Strategizing for Corporate Social Responsibility: Wells Fargo Case

Ines Montes-Stewart
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Strategizing for Corporate Social Responsibility: Wells Fargo Case

Cover Page Footnote
Professor Breena Coates, PhD - Through her passion in teaching about corporate social responsibility and Principles For Responsible Management Education (PRME) Dr. Coates inspired me to pursue conceptual and qualitative research to advance my understanding about how a corporation, such as Wells Fargo is able to create sustainable social, environmental and economic value for our communities. Dr. Coates’ guidance, support and direction have been priceless for the completion of this manuscript.

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Journal of Student Research

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Dear Readers:

It is with great pleasure that the members of the CSUSB Editorial Board introduce the Inaugural Volume, Spring 2013 of the OSR Journal of Student Research. In this volume, we present the research of six talented students at CSUSB, the proceedings from the 2nd Annual Student Symposium “Meeting of the Minds” and the 27th Annual Student Research Competition. As we grow, we hope to gradually include useful information for our readers and showcase the abilities and successes of all students, for the enhancement of their education, careers, and lives.

The mission of the OSR Journal of Student Research is to serve as an online-centralized peer-reviewed, interdisciplinary journal to advance theory and practice related to all forms of research and creative activities. Our goal is to provide an outlet for students to publish their research and creative activities and to promote the conduction of research.

We hope this publication serves as an open door for our fellow students to pursue future academic opportunities and to present to the campus community the exceptional work being performed. This compilation of research is not only the result of students’ hard work, but the willingness of our faculty to mentor students through the process of conducting research.

We hope you appreciate the value of our journal and support our on-going efforts to publish student research and creative activities in future volumes.

If you wish to obtain a copy of this volume, are enthusiastic about joining the staff at OSR Journal of Student Research, or want to submit a manuscript for review, please email us at osrjournal@gmail.com.

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Dr. Jeffrey Thompson
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Natasha Smith
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Strategizing for Corporate Social Responsibility: Wells Fargo Case

Ines Montes-Stewart

Abstract
This study evaluates Wells Fargo Corporation’s Corporate Social Responsibility strategy. It employs a qualitative methodology using the instrumental case study approach, within which the broad research question is raised: How does the Wells Fargo Corporation strategize for, and implement, corporate social responsibility? Our findings revealed that Wells Fargo has a solid, well-integrated CSR strategy deeply engrained within its culture, skillfully aligned with its capabilities and resources, and that this plan has been executed expertly within the corporation. We will communicate our findings to their leadership team in hopes they continue expansion of their CSR strategies and recommend they consider seeking status as a B-Corporation.

Author Interview

Which professors (if any) have helped you in your research?
Dr. Breena Coates

What are your research interests?
Corporate Social Responsibility

What are your plans after earning your degree? What is your ultimate career goal?
My plans after earning my degree are to continue my career progression at my current employment. My ultimate career goal is to expand my area of responsibility to the consumer-lending group at Wells Fargo and progress to a role of Senior Vice President in strategic diversity and inclusion.

Acknowledgements
Professor Breena Coates, PhD - Through her passion in teaching about corporate social responsibility and Principles For Responsible Management Education (PRME) Dr. Coates inspired me to pursue conceptual and qualitative research to advance my understanding about how a corporation, such as Wells Fargo is able to create sustainable social, environmental and economic value for our communities. Dr. Coates’ guidance, support and direction have been priceless for the completion of this manuscript.

Keywords: CSR, Corporate Responsibility, Social Responsibility, Corporate Social Responsibility, Strategy for CSR, Wells Fargo Social Responsibility, CSR Strategy
Introduction

This research document will focus on fact-finding information and analysis of the Corporate Social Responsibility (CSR) strategy at Wells Fargo & Company (Wells Fargo). It will define Corporate Social Responsibility (CSR) and will explore potential reasons why many companies are now more than ever, integrating this element into their corporate strategy. It will then shift its focus into understanding one company’s CSR strategy. This research will explore Wells Fargo’s CSR strategy which was formally implemented as recently as 2009. It will review some of their priorities allocated to their CSR strategy as a leading Mortgage Banking institution during these times of financial distress. This research will rely on a variety of sources such as, public and internal CSR information published via Internet and Intranet, secondary research through scholarly journals to augment understanding of industry-wide perceptions of CSR strategy, and finally a personal interview with Kim Cousin, CSR Strategic Planning Manager at Wells Fargo. The data analysis on this report is qualitative; using content analysis of this data analyzed using a comprehensive CSR framework and a SWOT analysis. Results from this analysis will provide deeper understanding of Wells Fargo’s CSR strategy and the opportunities and strengths they bring. It will conclude with closing comments and recommendations to Wells Fargo on potential areas of opportunities. It is the intent to share these findings and recommendations with organization’s stakeholders in hopes they find this information of value as they prepare future strategies.

Understanding CSR and why Companies are Pursuing it

Peng (2009) defines Corporate Social Responsibility (CSR) as “the consideration of, and response to, issues beyond the narrow economic, technical, and legal requirements of the firm to accomplish social benefits along with the traditional economic gains that the firm seeks” (p.354). These actions are seen not as legally required, but as voluntary, and sometimes expected actions from organizations to pay back or help the communities. It is important to mention that “at the heart of CSR is the concept of “stakeholders” defined as any group or individual who can affect or is affected by the achievement of the organization’s objective” (Peng, 2009, p.354). In other words, CSR impacts a variety of individuals who have a relationship, primary or secondary, with the organization. Snider, Hill & Martin (2003) conducted a qualitative study of the legal, ethical and moral statements made available on the websites of Forbes magazine’s top 50 U.S. and top 50 multinational firms within the context of stakeholder theory. They concluded that there was great consistency among organizations in the presentation of CSR messages, mostly reflecting three stakeholder groupings as essential for ultimate success of companies - customers, employees and owners.

There is great interest generated in Corporate Social Responsibility from two different audiences. First, our customers and communities expect much more from large corporations beyond providing products and services; they expect profitable corporation to “pay it forward” and give back to their communities. Second, companies have realized there is added value such as recognition and reputational benefit when they sponsor Corporate Social Responsibility (CSR) strategies. Peng (2009) posits that part of the reason for the interest and increase in CSR is as a result of the many recent disasters and scandals, such as the 1989 Exxon Valdez oil spill and scandals between 2001 - 2002 of Enron, WorldCom and others that brought CSR to the forefront of public policy and management discussions (p. 359).

Furthermore, Argandoña (2009) poses that the financial crises started in the US in 2007 as a result of, among other causes, the abundance of unethical behaviors on the part of many of those who made the financial decisions – such as regulators, supervisors, manager or employees. Argandoña’s (2009) research shows how “the generalized practice of CSR within financial institutions could have helped reduce the magnitude of the crisis, perhaps not systemically but definitely in some of the
organizations that have been most affected by the crisis.” Finally, as an added element specific to the banking and mortgage industry, the regulations under the anti-redlining Community Reinvestment Act (CRA) were now viewed as an act of voluntary Corporate Social Responsibility (Vitaliano & Stella 2004).

There are no clear specifics for managers on “how to” implement or choose their policies for CSR, which makes each corporation elect how they will define their role contributing to CSR. It is possible however, that some of the motives to use CSR may not be a genuine desire to “help others”, but self-interest to promote the organization, create reputational goodwill, and long-term benefits to increase market share. Peng (2009) poses that there is a debate on CSR as to whether manager’s efforts to promote the interests of stakeholders are at odds with their fiduciary duty to safeguard shareholder interests (p.355). This presents yet another element to consider since the firms are not social agencies whose primary objective is to serve as economic enterprises. How much should the organization do for the communities? How much is too much? Peng posits that the key here is to determine how to strategize with CSR.

Wells Fargo Corporate Social Responsibility Strategy

**Vision and Values**

Wells Fargo’s Corporate Social Responsibility strategy emerged from its Vision and Values statement. Its vision states: “We want to satisfy all our current customer’s financial needs and help them succeed financially” (Vision and Values of Wells Fargo, 2012). Under this premise, Chairman, President and CEO John G. Stumpf further indicated that “Our vision has nothing to do with transactions, pushing products or getting bigger for the sake of business. It’s about building lifelong relationships one customer at a time.” (p.4) Wells Fargo’s core values are based on this vision and reflect five primary values as the foundation for everything they do: people as a competitive advantage, ethics, what’s right for customers, diversity and inclusion, and leadership. (Vision and Values of Wells Fargo, 2012, p.6) Within Wells Fargo’s five strategic priorities, John G. Stumpf, CEO includes connecting with communities and stakeholders to listen and understand, to do what’s right, to admit our mistakes and learn from them. Mr. Stumpf refers to it as “our commitment to investments in community non-profit organizations, team member volunteer assistance and our partnership with human rights, social services and environmental organizations.” Please refer to Appendix: Excerpts of Wells Fargo & Company Corporate Social Responsibility Report 2011 for more detailed information.

Wells Fargo has an entire Line of Business dedicated to Social Responsibility and Diversity, led by our Executive Vice President Jon Campbell, with many leaders and over 100 team members nationwide who work to find solutions to the social, economic and environmental issues faced in the communities they serve. Wells Fargo has a strong presence and website communication strategy to their internal and external stakeholders. Through this venue Wells Fargo declares that customers are at the heart of everything they do. They believe that if the customers prosper, so will they. This aligns to Wells Fargo’s Vision & Values which promotes long-term economic prosperity and quality of life for everyone in their communities. Wells Fargo encourages all team members to be community leaders and become the company’s eyes and ears to help decide how they can best contribute to their communities’ success. When defining their involvement as community leaders, Wells Fargo team members partner with a multitude of organizations across the country to promote prosperity and quality of life. Through their philanthropic strategies they donate nearly a quarter of a billion dollars in charitable contributions to non-profits annually, such as Community Support and United Way Campaign, donating thousands of Volunteer time hours to save the planet, fight diseases, educate children, provide education matching gift programs, save animals, and many, numerous other causes. In fact, known as one of America’s most generous companies, Wells Fargo ranked in the top 25 on the Fortune 500 list, and Journal of Philanthropy ranks them number 3 in corporate-giving.
Another way Wells Fargo shows its dedication and care for our communities is through its commitment to the environment. Wells Fargo is keenly aware of the effect that its operations have on the environment and the natural resources it uses today that must be protected and preserved for future generations. Wells Fargo is committed to run the company as efficiently as possible, reducing paper and energy use. It has set a goal to reduce its greenhouse gas emissions by 20% from 2008 levels by 2018. Wells Fargo has a comprehensive recycling program at its banking stores with goals of increasing recycling rate to 65%, and is using energy-saving design elements in its new banking stores to increase the energy efficiency to 40% and ensure that 35% of the leased and owned buildings are LEED® certified. These are just a few of the reasons why Newsweek named Wells Fargo America’s #1 Green Bank in September 2009.

In addition to Wells Fargo’s community involvement and environmental consciousness, the promotion of diversity and inclusion is a key component of its business’ success. Wells Fargo is committed to recruiting, placing, developing, and retaining diverse team members and increasing the number of people of color, women, and members of other diverse groups in senior leadership positions. “We want to support all of our team members by making sure that they feel valued for their culture, skills, and traits” commented John Stumpf, CEO through the vision and values.

Mr. Stumpf, CEO, further expands by positing that “I believe that Wells Fargo can’t be one of the world’s great companies unless we become more diverse and inclusive.” Wells Fargo believes that this is a tremendous business opportunity because it enables its use of creativity and multiple perspectives to respond quickly and effectively to the customers’ needs. By making diversity a competitive advantage, Wells Fargo can make the company a better place to work, better understand the diverse customers’ needs, give customers and communities’ outstanding service, and deliver more value to the stockholders.

Analysis: A Comprehensive Model of Corporate Social Responsibility

In order to analyze Wells Fargo’s current CSR strategy, “strategy tripod” reflecting the three traditional perspectives on strategy as used by Peng (2009) in Global Strategy, will be used. This framework includes economist Michael Porter’s Five Forces Framework under the industry-based considerations; the VRIO Framework focusing on resource-based capabilities; and the Strategic Responses Framework for Ethical Challenges on institution-based considerations.

Industry-based considerations

Rivalry Among competitors – Wells Fargo is in the mortgage banking industry, and while many small banks are no longer in business, drastically reducing this industry to a smaller number of large banks, there is pressure and rivalry among competitors. Rivals seek to differentiate themselves with novel CSR strategies to earn customers and communities’ reputation thus increasing market share. Threat of Potential Entry – the use of technologies may provide Wells Fargo some effective temporary entry barriers in some of the CSR initiatives such as bank-driven, multi-language strategies, Global remittance services, financial literacy education and mobile banking applications’ technology. Bargaining Power of Suppliers – this is a strong focus for Wells Fargo having a 23% market share and the ability to assert its bargaining power with suppliers. Wells Fargo has strong supplier diversity programs, score cards and service level expectations. Threat of Substitutes- This area will require that Wells Fargo become more vigilant about the broader environment, understanding the threat of product and service substitutes, carefully avoiding an industry-narrow focus approach. From an industry-based perspective it can be concluded that, there appears to be no significant areas impacting positively or negatively to Wells Fargo CSR strategy.

Resource-based considerations

Value – Peng (2009) defines this as the arsenal of financial, technological, and human resources that can be applied to CSR causes
Among these activities Peng refers to social issue participation as the firm’s participation in social causes not directly related to managing primary stakeholders. Wells Fargo, as an example has several CSR strategies such as educational and environmental programs that would fit within this definition, thus creating excellent value to the primary and secondary stakeholders. In addition, Wells Fargo has diversity programs and initiatives strongly embedded in its core values, operational goals and financial metrics.

**Rarity** – This is defined as containing certain valuable resources that the competition may not have. Wells Fargo defines people, an intangible resource, as its competitive advantage. People’s passion, dedication and commitment along with the firm’s infrastructure to stretch and maximize human capital resources can be considered valuable and rare to the competition. **Imitability** – CSR strategies are deeply engrained in Wells Fargo’s vision and values, everyday attitudes and passions. The enthusiasm, resources allocation and capabilities, and support from the top of the house to execute and “doing what’s right”, are not easy to imitate.

**Organizational capabilities** – this is a strong component at Wells Fargo. Its robust infrastructure reflects adequate manager control systems and relationships between team members and leaders. Another strategic effort includes education and training to team members and managers. In many instances, this creates the resource of rarity (see above) of their human capital. Wells Fargo also leverages from complementary assets which are grown from its own business strategies in pursuit of solid CSR practices.

**Institution-based considerations**

The analysis of this view helps gain better understanding of the organization’s CSR movement and its strategic responses. Peng (2009) poses that “at the most fundamental level, regulatory pressures underpin formal institutions, whereas normative and cognitive pressures support informal institutions” (p. 365). This framework addresses four strategic responses: reactive, defensive, accommodative and proactive strategies.

After reviewing Wells Fargo’s CSR strategy against the strategic responses of this framework, it’s concluded that there is a possibility that Wells Fargo could have reacted in an accommodative strategic response at the onset. During this time the economic crises had degraded, regulators and government agencies had imposed swift, heavy rules, and regulations to the banking and mortgage industry were rigorous. However, quickly after the onset of the economic turmoil, Wells Fargo transitioned from reactive to a proactive role working not only with regulators and government agencies, but initiated a call to action reaching out to the competitors to partner in search of new solutions. Wells Fargo’s proactive strategic response was soon its modus operandi in many of the core CSR decisions made. This evolution, blossoming as the company matured with their CSR strategy, is reflective of a well-thought out and fully supportive strategy. A strategy that grew from the genuine passion and desire “to help our customers and communities succeed” as articulated by Wells Fargo CEO, John Stumpf.
SWOT Analysis of Wells Fargo CSR Strategy

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<th>Strengths</th>
<th>Resource-base considerations: excellent value with a wide variety of CSR offerings</th>
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<td>Organizational capabilities – robust infrastructure to execute on CSR strategy</td>
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<td></td>
<td>People as competitive advantage – energy, passion, commitment at all levels</td>
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<td></td>
<td>Organization is well-recognized, strong reputation and branding (160 years)</td>
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<th>Weaknesses</th>
<th>Rivalry among competitors – other firms trying to copy or “one-up” initiatives</th>
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<td>Potential conflicting interests from organizations decision maker leaders</td>
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<td>Ability to resonate across America’s footprint, not just at the local markets</td>
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<th>Opportunities</th>
<th>Explore additional avenues to expand CSR impact while keeping cost at bay</th>
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<td>Engage other partners, suppliers, community to determine additional ways to</td>
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<td>give back to the communities, both financial and services</td>
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<td>Increase alignment and coordination of CSR strategies</td>
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<th>Threats</th>
<th>Damaging Industry-based low perception of banks due to financial distress</th>
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<td>Potential conflict between firms’ bottom line and CSR costs</td>
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<td>Reputational risk around activist groups</td>
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<td>Receiving unsatisfactory Community Reinvestment Act (CRA) rating</td>
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Conclusion and Recommendations

At the conclusion of this report, recommendations and an implementation plan will be given to the corporation as hopes they will find the research useful as it formulates its future strategic goals and objectives for years to come. The initial reaction after just ‘brushing the tip of the iceberg’ about Wells Fargo & Company’s Corporate Social Responsibility strategy is that Wells Fargo has created a solid integrated strategy. It has aligned necessary capabilities and resources to execute flawlessly on a well-thought-out plan which provides viable social, economic and environmental solutions to its communities. The vision, mission, core values, and organization’s culture has deeply engrained strong elements of social responsibility demonstrated not only by what they “say” but also by what they “do”.

The comprehensive model of Corporate Social Responsibility and SWOT analysis framework provided deeper understanding of Wells Fargo’s CSR strategy and its potential opportunities for long-term sustainability. The following are a few recommendations:

- Continue to integrate CSR strategies as part of core activities for all Lines of Business and processes in the organization.
- Seek greater alignment and coordination between resources and the communities.
• Be wise in the selection of CSR initiatives – avoid imitating other firms’ CSRs.
• Be a savvy strategist by understanding the rules of the games. Become vigilant of impending changes, and be proactive in the actions to shape and influence changes. Peng (2009)
• Put customers first and connect to communities; the product is service.

References

Wells Fargo Intranet and Internet site at: www.wellsfargo.com/about/csr
Wells Fargo and Glade partnership: https://www.youtube.com/watch?v=9wnEa8Eyz4
Appendix A

A Comprehensive Model of Corporate Social Responsibility (Peng, 2009, p.360)

**Industry-based considerations**
- Rivalry among competitors
- Threat of potential entry
- Bargaining power of suppliers
- Bargaining power of buyers
- Threat of substitutes

**Resource-based considerations**
- Value
- Rarity
- Imitability
- Organizational capabilities

**Institution-based considerations**
- Reactive Strategy
- Defensive Strategy
- Accommodative Strategy
- Proactive Strategy

Scale and scope of corporate social responsibility activities
100 Dinners Project, Conceptual Change Theory in Education: Reshaping Teacher Perceptions of Students Through Dinner-Home-Visits

Audrey Hovannesian

Abstract
Teacher perceptions of their students have been shown to play a key role in how teachers design and implement curriculum (Scruggs & Mastropieri, 1996) as well as how ‘connected’ a student feels within the classroom (McNeeley, Nonnemaker, & Blum, 2002). In areas undergoing rapid changes in student demographics, measures may need to be taken to ensure teacher perceptions of their students are aligned with actual student attributes to maintain a high level of School Connectedness.

The 100 Dinners Project, a mixed-methods study designed to reshape the perceptions of teachers to increase School Connectedness through application of the Conceptual Change Theory Protocol (CCTP) is presented. The CCTP aligns with Posner, Strike, Hewson, and Gertzog’s (1982) goal of creating four situations to create conditions necessary for conceptual change.

Teacher participants, Team Members, underwent the CCTP through a series of meetings, attendance of dinner-home-visits, reflections, and interviews. The CCTP was successful in reshaping teacher perceptions of students through the critical situation of dinner-home-visits in which teachers were exposed to actual attributes or funds of knowledge, to form their perceptions of students rather than relying on extrinsic student behaviors.

Recommendations for administrators include assessing School Climate often to measure barriers inhibiting and items which foster School Connectedness. If barriers are identified, use of the CCTP focused on the perceived barrier area, may assist in reshaping perceptions and increase School Connectedness for the benefit of students, families, and staff.

Author Interview

Which professors (if any) have helped you in your research?
All of the professors in the Ed.D program added to the creation of my overall study whether through the suggestion of articles to read, theories to pursue, or methodologies to utilize. My committee members (Dr. Piller and Dr. Sandlin) provided a wonderful practitioner lens while my Committee Chair, Dr. Mahoney, challenged me as a researcher and educational leader.

What are your research interests?
My research interests include advocating for the creation of programs which develop strong scholarly practitioners solving problems of practice through action research. I’m also interested in change models related to K-12 and higher education and the construct of connectedness.

What are your plans after earning your degree? What is your ultimate career goal?
My current plans include retaining my current contract as Assessment Coordinator, Program Evaluator, and Common Core Curriculum Specialist. I enjoy working on many projects that are both interesting and challenging. My future career goal is to find a position which best utilizes my educational, business, leadership, and philanthropic skills. I hope to excel in one fantastic position rather than juggling many positions.

Acknowledgements
I would like to professionally acknowledge Dean Fiene for his support and believing in me. I would personally like to thank my husband for his sacrifice of time and resources to support my many research ventures.

Keywords: Perceptions, School Connectedness, Conceptual Change Theory Protocol, Dinner-Home-Visits, Funds of Knowledge, Data Visualization
Introduction

All change, even very large and powerful change, begins when a few people start talking with one another about something they care about. Simple conversations held at kitchen tables, or seated on the ground, or leaning against doorways are powerful means to start influencing and changing our world (Wheatley, 1996, p. 67).

Areas across the country have undergone demographic shifts, causing periods of change, confusion, and conflict. Our country’s uniqueness derives from diverse populations’ merging to create an eclectic society drawing from attributes of the parts. Unfamiliar with changing student demographics, teachers may rely on perceptions of students formed by outside sources such as the media (Solorzano & Yosso, 2001), teacher preparation courses (Raths, 2000), and other teachers. Perceptions formed by such constructs often do not align with actual student attributes. Though teachers design lessons to best fit their students, their student perceptions may alter lesson directions and result in a lack of student-teacher connection or School Connectedness.

The 100 Dinners Project, a participatory action research study, was designed to align teacher perceptions of students with actual student attributes. The Conceptual Change Theory Protocol (CCTP) was the change vehicle employed to identify current teacher perceptions of students, how perceptions were formed, and to reshape perceptions found to be misaligned to actual student attributes.

The CCTP has previously reshaped student perceptions of math and science concepts (Posner, Strike, Hewson, & Gertzog, 1982). Due to the similar underlying structure of conceptual formation, this study used the CCTP to reshape perceptions teachers held regarding their students to increase School Connectedness. This involved learners’ (i.e., six participant teachers identified as Team Members) identification of current perceptions of students through facilitator-led discussion (team meetings). Team Members experienced a critical situation (dinner-home-visit) to expose them to new information regarding their students, followed by encouragement and guidance to restructure perceptions (team meetings).

Key to the CCTP is the catalyst of perceptual reformation, the critical situation. Dinner-home-visits were the critical situation to assist reshaping of teacher perceptions by placing teachers in an unfamiliar social environment. The dinner-home-visit provided social interactions between teacher, student, and parent, not often experienced, to increase communication and provide educators with valuable information about the student and their family (Ginsberg, 2007).

During the fall 2010, the researcher was employed at a junior high school located in the “high desert” region of Southern California. Originally a desert getaway for 1950’s celebrities, the area has become home to increased populations from a variety of ethnic backgrounds moving from urban regions throughout California. Though the community demographic has shifted from 84 percent White, 10 percent Hispanic, 3 percent Asian, 3 percent from other races in 1980 (Meyers & Park, 2001) to 31 percent White, 43 percent Hispanic, 20 percent Black, 6 percent from other races in 2009 (www.city-data.com/city/Victorville-California.html), teacher demographics at the participating junior high school site remained relatively static; ten years ago 87.5 percent of teachers identified themselves as White, while in 2011 77 percent identified themselves as White. This shift in student demographics contributed to a disconnect between staff and students which led to discipline issues and low staff morale, resulting in low School Connectedness.

In 2010, the school’s student population was 881 7th and 8th grade students. 89.80 percent of students received free or reduced lunch. 57 percent of students were identified as Hispanic/Latino, 28 percent as African American, and 11 percent as White. The remaining 4 percent identified from various other ethnic backgrounds. In contrast, teacher ethnicities identified as 77 percent White, 17 percent Hispanic/Latino, and the remaining 6 percent as Asian and African American.

To address the issues of low School Connectedness, this study was driven by the following questions:
1) The Conceptual Change Theory Protocol has been demonstrated effective in changing subject-content concepts in students. The applicability of this protocol will be investigated in teacher perceptions.

2) How have dinner-home-visits served as a critical situation and acted as a catalyst for perceptual change among Team Members?

Study participants included a 100 Dinners Project Team comprised of six (6) volunteer junior high classroom teachers (termed Team Members). Included on the 100 Dinners Project Team was a teacher-researcher facilitator (the author). The six Team Members represented 20 percent of the credentialed teaching staff. The number of participating Team Members was purposely limited to maintain a small, tightly knit action research group. The selection process ensured representation from each grade level (7th and 8th grade), CORE subject area (English and Math), and representatives from other departments (Science, Electives, and Special Education). Team Members received a $1,000 stipend as compensation for time to complete the dinner-home-visits, write narrative Reflections after each dinner-home-visit, attend Team Meetings, and complete an Individual Interview. In addition to the Dinners Project Team, participants included parents of students from each Team Member’s classroom who partook in dinner-home-visits. No compensation was provided to parents.

Step 1: Identify Current Perceptions of Students

To identify teacher perceptions of students, Team Members completed the Teacher School Climate Survey to assess School Climate. The survey was created from the 2008-2009 California School Climate Survey (CSCS) (WestEd, 2004) and researcher created items. The CSCS is utilized statewide to guide school improvement and foster positive teaching and learning environments. The CSCS has been used since 2004 by California school districts as part of No Child Left Behind (NCLB, 2001) compliance, and is used nationally by schools participating in the Safe Schools Healthy Students program. The CSCS is a unidimensional measure with acceptable reliability (α = .82 to .88) and concurrent validity (r = .44 to .55) across 18 sociocultural groups (Furlong & O’Brien, 2011). Cronbach’s alpha was not calculated due to only six respondents. Five surveys responses were complete. Survey results were not shared with Team Members during the study.

Team Members’ Initial Perceptions of Students as Indicated on the Teacher School Climate Survey

Survey results are presented as a data visualization spectrum (See Figure 1: Teacher School Climate Survey Spectrum).
Figure 1: Teacher School Climate Survey Spectrum

Teacher perceived student-related barriers inhibiting School Connectedness
Teacher perceived school environment-related barriers inhibiting School Connectedness
Teacher perceived staff-related barriers inhibiting School Connectedness
Responses indicated a concentration of student-related items which inhibited or acted as barriers to School Connectedness related to extrinsic student traits. Although Team Members identified nearly all students as being healthy, physically fit, alert, and rested when they arrived at school, they also identified students as being unwilling or unable to turn in homework assignments and lacking pride in their work. Team Members also overwhelmingly identified their student perceptions based on other extrinsic traits such as being disruptive and lacking respect for staff. Team Members reported students, occasionally, engaged in physical fighting with other students. Team Members also reported perceiving students as moderately or mildly dealing with alcohol or drug related issues. Harassment and bullying were perceived as a severe to moderate problem among students. Other barriers reported were vandalism and theft.

Team Member perceptions of students supported prior findings on School Connectedness. Based on Team Members’ perceptions, students demonstrated extrinsic behaviors which acted as barriers to School Connectedness related to school protocols and staff relationships. Students were perceived to have few intrinsic issues related to School Connectedness, including overall health and mental capacity. Although students were perceived as demonstrating extrinsic behaviors related to barriers of School Connectedness, such as missing assignments or being disruptive, they were also perceived to harbor intrinsic elements (healthy, alert, rested) which foster School Connectedness.

As Figure 1 reveals, Team Members perceived fewer barriers to School Connectedness related to school environment than student-related-barriers. When asked about their own teaching and behaviors, Team Members indicated their actions fostered School Connectedness. Results not only uncovered current perceptions Team Members held regarding students, but also indicated actions to resolve School Connectedness should focus on the teacher-student relationship. With Team Member perceptions identified, the study moved to Step 2 of the CCTP.

**Step 2: Discuss Current Perceptions of Students**

At the first Team Meeting, dinner-home-visit protocols, safety protocols, and current perceptions of students were discussed. Team Members engaged in a discussion led by the researcher-facilitator regarding perceptions of junior high school students in general, and then their specific students. Responses were recorded on a poster-size sheet of paper for Team Members to view. Team Members identified junior high school students in general as “squirrely, sweet, hormonal, inquisitive, having pride, doing well, being monsters, carrying what their peers think, and having high, unrealistic, expectations.” Perceptions of their specific students included, “coming from broken homes, affected by deaths, having baggage, multi-cultural, rural, transient, having a gang mentality as well as having a pack mentality.” These perceptions were similar to findings on the Teacher School Climate Survey.

After the initial perceptions discussion, the dinner-home-visit protocol was shared with Team Members. The protocol included how to solicit dinner-home-visits from student’s families, how to conduct a dinner-home-visit, and how to stay safe when entering the homes of virtual strangers. After the meeting, Team Members read a script to their class describing The 100 Dinners Project, and distributed Parent Information Packets containing a parent/guardian letter describing the program and voluntary signup information. Ten families were randomly selected from the volunteers for each Team Member.

**Step 3: Create Conceptual Conflict with Current Conceptions: Dinner-Home-Visits:**

The conceptual conflict or critical situation proposed by this study was a new version of the traditional home-visit. Home visits are the practice of a teacher visiting student homes. The ‘home visit’ provides interactions between teacher, parent, and student which increases communication and may provide information about the student and their family (Ginsberg, 2007). The dinner-home-visit added the sharing of a family meal, as traditional
home visits are semi-structured parent-teacher conferences. Addition of a meal potentially increased opportunities for unstructured social interaction to discover family Funds of Knowledge. This increase in family information, in addition to the Team Member being in an unfamiliar setting, created a situation for dinner-home-visits to be a vehicle to reshape teacher perceptions of students. In addition to the 10 dinner-home-visits each Team Member participated in, they completed a written narrative Reflection of each dinner-home-visit. The Reflections had no structure; Team Members were instructed to record the dinner-home-visit, and their thoughts and feelings.

The written Reflections were collected throughout the study and analyzed using Ryan and Bernard’s (2003) four category approach when inducing themes from qualitative data. These categories include: word analysis; scrutiny of large text blocks; analysis of linguistic features; and, physical text manipulation. Emergent key themes identified were similar to themes from the Teacher School Climate Survey. Themes related to items which either fostered or inhibited School Connectedness emerged from the Reflections. Other identified themes included discovery of funds of knowledge, evidence of change in perceptions, evidence of emerging connectedness, and descriptions of dinner-home-visits.

To ensure reliability of identified themes and codes, an external coder coded a random 20 percent sample of the written Reflections. The external coder was selected based on their educational expertise and educational practitioner experience. The researcher and external coder met for approximately two hours to discuss the study and task. The external coder and researcher achieved an 81 percent agreement in identified codes. The 19 percent discrepancy was attributed to codes with low frequencies.

Team Member Reflections supported findings from the Teacher School Climate Survey and revealed similar descriptions of student-related barriers affecting School Connectedness, as well as descriptions which fostered School Connectedness. Figure 2: Reflection Spectrum identifies the reported barriers and items which foster School Connectedness, as well as a focus on discussions of funds of knowledge, an emergence of change in teacher perceptions, increased connectedness, and identification of dinner-home-visits as a critical situation.
Figure 2. Reflection Spectrum

- Teacher reported student-barriers inhibiting School Connectedness
- Teacher reported student-related-items which foster School Connectedness
- Increased focus on the discovery of Funds of Knowledge
- Teacher reported emerging change

School Connectedness Spectrum Key
- Items which foster School Connectedness
- Items which inhibit School Connectedness
- Reported Funds of Knowledge
- Reported Change
- Reported Connectedness
- Dinner-Home-Visit Comments
Reflections indicated intrinsic student-related behaviors which fostered School Connectedness included students being bright, smart, amazing, excellent, role models, hardworking, and helpful. One Team Member described a student as, “productive and has a positive attitude with her class work and tries her best.” Team Members described students as an, “excellent student that loves to learn,” “naturally smart and a natural born leader,” and “amazing and unusually mature—a student any teacher loves to teach.” Two Reflections noted attributes which fostered School Connectedness and offered insight into a student behavioral barrier. One Team Member described a student as, “motivated, hardworking student, but the area she needs to work on is speaking in class during presentations. She becomes very nervous, turns red, and refuses to make eye contact.” Similarly, another Team Member described one of their students as, “a well-mannered and respectful student for the most part. She is capable of doing better work, if she could just focus more. She gets along well with other classmates, but often she’s distracted by her friends.”

Student-related barriers inhibiting School Connectedness were similar to those identified on the survey, and related to extrinsic student behaviors. Team Members attributed poor grades to a lack of organization and focus resulting in missing assignments. One Team Member explained a student, “completes his homework and forgets it at home in his backpack, or under his bed.” Another Team Member shared, “his backpack is like a huge filing cabinet without any folders, and he carries it around everywhere.” Additionally, a Team Member noted a student, “is struggling with not only organization but time management.” Team Members also attributed poor grades to a lack of focus by describing a student as, “losing focus due to distractions in the class.” Laziness was also reported, “(student name omitted) admitted that she can do the work but she is lazy.”

Reflections also uncovered similar extrinsic peer issues as identified on the survey such as bullying, fighting, and being disruptive. One Team Member described the peer issue as, “the student population at (school name omitted) tend to bring excellent students down due to disruptions, fights, and lack of academic interest for some students.” One Team Member reported an experience amongst a student’s peers. “In talking with dad I learned that (student name omitted) has had a difficult time with being harassed at school.” Another Team Member shared the influence of student peers, “The mother, who went to high school in Alta Loma, has noticed that (student name omitted) is attempting to adapt to (school name omitted) by sagging his pants like everybody else. The behavior of sagging the pants illustrates how the environment, or school culture influence students to go in the wrong way in terms of perception.” Another Team Member shared a story of peer influence on perceptions:

Recently, one of my students fell from the wall climber during P.E. One of my students told me that she broke her back and that she was possibly paralyzed. I was disturbed by the news. The next day in class, I heard a student making fun of the student that fell. She was laughing and saying that she was twitching on the floor and that she couldn’t move. It is these type of remarks and lack of sympathy among students that ruin the school culture.

Team Members also discovered difficulties with peers and the local community. A Team Member described an after school situation in which, “an adult African-American man walked up to him, punched him in the face, took the IPod and left.” Team Members also discussed other difficult issues occurring outside of school associated with student-related barriers to School Connectedness. A difficult issue described by all Team Members was separation from family members. One Team Member stated, “I also inquired if (student name omitted) had any siblings and she said that she had a brother and sister that live in Los Angeles. They don’t really see each other because of the distance but they do meet up during the summer and some holidays.” Another Team Member described similar issues of sibling separation, “(student name omitted) has many half brothers and sisters but they never come to see her and therefore are not close.”
In addition to family separations, Team Members described loss of family members. One Team Member reported a student’s, “father had died of a drug overdose and his mother was also a drug addict and a manic depressant/bipolar. (Student name omitted) was also little when his father died but he was present when his mother over-dosed accidentally on her medication.” Another Team Member similarly shared, “her grandfather was like an open book and explained to us that his wife had passed away due to lung cancer and the girls’ father was taken in a car accident.” In addition, Team Members noted other family related difficulties. One Team Member reported, “(student name omitted) shared with us a friend of hers was getting ready to undergo a massive surgery; a double lung transplant.” The same Team Member went on to describe, “This opened the conversation to mom sharing with us that she also has health problems. Mom’s arteries are shutting down, and can’t afford medical insurance to have her condition checked regularly.”

Team Members also discussed health issues affecting students. “Grandma told us that (student’s name omitted) mother had been a drug addict and was a heavy user while she was pregnant so (student name omitted) is a FAS (Fetal Alcohol Syndrome) baby.” Another Team Member described, “(student name omitted) is anemic which causes her to become very sleepy and not want to do anything in class. Her mom has vitamins and iron medication for her but expressed to us that she will often not take it or spit it out.”

Team Members’ style of recording family and student difficulties was matter-of-fact, and included parallels between these difficulties and student behaviors identified as barriers to School Connectedness. Reflections offered insights and reasons for the previous survey responses and indicated Team Members were beginning to uncover reasons for barriers previously identified as disruptive, defiant, or lacking focus. Team Members’ reporting demonstrated their continual gathering of information as they began to reshape and form new perceptions.

Though Team Members shared stories of student difficulties and family hardship, they also included details of how families had overcome and persevered. This demonstrated Team Members were involved in the third step of the CCTP in which conceptual conflict created an environment to challenge earlier perceptions and become cognizant of the actual issues affecting their students’ lives, as well as, family strengths and resources termed funds of knowledge.

**Discovery of Funds of Knowledge:**

Reflections revealed a focus (the most frequently mentioned code, discussed by all Team Members a total of 135 times) on discovery of funds of knowledge or new information of family backgrounds, talents, and resources. Discovery of Funds of Knowledge was referenced more frequently than barriers, fostering, or change.

Team Members wrote about discovery of Funds of Knowledge through references to family traditions, culture, ethnicity, hopes, dreams, occupations, and food. A large amount of Funds of Knowledge (See Figure 2: Reflection Spectrum) were shared during the dinner portion of the dinner-home-visit. One Team Member described learning his student had an interest in becoming a Highway Patrol officer after attending a 4-year university. Another Team Member reflected, “(student name omitted) showed me a fabulous collection of drawings he did for science. He thinks he might like to be an architect or engineer, or maybe a Navel Special Forces officer.” Parent occupations were also discussed, “(student name omitted) father works at a juvenile detention,” and, “that Mr. (family last name omitted) was employed at the airport on the former George AFB.”

Team Members’ discovered hidden resources and interests of students. “I didn’t know about her twin and was totally shocked that I haven’t seen him at (school name omitted). I asked him several questions to find out if they two have the same or similar likes. They don’t look alike, she’s tall and he’s short, and they’re future occupations are totally different too. He wants to be a policeman and she wants to be professional singer.” Another Team Member described, “during the summer they are very involved in reading programs at the city library.” Another Team Member described learning a
parent was actively “involved with many programs that support female empowerment like the Latina Summit and other programs like ELAC and DELAC.”

Team Members also identified ethnic and cultural Funds of Knowledge. “The father met me at the door. I thought he was from Jamaica, but he’s from Africa. I think he said Nigeria.” During a different dinner-home-visit, a Team Member learned his student’s family was from Egypt but the student was, “from London, and moved to America when she was really young.”

Other Team Members reported learning about students’ Funds of Knowledge through the food served. The meal itself provided a conversation starter of the origin of the dish and the family, and also provided an opportunity for Team Members to connect with families by sharing their own backgrounds and origins. In many Reflections, Team Members described their appreciation for delicious foods which, when shared with the family, was perceived as a validation and appreciation for family and culture.

I was expecting spaghetti and instead was served pupusas. I didn’t realize that (student’s name omitted) mom was from El Salvador and that it was their favorite. I love pupusas and hadn’t had some in several years. They also served a popular soda from El Salvador called “Colachampane.” I had seen it before when I taught in Los Angeles about 6 years ago. For desert we had homemade brownies and then another popular Salvadorian treat, “quesadillas.” I was not aware that it was a type of bread with a nice glaze and sesame seeds on top. We also had Salvadorian coffee made from corn.

A Team Member asked to be taught about certain aspects of the meal. “I asked some questions about Mexican cooking, especially about tomatillos, and they showed me one and explained how they add to the Mexican flavors. I enjoyed the foray into the cooking of that culture.” Team Members’ interests in foods and desire to learn more demonstrated an appreciation for the family and their culture not replicable in other home-school interactions.

In addition to acquiring Funds of Knowledge from students and their families, Team Members felt inclined to share their own Funds of Knowledge which created connections to their own personal backgrounds and the backgrounds of their students. One Team Member described, “We ate pozole; a personal favorite of mine, and Mom made it just like my mom makes it without the pig’s feet.” Team Members identified other commonalities among themselves and their students over the meal.

One Team Member recognized the meal as one he had enjoyed at his favorite eatery, “Mr. (name omitted) owned some restaurants in town by the name of (name omitted). Both of (student name omitted) parents worked for years at the restaurants. I was happy to tell them that my wife and I frequently dined at the restaurant, it was one of our favorites and we were disappointed when it closed.”

In addition to food playing a role in acquiring Funds of Knowledge, the meal helped to relax and provide an opportunity for social interaction, allowing for numerous topics to be shared. Team Members reported attaining new knowledge on topics of interest from Funds of Knowledge, for example,

I learned that part of (parent name omitted) business is making mouth pieces for many professional athletes, including (professional athlete name omitted) and other professional mixed martial artists. (Parent name omitted) and his brother work for a dental office in (city name omitted) making mouth pieces. As a side business (parent name omitted) and his brother make special mouth pieces for athletes around the country. I was able to see pictures of the girls with some of the athletes. As I was leaving I was able to see some of (parent name omitted) sports memorabilia which was very impressive.

Other forms of Funds of Knowledge uncovered by Team Members included information on special interests or hobbies. A Team Member observed, “We then moved our conversation to the backyard to see the two dogs and four cats. The (name omitted) are definitely animal lovers.” Another Team Member described,
(Student name omitted) started playing baseball one year ago, and has become a star—accepting the coaching tips, bringing no bad habits, but lots of good work ethic, to the team...He loves to draw and plays the trumpet. He took the ASES beading program and showed me beautiful designer necklaces he made for his mom, who is also a “beader.”

Reflections also included descriptions of discovering Funds of Knowledge through student and family pride in sharing special interests or prized possessions. One Team Member described, “each of the kids’ rooms is decorated specifically for that child. (students name omitted) room is decorated with the Laker’s with a giant picture of Kobe Bryant. Before leaving (student name omitted) and his dad had to show me their quads and wide assortment of fishing poles.” The Team Member also shared, “the last stop in the tour was showing me their Bulley dogs.” Another Team Member described, “the large living room had only a bench and it was explained to me that it is Samoan tradition to leave the living room bare so that relatives can come over, sit on the Samoan fatwa mats, and eat dinner all together.”

Team Members discussed how such interest and artifacts can be useful in creating and supporting classroom instructional activities.

Descriptions of Funds of Knowledge permeated each Reflection. Not only did Team Members report information they learned, they did so with intricacies which indicated Funds of Knowledge’s deep impact. To have such recall of specific events is attributed to Team Members’ new found interest in their students and families and transition from Step 3 in the CCTP (conceptual conflict) to Step 4 when Team Members begin to restructure or change their perceptions resulting in greater connectedness with students and families.

**Change:** Each Team Member self-reported instances of change throughout their 10 Reflections. Change among Team Members included changes in perceptions of students, families, and Funds of Knowledge. The change translated into new behaviors in Team Members.

Reflections of change regarding how they perceived their students were mentioned by all Team Members. “After coming to their home, I had a completely different understanding of my student. The mother stated that after meeting me, she has a much better impression of (school name omitted).” Another Team Member reported, “I learned a lot about my student and his family, things I couldn’t have learned only through my class interactions.”

Team Members also noted changes in perceptions they held regarding their student’s families. One Team Member shared surprise when an assumption regarding a student’s family was proven false. The Team Member thought the parents would be “traditional Mexican parents that don’t speak English very well.” But to his, “surprise, the mother and father speak English and Spanish fluently,” and were “a very structured family.” The same Team Member stated, “I am beginning to see the impact that teachers have in the community and the desire to success that parents have for their children.” The Team Member’s change in perception triggered the question, “How can I improve their ability to think critically in the 21st century?” at the end of the Reflection to indicate a change in perception.

Due to their dinner-home-visit experiences, Team Members began to view students as individuals rather than as a mass of students. “I am beginning to see them as three-dimensional people in their own setting. In literature, we always emphasize how the setting plays an important factor in a story for characters and events to develop. Similarly, the home serves as a place for (student name omitted) to develop into his own person with the influence of his mother and the neighborhood, (city name omitted).” Another Team Member reflected, “this program gave me the opportunity to get to know (student name omitted) and other students on a more personal level.” Team Members mentioned an increased sense of community and need for other resources to support students outside of the classroom.

A Team Member shared, “I learned that student motivation is based on a team effort in the family.” Another Team Member indicated, “I’m beginning to see the pressure the students get from the parent’s side. It is that type of parental involvement that is necessary for student success.” Team Members also attributed
their change in perceptions directly to the dinner-home-visits instead of other information sources, such as assignments or current communication methods.

One Team Member shared, “in my travels, through this project, I have really got to know my families. I learn more about them, which I like.” Another Team Member wrote about reading of a particular family situation in an assignment and the impact the same story had in person, “I know the overview of their story from the “My Life Story” (student name omitted) turned in, but I learned so much more tonight.”

Reflection formats themselves also demonstrated the change process. Though no Reflection format was provided, each followed a similar pattern of first describing extrinsic and intrinsic behaviors and attributes of parents and students, followed by descriptions of the meal which often included acquiring Funds of Knowledge. The final section of the Reflections summarized learning about their students and families and how their own perceptions had changed or altered. This pattern mirrors the CCTP and assisted in demonstrating the applicability of the CCTP to reshaping teacher perceptions of students.

As demonstrated by the reflections, Team Members actively entered the final step (restructuring and building new perceptions) of the CCTP. Reflections demonstrated their ability to recognize and verbalize their change in perceptions of students, and changes in their own behaviors. Reflections also revealed increased connectedness.

**Connectedness:** Team Member responses revealed they themselves, as well as students and parents, were exhibiting behaviors to increase School Connectedness. This was indicated through students sharing personal belongings and information with the Team Member, bonding with the family, wanting another family visit, sharing concern for the student, and reporting to now “know” the student.

Team Members exhibited behaviors of increased School Connectedness by wanting to prolong or return for another visit, “I could have talked for hours with this family.” One Team Member shared, “as the dinner came to an end, it was hard to leave. It gives me hope to see families who are raising their children in acceptance, motivating them with love, and disciplining in such positive ways.” Another Team Member described, “As the evening drew to a close, we both expressed hope that this wouldn’t be the last dinner we would eat together.” Another Team Member reported, “she told me I was welcome any time; she asked me to stop by whenever I wanted to. When we said goodbye, a tear almost budded in my eye at the prick of her loneliness I felt mirrored in my own heart.” Team Members also discussed bonding behaviors shared with family members. A Team Member described, “while we were eating, the four-year-old son of the daughter’s friend, who was wearing braces on both legs, joined us. There were not enough chairs so I held him on one leg and set his plate near mine.”

Team Members demonstrated increased connectedness with the family through discussion of similar heritages. One Team Member shared, “we both come from first generation parents. His parents are from Mexico, just like mine.” Another Team Member made connections with indicating, “we established some common ground. We both have parents that are first generation, sisters that still live at home, and parents that are part of our lives.” Another Team Member formed connections based on growing up in the same area describing, “I learned in our discussion that we know many of the same people and had many laughs.” The Team Member added, “The (family name omitted) reside in my old stomping ground.” Another Team Member shared,“(student’s name omitted) grandmother spoke of the days when (city name omitted) was not as populated. This I could relate to, and I shared that I had lived here in (city name omitted) some 40 years ago and still remember when there were maybe 4 houses on a street.”

Team Members also connected based on similar religious backgrounds. A Team Member noted, “they have the same religious beliefs as I do, so we had many things in common.” Another Team Member connected with the family due to similar parenting styles sharing, “(student’s name omitted) mom makes the kids not getting good grades do chores, while the kids getting “A’s” don’t have to; my parents fed us
only bread, milk, and apples if we got less than “A’s” or “B’s.” Another Team Member described similarities in financial situations while growing by indicating, “We have similar farm/ranch backgrounds—limited money, but plenty of life’s necessities, growing our own food, enjoying the quietness of our surroundings, and enjoying our families.”

Signs of increased connectedness consisted of Team Member descriptions of changes in their behaviors or teaching styles based on their new knowledge. One Team Member described, “Ongoing incidents of another student tormenting him in the class came out. They were passing notes around him and he won’t pass the notes so they have written mean words on his jacket, taken his belongings, and said mean things to him. He named names and I am going to fix this problem immediately.”

Team Members also noted instances of connecting on issues unrelated to education. She asked my advice about fixing things, parenting decisions, some worries she had about the boys finding good careers, and whether some of her dreams are really attainable for someone with no education. I felt like a temporary stand-in for her life partner—just someone with whom to bounce back and forth her ideas and to reassure her how special and amazing she is.

Reflections demonstrated Team Members were actively in the process of reshaping their perceptions of students. During the conceptual conflict period of the CCTP, Team Members underwent a process of moving from focusing on extrinsic student and family factors (missing assignments, limited finances) to a focus on intrinsic student and parent related factors (Funds of Knowledge, and actual student and family attributes) which foster School Connectedness. These changes in perceptions and increases in School Connectedness were attributed to Team Member Reflection data regarding dinner-home-visits.

## Dinner-Home-Visits as a Critical Situation/Catalyst for Change

The change catalyst, dinner-home-visits, was discussed throughout the Reflections. Dinner-home-visits are a new form of home-school communication. Reflections demonstrated the meal’s role in increasing connectedness between Team Members and families. One Team Member described, After the dinner, we sat down and had some cookies as a dessert. The mother encouraged us to have some fruit. I guess all mothers want everyone to eat. I could only assume that food plays a vital role in (student name omitted) household. It brings the family together around the table with such large displays of different foods. It was an excellent evening and I was able to meet some very nice people that really care about their children.

Another Team Member discussed the impact of sharing a meal with a students’ family by sharing, “the style of eating was gracious, meaning that the food was really the backup to the fine conversation. Slow, small bites punctuated family stories told by them and me.”

Another Team Member also mentioned the meal with a description of the family, “how delicious it all was, was surpassed only by how exquisite the company.”

Another Team Member also blended the description of the meal and family attributes describing, Dinner was family favorites punctuated with family stories—spaghetti disguised as rotellini because one daughter doesn’t like spaghetti, green salad with olives and bacon bits added because of the way it calls them to travel the Mediterranean, homemade bread sticks, a favorite of the eldest son, and cheesecake, a family favorite. Stories of the annual river rafting vacations, with their attendant capsizes and rescues, brought out how much (student name omitted) loves the outdoors, and how the whole family loves spending time with family and friends.
Introduction of dinner-home-visits as a new form of home-school communication provided Team Members with the opportunity to witness often unseen customs and traditions which foster School Connectedness. The meal introduced an element of reciprocation of goodwill and sharing to form new perceptions of students and families through an experience perceived as culturally bonding throughout the world: eating. As meals are infinitely customizable based on culture, tradition, and experiences, meals send deep messages while satisfying the basic human need of nourishment.

During the time Team Members participated in dinner-home-visits, a second team meeting occurred one month after the first Team Meeting. Meeting time was spent describing dinner-home-visits already completed. Transcriptions revealed Team Members utilization of “amazing” and “interesting” to describe their dinner-home-visit experiences. The researcher-facilitator did not structure the discussion; however, evidence of changes to teacher perceptions of students began to emerge.

**Step 4: Encourage and Guide Conceptual Restructuring to Build New Conceptions: Final Team Meeting and Individual Interviews**

The final team member meeting took place approximately three months after the first Team Meeting, at which time the majority of Team Members had completed their dinner-home-visits. The researcher-facilitator led a discussion regarding any changes in the initial perceptions Team Members held regarding their students that changed as a result of dinner-home-visits. When asked to describe their students after the completion of the dinner-home-visits, Team Members reported, “charming, brats, family-oriented, really cute, followers, polite and respectful, quicker to respond to discipline, and not as defiant.” Also discussed, were possible changes to curriculum, pedagogy, or forms of communication to align with the student population. Team Members were very receptive to integrating Funds of Knowledge and newly acquired student attributes into instruction. These descriptions indicated a change in perceptions which were further explored in Individual Interviews.

Individual Interviews were coded utilizing a grounded theory approach. Key themes and codes earlier identified through analysis of the Reflections were used to code the Individual Interview transcriptions. Figure 3: Individual Interview Spectrum demonstrates Individual Interview code distribution.
Figure 3. Individual Interview Spectrum

Teacher reported student-barriers inhibiting School Connectedness

Teacher reported student-related-items which foster School Connectedness

Teacher increased reported change

Teacher reported Funds of Knowledge

School Connectedness Spectrum Key
- Items which foster School Connectedness
- Items which inhibit School Connectedness
- Reported Funds of Knowledge
- Reported Change
- Reported Connectedness
- Dinner-Home-Visit Comments
As demonstrated in Figure 3: Individual Interview Spectrum, Individual Interviews reported a substantial drop in barriers inhibiting School Connectedness in areas related to students, parents, and teacher behaviors. Completion of the CCTP yielded a change in Team Member perceptions of students away from student-related barriers towards their actual attributes. Interview responses focused on issues of change and items fostering School Connectedness. This shift in Team Member focus demonstrated successful completion of the change protocol.

A reported change, which was supported the Reflections findings, was an emphasis on intrinsic student attributes versus a focus on extrinsic student behaviors. A Team Member shared initially viewing a student by, “their outer, their exterior,” but due to the dinner-home-visit now views students on “a deeper level.” One Team Member summarized their experience as, “I’m glad to have been part of it (100 Dinners Project) because, you know, if I wasn’t, my – my opinion would still have been the same, and you know, it just – it makes you look really ignorant, after the fact.” This shift was important as a focus on intrinsic attributes assists teachers in developing long-term goals and expectations for students rather than utilizing coping behaviors to solve issues in the short term.

A new theme which emerged was a focus on the presence and role of extended family. Team Members discussed this most frequently during their Interviews. One Team Member shared, “the sample that I’ve done for the home visits, the majority aren’t raised by mom and dad. I definitely have a new insight, the traditional home, home life is not, not common.” Other Team Members discussed discovery of family dynamics which differed from the traditional family. One Team Member added, “there were several, several people with grandma, grandpa, actually not really grandpa, just grandma and maybe a sister or an aunt or someone else.” Having discovered new family dynamics, Team Members reinforced this focus. A Team Member stated, “her grandpa just was amazing – amazing, how in touch he was with the school system, and you know, how much he wanted to support it and make sure that his girls had everything they needed. You don’t find that very often. You know, it was – he was great.”

Consistent with the Reflections, Team Members discussed families being welcoming, generous, friendly, living in a nice home, being concerned over academic progress of their child, working hard, and wanting more for their child than they had. All Team Members discussed the supportiveness of parents. Most comments were similar to, “they’re (parents) more supportive than what I might had thought.” As Team Members completed the CCTP, it was expected they would report a decreased number of parent-related-barriers as they were now cognizant of actual student attributes and demonstrated increased feelings of connectedness.

Change was also present in Team Member responses regarding their own behaviors. Few discussed issues which acted as barriers to School Connectedness. Half of the Team Members reported similar behaviors as reported in the Reflections, which acted to foster School Connectedness through sharing sympathy for the student or family.

Though previously the highest frequency codes in the Reflections, Individual Interviews revealed a significant decrease in discussions of Funds of Knowledge. Team Member completion of the CCTP is demonstrated in their lack of discussion of Funds of Knowledge based on Team Members having synthesized such information and finding their new perceptions to be fruitful, intelligible, and plausible. Only four Team Members mentioned information they learned about student and family resources and knowledge once. Rather than simply describing Funds of Knowledge, Team Members discussed attributes such as pride related to specific resources. One Team Member stated, “If you go in the home and they’re proud of education, they’re proud of their success, they’re proud that they’re a dog owner.” Team Members rather focused on how they themselves had changed their thinking and practices related to students.

Team Members discussed personal change in higher frequency than other codes. A Team Member summarized the newly acquired information and their change stating, “It’s completely different than what I realized.” One Team Member attributed learning new
information regarding their students and families to students being willing to “indulge or come forward with” information when teachers were in their home versus at school.

Team Members also discussed changes to their classroom and instructional protocols and procedures. One Team Member noted changes to,

The way the homework is set up. Like now what I do is I’ll give an assignment and then you know either finish it at home for homework or there’s a part to it that gets given to them. Now I might just have a well-scripted homework like assignment which would require them to do like one assignment per night. And then it’s all turned in on Friday. So it might be a little more structured in that sense.

Team Members described changing their behaviors by being, “a better listener and more conscious of how I am as a listener,” and being more “consistent.” Another Team Member described “not being so picky” about small details that may be difficult for families to comply with due to family difficulties and separations uncovered during the dinner-home-visits. Similarly another Team Member discussed being,

A little more patient because I understand better that, no matter how they are in the classroom. Naturally you think, oh they’re acting this way because, you know, because the way their parents are. And uh, I’ve learned that’s not necessarily true because parents are very supportive. So I think I’m more patient.

Other reported changes in Team Member behaviors indicated they now have higher expectations for their students after attending dinner-home-visits and witnessing examples of parental support, “I’ve learned, you know, just by their parent’s actions, it’s okay to be harder on them.” The Team Member added, “Because the parents are no-nonsense.” Changes in expectations, as well as increased connectedness, were also present when a Team Member stated, “I’m more conscientious about the grouping that I put that student in. I know them better, and I’ve talked to their parents, and I know what their parents want.” Team Members also discussed changes in their behaviors which altered how they will handle a potential disruptive student in the future. One Team Member mentioned, “for example, if they’re acting out, I might, you know, instead of saying, “Oh,” you know, “they just come from a family who doesn’t care,” you know, I – I may question, “Okay, what’s going on at home? You know, why are you acting this way, you know, and – and do your parents know that you’re acting this way?”

Team Members also reported changes to their future communication behaviors with parents. One Team Member described himself as, “more apt to call the parents you know, better communication.”

Interviews revealed increases in School Connectedness paralleled the Reflections. Responses revealed Team Members or their students and parents were now exhibiting behaviors related to being connected due to their dinner-home-visit interaction. Team Members also reflected on reasons they were not previously connected to the student. “I really like to get to know the families because it does make things different. It makes it more personal. They see me different. I see them different.” Another Team Member shared, “I know who the parents are … I feel a little bit more relaxed because we’ve built a rapport, we’ve built that connect.” Similarly a Team Member said, “I know what their families are about.” Another Team Member shared, “you’re building that bond because you know for the most part they’re only hearing what the children are saying and sometimes, you know there are other children and neighbor’s children are also saying about that teacher but this is their experience.” A Team Member described feelings of increased Connectedness stating “I have a good connection with her (mom).” Lastly, a different Team Member stated, “It (100 Dinners Project) really does change the connection. I look at them, and I see their whole background.” Increases in Connectedness translated into increases in School Connectedness through statements as, “when
they come and tell me something, especially the kids I went to their dinners, I back them up.”

Interview responses differed from responses on the Teacher School Climate Survey and the Reflections due to changes in perception. Team Members now held regarding their students, their students’ families, and the resources and skills (Funds of Knowledge) identified. Individual Interviews focused on changes Team Members underwent, demonstrating successful completion of the CCTP. Experiencing the dinner-home-visit critical situation resulted in perceptions formation based on actual student attributes. Team Members were now primed to integrate Funds of Knowledge into their curriculum to continue to increase connectedness. One Team Member discussed future integration of Funds of Knowledge stating, “I would use more about their interest in sports and interest in games.”

In addressing the research questions, Team Members self-reported change in their perceptions of students, student families, student Funds of Knowledge, and change to their own behaviors. Changes were most often reported during the final step in the CCTP. Secondly, Team Member perceptions were reshaped to reflect actual student attributes. Student perceptions were now based on individual student needs and resources. Team Members reported increases in overall Connectedness which increased School Connectedness. Team Members reported behavioral changes (e.g., being more patient) and plans to change behaviors (e.g., increasing communication with parents) which increase School Connectedness. Finally, the CCTP was effective in reshaping teacher perceptions of students.

Dinner-home-visits served as a critical situation and a catalyst for perceptual change. Dinner-home-visits allowed for unstructured social interaction between teacher, student, and family to increase opportunities to learn more about the family through conversation, and allowed for food to represent families’ cultures. All participants noted the meal’s role in stimulating conversation and portraying important information about the family. Team Members described the dinner-home-visit experience as “rewarding,” “an eye opening experience,” and being “pleasantly surprised.”

**Conclusions and Recommendations**

**Overview**

Opportunities, such as the 100 Dinners Project, allowed for teachers to gain insights into students’ lives. Team Member participants directly attributed study participation to increased knowledge of actual student attributes and the reshaping of their perceptions toward their students. “I learned a lot about my student and his family, things I couldn’t have learned only through my class interactions with my student.” The 100 Dinners Project allowed for enough interaction to reshape teacher perceptions of their students via the CCTP.

Although, the 100 Dinners Project did not uncover the role Teacher Socialization played in the formation of student perceptions, Teacher Socialization may incorporate similar change catalysts to increase School Connectedness and to shape accurate perceptions of students. New teacher candidates, identified as being driven to belong to the group providing new information (Solomon, 1997), may be driven by these new perceptions. Just as teacher candidates may assimilate into accepting a School Climate driven by low levels of School Connectedness, they too can assimilate to a School Climate with high levels of School Connectedness.

Contrary to previous findings, support was not found for the influence of the Media (Solórzano & Yosso, 2001) as a source of information to form teachers’ perceptions of students. Team Members did not indicate newspapers, social media, or television news had influenced their perceptions.

**Recommendations**

Future research may include the CCTP in situations related to reshaping teachers’ perceptions of students, and in educational situations where change is required. The CCTP’s effectiveness of reshaping Team Members’ perceptions may also be effective in reshaping perceptions related to educational issues, such as new curriculum or administration. To address budget concerns of implementing a change project, not all staff may need to participate in order to create change at a
school site. Use of the CCTP may be successful if a group of change agents influence other staff members.

It is recommended Educational Leaders use student and parent surveys to measure perceptions of School Climate to identify inconsistencies between perceptions of these groups and teachers’ perceptions. The California School Climate Survey (CSCS) has two accompanying surveys, the California Healthy Kids Survey and the California Parent Survey, to measure student and parent perceptions of similar constructs. Knowledge of the perceptions of these three groups will provide a comprehensive assessment of School Climate and identify actual or perceived barriers to School Connectedness.

Educational Leaders should create an accountability protocol addressing School Climate to hold school sites accountable for maintaining adequate levels of School Connectedness. Accountability protocols may be aligned with a school district’s Strategic Plan. Under the Strategic Plan, an Action Committee may be created to monitor and report on School Connectedness. Protocols should be put in place to identify activities to increase School Connectedness. Activities to increase School Connectedness must be customized to each school site even among school districts with similar student and community demographics. Many factors must be included in the customization of School Connectedness activities. These factors include staff comfort level with community outreach activities, grade level, safety concerns, immediate need, and available resources.

Other forms of critical situations may be employed in addition to dinner-home-visits. Options include hosting a school site potluck dinner and invite multiple families to attend and visit with teachers. Other suggestions include incorporation of fundraisers, already occurring in schools, to endorse a certain restaurant and receive a percentage of sales on a designated night. Teachers may be present at these functions for social interaction with students and families. School sites may consider identifying parents willing to serve as School Ambassadors, willing to open their homes to host staff meetings and allow teachers, possibly uncomfortable with the individual dinner setting, to interact with students and families outside of the classroom. Finally, educators may increase interaction with students and families by collecting information regarding community, sporting, or other outside school activities students are a part of. Educators may coordinate visits to these events in order to capture student interests and have the potential to increase interaction with students and families outside of school.

In designing critical change situations, districts and schools should designate funds to cover activity costs. Many Team Members discussed the limited finances of families and wanting to contribute to the meal themselves. Additionally, legislation, such as the Nell Soto Parent Involvement Program (1999,) to assist schools with these types of activities should be funded.

Limitations

The greatest study limitation was teacher participant sample size. While six Team Members allowed for close contact with the researcher throughout the study, generalizability of results are limited. Another limitation may be a self-selection bias for teacher and family participants. Team Members received a stipend for participating and may have been interested in School Connectedness. It was possible parents willing participate had higher performing students. Though it was a concern that families of students with poor grades might not participate, this was not the case as students had a variety of academic achievement and student behaviors. Family volunteers may have been limited due to the financial burden preparing a meal for a teacher.

A final limitation involved the dinner-home-visits occurring close to the end of the school year. Team Members frequently mentioned wishing they had more time to implement changes to instructional practices they were motivated to enact due to their participation. “It is too bad we could not have done this sooner so we could try to prevent students from slipping through the cracks.” Findings may have indicated higher levels of change if Team Members had enough time to
implement their new knowledge into the curriculum.

Conclusion

The 100 Dinners Project contributed to increasing School Connectedness and aligned School Connectedness to the concept of it taking a village to raise a child. A comprehensive education requires a bond between school, parents, and community. Team Members discussed the bonds created with their students and student families. One Team Member indicated a continuing new bond, “When I walked out the house, the family left the door open. I think it was a gesture to show that I’m welcomed at their home anytime.” Another Team Member wrote, “The one thing that should be valued the most is a good education alongside with good people that support one another.”

The concept of a village requires those within the village to venture out to discover their surroundings and other inhabitants. This venturing was described as becoming “more human” to students. One Team Member summarized the dinner-home-visit experience as, “an opportunity to see the student in their home environment with their families and expectations.”

The time is now to make a change in our academic structure to reflect a village-concept in education which celebrates students’ whole life, beyond what is found in the classroom. One Team Member described the importance of individuals working together with the need to figure “out the balance” of communication and interaction between home-school. Parents, the community, and teachers are ready to come together. As one Team Member wrote, I learned from this visit that our parents want the schools to be more open, and he appreciates the fact that there are caring people who want to come and make these visits to connect with the community. This was another topic that came up that really meant a lot to him; the lack of community in our schools and neighborhoods. He reflected on his youth when you knew your neighbor and kids played together. He wishes things could be more like that again.

The 100 Dinners Project demonstrated it is possible to increase School Connectedness, which results in open and connected schools. Joining home-school resources to create the “village” can, as one Team Member stated, create “a map, like a road to success.” Along this road of success, one Team Member summarized the effect of this study best by explaining parents, students, and teachers now, “know each other as friends, as well as educational partners.”

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Senate Bill 33, Nell Soto Parent Teacher Involvement Grant (1999).

No Child Left Behind Act (2001)


research synthesis. Exceptional Children, 63, 59-74.
Fiducial-free Alignment Verification Techniques for Intracranial Radiosurgery

Kenneth Williams

Abstract
The current process of intracranial radiosurgery treatment uses implanted titanium fiducials in the skull to assist in alignment of the patient. These fiducials add an element of physical and emotional stress to the patient, and scheduling the implantation procedures adds a delay of a few extra days before the radiosurgery procedure can begin. During the radiosurgery treatment, each proton beam is manually aligned by the therapist/physician with X-ray images and the fiducials that are visible on these images. This method of alignment can be time-intensive and requires personnel who are specifically trained in patient alignment. We propose a new method using image registration to automate this process in an effort to eliminate the need for surgical implantation of fiducials prior to treatment as well as to improve the accuracy and efficiency of alignment during treatment. Image registration is a technique used to align a moving image with respect to its known fixed image. Several methods of image registration are used for comparison: an enhanced correlation coefficient maximization algorithm, a mutual information maximization algorithm, and an extended phase correlation algorithm. Accuracy, robustness, and performance are emphasized in the comparison of these algorithms. Due to patient privacy, test images from MATLAB will be shown in this paper. This research was conducted under the clinical supervision of Dr. Andrew Wroe and Dr. Reinhard Schulte of the Loma Linda University Medical Center (LLUMC).

Author Interview

Which professors (if any) have helped you in your research?
Dr. Keith Schubert (With Dr. Andrew Wroe and Dr. Reinhard Schulte of LLUMC as clinical supervisors)

What are your research interests?
Medical imaging and software engineering

What are your plans after earning your degree? What is your ultimate career goal?
I plan to work with Loma Linda under a grant before pursuing my PhD. I would like to become a professor to assist students pursuing research in computer science as applied to the medical field.

Acknowledgements
I would like to thank Tom Lee, a senior software engineer at Optivus Proton Therapy, for his assistance with the Dicom medical image format. I would like to thank Dr. Keith Schubert, my advisor, for his guidance and the technical expertise he has provided throughout my research efforts, and I would like to thank Dr. Reinhard Schulte and Dr. Andrew Wroe for their medical expertise with which I have combined my technical experience to explore new opportunities.

*The test image used in this research is copyrighted by the Massachusetts Institute of Technology and is used with permission.

Keywords: Skull Alignment, Radiosurgery, Image Registration, Enhanced Correlation Coefficient, Mutual Information, Iterative Closest Point, Phase Correlation
Introduction

The current process for alignment during radiosurgery utilizes titanium fiducials that are implanted into the patient's skull during a surgery scheduled prior to treatment. During treatment, each proton beam is manually aligned by the therapist or physician with digital X-ray images and the fiducials that are visible on these images. The focus point at which the beam's dose is the greatest, known as the Bragg peak, is a phenomenon exploited by proton radiation therapy for cancer to concentrate the effect of the proton beams on the tumor while minimizing damage to critical structures and other healthy issue within the patient undergoing treatment. This peak in the proton's dose distribution occurs because the interaction cross section increases as the energy decreases. To maximize the effectiveness of the Bragg peak, the patient must be aligned properly for accurate targeting of the tumor volume. This process can be time consuming, therefore in an effort to reduce unnecessary delays caused by the fiducials as well as increase efficiency of this process, Dr. Andrew Wroe and Dr. Reinhard Schulte of LLUMC have expressed the desire to research new methods of skull alignment for intracranial radiosurgery.

Background

Stereotactic radiosurgery is a treatment that uses focused beams of radiation, either with gamma rays, X-rays, or protons, to treat cancerous tissues without a surgical incision or opening. The form of radiosurgery for which this research is intended uses a proton beam to treat the patient. Proton beam therapy uses a particle beam for its treatment rather than rays of radiation. The beams are focused on an intended volume of cancerous tissue by utilizing what is known as the particles' Bragg peak. This peak occurs on the Bragg curve, named after its discoverer William Henry Bragg in 1903, which is a graph that plots the loss of energy of ionizing radiation during its traversal through matter. This peak occurs just before the particles come to rest. To effectively utilize the Bragg peak, both the patient and the beam must be accurately aligned so that no healthy tissue or critical structures within the patient are damaged. This research focuses on the alignment of the patient during the radiosurgery treatment.

Purpose

We propose a new method for skull alignment using image registration. This will eliminate the need for the implanted fiducials and further automate the alignment process during treatment which will provide benefits with respect to accuracy and efficiency over the current methods of alignment. Another aspect of reducing the delays caused by the surgery to implant the fiducials is the potential ability to eliminate any further growth of the cancerous tissue before the treatment occurs. The total duration of the current process is estimated to last up to one month, including surgery to implant the fiducials into the patient's skull, patient imaging, treatment planning, calibration, and the radiosurgery treatment itself. By automating this process using image registration methods and removing the need for the implanted fiducials, the length of time for this process can be reduced to approximately one week.

Image Registration

Image registration is the process of transforming a captured image in order to align it with its known reference image. While the various papers discussing the image registration methods used in this paper refer to these images by different names, these images will be referred to in this paper as the moving and fixed images, respectfully. Image registration is useful for automating skull alignment for radiosurgery to significantly reduce delays throughout the treatment process and greatly increase its efficiency. Many applications for image registration exist, therefore the first step of registration is to determine the type of transformation that models the mapping of the fixed and moving images. As the skull does not have a tendency to become warped in the given time frame of the procedure for radiosurgery nor
does this time frame allow for the skull to grow by any significant amount, the algorithms used in this procedure only need to take into account rigid transformations, which include the rotation and translation of the images. As the fixed and moving images are captured using different devices, the algorithms must take into account a multimodal image capture modality, as well as the noise and difference in illumination between the two images. Methods of image registration compared in this thesis include a forward additive enhanced correlation coefficient maximization algorithm (Evangelidis & Psarakis, 2008), a mutual information maximization algorithm (Mattes, Haynor, Vesselle, Lewellen, & Eubank, 2001), and a log-polar fast Fourier transform-based phase correlation method (Reddy & Chatterji, 1996). Given the sensitivity of the application regarding its use in the treatment of a patient, the image registration method(s) must fulfill basic requirements in accuracy, robustness, and performance.

**Enhanced Coefficient Correlation Maximization**

The enhanced correlation coefficient method maximizes the linear dependence between the fixed and moving images in order to achieve the optimal alignment. This algorithm uses an iterative forwards additive approach to determine the alignment, sacrificing low computational complexity, in comparison to alternative versions of this method, for more accurate results (Evangelidis & Psarakis, 2008). The difference from other methods using this metric, such as an inverse compositional method, is that the forward additive approach uses an approximated parameter vector that is optimized each iteration until its norm becomes smaller than a predefined threshold.

The enhanced correlation coefficient maximization algorithm begins with initializing a warping transformation matrix using a given initial estimate. Next, the algorithm defines a region of interest, which in our case just ignores a margin of the image of five percent of the mean of the height and width of the image. Using the initial transformation estimate, the moving image is warped and the zero-mean vectors are compared using a pre-defined threshold. This process repeats until the allotted amount of iterations and pyramid levels have been exhausted or the alignment has been determined optimal.

This algorithm is beneficial for this application as it is known for its robustness regarding noisy conditions and photometric distortions in contrast and brightness as well as a statistical robustness against outliers. However, this method has disadvantages that must be considered, including its computational complexity and the fact that it does not imply causality. Uncorrelated variables may not necessarily be independent, which means two uncorrelated images may still be related by a particular transformation that this method was unable to determine.

This algorithm was chosen for this research as it has already been shown to be superior to similar algorithms such as the Lucas-Kanade and Simultaneous Inverse Compositional registration methods (Evangelidis & Psarakis, 2008). While two versions of this method were introduced, for simplicity only the forward additive version is used.

**Mutual Information Maximization**

Mutual information is a statistically-based metric derived from probabilistic measures of image intensity values (Mattes, et al., 2001). This algorithm uses the joint probability distribution of a set of pixels from the fixed and moving images to iteratively measure the certainty that the set of pixels from one image map to a set of pixels to the other image. The probability distributions are based on marginal and joint histograms of the fixed and moving images. Higher mutual information implies lower uncertainty, thus also implying the images are more likely aligned than previous iterations. This algorithm uses a specified number of samples used to compute the probability density estimates and the number of bins used to compute the uncertainty. The joint probability density function is then evaluated at each bin using the samples, while entropy is computed by summing over the bins. Zero-order
and third-order B-spline kernels are used to compute the probability density functions of both images.

Mutual information maximization is a direct measure of the probabilistic relationship of two random variables, which implies that if two images do not share mutual information, then they are not related by a particular transformation. This allows the algorithm to determine that two images cannot be aligned. Like the enhanced correlation coefficient maximization algorithm, mutual information maximization is also computationally intensive. Another drawback to this method is that an increase in noise results in a decrease in mutual information, thus finding an optimal alignment is more difficult.

**Log-Polar Fast Fourier Transform / Phase Correlation**

The frequency domain approach used in this research extends the phase correlation technique to find simple transformations such as rotation, translation, and scale by converting the fixed and moving images to log-polar coordinates (Reddy & Chatterji, 1996). This algorithm differs from intensity-based or feature-based algorithms as it uses properties of the Fourier transform to find the optimal alignment. Benefits of this algorithm include robustness against noise, low computational cost, and rotation and scale can be found invariant to translation. Note, however, that scaling is ignored in this research as a patient’s skull will not expand within the time frame for the radiosurgery treatments.

First, the fast Fourier transform of the fixed and moving images are taken and then converted into log-polar coordinates. Another fast Fourier transform is calculated before computing the phase correlation between the two images. The peak of this phase correlation provides the angle of rotation of the moving image from its fixed image. Similarly, this process is repeated outside of log-polar space to obtain the translation in the x and y directions. The peak in this case is the location in the phase correlation matrix of the maximum value. The order in which the angle of rotation and the translation values are calculated is not pertinent and can be reversed from this process. The ability to change the order in which these transformations are calculated lends itself to parallelization of the algorithm which can further increase its efficiency.

Unlike the previously discussed algorithms, fast Fourier transforms are computationally efficient. This algorithm is also highly resilient to noise and allows rotation to be found invariant to translation, which allows for both transformations to be determined in parallel. A disadvantage to this method is that performance is reduced if the shift is linear, as opposed to circular. A circular shift, in the context of image manipulation, essentially wraps the portion of an image that would be shifted out of the original boundaries of the image to its opposing region of the image. For example, given a downward shift of ten pixels, the bottom ten pixels of the shifted image would be moved to the top of the image.

**Data**

The first iteration of this research was conducted using test images from MATLAB. Due patient privacy regulations, we opted to show the test images for this paper instead of Dicom images of a patient's skull. The original test image acts as the fixed image, while the moving image is derived from the fixed. To obtain the moving image, the fixed image is rotated six degrees in the counter-clockwise direction and a translated ten pixels to the right and ten pixels downward. See Illustration 1 for the input images used to compare each algorithm.
Results

The results of the three algorithms – enhanced correlation coefficient (ECC) maximization, mutual information maximization, and log-polar fast Fourier transform (FFT) based phase correlation – are as shown in Table 1. Each algorithm is implemented using MATLAB and its run time is calculated using MATLAB's built-in stopwatch timer. The angles of rotation are in degrees, the translations in X and Y are in pixels, and the values of time are in seconds. The fixed and aligned moving images are also shown in an overlay fashion to visually demonstrate the accuracy of each algorithm.

<table>
<thead>
<tr>
<th></th>
<th>ECC</th>
<th>Mutual Information</th>
<th>FFT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angle of Rotation</td>
<td>6.000218</td>
<td>6.221918</td>
<td>5.625</td>
</tr>
<tr>
<td>X Translation</td>
<td>10.00038</td>
<td>8.849472</td>
<td>10</td>
</tr>
<tr>
<td>Y Translation</td>
<td>9.999519</td>
<td>10.78977</td>
<td>10</td>
</tr>
<tr>
<td>Execution Time</td>
<td>2.5464</td>
<td>2.4900</td>
<td>0.2219</td>
</tr>
</tbody>
</table>

Table 1: Registration Results
Illustration 2: ECC Registration

Illustration 3: Mutual Information Registration
The included illustrations show the alignment of the moving image onto its fixed image for each algorithm. The green and purple overlays indicated the difference between the moving and the fixed images, respectfully. The enhanced correlation coefficient maximization image result is noteworthy as the green overlay is much larger than that of the other two illustrations. This is due to the algorithm's nature of sub-region mapping as opposed to the algorithm aligning the entire image at once.

To calculate the error, each calculated rotation and translation value from the Table 1 is compared to the known respective values for rotation and translation in the x and y directions from which the moving image was produced. The errors in percentages are shown in Table 2.

<table>
<thead>
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<th></th>
<th>ECC</th>
<th>Mutual Information</th>
<th>FFT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angle of Rotation</td>
<td>0.003633%</td>
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<td>6.25%</td>
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<tr>
<td>X Translation</td>
<td>0.003799%</td>
<td>11.50527%</td>
<td>0%</td>
</tr>
<tr>
<td>Y Translation</td>
<td>0.004810%</td>
<td>7.897700%</td>
<td>0%</td>
</tr>
</tbody>
</table>

**Table 2: Registration Error**

**Conclusions**

The gradient-based forward additive enhanced correlation coefficient algorithm provides the most accurate angle of rotation, while the frequency-based Fourier transform provides the most accurate translations in the x and y directions. The fastest overall algorithm is the Fourier transform algorithm. The mutual information algorithm did not provide any
significant benefits in accuracy or performance over either the enhanced coefficient correlation maximization algorithm nor the fast Fourier transform phase correlation algorithm. Refer back to Illustration 2 for image results of the enhanced correlation coefficient maximization algorithm, Illustration 3 for image results of the mutual information maximization algorithm, and Illustration 4 for image results of the fast Fourier transform-based phase correlation algorithm.

Given our results, the mutual information maximization algorithm can be ruled out as insufficient for our purposes due to its low accuracy in comparison to the other two algorithms, while the results of the Fourier transform and the forward additive enhanced correlation coefficient algorithms are much closer with respect to accuracy. They both provide fairly accurate results, and considering the current methods of skull alignment take time on the order of minutes, the longer execution time of the enhanced correlation coefficient algorithm is negligible. Due to the similar accuracy of the Fourier transform and ECC algorithms, these algorithms will be considered for parallel calculations during treatment and determined on an individual treatment basis.

**Future Work**

Another algorithm to be considered for future work for this research is a feature-based algorithm using an iterative closest point technique. This method is an iterative process that works in two steps. Each iteration first matches points based on the latest transformation estimate and then refines the estimate based on the matches. Normally, this algorithm requires a good initial estimate for the overall image, however, the dual-bootstrap method (Stewart, Tsai, & Roysam, 2003) requires the initial estimate to be accurate only over a sub-region of the image. During each iteration of this algorithm, the region over which the model is accurate, the bootstrap region, and the chosen transformation model are expanded until the bootstrap region fits the entire image.

While computationally efficient, this algorithm is prone to accumulative errors as each iteration heavily relies on the calculated transformation of the previous iteration. This drawback explains the requirements of an accurate initial estimate. Beyond this disadvantage, any further disadvantages are yet to be seen regarding how it compares to the previously tested algorithms.

Upon finalization of this research, including fine-tuning of the image registration algorithms, pre-conditioning of the fixed and moving images in order to approach ideal conditions under which the algorithms operate optimally, and exhaustive testing to include various conditions of noise and geometric and photometric distortion to verify which algorithms provide optimal accuracy, efficiency, and robustness, this research will be used to treat patients undergoing radiosurgery. If a particular algorithm outperforms all of the tested algorithms in all conditions, it will be solely implemented into the Odyssey treatment planning software developed by Optivus Proton Therapy, Inc which is currently used by LLUMC. If multiple algorithms prove optimal for certain conditions, they will be implemented in a parallel, tournament-style approach in order to determine the most accurate alignment.

**References**


The Effects of Serum Starvation on Cell Cycle Synchronization

Negin Baghdadchi

Abstract
Human pluripotent stem cells (hPSC) provide a valuable model for studying organogenesis and recapitulating human diseases. Notably, genetic modification techniques can be harnessed to realize potential of these cells. hPSC display the features of indefinite self-renewal and the potential to differentiate into three germ layers, which holds great promise for regenerative medicine and human disease research. Genetic manipulation continues to be a powerful tool to study the properties of hPSC. Despite current advances in optimization of transfection procedures, genetic manipulation of hPSC remains a capricious process. On the other hand, controlled differentiation also yielded a variable and unpredictable efficiency in different hPSC lines. Recent studies have shown that serum starvation-induced cell cycle synchronization significantly improved reprogramming efficiency in human fibroblast and increased transient gene delivery into mouse embryonic stem cells. Nevertheless, hPSC lines are routinely cultured in KnockOut Serum Replacement (KO-SR), a serum-free formulation that directly replaces serum in culture. In this regard, we hypothesized that reduction of KO-SR exerts a profound effect in transfection and differentiation efficiency of hPSC. Our procedure mirrors effect of serum starvation by synchronizing hPSC cultures in G1 phase. We showed that transient transfection efficiency could be increased by culturing hPSC in 5% KO-SR for 2 days. Furthermore, our procedure resulted in six-fold increment in the derivation of stably eGFP-expressing transfectants. Interestingly, KO-SR synchronized hPSC also differentiated in a more homogenous manner, as evidenced by a significantly stronger induction of lineage-specific progenitors and an absence of OCT4-expressing residual undifferentiated cells. These results demonstrate that cell cycle synchronization is a key milepost on the path to reducing heterogeneity of hPSC and should be useful in exploring the use of these cells in a predictable manner.

Author Interview

Which professors (if any) have helped you in your research?
Dr. Chee Gee Liew and Dr. Nicole Bournias.

What are your research interests?
My research interests are stem and cancer cell studies.

What are your plans after earning your degree? What is your ultimate career goal?
After earning my degree I plan on pursuing a PhD and become a researcher.

Acknowledgements
I like to thank Dr. Nicole Bournias for all the support and opportunities, and all of the laboratory staff of UCR Stem Cell Core for providing a friendly working environment.

Keywords: Human Pluripotent Stem Cells, Induced Pluripotent Stem Cells, Transfection, Differentiation, Serum Starvation.
Introduction

Human embryonic stem (ES) cells are derived from inner cell mass of blastocyst and are capable of unlimited expansion and differentiation \textit{in vitro} \cite{10}. The ability of these cells to differentiate and generate cell types corresponding to all three embryonic germ layers makes them as an important target in all different research arenas. Furthermore, these cells are capable of retaining a normal karyotype for prolonged periods in culture \cite{7}. Ectopic expression of reprogramming factors can result in the derivation of induced pluripotent stem cell (iPSCs) from somatic cells. The first establishment of murine iPSCs was reported by Takahashi and Yamanaka (2006) in 2006 \cite{5}. This was done by transducing mouse embryonic fibroblast with retroviruses encoding cMyc, Oct3/4, Sox2 and klf4. Subsequently, the first hiPSC lines were derived in 2007 (Yu et al. 2007; Takahashi et al., 2007) \cite{10, 12}. Similar to ES cells, iPSC lines can be maintained in their undifferentiated state and yet be differentiated into various cell types, providing a resource of considerable promise for the future of disease modeling and drug discovery. To date, however, reprograming of human adult cells is still challenging and inefficient. To realize the potential of hESCs, efficient methods are required to manipulate their genomes. Progress in certain conditions resulted in poor transfection and low single-cell cloning efficiencies. Although recent studies have suggested robust methods of transfection of hESCs, routine production of stable transfectants are still indefinable \cite{9}. This applies for both transient assays as well as the generation of stable lines.

In order to increase the differentiation and nucleofection efficiency of the ESC, it is important to understand their cell cycle pattern. It is revealed that cell cycle is a key parameter driving epigenetic reprogramming to pluripotency \cite{7}. Recent studies have shown that serum starvation and chemical inhibitors have caused cell cycle synchronization of the somatic cells. A summary of these studies is shown in figure 1 \cite{5}. However, unlike the somatic cell cycle, ESCs have a very short G0 phase as the cells proliferate more rapidly throughout their lifetime. A comparison between the cell cycle of somatic cells and stem cells is shown in figure 2.

![Figure 1: Representative Histograms of DNA](image)

Figure 1. Representative histograms of DNA content using flow cytometry of canine dermal fibroblasts cultured under various conditions: cycling, serum starvation (24 h). M1: G0/G1 (2C DNA content), M2: S (between 2C and 4C), M3: G2/M (4C), and M4: apoptosis (2C) \cite{5}.
Figure 2: Cell Cycle in Somatic Cells vs. ESCs

Figure 2. Cell cycle in somatic cells vs. ESCs. (a) Cell cycle regulation in somatic cells: (b) Cell cycle regulation in ESCs as is currently understood [9].

The normal cell cycle distribution of the ESC can be demonstrated using flow cytometry analysis, shown in figure 3. As it is presented majority of the ES cells (50%) are in the S phase, leaving 30% for G1 and 19% for the G2 phase.

Figure 3: Flow Cytometry Analysis of Cell Cycle of hESCs (H9) [7]

It is well known that the cell cycle plays an essential role in the differentiation and nucleofection efficiency. The cell cycle stages of cultured cells can be synchronized by serum starvation, contact inhibition, and chemical treatments. Serum starvation is widely used for synchronizing donor cells by arresting them in the G0/G1 phase of the cell cycle, but it often reduces cell survival and increases the DNA fragmentation. In this study, using iPSCs and ESC, we have shown that starving the cells with 5% KOSR for the duration of two days can significantly increase the differentiation and nucleofection efficiency.
Methods and Materials

H9 human ESC and Riv9 human iPSC were cultured at 37°C in a humidified atmosphere containing 5% CO₂. Medium was changed daily for hESC cultures and every 3-4 days during differentiation, depending on the differentiation protocol. For the study purpose, the ESC and iPSC were starved with different concentrations of Knock out Serum Replacement (KOSR): 20% (control), 5% and 0.5%. The starvation period was set into 1 day, 2 days and 3 days.

Immunocytochemistry analysis: Cells were washed twice with PBS and fixed in 4% paraformaldehyde in PBS and blocked with PBS with 0.1% Triton-X and 1% blocking serum for 30 min. Following blocking, cells were incubated with primary antibodies in blocking solution overnight: anti-BLIMP1 (1:100), anti-OCT 4 (Santa Cruz; 1:50) and anti-FOXA2 (cell signaling technology 1:100). Cells were then washed in blocking solution and incubated with Alexa488 or Alexa 598 secondary antibodies (Molecular Probes; 1:500) for one hour at room temperature, followed by two washes with blocking solution and third wash with PBS. Cells were mounted with DAPI mounting reagent (Vectashield). Images were captured using Nikon Eclipse Ti microscope.

Differentiation of HESC and iPSCs: For the germ cell differentiation, cells were cultured in human embryonic stem cell (HES) media with bone morphogenetic protein-4 for 5 days.

Cell cycle analysis: Cells were harvested using 0.25% trypsin/EDTA and resuspended in DMEM at a concentration of 1X10⁶ cells per tube. After centrifugation at 700 X g for 10 min, the supernatant solution was removed and, while vortexing gently, cell were fixed by drop-wise addition of 0.8 ml cold methanol to the tube containing 0.2 ml of cell suspension. After fixation, fixed cells were again centrifuged and washed with cold PBS. Then, 0.25 mL of propidium iodide solution (PBS) containing 50 µg/ml propidium iodide and 0.1% Triton X-100 was added. After incubating at 37°C for 30 min, cells were ready for flow cytometry.

Nucleofection: Cells were pretreated with Rock inhibitor for one hour, after which single cells were obtained by trypsinization. To nucleofect the cells, the Green Fluorescent Protein (GFP) plasmid was added to the cells and using program B16 in Lonza nucleofector, the plasmid was transferred into the nucleus. The cells were let recovered in the incubator for 10 minutes and cultured in mTeSR media.

Flow cytometry: Cells were harvested using 0.25% trypsin/EDTA and resuspended in DMEM at a concentration of 1X10⁶ cells per tube and subjected for flow cytometry analysis on a Beckman Coulter Sc Quanta flow cytometer.

Results

We demonstrate that serum starvation in hPSC resulted in the cell cycle arrest in the G0 phase and hPSC that have been starved for 2 days with 5% KOSR yielded a significant increase in transfection and nucleofection efficiency.

Establishment and culture of H9 and Riv9 cells: H9 and Riv9 cells both cultured on Geltrex-coated plates with mTeSR medium supplemented with conditioned media (CM) in the ratio of 4:1. The CM was collected from the irradiated mouse embryonic fibroblast (MEF) cells and contained necessary growth factors for feeder-free hPSC growth. The cells were passaged upon reaching 70%-80% confluency, every 4-5 days. Each experiment has been repeated at least 3 times and consistent results were observed.

PI staining analysis: We examined the effect of serum starvation on cell cycle distribution of hPSC. As shown in figure 4, there is a clear shift of the cell cycle toward G1 phase in cells starved with 5% KOSR for 2 days compared to the control unstarved cells.
Figure 4, shows a significant increase in a G1 cell population was obtained following a 2-day starvation. Nucleofection of the Stem Cells: The H9 and Riv 9 cells were starved with 5% and 0.5% KOSR for the duration of 1, 2, and 3 days. The control cells were cultured with 20% KOSR. After nucleofection, the cells were cultured in mTeSR and the analyzed 24 hours following the nucleofection. Prior to flow cytometry analysis, microscopy images of the cells were taken (figure 5). All KOSR-starved cells yielded higher nucleofection efficiency compared to the non-starved control.

Figure 5, shows transient transfection efficiency in hPSC following 1, 2 and 3-day starvation with 5% and 0.5% KOSR is compared with control cells cultured in 20% KOSR. Nucleofection efficiency was higher in starved cells, A) GFP expression in Riv9 cells, B) GFP
expression in H9 cells. Flow cytometric analyses were then done on the nucleofected cells. In this regard the expression of GFP was measured and the data was analyzed using Flowjo software. Figure 6 shows the results of 6 treatments representing the highest expression of GFP. As it is seen, the red line is the negative control in which there was no nucleofection therefore there was no GFP expression. Figure 6a displays the Riv9 cells. In this group the blue line is representative of GFP expression in control cells, which were nucleofected without starvation. In same group, the dark green line represents the GFP expression in Riv9 cells that were nucleofected after 2 days being starved with 5% KOSR. As is seen, these cells show the highest expression of GFP in the group.

![Figure 6a](image1.png)

**Figure 6a:** Flow cytometric analyses of Riv9 and H9 cells

![Figure 6b](image2.png)

**Figure 6b:** Flow cytometric analysis on H9 cells

The Figure 6, shows the flow cytometric analyses of Riv9 and H9 cells. In this figure the highest 4 results are picked and compared to the positive and negative control. This means that all other groups had lower GFP expression compared to this group. a) shows the Riv9 cells and b) the H9 cells. 2D: 2 Days starvation, 5% and 0.5%: starvation with 5% and 0.5% KOSR respectively.

Figure 6b shows the flow cytometric analysis on H9 cells. In this group, also, the blue line in representative of control cells that were nucleofected without being starved. It is clear that in H9 cells, the control population had lower nucleofection efficiency compared to other groups. However, there were variations in the results of the cells starved with 0.5% KOSR for 2 days. The average of GFP expression in H9 cells starved with 5% KOSR for 2 days was the highest among all other groups in H9 cells.

**Differentiation efficiency of Riv9 and H9 cells:** We next evaluated the effect of serum starvation on germ cell (GC) differentiation. hPSC were starved prior to treatment with BMP4. Experiments were done in triplicate. Differentiated cells were analyzed by immunocytochemistry analysis with anti-OCT and anti-BLIMP1 antibodies. OCT4 is a marker for undifferentiated hPSC and BLIMP1 is the GC marker. The number of cells expressing each marker was counted manually and the result is presented in figure 7. There was still a high percentage of cells expressing OCT4 in unstarved and 1-day starved cells, indicates the presence of residual undifferentiated stem cells. In addition, only a small percentage of cells expressed BLIMP1. Nonetheless, 2-day starvation resulted in a significant increase of BLIMP but a complete loss of OCT4 expression. Furthermore, serum starvation also resulted in a more consistent differentiation outcome, as indicated by the smaller error bars in 2- and 3-day starved cells.
Figure 7, shows the expression of germ cell markers in Riv9 (a) and H9 cells (b) after being differentiated into these cells. The chart is representative of triplicated analyses.

**Discussion**

Here, in this study, we demonstrate that serum starvation synchronized hESC and iPSC in G0/G1 stage of the cell cycle. The synchronizing effect of serum starvation on the cell cycle was achieved by starving the cells for 2 days with 5% KOSR. Extended serum starvation periods (more than 48 hours) did not significantly increase the proportion of G0/G1 cells. The synchronized cells showed significantly higher nucleofection and differentiation efficiency compared to the non-starved cells.

**References**


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Microsatellite Analysis of Population Structure in the Santa Ana Speckled Dace (Rhinichthys osculus): Conservation and Evolution

Stacey Nerkowski

Abstract
Geographic isolation and habitat fragmentation can cause a population to undergo independent evolutionary trajectories. Stream dwelling vertebrates such as the minnows belonging to the Cyprinidae family, one of the most genetically variable and geographically distributed groups, are excellent models for examining the genetic effects of population isolation and substructure. *Rhinichthys osculus*, a freshwater minnow, is a local species of concern that inhabits the Santa Ana and San Gabriel watershed systems within the Southern California region. 23 polymorphic microsatellite loci were characterized and identified for *Rhinichthys osculus* in conjunction with the Savannah River Ecology Lab. These microsatellite loci have been visualized in local lab settings. Currently over 150 samples of *Rhinichthys osculus* are being genotyped for each of the microsatellite loci to examine various population genetic parameters. The statistical analyses of the data will assist in potential conservation management.

Author Interview

Which professors (if any) have helped you in your research?
Dr. Tony Metcalf.

What are your research interests?
My research interests are population genetics, molecular ecology, and evolution.

What are your plans after earning your degree? What is your ultimate career goal?
After earning my degree I plan on pursuing a PhD in Ecology & evolution. I ultimately want to teach as a university professor while consulting for government agencies such as Fish & Wildlife and the U.S. Forest Service.

Acknowledgements
I wish to thank the USDA Forest Service San Bernardino, the California Department of Fish and Wildlife, the Associated Student Body, Inc., California State University, San Bernardino, the Biology Department of California State University, San Bernardino and the Water Resources Institute, California State University, San Bernardino for logistical support and funding. I would also like to thank my fellow lab members of the Metcalf lab; Liane Greaver, Jay and Pia Van Meter, and Joe Riley for assistance in the DNA extractions and PCR preparations for the microsatellite identification and characterization. I would also like to acknowledge the contributions of experience and funding support provided by my advisor, Dr. Tony Metcalf.

KEYWORDS: *Rhinichthys osculus*, Illumina, Microsatellite, PCR Primers, SSR, STR, Conservation
Introduction

Stream dwelling vertebrates, in particular fish, and provide an excellent model for examining population substructure and genetic differentiation. Gene flow between tributaries and watersheds normally only occurs during times of flooding allowing for these populations to be geographically isolated from one another for extended periods. Each population may be independently influenced by various evolutionary forces due to their isolation causing for independent evolutionary lineages of particular genes to form. These genes become a part of the population’s gene pool through mutations that randomly occur but then become unique to the population due to the extended period of isolation and habitat fragmentation.

Rhinichthys osculus, the speckled dace (Figure 1), is considered to be one of the most ubiquitous freshwater fish in the Western United States and occupies a variety of environments (Hubbs, Miller, & Hubbs, 1974). In the Western United States, the speckled dace is the only native fish to be represented in all 7 drainage systems (Miller, 1958). Locally, the speckled dace is found in such creeks as Lytle Creek, Cajon Creek, City Creek and Mill Creek. Rhinichthys osculus belongs to the Cyprinidae family, one of the most diverse families of freshwater fish. The species belonging to the Cyprinidae family inhabit a variety of environments including lakes, ponds, creeks, tributaries and even isolated springs across North America. Each of these environments contains different characteristics and histories. The Cyprinid family’s ability to adapt to habitat changes in evidenced by their continued success in these ever changing environments, which may be in part, due to the increased genetic variability within the family (Moyle & Marchetti, 2006). Due to the highly variable characteristics of these habitats, the species of the Cyprinidae family have proven to be relevant models to address environmental and ecological changes from an evolutionary perspective (Scott & Crossman, 1973; Simons, Berendzen, & Mayden, 2003).

Rhinichthys osculus, the Santa Ana Speckled Dace (Figure 1), is a small, cyprinid fish approximately 80mm in length and inhabits environments containing shallow cobble, gravel riffles and mixed sand habitats with overhanging riparian flora which provide a defensive measure to the fish from predators (Moyle & Marchetti, 2006); although they can inhabit environments that are fairly exposed, as well. The Santa Ana Speckled Dace once occupied the majority of the Santa Ana, San Gabriel and Los Angeles River systems but due to anthropogenic effects, their habitat has become highly fragmented. They were reported extirpated from the Los Angeles River system in the early 1990’s which was most likely attributed to the urbanization of the watershed and creation of water divisions ((SAWPA), 2004). The populations of the Santa Ana Speckled Dace are highly effected by climatic events such as fire and floods. In 1995, the Santa Ana Speckled Dace was listed as a species of special concern by the California Department of Fish and Wildlife. Then in 1998 it was listed as a species of concern by the United States Forest Service. The Santa Ana Speckled Dace was not listed as a federally protected endangered species due to the lack of formal peer reviewed taxonomic description including a genetic description of the taxon and population level diversity (Moyle & Marchetti, 2006).

An excellent source of population genetic analyses is the highly polymorphic markers, microsatellites. Currently, no such markers have been identified for the speckled dace. The objective of this project is to characterize microsatellite loci for...
Rhinichthys osculus and then perform molecular analysis on the data acquired from a variety of populations across Southern California to examine gene flow and historic patterns of interbreeding among creeks. Research is currently being performed in the Molecular Ecology and Evolution lab of Dr. Tony Metcalf on the cyt b and d-loop regions of mitochondrial DNA (mtDNA); mtDNA is only inherited from the maternal lineage of an organism. Microsatellites, because they are located on nuclear DNA, represent both the maternal and paternal lineages of the specimen. With this data, we hope to gain a better understanding of the evolutionary histories and developments that have occurred among the local populations of Rhinichthys osculus.

**Materials & Methods**

In order to evaluate the genetic variation that exists between the various tributaries of the Santa Ana River Watershed, Rhinichthys osculus samples were collected, in collaboration with the United States Forest Service and California Department of Fish and Wildlife, from various sampling sites representing each of the local watershed tributaries, as well as neighboring watershed habitats for comparison (Figure 2).

In addition, newly acquired samples will be collected using proper electroshocking technique under accordance with permits issued to the Metcalf Lab by the United States Forest Service. For each specimen that has been collected by the Metcalf Lab, GPS coordinates were taken from the sampling location on the designated tributary. A minimum of seven R. osculus samples were acquired from each tributary making sure that specimens were acquired from various locations in the tributary in order to evaluate genetic variation within the populations inhabiting the tributary. Each R. osculus sample underwent genomic DNA extraction using phenol-chloroform extraction methods utilizing phase lock gels (PLG) as set forth in Eppendorf’s Phase Lock Gel Manual (Mouse Tail Genomic DNA Isolation Protocol). Genomic DNA extractions were then visualized using agarose gel electrophoresis. DNA concentrations were analyzed for all tissue extractions using spectrophotometry (A260/A280 and A234/A260). Thirty-three Rhinichthys osculus samples were used to characterize and identify microsatellite loci in conjunction with the Savannah River Ecology

![Figure 2: Rhinichthys osculus California Range Map. Areas bordered in dark are known to contain Rhinichthys osculus within river drainages of that region. Proposed watershed sampling locations are denoted in red numbered circles. 1=Colorado River; 2=Santa Ana River; 3=San Gabriel River; 4=Santa Maria River; 5=San Luis Obispo River; 6=Owens River.](image)
Utilizing pair-end Illumina shotgun sequencing, microsatellite loci were identified for *R. osculus*. Using specific conditions and parameters in PAL_FINDER_v0.02.03 (Castoe, et al., 2012), 48 microsatellite loci were identified and primers were designed. Forty-eight primer pairs were then tested for amplification and presence of polymorphisms using DNA obtained from eight individuals. PCR amplifications were performed in a 12.5 µL volume (10mM Tris pH 8.4, 50mM KCl, 25.0 µg/ml BSA, 0.4 µM unlabeled primer, 0.04µM tag labeled primer, 0.36µM universal dye-labeled primer, 3.0mM MgCl2, 0.8mM dNTPs, 0.5 units AmpliTaq Gold® Polymerase (Applied Biosystems), and 20ng DNA template) using an Applied Biosystems GeneAmp 9700. Loci were amplified using a touchdown thermal cycling program (Don, Cox, Wainwright, Baker, & Mattick, 1991)covering a 10°C span of annealing temperatures ranging between 65-55°C (TD65).

Touchdown cycling parameters consisted of an initial denaturation step of 5 min at 95°C followed by 20 cycles of 95°C for 30 s, 65°C (decreased 0.5°C per cycle) for 30 s, and 72°C for 30s; and 20 cycles of 95°C for 30 s, 55°C for 30 s, and 72°C for 30 s. Loci that did not amplify with a touchdown PCR protocol were screened with the same PCR protocol but using a single annealing temperature of 65°C for all 40 cycles. PCR products were run on an ABI-3130xl sequencer and sized with Naurox size standard prepared as described in DeWoody et al. (2004). Results were analyzed using GeneMapper version 3.7 (Applied Biosystems). Twenty-three of the tested primer pairs amplified high quality PCR product that exhibited polymorphism (Taken from Nunziata, Lance, Jones, Nerkowski, & Metcalf, 2003).

All twenty-three polymorphic microsatellite loci have undergone amplification utilizing the Metcalf lab equipment, through the use of PCR and the corresponding unlabeled primer pairs. PCR conditions initially followed the protocols used in Girard and Angers (2006). Each 12.5µL PCR reaction consisted of 1.5mM of MgCl2, 2.5mM of each dNTP, 0.2U of Taq polymerase, 1.25µL of 10x Taq polymerase buffer, 10pmol of each primer and 10ng of genomic DNA. The PCR program, utilizing BioRad C1000 Thermal Cycler, consisted of an initial denaturing temperature of 92°C for 30s, then 45 cycles of the following profile: 92°C for denaturation, 15 seconds at annealing temperature 65°C, and 5 seconds at 68°C. The final phase of the cycle is a 2 minute extension at 68°C. PCR amplicons were then visualized utilizing a 2% METAPHOR® gel. PCR analysis and examination of the amplified products are being further evaluated and analyzed on a 6.5% polyacrylamide gel using the LICOR model 4300 automated DNA analyzer.

PCR protocols, annealing temperatures and reagent concentrations are currently being adjusted to provide maximal optimization of the microsatellite loci. A microsatellite locus is considered optimal in agarose gel electrophoresis by a strong single or double band without the presence of stutter bands or other products. Each sample, with an amplified microsatellite locus, will be scored to determine base pair length and polymorphism using SAGA (LI-COR, INC.). Currently, each locus is being analyzed to determine its usefulness in analyzing genetic variation among and within populations of *R. osculus*. Various statistical programs will be utilized to examine multiple population genetic parameters.

**Results**

Thirty-three *Rhinichthys osculus* samples were used to characterize and identify the 23 polymorphic microsatellite loci at the Savannah River Ecology Lab. Table 1 represents all 23 polymorphic microsatellite loci identified. When analyzing the repeats at each locus, they identified eight microsatellite loci with significant deviations from the Hardy-Weinberg expectations (linkage disequilibrium); Rhos 1, Rhos 8, Rhos 9, Rhos 21, Rhos 22, Rhos 25, Rhos 31 and Rhos 35 (Nunziata, Lance, Jones, Nerkowski, & Metcalf, 2003). In addition, 7-25 alleles were observed at each of the various loci.

Twenty-one of the twenty-three microsatellite loci successfully amplified under the protocols set forth by Girard and Angers (2006). Figure 3 illustrates a 2% metaphor gel for locus, Rhos 10.
As seen in Figure 3, homozygotes and heterozygotes are observed, as well as various repeat numbers, which suggests genetic variation within the population for this particular locus. Each of the other microsatellite loci exhibited similar 2% metaphor gel images suggesting that the microsatellite loci that were identified were indeed polymorphic and useful in our genetic studies.

**Discussion**

This purpose of this study is to examine the biogeography of populations through the analysis of microsatellite loci that are less variable and more conserved, and comparing them to the Owens River, Central Coast and Colorado River populations of *Rhinichthys osculus*. The Southern California region has gone through extensive geological and climatal changes throughout its history altering the landscape and topography of the region including pluvial and arid time intervals (Colburn, 2006). Each of these events could alter the evolutionary history of an organism and determine the levels of dispersal as well as gene flow that can exist between populations. Freshwater tributaries within the Santa Ana River Watershed have also undergone such events that will lead to the divergence of aquatic populations. *R. osculus* was once able to freely inhabit the free flowing and perennial rivers within the Santa Ana River Watershed but due to changes in climate and geology and more recent anthropogenic causes in the last century, their habitat became discontinuous and fragmented. Currently, due to the discontinuous and fragmented habitats of *Rhinichthys osculus*, the degree of gene flow between populations is very limited, if it exists at all (Cornelius, 1969; Oakey, 2004).

In addition, this study, in conjunction with the Savannah River Ecology Lab has developed a library of microsatellite loci for *Rhinichthys osculus*. Twenty-three polymorphic microsatellite loci (Table 1) have been identified that may be useful in our studies of *Rhinichthys osculus* populations. This research project is ongoing. Currently over 150 samples of *Rhinichthys osculus* are being genotyped for fifteen different microsatellite loci. Upon analysis of the data we will examine the relationships between the populations inhabiting the tributaries of the Santa Ana Watershed system as well as the San Gabriel Watershed system. Through our analysis we hope to gain a better understanding of the molecular evolution, phylogeography, population genetics and conservation of the local populations of the Santa Ana Speckled Dace. This data, along with the mtDNA work and other nuclear DNA work that is being performed in the Metcalf lab, will allow government agencies to determine if conservation management strategies are necessary.
Table 1: Microsatellite loci and primer information developed in conjunction with the Savannah River Ecology Lab. The size (bp) indicates the range of observed alleles in base pairs and includes the length of the CAG tag, * indicates CAG tag (5’-CAGTCGGGCGTCATCA-3’) label (modified from Nunziata et al. 2013).

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References


Perceived Social Norms and Health Behaviors: Are College Drinking Behaviors Mediated by University Attachment?

Jordyn C. Wheeler

Abstract
The purpose of this study was to assess school attachment in college students and alcohol use. High perceptions of peer alcohol use were expected to be positively correlated with rates of individual student use. Also, as students reported higher rates of attachment to their university, rates of alcohol use would decrease. Furthermore, it was expected that affiliation with a fraternity or sorority would alter the relationship between university attachment and alcohol use. Existing data from LaChausse’s (2012) CSUSB Student Health Survey was used; 311 participants completed the survey, which included measures of current alcohol and other drug use, perceived CSUSB student use, and ratings of university attachment. Pearson correlation coefficients indicated significant results supporting two of the hypotheses. Perceptions of peer alcohol use were predictive of individual use. There was also a positive linear relationship between fraternity and sorority members’ rates of university attachment and alcohol use, as well as a negative linear relationship between non-affiliated student’s rates of university attachment and alcohol use. The results indicate that higher rates of university attachment are related to lower levels of alcohol use.

Author Interview

Which professors (if any) have helped you in your research?
Dr. Robert LaChausse.

What are your research interests?
My research interests are social psychology, health behaviors, and drug and alcohol abuse.

What are your plans after earning your degree? What is your ultimate career goal?
I will be applying to doctoral programs in social psychology to further my research career. I plan to continue my career doing research in the field of social psychology, and secure a position at a university, where I can teach courses in my field.

Keywords: University Attachment, Alcohol use, College Students, Fraternity and Sorority
Introduction

Drinking patterns among college students have long been considered problematic with trends steadily increasing in recent years. For example, 45% of undergraduates reported they engaged in binge drinking in the previous month (Cox & Bates, 2011; Crawford & Novak, 2010). In 2001, alcohol was involved in more than 1,700 deaths of U.S college students and 500,000 unintentional injuries (LaBrie, Hummer, Neighbors, & Larimer, 2010). The consequences of alcohol use do not end with the involved individual, but subsequently affect other students, and communities of the campuses (LaBrie et al., 2010).

Social Norms Theory suggests that individual behavior is largely influenced by the perceptions of behaviors of their peer group (LaBrie et al., 2010). Considerable research has applied this theory to predict alcohol use for college students, demonstrating a strong relationship of perceived peer drinking norms influencing behavior (Cox & Bates, 2011; Crawford & Novak, 2010; Halim, Hasking & Allen, 2012; LaBrie et al., 2010). Particularly, these studies show that individuals who perceive the majority of their peers are drinking in large quantities and approve of doing so, are more likely to drink more themselves (Halim et al., 2012). This perception is especially dangerous because research from 100 U.S. colleges indicates that students often overestimate alcohol use of their peers and subsequently also increase their individual consumption (Crawford & Novak, 2010; Halim et al., 2012; LaBrie et al., 2010; Perkins, Haines, & Rice, 2005).

Another predictor of student behavior is derived from measuring students’ attachment to their school (France, Finney, & Swerdzewski, 2010). France et al.’s (2010), in the study of university attachment and development of the University Attachment Scale, identified a lack of research on attachment at the university level. Nevertheless, France et al. reported school attachment to be positively associated with behavioral and educational success such as academic achievement, effort, and degree of academic value. Student perceptions of connectedness to their university might also have an effect on alcohol and other drug (ATOD) use. Despite the paucity of research in this area, the relationship between school attachment and health risk behaviors has been established among high school students (Dever et al., 2012). For example, Dever et al.’s (2012) study found that “school bonding” was correlated with later onset and lower averages of substance use. Moreover, this relationship is much stronger for high school students than for lower grade students. As a result, it would be reasonable to assume that as students transition from high school to college, that this concept of school connectedness would have an equal or greater effect on their health behaviors.

Purpose

The purpose of this study is to examine the relationship between school bonding (i.e. university attachment) and alcohol use among college students. It is hypothesized that the students’ perceptions of social norms will influence their own drinking behaviors. Specifically, higher perceptions of alcohol use will be positively correlated with individual alcohol use. It is also hypothesized that there is a negative correlation between university attachment and alcohol use among college students.

Methods

This study uses existing data from the CSUSB Student Health Survey (LaChausse, 2012). Surveys were distributed to a random sample of students at California State University, San Bernardino (CSUSB). Participation in the survey was voluntary. The CSUSB Institutional Review Board reviewed and approved this study. The sample includes 82 (26.2%) male and 229 (73.2%) female college students (N=311) between the ages of 18 and 57 from CSUSB. Of the participating students, 29.1% were Non-Hispanic White, 42.8% Hispanic/Latino, 11.2% African American, 11.5% Asian, and .3% Native American. Twenty of the participating students reported being a member of a fraternity or sorority at CSUSB. The CSUSB Student Health Survey included items measuring student demographics, safety and violence, lifetime ATOD use, ATOD use in the past month (current
use) and perceived CSUSB student use, sexual health behaviors, behaviors related to nutrition, exercise, and physical activity, university attachment, and stress. This study used the measures of current ATOD use, and perceived CSUSB student ATOD use, as well as university attachment using the University Attachment Scale (France et al., 2010). The University Attachment Scale asks questions like “How accurate would it be to describe you as a typical CSUSB student?” on a Likert scale, with satisfactory reliability (Cronbach’s $\alpha=.84$) (France et al., 2010).

**Results**

A Pearson correlation coefficient was calculated examining the relationship between university attachment and current alcohol use. No significant relationship was found ($r (288) = - .049, p = .40$). As a result, university attachment is not related to the degree of current alcohol use. A second Pearson correlation coefficient was calculated to examine the relationship between university attachment and current alcohol use for fraternity and sorority members. A strong positive correlation was found ($r (16) = .567, p = .01$), indicating a significant linear relationship between the two variables. That is, as fraternity and sorority members reported higher rates of university attachment, their rates of current alcohol use also increased. A Pearson correlation coefficient was calculated for the relationship between university attachment and current alcohol use for non-sorority/fraternity members. A negative correlation was found ($r (270) = -.13, p = .03$), indicating a significant linear relationship between the two variables. In contrast to students that were members of a fraternity or sorority, non-members reported higher levels of university attachment, and also reported lower levels of current alcohol use.

**Discussion**

The results of this study confirm that higher levels of university attachment were related to lowers levels of current alcohol use. Student’s perceptions of peer alcohol use were predictive of individual alcohol use. The analyses indicated that rates of university attachment were not significantly correlated with rates of alcohol use. Alternatively, there was a positive linear relationship for affiliated student’s rates of university attachment and alcohol use, as well as a negative linear relationship for non-affiliated student’s rates of university attachment and alcohol use. This means that as affiliated students report higher levels of attachment, their alcohol use also increases. However, for non-affiliated students, as level of attachment increases, alcohol use decreases. It is probable that because opposing trends are seen in these two sub-groups, it caused the non-significant results between university attachment and alcohol use.

Research indicates that feelings of connectedness have shown a tendency of individuals to behave in accordance with dominant norms (Hummer, LaBrie, & Pedersen, 2012). This association may explain the trend seen with alcohol for fraternity and sorority students. If alcohol consumption is accepted and common within these student groups, the individual behavior is then sanctioned. In this circumstance, high levels of attachment or connection may influence individuals to consume more alcohol.

Alcohol trends among college students are a public health concern. Not only is it harmful for the student, in terms of academic impairment, injury, or addiction, but it also affects other students and the communities of the campuses. Often these effects are seen in form of low graduation rates and high attrition rates. This research distinguishes patterns of alcohol use among college students; for example, fraternity and sorority members are more likely to drink. This information can be used in conjunction with other research to shape prevention and intervention programs to reduce risk for the college population.

**Implications**

This research can be used to report accurate rates of drinking in the college community to convey the true norm, and give students the opportunity to adjust their perceptions, and thus their own behavior. It can also be used to implement programs to increase
feelings of connectedness and student involvement on campus. Such programs may tackle, in part, the issue some universities have with graduation and attrition rates. Campuses need to increase connectedness for their students, but in appropriate ways, such that they avoid increasing alcohol trends like those seen within the fraternity and sorority groups. Effective programs could determine appropriate forms of increasing university bonding and also reduce rates of student alcohol use.

Future Studies

Future research on this topic may examine these relationships of attachment and alcohol use in other students groups (i.e. student government, athletic clubs, academic clubs) to identify and other possible trends in the subsets of the college population. This information will allow universities to better regulate the patterns of alcohol use.

References


LaChausse, R. (2012). *CSUSB Student Health Survey* [Data file and code book].

Proceedings (Abstracts) from
The 2nd Annual Student Research Symposium “Meeting of the Minds” and the
27th Annual CSUSB Student Research Competition

On February 27, 2013, the Office of Student Research and the Office of Graduate Studies held the 2nd Annual Student Research Symposium “Meeting of the Minds” and the 27th Annual CSUSB Student Research Competition. The purpose of the event was to recognize the various academic achievements of our students and our faculty mentors.

College of Arts & Letters

“Bennet Girls on Film: A Pride and Prejudice Adaptation Study”

Kristen Jensen
Faculty Sponsor: Dr. Luz Elena Ramirez

A study of various adaptations on Jane Austen’s novel, Pride and Prejudice.

“Teaching off the Wall”

Daniel G. Ayala
Faculty Sponsor: Dr. Katherine Thomerson Bird

Using creativity in the classroom to motivate children to learn. This is exemplified by bulletin boards and interactive boards/walls that challenge the child to learn and feel as if they are accomplishing the skills the teacher wants them to learn.

“Redemption and Ridicule: Wyclef Jean, Sean Penn, and Western/Haitian Diasporic Understanding of Celebrity Activism in Post-Earthquake Haiti”

Elena Martinez
Faculty Sponsor: Dr. Bradford Owen

A textual analysis was conducted of US news representatives of American celebrity activism in Haiti as well as online discussion by the Haitian Diaspora concerning the same relief work, themes of representation and identified and post-colonial implications are discussed.

“First, Do No Harm: The Power of a Good Title in Native American Bildungsromans”

Jonathan Maule
Faculty Sponsor: Dr. Luz Elena Ramirez

The essay analyzes Sherman Alexie’s “Smoke Signals” and Louise Erdrich’s “Tracks,” and by comparing and contrasting key passages, illustrates how both titles complicate and reinforce four literary themes—destruction and regeneration, power and prestige, the oral tradition, and initiation. Both texts are then situated within a larger context of loss and renewal within Native American Bildungsromans.
“Madness in Memoir: The Representation of the Unmarked Body”

Krystin Rauma

Faculty Sponsor: Dr. Jessica Luck

Darkness visible is a compelling memoir in which William Styron depicts his personal battle with depression. My projects explores depression in memoir as a kind of “coming out” narrative that moves past society’s call for a “performance of normalcy” from the unmarked disabled body.
College of Business & Public Administration

“From Charity to CSR”

Danielle Marie Chavez

Faculty Sponsor: Dr. Breena Coates

Businesses and their use of corporate power in a democratic society is becoming more influential. There has been a move from charity to corporate social responsibility. I examined the critical arguments for and against corporate social responsibility, recognizing socially responsible best practices emerging from the research.

“Destination Branding for Foreign Direct Investment”

Marion deRiviere de La Mure, Valentine Cereza, Lou Lebrun-Gonnet

Faculty Sponsor: Dr. Jason Ryan

The project examines whether countries are branding themselves and how they attract foreign direct investment.

“Analyzing the Demand and Supply of E-Government Service: A Case of Bilingual Services on California Websites”

Shan-Ju Ho

Faculty Sponsor: Dr. Anna Ni, Dr. Francisca Beer

The current e-services provision is lack of taking the demands of citizens into consideration. The U.S. Census 2011 for the nation shows that the Hispanic population will comprise of 16.7% of the population. The shift is dramatic especially in the State of California, which the Hispanic population will become a minority for 38.1% of total population. In general, the government agencies in California counties and cities have not developed much of bilingual services. By using correlation analysis, this research tests the hypothesis that the current e-services provision for 478 California cities and 58 California counties is more supply-driven than demand-driven. Finding the current e-services not reflecting the needs of California residents, this research also provides insights into the best practices of e-government around the world; one is Singapore (bilingual website); Seoul of South Korea (citizen-oriented website). Our findings will contribute to providing practical lessons for public practitioners to improve e-service delivery.

“An Examination of the Impact of CSR in Technology-Driven Society”

Balaji Kannan

Faculty Sponsor: Dr. Breena Coates

Companies have to survive in the competitive business landscape field by constant need for monetary growth and the changing societal needs. Technology used to address regulatory needs can make the difference—help make organizations socially sustainable or break them into oblivion.
“QueuePay.com, Building a System for Cardholder-Transaction Security”

Jose R. Gonzalez

Faculty Sponsor: Dr. Conrad Shayo

A new method to prevent unauthorized payment of card transactions. A cardholder will be able to place payment card transactions on a queue as a method of preauthorization before initiating a transaction with a merchant. The queue will act as a new variable to complete an authorized transaction.

“Strategizing for Corporate Responsibility: A Wells Fargo Case Analysis”

Ines M. Stewart

Faculty Sponsor: Dr. Breena Coates

The research explores Wells Fargo’s use of corporate social responsibility strategy through qualitative data research, the comprehensive corporate social responsibility framework, and SWOT analysis. Findings, conclusions, and recommendations to stakeholders will be discussed.

“Benefit Corporation, Flexible-Purpose Corporation, and the certified B Corporation”

Suu Elen Manzano

Faculty Sponsor: Dr. Breena Coates

Explanation of flex-purpose, benefit corporation, and B-lab as a response to corporate social responsibility (CSR). How far will California go to legally express their commitment to CSR? The new laws and certification are more encompassing of social and environmental activities in corporations.
College of Education

“I Hope To Be a Symbol of Encouragement”: Using CRAFT in Community Colleges to Facilitate Student Voice in the Remedial Studies Debate”

Dr. Aja Henriquez
Faculty Sponsor: Dr. Louie Rodriguez

Current changes of remedial coursework in higher education have been influenced by economic and political pressures, while students affected by these changes are a wealth of insight on student success. This research facilitates student voice in order to inform decision-making regarding “remedial students.”

“Neurofeedback”

La Resha Lyles, Sandra Kellmer, Shereece Jefferson
Faculty Sponsor: Dr. Donna Schnorr

The study associated with this presentation explored seven cases of individuals who were struggling with inattention and focus, some of whom had been diagnosed with ADHD or PTSD. Pre and Post scores were administered using the Integrated Visual and Auditory Continuous Performance Test (IVA). Observations and Interviews were also used for explanatory purposes.

“Education Technology in Kindergarten”

Mauricio Cadavid
Faculty Sponsor: Dr. Marita Mahoney

This research looked at the implementation of educational technologies (iPad and iPod Touch) used in a kindergarten classroom to teach students to learn to read and write. The three main areas covered in the literature include learning and institution, curriculum, and educational technologies.

“Undercover Anti-Bullying Teams”

Juanita Williams, Harpreet Uppal, Evelyn Knox, Felipe Barha
Faculty Sponsor: Dr. John Winslade

The research focuses on bullying as an external relation phenomenon that draws the people who get directly and indirectly entangled in them. The analysis inquired whether peers are an effective option that counselors, teachers, and school administrators can rely on to eradicate bullying in school which differ from traditional authoritarian and punitive strategies.

“Promoting Student Engagement through Physical Activity”

Courtney Doussett
Faculty Sponsor: Dr. Marita Mahoney

Helping elementary school teachers to use physical activities to promote on-task behavior, student engagement, and motivation. How 5-minute physical activity bursts aid students to focus and engage on targeted cognitive activities.
“Contributions of Wellness on Student Achievement and Behavioral Engagement”

Eric Vreeman

**Faculty Sponsor:** Dr. Donna Schnorr

A correlational model was used to test hypothesized relationships between ten domains of wellness (adaptability, connectedness, conscientiousness, emotional self-regulation, empathy, initiative, mindfulness, optimism, self-efficacy, social competence) as measured by the Child and Adolescent Wellness Scale (CAWS) and factors of academic achievement and behavioral engagement.

“100 DINNERS PROJECT - Conceptual Change Theory in Education: Using Home Visits to Reshape Teacher Perceptions of Students”

Aubrey Hovannesian

**Faculty Sponsor:** Dr. Marita Mahoney

The 100 Dinners Project utilizes the Conceptual Change Theory Protocol in an effort to identify and solve issues related to Schools Connectedness
College of National Sciences

“Analysis and Comparison of Protected and Exploited Toothshell (Nerita scabricosta) on the Pacific Coast of Costa Rica”

Emilia Escobar
Faculty Sponsor: Dr. Belisario Ventura

Tooth snails, Nerita scabricosta (Gastropoda: Nertidae) are gathered for food along the Pacific coast of Costa Rica. Snails reside on both vertical and horizontal surfaces of rocky intertidal beaches. We assessed snail density, size distribution, and spatial dispersion pattern of these snails at three sites with progressively decreasing levels of protection from human access.

“The Role of the Caudofemoralis Longus Muscle in Alligator Locomotion”

Jessica Joneson
Faculty Sponsor: Dr. Tomasz Owerkowicz

To determine the function of the Caudofemoralis Longus, a well-developed muscle in the tails of reptiles with sprawling gaits, we cut the tendon to the CFPL in juvenile American alligators. Altered animals exhibited no changes in loco motor patterns based on before and after footage, and compared to controls.

“Radio Number for Fifth Power Paths”

Alberto Acenedo and Samuel Marrujo
Faculty Sponsor: Dr. Belisario Ventura

Let G be a connected graph and for any two vertices, u, v, let d(u,v) be distances in G. The maximum distance is called the diameter of G, diam(G). Then we find a radio labeling of G such that the inequality \(1F(w) - F(v) + 1 \geq \text{diam}(G) - d(u,v) + 1\) holds. The radio number is the minimum span in G. We will discuss the progress made towards finding the radio number for the 5th power graph.

“Exploration of Robotic Systems with Microcontroller”

Christopher Ramirez
Faculty Sponsor: Dr. Haiyan Qiao

To learn about the fields of engineering, mechatronics, and software development through a series of hands on activities in constructing, wiring, and programming an autonomous robot.

“Accurate Skull Alignment for Radiosurgery”

Kenneth Williams
Faculty Sponsor: Dr. Keith Schubert

I compared three image registration algorithms for skull alignment during radiosurgery. The process of image registration consists of aligning a transformed image against its reference image. The primary concerns of this research were efficiency and accuracy. For this presentation, a stock image is used due to patient privacy.
“Jar Test Study on the Use of Aluminum for Turbidity and Nutrient Removal in Canyon Lake, CA”

Gracie Cervantes and Emmett Campbell

**Faculty Sponsor:** Dr. James Noblet

Aluminum Sulfate was used to remove both turbidity and nutrients from the water in Canyon Lake, CA.

“New Experimental Model to Investigate the Effects of Augmented Intra-cardiac Shunt”

Elisabeth Cook

**Faculty Sponsor:** Dr. Tomasz Owerkowicz

The cardiovascular shunting seen in non-avian reptiles has many hypothesized adoptive functions all lacking in substantial support. In my current research I am developing a new model in varanus exantematicus (Savannah Monitors) to study/investigate the hypothesized functions further.

“Analyzing EEG Data of Alcoholic Patients Using Time Series Analysis and Machine Learning Techniques”

Regie Felix

**Faculty Sponsor:** Dr. Arturo Concepcion

Time series are data take in time intervals. This analysis can predict future data in three steps: preprocessing, analysis, and diagnostics. Time series classification uses machine learning (decision trees and artificial neural networks) to classify a dataset. We analyzed EEG data of alcoholics and non-alcoholics to predict their status.

“Cell Type Difference in Role of Host NxF1 for Influenza NPmRNA Nuclear Export”

Veronica Perez

**Faculty Sponsor:** Dr. Laura Newcomb

Influenza invades cells to replicate itself by sending mRNAs to the nucleus so they can be made into proteins. But, mRNA nuclear export requires protein interaction. Our research shows that the flu NPmRNA is neither NxF1-mediated or not NxF1-mediated, depending on cell type.

“An Influenza N-Terminal Nucleoprotein Mutant Reveals Roles of Influenza NS Proteins in Viral Gene Expression”

Jose M. Ramirez

**Faculty Sponsor:** Dr. Laura Newcomb

Using a truncated Influenza Nucleoprotein that is defective in viral replication and transcription, we can reveal the role of influenza NS protein in viral replication and transcription. Our current work shows NS proteins rescue the defect of our mutant Nucleoprotein at the level of translation.
“Characterization of Two Influenza Nucleoprotein Body Domain Mutants”

Anita Sahagian  
**Faculty Sponsor:** Dr. Laura Newcomb

The purpose of this study is to characterize an NP mutant, Npbd3, designed to disrupt interaction with viral RdRP. NPbd3 is defective for viral mRNA transcription and viral RNA replication. We aim to identify any NP interactions that are altered in the presence of NPbd3 in order to identify potential antiviral targets.

“VLBA Observations of H2O Masers Around the Evolved Star W434K”

De Andra Salley  
**Faculty Sponsor:** Dr. Belisario Ventura

We present observations and preliminary results of H2O maser emissions in the circumstellar envelope of the evolved star W434K, obtained by the very large baseline array at the three epochs from 2003 to 2004 with time spacing between 2-3 months. By observing the masers with this time spacing, the change in position can be determined. Moreover, by determining the motion and estimating the maser shell thickness, we should be able to calculate the mass loss rate of the evolved star.

“Green Conversion of Eugenol to Isoeugenol”

Brittney Sandoval  
**Faculty Sponsor:** Dr. Kimberley Cousins

Eugenol is used in the flavor and fragrance industry and also used as a model reaction for isomerization of allylic to vinylic ph bonds. Conversion can be made greener by substituting water for most of ethylene glycol. This ensures the lease amount of waste.

“Serum Starvation Increases the Transfection and Differentiation Efficiency”

Negin Baghdadchi  
**Faculty Sponsor:** Dr. Nicole Bournias

Induced pluripotent stem cells and human pluripotent stem cells are starved with SI and DSI KOSR serum. The results showed that 2 day starvation with SI KOSR serum causes significant increase in differentiation and nucleofection efficiency.

“Geographic Population Structure of Rhinichthys Osculus, the Santa Ana Speckled Dace, among Southern California Watershed Habitats”

Liane R. Greaver  
**Faculty Sponsor:** Dr. Anthony Metcalf

Genetic descriptions of Rhinichthys osculus remain incomplete. Utilizing intron sequences in nuclear DNA, taxonomic relationships will be examined among neighboring watershed populations including Southern California, Owens River, and Central Coast. The study analyzes three introns to determine if sufficient genetic differentiation has occurred to consider each of its own taxa.
“Unmasking the Mysteries of the Mosaics”

Amandeep Kaur

**Faculty Sponsor:** Dr. David Maynard

Mayan artifacts, obtained for the National Museum of the American Indian Smithsonian Institute, were analyzed by the spectroscopic methods and found to contain copal.

“Directing Neural Retina Cell Fates from Human Pluripotent Stem Cells”

Meredith Lujan

**Faculty Sponsor:** Dr. Nicole Bournias and Dr. Chee Gee Liew

This project will use both human embryonic and induced pluripotent stem cells to generate retinal cells by utilizing well-characterized pathways first identified in early animal model studies.

“Importance of the Cakareous Eggshell to Normal Development in the American Alligator”

Nelson A. Membreno

**Faculty Sponsor:** Dr. Tomasz Owerkowicz

Crocotilians and birds lay heavily mineralized eggs as opposed to the leathery eggs of other amniotes. The mineralized layer of experimental American alligator eggs was removed and experimental eggs were incubated alongside control eggs. Results show that experimental hatchlings were smaller and hard larger yolk sacks than hatchlings.

“Microsatellite Analysis of Population Structure in the Santa Ana Speckled Dace (Rhinichthys Osculus): Conservation and Evolution”

Stacey A. Nerkowski

**Faculty Sponsor:** Dr. Anthony Metcalf

The Santa Ana Speckled Dace has been a species of concern among local watershed- utilizing microsatellites, population structure, and genetic diversity will be examined among Southern California streams. 23 microsatellite loci have been identified and are being analyzed for 150 individuals. This data will be used for conservation and management purposes.

“Methods of Administration and their Effect on Social Desirability Bias”

Elizabeth Castaneda

**Faculty Sponsor:** Dr. Jodie Ullman

This study addresses an important factor concerning the validity of self-report questionnaires and the effect of social desirability on self-report measures.
“Failure and Shifting Standards: How Failure can Positively Affect Subjective Evaluations of Stereotyped Group Members”

Michelle Fabros  
Faculty Sponsor: Dr. Donna Garcia

Using the shifting standards model, the positive influence of failure can lead to better subjective -but not objective- evaluations of stereotyped group members.

“The Role of Ideology in Negotiation and Conflict Resolution During the Tuareg Rebellions”

Raymond Miller III  
Faculty Sponsor: Dr. Mark Clark

This work traces the four Tuareg Rebellions in Mali after the French Occupation and discovers the role ideology played during those rebellions to present.

“International Cocaine and Heroin Trafficking: A Social Network Approach”

Stephen Anderson  
Faculty Sponsor: Dr. Gisela Bichler

This study uses social network analysis to identify the important transit countries for cocaine and heroin, respectively.

“A Proton Simulator for Testing Implementation of Proton CT”

Micah Witt  
Faculty Sponsor: Dr. Keith Schubert

Reconstruction Algorithms on GPGPU Clusters

“Accurate Skill Alignment for Radiosurgery”

Kenneth Williams  
Faculty Sponsor: Dr. Keith Schubert

Abstract: In this research, image registration algorithms and compared with an emphasis on testing their efficiency and accuracy on their calculated transformations.

“National Policy to Combat Breast Cancer”

Mahbuba Hammad  
Faculty Sponsor: Dr. Daniel Fahey

This research paper discusses the manner in which Qatar is combating breast cancer at a national level.
“Effects of Juvenile Methylphenidate Exposure on Cocaine Self-Administration and Escalation in Rats”

Graham Kaplan

Faculty Sponsor: Dr. Cynthia Crawford

A self-administration paradigm was used to access the impact of juvenile methylphenidate exposure on cocaine seeking behavior in adulthood.

“The Effects of Perceived "Backward and Forward" Group Continuity on Well Being”

Jennifer Wacan

Faculty Sponsor: Dr. Donna Garcia

We expect the degree to which one perceives their ethnic group as having an extensive historical past and lengthy future will impact individual scores on measures of wellbeing (i.e. individual self-esteem).

“Serum Starvation Enhances Transfection and Differentiation Efficiency in Human Pluripotent Stem Cells”

Negin Baghdadchi

Faculty Sponsor: Dr. Nicole Bournias

Serum Starvation can increase the nuclear faction as well as differentiation efficiency in hpsc and ipsc.

“Directing Neural Retina Cell Fates from Human Pluripotent Stem Cells”

Meredith Lujan

Faculty Sponsor: Dr. Nicole Bournias & Dr. Chee Leiw (UCR)

This project will use both human embryonic and induced pluripotent stem cells to generate retinal cells by utilizing signaling factors first identified in early developmental studies.

“Microsatellite Analysis of Population Structure in the Santa Ana Dace (Rhinichthysosculus): Conservation and Evolution”

Stacy Nerkowski

Faculty Sponsor: Dr. Tony Metcalf

Utilizing microsatellites, population structure and genetic diversity will be examined in Rhinichthys osculus among Southern California streams. 23 microsatellite loci have been identified and are being analyzed for conservation and evolution.
“Examining the Effects of Parental Influences on Child Nutrition Behavior”

Molly Nazeck

**Faculty Sponsor:** Dr. Robert LaChausse

This study is examining the relationship between fruit/vegetable availability and the mediating effects of parental influences.

“Reverse Genetics of Influenza Virus”

Juana Zamora

**Faculty Sponsor:** Dr. Laura Newcomb

Using the reverse genetics to generate virus with WT NP and NP with an epitope FLAG tag at the C-Terminus end result in no production of virions however, the NP was being expressed and synthesized. This alludes to a virion assembly function of the NP C-terminus.

“Ethnic Differences in Weight Perception and Obesity Among College Students”

William Landa

**Faculty Sponsor:** Dr. Robert LaChausse

This study examines the relationship between ethnicity and weight perceptions among university studies. The results of this study have program and policy implications for U.S. Universities.

“Unmasking the Mysteries of the Mosaics”

Amandeep Kaur

**Faculty Sponsor:** Dr. David Maynard

Myan artifact, obtained for the National Museum of the American Indian at the Smithsonian Institute, were analyzed by spectroscopic methods and found to contain copal.
College of Social & Behavior Sciences

“We Be Drinkin’”

Juan Franquez

Faculty Sponsor: Dr. Gisela Bichler

This is a study of place management and design of problematic bars and nightclubs. Site observations of 87 bars and 17 nightclubs resulted in robust indicators of crime and disorder in respective settings. This study also tests a new crime and disorder indicator- public notoriety as measured by yelp.com.

“Measuring College Success by Student Resiliency and High School Academic Performance Index Scores”

Marlena Hernandez

Faculty Sponsor: Dr. Sharon Ward

A correlational relationship between CSUSB students’ past high school API scores and their present resiliency factors may create a measure to better determine college success. It is hypothesized that past high school API scores will influence college success. Therefore, students that come from high performing API high schools paired with high individual resiliency factors will have more college success and a higher GPA.

“Prozac ® Exposure During Adolescence Impairs Spatial Memory Performance in Adulthood.”

Michelle J. Stone

Faculty Sponsor: Dr. Sergio Iniguez

Within the adolescent population, there has been an increase in the prescription rates of the antidepressant Prozac ®. The current study was designed to examine for potential long lasting spatial memory related deficits as a result of chronic exposure to Prozac during adolescence, using C57Bl/6 mice.

“Cognitive Vulnerability for Anxiety: A Comparison of Competing Models”

Matthew Arias

Faculty Sponsor: Dr. Michael Lewin

The study examined four competing cognitive vulnerability models of anxiety (i.e. Vulnerability to Harm-Schema Model, Looming Cognitive Style, Anxiety Sensitivity, and Fear of Negative Evolution.) Results revealed that these cognitive models significantly mediated the relationship between recollections of dysfunctional parenting and current anxiety. Implications and future research will be discussed.

“Negative Couple Rituals: A Qualitative Study”

Bridgit Berney

Faculty Sponsor: Dr. Kelly Campbell

This study seeks to expound upon one type of couple behavior, negative couple rituals, which are defined as repeated behaviors that partners enact together. Central themes from participation responses will be presented. The association with commitment and relational satisfaction will be examined.
“Are Expensive Weddings More Satisfying?”

Nicole Leitner

Faculty Sponsor: Dr. Kelly Campbell

Do the high costs and elaborateness associated with weddings pay off in terms of wedding ritual satisfaction? The current study predicted that married people’s satisfaction in their wedding rituals would increase in conjunction with cost and elaborateness. Results will be presented.

“The Influence of Family Acceptance on Mental Health among LGBT Individuals”

Mary Arroyo

Faculty Sponsor: Dr. David Chavez

It has been found that support can have a buffering impact regarding poor mental health and health risk behaviors in the LGBT community; whereas unsupportive behavior can lead LGBT individuals to engage in risky behavior. It was hypothesized that family acceptance would increase positive outcomes, specifically self-efficacy, self-esteem, and general health. Additionally, it was expected that it would also be negatively associated with negative outcomes, specifically substance abuse, psychological distress, and suicide ideation.

“Interpersonal Chemistry in Friendship and Romance”

Jessie Nelson

Faculty Sponsor: Dr. Kelly Campbell

Chemistry refers to an instant connection between two individuals. Our goal is to identify, underlying components of interpersonal chemistry in friendships and romantic relationships. Participants responded to an online questionnaire that included open ended questions regarding chemistry. Data were coded using constant comparative method.

“Early Maladaptive Schemas, Personality, and Aggression”

Alexander Ojeda

Faculty Sponsor: Dr. Michael Lewin

The object of this study was to examine the relationship between gender, the five factor model of personality traits, and cognitive vulnerability factors, i.e., early maladaptive schemas as predictors of verbal and physical aggression.

“Love and Athletic Performance: A Pilot Study with Collegiate Athletes”

Meriam Sahak

Faculty Sponsor: Dr. Kelly Campbell

We examined the possibility that athletes who are “in love” may perform better in athletic activities, because both love and athletics involve intense focus on rewarding outcomes. After assessing the athletes through performance tasks and having them think of love, we found positive results for our hypothesis.
“The Role of Primacy and Recency Effects and Need for Cognition in a Simulated Structured Interview”

Amanda Gonzales

Faculty Sponsor: Dr. Janet Kottke

Different biases occur in structured interviews. We will be examining two important biases: primary and recency effects. Both of which can influence an interviewer’s response based on when information is presented. We will examine difference in ratings of a fictitious applicant due to order of question/answer placement. Also, participant’s level of need for cognition will be measured as a moderating variable for primacy and recency effects.

“Relationships of Olympic Athletes at the Games: Media vs. Research Reports”

Cheyenne Hosseini

Faculty Sponsor: Dr. Kelly Campbell

This presentation will compare the relationships of Olympic athletes from two perspectives, media and research. Recent reports indicated that once athletes are staying in Olympic Village, sexual encounters are abundant. A majority of athletes reported being exclusively focused on their sport, although a small number commented on prospective romantic.

“Creativity, Mental Health, and Metacognition”

Yessenia Silva

Faculty Sponsor: Dr. Michael Lewin

The study investigated creativity and other variables such as depression and mood. Additionally we investigated self-measures including personality, need for cognition, creative self-efficacy, creative metacognition, and self-esteem. Participants also completed actual creative performances across three domains and a metacognition measure for each task.

“Social Defeat Stress, Results in Pro-depressive Behaviors”

Lace M. Riggs

Faculty Sponsor: Dr. Sergio Iniguez

A more focused approach to depression research is needed at the pre-clinical level. We investigated whether the social defeat model would result in pro-depressive behaviors in adolescence using the social interaction test.

“Shared Spaces, Separate Lives: Community Formation in the California Citrus Industry During the Great Depression”

David Shanta

Faculty Sponsor: Dr. Cherstin Lyon

Benedict Anderson’s work Imagined Communities: Reflections on the Origin and Spread of Nationalism is used to examine the community-forming process of citrus growers and workers, in Riverside and San Bernardino counties, leading up to and including the 1930’s. Research was based on oral histories, newspapers, and government documents.
“I Am Not a Man but Also an Explorer?”

Ryan Minor  
Faculty Sponsor: Dr. Tiffany Jones

The research focuses on the contradictory treatment of labor along the English chocolate industry’s multinational supply chain at the turn of the 20th century. The greater purpose of this research is to use this particular industry to examine universal connections between industrial capitalism and mistreatment of labor in Africa over the last two centuries.

“Effects of Juvenile Methylphenidate Exposure on Cocaine Self Administration and Escalation in Adult Rats”

Graham Kaplan  
Faculty Sponsor: Dr. Cynthia Crawford

Methylphenidate is a highly prescribed psycho-stimulant for the treatment of ADHD; however, little is known about its long term effects. The present study tested an animal (rodent) model with self-administration paradigm to assess the impact of juvenile methylphenidate exposure on cocaine seeking behavior in adulthood.

“Creativity, Impulsivity, and Borderline Traits”

Tessy Pumacahua  
Faculty Sponsor: Dr. James C. Kaufman

The purpose of this study is to investigate the relationship between impulsivity and creativity. Another goal of this study is to also compare the creative abilities of individuals with high levels of BPD traits to a control group, through the use of different creative measures.

“The Perception and Power of Crime Films”

Kamelle Leggette  
Faculty Sponsor: Dr. Kathy Nadeau

The following research applies Boren’s theory “that the over exposure of crime films induces criminal activity within that society.” By analyzing post-Rwandan genocide crime films from a cultural anthropological perspective, contrary to Boren’s theory, Rwandan crime films are used to socially reconstruct a society, by means of reconciliation, acceptance and psychological ventilation.

“The Role of Ideology in Negotiation and Conflict Resolution During the Tuareg Rebellions”

Raymond Albert Miller III  
Faculty Sponsor: Dr. Mark T. Clark

The work traces the four Tuareg Rebellions in Mali after the French Occupation and discovers the role that ideology played during those rebellions to present.
“Environmental Causes of Multiple Sclerosis and certain other Co-occurring Diseases”

Brian Evans

Faculty Sponsor: Dr. Robert Shaw & Dr. Wesley Niewoehner

Environmental Causes: Multiple Sclerosis and co-occurrence of many other immune system dysfunctions, certain non-viral genetic cancers and mitochondrial mutations. A translational medical anthropological research discovery.

“We Be Drinkin’”

Juan Franquez

Faculty Sponsor: Dr. Gisela Bichler

A study on place management and design of problematic bars and night clubs. Place management, crowdedness, and place design resulted to be robust indicators of crime and disorder.

“Hijacking History: Censorship and Cultural Genocide as Weapons of Racism in Arizona”

Charlene Eaton

Faculty Sponsor: Dr. Elsa Valdez

An analysis of HB2281, the Ethnic Studies ban in Arizona: what is actually says, how it was passed, what educators are saying about it and how it has impacted the children of Mexican and Indigenous ancestry explain the ability to distinguish opinions on moral values and criminality in comics. Belgians have a "black and white" view; Americans see crime relative to motivations mics. Belgians have a "black and white" view; Americans see crime relative to motivations.

“Disparity in Western Comics: A Reflection of Values and Crime”

Racheal Morgan

Faculty Sponsor: Dr. Katherine Nadeau

A cultural perception of “crime” explains the ability to distinguish opinions on moral values and criminality in cultural perceptions of “crime” explains the ability to distinguish opinions on moral values and criminality in comics. Belgians have a "black and white" view; Americans see crime relative to motivations. Belgians have a "black and white" view; Americans see crime relative to motivations.

“Perceived Social Norms and Health Behaviors: Are College Drinking Behaviors Mediated by University Attachment?”

Jordyn Wheeler

Faculty Sponsor: Dr. Robert LaChausse

This study examines the relationship between school connectedness and health risk behaviors, specifically between perceived social norms, alcohol, and university attachment among college students.
“Social Defeat Stress in Adolescence Results in Pro-Depressive Behaviors”

Lace Riggs

Faculty Sponsor: Dr. Sergio Iniguez

Since the incident of adolescent depression has increased, a more focused approach to depression research is needed at the preclinical level. Since previous research demonstrates that the social defeat model results in a depression-like phenotype in adult animal, we investigated whether this model will yield similar results during adolescence using the social interaction test.

“A Closet Full of History: Perceptions of Backwards and Forwards Cultural Continuity in LGBTQQI Community”

Gabino Gomez

Faculty Sponsor: Dr. Donna Garcia

Measuring individual perceptions of "backward and forward' collective continuity in self-identified members of the LGBTQQI community.

“Measuring College Success by Student Resiliency and High School Academic Performance Index Scores”

Marlena Hernandez

Faculty Sponsor: Dr. Sharon Ward

A correlational relationship between CSUSB students' past high school API scores and their present resiliency factors may create a measure to better determine college success to corporate social responsibility. I examined the critical arguments for and against corporate social responsibility, recognizing socially responsible best practices emerging from the research.
How to Get Involved in Research

Types of Research

<table>
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<tr>
<th>Quantitative Research</th>
<th>Qualitative Research</th>
<th>Meta-Analysis</th>
<th>Literature Review</th>
<th>Empirical Research</th>
</tr>
</thead>
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To get Started
- Ask your professors about their exciting research.
- Search department website for Principal Investigators (PI) in your field of interest.
- Search Student Employment Website.

Looking Ahead
- Professors seek research assistants year round.
- Contact your professor & express interest
  - Send email/hard copy of cover letter & attach a resume.
  - Express your research interests.
  - Network to get to know your professors better.

Benefits of Research
- Contributes to the advancement of human knowledge.
- Builds a unique set of skills and hands on experience.
- Helps identify your academic and career interests.
- Prepares you for graduate opportunities.
- Provides income or academic credit.