kasten, Kristo, &amp; McClure, 2005, p. 132).</td>
</tr>
<tr>
<td>Characterization</td>
<td>The story portrays influential protagonists who can serve as guidance for children who may experience similar situations. The protagonists show a “sense of identity and social consciousness” (Medina &amp; Enciso, 2002, p. 38).</td>
</tr>
</tbody>
</table>
After specific books were selected, they were analyzed using Lewison, Fling and Van Sluys’ (2002, p. 382) four dimensions of critical literacy: “(1) disrupting the commonplace, (2) interrogating multiple viewpoints, (3) focusing on sociopolitical issues, and (4) taking action and promoting social justice.” The questions for reflection and problem posing were structured based on the following categories:

<table>
<thead>
<tr>
<th>Social Justice Qualities</th>
<th>“Is realistic, logical, equitable, just, kind, and generous” (Ada, 2003, p. 14). It might be that some texts portray injustices or stereotypes towards people; in this case the book can be analyzed differently. These books can serve as examples of how social/economical and political issues affect communities and people. It will be used to discover those stereotypes, talk about them, and break them down.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stereotypes</td>
<td>Recognize bias in literature (Kasten et al., 2005) “Stereotypes in literature can perpetuate biases toward individuals who are members of a particular group” (Stoodt-Hill &amp; Amspaugh-Corson, 2009, p. 47). “If young children are repeatedly exposed to biased representations through words and pictures, there is a danger that such distortions will become a part of their thinking, especially if reinforced by societal biases” (AntiDefamation League 2003, p. 1).</td>
</tr>
<tr>
<td>Gender Roles</td>
<td>How are men and women represented? This topic can create space for analysis and reflection about the societal construction of gender roles.</td>
</tr>
<tr>
<td>Socioeconomic Class</td>
<td>Plots that portray issues of socioeconomic class allow for reflection and analysis of how socioeconomic structures manipulate the actions and decisions of people. How are people from different socioeconomic backgrounds represented?</td>
</tr>
<tr>
<td>Accuracy and Authenticity</td>
<td>Portrays the world and situations as accurate and authentic as they are in real life?</td>
</tr>
<tr>
<td>Racial &amp; Ethnic Portrayal</td>
<td>Representation of people from different ethnicities and races. It is important to consider the racial and ethnic representation of characters. The theme of the story can portray issues of discrimination and racism within the plot, however, it should never communicate a discriminatory message against any race or ethnicity.</td>
</tr>
<tr>
<td>Action / Praxis</td>
<td>The decision that the protagonists take in order to change the course of the story and solve the pressing conflict. Action steps for social justice (Lewison et al., 2002).</td>
</tr>
</tbody>
</table>

The literature in question can be used, as Lewison, Fling and Van Sluys (2002, p. 382) propose, to “disrupt the commonplace” and problematize the status quo in order to study the existing structures of inequity and oppression; to “interrogate multiple viewpoints” with the purpose of reflecting on the power relationships between characters, and the actions they take; to “focus on sociopolitical issues” to analyze how social, political end economic systems affect the standard of living and opportunities of people in society, and “shape perceptions, responses and actions” (p. 383); and by analyzing how the protagonists of the stories engage in praxis to confront the antagonisms that oppress them, students can find examples to follow to challenge the status quo, “take action and promote social justice.” As McLaughlin and DeVoogd (2004, p. 54) explain: “It is important to note that although these books facilitate critical literacy experiences it is not the reading of these texts that generates critical consciousness but rather the critical analysis and discussion in which we and our students engage.”

**Results**

After analyzing the literature, several books were selected to create a critical literacy curriculum resource. This collection of literature is intended to provide educators with resources that can be used in bilingual Spanish-English classrooms to promote dialogue and reflection about issues of social justice. The curriculum resource does not contain already-made lesson plans; it provides an annotated bibliography and some suggestions for reflection and dialogue. The curriculum resource is for educators to create lessons and dialogue based on their classroom
environment, culture and most important to adapt it to each student’s world. Please see annexed document to access the curriculum resource.

**Conclusion and Future Considerations**

Some Latino children are susceptible to internalized oppression, which is caused by living under structures of social and political oppression, and may lead to a sense of worthlessness and hopelessness. As socially aware educators, we need to attempt to break this cycle of oppression. Critical literacy, the concept of reading the world and the word, is a well-known and respected approach to dealing with social issues in the classroom setting. Using guidelines outlined by critical literacy standards and scholarly research, the purpose of this paper was to evaluate an assortment of children’s books in an attempt to offer teachers a list of resources they can use in their classrooms. By providing this select reading material, the teacher can encourage dialogue and analysis of these sensitive topics, in an attempt to inform and empower their students. Further considerations for this study will consist on case studies, where the selected critical literacy curriculum resource is used in classroom settings. It would be essential to study Latino students’ reactions and interactions with the selected books, and analyze how influential these resources are in acquiring critical consciousness and deconstructing internalized oppression.

**References**

Linguistic Politics:  
Creating a Communication Canon Post World War II

Erin Miller: McNair Scholar
Dr. Ed McLuskie: Mentor

Communication

Abstract

What does it mean to communicate and how “best” can this action be accomplished? Perhaps the second part of this question, rather than the first, describes the history of approaches to ideas of communication and their practices. The first “official” textbook providing a window on this history reveals a remarkable consensus on what “communication” and related terms should mean, if not directly in models, then in their assumptions and, especially, their orientations—both of which grew out of World War II and migrated quickly into the 1950’s. The field of communication was nascent when, in 1954, The Process and Effects of Mass Communication was published as educational content for budding scholars. The relevance of this “first” literature for the social sciences of communication is the variety of linearity growing out of that literature’s veiled militaristic language. This paper looks behind the veil.

Introduction

The Process and Effects of Mass Communication set the stage for an emerging social science of communication which, as a text-compilation edited by Wilbur Schramm, reflected its WWII roots. The legacy lies in the subsequent influence on generations of communication scholars to come to think about communication in militaristic ways. Writings by social scientists became “founders” of the field, whose names and works remain in 21st-century textbooks and journal bibliographies. This paper suggests that such work was and remains ideological. Its ideology found purpose in psychologically analyzing how people behaved in certain stressful situations (after dropping H-bomb on Hiroshima or consequences from Nazi Germany) and went on to create a milieu of research regarding how people process effects of traumatic situations. The work upheld propaganda models used in World War II as relevant processes of how to conduct psychological warfare.

The research conducted was then used to group people into numbers and variables and further confirm status in narrow categories in order to understand how they behave, albeit a linear lens. As a result of understanding behaviors, early communication scholars then formulated ways to modify the populace’s actions and behaviors in what became varying sub fields of communication. Audience became a term synonymous with capital. In order to get the audience to buy what was being sold (verbal, ideological or material capital) there was a need to perfect a process to achieve these ends. Through political rhetoric and well prepared linguistic methods such as presupposition and implicature, audiences were (and still are) won over by perceived authority. Source credibility became a goal to achieve despite using manipulative or deceptive means. And International Communication became a study to force political ideology onto other countries. Through this whole process a malignant normalization has occurred. From the early 1950’s to present, the taken-for-granted history displays a large gap of understanding in the field; understanding how to step outside of obsolete principles to conceive of communication as more than an instrumental imposition of will onto others. Whether the word is communication (and all varying subfields), spin, rhetoric, or strategy, propaganda by any other name is still propaganda.

In the following pages, I will expand on the discourse analysis aspect of this research that specifically references words I searched for and the results I found. The words I chose to search for were words that re-emerged throughout the book numerous times and in different contexts. The commonality of thought, from the authors that contributed to the book, stretch across themes of communication regardless of subtitles. Through allowing the book The Process and Effects of Mass Communication to speak as closely as possible to the original context, the basis of a canon becomes apparent in subsequent analysis.
Background

In tandem with the logical positivist philosophy inherent in the text, which I will refer to here-forward as “Process,” I present the writing as replete with militaristic and/or linear thought. How this genre of language is used within the discourse analysis painted in this historical picture is the premise for the field of study understood today. The book *Culture and Imperialism* by Edward Said (1993), discusses continua this way:

[T.S. Eliot’s] synthesis of past, present, and future, however, is idealistic and in important ways a function of his own peculiar history; also, its conception of time leaves out the combativeness with which individuals and institutions decide on what is tradition and what is not, what relevant and what not. But his central idea is valid: how we formulate or represent the past shapes our understanding and views of the present (p. 34).

There is a genre of language perpetuated in “Process” that adheres to scientific denotations of thought within academia. The reference to people as subjects (through experiments or empirical research findings) legitimizes the perception inherent in the text that implicates people solely on their “usefulness.” Not only as subjects within a research experiment but, also, the construct of people as objects, participants, audience members, or observant in a large empirical system definitively separates the totality of complexity from the person. Neatly organized labels and definitions place people in obtuse houses of efficient understanding. The only interpreters of this environment then, are experts who created the simulation.

Results of this erudite language, as aligned with scientific conceptions of how to gauge actions related to themes of communication, has become an area used for consumerist exploitation. Even if the earliest intentions of reference to people in this light was for benevolence, the resulting objectification has produced gaping holes illuminated in categorical terms such as “us” and “them.” Also, the ability to understand people in diverse and multifaceted cultures as evolved over time becomes reduced to predictability through quantitative analysis, such as percentiles and ratios. Totalities of populations, in groups and individually speaking, have been stripped of holistic interpretations while scientists conduct the melody of marginal predictability in the social sciences.

The following tables are drawn from the software program Document Explorer, which was used to complete the discourse analysis. The words I chose for this paper relate to the theme of militaristic and/or linear frameworks that define the book. For example, in plugging in a search for the words Propag*, Milit*, and War*, one of these words is found every nine words throughout the 562 page book. Of the words, Nazi*, German*, and Fuehrer*, one of these words will be found every 34 words in the book. To give foresight, there are approximately between 400-500 words per page. The second set of words used denotes the increased sense of vernacular influenced from World War II.

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1 The book *Process and Effects of Mass Communication* was indexed through a database, Document Explorer 6.0. Since no electronic version of the original edition is available, the book was manually scanned into a MS Word document and edited for scanning errors. Next, the document was indexed into a database and formatted to the nuances of Document Explorer as the last step in this conversion before analysis.
<table>
<thead>
<tr>
<th>Table 1</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Propag</strong>*</td>
</tr>
<tr>
<td>Total # of times used</td>
</tr>
<tr>
<td>Highest Use by Author</td>
</tr>
<tr>
<td>Highest Use by Chapter Title</td>
</tr>
</tbody>
</table>

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<tr>
<th>Table 2</th>
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<tbody>
<tr>
<td><strong>German</strong>*</td>
</tr>
<tr>
<td>Total # of Times Used</td>
</tr>
<tr>
<td>Highest Use by Chapter Title</td>
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<tr>
<th>Table 3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Word(s) Used</strong></td>
</tr>
<tr>
<td>Total # of Times Used</td>
</tr>
</tbody>
</table>

2 The symbol “*” denotes all forms associated with the root word. For example, “Propag***” represents “propaganda” as well as “propagandist,” “propaganditis,” “propagate,” and any other words found with propag* as the root.
Table 4

<table>
<thead>
<tr>
<th>Word Used</th>
<th>Communic*</th>
<th>Propag*</th>
<th>Milit*</th>
<th>Politic*</th>
<th>Power*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Word association (most used words neighboring original search term)</td>
<td>Mass, international, opinion, process, credibility, channels, research, effect, audience</td>
<td>Goebbels, Policy, Allied, Monopoly, Enemy, Russian, German, Goals, Lasswell, Task</td>
<td>Elite, Germany’s, Political, Range, Fight, Counter-Elite, Deception, Supreme, Wished, Ability</td>
<td>Elite, Range, International, Warfare, Military, Decisions, Economic, Power, Organizational, Objectives</td>
<td>Seizure, Rival, Elite, Struggle, Aim, Ruling, Regime, Reactive, Bloc, Economize</td>
</tr>
</tbody>
</table>

“Linguistic” within this paper refers to the analysis of the language in the book “Process,” and is unpacked in the diverse themes presented. Primarily, however, this refers to the ways in which authors present language as presupposition and implicature. Thomas et al. (2004) describes language as mediated understandings of reality through the system of signs historically available to us. The encoding of symbols called language is more a reflection of culture than individuality and can therefore be more easily normalized (Thomas et. al, 2004). While communication science argues for an objective sensibility, the argument itself is mired in realities that cannot be escaped for purposes of analysis. All signs are rooted deeply in cultural practices defining “vantage” points. The ideology that seeps into societal cracks becomes a paradigm implemented from agreed upon amorphous sources of “power.” The potential to use ideology to control the way people believe and think can be achieved through well-placed linguistic techniques. This becomes then, the locus for research: to perfect and dispel linguistic power to would-be propagandists within many areas of the public sphere.

The ways in which language is laden with power techniques, resuming with presupposition and implicature, can lead the person at the “end” of the communication chain to make assumptions not necessarily referenced in the text, rather implied. This technique allows for a scapegoat clause since the speaker did not actually state what is implied. Implicature and presupposition become a discourse especially rooted in advertising, political discourse, and prevalent in the book “Process.” The results of these tools create difficulty for the audience to denote and or reject perceptions communicated. Overall, the problem with utilizing these types of techniques lead to taken-for-granted stances when in actuality, the statement(s) are open for deliberation (Thomas et. al 2004).

The Book

The processes of communication, if such methods can exist, are saturated throughout the book “Process.” An overflow of ways in which to identify, improve, and solidify propaganda in communication, seeps across contributions. From all authors a consistent message bleeds across the first page to the last page: communication as a power to control. In many ways “propaganda” becomes synonymous with “communication.” A definition of communication as pointed out in Chris Simpson’s book, “The Science of Coercion” describes the initial definition, etymologically speaking, as the sharing of duties. As the book “Process” ensues the definition of communication that becomes shaped looks more like an imposition of will onto others (Simpson 1994). Propaganda becomes situated where the word communication is used. While each author has ideas of what communication is, manipulation and/or deception substitutes for alternate views of possibilities of a shared democratic community.

The demarcation of propaganda in “Process” (1954) is a straightforward explanation, “A deliberately evoked and guided campaign to induce people to accept a given view, sentiment, or value. Its peculiarity is that in seeking to attain this end it does not give fair consideration to opposing views” (p. 376). While at first glance this statement may appear critical of the ends of propaganda, the book’s course is lined with explicit statements regarding the necessity for propaganda. The audience may not know what they need, however, the authorities or “powers that be” do and they are not squeamish about using coercion to justify preservation of a nation while fervently defending the “status quo.” Often times the necessity for propaganda in the book is predicated on the fears, experiences, and lessons that war arouses.

Sole contributions and collaborations by varying authors prime the field of communication by problematizing varying behaviors and motivations of audiences. The goal through much of the book is to locate and pass on (through ensuing education) the key to unlocking methods in which an audience’s attention will be forced.
This is accomplished through quantitative analysis. Tables, graphs, and psycho-analysis drawing on scientific methods (personality, etc...) to predict and decode actions, is the modus operandi that is relied upon in the book. Waples, Berelson, and Bradshaw (1954) analyze the situation of a boy who rejects certain editorials because “his intelligence and training, his combined motives urged him toward publications stressing urgency of solution, sudden persuasion, and specific goals” (p.67). Another analysis is drawn to the “opposite extreme”. “We have the lonely, inferior, introverted reader, dissatisfied with herself, her family, and the social order.” The female in this scenario has never read anything save certain editorials that the male in the former scenario rejected. She is analyzed from the vantage point that “the reader’s sex, limited schooling, low occupational status, and other handicaps explain her attitudes of inferiority and insecurity” (p. 67). Polarizations of experiences from varying cultural vantage points are relied heavily upon. Differences between men and women in this article are grouped according to cultural norms of the 1950’s: men are defined by their intellect and status outside of the home and women are defined by their domesticity and lack of understanding of the world around them. Gender, as well as class differences, describe not only why certain people read, also, speaks toward behaviors that certain groups find favorable and deem acceptable.

What follows from explanations on grasping and retaining audience behavior is: “The Effect of Different Channels.” Joseph Klapper (1954) describes the “Comparative Effects of the Various Media” as, “effectiveness of the various media as instruments of informal pedagogy and of persuasion” (p. 91). Through experiments that measure retention of given material and alterations of audience attitude, Klapper can investigate preferable forms of media through empirical evidence. The type of conclusions drawn are, for example that “Radio was also established as the more common agent for changes in vote intention” as well as benefits for each genus of media. There was found a “pedagogical and persuasive effectiveness of mass media supplemented by face-to-face contact” (p. 102). This has been demonstrated by controlled experiments and Klapper cites, “The combined use of mass media and face-to-face contact has characterized several highly successful propaganda campaigns. The propaganda successes of Father Coughlin, the Nazis, and the Soviet Union are cases in point.” Interpretive psychoanalysis supports these powerful techniques as does the appeal of mass media and face to face contact. Klapper describes this utility: “Their analysis of its peculiar power emphasizes the manner in which such a combination provides the audience with certain psychological requisites of suggestibility” (p. 103).

“Getting the Meaning Understood” with the first contribution by David Krech and Richard Crutchfield, “Perceiving the World,” frames the next major category in “Process.” While these authors discuss determinants of perception from a functional analysis, the next author, Leonard Doob (1954) engages the audience with the “Perception of Propaganda.” Doob starts out by taking the reader on a “sense” journey in which all of the tactile senses are stimulated deriving from brain reception of this sensory experience. The purpose of this is engaged in a debate between physiologists and psychologists and the nuances between what is consciously perceived and what is established as stimuli in an environment. The purpose of these statements explains ways in which perception can be morphed into a habit. Therefore, propaganda must be perceived for effect to take place.

The war propagandist seeks desperately to break through the perceptual barriers which the enemy erects to prevent the home and fighting fronts from hearing or seeing anything which might be demoralizing. The propagandist who does not reach his audience is a failure from the outset (p. 140).

While Doob’s analysis solidified the use of creating a “propaganda drug,” the next authors in “Process” provided the paraphernalia through guise of psychological analysis.

A section by Gordon Allport and Leo Postman deemed: “The Basic Psychology of Rumor” focuses exclusively on wartime rumors. Experimental approaches leave the “broader social setting of the problem” to pose the question: “what processes in the human mind account for the spectacular distortions and exaggerations that enter into the rumor process and lead to so much damage to the public intelligence and public conscience”? Through “leveling, sharpening, and assimilation” the embedding process is explained. One of the major conclusions Allport and Postman make is that:

A subjective structuring process is started [result of embedding]. Although the process is complex (involving as it does, leveling, sharpening, and assimilation), its essential nature can be characterized as an effort to reduce the stimulus to a simple and meaningful structure (p. 154).

Alexander Leighton and Morris Opler (1954) collaborate on the first article in the section “Communicating to Another Culture,” with their analysis, “Psychiatry and Applied Anthropology in Psychological Warfare against Japan.” Leighton and Opler analyze the Japanese on the basis of WWII and American perceptions of Japanese
society and culture through “fighting forces.” The Japanese morale was perceived as an unmovable structure of collaborative strength in their military “with every enemy soldier an ideal fighting machine—fearless, fanatic, obeying instantly without question and looking only for an opportunity to die for the Emperor.” Since this was the collective view of Japanese culture, the United States needed to prepare for a long and costly war. The immediate conclusion drawn was that every Japanese force would need to be eradicated regardless of how hopeless the situation. There would be a “painful process of taking Japan foot by foot and of endless mopping up behind the lines wherever Japanese were left alive” (p. 157). In an attempt to circumvent fatalities, the question in Leighton and Opler’s article addresses whether psychological warfare could reduce the enemy’s fighting effectiveness and whether the Japanese would be more apt to surrender. The pervasiveness of this question was applied to civilians and whether the morale on the “home front” would be comparable to that of the Japanese fighting forces. In an effort to predict the enemy, Leighton and Opler use metaphors of medical practice, specifically, psychiatry to deepen the understanding of what the enemy may be thinking. When Japanese were prolonged to military defeat for a substantial amount of time, the results would be a decrease in morale (p. 159). The purpose of this research is for gauging the “right time” to embark on a psychological warfare campaign. Psychology and an understanding of Japanese people’s feelings and beliefs are understood and modified through group pressure. While Leighton and Opler were not proponents of war, per se, they ascribed to psychological manipulation of others and psychological warfare as a way to conserve economic outpouring toward war.

Within the category “Communicating to Another Culture” is an article authored by Ralph White (1954) titled, “The New Resistance to International Propaganda.” While initially asserting the prevalence and unrest with the word, propaganda, White goes on to explain that antagonism toward the term is a disservice to achieving effectiveness specifically, in combating communists. Regardless of the upheaval surrounding propaganda by those who belittle potential effectiveness of propagandist action, there is a need to improve upon the “weaknesses” of a slippery slope. White uses communist and soviet military tensions as justification for correcting the decline of the word. In order to achieve a successful democracy, America needs to embrace the reasons for using propaganda to combat soviet aggressiveness and preserve a non-communist world.

First, our actions must be in line with our words. The propaganda of the deed is more potent than the propaganda of the word, and the propaganda of the word is effective in direct proportion to the deeds which it is able to publicize (p. 181).

“Modifying Attitudes and Opinions” is the fourth major category. In continuing with the continuity of the theme, Charles Osgood and Percy Tannenbaum (1954) co-authored “Attitude Change and the Principle of Congruity.” Their research points out specific variables rolled into what becomes attitude theory and measurement. The variables of “existing attitude toward the source of a message, existing attitude toward the concept evaluated by the source, and the nature of the evaluative assertion which relates to the source and concept in the message” (p. 251). In presenting the scales of this empirically driven research, the labels attached to analysis derived in the form of “good, bad, fair, unfair, valuable, worthless…and the like.” In order to conduct the research comparatively there was a need for a generalized attitude scale (p. 252). This scale is useful in determining congruity in order to anticipate attitude change. Osgood and Tannenbaum note that linguistic assertions of implicature and presupposition shape congruity or incongruity and the latter cannot exist in neutral statements. The authors create their “generalized measuring instrument which provides quantitative unites of attitude for any object of judgment” for the purpose of locating maximum congruity. For example, the audience’s attitudes (measured by the scale mentioned) can be analyzed in order for perceptions to be changed through (speakers) presenting congruent statements or ideas to gain favorable reception (p. 259).

After research is explained on how to change opinions on a controversial subject, Hovland and Walter Weiss (1954) launch into the perceived next step: “The Influence of Source Credibility on Communication Effectiveness.” Continuing in the fashion of the books predecessors, importance is necessitated through evaluating audience attitudes toward the communicator. As most communication students are taught, prestige is a large factor in credibility. Impression management can be relegated to a whole course in communication departments. Responsiveness to an unsavory source can be circumvented when suspicion arises. Alignment with the communicator or mass media sources rests in methodologically gaining audience trust. The question becomes: how is credibility gained when sources are perceived as “untrustworthy?”

The present study was designed to minimize methodological difficulties by experimentally controlling the source and checking effects of the source in a situation in which the subject’s own opinion was obtained without reference to the source (p. 276).
The matter of untrustworthiness becomes a moot point. The difficulties that come with ascertaining trustworthiness are shown to subside after a gap in time and not immediately after the particular communication. This phenomenon has been dubbed as the “sleeper effect” (p. 276). As the passing of time fades (after initial unfavorable communication) so does the memory of “who said what to whom…” and a once negative perception can transcend into a favorable position of “what was communicated” while forgetting “who communicated it.” The results found factual information that may have transpired in communication was irrelevant to conclusions of constructed credibility. This credibility could be attained more “effectively” in light of group consensus and influence.

Communication can be synonymous with “groups” in certain circles of academia and social constructs. In “Effects in Terms of Groups” Herbert Blumer (1954) inaugurates this section with his essay: “The Crowd, the Public, and the Mass.” Collective behavior has been psychoanalyzed and prominent in early theorists’ work such as Plato, Descartes, and more modern social theorists such as Arendt and Mills. While those mentioned take varying stances on explanations of collective behavior Blumer asserts that an understanding of the crowd, the public and the mass is a priori in implicating propaganda. He breaks this down in expanding on the types, formation, characteristics, and varying expressive crowds to determine order and authority within. The struggle between individuality and cohesion in masses creates tension and suggestibility can fill the gaps created by antithetical roles within the mass. The mass is however, ultimately distinguished by their homogeneity. As the tension between varying roles surfaces, “organization” sinks and “effective” communication can cease. Therefore public opinion can step in, hold the reigns and resume solidarity under certain influences. Influences arise out of discourse where concessions are made and the public can “act as a unit.” While the descriptions of varying factions of social groups seem benign up to this point, a shift occurs in which Blumer addresses the insidiousness of propaganda:

Propaganda can be thought of as a deliberately evoked and guided campaign to induce people to accept a given view, sentiment, or value. Its peculiarity is that in seeking to attain this end it does not give fair consideration to opposing views. The end is dominant and the means are subservient to this end. Hence, we find that a primary characteristic of propaganda is the effort to gain the acceptance of a view not on the basis of the merits of that view, but instead, by appealing to other motives (p. 377).

While at once Blumer seems to acknowledge the “mold” of propaganda and the deceitfulness of playing upon emotions, attitudes and feelings disguised as logic, he nonetheless prescribes propaganda as a successful way for groups to collaborate and adhere to prevailing norms. Blumer’s cognition of propaganda’s downfalls does not prevent him advocating for its uses. This is representative of a larger theme in the book: cognition of propaganda’s short-comings, yet a zealous inclination to advocate for the many and varied uses- regardless. While some authors at once recognize inequalities produced in this environment, they end up devoting most of their work to fervently selling the functions of propaganda. As well, they concoct ways of making deceit and manipulation more effective. Recognition of the traps and deceitful purposes, do not slow the propaganda process. The tenets of propaganda multiply with all the focus placed on improving methods and expansion of uses. Through trying to determine what motivations the authors subscribe to, there is an insidious thread in attempting to understand how cognitive realizations of wrong-doings persist. In light of this antithetical relationship, sociological analysis within communication studies remains focused through constricting ideology.

While a perception can be justified in recognizing the lack of sociological analysis of degenerating social structures created in these varying pools of propaganda, an essay presents a once hopeful glimpse into an overlooked analysis. “A Sociological Approach to Communications Research” by Matilda While Riley and John Riley (1954) commences with a need to understand the social structures in which attitudes and opinions are formed. The authors proclaim a need for further “communications research” to be directed. However, the direction in which this research should head is apparently another justification for examining “operational terms…and long neglected social factors in the process of opinion formation” (p. 389). Taking Mannheim’s analyses a need is thrown out in which “a description and structural analysis of the ways in which social relationships, in fact, influence thought.” Through empirical evidence in the “sociology of knowledge” impulses can be derived from this “sociological” awareness. This also presents a challenge as to whether,

Operationally adequate techniques can be devised to effectively and accurately measure the relationship between the social position of the recipient of a communicated message and his awareness, rejection, acceptance, or distortion of the message itself (p. 390).

Through charts and percentages research is conducted toward children and how they attain perceptions as well as how this relates to their social groups. Regardless of age, public conduct is an integral idea in understanding
communication, especially within this text. Peer influence and issues of resulting conformity press into the public and private sphere. The political implications are supportive of an economic purpose driving capital and supporting a consumerist democracy. Ideas of morals become subservient to motives of policy. Where there might have been a once strong and assertive voice coming from an engaged public citizen is left a passive, compliant (albeit vox) audience member as citizen. The conduct of citizens is modeled by the political. Hannah Arendt discusses the political realm as being solely judged on conduct, whereas, morals are inclusive of for example, intentions (Arendt 1982).

Emphasis on the concept of audience is not embryonic in the field of communication. Twenty five (out of thirty nine), or sixty-four percent, of the segmented pieces in “Process” include mention of audience in varying contexts. The catchphrase thrown around in the field of communication is the goal of “targeting the audience.” In order for a “speaker” to get across the “message” there is a requirement of “framing” an opinion, idea, etc… to nestle inconspicuously between speaker and audience. In the branch of communication known as advertising or public relations the need for “just the right message” dictates perfection of how to direct and massage audience conception. The perfunctory nature of audience studies was a heavy intrigue sparked prior to “Process” being published and continues today. An abundance of behavior studies conducted largely by psychiatrists and psychologists (aka communication scholars) directly deals with the problem of audience perceptions. Tied to the audience is its other half, so to speak: reductionism. As reductionism uses ready-made labels to synthesize (dumb-down) information for audiences, a process of coercing audiences becomes less taxing and possibilities for capital increase. Ed McLuskie (2009) says:

Anticipating the globalization of the audience commodity in advanced capitalism, Smythe (1977) located the audience labor within “free time” and “leisure,” joining “the monopoly capitalist lexicon alongside “free world,” “free enterprise,” “free elections,” “free speech,” and “free flow” of information (p. 13).

The history and problems with ideas of audience commodity was not just a domestic issue. The notions imparted by the voices in “Process” regarded cultural communication or international communication as one more war to win. They perceive diverse cultural audiences as less a field for understanding intricacies of an established culture (traditions, beliefs, texts) for the sake of reciprocity. The opportunity presented is more about surface understanding of the culture for coercion. These explanations are born out of linear desire to draw out how to form and change opinions favorable to United States policy and specifically, militaristic endeavors.

Tying in with issues pertaining to international audiences, the next major category in “Process,” discusses the “Special Problems of Achieving an Effect with International Communications.” The first authors, W. Phillips Davison and Alexander George (1954), launch into these perceived problems describing why studies of international communications have been nascent. One reason is attributed to the study of international communications as cross disciplinary. The authors believe that one field of study needs to possess the expertise of data regarding human behavior, in lieu of many varying fields within the social sciences. The second reason, dealing with complexities of communication, addresses systematic study:

As we turn our attention to international political communication, where the “who” is a complicated propaganda apparatus in one culture, the “whom” is often an amorphous audience in another culture, and the purposes and circumstances are bound up with all the intricacies of international relations, then it is clear that we are not yet qualified to undertake a systematic study of international political communication (p. 434).

Another main reason given for embryonic notions of international communication is due to effect. Because effects have not been fully understood by social scientists, a successful “propaganda campaign” cannot be enforced. Effectiveness is explained through the statement made by Davison and George, “whether or not the audience likes or buys the product” (p.434). Communicative polices are vital then, to national policies concerning the international structure. Communication policy, behavior and content can take international policies and merge this with action:

...a broadcast, a leaflet, a diplomatic note- and so on... study of communication behavior includes consideration of the machinery by which communication policy is transformed [and there is a need to study] personnel who operate this machinery... (439).

While the authors momentarily diverge into the specifics of how policies can be employed, understood, etc...the focus returns back to the notion of effectiveness. The environment in which communication is received becomes
imperative to understand, most importantly, within the audience. This is referred to as “conditions” of communication. “The conditions of any given communication [referring to propaganda] include such matters as “timeliness,” whether it is forced to compete…or enjoys a monopoly position.” The actions of communication shape what the audience conceives and this can be accomplished by the propagandist exaggerating the story or giving it an “angle” (p.440). The desired impact of the audience provided a certain type of lens with which to “understand” what takes place, the purpose of communicative action. Returning again to the audience, Davison and George write, “this means that an important part of our audience or “target” analysis must be to assess in detail the political structure and dynamic political processes… How is power and influence distributed” (p.440)? Because studies of the audience can become overly involved with intricate details, the audience must be reduced to the reference of a specific attitude or behavior in which the propagandist wishes to impart. This article clearly presents the stance on the relationship procured within international communications, if not what “is,” then what “should be” from a narrow canal of thought. The notion of empire becomes very clear within “Process” as the United States, after WWII, attempts to force domestic policies and political ideologies in the laps of “other” countries in the name of “democracy” over communism.

There is a domestic perception that the United States is responsible for procuring democracy all over the world – despite opinions and deeply rooted cultures elsewhere. Some arguments refer to the monetary gain to be had by controlling other countries and political processes. Others, such as the authors in “Process” would maintain that other countries need political direction, hence, propaganda. Said, and historian Patrick O’Brien (1993) discuss the profitability of empires in noting,

We are at a point in our work when we can no longer ignore empires and the imperial context in our studies… the propaganda for an expanding empire [which] created illusions of security and false expectations that high returns would accrue to those who invested beyond its boundaries (p. 6).

The ways in which propaganda is secured can occur through specific actions: physical force, coercion (psychological warfare) or through social and cultural dependence (p.9). Authors in “Process” found psychological warfare to be best suited for matters of international purpose.

Under implicit pretense of saving lives, the section devoted to international communication emphasizes, “Psychological Warfare Reconsidered.” A lengthy explanation is given on the inadequacies of psychological warfare, how this can best be utilized, the ability and will to fight, and the democratic fallacy in mass propaganda. The fallacy is that what is portrayed in mass propaganda has to be for the control of audience to align beliefs with the propagandist. As a result, whatever picture is portrayed should be constructed based on what authorities deem necessary. Much of what Hans Speier (1954) emphasizes is “structure” within the political community through examples of using deliberate misconceptions. His specific analyses involve studying deception, political warfare (for or against) elites, and illuminating his explanations from German and/or Soviet actions. For example, Speier uses an example from Hitler (speaking to General Jodl) in order to illuminate the benefits of deception. The communicative transaction involves a false report given to the English in order to arouse suspicion that Russians (led by communist generals) will march into Germany, and Hitler says, “I told the Foreign minister to do that. That will make them [English] feel as if someone had stuck a needle into them” (p.468).

Philip Selznick (1954) concludes the book summing up the entire sweep of the book:

We must conclude…in the long view [that] political combat plays only a tactical role. Great social issues, such as those which divide communism and democracy, are not decided by political combat, perhaps not even by military clashes. They are decided by the relative ability of the contending systems to win and to maintain enduring loyalties (p. 562).

Messages become the linguistic embedding of the idea that political combat and military actions are inseparable and should prevail. The view of communication is conceived through camouflage-colored lenses. Selznick speaks of “contending systems,” “win,” and “combat” to elucidate functions of psychological warfare inherent in communication. The polarizations are representative perceptions of communication. If not winning, then losing; if not rising, then descending; and in absence of power and cunning, there must be weakness. Latent implications of manipulation and deception from this early textbook for generations of communication scholars provide bearings that persist in conceptions and orientations of communication.
Conclusion

How far can one get from history before realizing that the past is present all along—in a different shape, form, manner, perhaps, but still bound by the texts and traditions of history? This history has shaped the present to the extent of forgetting or taking for granted. There is a parable of a proverbial fish seemingly unaware of the water she has been surrounded by the whole time. The story progresses, but the fundamental nature is that this water has a history embedded in the everyday life of the fish (regardless of cognizance). In practical application of this parable within academia, to what degree is cognition surrounding world views connected to the history and culture form which we are cultivated? When ideas (realities) become taken for granted there is necessarily a lack of questioning. What this implies is a lack of understanding of the future as well as the present. The book, “Propaganda and Persuasion” (2006), cites Jacques Ellul’s ramifications of propaganda stating: “Because propaganda is instantaneous, it destroys ones sense of history and disallows critical reflection” (p.4).

While Ellul notes here the negative implications of propaganda he also justifies the use of the word. Ellul sees propaganda as a necessary way in which mass society can participate in civic events and exercise their democracy. He expands further to say that there are no “moral forms” associated with propaganda on the ambiguous note that propaganda uses, “truth, half truth, and limited truth” (p.4). The logic is: because there is some truth, there are no immoral implications on the term- propaganda. If persuasion has no moral forms, then emphasis on ascertaining how people feel and behave regarding the persuasion would seem irrelevant. In that context, determining the morality of people is very relevant and helpful to do “effective” propaganda. To what extent do the people being primed for propaganda retain their sense of feelings and emotions as something uniquely their own? What ends up happening to the feelings emoted is capitalization of how to direct these reactions in a beneficial way for the propagandist.

In many instances, the use of persuasion via pathos is what is most heavily relied upon. The social-psychological research completed within “Process” attempts to draw out people’s emotions in order to, if not predict, then win-over support through emotionally deceptive messages. Ellul’s justifications of propaganda are based on the normalization: everyone uses propaganda. This is predicated on a necessity to continue traditions which leads me to ask the question, if there are parts to a tradition, what sections should be maintained through ever changing times? Even now, as the tradition of how marriage is defined enters into social consciousness, so do the inevitable challenges presented when power structures are asked to change or accommodate those not included in this tradition.

The militaristic or linear terminology prevalent throughout the book “Process” can best be described by Finley (2003) in her article, “Militarism goes to school” when she notes: “Militarism refers to a set of values or ideologies that include hierarchical relationships and domination” (p.1). The reference to hierarchy and domination arises out of a time in history in which the field of communication was struggling to create a culture amidst international power struggles. Political and economic motives were weighed against the backdrop of two world wars and the mist settling into a tense cold war with the Soviet Union. The authorities making decisions were doing so from militaristic and scientific worldviews as this was a credible tradition within this patriarchy. This way of making decisions leaves out many voices from being engaged in actions that countries act upon. While democracies have attempted to alleviate this issue through bi-partisan representation and democratic principles, the tenets of capitalism, and specifically consumer consumption, plague the process through material distractions.

Converting “audience” beliefs for political gain or economic incentive is a necessary step in a process, producing civic incompetence. Democracy cannot thrive when critical citizenship has been replaced with complicit citizenship. Notions from political representation to claiming an education have been normalized as taken for granted actions/behaviors in society. Therefore, how can the actions of voting for political representation or claiming an education increase a society’s desire to engage in civic responsibilities? An integral part of this question that remains buried in political rhetoric is: what exactly is political representation and education if not a way to engage people as citizens of a democracy? Consequently to what extent should people, outside of “strategically placed propaganda” be a part of their community and world? If desires have been replaced by impulses then the power to be grasped is through control of these impulses. Propaganda has seeped so deeply into this reactive culture that redemption through action becomes muted and unnecessary. The content perfected by audience experts becomes a democracy only understood and defined by experts. Passivity is submerged under the force of the credibility of authoritarian mandates. Through passive actions, everything from politics to civic domains become areas for the expansion of capital, i.e. power. Meanwhile, the potentially engaged citizens have checked into technological enchantment conceived of by another venue of experts; scientific experts that have given the people “what they want”: I-pods, plasma screen TV’s, and arbitrary internet information. Through these advances, this culture maintains a masquerade of participation. Can responsibility of a more hopeful future be found in the same residence
that fostered these experts: academia? If there is a corner on responsibility regarding hope for the future, academia can shed some insight into the pseudo-involved society mentioned here.

Speaking in the sphere of academia, Henry Giroux (2006) addresses the problem of complicit citizens. However, he replaces this with the hope of inspired critical citizens within a democracy as he claims:

Critical pedagogy is not a method looking for an audience or context; on the contrary, it is a practice that emerges out of its allegiance to the imperatives of a democracy…critical pedagogy is one of the few theoretical and pedagogical traditions that offers the history, knowledge, skills and theories [that promotes] the connection between learning and social responsibility, and schooling and democracy (p.8).

While Giroux claims that pedagogy is the answer, this is premised on academia taking a larger role in the sphere of education as a form of democracy. What results is unlimited questioning and a sustained dialogue that asks questions of what is taken for granted. There is no assumed empirical stance on necessarily what is “right” and experts are unnecessary. Experts are realized as a fallacy of people who assume all-knowing. In a time when history is so fragmented, and often forgotten, that the possibility of possessing omnipotence becomes absurd. In the absence of supremacy, communication can come closer to the etymological function as a way to share burdens and duties.

The field of communication has not travelled very far from the roots of canonical empiricism. The notion that the voices best to be listened to are that of academics, political leaders, and other “influential” (powerful) figures still directs the field. Their responsibility is manifest as the elusive “man” behind the curtain conducting necessary activities and largely shaping the present and future through perpetuating or concealing understanding of a rich and somewhat haunting past, a past ripe with: “effectiveness” via reductionism, scientific objectives for measuring behavior and attitude change, and ideas of “manufacturing consent.” Separating people into categories and groups produces quicker assessments for deriving methods to break into their thoughts and desires; this is an applauded research endeavor, as well as, perfecting psychological “warfare” in order to levy the status quo. Limiting access or affinity with a holistic past via preoccupations with deceptive messages is a wide spread academic practice. It was Voltaire that said, “Those who can make you believe absurdities can make you commit atrocities.” In an illustrative example, Goebbels is quoted as saying that the “secret” of propaganda is for those being persuaded to never know they are consumed by propaganda’s grip (Pratkanis & Aronson, p. 87). Through a numbing effect of the language used to accomplish this effect, people then become pawns across domestic and international political, social, and economic rhetorical checkerboards.

While the language surrounding the essence of propaganda has turned into insidious threads in varying sub-disciplines in communication studies, this is an ever present practice. Words like “spin,” “rhetoric,” and many other colorful metaphors have replaced propaganda. Public speaking courses preach how to structure a speech in order to reel the audience in, and the imperative of “knowing your audience” is practiced. Public relations perfect ideas of impression management in order to represent companies’ favorably (regardless of reputation). Persuasion courses are the equivalent of a “how-to” manual of “doing” propaganda in order to win over the audience. Still much research conducted in the field focuses on how people behave and how people feel, for example, about a specific product, in order to perfect the media message for maximum consumption. Drawing upon theoretical models used in Nazi Germany or Soviet Russia have been normalized and reincarnated through more present interpretations in modern theory books. While the book *Process* has been buried under years of forgotten history, the voices and the messages they emphasized are alive and well in 21st century communication studies. Under the umbrella of achieving hegemony are those forgotten voices present in *Process* and now manifest in the praxis of the communication discipline. Regardless of time, place, or space, history is but a whisper away.

**Works Cited**


Literature Reviewed

Personality and Character Selection in World of Warcraft

Ian D. Mosley: McNair Scholar

Dr. Steven Patrick: Mentor

Sociology

Abstract

The present study examined the relationship between players’ personality characteristics and their online behaviors, including character faction, class selection, and game play in the massively multiplayer online role playing game the World of Warcraft (WoW). Data were collected from 205 WoW players who participated in an online survey that included the Big 5 Personality Inventory (Extroversion, Agreeableness, Conscientiousness, Emotional Stability and Openness to Experience) and portions of the California Personality Index, as well as original questions pertaining to WoW (Goldberg, et al. 2006). Statistical analysis showed that although there was not a significant relationship between player personality traits and their class or faction selection, there were significant relationships between personality traits and engagement in player versus player game play.

Introduction

Game developers go to great lengths to ensure that game worlds are realistic to players. This is perhaps most present in World of Warcraft (WoW). Although the overarching theme of the game may be fantasy, there are several elements to the game that parallel our own world and history (Krzywinslca, 2006). These parallels further the attachment players develop to the characters they portray, and the transference players experience from their game world interaction into their out of game lives. WoW and other games are now so well constructed that it has even been suggested that they could be “…windows into and catalysts in existing relationships in the material world” (Yee, 2006, p. 312).

In WoW and all other massively multi-player online role playing games (MMORPG’s) players self select into specific racial and cultural stereotypes. These characters are designed by the game developers and are the only options available to players. But although the character norms are governed by the game, in-game social interactions are governed by the same social norms as those in the physical world (Yee, Bailenson, UrBanek, Chang & Merget 2007). This begs the question: do in-game differences influence character choice, or do player choices lead to game-world partitions (Chen, Sun & Hsieh, 2008)? In order to answer this, and other questions about the criteria that influence character selection, researchers have to learn more about the players themselves (Chen, et al.).

Contrary to popular belief, research has shown that not all MMORPG players are sexually withdrawn young males (Griffiths, Davis & Chappell 2003). Yee (2006), found that the demographics of MMORPG players are as diverse as the populations they come from; likewise both Griffiths, et al., (2003) and Yee reported that video game and MMORPG play does not lead to violent or deviant behavior. Although research shows that game play is representative of the population and that it does not in itself lead to violent behavior, because both character selection and world development are influenced by player personality, we must ask how much of the game really is just a game.

Bessier, Seay, and Kiesler (2007), noted that most players feel a psychological connection to their characters. In their recent work Bessier, et al., found that players believe their characters are more like their ideal selves than their actual selves and that they use the game to “enact aspects of their ideal selves” (p. 531). With this being the case it is plausible to “…derive revealing personality information from a user’s behavior in a virtual environment” (Yee, 2006, p. 325).

World of Warcraft

For this study I chose WoW as the environment and WoW players as the population. Using WoW has several benefits. With 11.5 million players worldwide, WoW is the most widely played MMORPG in the world.
Beyond this both the structure of the game and the prior research supported the use of WoW. Griffiths et al. (2003) reported that over two thirds of WoW players have only one avatar, or character, in the game. In addition the structure of the game itself leads to more meaningful and dramatic inferences about its players. When a player sits down to create a character, their options are limited to several pre-determined factors. They are forced to select what server type, faction, race and class they will portray in the game. Each of these factors is pre-determined by the game. All Horde represent the same political beliefs, all warriors have the same access to talents and skill sets and responsibilities within the game. These pre-determined categories provide a reliable control for conducting this research.

WoW is divided into three styles of game play: player versus player (PvP), player versus environment (PvE) and role playing (RP). Players select which style to play by selecting a game server that only permits the selected style. For the purpose of this study I will focus on only PvP and PvE.

**PvP:** Player verses player, where the primary theme of game play is competition between and against other players. Players fight in arenas, battlegrounds and anywhere else in the game world where they encounter players of the opposing faction.

**PvE:** Player verses environment, where the primary theme of game play is cooperation with other players to accomplish difficult tasks controlled by the computer. While the option for PvP is still present, it is not forced on PvE servers.

After considering style of play we must also consider faction and race. In WoW “…the more western, or first-world Alliance, fights the more non-western, or third-world Horde” (Schwartz, 2006, p. 319).

**Alliance:** The Alliance consists of 5 races: the noble humans, the adventurous dwarves, the enigmatic night elves, the ingenious gnomes, and the honorable draenei. Bound by a loathing for all things demonic, they fight to restore order in this war-torn world. (World of Warcraft, 2009).

**Horde:** Five races comprise the Horde: the brutal orcs, the shadowy undead, the spiritual tauren, the quick-witted trolls, and the driven blood elves. Beset by enemies on all sides, the outcasts have forged a union they hope will ensure their mutual survival. (World of Warcraft, 2009).

With this understanding and in this context it makes sense that 48% of Horde players play on PvP servers (Chen et al., 2008). A players’ choice of race is also strongly associated with what type of server they choose to play on (Chen et al.).

Present study

To investigate whether character, faction, or server relates to players’ personality, I administered a variation of the International Personality Item Pool (IPIP) (Goldberg et al., 2006) containing questions from the Big 5 Personality Inventory. This instrument has proven to be useful in online research in the past (Bessier, et al., 2007; Cole & Griffiths, 2007). Based on the game descriptions of not only the factions themselves, but also the races that make up the factions, I expected to find that individuals with more aggressive, antisocial personalities would play Horde than Alliance characters, and that Alliance players would report more conservative and careful personality traits. In an effort to determine if the first-world versus third world comparison of the factions was reflected in players choices of what to play, I also examined whether player demographic information such as sexual orientation and economic status was consistent within factions. Finally I compared in-game behaviors to each other, such as class and faction selection, to see if there were any variables within the game that might be connected to players’ personality scores. I expected there to be a significant relationship between faction and time spent in PvP, as well as relationships between class and faction selection.

**Method**

**Participants**

Participants self-selected into taking the survey by visiting the survey website. Overall there were 205 participants (152 male, 52 female, 1 unspecified). Participant ages ranged from 18 to 64 ($M = 23.57, SD = 8.03$). Of the 136 respondents that provided their server information, 55 reporting playing on only PvP servers, 60 on PvE servers, and 21 on other server options. Because World of Warcraft attracts players of every age the first survey item was a screening question. Data from participants under 18 years old were not used in the final analysis.
Materials

Participants answered a 172 item survey online hosted by the university’s Qualtrics survey software. Thirty two items on the survey were created by myself and were specific to World of Warcraft. The remaining 140 questions were taken from the International Personality Item Pool (IPIP) (Goldberg, et al. 2006). The specific subset of questions from the IPIP measured the Big 5 personality characteristics, as well as a subset of behavioral facets. Refer to Appendix 1 for specific survey items.

Procedure

Survey participants were recruited via postings on popular internet message boards that are specific to World of Warcraft. Participants were asked to visit the URL for the online survey and complete the survey in their own time. Participants were informed before starting the survey that all of their answers would be kept confidential and that participation was completely voluntary. They were also informed that this project about explored themes and trends in character selection and play style in World of Warcraft. As an incentive to complete the survey, participants were given the option to provide an email address where they would like to have a copy of the final project sent upon its completion.

Results

The data were examined in three categories: the relationships present between in-game variables and personality traits, the relationships between in-game variables and the relationships between player demographic information and in-game variables. Initial correlations were conducted to determine the strength of the relationships between variables followed by a regression and cross-tabulator analysis.

In-game to in-game variables

A simple comparison of means revealed that Horde players engaged in PvP an average of 2 more hours a week than Alliance players (Alliance: $M = 5.06, SD = 7.76$, Horde: $M = 7.44, SD = 2.09$). Although this is an interesting finding, it was not significant, $t(131) = -.80$. There was, however, a moderate correlation between time spend engaged in PvP playing WoW for the joy of competition, $r(132) = -.30, p < .05$.

Although it was not unexpected to find a relationship between character race and faction, as faction selection dictates what race a player can select, $c^2(9, N = 136) = 1.29, p < .05$, a weak relationship was also present between faction and server type, $c^2(3, N = 136) = 6.24, p < .05$. See Table 1 for cross-tablature analysis of faction and class selection.

<table>
<thead>
<tr>
<th></th>
<th>Alliance</th>
<th>Horde</th>
</tr>
</thead>
<tbody>
<tr>
<td>Death Knight</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Druid</td>
<td>3</td>
<td>11</td>
</tr>
<tr>
<td>Hunter</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>Mage</td>
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<td>Paladin</td>
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<td>11</td>
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<tr>
<td>Rogue</td>
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<td>9</td>
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<tr>
<td>Shaman</td>
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<tr>
<td>Warlock</td>
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<td>9</td>
</tr>
<tr>
<td>Warrior</td>
<td>6</td>
<td>11</td>
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<tr>
<td></td>
<td>$N = 54$</td>
<td>$N = 82$</td>
</tr>
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</table>
In-game variables to demographics

There was a weak relationship between a players age and what type of server they select to play on, \( F(3, 131) = 5.32, p < .05 \). There were moderate differences present between players ages and their preferred game play style, \( F(1, 131) = 20.20, p < .05 \), their gender, \( F(1, 190) = 15.30, p < .05 \), and their marital status, \( F(4, 105) = 22.75, p < .05 \). There were weak relationships present between gender and players preferred game play style, \( c^2(1, N = 134) = 4.40, p < .05 \), and marital status \( c^2(4, N = 201) = 10.13, p < .05 \). There was also a weak relationship between players sexual orientation and their gender, \( c^2(2, N = 202) = 19.64, p < .05 \).

There was a strong relationship between players gender and their selection of their character’s gender, \( c^2(1, N = 135) = 58.83, p < .05 \). A cross tabulation and logistical regression analysis showed that although both men and women engage in cross-gender play, men more likely to engage in cross-gender play than are women, \( \beta = 4.14, SE = .77, F(1) = 102.75, R^2 = .44, p < .05 \). There was also a moderate correlation between players age and their time spent in PvP, \( r(132) = -.32, p < .05 \).

In-game to personality characteristics

See Table 2 for a comprehensive list of correlations. Respondents who reported primarily playing WoW for the joy of completing cooperative objectives also scored high on extroversion, agreeableness, intellect, and dominance. Whereas these correlations are weak at best, this does draw a distinction between those who play for the joy of competition and those that play to cooperate with others. In the case of those who reported playing more for the joy of competition, the correlations were present in the dominance, tolerance, leadership, masculinity, femininity, and narcissism scales.

<table>
<thead>
<tr>
<th>Group Objectives</th>
<th>Joy of Competition</th>
<th>Hours PvP</th>
<th>Hours of PvP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agreeableness</td>
<td>.21*</td>
<td>-.09</td>
<td>.05</td>
</tr>
<tr>
<td>Dominance</td>
<td>.26*</td>
<td>.23*</td>
<td>-.01</td>
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<td>.18*</td>
<td>.10</td>
<td>.00</td>
</tr>
<tr>
<td>Femininity</td>
<td>-.08</td>
<td>-.33*</td>
<td>.22*</td>
</tr>
<tr>
<td>Intellect</td>
<td>.19*</td>
<td>.15</td>
<td>.10</td>
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<tr>
<td>Introversion</td>
<td>.20*</td>
<td>-.12</td>
<td>-.03</td>
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<td>Leadership</td>
<td>.11</td>
<td>.20*</td>
<td>-.03</td>
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<tr>
<td>Masculinity</td>
<td>.18*</td>
<td>.23*</td>
<td>.14</td>
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<tr>
<td>Narcissism</td>
<td>.02</td>
<td>.33*</td>
<td>.22*</td>
</tr>
<tr>
<td>Sociability</td>
<td>.17</td>
<td>.36</td>
<td>.05</td>
</tr>
<tr>
<td>Tolerance</td>
<td>.07</td>
<td>-.24*</td>
<td>.19*</td>
</tr>
</tbody>
</table>

*Note. *\( p < .05 \)

Correlations were also present between tolerance, \( r(125) = .19 \), femininity, \( r(120) = .22 \), and narcissism, \( r(119) = -.22 \), scales (all \( p < .05 \)), and the amount of time players spent engaged in PvP. The only personality trait that correlated with a players choice of faction was the femininity scale, \( r(120) = .18, p < .05 \). A linear regression analysis revealed that femininity scores were also a highly significant predictor of a player’s hours engaged in PvP, \( \beta = .22, t(118) = 2.46, p < .05 \). Femininity scores also explained a significant proportion of variance in the amount of time spent in PvP, \( R^2 = .05, F(1, 118) = 6.07, p < .05 \).
Discussion

The purpose of the present study was three-fold. First, we examined the relationships between in-game variables (e.g., class and faction selection). It was hypothesized that there would be a significant relationship between faction and time spent in PvP, as well as relationships between class and faction selection. Second, we investigated the relationships among demographic variables and in-game behaviors. We also examined whether player demographic information such as sexual orientation and economic status was consistent within factions. Finally, we examined the relationships between personality characteristics and in-game behaviors. It was expected that individuals with more aggressive, antisocial personalities would choose Horde, whereas Alliance players would be more conservative and careful. The results are presented in the paragraphs below.

In-game to in-game

The hypotheses regarding in-game variable relationships were partially supported. Finding that Horde players spend more time in PvP than Alliance players do fits with the stereotype among World of Warcraft players. Because the sample was not random and was relatively small, it is not surprising that this finding was significant. In the case of players reporting of playing WoW for the joy of competition, it makes sense they would also engage in more PvP. What makes this finding difficult to justify is that there was not a significant correlation between players playing for the joy of completing group objectives and their time spent in PvE. I again attribute this to the sample size and non-random nature of recruitment.

In examining the relationship between faction and server type selection I also found that Horde players are more likely to play on PvP servers, further strengthening the stereotype that Horde players are more aggressive and/or interested in the competition aspects of the game.

In-game to demographic

Contrary to my hypothesis, the data revealed no significant relationships between player demographic information and their selection of faction or character class. This suggests that character and faction selection may be influenced by factors not measured in this survey. Although in-game demographics were not influenced by out of game demographics, a player’s age did have a moderate correlation with both the amount of time spent engaged in PvP, and the types of servers players selected to play on. The data shows that younger players (under 25 years of age) were more likely to play on PvP servers whereas older players were more likely to play on Normal or RP servers.

In analyzing the relationship between player gender and character gender, findings were consistent with existing literature in the field (Hussain, & Griffiths, 2008). Although both men and women engage in cross-gender play, men were four times more likely to play the opposite sex than women are.

In-game to personality variables

The data does not support the hypothesis that player faction and class selection are dependent on player personality traits. In fact there is no data to support this and it appears that faction and class selection is entirely random. Although players’ choices of race and faction were not related to their personality traits, their behavior within game was. Players who reported playing World of Warcraft for the joy of completing group and cooperative objectives also showed high scores in extroversion, agreeableness, intellect and tolerance. These findings suggest that PvP players are generally more energetic than PvE players, more compassionate and willing to cooperate with others, more open to new ideas, possessed of a stronger sense of adventure and more likely to be trusting and forgiving of the shortcomings of others. While this does not suggest that PvP players do not also possess these traits, it does suggest that a PvP player is more likely to be possessed of these characteristics.

In contrast to this, players who reported playing World of Warcraft for the joy of competition scored high in dominance, leadership, masculinity and narcissism, and low in tolerance and femininity. Combined with the moderate correlation present between the time players spend in PvP and their reporting of playing WoW for the joy of competition, it appears that PvP players are generally more domineering and willing to take charge, more confident in their own abilities, more willing to take risks and possessed of a strong desire to control others around them. Further, PvP players are less likely to be tolerant of mistakes made by other players and more likely to take action without first considering consequences.
After multi-variant analysis, femininity is the only score that remains significant to time spent in PvP. All other scores fall away. This further supports the hypothesis that PvP players are risk takers, generally more interested in quick gratification than in carefully planned strategies. It is interesting to find that there also no connection between a player’s age and their hours spent in PvP or the personality scores, leading to the conclusion that PvP players from all demographics could share these characteristics.

Limitations

Significant limitations in this research were the sample size and the non-random nature of the participant recruitment. In order for studies like this one to be generalized to the population there would need to be a random selection taken from all World of Warcraft players. Lastly, the current research lacks a qualitative element that individual interviews could account for. There are undoubtedly other circumstances affecting a player’s choice of class, faction and engagement in PvP or PvE activities. It is beyond the scope of this research to account for all of these elements. Interviews of World of Warcraft players would give future researchers the chance to more fully understand the players and strengthen the inferences that could be made based on observing their behaviors in the digital world.

Conclusions

The current research shows that MMORPG’s like World of Warcraft can, in fact, be used as representations of their populations. The key in using MMORPG’s as research populations in the future will lie in understanding which aspects of the game are representative and which are not. This study shows that character selection choices such as class and faction are not related to the player’s personality therefore would be a poor choice for future researchers to use. However the research does show that researchers can make inferences about player personality traits based on their behaviors in relation to other players in the game. This is consistent with other research into MMORPG players and playing practices.

References


Cupping the Spark in Our Hands: Developing a Better Understanding of the Research Question in Inquiry-Based Writing

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Abstract

This article serves to highlight the unique position the research question holds in inquiry-based research writing. Inquiry-based educational theories (see Dewey; 1910, Bruner; 1962, Ballenger; 1997) contend that learning begins with the act of questioning. Research writing remains especially challenging for many first-year college students (see Larsen; 1982, Carroll; 2002, Alsup; 2002). The author conducts a two part study of writing inquiry-based research writing samples and concludes that the inquiry-based research question should be treated as text in its own right and as such should be approached through process writing. Students should be encouraged to pre-write, draft, and revise their research question before they begin their research project. In this article the author discusses the writing sample study, and possible strategies and pre-writing exercises based in low-stake imaginative writing genres like fiction and poetry as a method of teaching first-year writing students to form inquiry-based research questions which are focused and well-developed.

The key to wisdom is knowing all the right questions.
— John A. Simone Sr.

Introduction

In The Companion Website for the Curious Writer, Michelle Payne describes the process of inquiry as “begin[ning] with the premise that students and teachers are collaborators in learning, creating knowledge together through the questions they ask and the methods that best help them answer them.” Inquiry theorists, including John Dewey, Jerome Bruner, and Bruce Ballenger contend that the act of questioning is central to academic inquiry. We begin with questions; we focus on the process of inquiry, of searching, of trying something in a way that is new to us. Yet first-year writing students are rarely taught how to craft well-developed questions as part of inquiry-based research writing.

It is my contention that because the research question holds a unique position in inquiry-based research writing it deserves special consideration in the first-year writing classroom. According to inquiry-based education, the research question acts both as the driving force of the inquiry process and as a focal point in the finished product. In “Skating Backwards on Thin Ice,” Ballenger says, “At the heart of inquiry—and essay writing for that matter—is finding the questions that make even the most mundane topics come to life” (103).

Students can benefit from learning to craft a well-developed research question because it will allow them to better engage in the inquiry process, to create more focused products, and to better understand research writing as artistic and imaginative. Because the research question is so important to the outcome of an inquiry-based research project, it should be taught not as a pre-writing strategy for the researched essay but as an important text in and of itself. Students benefit from crafting their questions through a process of pre-writing, drafting, and revision. In this article I will discuss my research of the inquiry-based research question, which includes an analysis of anonymous student samples, a unit I designed and taught to a summer class of English 101 students, and an analysis of the papers those students produced.
Inquiry Theory and First-Year Writing

Students are most often introduced to inquiry-based research writing during their first year because first-year writing classes offer an ideal environment for students to focus on writing as the content of their classes rather than as a vehicle to better understanding the class material (Ballenger, “Skating Backwards”; Lauer; Harrington). In a first-year writing class we often concentrate on how to write, rather than on what to write. While doing so, we should also focus on learning how to write good questions in addition to learning how to write about good questions. Because inquiry-based writing is utilized by writing programs across the country in an effort to engage students in writing research (Ballenger, “Skating Backwards”; Boyer Commission; Lauer), it also offers an ideal opportunity to teach students to craft and develop questions as a writing process.

Even though the inquiry-based research question is acknowledged to be crucial to the inquiry process, the actual act of crafting a good research question is often glossed over, or mentioned only briefly as part of the pre-writing stage of the project. This may be due to the assumption that students already know how to ask questions, or perhaps we simply assume it is a skill they will pick up over time. Whatever the reason, students are often given little direction but are expected to find, come up with, or decide on a question quickly and to use that question to direct their research.

Yet students need to understand both the purpose of the research question and the language and syntax that inform how questions are constructed. They should have a clear understanding of the difference between surface questions, short-answer questions, and complex questions.

Like many students, I was introduced to inquiry-based research as first-year writer. Professor Arnold, my English 101 professor, asked us to read “The Bothersome Beauty of Pigeons” by Bruce Ballenger in our text, The Curious Researcher. It read sweet-coffee smooth, painted pictures of a Europe I longed to see, and offered up lines like, “Pigeons are punks. Looking them in the eye, I’m sure they know this but they just don’t care” (16–17). In all seriousness, he told us the “pigeons” piece was research. He told us a researched essay was a style of writing that encouraged the exploration of questions, a way to better understand something that interested us. He told us it would be more interesting, more personal, and more fun to write than the research papers we remembered from high school.

But to me the research essay felt contradictory, like a mythical beast made of bits and pieces of genres I knew but they were mixed-up in a way I had never seen before. It had the voice and heart of a personal essay, the backbone of a research paper, and a wild exploratory spirit. I had no experience with such a paper and no idea where to begin. Professor Arnold told us we would “begin with a question.” It was the first time I had heard that phrase and I remember wondering what it meant. I would continue to wonder every time I came across a researched essay, and eventually that wondering influenced the research that led to this article.

In class we worked through a few pre-writing exercises. We made lists of questions, we questioned each other’s questions, and we drew spider graphs, free-wrote, and then sallied forth to the library. I chose fairy tales and folklore as a topic and wrote three drafts. I did not begin with a question. If asked to articulate a question from the nebulous thought process I employed to write that paper, it might be something like: What’s up with fairy tales?

The first draft was about my family folklore. The second was a mangled overview of European fairy tales, and the finished draft was a long-winded conversation about the effects of fairy tales on children. I decided to write the third draft because I could add the question “Are fairy tales good for kids?” which was a requirement of the paper. In every draft I diminished, my voice faded in an effort to balance what I cared about and what I thought of as research. I earned an A on the paper but the project left me frustrated and unsure of what makes a good research essay. To this day I wish I’d kept and reworked that first draft.

This is not a unique story. Academic writing is hard to learn and hard to teach. First-year writers struggle to understand what is expected of them and to execute it (Carroll; Alsup and Bernard-Donals). In a longitudinal study of first-year writers, Sommers and Saltz said, “Students are asked as freshmen to leave something behind and to locate themselves in the realms of un-certainty and ambiguity” (126). First-year writers are asked to leave behind the safety nets of formulaic writing and asked to use writing as a mode of learning rather than a mode of recording, at the same time they are expected to, as Lee Ann Carroll points out, “be able to write fluently and correctly on any topic, at any time, in any context” (1). This leaves them unsure of their writing skills, their voice, and their ability to contribute to the discourse. It makes it very tempting to fall back on what they know, which is fact, figures, and reporting information. David Bartholomae points out that students have to “invent the university” by an immersion process, by being tossed into a new environment where they bluff, pose, fake, and mimic their way into an understanding of the discourse. However, there are skills that cannot be faked; they must be understood and practiced. Asking questions is one of those skills.
In addition, research just doesn’t feel interesting or personal to most first-year writers. They struggle to understand research writing as artistic or imaginative. In the article *When All Writing Is Creative and Student Writing Is Literature*, Wendy Bishop documented attitudes students held toward writing. Simply put, they believed creative writing was fun and interesting, and fact-based writing, assigned writing, and writing research-based projects were boring. Her students felt there was a divide between composition writing—what Bishop called “bread and butter” writing—and creative writing—what she called “jelly.” Like Bishop, I believe that our “bread and butter” is given flavor with a little “jelly,” and our “jelly” gains substance when mixed with “bread and butter” (192-202).

Bruce Ballenger documented many of the same attitudes. In *Beyond Note Cards: Rethinking the Research Paper*, he wrote, “What they [students] seem to believe most of all is that ‘facts’ poison prose; any writing that deploys research has got to be dull, dull, dull” (101). And he points out that the inquiry-based research essay offers a format that encourages the mixing of both the substance of good composition writing and the flavor of creative writing.

I agree with Bishop and Ballenger. First-year writers need to understand that academic writing isn’t all “bread and butter” and creative writing isn’t all “jelly”; the two intermingle. They need to understand that all writing, including research-based writing, has the potential to be creative. However, I also understand why it can be difficult for young writers to embrace research as artistic or imaginative. Like Bishop, I think “writers need classes that allow them to take risks and experiment with prose, and they need to see similarities between the types of composing they do, adding a little jelly to their bread and butter writing” (28).

I see the act of asking and writing questions as just the place for “jelly” in the “bread and butter” process. Crafting research questions opens up a place in the process to be artistic, to be imaginative, because it forces students to think about what is unknown. It opens a space to write about the things that interest us, to ask why they interest us, how they interest us. It opens a space to experiment with our writing. A student might write a poem about his or her research interests, a personal narrative may illuminate why he or she cares about the research topic, or a short story might spark ideas of experimentation or hypothesis. The possibilities for imaginative and artistic approaches to the act of questioning are endless. But first, students need to understand that a great question isn’t written in one try any more than a great essay, article, or story.

**First-Year Writers and the Act of Questioning**

As a first-year writer, I had a great deal of trouble articulating my thoughts as a question. I could never find the right words, or the right form to write a clear question. I observed many of my fellow students struggling in the same way. When I began this project for the McNair Scholars Program (a program designed to help prepare first-generation, low-income, or underrepresented students for graduate studies), I found I was struggling again; my question was nebulous and amorphous. I knew I wanted to better understand first-year writers, and I knew I wanted to find ways to encourage first-year students to engage more fully with research writing. To do so I needed to begin at the beginning, so I looked more closely at how I was taught to write research, which led me to writing about the inquiry process. Yet I continued to find myself getting stuck. I still didn’t understand how to begin with a question. Instead, I began by diving into the discourse, searching for a focus, a compass.

I came across a case study called “Learning to Question for Inquiry” in which Marian Martinello paired graduate students and children of grade school age and asked them to devise a research project and write a paper. She found that children often lacked the syntax for constructing complex question. They had trouble creating questions even about topics they picked, and they gravitated to yes or no and short-answer questions. She found that her students lacked a process or system of refining or revising their question, and they lacked an understanding of the purpose or point of asking good questions. I saw myself and my struggles in her students, and I wondered how many first-year writers would recognize their own struggles in this study.

I began to see that I expected a question to start out well formed, to begin well developed. I realized that I had never considered revising a question, not in the same sense I would revise a paper. In revising a draft I would reimagine the draft, changing entire passages and concepts, reorganizing or even beginning fresh on a section I wasn’t happy with. I had been asked revise my question in my scholars program but I didn’t revise, I edited, exchanging one word for another, cleaning up grammar. I never rethought, reenvisioned, or rewrote my research questions.

It wasn’t until I was writing my concept paper, and then my research proposal, and then my first drafts that I began to see new and interesting questions surfacing from my on-paper musing. Once I had spent some time reading and learning about what interested me about inquiry-based research writing, I began writing from ideas. Unfortunately, I would then turn around and try to fit those ideas into the confines of my original questions instead
of revising these to fit my evolving understanding of my research. Once I began to see this pattern, I realized my
struggles were due not to my lack of research skills or writing skills, but due to my lack of questioning skills.

Once I began to treat my questions the same way I wrote a draft, through pre-writing, drafting, and
revising, I began to develop an understanding of the purpose of asking good questions. I began to see how they
would connect to my research process and to my finished product. In the process of writing my questions I finally
began to understand why beginning with a good question is so important in inquiry-based writing. Which led me to
wonder how first-year writing students understood the act of questioning. Do they understand how to craft a
question? Do they understand how their question influences their writing? Or do they expect good questions to
simply spring to life fully formed and ready to be researched?

Joop van der Schee, a Dutch scholar, also noted the difficulty students had with writing good research
questions. In an article titled “How to Train Students to Formulate Good Research Questions,” he looked at research
writing in Dutch curriculums. The goal was promote a “more active and independent learning.” However, “in Dutch
education there is no long tradition of writing research papers . . . [so the] article . . . reports on the first Dutch
experience in the field” (245–47). In an effort to better understand the research process and the act of questioning,
several experiments and approaches were tried.

One involved simply having students develop a project and asking them to concentrate on choosing a
theme, formulating a central question, formulating two sub-questions, and making a plan. Seventy percent of those
students found formulating their central question difficult. In a second experiment, students were asked to write
research papers mixing geography with history; they were given instructions and had access to coaching via
instructors. Nine out of ten of those students showed “a low level of competence in formulating central questions”
(251). In a third experiment, students were given an extensive handout explaining the research process, criteria
showing them what was expected of them, and some mapping exercises to help focus their central question. This
produced better work, but the students continued to struggle with evaluating what made a good central question.

This article simply reinforced my belief that many students do not understand how to craft a question, they
have no process for writing a question; they lack the language, syntax, and semantics of well-developed questions. It
also strengthened my contention that a well-developed research question can help students navigate through the
process of inquiry by sparking their curiosity, providing them with a filter as they gather information, and providing
a lens through which to question, discuss, and unpack that information. In the drafting and revising process, the
research question can act as a starting point and lens, helping students navigate the challenges of organization. By
taking the time to teach students to form a good question through a process, giving them a chance to understand the
purposes a good question serves, and letting them experiment and explore their own beliefs, ideas, and curiosities,
we can offer them a chance to take risks, be imaginative, and develop a better understanding of the inquiry-based
research process.

Doing the Research: Methods and Findings

In order to better understand how students dealt with the act of questioning in their writing, I gathered
samples of researched essays from my mentors, from old portfolios, and from an online publication of first-year
writing produced in by my university. I read over one hundred researched essays looking to see how students wrote
questions, why they asked those questions, and how they discussed those questions. I made no judgment on the
quality of the writing or the content, focusing only on how the student dealt with questions. I was granted permission
by the intuitional review board of Boise State University to conduct this research and the essays I used were either
from portfolios or from an online publication of first-year writing. Permission was granted for any student work
quoted in this article.

Findings from the anonymous student samples

Three key points surfaced from my samples:

1. Students who wrote about their questions, rewriting them throughout the work, ended up with better
   questions.
2. Students who voiced their reasons for asking their question and understood their personal stakes in the
   project produced better questions.
3. Dealing with information, particularly finding and utilizing sources were clearly areas of difficulty for many students, but the students who articulated a good line of questioning often seemed to use those questions as a way of interacting with their sources.

Organization in the anonymous student samples

Broad, undefined questions like “What is wrong with us?” or “What is pain?” were common in my sample. These questions, about the topic of mental disorders, were undefined and undeveloped.

The student who asked, “What is pain?” started by discussing types of disorders, then the drug industry and how it may or may not impact the rise in mental disorders. She speculated about the relationship between mental disorders and changes in culture and society. Eventually she focused on depression on the second-to-last page. She just kept writing questions throughout the paper. She eventually came to a more focused question, “Why are so many people depressed?” through her conversation about mental disorders and through refining her question as she was writing. This student’s paper was particularly interesting because of the heroic attempt she made to categorize and focus her discussion of pain. She worked so hard to categorize her information but never came to a question or line of questioning that might have helped focus her topic.

Another trend that emerged in my review of the student samples was the tendency to explicitly state a question and then write a discussion on something else entirely. For example, one student asked, “Why do we love to be scared?” and then wrote a personal exploration of a local haunting. She never attempted to revise her question.

After reading these papers, I could see that the students lacked a process of revision for their questions, and since their questions often remained undeveloped and vague, those questions were of little help to them in their research. I’ve added a list of questions asked by the students in the papers (see appendix I)

Personal stakes in the anonymous student samples

Two things that stood out to me were the students’ desire to explain their reasons for their questions and their desire to write about something they cared about. They narrated family stories, talked about tragedy and turmoil, fear and stress. The more they wrote about their stakes in their questions, the more curious they seemed to be to find answers. For example, one student’s mother was a teacher and watching her mother struggle with the demands of the No Child Left Behind laws prompted the student to question the laws’ validity. Throughout the essay she relies on her observations of her mother to prompt her questions. Another student’s negative experience with voting made him wonder if he was too young to vote. He writes, “I feel with a few more years of the adult life and experiences, as well as finishing college. I may one day vote but for now I have too much going on to know the issues, and who is running.”

I saw this tendency to make the research question personal as an opportunity, a possible way of helping students better understand research. If they understand their own motivations, they might develop a deeper curiosity about the world around them, which might encourage them to write more complex questions and search out answers about topics that matter to them.

Sources used in the anonymous student samples

The most prevalent trend I saw in the samples was the tendency to ask questions that are easily answered. These papers felt like a one-sided conversation, like catching bits and pieces of a passerby’s cell phone call. These are yes or no questions, short-answer questions, questions that are answerable only by opinion or speculation. These types of questions offer the writer no way to navigate the discourse, no way to decode what the sources are saying, and no way to filter all the voices discussing the topic. For example, one student wrote about horses but never articulated any questions, problem, or conflict. Without a clear question, he had no guide to the information about horses. How can any student be expected to navigate all the information and sources available without a focus point?

It was clear to me that students needed to understand what part a question plays in research and a better way to write questions so I designed a mini–teaching unit about the act of questioning to use in the classroom. I was fortunate enough to have the opportunity to teach that mini-unit to a summer English 101 course on my campus.
Textual Analysis of Classroom Samples

The English 101 class consisted of thirteen first-year writers and an excellent instructor, who assisted me in my research while expertly guiding her students through a vigorous and demanding curriculum. This study was conducted under a number of limitations, including a small sample set of finished products, a small group of student participants, and a very short period of time. The assignment the students were given called for research essays that discussed some aspect of higher education. The students had a two-week period to complete the unit. I was able to collect only rough drafts. All of the students were informed of the research in the beginning of this research, but because the research was part of the planned classroom activity they could not refuse to participate however no sample, taken, read by me, or used without a consent form.

The unit included:

• A PowerPoint presentation and discussion of the purpose of a research question, the syntax and language used in creating a question, and the ways a well-developed research question can help guide the research process.
• Two writing prompts that utilized low-stake genres, including poetry and narrative (see appendix II). The prompts were used to guide the students through the pre-writing, writing, and revision process.

Throughout the unit, I observed the students’ process of questionning from the beginning to the end of their research unit and collected their prompt responses and finished essays. I observed and helped them to develop a question, research that question, and rewrite the question, all before they actually began working on the researched essay.

As with the anonymous samples, several key points surfaced during the reading of the classroom samples:

1. These students began with well-developed questions and the information they gathered was more focused. They rarely rewrote or revised the question in the finished product.
2. Throughout this sample set, students referred back to their questions. They talked about why they posed their question, they talked about their process, and they talked about the difficulties they encountered in their research.
3. These students navigated the information with a clear guide and rarely got bogged down in the discourse.
4. The most interesting trend I saw among this sample was the number of students who made statements indicating how they might approach or go about further research if they had more time.

After reading my classroom set and working with this group of students, I am more convinced than ever of the value of inquiry-based writing. I am also more convinced that one of the keys to making inquiry-based writing engaging for first-year writers is to help them to write good questions.

Organization in the classroom student samples

In the beginning of the research unit, my co-instructor built a spider graph with the words “higher education” in the center and asked the students to suggest sub-topics or research ideas. They responded with terms like empowerment, sports, family, and challenges. She then asked them to ask question about these terms and they asked questions like, “Is college empowering to women?” Next she asked them to define a researchable question. She drew two columns on the board and asked them to define researchable questions versus other questions. They responded by saying a researchable question is one that isn’t easy to answer, or isn’t a yes or no question, or isn’t a big question like “Is college good?” They said a researchable question should have sources and should be relevant. The instructor then gave a few verbal examples of researchable questions before they began writing their questions. At this point I began my unit.

I asked the students to begin with writing a question. Even though they had discussed the act of questioning, when they began writing their questions they wrote short-answer questions or yes and no questions. They used terms like “is” as in “Is college empowering?” or “are” as in “Are drugs causing dropouts?” or “how” as in “How does college build confidence?” I asked them to rethink those questions using phrases like “in what ways?” “what is the relationship between?” and “how might x cause y?” I also asked them to consider which questions might be more helpful in their research.

My first step in helping the students refine their questions was a PowerPoint presentation about the purpose of a good question. I gave them examples of how a good question would contain a direction for their research. For
example, instead of “Is college empowering to women?” I asked, “In what ways can a college education empower a woman in the job market?” I pointed out that this question contained a demographic (women) and a relationship (college and the job market) but was open enough to allow for exploration and interpretation.

Next we talked about the language and syntax of asking a question. I asked them to consider the difference between a question like “What is the relationship between sports and academic success and how might it affect students in their first year at college?” and a question like “Does playing a sport help students succeed?” I pointed out the difference between “what is the relationship” and “does,” explaining how the first one offers more room for exploration while at the same time focusing the research. We also discussed cause and effect questions, such as “How does binge drinking affect the freshman dropout rate?”

Next we discussed what I called the basics of a research question. I asked them to look at these questions and see if they could answer them about their research question.

• Who is the question about?
• What relationship, phenomenon, situation, or aspect of the “who” is the question about?
• What kinds of information might you need to explore this question?
• Where might you find this information?
• How can this question help you organize your paper?

Then I asked them to rewrite their question. In the second set of questions they struggled with syntax, asking questions like “How might college empower women who are coming back to school?”

Next I had students work through a series of prompts (see appendix II) intended to get them thinking about their interests, their curiosities, and their topics. At the end of each prompt they were asked to rewrite their question. We also spent a day at the library, where their instructor set up a session with one of our librarians. The librarian walked them through different types of sources and showed them how to locate library material. At the end of the day they were asked to turn in their final version of their question.

At this point I also explained to them that questions often change during research and reminded them to rewrite their question if they came across information that changed the course of their research. What I saw during this time was that it wasn’t until the students had a chance to discuss and write about their interests that their questions began to take a more distinct shape. One of the most interesting things I saw in these samples was that students used their questions in their opening statements in their final project (see appendix II). For example, one student wrote, “How does education empower a non-traditional female student in the U.S. today? That seems to be a big question in today’s society with so many non-traditional female students returning to school.” Another began with, “When I had made the decision to write about patriotism and what we learn about it through higher education, I had to stop and ask myself, what does patriotism actually mean?”

Others gravitated to personal narratives that set up their reasons for asking these questions, as the following example illustrates:

I didn’t want him [my father] to read it. I wished I could have turned back the clock by nine months. I don’t know what I was thinking by lying to my dad about my school status. “I did great, Dad. Boise State is an easy school.” I continued to spin this thought to my family for the entire course of my first go around at Boise State University. Unfortunately, the school year had to come to an end some time.

This student had asked, “How does Hispanic culture affect Hispanic college students?”

Another student wrote, “I did my first line of ‘coke’ at BSU in the late 1970’s. College campuses were just getting over the aftermath of the 60’s, peace, love, harmony and free spirits and free sex; free meaning, free from being committed to a relationship.” This student had asked, “How are Boise State university students affected by drugs and alcohol?” Throughout each of these essays, the question remains a constant, unifying thread tying their writing together.

This isn’t to say that students didn’t struggle with organization or writing or grammar, as they do in any writing class, only to say that once most of them gained a better understanding of the act of questioning, it positively affected their work. Overall, the students who had a well-developed question to begin their project seemed more engaged in the research. I’ve added a list of the questions students asked. (see Appendix I)
Personal stakes in the classroom student samples

One the most compelling trends in both samples was the students’ tendency to talk about themselves, to tell the reader about themselves, about why they care about the research. In the classroom sample, this tendency really took over in some cases. A number of essays were explorations of personal questions. One student asked, “How would my life be different if I were a traditional student without all of the responsibilities of raising kids and having a family?” This student discussed learning new things about himself and students like him through his research. Throughout the essay this student questions his own ability to succeed as a nontraditional student but eventually comes to the conclusion that his life experiences could be motivating, making him a stronger student than he might have been at eighteen.

These personal insights and discoveries are a big part of what the research essay is supposed to be and when students find a personal stake in their questions, when they have the time to explore themselves as well as research on a wider level, they synthesize information at a deeper level than if they were doing one or the other exclusively. This is not to say that all of these students were able or willing to make the writing about personal discovery. As in my anonymous sample, there were two students of the thirteen who wrote a question on the first day and never revised or explored it.

Sources used in the classroom student samples

One trend I was extremely pleased with was my students’ use of sources. They used mostly scholarly articles and they used them well. For example, one student wrote:

In my mind I knew I had made the right decision and that I would be able to keep up. Nancy Shields has done a very good job of encapsulating the feelings some older students have: “... the findings are interesting in light of stereotypes of ‘nontraditional’ students—for example, feeling ‘too old’ to be a student, feeling academically inferior to traditional age students, feeling out of place on campus, and so forth.”

Another student wrote:

[My father] told me to think about my nieces and nephews who look up to me. What would they think if not even the great Uncle Junior could pass college? I needed to set an example. A family tradition of graduating college must be started. Lionel Sosa, author of *The Americano Dream*, states that one factor as to why Hispanics don't attend/complete college is because, “...we see so few of our own earning diplomas, we do not have a frame of reference for the possibilities” (Sosa 90). My family and community need to see a familiar face finishing college.

I believe these students handled their sources as well as they did largely due to the amount of time their instructor and one of our librarians spent in the library with them helping them to understand how to differentiate sources and how to read them. But I also believe that part of the reason these students were able to engage with their sources as well as they did was because they started with questions that helped them to sort through a vast amount of information. Having a clear, well-written question in mind for a research essay is crucial to the process. It is also crucial that students understand that a good question is the result of a process.

The unexpected trend

The unexpected trend I saw in the classroom samples was the number of students who speculated on what they would do if they had more time. The fact that students wanted to continue researching, wanted to better understand their projects, surprised me. I expected them to be thrilled just to be finished with their papers. One student writes, “I have to close this paper now, because I am out of time. ... I have so much more to talk about and I want to share with you the discovery I made. ... I will use this information to develop a strategy of prevention for my addictions study class next week.”

To me this is what teaching inquiry-based writing is all about, cupping that spark of interest in our hands and blowing it into real academic curiosity. It’s about watching our students grasp the idea that inquiry and research are one way we experience the world, how we come to new knowledge: it’s how we change the world around us.
We teach our students in the hope that they will further the academic conversation, in the hope that they will surpass their masters, in the hope that each new generation will make the world a better place. Inquiry-based writing is one of the best tools we have to help students be academically creative, academically curious. Many teachers, like Bruce Ballenger, have generated and sustained the spirit of inquiry through innovative and inventive teaching methods, showing us how important it is to begin with a question. The next step is ensuring that our students understand how to create a well-thought-out, well-developed, carefully crafted question.

Cupping the Spark

At last count this project, which began in the fall of 2008, has, from concept to final draft, undergone something like twenty-one revisions—each of them a true re-vision where my ideas and questions were turned upside down and inside out. I began with so many question and ideas, mountains of information, and valuable input from my instructors, my mentor, and my peers. There were times when I was sure I would never find my way to the end of the journey. Perhaps I can honestly say this project really began when I was a first-year writer questioning what it meant to begin a research project with a question. That the sparks began to fly when I was struggling to write a paper in which my voice wasn’t overpowered by facts, figures, and sources, a paper that I felt led me to something wonderful. And now I can finally say I understand what it means to begin with a question.

Works Cited

APPENDIX I:
Questions the Students Asked

The anonymous samples

- Will you ever grow up?
- What is wrong with us?
- When you look back at your childhood, what do you remember?
- What is the impact of media on our children’s behavior?
- Is $65 a lot of money?
- So who did discover America?
- But just how safe and useful are the sidewalks of Meridian?
- What were my experiences with death? How did I deal with them?
- Social Security: economic security or government pyramid scheme?
- Why does one event have multiple stories depending on who you talk to? And more importantly, why would someone tell the story inaccurately on purpose? What are they trying to make the audience feel?
- Why do people choose too take these [immigration] risks?
- Are cell phones driving [you] crazy?
- How do we suffer gracefully? Is there an art to [suffering?]

The classroom samples

- What are the challenges and reasons doe non-traditional female students to seek empowerment by returning to school?
- What measure do universities have implementer to better accommodate soldier through their time in a higher education setting?
- How does gender affect an ideal learning environment?
- Does drug and alcohol abuse between the ages of 18–25 have long term affects?
- How are Boise State university students affected by drugs and alcohol?
- How do sports affect university life?
- University is for me or not? What are the problems of widening participation in Higher education. [This student’s first language is Chinese and the student struggled with syntax and grammar.]
- Should American born children of undocumented Latino immigrants be allowed to attend university?
- How does Hispanic culture affect Hispanic college students?
- What are the affect of affirmative action in higher education?
- What affect does higher education have on patriotism?
- How does higher education promote patriotism?
- What factors might impact gay men so that they are more successful in the academic sense?
- Are there any new ideas about the grading system that will revolutionize this seemingly robotic way we look at education?
- How would my life be different if I were a traditional student without all of the responsibilities of raising kids and having a family?
APPENDIX II: The Prompts

Focusing your topic

Please fill in the blanks.
Your research question or topic: ———
Rewrite it by filling in the blanks:
I want to study ——— because I want to better understand ———.
Can you state your topic in the form of a question? For example, can you fill in one or more of these blanks?
What is the relationship between ——— and ———?
How does ——— affect ———?
Why does ——— affect ———?
Why does ——— cause ———?
What causes ———?
What causes ——— in ———?
Does your question generate more questions? Please write 3–5 questions your topic brings to mind.
What does your topic question suggest to you about organizing your paper?

Check anything on this list you think apply to your topic question.
___My question will generate a lot of information.
___My question will help me decide what information to use and what not to use.
___My question will lead me to new ideas but may not be able to be answered.
___My goal is to write a paper that will answer my question.
___My goal is to write a paper that will better help me and my readers understand my question topic and its significance.

Rewrite your question in your own words, but make sure it is in the form of a question.

Writing prompt #1:

Poetry is an act of distilment. The short space of a poem often forces us to decide what is most important to us about our subject. Your subject is your topic question. Write me a poem. It can be any type of poem, or just free verse. What is important is to get the most important aspects of your subject on paper. Underline what you think are the most important lines in your poem. Then rewrite your topic question . . . Has it changed?

Writing prompt #2:

Part of being a writer is finding new angles to view the world from. We draw inspiration from personal experience and from the things that are important to us. All writers suffer from an enlarged ego, no matter what form, style, or format we are writing in, we find ways to make it about us. We find ways to make it important, relevant and significant to our lives, our opinions, our beliefs. Be as egotistical as you can be. Make it all about you. Tell me why you want to write about your topic then rewrite your topic question . . . Has it changed?
Support for Success:
An Exploration of the Support Networks of Latino Students in the College Assistance Migrant Program

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Sociology

Abstract

Research on Latino college students finds high attrition and low completion rates at the four-year level. This study explores the support networks of Latino students in the College Assistance Migrant Program (CAMP) during their first year in college. Surveys and interviews were used to determine which individuals the students went to for support on academic matters, educational and occupational plans, personal matters, and information on job opportunities. The main goal of this study is to learn about the individuals that form the students’ support networks and the resources that emerge from the ties to those individuals for each type of support. The students were able to gain valuable resources through these ties, which helped them persist in college and navigate the school system. Findings indicate that CAMP staff and family are important sources of emotional and informational support for the students and are helpful in their adjustment and persistence in college.

Introduction

Latinos are the largest and fastest-growing ethnic minority group in the United States. Latinos are projected to make up about 25 percent of the population by the year 2050 (U.S. Census Bureau 2004). In some states, such as California, Latinos will make up over 50 percent of the population by 2050 (State of California 2007). Despite their growing number, Latinos remain one of the least educated ethnic groups in the U.S. This is creating problems and it will exacerbate them if this trend continues. Latinos will not be able to compete for occupations that require educational credentials beyond high school, thus hindering their role in the economy and the social conditions of the Latino population. This will not only affect Latinos, but all of society because this will create economic hardship for all of the population, such as a decrease in per capita income (Gandara and Contreras 2009).

The educational attainment of Latinos has seen some improvement, but there are still many problems. One of these is the high attrition rates that exist at all levels of education for many Latino groups. Even though the dropout rate has declined from 1980 to 2007 for many racial/ethnic groups, the dropout rate was higher for Latinos than for Whites and Blacks every year (Planty et al. 2009).

Two other big concerns are the low college enrollment and completion rates for Latinos. In 2007, the percentage of Latinos ages 18 to 24 enrolled in a college or university was 27. The enrollment rate for Non-Hispanic Whites was 43 percent, and for non-Hispanic Blacks it was 33 percent (U.S. Department of Education 2008). The number of Latinos completing a college degree is much bleaker. In 2005, about 11 percent of 25 to 29 year-old Latinos had completed a bachelor’s degree or higher (U.S. Department of Education 2005). In comparison, 17 percent of Blacks and 33 percent of Whites had completed a bachelor’s degree or higher (U.S. Department of Education 2005).

The retention of Latinos in higher education has been widely researched and several factors are considered important for their success and persistence in school. One important factor is social support. Research has shown that social support from family, friends, faculty, and college staff can help students adjust to college and help prevent them from dropping out. Social support can make a big difference in the students’ decisions to remain in school and help them succeed academically.

Emotional and informational support is crucial for Latino students who are trying to navigate the educational system. Latino students often don’t possess the necessary social or cultural capital to succeed in school. This pushes them to rely on a variety of supportive individuals outside the family structure to provide the resources
and information necessary to succeed academically and persist in college. These individuals are vital for the retention of Latinos in postsecondary institutions. Students can gain access to supportive individuals through college assistance programs intended to assist minority students get a postsecondary degree. One such program is the College Assistance Migrant Program (CAMP), which is a federally funded scholarship program that assists migrant or seasonal farmworkers and their children during their first year in college.

This study explores the social support networks of Latino students in CAMP. The primary focus of this study is to learn about the individuals who make up the students’ support networks and the resources they provided to the students that helped the students adjust and persist in college. For this study, a social support network was defined as the group of people the students had the confidence of going to and that they can count on for help and resources. The term “resource” can mean many things, including material resources, but for this study it is used primarily to refer to the information, assistance, guidance, and emotional support the students need to be successful students in college. The students were asked to indicate the individuals they would go to for four types of support: academic matters, educational and occupational planning, personal matters, and job opportunities. Their ties to the individuals in their support networks revealed who was or could be providing resources to them and to some extent the assistance they received.

This study is situated in social network and social capital theory. Social network theory is used to study the social structure by examining the different ties linking people in society and how, through these ties, people can gain access to resources and opportunities. It is mainly used to study how ties to individuals with higher statuses, prestige, and wealth can provide people with access to better job opportunities and resources. To refer to these networks, Wellman (1983) uses the phrase “the social distribution of possibilities,” which he describes “as the unequal availability of resources such as information, wealth, and influence as well as the structures through which people may have access to these resources” (P. 163). People gain access to resources by having relationships with individuals that have some degree of control over resources.

Bourdieu defines “social capital” as the actual and potential resources that result from membership in a group. He indicates that access to social capital is affected by networks: “the volume of the social capital possessed by a given agent thus depends on the size of the network of connections he can effectively mobilize and on the volume of the capital (economic, cultural, or symbolic) possessed in his own right by each of those to whom he is connected” (Bourdieu 1986:249). He also provides the framework to understand how the use and access to resources is affected by race, class, and ethnicity. Individuals who come from ethnic minority groups and lower social classes are disadvantaged because they generally lack the ties that lead to highly valued resources in society, and have not been accumulating the resources upper-class individuals have been enjoying over time through their ties to higher status individuals. The theories indicate that the ties between individuals do not guarantee resources, but point to the potential resources that could emerge from such relationships.

This study sets out to learn about the individuals that form the students’ support networks and the resources that emerge from the ties to those individuals for each type of support. Through these ties, the students were able to gain valuable resources that helped them navigate the school system and persist in college. Since CAMP students come from disadvantaged backgrounds, the social capital they have becomes crucial in their pursuit of a college degree. They rely on supportive individuals for resources that they would not have gotten from their families. In several of his works, Stanton-Salazar (1997; 2001; Stanton-Salazar and Dornbusch 1995) discusses the development of relationships between racial minority children and institutional agents. He defined “institutional agents” as the individuals that have the capacity and commitment to transmit directly, or negotiate the transmission of, institutional resources and opportunities (1997). He admits that institutional agents can reproduce racial, class, and gender inequalities, but they can also help ethnic minority individuals overcome social structural barriers and help them achieve school success and social mobility (1997).

Social Support

Social support can be one of the most important factors for Latino students when it comes to persisting in school. Social support in general can be instrumental for students in various ways, such as lowering stress and helping in the adjustment to college. Higher levels of social support have been linked to less distress for Latina college students of Mexican descent (Castillo and Hill 2004). For Latino students, social support has been found to be related to college adjustment (Jamara, Belgrave, and Zea 1996).

The possession of social support is important, but where the social support is coming from is just as critical. Social support from various sources is very important for minority students in order to succeed academically in college. Students’ inclination to mobilize support through the creation of new networks, and the maintenance of and reliance upon old networks of support may help student do better academically (Saunders and Serna 2004). Support
from faculty and staff is crucial for the retention of Latino college students (Hernandez 2000). Faculty/staff mentorship helps decrease academic non-persistence decisions among Latino undergraduate students (Gloria, Castellanos, Lopez, and Rosales 2005).

Friends and peers are also instrumental for Latino students in academic persistence and retention (Gloria et al. 2005; Hernandez 2000). Hurtado, Carter, and Spuler (1996) found peers and friends to be a good source of support and helpful in college adjustment for Latino students. In fact, peers may be a more important factor in school performance patterns for working-class and migrant students than peers for students from more advantaged and privileged positions (Gibson, Gandara, and Koyama 2004). Nonminority peers can be crucial for disadvantaged students. Peers that are non-ethnic minorities and have higher socioeconomic status can be important sources of support and can push ethnic students to take more challenging classes, which will help them make the college transition (Gandara 1995).

Family support and encouragement are especially important in academic persistence for Latino students. Even though parents and siblings may have low educational attainment, having family members that are supportive of the student’s educational aspirations is crucial for academic success and decisions to persist in school. Gloria, Castellanos, Lopez, and Rosales (2005) found that social support was the strongest predictor for non-persistence decisions in college. They also found students with educational encouragement and social support from family had a decrease in academic non-persistence decisions. Encouragement and support from family, especially from mothers, are important factors that positively affect the retention of Latino students (Gandara 1995; Hernandez 2000). Family also played an important role for Latino students in deciding to attend college and in their transition and adjustment in college (Hurtado et al. 1996). Older siblings with college experience were an important source of support because they provided resources and knowledge about college and the college application process that parents were not able to provide to Latina students (Ceja 2006; Gonzalez, Stoner, and Jovel 2003).

Migrant Students

The majority of students that participate in CAMP are migrant students from Latino backgrounds. Migrant students are reported to have the lowest school completion rates of any other population group in public schools (Garza, Reyes, and Trueba 2004). This is due to constant moving, economic hardships, limited English proficiency, and differences in cultural values between the school system and that of Latino children that affect the school performance of migrant students.

The interruptions caused by seasonal migration create educational challenges for migrant children. This has led to the creation of state and federal programs to help migrant students overcome some of the educational challenges they face due to their migrant status. In 1966, the Migrant Education Program, part of the Elementary and Secondary Education Act (ESEA), was established to help migrant students (Kuenzi 2002). Programs intended to aid migrant students are essential for their educational advancement and eventual social mobility. Programs such as CAMP can help students not only obtain the necessary information and knowledge, but also provide them personal and academic support (Reyes 2007).

In order for migrant students to advance in the educational system, they must gain the needed knowledge and resources to navigate it. This can be done through participation in programs for migrant students and/or from supportive individuals. Families of migrant students are not able to provide the necessary information regarding college, but they are important in helping them decide to attend college (McHatton, Zalaquett, and Cranson-Gingras 2006). Migrant students have indicated that a support system is necessary to learn about school opportunities and develop a desire to pursue college and teachers and school staff can provide this support (McHatton et al. 2006). Reyes (2009) found that significant interactions with educators can give “a sense of agency, knowledge, and/or empowerment to the students” (P. 115). This can motivate them to perform better academically.

College Assistance Migrant Program

College assistance programs have been implemented successfully to recruit and retain minority students in higher education (Abrego 2008; Aguirre and Martinez 1993). The programs are necessary and have been instrumental in helping Latino students adjust to the new environment and the rigors of college life (Hurtado and Kamimura 2003). Programs such as CAMP have been successful in helping students adjust to college. CAMP is a federally-funded program that assists migrant or seasonal farm workers and their children during their first year of postsecondary studies. During the first year in college, CAMP provides financial assistance and supportive services, such as counseling, mentoring, and tutoring. Federal spending affects the number of CAMP programs at colleges.
and universities every year. In 2008, there were 38 CAMP programs nationally, serving over 2,000 students (U.S. Department of Education 2008). The program has been quite successful in accomplishing two of its goals set in 2004 by the General Performance and Results Act (GPRA): successful completion of the first academic year in college and continuing in a postsecondary institution. From 2004 to 2007, the percentage of CAMP participants that completed the first academic year at a postsecondary institution in good standing ranged from 75 percent to 91 percent (U.S. Department of Education 2008). For those same years, the percentage of CAMP participants that after completing their first year in college went on to their second year ranged from 91 percent to 96 percent (U.S. Department of Education 2008). The program’s retention rate of students into the second year is impressive, considering the national average retention rates of first-time college freshmen into the second year of college for 2004 to 2007 has been 75.7 percent (National Center for Public Policy and Higher Education 2007). Overall, CAMP has been found to have a positive effect on educational attainment and academic success (Willison and Jang 2009).

This study highlights the CAMP program at a large public institution in the Intermountain West. The program, which has been operating at this institution for 25 years, admits about 40 students every year. The program has adapted to meet the needs of the student population it serves. Every year before the school year begins, the program hosts an orientation, where both the parents and students are encouraged to attend to familiarize them with how the program works, the services they provide, and financial aid. After the orientation, the incoming students and CAMP personnel go on a retreat to get both the students and staff acquainted with one another and begin establishing the relationships between the students that will be crucial for their adjustment to college. CAMP offers a class for all the students to take both semesters they are in the program. During the class the students learn about scholarship opportunities, school resources, community leaders, and how to construct resumes and cover letters. The course alternates between class instruction and study sessions where the students are given time to work on their homework and have tutors available to assist them. There is a computer lab for the students where they can go to between classes and do homework. Students meet regularly with assigned CAMP counselors. CAMP staff members are available daily for the students who need advising or assistance of any kind.

Data and Methods

Survey

The survey portion was conducted in a class CAMP designed for the students in the program. Questionnaires were available in English and Spanish and were distributed to all the students in the class two weeks before the end of their second semester in the program. All students completed the questionnaire in English. The questionnaire consisted of demographic and social support questions.

The demographic portion consisted of questions that addressed age, gender, race/ethnicity, generational status, language use, grade point average, future educational plans, and familial education. For the social support portion, the students were asked to select an individual to whom they would go in seeking four types of support: (1) help or advice on academic decisions (choosing classes, tutoring, etc); (2) guidance and information on educational and occupational plans; (3) help or advice on personal nonacademic matters (experiencing personal, economic, or family problems); and (4) information about current job opportunities (Stanton-Salazar and Dornbusch 1995; Stanton-Salazar 2001).

All participants in this study were in the CAMP program. Twenty-six out of 40 students in the program completed the survey. Of these, 23 meet the study criteria of first-year CAMP students of Latino/a heritage. For this study Latino/a heritage was determined as those participants who self-identified as Latinos or had one parent or both parents born in a Latin American country.

The sample consisted of 14 males and 9 females. The ages of participants ranged from 18 to 36 years, with an average age of 19.65 years (SD = 3.688). All participants were of Mexican descent. The majority of participants were born in the United States (n = 17) and the rest in Mexico (n = 5). Over half of respondents (n = 14) were living in residence halls. Three respondents reported living with parents or had other living arrangements (n = 5). The students’ self-reported GPAs ranged from 2.70 to 4.00 (M = 3.427, SD = .402). The majority of the respondents (n = 22) reported that they were very sure they would enroll for classes at a college or university for the following semester. Most of the respondents (n = 19) indicated they were very sure they were going to graduate from college. Two of the respondents indicated that they would probably graduate and two did not know.

Nineteen of the respondent’s mothers were born in Mexico, while two were born in the U.S (two students did not respond). All of the respondent’s fathers had been born in Mexico. Nearly all of the respondents (n = 22)
reported the first language spoken at home to be Spanish. Twenty of them reported Spanish to be the language usually spoken at home. There was low educational attainment reported among both mothers and fathers. For the mothers, 16 did not finish high school, four graduated high school or received a GED, one went on to college, but did not graduate, and one graduated from college. Among the fathers, 20 did not finish high school, one graduated from high school or received a GED, and one completed some college. Over half of the respondents (16 out of 23) had at least one sibling who was either attending or had attended college.

Interview

All interviews were conducted in English. An incentive was provided to the students to participate in the interviews. The focus of the interviews was on the individuals the students went to for each source of support. For each type of support, the students were asked to identify the individuals they had confidence in approaching for support, to give an example of how the individual helped them, how often they sought out this person, how recently they had done so, and whether they considered the help or advice given useful or helpful.

Five out of the 23 students that completed the survey participated in the interview portion of this study. The interview was designed to give a more in-depth look into the individuals that provide support for students in CAMP.

All five students, Ruben, Laura, Angela, Martina, and Samuel\(^1\) were born in the United States and were second-generation immigrants. Ruben, 18, is a Marketing major with a 3.6 GPA. He currently has an older sister attending college. Laura, 19, has a 4.0 GPA and is majoring in Bilingual Education. She has three younger siblings and is the first in her family to attend college. Angela, who is 19, is majoring in Elementary Education and has a 3.7 GPA. She has an older brother attending a community college in a different state. Martina, 19, is Nursing major with a GPA of 3.7. She has two younger siblings and one older sibling attending college. Samuel, 18, is majoring in Art and has a 3.8 GPA. He has a younger sister and is the first male in his family to graduate from high school and attend college.

Findings

Survey

Participants were asked to identify an individual they would go to for each type of support. The majority of respondents indicated one person they would go to, but there were three or four that indicated several persons for each type of support. The respondents that indicated using more than one person for a specific type of support will be discussed at the end of each support section.

*Academic decisions.* Over half of the students (n = 11) listed CAMP staff as a source of support for help or advice on academic decisions (choosing classes, tutoring, etc.) The other students reported non-CAMP counselors, friends, and family as sources of support. Three students reported more than one source of support, however, all three included CAMP staff as one source of support and two included friends. Other sources included family and professor/instructor.

*Educational and occupational plans.* Most common source of support for guidance on educational and occupational planning was CAMP staff (n = 11). The second most common source was non-CAMP counselors, followed by family. Three students reported more than one source of support. The following were sources of support listed by these students: family members (n = 2), CAMP staff (n = 2), professor/instructor (n = 2), friend (n = 1), and non-CAMP counselors (n = 1).

*Personal matters.* For advice on personal non-academic matters (personal, economic, or family problems), the most common sources of support listed by students were family (n= 9), friends (n = 6), CAMP staff (n = 3), and

\(^1\) All names for student and staff members used in this study are pseudonyms to help protect the identity of the participants.
other (n = 1). Four students reported several sources of support. Three listed family members and friends and two listed CAMP staff. Other sources were professor/instructors, non-camp counselors, and other.

**Job opportunities.** The majority of the students (n = 15) reported CAMP staff as a source of support for information about job opportunities. Other sources of support included family, friends, and other. There were four students that listed more than one source of support including family (n = 3), friends (n = 3), CAMP staff (n = 3), and non-CAMP counselors.

<table>
<thead>
<tr>
<th>Table 1: Survey findings</th>
</tr>
</thead>
</table>

<table>
<thead>
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<th>Type of Support</th>
<th>CAMP Staff</th>
<th>Family</th>
<th>Friends</th>
<th>Counselors</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Academic Matters</td>
<td>11 (55%)</td>
<td>2 (10%)</td>
<td>2 (10%)</td>
<td>5 (25%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>Educational and Occupational Plans</td>
<td>11 (55%)</td>
<td>4 (20%)</td>
<td>0 (0%)</td>
<td>5 (25%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>Personal Matters</td>
<td>3 (16%)</td>
<td>9 (47%)</td>
<td>6 (32%)</td>
<td>0 (0%)</td>
<td>1 (5%)</td>
</tr>
<tr>
<td>Job Opportunities</td>
<td>15 (79%)</td>
<td>2 (11%)</td>
<td>1 (5%)</td>
<td>0 (0%)</td>
<td>1 (5%)</td>
</tr>
</tbody>
</table>

Statistical tests were not run because of the small sample size. There weren’t any obvious differences in the individuals the students went to for support on any of the variables examined (gender, age, birth place, housing, and GPA). The majority of the students would go to CAMP staff for help on academic decisions, educational and occupational plans, and job opportunities. Most of the students who did not have any siblings with college experience reported going to non-CAMP counselor for academic decisions and educational and occupational plans. In contrast, most of the students that had siblings with college experience reported going to CAMP staff.

**Interview**

**Academic decisions.** Support on academic matters is important for first-year students in college. The students are unfamiliar with the academic process and unaware of the resources available to them on campus (for example, tutoring). It is important to learn who the students are relying upon for this crucial information. The students were asked to indicate whom they would have the confidence of going to if they needed advice on academic matters. CAMP staff was listed as a source of support by all five students. Samuel found the CAMP counselors to be particularly helpful in academic matters:

This is my first year and for all of that stuff, because nobody in my family is ever been in college, I would ask the counselors. [I would ask] the CAMP counselors mostly because they seem to know the kind of position I’m in and my unfamiliarity [with college]. I wouldn’t feel stupid to ask them a question that might be, you know, really clear to other people. So mostly, I talk[ed] to them my first semester and [then] I kind of went on my own. [The first semester] I didn’t really have a major or anything. This semester though, now that I have more of a focus of what I want to be doing, I sought out the teachers that taught the subjects I liked, and I asked them, where do I need
to be and things like that. [I] balanced it with CAMP’s advice and tried to find what would be the best decision [for me], but for the most part it was CAMP.

Samuel, like most first-generation college students, expressed unfamiliarity and uncertainty when it came to academic matters at the university level. He was not afraid to ask for help and was aware of the resources and support CAMP offers through its staff. Samuel was also conscious that the program was designed to help students with his background adjust to college and to succeed academically in their first year at a postsecondary institution. This aided in his decision to seek out the CAMP counselors.

The other students, like Samuel, said they would go to the main CAMP counselors for help on academic matters. Each student is assigned to one of the two counselors, but there were three students that would go to both counselors for help. Students also listed other CAMP staff as sources of support, particularly for help on homework in areas such as math or English.

The students reported going to the CAMP counselors mostly for advice and guidance regarding class selection. They expressed unfamiliarity with the classes offered at the university. Angela expressed anxiety when it came to choosing classes and attending college in general. Here she tells how her CAMP counselor provided support for her:

When I first met Cristina [a CAMP counselor], she was really willing to help [me]… [She said] we can just work [things] out, … just come and see me. I remember because I did not know how the whole college thing worked and I [was] overwhelmed. What the heck is going on? What are these classes with these numbers mean? It was good to have them there, definitely. I’m glad I was able to do CAMP my first year because I would have been way lost with not knowing anyone that’s from here.

Angela also mentioned her older brother, who is attending a community college, as a source of support for academic matters. She described her brother as her role model and their relationship as close, even though there was a five-year age difference between them and they were attending different colleges in different states. Angela said that her brother helped her through college and provided guidance in areas with which she was unfamiliar and had no previous experience.

When asked how often they went to their source of support, the male students reported going to the individuals on a bi-weekly basis. The female students reported going to them at least once a week, if not more.

All students reported going to a CAMP counselor or other staff members for support on academic matters. Students described having a lack of knowledge in dealing with academic matters, such as knowing which classes are available, how to register, and which classes they need to take for their major. With the help and advice the students received from CAMP staff, the students became familiar and more knowledgeable in the process of choosing classes and other matters. This aided in the students’ adjustment and persistence in college by providing crucial information that will be used by the students in subsequent years in college. This prepares the students to make these kinds of decisions on their own without so much assistance from others. Becoming familiar with some academic processes at the university may help increase the students’ comfort and decrease their feeling of alienation that was a result of the lack of knowledge in those processes. This would also help students adapt to college and could increase the students’ decision to persist in college.

Educational and occupational plans. CAMP staff and counselors played an integral part in providing guidance and information on educational and occupational planning to the students. Teresa, the follow up and career coordinator, was the person that most of the students would go to for support in this area. She is the instructor for the CAMP University Success class, required for students in the program. During this class, the students learn about career planning and the resources available on campus. There are also guest speakers invited to the classes.

Students cited the homework she assigned the class as really helpful for educational and occupational planning. Martina found the cover letter and resume done for class to be useful for jobs and applying to scholarships. Another assignment that was valuable to the students was planning out classes for the next four semesters. Angela found this assignment to be helpful in keeping her on track with the classes that she needed to be taking and avoiding the unnecessary classes that would have delayed her graduation. She also mentioned that this assignment and CAMP staff encouraged her to seek support outside the CAMP program. She sought assistance from a counselor from the center that offers academic counseling on campus. Angela listed Teresa and this counselor as sources of support planning out her classes.
Samuel listed Cristina, his CAMP counselor, as one of the persons he sought for support on educational and occupational planning. He is an Art major and plans to transfer into a university in Chicago to study film next school year. Samuel indicated that she was helpful and supportive of his plans to go to school in Chicago:

I know that she would like it if I would stay because I’m a good student. I have a pretty high GPA and I think I represent the program fairly well. And it would be, you know in her professional best interest to try to keep me [here at the university], as [an] example of what the CAMP program can do.…. When I told her that I’d like to go to Chicago and study film, she was just like okay, let’s do it. She helped me get set up with everything, get in touch with the counselors [and] the staff there, kept me on a deadline of when to get my stuff turned in and get everything done, my FAFSA and everything. I think that’s a good example because it’s just her stepping outside of, you know, what she ideally should want with being a counselor … and more just looking at my best interest[s]. Like if you want to do this and you’re willing to put the work in, then I’ll help you the best I can.

Students had a difficult time telling me how often they went to the CAMP staff for support in this area. Since they had class twice a week and often did their homework in a computer lab designated for CAMP students, they saw the staff almost every day. Laura, who listed Teresa as a source of support, had this trouble when asked how often she went to Teresa:

[It] seems like I go to Teresa a lot because I’m in the lab a lot, so I see her all the time…. That’s a tricky question because like I said I see her all the time, so it feels like I go [to] her every day. I don’t know exactly how often.

CAMP staff was a major source of support for educational and occupational planning. The class the students took from the CAMP staff was beneficial to them. The assignments given for the class were valuable to the students and the students recognized this. Planning out classes and constructing a resume were considered helpful in looking at the future and in making the connections between what they are doing now and how it affects their educational and occupational goals. An understanding of how what they are doing now is linked to the future is crucial to the students because it gives them something to look forward to. This could help them remain in school by giving direction to the students’ educational aspirations and reassuring them that they are on the right path.

Personal matters. Students were asked to name a person they went to for help or advice on personal non-academic matters, for example if they were experiencing personal, economic, or family problems. This area of support is important for academic persistence because non-academic matters are often the push factor for students when they decide to leave school. Students reported going to both family members and CAMP staff.

Martina and Ruben reported going to family members for personal matters and preferred to keep personal matters within the family. Ruben went to his sister for support:

There’s been times when I’ve needed like [a] little bit of economic support and she’s been able to support me on that, especially in the first semester when I was running scarce on money before I found a job. When I have troubles, over here I could just talk to her and let it out. You know just knowing it’s going to stay in that trust, that circle of trust.

His sister has been a source of support for Ruben, but he does not go to her as frequently as he would like because she is attending a technical college in a different part of the state. He does, however, keep in touch with her over the telephone and she had recently visited him.

Students also reported going to CAMP staff. Angela listed Gabriela, a CAMP counselor, as a person who provided help and advice on personal matters. Angela was the first one in her family to “officially” move out of the house. Her older brother attended college close to the family home, about 50 miles away. However, she decided to go to a university that is over 550 miles away from her parents’ home. Angela had a hard time adjusting to college and being away from her family, but she recalled how Gabriela was able to help her during that difficult time:

It was probably the beginning of the first semester for me and I was still like, I hate [it] here, I hate it, take me back…. I went to Gabriela and I was, like, I miss my family, I can’t handle this, take
me back. She’s just telling me it’s going to be good mija, you know, … calming me down. I was definitely crying … and I didn’t have a cell phone at the time … so for a whole month I was borrowing people’s cell phones, and be like mom, hi. I’m like not trying to cry because if I start crying, she’s going to start crying you know. I’m, like, this is not going to work. So I definitely went to Gabriela about that and so she definitely saw me cry. I was lonely, but I mean now she’s even told me, you know, like you make friends, you adjust to the college life and everything …. She’s, like, I’ve seen this before, you know, you like freak out the first month or two weeks, but you’ll make it, you get used to it. So I’m like, okay, I will survive. You know I’m gonna make it, so it was nice to do that and just to calm down. Talk it out, you know, not freak out.

Laura, Martina, and Samuel reported going to Maria, the Associate Director of the CAMP program for financial matters. They went to her when they had trouble with FAFSA, getting financial aid, or needed money. Samuel went to her when he ran out of money on his student ID card, which works like a debit card around campus:

[She is] the person that handles the money for the program and she’s nice. She’s really helpful. She’s surprisingly reasonable, like there [were] a couple instances where I just needed some money … and she told me that CAMP was thinking about taking care of the last dorm payment. I was like, oh well, if she did that, I could have the money that I would be spending on my dorm payment and buy all this food with it. She’ll really work with the students and go out of her way to get grants and things. [She’s] another person that’s just really passionate of what they do. I usually gravitate towards people like that because I feel like they actually do take what they’re doing seriously. So Maria would be, would be the person I go to talk to about like personal, financial struggles or stuff like that.

Students that were experiencing financial problems related to school went to Maria for support. Laura and Samuel reported going to Maria, but not with much frequency. Martina had been going to her throughout the year because she had been having trouble getting financial aid:

I’ve been working with her all year as I said because I was trying to get Pell [Grants]. That was based on my parents’ income and so I don’t know. There’s an issue with it so I had to wait for this year’s taxes, which was a real hassle. She helped me through all of that. I think in total it was a hundred and five pages long of just tax information and stuff I had to turn in into financial aid.

Students also reported going to CAMP counselors, but Maria was usually the person that provided assistance in difficult cases like Martina’s. Students were aware of Maria’s expertise on financial matters, and when students were experiencing difficulties receiving financial aid or other school finance problems they usually went to Maria or were referred to her by the staff.

Family and CAMP staff were important sources of support for the students in personal matters. The resources they provided came in the form of consolation, money, and information. A great deal of trust and comfort would be needed between the student and the persons they went to for personal matters. This shows that some of the students formed close personal relationships with the CAMP staff.

Job opportunities. CAMP staff was a big source of support in providing information on employment opportunities to the students. Teresa, the follow up and career coordinator, was the person most of the students would go to for information on employment. Teresa often sends e-mails to current and former CAMP students about internships and job opportunities. Laura found the e-mails to be beneficial even though she already has a job:

She’s given me a few e-mails and she’s also given me, like, hard copies, when I’m there of, like, applications and qualifications you need to have for certain jobs and stuff…. She knows I have a job. She knows my major and anything that sounds like it would tie in somehow, she would just give it to me, even though she knows I have a job. It’s good because then I am learning about these opportunities.

Angela was not interested in working her first year in college, but she also found the e-mails and different activities for CAMP class useful:
I should have done work-study maybe this semester or last semester, but … I didn’t want to work because I’m still trying to get used to everything. I don’t want to be stressed with like having a job…. But, Teresa [would] definitely be for that [providing information on job opportunities] and when we had … a career fair thing at the SUB, that was also pretty cool, get[ting] to know little businesses here…. I really don’t know [the area] still and I’ve lived here since like August…. So it was nice to get the exposure, I guess for careers or just like part-time [jobs and] summer job internships. So I think that was good.

The students had confidence in going to Teresa because she was the CAMP class instructor and she regularly was in the computer lab for CAMP students. Students found the e-mails and her presence in the computer lab convenient. The students usually go to the lab in between classes. Martina, who commutes to school every day, is often in the computer lab and found it advantageous to have Teresa there:

[I go to Teresa] mostly just because I see her on campus. I don’t really have time to go seek employment on my own, like off-campus because I spent so much time here…. I don’t want to be running around when I have to come back to class here in an hour…. It’s easier for me to just go to the CAMP office and talk [to] Teresa.

Students reported going to CAMP staff for information on job opportunities. The students may not have needed the information, but they found it useful for future reference. Learning about job opportunities and employers around campus helped the students see the different employment opportunities available to them after their first year in college. Most of them will not be receiving as much financial aid as they did the first year, therefore learning about employment opportunities will help them see that there are other ways to pay for school.

Discussion and Conclusion

The findings from both the survey and interviews reveal that for support on academic matters, educational and occupational planning, and information about job opportunities, the majority of students went to CAMP staff. Family was also mentioned, but less frequently. Students that sought support from family for academic matters usually went to older siblings that had attended or were attending college. For personal matters, most of the students reported going to their family for support, but CAMP staff was also listed as a source of support.

Family was important in the support networks of students. Older siblings that were attending college or had previously attended college were critical for the students because they provided encouragement, information, guidance, and were a source of support. They are able to help the students persist in school by validating the students’ fears, doubts, and experiences. Parents were probably not mentioned because they lacked knowledge and experience with the educational system. The students’ reliance on support from older siblings with college experience on academic matters is significant because it demonstrates how individuals with experience in and familiarity with in higher education are necessary critical in their support networks once they are in college. Since they come from families with low educational levels, the family support available to them is severely limited to those few that have some education beyond high school. This also limits the resources the students are able to obtain from their family. Therefore, most of the students’ family members are not able to help or guide them once they are in college.

CAMP staff members were also crucial in the students’ social support network. It was expected for CAMP staff to be an important source of support in matters related to academics, but not for personal matters. This demonstrates that CAMP staff went beyond their role as educators and formed close personal relationships with many of the students. These relationships facilitated the transmission of expectations, norms, and resources to the students, which were crucial for college adjustment and academic persistence. This also may be helping CAMP staff to accomplish the program’s goals: successful completion of the first year in college and continuing their college education. The close relationships between the students and CAMP staff could be a possible explanation as to why the CAMP program is so successful.

This study contains important limitations. First, the results should not be generalized to all Latino postsecondary students or even all CAMP students. Second, the small sample size did not make it possible to see any differences (such as gender, future educational plans, and acculturation levels) in the individuals they went to for support.

The students’ support networks indicate that the students had to go outside their family and to individuals with experience in higher education. Ties to these supportive individuals gave students the resources necessary to
navigate through the school system. Most of the students reported going to CAMP staff. CAMP staff would be considered what Ricardo Stanton-Salazar called “institutional agents.” Students in the CAMP program who formed relationships with CAMP staff were gaining resources and support necessary to persist in college. These relationships were crucial for students from disadvantaged backgrounds, like the participants in the CAMP program.

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References


Towards Optimization of a Low Temperature Co-Fired Ceramic Catalyst Chamber for a Monopropellant Microthruster

Andrew Vissotski: McNair Scholar
Dr. Don Plumlee: Mentor

Abstract

The reduction in space vehicle size and mass presents the need to develop a proportionally smaller propulsion system for orbital station keeping. A Low Temperature Co-Fired Ceramic (LTCC) monopropellant micropropulsion device has been developed at BSU. The simple, robust design features a heterogeneous catalyst chamber used to decompose a rocket-grade hydrogen peroxide monopropellant, to produce thrust. Initial prototype testing indicates only partial peroxide decomposition requiring an in-depth analysis of the geometric layout of the devices to increase system efficiency. This study employs a control volume based methodology to analyze the performance of various catalyst chamber designs. This approach was chosen due to the inaccuracies and difficulties associated with modeling the exact kinetics of a two-phase, catalytic reaction at the micro-scale. A full factorial experiment was established to investigate the effects of several geometries, typical to LTCC fluidics, on the hydrogen peroxide decomposition percentage. Chamber geometries were chosen based on previous thruster designs as well as constraints related to LTCC fabrication capabilities. Test results will determine which chamber designs to investigate in future optimization efforts. Reaction completion percentage and chamber temperatures are measured at steady state operation and used to compare the chamber geometries studied. Initial testing validated the accuracy and repeatability of the test apparatus. Mechanical failure of devices occurred during the transient start-up phase of device testing as a result of localized thermal expansion. A functional prototype was achieved by decreasing propellant flowrate and cross-sectional area reducing the released thermal energy. This lowered thermal stresses within the LTCC to a controllable level. Test results suggest three-dimensional fluidic channels produce higher decomposition percentages than similar configurations limited to a single plane.

Introduction

Background

The current trend in satellite design is the significant reduction in size and mass. The rapidly expanding field of Micro-Electro Mechanical Systems (MEMS) allows aerospace companies to minimize spacecraft volume without sacrificing function. This new breed of “micro-satellites” is defined as any spacecraft with a mass of 10-100 kg[1]. The smaller size offers a lower initial cost, increased redundancy and reduced launch costs. Single function, Micro-satellites will enable the deployment of clusters to replace larger traditional satellites, increasing the overall robustness of the system. For example, if a single micro-satellite were lost, the cluster would still retain most of its functionality.

The considerable decrease in satellite mass and volume presents new challenges to propulsion technology. Station keeping thrusters must also undergo a proportional reduction in size to maintain precise maneuverability. There are several micro-propulsion concepts currently being developed by aerospace companies and research universities to meet these requirements. These concepts are categorized according to propulsive energy type: electrical or chemical. Electric propulsion devices rely on the interactions between electrical and magnetic fields to accelerate particles to high velocities in order to produce thrust. The magnitude of thrust produced by this method is relatively low due to low mass flow rate of the fuel. In contrast, the specific impulse is usually very large for electrical propulsion devices due to the high exit velocities. Chemical thrusters utilize chemical reactions to convert propellant into thrust. A wide variety of potential propellants produce a wide range of chemical propulsion designs from solid rocket motors to liquid monopropellant and bi-propellant engines.
Each propellant type presents unique design challenges at the micro-scale. The liquid monopropellant concept is favorable due to its ability to be miniaturized without complexities associated with fuel/oxidizer mixing and ignition. It features a single propellant injected into a reaction chamber where it decomposes when in contact with a catalyst material. Additionally, cryogenic storage is not necessary because typical monopropellants are liquid at room temperature and atmospheric pressure. The most common monopropellants are hydrogen peroxide and mono-methyl hydrazine (MMH). The higher energy density of hydrazine is advantageous but its toxic exhaust products are a concern. The alternative hydrogen peroxide is considered a “green” fuel because it decomposes into a benign mixture of water vapor and oxygen when exposed to a catalyst\[7\]. Equation (1) describes the reaction for the catalytic decomposition of hydrogen peroxide.

$$2\text{H}_2\text{O}_2(l) \rightarrow 2\text{O}_2(g) + \text{H}_2\text{O}(g) + 23.44 \text{ kcal/mol}$$

As with any chemical propellant, the degree and rate of reaction are directly related to the energy release. The ideal chemical propulsion device maximizes chemical energy released from the propellant in the shortest amount of time. This is also true of micro-propulsion devices. Propellant residence time, proper catalyst size coupled with chamber volume and enhanced heat loss associated with the small scale have been described by Kuan\[5\] and Platt\[6\] as major factors which greatly affect the decomposition efficiency. To improve decomposition rate within a catalyst chamber, a high catalyst surface area to chamber volume is preferred.

Motivation

Silicon MEMS thrusters have been developed and tested by Hitt, et al.\[2\] that use of High Test Peroxide (HTP) as a monopropellant. These devices were fabricated using typical silicon MEMS fabrication techniques. The silicon MEMS fabrication process limits the device to a planar configuration. The silver catalyst was deposited onto the substrate with an aluminum shadow mask forming an array of diamond-shaped pillars within the catalyst chamber. Several of these cantilevered pillars failed during testing as shown in Figure 1. This presents questions regarding the structural integrity of silicon as a suitable material for micro-fluidic applications.

Figure 1. Silicon based HTP micro-thruster

Low Temperature Co-Fired Ceramics (LTCC) is an alternative material system available to the MEMS industry. LTCC has several advantages over silicon that make it a favorable material for MEMS applications, particularly monopropellant micro-thrusters. The compatibility with embedded silver catalyst and internal 3-D fluidic channel capability provides a wider range for catalyst chamber designs. The tolerance to high temperatures and high strength of LTCC are critical to developing a functional and durable monopropellant micro-propulsion device. One such micro-propulsion device is currently under development at Boise State University by Plumlee, et al.\[3,4\]. This device utilizes 90% HTP as a propellant to produce low levels of thrust for station keeping of micro-satellites. Four basic LTCC catalyst chamber designs were established and integrated with a previously developed converging-diverging nozzle. Each design features either a “Planar” or “3-D” concept as seen in Figure 2. This convention was established to describe the shape of the catalyst chamber channels. The term “3D” describes channels that transition vertically through the LTCC substrate by changing layers. Conversely, the term “planar” depicts a chamber design that remains in a single layer of LTCC. Silver is the preferred catalyst material for these thrusters and is deposited on the top and bottom surface of each embedded channel. A kinetic model of the catalytic reaction was established to determine the propellant residence time within the catalyst chamber. For a given volumetric flow rate, specified channel cross-section and predicted dwell time, a channel path length of 15 mm was determined to be used as a baseline reactor length and can be seen in Figure 2.
Silicon and LTCC monopropellant micro-thruster designs are challenged by incomplete chemical decomposition, made evident by a visible exhaust plume during laboratory testing. Fuel efficiency is a vital operating parameter to spacecraft. Larger fuel efficiencies allow for lower volumes of propellant required for a particular mission. Future applications to micro-satellites demand optimizing thruster design to ultimately reduce costs and save space. Such a catalyst chamber is theoretically attainable and necessitates further investigation.

Methodology

Effective monopropellant decomposition is a complex phenomena that is difficult to model numerically. The coupled chemical kinetics and hydrodynamic behavior of the fluid within the catalyst chamber make theoretical and computational modeling extremely difficult at such a small scale[2]. The chemical kinetic model used to size the LTCC catalyst chamber assumed an isothermal reaction along the entire channel path length[3]. The propellant dwell time within the catalyst chamber was underestimated as a result of this assumption causing incomplete decomposition during laboratory tests. In an effort to increase LTCC micro-thruster performance, improvements to catalyst chamber design are under investigation at Boise State University. Proposed designs require experimental validation in order to accurately quantify their performance.
% Decomposition \( = 100 \cdot \frac{(X_i - X_e)}{X_i} \)  

Dupont\textsuperscript{TM} 951 LTCC Green Tape was used exclusively for prototyping in this work. The current LTCC fabrication capabilities confine catalyst material deposition to the top and bottom channel surfaces. Device fabrication follows the C-MEMS procedure documented by Plumlee.\cite{3,4} A CNC LASER mill was used to cut channel geometries into the Green Tape and a screen-printing technique was utilized to provide consistent silver paste deposition. Carbon tape was placed inside channels to ensure structural integrity during the 3,000 psi lamination process. The stack of LTCC Green Tape layers sinter together when fired at 850°C, forming a uniform rigid body. The carbon placed inside each channel burns out during this process leaving internal fluidic channel with a rectangular cross-section. The LTCC material experiences shrinkage of \( \sim 14.5\% \) along each axis. This is considered in the 3D design stage and all dimensions are scaled by a factor of 1.145 to compensate for shrinkage during firing.

To further reduce the variability between test devices, several parameters will be held constant. First, channel height is limited to a single layer of LTCC, totaling \( \sim 0.2 \) mm after firing. This provides a constant catalytic surface area to volume ratio within the chamber. Secondly, all prototypes will share a common cross-sectional area in order to assure the pressure drop is similar for each device. In addition, the total layers of LTCC per device will be the same to provide an equivalent thermal mass. Test substrate design, including embedded catalyst chambers exhibit symmetry about the device center to simulate equal thermal resistances allowing for heat generated from the reaction to dissipate evenly throughout the substrate.

Fluidic channels embedded in LTCC substrates feature several geometric characteristics that are unique to the material system. Several of these geometric factors, listed in the left hand column of Table 1, are thought to affect the catalyst chamber performance and are the primary focus of this study. They were selected based on previous micro-thruster designs featured in Figure 2.\cite{3,4} A full factorial experiment was established to understand how each factor influences the decomposition of hydrogen peroxide. Each factor was assigned two values representing a range of potential values. The factors were limited to a “high” and a “low” value to reduce sample population. Three factors held at two discrete levels presents eight feasible combinations to be designed and tested.

<table>
<thead>
<tr>
<th>Table 1. Experimental factors and corresponding levels</th>
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<tr>
<td><strong>Factor Name</strong></td>
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<tr>
<td>Channel Shape</td>
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<tr>
<td>Path length</td>
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<tr>
<td>Number of Channels</td>
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The last factor listed in Table 1, “Number of Channels,” is detailed in the cross-sectional view of Figure 4. Each prototype shares a common channel cross-sectional area and is restricted to a single layer of LTCC as seen in the figure. A cumulative channel width, \( w \), is the only dimension required to design a multi-channel catalyst chamber. The individual channel width is simply a fraction of the total width. The fundamental difference between the low and high number of channels in Table 1 is the hydraulic diameter. It was decided that two and six channels represented an adequate amount of channel size variation to provide significant results without adding complexities to the fabrication process.

![Figure 4. Cross-sectional view of LTCC prototypes illustrating “2 channels” and “6 channels”](image-url)
“Channel shape” is hypothesized to be the most influential factor affecting catalyst chamber performance based on previous experimental testing. The 3D channel concept located at the top of Figure 5 is thought to enhance propellant mixing within the catalyst chamber caused by the abrupt vertical transitions between LTCC layers. The Planar channel configuration was proposed to illustrate any advantages or disadvantages inherent to the 3D configurations. “Path Length” describes the longitudinal distance covered by the silver catalyst, represented by solid black lines located on the top and bottom of the channel in Figure 5. The convention defines equivalent catalyst contact areas between planar and 3D configurations and can also be seen in the figure. This convention is followed for every design tested.

![Figure 5](image)

**Experimental Setup**

In theory, the percent decomposition in Equation 2 of rocket grade hydrogen peroxide is a direct representation of catalyst chamber performance providing the analysis platform for a full factorial experimental design. In order to determine the presence, if any, of un-decomposed hydrogen peroxide in the exhaust plume, the hot gases exiting the catalyst chamber must be captured and then condensed into an aqueous form. When a liquid sample of the chamber exhaust is obtained, it can then be analyzed with a digital refractometer to measure the mass fraction of hydrogen peroxide contained within the sample. A liquid sample of exhaust products containing pure water indicates complete decomposition of the HTP. To ensure a valid comparison of factors, the test prototypes must reach steady state operating conditions prior to sample collection. Obtaining an exhaust sample during the transient start-up phase could yield a highly inaccurate representation of that device’s performance and is beyond the scope of this work. As observed in previous tests, the mass fraction of HTP in the exhaust is highly variable during this phase but will eventually plateau when the catalyst chamber reaches a self-sustaining state of operation. The catalyst chamber substrate will also reach a relatively constant temperature during this steady state operation. For this reason, substrate surface temperature will be logged with a Type-K thermocouple and will be used to indicate when a steady state operating condition is achieved.

**Test apparatus**

Initial hardware was used with an addition to measure the catalyst chamber performance. The original test stand shown in Figure 6 is fabricated primarily from 1/2" Aluminum stock and controlled using a LabVIEW interface, a programmable software package. Featured hardware includes a 20mL Stainless Steel syringe pump capable of supplying HTP propellant to the LTCC device at virtually any flow rate. After the 1/8” SS tubing system is purged via high/low-point bleed valves, the propellant travels through the main shut-off valve where it then passes...
through the middle of the three small holes located on the vertical plate. Prior to this study, prototype testing was achieved by directly interfacing propellant supply system to LTCC substrates through a Teflon o-ring compression fitting, downstream from the main shut-off valve. Two socket head screws align with the threaded holes on either side of the propellant supply port and tightened by hand until properly sealed. The first generation HTP test stand was designed specifically for the monopropellant LTCC micro-thruster concept and focused primarily on device functionality rather than performance.

The original test stand was modified for retrieval of the above-mentioned data points. The modifications enable the controlling, condensing, and characterizing of catalyst chamber exhaust during operation and are circled in the left hand side of Figure 6. It was designed to integrate with the original test stand without any physical modification thus maintaining its original functionality. The device mounting bracket secures to the test stand through existing fastener connections and interfaces the propellant supply via the existing Teflon o-ring compression connection. A close-up of the mounting bracket connected to the test stand can be seen on the left-hand side of Figure 7.

![Figure 6. Schematic of HTP test setup](image)

![Figure 7. Close-up view of test stand modifications](image)
The Teflon spacers indicated in this figure serve a multi-functional purpose. Teflon’s inherently low thermal conductivity provides thermal isolation between test prototypes and the large heat sink associated with the aluminum test stand. In addition to being chemically resistive to hydrogen peroxide, Teflon is an exceptional gasket material for LTCC fluidic connections. Toggle clamps provide a sufficient clamping force to seal the connections between the LTCC device, Teflon spacers, and device mounting bracket. All fittings and the device mounting bracket were cleaned numerous times with isopropyl alcohol to remove any residual hydrocarbons that may decompose hydrogen peroxide outside the catalyst chamber providing an inaccurate sample. After integrating the modifications with the test stand, the entire propellant piping network was passivated with nitric acid for 24 hours to protect against corrosion.

Testing procedure

Figure 8 shows a piping schematic of the test stand modifications shown in Figure 6 and used to describe the testing procedure. The two valves labeled “A” and “B”, control the flow of exhaust exiting the LTCC catalyst chamber through the 1/8” SS tubing. Before a test run is allowed to initiate, the operator must manually open valve “B” and close valve “A”. The initial valve configuration allows the mostly un-reacted liquid to fall into a collection facility once the test begins and the device warms-up. The horizontal and vertical orientation of valves “A” and “B” respectively were chosen purposely to prevent any fluid leaving the catalyst chamber throughout transient operation to enter the ice bath piping system contaminating the sample. The test sequence was initiated by infusing the 20mL SS syringe with 90% HTP from a gravity fed reservoir, not pictured in Figure 6. Propellant was then supplied to the LTCC test device clamped in the horizontal orientation shown in Figure 7 at a flow rate of 1mL/min. This low flow rate was governed by the volume of the syringe pump and the often lengthy “ignition times” of some prototypes. A type-K thermocouple was placed on the top surface at center of the embedded catalyst chamber for every test run. Surface temperature was manually monitored throughout device warm-up.

Surface temperature was monitored until the device reached a steady value. The test operator recorded the steady state operating temperature and proceeded to open valve “A” followed immediately by the closing valve “B” to direct all exhaust through the coiled tube within the ice bath. There the gaseous mixture condensed into an aqueous solution composed of water and un-reacted hydrogen peroxide. A graduated cylinder collected the condensed sample, which was then analyzed with a digital refractometer to obtain the mass fraction of hydrogen peroxide present in the exhaust sample. This data was then used to calculate the percent decomposition of hydrogen peroxide, the primary data of this study. After completing a test, the stainless steel tubing within the ice bath was flushed several times with DI water to clear out any residual hydrogen peroxide that may contaminate the next sample. The graduated cyclinders used to obtain the condensed exaust sample and digital refractometer were also cleaned with DI water and dried before any subsequent tests were performed.
Test devices

A full factorial experiment was established to investigate the three factors at two levels listed in Table 1. The resulting test matrix is shown in Table 2 and encompasses all combinations of each factor at two levels. Combining factors in this manner will potentially provide a valuable understanding of a factor’s level of influence on the measured response, decomposition of hydrogen peroxide. A sample size of eight devices is reasonable considering the resource limitations. The nomenclature listed in the rightmost column of Table 2 classifies each configuration and clearly indicates the level of each factor in a fairly straightforward manner. Hyphens separate the three factors and corresponding values. For example, the reference nomenclature for configuration number six is “3D-C2-L20”, denoting a three-dimensional channel shape, two channels and a twenty millimeter catalyst chamber Path Length. The test matrix denotes eight distinct catalyst chamber designs, fabricated and tested within an LTCC substrate.

<table>
<thead>
<tr>
<th>Configuration</th>
<th>Channel Shape</th>
<th>Number of Channels</th>
<th>Path Length (mm)</th>
<th>Nomenclature</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Planar</td>
<td>2</td>
<td>10</td>
<td>P-C2-L10</td>
</tr>
<tr>
<td>2</td>
<td>Planar</td>
<td>2</td>
<td>20</td>
<td>P-C2-L20</td>
</tr>
<tr>
<td>3</td>
<td>Planar</td>
<td>6</td>
<td>10</td>
<td>P-C6-L10</td>
</tr>
<tr>
<td>4</td>
<td>Planar</td>
<td>6</td>
<td>20</td>
<td>P-C6-L20</td>
</tr>
<tr>
<td>5</td>
<td>3-D</td>
<td>2</td>
<td>10</td>
<td>3D-C2-L10</td>
</tr>
<tr>
<td>6</td>
<td>3-D</td>
<td>2</td>
<td>20</td>
<td>3D-C2-L20</td>
</tr>
<tr>
<td>7</td>
<td>3-D</td>
<td>6</td>
<td>10</td>
<td>3D-C6-L10</td>
</tr>
<tr>
<td>8</td>
<td>3-D</td>
<td>6</td>
<td>20</td>
<td>3D-C6-L20</td>
</tr>
</tbody>
</table>

The overall design of each prototype lowers the cost and time to fabricate while maintaining the geometry required to properly interface with the test stand. The design is such that two identical test devices are located within a single LTCC substrate to be fabricated simultaneously. Producing two functional devices in the amount of time typically required for single LTCC device greatly reduces fabrication costs while increasing yield. The two test devices undergo additional processing after firing to be separated resulting with individual test devices. An example test device can be seen in Figure 9, which features the “P-C2-L20” configuration in a transparent view. Note in this figure that all features are symmetric about the center, which is a commonality between all catalyst chamber designs pertaining to this study. The catalyst chamber in this figure is denoted by the dark colored channel surfaces, representing the silver deposited on top and bottom channel surfaces over a 20mm Path Length. Also note in this figure, the inlet and outlet geometry, which is universal to all prototypes.

Figure 9. A transparent-isometric view of test device: “P-C2-L20”. The silver catalyst (dark grey) deposited on the top and bottom channel surface within the catalyst chamber.
Testing parameters such as overall catalyst chamber volume, propellant flowrate, and channel cross-sectional area are listed in Table 3. The initial flowrate and cross-sectional area values were modeled after previous chamber designs. Initial testing led to mechanical failure of prototypes due to thermal expansion caused by critical amounts of thermal energy released during transient response. A functional prototype design was obtained by greatly reducing the parameters listed in this table as “actual” values. This restricted thermal energy entering the control volume to a manageable level.

<table>
<thead>
<tr>
<th>Overall Volume (mm³)</th>
<th>Propellant Flowrate (mL/min)</th>
<th>Cross-Section Channel Area (mm²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial</td>
<td>10500</td>
<td>5</td>
</tr>
<tr>
<td>Actual</td>
<td>4050</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 3. Initial and actual testing parameters

Results & Analysis

Repeatability & measurement error

The LTCC material system experiences a consistent amount of lateral shrinkage during the firing process and is published by the manufacturer, DuPont. Therefore, any error associated with material shrinkage is minute and can be neglected. In an effort to increase data accuracy, two identical devices were fabricated and tested for the eight configurations outlined by the test matrix.

Testing occurred in a randomized order to reduce any experimental bias. Two samples were harvested from the catalyst chamber exhaust during every experimental test run. With this method, the primary data possessed a maximum standard deviation of 0.058 belonging to the “P-C2-L10” configuration. Based on this value, the experimental data obtained from analyzing condensed exhaust products represents the steady state operating performance particular to the catalyst chamber with reasonable accuracy.

However, the method of obtaining surface temperature data is a potential error source. Experimental temperature data reflects a mean value observed by the experimenter during steady operation. Actual temperatures fluctuated about the recorded mean. The observed fluctuations became large as +/- 10°C in some cases raising suspicions relating to the accuracy of the recorded value.

Results overview

Test results for all eight configurations are listed in Table 4. The Analysis of Variance technique was employed to analyze the effectiveness of the three factors between low and high values. The factorial experiment was duplicated to improve statistical accuracy. The factorial experiment was duplicated to improve statistical accuracy. Experimental results show two factors to be a significant influence on the performance while the third factor remains inconclusive.

<table>
<thead>
<tr>
<th>Configuration</th>
<th>Test Device 1</th>
<th>Test Device 2</th>
<th>Sample Mean</th>
<th>St. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>% Decomp.</td>
<td>Temp (°C)</td>
<td>%Decomp.</td>
<td>Temp (°C)</td>
</tr>
<tr>
<td>P-C2-L10</td>
<td>77.8</td>
<td>225</td>
<td>87.2</td>
<td>260</td>
</tr>
<tr>
<td>P-C2-L20</td>
<td>54.3</td>
<td>210</td>
<td>52.6</td>
<td>205</td>
</tr>
<tr>
<td>P-C6-L10</td>
<td>90.0</td>
<td>277</td>
<td>88.1</td>
<td>300</td>
</tr>
<tr>
<td>P-C6-L20</td>
<td>88.5</td>
<td>265</td>
<td>87.5</td>
<td>280</td>
</tr>
<tr>
<td>3D-C2-L10</td>
<td>80.8</td>
<td>255</td>
<td>73.5</td>
<td>200</td>
</tr>
<tr>
<td>3D-C2-L20</td>
<td>96.5</td>
<td>270</td>
<td>92.7</td>
<td>265</td>
</tr>
<tr>
<td>3D-C6-L10</td>
<td>91.6</td>
<td>290</td>
<td>90.3</td>
<td>297</td>
</tr>
<tr>
<td>3D-C6-L20</td>
<td>97.7</td>
<td>275</td>
<td>96.7</td>
<td>290</td>
</tr>
</tbody>
</table>
Experimental data shown in Figure 10 illustrates the influence Channel Shape has on catalyst chamber performance. There is a trend of increasing Percent Decomposition with increasing temperature for both configurations. For temperatures greater than 255°C, several of the 3D configurations approach the maximum decomposition of 100% while the planar configurations do not rise above 90°C. Overall, the planar configurations are the lowest performers.

With the planar design, the fluidic boundary layer along the upper and lower walls is undisrupted. Depleted regions might form near the channel walls in the slow moving boundary layer[3]. The highly laminar boundary layer limits the rate at which un-reacted molecules attach to the silver catalyst. Un-reacted core flow will likely exit the catalyst chamber before it can decompose. Conversely, vertical layer changes are believed to disrupt the boundary layer more effectively. Hydrogen peroxide molecules are more likely to come in contact with a catalyst site resulting in a higher decomposition fraction. Experimental results suggest the 3D channel shape is a highly effective catalyst chamber design. Additionally, this type of fluidic structure highlights the advantages of LTCC making it a desirable material.

The Number of Channels factor also shows a significant influence on catalyst chamber performance, as seen in Figure 11. The graph compares devices containing the same Channel Shape and Path Length combination at their two and six channel states. Each device in Figure 11 demonstrates higher decomposition efficiencies at the
“C6” configuration than the corresponding “C2” design. A smaller spread of variation for the “C6” data is also observed. The largest change occurs for the P-L20 configuration whereas the 3D-L20 has the least change with channel number. Also note that both 3D configurations reach a decomposition percentage better than 90% with the six-channel configuration.

Reducing the hydraulic diameter of an individual channel is believed to improve the catalyst chamber performance. Fundamentally, it reduces the core flow region per channel where un-reacted hydrogen peroxide exists. This is depicted in Figure 12 with cross-sectional views of the two and six channel devices. The larger channels belonging to “C2” have more volume for un-reacted hydrogen peroxide to exist. The larger core flow tends to move through the channels without as much mixing as the “C6” configuration. Additional sidewalls cause additional mixing that allows more core flow to reach the catalyst surface thus improving the reaction and the balance of energy crossing the control volume boundary.

Figure 13 analyzes the Path Length factor in a manner similar to that of Figure 11. The experimental data presented in this graph suggest longer Path Lengths improve the performance of both 3D devices. The “P-C6” configuration performs slightly worse with a 20mm Path Length, while “P-C2” appears to perform much worse with the longer Path Length. However, an error in fabrication of the “P-C2-L20” device may have occurred resulting with the low performance. The contradicting behavior between 3D and Planar configurations in this figure suggests the possibility of an optimal length. Further investigation on this factor is left for future work. A qualitative effort has
been made to interpret the data in Figure 13. One possible explanation takes into account the heat of reaction spreading throughout the device due to the high thermal conductivity of silver.

![Figure 14. Top view of “3D” (left) and “Planar” (right) of silver catalyst embedded on the LTCC surface of the catalyst chamber layer.](image)

Catalyst chamber performance will degrade as heat loss increases. Depending on the configuration, the silver catalyst is thought to promote or retard the heat of reaction conducting into the substrate, due to silver being 130 times more thermally conductive than LTCC. This is particularly the case for Planar catalyst chambers with silver deposited on a single layer of LTCC. The continuous silver material inherent to Planar configurations provides a highly conductive path to spread heat quickly throughout substrate. Illustrated in the right side of Figure 14 is a top view schematic of the “P-C2-L20” configuration. The low performance demonstrated by this configuration could be attributed to the large thermally conductive paths promoting heat loss. Similarly, improvement in 3D catalyst chamber performance is believed to be characteristic of the silver “islands” illustrated on the left side of Figure 14. Surrounded by LTCC, reaction heat is confined to the small silver regions embedded on a single layer of LTCC.

![Figure 15. Non-dimensionalized graph depicting % decomposition vs. the characteristic channel length data for tests 1 and 2 for all “3D” and “Planar” configurations](image)

To better capture the channel geometry effects, a non-dimensional characteristic length is defined according to equation (3). Where $L^*$ is the characteristic length, $L$ is the catalyst path length and $D_h$ is the hydraulic channel diameter for a single channel. For the rectangular cross-sections inherent to fluidics in LTCC, $D_h$ for this study is defined in equation (4). Where the wetted area, $A = w_c h$, is the product of the individual channel width and height, and the wetted perimeter, $P = 2(w_c + h)$.

$$L^* = \frac{D_h}{L} \quad (3)$$

$$D_h = \frac{4A}{P} = 2w_c h/(w_c + h) \quad (4)$$

An interesting trend is obtained in the non-dimensional plot of Figure 15 containing percent decomposition vs. the characteristic length. The two data points in the 50-60% decomposition range belong to the “P-C2-L20” configuration and are an obvious outlier to this trend. Catalyst chamber prototypes can become defective due to a wide range of fabrication anomalies. These two points are 20% lower than any other data set and indicate an issue
with the two identical devices. It is therefore reasonable to discard the “P-C2-L20” data set without drastically affecting the previous results.

Neglecting those points, better decomposition is achieved with both Planar and 3D devices as the value of \(L^*\) becomes lower. This can occur as a result of longer Path Lengths or smaller hydraulic diameter. Longer Path Lengths would increase the propellant dwell time allowing more decomposition to occur. Also, small \(D_h\) might promote fluidic mixing as a result of a higher core flow velocity. This trend indicates a geometric relationship directly related to \(L^*\) that appears to be configuration independent based on this data.

Statistical analysis

Statistical analysis of the experimental data reveals the significance of the three factors. Channel Shape and Number of Channels are highly significant factors influencing catalyst chamber performance due to the low p-values of 0.0213 and 0.0517, respectively. Catalyst Path Length possessed a relatively high p-value of 0.7706, rendering it inconclusive and again suggests an optimal length. Additional duplication of the experiment is necessary to increase statistical significance of the results.

Concluding Remarks

A full factorial experiment was created to investigate various channel characteristics believed to influence the performance on a catalyst chamber embedded in LTCC. Three factors were chosen based on previous work and varied between two distinct levels, resulting with eight test configurations. Initial tests emphasized the importance of thermal management on LTCC microthruster design as in larger engines, such as the Space Shuttle Main Engine. Experimental results emphasize the effectiveness three dimensional fluidic structures have on catalyst chamber performance. This result indicates key advantages of the LTCC material system for similar applications. Secondly, smaller channels have been determined to improve catalyst chamber performance for Planar or 3D configurations. Also, Catalyst Path Length was determined to be inconclusive with a high p-value. Lastly, an interesting geometric trend independent of configuration was observed by analyzing the characteristic channel length and lead to the discovery of a defective prototype creating an outlier in the data set.

Experimental results are still being considered at this time. Additional repetitions of the experimental test matrix are required to improve statistical significance of the data. The test matrix will be expanded to encompass mid-range values of the Number of Channels and Catalyst Path Length factors. This will provide a better understanding of a factor’s effectiveness on catalyst chamber performance. The mid-range Path Length values will also indicate the presence of any optimal length.

References

Seismicity Associated with Geothermal Systems

Randi Walters: McNair Scholar

Dr. Kasper van Wijk: Mentor

Geosciences

Abstract

Studying natural and induced seismicity associated with geothermal systems can provide information regarding the location and magnitude of hydraulic fracturing. Understanding the fracture system can aid geothermal exploration. In addition, seismicity can affect the output of a geothermal reservoir, and potentially be a seismic hazard to the surrounding area. This study focuses on two geothermal systems: the Raft River Geothermal System (RRGS) in southern Idaho and the Mt. Princeton Geothermal System (MPGS) in central Colorado. The seismic data analyzed for the RRGS is from the broadband sensors that are part of the EarthScope Project’s Transportable Array (TA), while the seismic data from the MPGS is from broadband and short-period sensors from the IRIS PASSCAL Instrument Center. A significant increase in seismic activity was measured on the TA station L14A near the RRGS, indicating pump testing and production caused induced seismicity. At MPGS, local events were identified, possibly related to natural hydraulic fracturing caused by near-surface hot fluid movement.

Introduction

Geothermal energy

Better understanding the production of geothermal energy from geothermal systems (Figure 1) is currently of great interest due to the global energy crisis and global warming. We investigate how seismic activity associated with geothermal systems can provide information on the productivity of power generation.

Figure 1. This figure shows a generic heat source and hydrothermal fluids moving along a normal fault system with a hot springs at the surface. This diagram is consistent with the proposed geothermal environment of the Mount Princeton Geothermal System. Not drawn to scale.
Seismicity

The two types of seismic activity considered for this research were induced seismicity and natural seismicity. Induced seismicity is ground motion generally associated with anthropogenic sources. For instance, people causing a change in the pore pressure of subsurface rocks by injecting water into or extracting water from a geothermal system. Pore pressure can also be altered by anthropogenic activities such as mining and the extraction of hydrocarbons and natural gases (Bommer, 2006). The presence of induced seismicity can lead to information regarding both the productivity and safety of a geothermal system. Induced seismicity can either increase or reduce permeability, potentially affecting productivity of a geothermal system. Induced seismicity can also cause temporary or permanent shutdowns of a plant, if it causes damage to equipment or creates seismic hazards.

As previously stated, induced seismicity is caused by changes in lithologic pore pressure. An increase in pore pressure associated with water injection in geothermal systems generally causes a decrease in the effective normal stress, resulting in shear stress. This decrease in effective normal stress occurs along already existing fractures (Cornet, 1995). Alternatively, extracting water, thereby reducing the pore pressure, is also correlated with induced seismicity. This type of induced seismicity may be explained by poroelastic stresses from changes in pore fluid distributions (Segall, 1989). Along with injecting and extracting water into the subsurface as a way of producing geothermal energy, pore pressure can be altered by activities such as mining and the extraction of hydrocarbons and natural gases (Bommer, 2006). The variety of ways in which induced seismicity may occur, many of which are related to alternative energy or the global economy, makes its study significant.

Natural seismicity occurs by natural means, for example movement along a fault due to strain caused by plate tectonics or the creation of hydraulic fractures due to water movement in the subsurface. The presence of natural seismicity can lead to information regarding the hydraulic fracturing in the geothermal system and monitoring of induced seismicity. Through analyzing clusters of events it is possible to determine where hydraulic fractures are occurring. There is a direct relationship between hydraulic fracturing and geothermal energy productivity. Also, implementing an array of stations before the start of geothermal power production will allow us to compare seismic activity before, during, and after the production of geothermal energy.

Geothermal Systems Considered

Two geothermal systems were considered as a part of this research project. The Raft River Geothermal System (RRGS), in southeastern Idaho, is operated by U.S. Geothermal Inc. and began production in January 2008 (U.S. Geothermal, 2007). Additionally, the Mt. Princeton Geothermal System (MPGS) is a geothermal system located in Chalk Creek Canyon, Colorado and is being carefully considered for geothermal exploration (Field Camp, 2009).

Raft River Geothermal System, Idaho

Introduction. The RRGS is located in a basin and range valley known as the Raft River Valley. The valley contains previously identified fault sequences that control the structural geology of the basin and the geothermal system. The basin has a Precambrian basement of quartz monzonite, overlain by Paleozoic metamorphics, such as schists and quartzites. Stratigraphically above the metamorphics are Tertiary deposits of primarily sedimentary rocks: gravels, alluvium, silt, and sand, along with volcanic sediments. The hydrothermal fluid in the RRGS is 140°C to 160°C. This is considered only a marginal temperature for a geothermal system. As a result, the Raft River Geothermal Power Plant uses a binary system where a secondary fluid with a lower boiling point than water is used. (Applegate, 2009)

Methods. Seismic data for this study was obtained by requesting data from the EarthScope project through the Incorporated Institutions for Seismology (IRIS) Data Management Center (DMC) using the WebRequest tool. The EarthScope Project focuses on installing numerous seismic stations across the United States (Figure 2) in order to gain a better understanding of the subsurface structure (EarthScope, 2009). Seismic data from two EarthScope Transportable Array (TA) stations show events before and after the start of energy production.

TA L14A and TA L13A are mapped relative to the RRGS in Figure 3. L13A is located approximately 50 km from the RRGS and L14A is located approximately 13 km from RRGS. The stations began acquiring data on julian day 199, 2007. Testing occurred at the RRGS from julian day 289 (October 16, 2007) to julian day 296
(October 23, 2007). A second phase of testing began on Julian day 329 (November 25, 2009) and its end date is unknown. Production at the RRGS began on Julian day 003 (January 3, 2008).

Figure 2. Map of the Transportable Array stations managed by the EarthScope project.

Figure 3. Map of the Raft River Geothermal System and the surrounding area, including the TA stations L13A and L14A.

Once the data was converted to the necessary format, the seismic analysis software PASSCAL Quick Look was used to scan the data (PQL, 2009). Events with amplitudes larger than 80 times the ambient noise were considered for both TA stations. The number of events that occurred between July 7, 2007 and April 3, 2008 were
compared to determine if induced seismicity might be occurring near the RRGS. The station TA L13A is used as a control station because it likely does not detect small seismic events induced by the RRGS, whereas station TA L14A will. An example of a possible RRGS induced event can be seen in Figure 4.

Figure 4. Example of an event at station L14A that may be induced by the RRGS. A 3Hz-8Hz filter was applied to the data in this image.

**Results.** Figure 5 is a histogram with the number of events that occurred during a specific time on TA L14A and TA L13A. The y-axis is the number of events and the x-axis is julian days. Compared to TA L13A, TA L14A shows much more seismic activity. In addition, the increased seismic activity seems to correlate with pump testing and production. This could indicate that the seismic activity for station L14A is associated with the geothermal exploration.

Figure 5. Number of events for TA L14A and TA L13A.
Conclusions. From the L14A histogram, it is apparent that there is little seismic activity prior to production at the RRGS, a small peak in activity during the testing phase, and a significant increase in activity during energy production. This is a strong indicator of induced seismicity present at the RRGS. The seismic activity seems to fit the criteria of local events; the wave forms of the events contain high frequencies. There is currently insufficient data for an analysis that includes determining the exact source locations of these events.

Mt. Princeton Geothermal System, Colorado

Introduction. The MPGS is a geothermal system that has been analyzed by Boise State University and Colorado School of Mines for the past five years in order to determine the geothermal characteristics of the area known as Chalk Creek Canyon, located at the foot of Mount Princeton, and how they fit the geologic structure of the Upper Arkansas Valley. The basement rock in the area of the Mt. Princeton Geothermal System is a granitic pluton that is estimated to be between tens to hundreds of meters below the surface. It is believed that the majority of the fluid movement is occurring within or near this granite. (Field Camp, 2009)

Contributors to the MPGS geothermal exploration acquired self-potential data in the Chalk Creek Canyon. This data suggests a shear zone in the canyon. The peak in the self-potential data suggests an area of fluid movement below the subsurface. This fluid movement is the basis for the proposed shear zone. It appears from these data (Figure 6) that there is a shear zone running parallel with the canyon (Richards, 2009). It is believed that the majority of the fluid movement is occurring within or near the granitic basement rock. Figure 6 shows the self-potential profile location with respect to the seismic stations and natural seismic events.

Figure 6. Self-potential data collected in Chalk Creek Canyon, CO. (Richards, 2009)
Methods. The passive seismic data were acquired by a network of seismic instruments from the IRIS PASSCAL Instrument Center. The data were analyzed by scanning for “unknown” events across multiple stations. An “unknown” event is one that is not noise and not a USGS archived regional or teleseismic event, making its source unknown (Figure 7). If an event was found on one station, but not a significant number of others, than it was likely noise (i.e. a vehicle driving by the station). If an event was found across multiple stations, but has a similar arrival time as a USGS archived event, than it is likely teleseismic and not one of the local events that we are interested in. Figure 7. “Unknown” event. Traces show the vertical components of seven different stations.

Once several events were classified as “unknown,” their parameters were entered into a code written in SciLab to approximate their source locations. The code was used to optimize the locations of the events based on the event arrival times and an initial best location guess. The code assumes that the depths of the events are shallow, based on the local geology of the area, effectively reducing out source location problem to a 2D one.

Results. One night of data was analyzed for “unknown” events. On day 151 (May 31, 2009), nine “unknown” events were identified on at least seven of the thirteen stations in operation. The events that were identified were used in order to construct an event location map (Figure 8). Of those nine events, seven of them fell within a reasonable zone to be considered potential events associated with the faulting sequence under consideration for the MPGS. The two north-west trending faults are normal faults associated with faceted spurs and can be seen from surface deformation and active seismic sections. The north-east trending fault is inferred by the self-potential data discussed in Figure 5. These events were located using a surface wave velocity model of 0.5 km/s. The average normal misfit of the event locations was 0.03 seconds.
Conclusions. Through identifying and locating “unknown” events in the proposed MPGS production area, we found local seismic activity. Based on faulting and surface geothermal expressions, we hypothesize these events are related to natural hot fluid flow in the near surface.

Other applications

Colorado debris flows. With the data collected from the MPGS, we also found that our seismic instruments have recorded several debris flows. Figure 9 is a seismic recording of a debris flow that occurred on June 2, 2009. From this unique data, in conjunction with video collected by the United States Geological Survey of the debris flow events, we may be able to learn more about the geomorphological events that occur in Chalk Creek Canyon, Colorado.
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