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Message from the Faculty Director of the McNair Program

It is my pleasure to present Volume XIII of the McNair Scholars Journal of the University of California, Davis. The McNair Scholars Program is named after Dr. Ronald E. McNair, the African-American physicist and astronaut who died in the 1986 Challenger space shuttle accident. As a memorial to Dr. McNair, the United States Congress established funding for this program in his name as a means to provide opportunities and encouragement to underrepresented and low-income undergraduate students who might otherwise not consider graduate study as an option. Funding for this program is provided through a grant from the U.S. Department of Education to assist students in attaining an advanced academic degree and a chance to succeed as exemplified by achievements of Dr. McNair. A significant component of the McNair Scholars Program at UC Davis is an individual, mentored research experience for each scholar. The research articles presented in the Journal are the culmination of a year's study and research conducted by the undergraduate students of the McNair Scholars Program. In addition to these papers, many of the scholars have presented their work at conferences and symposia throughout the country. We are justifiably proud of each of the McNair scholars whose research is presented in this journal. You will find that the papers cover a broad range of academic topics that the scholars have pursued using methodologies appropriate to their fields of study. However, the papers share a common theme in the way they exemplify the hard work, creativity and dedication that McNair scholars bring to the pursuit of their goals.



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Women's Markets During the Rif War, 1921-1926



Jorge González

Mentor: Susan G. Miller, Ph.D.
History

Abstract

This research focuses on the socio-political role of the markets that women regulated in the Rif Mountains of Northern Morocco from 1921 to 1926, especially their importance as a factor in encouraging the participation of women in the Rif War and in the organization of the Rif government. The Republic of the Rif was founded by an alliance of Berber tribes under the leadership of a local chief, `Abd al-Karim al-Khattabi, who sought to abolish Spanish colonial rule after World War I. The Berber leadership effectively mobilized every citizen of the republic, including women, thus allowing them to organize through the segregated markets that they controlled. Women's markets became places where socio-political and military planning occurred and contributed to the fighting and to the rapid formation of a new government. Through a detailed review of the available primary sources in English and Spanish, I argue that the social structures dominated by women and developed in the markets led to the participation of women as soldiers and spies in key roles

that aided the war effort. These social structures served as supportive environments in which women could directly participate in the forging of the new Rifi government.

Introduction

Hispano-Moroccan Relations in Early 20th Century

After the convention of Berlin in 1884, the scramble for Africa took its toll in the late 19th and early 20th Centuries, permitting European colonialism to reach the heartlands of Africa and divide up its territories into colonies and protectorates.¹ By 1912, after losing virtually all of its colonial possessions in the Americas and Pacific Islands, Spain set up a protectorate in the Rif Mountain range in Northern Morocco in order to exploit its natural, mineral, and agricultural resources.² The native inhabitants of the Rif Mountains area, 18 Berber tribes, tried to coexist with the Spanish for the development of their economic sector. Nevertheless, Ibero-Riffian relations worsened in subsequent years, and the Rifi fiercely opposed further inland colonization. Sporadic hostilities and military activity became evident, and by 1921, The Rif War was declared.³

Under the leadership of a charismatic and peculiar leader, `Abd al-Karim al-Khattabi, the native inhabitants of the Rif Mountains united under a Berber entity called al-jumhuriyya al-rifiyya (The Confederal Republic of the Tribes of the Rif) in early 1921.⁴ Nonetheless, by February 6, 1926, France entered the war under a mutually beneficial agreement with Spain. French General Philippe Pétain and Spanish Prime Minister Miguel Primo de Rivera made the arrangement forcing the Rifi state to fight a two-front war. Spanish forces pushed through the Mediterranean inland and the French attacked from its southern protectorate into the Rif. On May 26, 1926, `Abd al-Karim al-Khattabi officially surrendered to the French (he apparently preferred dealing with French authorities, in terms of surrender negotiations, rather than Spanish representatives). Thus, the Republic of the Rif entered history as one of the first modern Muslim states specifically organized to fight back European colonial imperialism.

¹ Marvin Perry, et al. *Western Civilization: Ideas, Politics, and Society, Volume II: From 1600*. Cengage Learning, 2008. 667.

² David S. Woolman. *Rebels in the Rif; Abd El Krim and the Rif Rebellion*. Stanford, Calif.: Stanford University Press, 1968.

³ María Rosa de Madariaga. *Marruecos, Ese Gran Desconocido: Breve Historia Del Protectorado Español: Breve Historia Del Protectorado Español*. Madrid: Alianza Editorial, 2012. 115-170.

⁴ Susan G. Miller. *A History of Modern Morocco*. New York: Cambridge University Press, (2013):107.

Various institutions created in the Rif Republic played a key role in battling European, especially Spanish, military forces and impeding further expansionism into the Rif. Women's markets, institutions that were hundreds of years old and as old as men's markets themselves, played a special role in the thriving republic during the Rif War. In accordance with various historians, anthropologists, and soldiers, women had strong influences in the social, military, and political arenas. For instance, the wife of 'Abd al-Karim al-Khattabi occupied the top level in the female social hierarchy. Therefore, women came to her and asked for favors for their husbands and families.⁵ Also, women had the means to increase the number of soldiers brought into the newly formed Rifi Harka, the Rifi standing army.⁶ Rifi women promoted and achieved governmental initiatives to educate other women and young girls, which, at this period of time, under the traditional Muslim patriarchal system, was a major social initiative.⁷ As Rifi victories over European armies became known in Europe, American and European historians, journalists, and writers paid close attention to the possible factors that might explain why well-equipped, modern elite armies were defeated by native Rifi troops on various occasions. Although extensive investigations have pointed to various reasons such as guerrilla warfare, knowledge of terrain, ability to mobilize in thin mountainous air, and assistance from natives, women's markets indeed played important military, intelligence, and socio-political roles.

Methods

This research is framed within the theory of Structural Functionalism, which intends to explain why society functions the way it does. Structural Functionalism was pioneered in the late 19th Century by English philosopher and anthropologist, Herbert Spencer. It focuses on the relations and interactions of social institutions in a macro-social sphere – in this case, the macro-societal phenomena that shaped Riffian society from 1921 to 1926. This investigation incorporates a thorough and careful analysis and interpretation of primary and secondary sources, and the re-evaluation of existing historiography on the field. Anthropological publications are used to meticulously examine and attempt to answer a specific question: How did Rifi women organize through the segregated markets they controlled?

Discussion

⁵ C. Richard Pennell. "Women and Resistance to Colonialism in Morocco: The Rif 1916-1926." *Journal of African history* 28, no. 1 (1987): 115.

⁶ Jean Tharaud, Jérôme Tharaud, and A. S. Moss-Blundell. *Spain and the Rif; Political Sketches*. London: Faber and Gwyer, 1926.

⁷ C.R. Pennell. *Morocco since 1830: a history*. NYU Press, 2000. 194.

Masquerading as Markets

During the Rif War, markets became centers for political and military activity because women owned their own markets and possessed a semi-independent society within them.⁸ As soon as war was declared, rapid military organization was needed for the newly independent Rifi government. Tribal women patriotically joined the struggle and engaged in social, political, and military activities such as making bread in factories, using their influence in the markets to recruit new soldiers, serving on the frontlines as nurses and soldiers, and even infiltrating enemy territory as spies. Intertribal connections and communication among women were possible because women were considered noncombatants and were free from Spanish oversight and punishment. British historian C.R. Pennell cites one Spanish officer:

The most dangerous and prejudicial espionage of which the rebels in this tribe make use is that carried out by women, since they are confident that the [Spanish authorities] will not suspect or punish them simply because they are women. Thus [many women]... are involved in actions which are prejudicial in the extreme and they must be punished.⁹

Compared to men, women carried and easily spread ideas, messages, and military resources in the Rif. They spread ideas and resources relatively easy and without much difficulty because it was a tradition for women to circulate amongst different markets in the region. According to French travelers and authors, Jean and Jerome Tharaud, women were engaged in the recruitment of soldiers for the Harka, the Rifi Army, along with smuggling weapons, ammunition, and resources.¹⁰

Intriguingly, two main questions emerge from the material so far covered: How were such contributions to the republic's development possible through the markets? How did women organize through the segregated markets they controlled? The answers are found in the traditional usage of the markets that females regulated. Under Muslim tradition, Rifi women were segregated into a social sphere apart from men. In comparison to men's markets, where fighting and shootings commonly occurred, women's markets were more stable.¹¹ According

⁸ Emilio Blanco Izaga and David M. Hart. *Emilio Blanco Izaga, Colonel in the Rif a Selection of His Material Published and Unpublished, on the Sociopolitical Structure of the Rifians of Northern Morocco*. Ethnography Series. New Haven, Conn.: Human Relations Area Files, inc., (1975): 105.

⁹ C.R. Pennell. "Women and Resistance to Colonialism in Morocco: The Rif 1916-1926." *Journal of African history* 28, no. 1 (1987): 113.

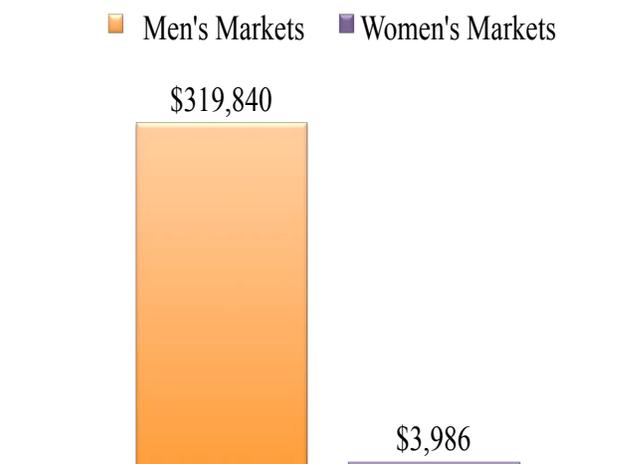
¹⁰ Jean Tharaud, Jérôme Tharaud, and A. S. Moss-Blundell. *Spain and the Riff; Political Sketches*. London: Faber and Gwyer, (1926). 52-53.

¹¹ David M. Hart. *The Aith Waryaghar of the Moroccan Rif: An Ethnography and History*. Viking Fund Publications in Anthropology. Tucson: Published for the Wenner-Gren Foundation for Anthropological Research by University of Arizona Press, (1976): 87.

to anthropological findings, the purpose of women's markets was social rather than economical. Emilio Blaco Izaga, Spanish General, anthropologist, and Head of Native Affairs in the Rif in the early 1930s, observed that Berber women did not experience the same social treatment as men. They did not enjoy equality before the law. Nevertheless, women organized markets where they encountered their relatives, conducted transactions, searched for brides, and spread the news of the day.¹²

Relatively insignificant small-scale selling of pottery and domestic products appears to be the only economic activity in women's markets that is cited in record books and other writings. A principal difficulty in terms of records describing rural areas in North Africa is that sources are more limited than those concerning urban areas. Yet, postwar data can provide a fair understanding of the economics of women's markets. Aith Waryaghar, the most notable Berber tribe in the Rif has women's markets still operating today. According to data gathered in 1949, Aith Waryaghar women's markets still show an enormous gain gap (see Figure 1).

Figure 1: Market gains for the tribe of the Aith Waryaghar in 1949



\$319,840 and \$3,986 pesetas are equivalent to \$2,579.06 and \$33.19 USD respectively.

Hart, David M. *The Aith Waryaghar of the Moroccan Rif* (1976): 76-88.

Organization Through Women's Markets

¹² Emilio Blanco Izaga and David M. Hart *Emilio Blanco Izaga, Colonel in the Rif a Selection of His Material Published and Unpublished, on the Sociopolitical Structure of the Rifians of Northern Morocco*. Ethnography Series. New Haven, Conn.: Human Relations Area Files, inc., (1975): 111.

Written sources do not mention any specific model or protocol through which women operated, yet selected reports reference a notable system of organization known as the Liff system. In early 1920, the British Vice-Consul in Tetuan, Isaac Abensur, reported that aside from military action, women engaged in socio-political activities through the markets they controlled. The following excerpt from one of his reports describes women “sacrificing” themselves (which is figurative language for a sacrifice that they performed) and the Khmas, an independent tribe inside a tribe, another way to describe the Rifi State. Abensur reported:

They [women] have gone to neighboring tribes' markets and sacrificed themselves to urge other women to convince their menfolk go to the aid of the Khmas.¹³

What Isaac Abensur vividly described was, without a question, the peculiar political alliance system known as the Liff. Previous to the establishment of the Rif Republic, the eighteen Berber tribes that inhabited the Rif Mountain range used this system as means to gain allies in times of conflict and protect themselves from extra-tribal and intertribal threat.¹⁴ The Liff consisted of offering sacrifices to the mosque of a third tribe with which an alliance was desired.¹⁵ A professional scholar in Muslim law, or Faqih, usually sacrificed a bull, the most expensive meat at this time, as it symbolized honor and a true disposition for alliance. As soon as the blood of the animal tinted the structure's walls or the ground, an alliance was systematically sealed between the tribes. After an agreed upon period of time, or after an agreement was fulfilled, the alliance was terminated.¹⁶ It is important to note that in order to honour his Liff alliances, 'Abd al-Karim al-Khattabi, assisted Berber tribes under the French protectorate, thus antagonizing French forces. These actions positioned the Rif Republic in opposition to France and led to a two-front war.¹⁷

The existence of the Liff system is known to western literature because extensive anthropological research has been done on men's markets. Nonetheless, little is known about women's markets and how the Liff was adopted. If the women of the Rif operated in segregated markets, how did they adapt the Liff to their segregated sphere? Common assumptions imply that women noticed the practicality and importance of the Liff system and simply adopted it; other assumptions imply that men instructed women on this institution.

¹³ C.R. Pennell (citing Atkinson to Kerr). *A Country with a Government and a Flag: The Rif War in Morocco, 1921-1926*. Outwell, Wisbech, Cambridgeshire, England Boulder, Colo., USA: Middle East and North African Studies Press; Distributed outside the UK by L. Rienner, (1986): 149.

¹⁴ Sebastian Balfour. *Deadly embrace: Morocco and the road to the Spanish Civil War*. Oxford: Oxford University Press, (2002): 184.

¹⁵ C.R. Pennell (citing Hart) "Women and Resistance to Colonialism in Morocco: The Rif 1916-1926." *Journal of African history* 28, no. 1, (1987): 114.

¹⁶ Rupert Furneaux. *Abdel Krim: Emir of the Rif*. London: Secker & Warburg, (1967): 26.

¹⁷ *Ibid.*, 85.

Yet, none of these can be corroborated with primary sources thus far. For instance, within the male sphere, tribe representatives were selected to perform the Liff and the person in charge of the sacrifice was a Faqih. Within the female sphere, in this specific period time, primary sources do not make mention of any women professionals in Muslim law. Also, whether specific women were selected as representatives of their markets remains unknown. A possible candidate for market representation could have been the Amina, a female market supervisor and regulator.¹⁸ Yet, no sources prove this statement.

Due to the exceptional organization demonstrated in the markets, clearly women displayed impressive skillfulness in medical, tactical, technical, and military training. Nevertheless, according to various authors, the Rif government did not have the initiative to set up military training programs for women. This fact does lead to the question: how did women acquire the capacity to be militarily competent? C.R. Pennell argues:

Since people do not simply pick up a gun and start shooting to any effect without any sort of knowledge of how to do it, this suggests that there must have been a far wider and longer acquaintanceship with firearms than the portrayal of women as socially and politically marginalized would allow. In fact, these women seem... to have been acting within a traditional context, this time one of military activity.¹⁹

It is important to note that the women in the Rif Mountain range had an interesting history involving warfare before the formation of the Republic. In the eyes of westerners, Rifi women were naturally talented as capable and lethal warriors.²⁰ Although that statement is rough and based on various oral accounts and legends, it can be corroborated by notable figures and primary sources. According to Muai Ahmed er Raisuni, Sharif of the tribal Jebala confederacy in late 19th Century and early 20th Century, Rifi women bravely engaged in combat as fighters and medics.²¹ In addition, anthropological findings report that traditionally, women in the Muslim world accompanied their husbands in the house, in the

¹⁸ Emilio Blanco Izaga and David M. Hart. *Emilio Blanco Izaga, Colonel in the Rif a Selection of His Material Published and Unpublished, on the Sociopolitical Structure of the Rifians of Northern Morocco*. Ethnography Series. New Haven, Conn.: Human Relations Area Files, inc., (1975): 87.

¹⁹ C.R. Pennell. "Women and Resistance to Colonialism in Morocco: The Rif 1916-1926." *Journal of African history* 28, no. 1, (1987): 115-116.

²⁰ Sebastian Balfour. *Deadly embrace: Morocco and the road to the Spanish Civil War*. Oxford: Oxford University Press, (2002): 198.

²¹ Rosita Forbes. *The Sultan of the Mountains: The Life Story of Raisuli*. New York: Holt, (1924): 224.

fields, and into the battlefield if necessary.²² As primary sources indicate, the women of the Anjara tribe from the Jebala were notable for their custom of accompanying their husbands into war, tending the wounded, reloading rifles, and even taking action in the front lines.²³ This research suggests that through segregated markets, military and medical training was passed down to younger generations from knowledgeable elders. Hence, this investigation argues the military training Rifi women displayed in the battlefield was acquired through women's markets based on their previous experiences rather than as a government incentive.

Elderly women oversaw preparing and instructing younger women in various activities in order to contribute to their republican entity. According to Mulai Ahmed er Raisuni, in 1921, tribal women in the Jebala utilized rifles that they had hidden in the mountains to ambush a Spanish detachment that was burning their houses while the men were absent. He mentions that an old woman known as "the sorceress" led the warring party into action.²⁴ This observation specifies the key role that experienced seniors played in the military instruction of younger generations.

In terms of medical training, the situation was slightly different. As 'Abd al-Karim al-Khattabi tried to forge a modern Muslim state patterned after European models, modern medical training had to be implemented. Yet, the medics could not work with Rifi women directly. For example, women looked after the wounded, but the person who knew most about modern medical care was a male pharmacist from Tangier named Mahbiub, who arrived in the Rif in 1921. Pennell elaborates:

He worked through men, teaching them the general principles of new methods of care so that they could pass them on to their wives. The only way of reaching women directly was through other women.²⁵

This observation clearly corroborates the assertion presented in this paper that women organized through the segregated markets they controlled since the markets were where women congregated.

The Collapse of the Republic

²² Emilio Blanco Izaga and David M. Hart. *Emilio Blanco Izaga, Colonel in the Rif a Selection of His Material Published and Unpublished, on the Sociopolitical Structure of the Rifians of Northern Morocco*. Ethnography Series. New Haven, Conn.: Human Relations Area Files, inc., (1975): 59.

²³ C.R. Pennell. *A Country with a Government and a Flag: The Rif War in Morocco, 1921-1926*. Outwell, Wisbech, Cambridgeshire, England Boulder, Colo., USA: Middle East and North African Studies Press; Distributed outside the UK by L. Rienner, (1986): 148.

²⁴ Rosita Forbes. *The Sultan of the Mountains: The Life Story of Raisuli*. New York: Holt, (1924): 334-335.

²⁵ C.R. Pennell. "Women and Resistance to Colonialism in Morocco: The Rif 1916-1926." *Journal of African history* 28, no. 1, (1987): 116.

As the Rif War progressed, the Rifi Harka suffered greatly. Spanish forces made use of post WWI warfare techniques and machinery including aerial bombardment, chemical weaponry, and armored tanks and cars.²⁶ The utilization of this type of arsenal caused a radical change in strategies and Rifi military planning. Iberian campaigns became more effective as indiscriminate bombing of villages began in addition to the illicit appropriation of Rifi food and cattle. On April 19, 1925, traveler and writer Jerome Tharaud interviewed Primo de Rivera in Madrid. Afterward, Tharaud wrote in his journal that the Spanish air force bombarded various markets and villages. Also, in order to demoralize and force the Rifi Harka to surrender, al-Karim's soldiers were deliberately starved. Iberian forces took herds of cattle and crops from Rifi tribes and villages.²⁷ Although men and women's markets functioned to sustain the republic, aerial bombardments made market organization unfeasible. Further organization in women's markets drastically decreased. By the end of the Rif Republic, women engaged directly in the front lines due to an environment of total war. According to Sheila Rowbotham, British socialist and writer, total war is a condition under which women occupy combat roles. She recalls:

This was apparently the case elsewhere as well: in Vietnam against the Americans, [and] in Cuba against the Spanish.²⁸

Although Rowbotham's argument is accurate, the peculiar difference amongst Rifi women is that it was through women's markets that female military actions were organized and executed to maximize effectiveness. The importance of these markets is demonstrated after the fall of the Rif when, after the surrender of 'Abd al-Karim al-Khattabi, various markets in the Rif became the headquarters of Spanish tribal administration.²⁹

Conclusion and Future Work

This research demonstrates how social networks and institutions maintained by Rifi women contributed significantly to the struggle against colonialism and the rapid formation of the Rifi Government. Indeed, women organized through the markets they controlled, and the

²⁶ Susan G. Miller. *A History of Modern Morocco*. New York: Cambridge University Press, (2013): 109.

²⁷ Jean Tharaud, Jérôme Tharaud, and A. S. Moss-Blundell. *Spain and the Riff; Political Sketches*. London,: Faber and Gwyer, (1926): 29-30.

²⁸ Sheila Rowbotham. *Women, Resistance and Revolution*. London: Allen Lane, (1972). 220.

²⁹ Emilio Blanco Izaga and David M. Hart. *Emilio Blanco Izaga, Colonel in the Rif a Selection of His Material Published and Unpublished, on the Sociopolitical Structure of the Rifians of Northern Morocco*. Ethnography Series. New Haven, Conn.: Human Relations Area Files, inc., (1975): 90.

elderly played a key role in terms of military training and socio-political influence. The Rif government implemented measures to establish modern medical care and technological innovations, and women's markets were the key institution by which all women from the Rif had access to information and training.

Nevertheless, due to limited primary sources and anthropological research regarding women's markets in the Rif Republic, this research is a work in progress. To achieve accurate and qualitative results, future archival research in Moroccan, French, British, and Spanish diplomacy documents is of crucial importance. Therefore, the further study of women's markets can help dissipate historical and anthropological incognita that regards the idiosyncratic institution of the Rif Republic and its astonishing effectiveness in clashing with the armies of two powerful European states, France and Spain.

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(Un)Smiling: Queering ChicanaDyke Smiles and Stories of *La Familia*



Sarah Maritza Hernández (sarita)

Mentor: Susy J. Zepeda, Ph.D.
Chicana/o Studies

Abstract

Through unraveling how smiling can be both a false form of protection as well as a comical form of resistance, I engage with domestic violence through Queer Chicana performance. This creative interdisciplinary project is conducted through autoethnographic digital filmmaking and silk screen-printing. Through autoethnography, I reflect on how smiling is a destructive form of survival with racialized, classed, sexualized, and gendered implications and unmask how performance, specifically payasa performance, is healing through resistance. In creating political art, I distribute these knowledges far beyond academia to reach the voices of domestic violence survivors that have endured the silence of smiling. This project aspires to increase awareness of the violence-inspired Chicana smile as well as to deconstruct the notion that la familia Chicano is home.

*Espalda*ⁱ Grounding

While reading Gloria E. Anzaldúa's and bell hooks' perceptions on familial love and masking, I fostered a deep interest in the family as a site of violence and performance of sanctuary. I reflected on how in my lived experience as a young Queer Chicana I failed to learn how to love. Not only did I learn how to fear, but I also learned how to perform through domestic violence. I engage with domestic violence as everyday performances and the different forms of resistance that occur within these performances. For my project, I define domestic violence as emotionally, verbally, and physically violent, nonconsensual abuse perpetrated upon family by other family members. This can include intimate partner violence, but my research focuses on the domestic violence inflicted upon children. *La familia Chicano*ⁱⁱ is not home when memories of bruises, trauma, and silence linger, too familiar. The discourse regarding *la familia Chicano* does not address what *familia* means for those who come from domestic violence and *machista*ⁱⁱⁱ families.

Since my project directly involves the politics of memory, emotion, and abuse and how these are manifested through everyday performances, I engage with my autoethnography through visual art, which is rooted in radical subjectivity. In Alison Jagger's *Love and Knowledge: Emotion in Feminist Epistemology*, she argues "Emotions differ from feelings, sensations or physiological responses in that they are dispositional rather than episodic" (1989, 489). Jagger addresses the distinction between emotional episodes and emotional disposition by stating that disposition can become a performance. Emotional disposition becomes a performance of embracing the power to deal with domestic violence as the performer chooses. In witnessing domestic violence, learning how to perform or disposition for survival emerges. Through visual art, I engage with Queer Chicana performance to further understand how smiling^{iv} is a performance of false protection and how the ridiculing performance of *la payasa*^v works as resistance to domestic violence.

My autoethnography is conducted through silkscreen prints, digital film narrative, and feminist theater performance. This visual art explores how the emotional and physical domestic violence in my Salvadorian-silenced and Mexican-*machista* family teaches Queer children the forced performance of fear, silence, and resistance to love as well as how it continues the performance of colonization through policing, othering, and smiling. By engaging oral histories and autoethnography, I focus on personal lived experiences to

ⁱ Translation: Back

ⁱⁱ Translation: The Chicano family

ⁱⁱⁱ Translation: Chauvinistic

^{iv} "Smiles" and "smiling" are subject to redefinition

^v Translation: Clown archetype

Sarah Maritza Hernández (sarita)
(Un)Smiling: Queering ChicanaDyke

embrace stories of resistance hidden behind the perpetrator narrative that frames survivors as agentless, silenced victims.

As a feminist film autoethnographer, I created *La Puente de Sonrisas*^{vi}, a digital film narrative, to be a reflection of my lived experience with domestic violence and masking as a process of smiling. In bell hooks' *All About Love: New Visions*, she theorizes, "Shamed by the feeling that they can never let anyone know who they really are, they may choose isolation and aloneness for fear of being unmasked" (2000, 60). bell hooks writes about love's direct communication to self-worth and violence by addressing lack of love as directly rooted in domestic violence perpetration and victimhood. Her insight allowed me to visualize what I had experienced by permitting her own experiences to be unmasked in *All About Love: New Visions*. In *La Puente de Sonrisas*, the process of masking, shaming, and isolation is visualized through a disjointed narrative that is incomprehensible to the gazes of hegemony. This film is for the smiling survivors who perform by masking bruises and scars with smiles. bell hooks' work inspires questions concerning the notion of the family and how questions of domestic violence continue to be masked in discourse regarding *la familia Chicano*.

Similar to ideas of "masking" in *La Puente de Sonrisas*, *la payasa* performance is manifested through my theater performance of "Slutty Hickeys" in UC Davis' VAGINA: OurStories 2012. In this performance, the performer is unmasking herself by demanding that society stop policing her body and gender expression. In Anzaldúa's introduction to *Haciendo Caras: Making Face, Making Soul*, she analyzes how "Our inner *payasa*, clown-face, is always aware of what's going on and uses humor to volley back the racial slurs" (1990, xxvii). She introduces this anthology by fleshing out reasons why women of color need to manipulate their facial expressions to reflect the experiences of their racialized, classed, and gendered bodies. She describes the concept of *la payasa* to be a woman of color who transforms situations of anxiety into sources of resistance through this comical "trickster" archetype. Not only does the theater performance's *payasa* resist the hegemony of discrimination that Anzaldúa addresses as "racial slurs," but *la payasa* is also resisting traditional forms of performance and visual art.

Similarly, in *Disidentifications: Queers of Color and the Performance of Politics*, José Esteban Muñoz (1999) describes "disidentification" as a process of transforming majority culture through embodying the outcast perspective of the racial and sexual others. Muñoz describes, "At times, resistance needs to be pronounced and direct; on other occasions, queers of color and other minority subjects need to follow a conformist path if they hope to survive a hostile public sphere" (5). The "disidentification" of *la payasa* transforms the majority performance of the perpetrator and revolutionizes the narrative of abuse into a

^{vi} Translation: The Bridge of Smiles

comical, ridiculing performance that critiques the perpetrator's violence by transfiguring it into a caricature. The *La Puente de Sonrisas* digital film and the "Slutty Hickeys" performance are both focused on processes of disidentifications with mainstream notions asserted about domestic violence and Queer Chicanas. The artist creators hope to disrupt the mainstream narrative of *la familia Chicano* and stereotypes imposed on Queer Chicanas and domestic violence by offering counter-narratives of smiles and *payasas*. I will build on Anzaldúa's and Muñoz's conversations on "making face" and "disidentification" by reframing the concept of *la payasa* as a performance of resistance, not only to "racial slurs" and performance art hegemony as they position it, but particularly as resistance to the perpetration of domestic violence in *la familia Chicano*. This smiling performance powered by racialized, gendered, and classed stereotypes assigned to Queer Chicanas structures the normalization of the Chicana-smiling silence.

This project merges the performing *payasa* and the smiling survivor by the masking performance of negotiation and survival. Through this creative visual autoethnography, I hope to increase awareness of the violence-inspired Chicana smile as well as to deconstruct the notion that *la familia Chicano* is the only kind of home.

Learning to Perform *Smiling* through Domestic Violence

Through engagement with smiles and domestic violence, I focus on the process and performance of false protection motivated by survival. Performance of false protection acts as a barrier to survivors of domestic violence because the smiling or false protection acts as a mask. This becomes a forced way of interacting with those around them and silences their experience with domestic violence. Constantly living in violence creates shame and silence, so this mask becomes the shield. But who does this *smile* actually protect?

I created the film called *La Puente de Sonrisas* to illustrate this performance of false protection and nonconsensual negotiation through the stitching of a smile mask, interaction with family photographs as well as capturing the internal dialogue of a trapped survivor who can solely express reality through the in-between spaces of washing dishes, praying, waiting for the bus, and walking. Although this film is about my lived experience with domestic violence, being filmed terrified me because it exposes the internal conflict that occurs within my smile. Graciously, my younger sister and maternal grandmother agreed to tell my story as the main characters in this film. This film is inspired by how discourse around *la familia Chicano* silences the experiences of Queer Chicana affected by domestic violence within *familia*.

Image 1: *La Puente de Sonrisas*, Image Stills, 2014



Using José Esteban Muñoz’s theory of “disidentifications,” I “disidentified” with how domestic violence was not addressed and how *la familia Chicano* was framed as the only *familia* that one should find as sanctuary. How is this narrative problematic for those who are running from their *familias* infested with domestic violence? The constant imposition of *la familia Chicano* as home condemns a Queer experience of surviving that familiarity and witnessing Queer *familias* for refuge. This film focuses on the power of bell hooks’ “oppositional gaze” by traveling beyond a pity gaze and subverting the chauvinistic *familia Chicano* narrative. When I started filming, I realized that I witnessed so much more than I assumed I was already aware of.

Image 2: *La Puente de Sonrisas*, Image Stills, 2014



La Puente de Sonrisas was inspired to create transformative justice through Queer, feminist research by exposing the hidden and masked realities faced by the smiling and masking survivor navigating the bridges that dictate negotiation. In bell hooks’ *Reel to Real*, she defines the oppositional gaze, “By courageously looking, we defiantly declared: ‘Not only

will I stare. I want my look to change reality.’ Even in the worst circumstances of domination, the ability to manipulate one’s gaze in the face of structures of domination that would contain it opens up the possibility of agency” (254). Through her definition of the oppositional gaze, hooks informs us of what the smiling survivor is unable to witness because the smile masks the reality. *La Puente de Sonrisas* serves as the oppositional gaze that attempts to fathom the reality of witnessing and the desire to create change within the family portrait. My oppositional gaze as the filmmaker is witnessing my reality through the removed existence of the camera lens aspiring to change that reality of silence, violence, and conformity to the Queer Chicana resistance of healing resilience.

Throughout the film, the moments of ‘in-between’ destinations illustrate the internal dialogue of anguish and desperation that can only be revealed in the Queer spaces of the ‘in-between’ where the smile becomes absent and the mask is temporarily removed. In Carla Trujillo’s *Living Chicana Theory*, Yolanda Chávez Leyva writes, “I stopped imagining silence as the absence of something. Rather I started to listen for what silences held within them” (1998, 429). These ‘in-between’ destinations symbolize the burden of silence on the backs of the bridges called the smiling domestic violence children. These ‘in-between’ states reveal the voice within the silence and the testimonies bound by the prescribed silence. Since domestic violence straddles the razor-sharp line of discipline and abuse, it is important to understand what this discipline evokes. In *Decolonizing Methodologies*, Linda Tuhiwai Smith addresses the function of discipline and colonized peoples when she argues, “The concept of discipline is even more interesting when we think about it not simply as a way of organizing systems of knowledge but also as a way of organizing people or bodies” (1999, 71). The act of abuse and domestic violence against children is disguised by discipline and child raising. This guise of discipline allows for abuse and violence toward “powerless” and oppressed bodies.

In the film, a deep voice yells for the main character in anger and this produces feelings of anxiety for the film viewers because it is the most jarring sound during the film. The angry voice symbolizes the power of the perpetrator and how fear is instilled in something as ordinary as calling a name. This moment of intense anxiety and exertion of anger disrupts the silence throughout the film and reveals the story behind that smile. This tonal and volume alteration forces the audience to listen through fear and creates a moment of empathy with the smiling child. This tonal attack intentionally shifts the internal reflection to the external force fueling the solemn energy of the film.

The repetition of the “Hail Mary” Catholic prayer and film shots of *La Virgen de Guadalupe*^{vii} serve to address the continuous cycle of colonization and violence normalized by patriarchy. The desperation in the recitation of this prayer addresses the terror instilled in

^{vii} Translation: The Virgin Mary

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smiling generations of domestic violence. This Catholic prayer is connected to the violence against indigenous peoples and the assimilation and colonization of lands and generations by enforcing this heteronormative, white patriarchy that punishes “the Other.” In *Living Chicana Theory*, Deena J. González explains, “Rape, battery, abuse, and violence are aspects of the vicious cycle of conquest and colonization, and they affect us daily in the institutions where we reside” (1999, 55). The cycle of conquest and colonization is not only manifested through institutions, but also through domestic violence and silence. The heteronormative, patriarchal, whitening project of *la familia* utilizes power, discipline, and punishment to reinforce the colonizing structure of domestic violence against children.

The multiple generations featured in the film, my younger sister, and maternal grandmother, emphasize the cycle of domestic violence, Catholic colonization, and silence illustrated through photographs. The acts of kissing photographs connect generations to illustrate the different moments of negotiating, masking, waiting, screaming, and silencing. The absence of words and lack of a comprehensible or accessible storyline demonstrate my own understanding of stitching smiles and removing stitches – it is the process of understanding what that silence embraces. I created this film to remember my witnessing, my “oppositional gaze,” and to transform the terrorizing reality of domestic violence and memories of nightmares. *La Puente de Sonrisas* illustrates the gender, the color, and the body of silence that lives within the wretched memories and resilient moments of my lived experience as a stitcher of smiles.

La Payasa’s Performance of Resistance

Since the performing *payasa* embodies the *machista* perpetrator performance through Queer, feminist, and performative critique of the patriarch, the performance emerges as a site of resistance to and survival of domestic violence. A Davis, California, community production called “VAGINA: OurStories,” inspired by Eve Ensler’s *Vagina Monologues*, critiques systems of oppression and brings awareness to domestic violence, gendered violence, and sexual assault issues through storytelling and performance as a site of resistance to gendered violence. I have participated in this production for three years through writing, performing, producing and directing. Year after year, I have witnessed the resilience radiating from the performers who are survivors of gendered violence.

This production is entirely community written, performed, produced, directed, and run. All the stories in this production are personal lived experiences. Entering the production as a writer and performer, I wrote “Slutty Hickeys,” which is a performance about slut-shaming and gender expression. I decided to perform “Slutty Hickeys” because it allowed me to perform the role of a resilient character that I knew I embodied. “Slutty Hickeys” is a

monologue about hickeys, dildos, fishnets, and short shorts that addresses body-shaming, slut-shaming, and gender policing, and declares an end to these issues by remembering personal experiences and conversations. When I performed *la payasa*, I remember feeling so resilient, like I held a shield that would fight off any demeaning slut shaming notions placed on my body.

Similar to this “masking,” in Anzaldúa’s *Haciendo Caras: Making Face, Making Soul*, she analyzes how the inner *payasa* is always aware of racial injustices and embraces humor and absurdity as a method of resilience. Anzaldúa’s interpretation of *la payasa* archetype is grounded in transformative justice similar to the performing *payasa* that utilizes comical performance to mimic and expose how ridiculous the violent performance of the perpetrator is manifested. This *payasa* exposes the violence by embracing the humor in the ridiculous nature of violence. My performance of “Slutty Hickeys” allowed me to disengage from the fear of slut-shaming. Moreover, I delivered a performance that transformed me into the resilient person I was struggling to create consciousness around. Being a ChicanaDyke in my stories of violence, *la payasa* sustained me when I had to be strong, when I had to be the bridge for *mi familia*. *La payasa* allowed a transformation from violence and despair to resilience and humor that ridiculed the perpetrator of violence.

Not only is performing *la payasa* practicing resilience, it also navigates the Queer space between reality and mockery. In living this murderous violence, performing humor ridicules the malice that harms those the performer entertains. José Esteban Muñoz’s *Disidentifications: Queers of Color and the Performance of Politics* addresses this idea of disidentification that he describes as, “the survival strategies the minority subject practices in order to negotiate a phobic majoritarian public sphere that continuously elides or punishes the existence of subjects who do not conform to the phantasm of normative citizenship” (19). *VAGINA: OurStories* brings awareness of sexual assault and gendered violence through this process of “disidentification.” These writers, performers, directors, and producers advocate against sexual assault and domestic violence because there is desire to create change and subvert the normalized violence forced on their particular oppressed bodies. This production is a “disidentification” with the gendered violence of mainstream theater productions and the reality of fear in domestic violence that silences the survivors of domestic violence and sexual assault. This production inspires the performance of resistance and silence by witnessing, telling, and healing - what Beth Brant’s “Telling” imagines. Through *VAGINA: OurStories*, the act of remembering violence through witnessing sparks a resilient act of telling and continues the soul-long process of healing from multiple violences of colonization, assimilation, and patriarchy. The performing *payasa* tells the violent truth of what she witnesses in the hope of healing from the generations of violence.

The Process of Negotiation for Survival

The Queer space between the performing *payasa* and the smiling survivor serves as a process of negotiation. Will I be perceived as weak if I don't smile? Will I be perceived as a troublemaker if I perform *la payasa*? These questions arise in moments split into seconds of negotiations. In finding that *la payasa* plays a sustaining role for her audience of survivors, she cannot smile the *payasa* smile in front of the perpetrator, so she smiles for her own survival even if it is embedded in falseness. The negotiation occurs within these 'in-between' spaces where the ChicanaDyke will inevitably be perceived as the toxically stereotypical "Chicana lesbiana" with all the gendered, sexualized, classed, and racialized consequences of the "Other." In order for her to survive, awareness of the ChicanaDyke's audience is vital.

Along with negotiating her performances in the sphere of the home, she also carries the weight of stereotypes placed upon her for being a ChicanaDyke. The ways in which she learns to perform through domestic violence creates an opportunity for gendered, racialized, sexualized, and classed analysis. The smiling performances are influenced by the way society perceives the performer's location in connection to violence and stereotypes that invalidate her experience of violence redefining the performer's smiling. It is gendered because "*calladitas se ven mas bonitas*."^{viii} It is sexual because Queer Chicanas are supposed to be spicy, hard, and inherently silenced objects. It is classed, because working Chicanas do not have time to deal with the emotional, physical, or mental reality of domestic violence. It is racialized because "It's fine, we're Mexican, that's just how we deal with our kids." The perceived core of a Mexican family identity is to physically abuse the children, especially if they are Queer, as well as emotionally and mentally abuse the children as the mother stands by, paralyzed. These gendered, sexualized, classed, and racialized experiences are embedded in stereotypes that structurally shape this silence to violence by being the commonly accepted norm. The ways in which the silence is transformed to either a false protection or comical resistance is rooted in the negotiation process of survival.

In Donna Kate Rushin's "The Bridge Poem" from *This Bridge Called My Back*, she declares her complete dissatisfaction with being "the damn bridge for everybody" and writes about the type of bridge she needs to be for her own survival. She conveys frustration, anger, and self-reconciliation through her emotions to form theoretical understandings that are accessible to everyone who feels and resonates with her experiences. She theorizes what is happening in many communities that displace women of color into destructive spaces of negotiation, code switching, and constant translation. In Rushin's poem, she redefines "being the bridge" as an exhausting, exploitative experience. She utilizes the emotion to support her understanding and intellect around the roles that people with intersectional identities encounter. She writes

^{viii} Translation: "Silenced girls look prettier."

about the struggle of being the bridge that exists at the razor-sharp borderland. Rushin writes, "I've had enough / I'm sick of seeing and touching / Both sides of things / Sick of being the damn bridge for everybody" (1981, xxi). She reveals this other aspect of connecting communities that exposes the violences and non-consensual or assumed consent when placing a woman of color's back into this position. At the end of the poem, she addresses what she needs to change in order to stop this exploitation: "I must be the bridge to nowhere / But my true self / And then / I will be useful" (xxii). She is sending a call for women of color bridges to remember themselves, remember their bodies, and remember to care for themselves because very quickly, the bridge for all communities will shatter unless she acknowledges that she needs to care for herself and be the connector of her thoughts and experiences.

Image 3: Fronteras y Puentes: Cuerpos de Resistencia. Silkscreen Print. 2013



Reflecting on Donna Kate Rushin's "The Bridge Poem," I created a silkscreen print that captures what I embraced from her political poem. As part of my autoethnography, this poster tells the story of my own experience of negotiation and being the bridge for *familia* in a site of domestic violence. Offered in the image above is a ChicanaDyke breaking out of the barbed wire. She is resisting the forced bridging placed on her body. She embraces the moon and the sun as they are often seen as opposing; she embraces them together, in all their parts. The barbed wire trapping her body symbolizes the back-breaking, non-consensual force inflicted upon her as "the damn bridge" connecting and working to hold her family together through the atmosphere of violence. The ChicanaDyke breaking out of this barbed wire displays her resistance and commitment to end this exploitation of her body. She carries tattooed images of scars and bruises and kisses on her body to reflect how domestic violence experiences have shaped how she witnesses the world. Sometimes, she must endure the

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nonconsensual bridging to survive and other times, she willingly embraces bridging all parts of herself by resisting the barbed wire. In this silkscreen print, the scars and bruises, kisses and flowers display the different patterns of negotiation in her process of survival. The process of negotiation illustrates when the different types of performed resistances that are vital to their survival in specific moments of violence.

Esperanzas^{ix}: Call for Action!

By unraveling these performances of false protection and resistance, I am making a call to spread consciousness regarding the different types of Chicano families and the different ways in which resistance to domestic violence is manifested. For a long time, I had the misconception that domestic violence and resistance to that violence only occurred in a singular manner. Through this project, I witnessed the multiple ways it manifests with different experiences. I am currently compiling oral histories and witnessing how resistance to domestic violence is shaped within them. In the future, I plan to complete collecting the oral herstories of Queer Chicanas who have participated in VAGINA: OurStories to see how our stories are in conversations and silences. I will also curate an interactive art gallery, in which I will display the artwork that I create from this creative autoethnography. In the art gallery, I plan to provide a space for conversation via creation. I will invite the attendees to share their reactions to the artwork. At the end of my project, I will create a call out for people that are willing to create zines exploring and documenting how they learned to perform through domestic violence. Creativity is core to my everyday resistance and through these zines, I hope contributors find healing. Healing is a soul long process, and I hope that this project continues conversations regarding the silence of the *la familia Chicano* discourse, disrupting the victim/perpetrator dichotomy and the stereotypes of violence forced on Chicanas.

^{ix} Translation: Hopes

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Preliminary Analysis of Seasonal Changes in Male Display Effort in Response to a Robotic Female in the Greater Sage-Grouse



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Abstract

*During courtship in many species, females choose mates by assessing male sexual signals, such as songs and courtship displays, which may indicate the male's underlying quality as a mate. But why should the female trust the male? How honesty in sexual signaling is maintained despite incentives to deceive is a controversial issue in evolutionary biology. One mechanism which may maintain honesty is the use of signals that are costly to produce, so that only individuals in good condition can afford to produce them. Here we test predictions of the hypothesis that sexual signals in male Greater Sage-Grouse (*Centrocercus urophasianus*) are energetically costly, and that variation in male display quantity over time is related to male reproductive success. To do so, we use a robotic female sage-grouse to elicit male courtship displays at different times throughout the breeding season and compare declines between males who are successful or unsuccessful in mating. In the breeding*

season, male sage-grouse congregate on display grounds (or leks) where they perform courtship displays known as struts, which include both visual and acoustic signaling components. Previous research suggests that females prefer males who strut more, but that strutting is energetically costly, with unsuccessful males decreasing in body weight more than successful males during the breeding season. We will measure the intensity (rate of display) and persistence (duration of display bouts) during experimental courtships with the robotic female. We predict that on average, individuals will show a decline in their display intensity and persistence during the breeding season; however, successful males will show smaller declines compared to unsuccessful males. Support for these predictions would suggest that courtship displays in sage-grouse are both costly and honest indicators of aspects of male quality related to success in mating.

Introduction

Originally introduced in the book, *On the Origin of Species by Means of Natural Selection* (1859) and *The Descent of Man, and Selection in Relation to Sex* (1871), Darwin developed his theories of natural and sexual selection to understand how animals adapt to the challenges of staying alive and reproducing. Natural selection generally focuses on the survival of individuals within a species, while sexual selection focuses on how individuals compete to increase their reproductive success by producing more offspring (Brock, 2007, Price, 1998). There is now strong evidence from many species to support the two complementary forms of sexual selection proposed by Darwin (1871): intrasexual and intersexual selection. Intrasexual selection involves competition for mates among members of the same sex. Male-male competition is a common form of intrasexual selection, where two or more males physically compete with one another for access to resources, such as food, territory, or mates. Intersexual selection refers to selective pressures caused by members of the opposite sex. Female choice is a form of intersexual selection, where females actively choose to mate with males with traits that they find attractive. For example, when attempting to attract females (peahens), male peafowl (peacocks) produce extravagant visual courtship displays that include shaking their uniquely patterned and colorful train. Peahens may be attracted to particular components of this display, such as the number of eyespots on the peacock's train (Petrie, 1994; Dakin, R. and R. Montgomerie, 2011). Because females are attracted to particular male display characteristics, males able to produce attractive signals are selected as mates over males that produce less attractive signals (Qvarnstrom et. al, 2002).

While there is evidence that females in many species may choose their mates based on male display traits (Andersson, 1994), the benefits females may gain from their choosiness have been more controversial. One possibility is that females assess male display traits to gain information about the underlying quality of their potential mate. By mating with a high-

quality male, females may gain direct benefits, such as male parental investment or physical resources, or indirect benefits, such as genes that will make her offspring healthier and more attractive (Andersson, 1994, Griffith and Sheldon, 2001; Qvarnstrom et al, 2002). But what prevents all males from producing identically attractive displays even if some have few benefits to offer? Honest signaling of male quality may evolve if male signals are costly to produce. For instance, the production of attractive displays can result in energetic costs, and different individuals may manage those costs more effectively than others due to differences in their physical condition and energetic resources (Grafen, 1990; Patricelli and Krakauer, 2010; Vehrencamp et al, 1989). Each male's condition and available energy may be determined by several factors, including his genetic make-up, his diet, and variation in the environment (Price, 1998; Moller, 1994). When there is variation in male signal production, females may gain information about a male's underlying quality as a mate by assessing his display characteristics (Petrie, 1994). When selection favors females who prefer signals that honestly reflect male health and condition, that process is known as handicap selection (Zahavi, 1975; Bradbury and Gibson, 1998).

How males allocate their available energy, either to maintain physiological functions or to perform different behaviors, such as the production of costly display traits, can be mediated by different behavioral decisions. Animals often have a range of alternative behaviors to choose from, and individuals may incur different costs or benefits when they select one behavioral tactic over another (Stearns, 1989). These behavioral trade-offs can often include temporal, as well as energetic costs. For example, displaying males invest energy and time to court the females that they encounter, and energy and time spent on one courtship may be unavailable for future interactions (Patricelli et al, 2011). Over time, males may need to adjust their display behavior to maintain an attractive signal, especially if both their energetic resources and their opportunities to court females decline as the breeding season progresses. For instance, a male that displays intensely early in the breeding season may be attractive to females encountered during that timeframe, but his attractiveness may fade later in the season if his courtship effort declines due to accumulated energetic costs (Griffith and Sheldon, 2001; Qvarnstrom et. al, 2002). Males with fewer energetic resources may tactically allocate their display effort by producing intense displays for shorter periods of time later in the breeding season. In this paper, we explore potential trade-offs in the courtship effort of lekking Greater Sage-Grouse (*Centrocercus urophasianus*) males across the breeding season.

Lek mating systems are particularly useful for studies addressing how male display effort relates to male mating success. Lekking species typically have highly skewed male reproductive success, where only a few top males are able to secure matings with females visiting the lek (Wiley, 1991). Males in lekking species also provide no parental care, so patterns of female choice can be attributed to differences in male behavior prior to mate selection more clearly than in species with bi-parental care. During courtship, male greater

sage-grouse produce a stereotypic visual and acoustic display called a “strut” (Wiley, 1973). Males also strut when there are no females around to attract females to the lek and to advertise their territories to other males (Wiley, 1973). Prior research suggests that females prefer males with higher strut rates; and males with higher strut counts also have higher mating success (Gibson and Bradbury, 1985; Gibson, 1996). This pattern of female choice could suggest that females are evaluating individual males based on their display output. Previous studies have also addressed the energetic costs associated with strutting in this species, finding that male sage-grouse tend to decrease in body weight during the mating season (Gibson and Bradbury, 1985; Beck and Braun, 1978; Hupp, 1989 and 1991). Furthermore, the energy expenditure of individual males was positively correlated with strut rate, time spent on the lek, and the overall number of struts given per day (Vehrencamp, et al. 1989). However, males who expended more energy lost less weight over the season, which suggests that there may be variation in male condition as well as in male display effort (Vehrencamp et al, 1989).

One way that males could manage the energetic costs of display is by varying their display intensity, persistence or both over either short or long time scales. Patricelli and Krakauer (2010) examined short-term adjustments in male display effort and found that individuals adjusted their display intensity (or rate) in response to female distance. Furthermore, Patricelli and Krakauer (2010) found that male responsiveness to female proximity was positively correlated with male mating success. These findings suggest that successful males may tactically deploy their display effort, by displaying less intensely when females are farther away to save energy and increasing the intensity of their display during close courtship when the likelihood of securing a mating is higher. These results may also suggest that sage-grouse males adjust their display behavior in response to female distance in order to manage an energetic trade-off between display intensity and persistence, where displaying intensely for shorter periods of time could be less energetically costly than longer display bouts. However, we currently know very little about how male display effort changes across longer time scales. Changes across the breeding season or among breeding seasons may be determined by long-term allocation decisions, similar to those observed by Patricelli and Krakauer (2010), as well as differences in food intake, body condition, and metabolic efficiency.

Here we measure changes in the display effort of male greater sage-grouse across the breeding season by eliciting courtship from males early and late in the breeding season using a robotic female stimulus. By measuring male display effort over the course of the breeding season, we hope to address the following questions: (1) As time progresses, does male display effort increase, decrease or stay constant? (2) Do display intensity and persistence trade-off over time, such that a male with consistent display intensity shows a decrease in his display persistence? (3) Do males adjust their display effort in response to female behavior

and does variation in male display behavior relate to male reproductive success? We predicted a negative relationship between male display effort and time in the breeding season, because the energetic costs of display should compound over time. Furthermore, we predict that variation in male display intensity and persistence will depend on the presence of conspecifics. By assessing trade-offs in display intensity and persistence within and between individuals over time, we will learn how males adjust their display behavior to manage their energy expenditure over time. Analysis of the data collected from these experiments is ongoing; here we present preliminary analysis of a subset of the experimental trials.

Materials and Methods

General Field Methods

We observed mating behaviors of 36 territory-holding adult male sage-grouse on Cottontail Lek (in Fremont County, Wyoming, USA, 42° 50', 108° 29') daily throughout the breeding season from March 10th until May 4th, 2014. To map individual positions, a grid was placed on the lek using wooden stakes placed 10 meters apart. Field assistants used spotting scopes to identify individual males by tail plumage patterns (Wiley, 1973, Patricelli, 2010). Positions of regular territory-holding males were recorded approximately two times per day. Counts of maximum male and female lek attendance were also recorded. We used blinds set up on an observation hill overlooking the lek to capture footage of the entire lek area throughout the breeding season. All male courtship displays (struts), mating events and other behaviors were recorded using Sony HDR-PJ430V video cameras. This research was approved by the Wyoming Game and Fish Department (permit 405) and UC Davis Animal Care and Use Committee (protocol 11662).

Robot Trials

We used two robots as a controlled female stimulus in this experiment (Patricelli and Krakauer, 2010). Observations of natural behaviors by females on the lek (A. Perry, A. Krakauer and G. Patricelli, pers. obs.) suggested that females who are looking back and forth from an upright body position are more likely to mate, thus we simulated these behaviors with the robot to mimic an “interested” female. In contrast, females unlikely to mate typically forage when moving across the lek, which involves tilting their body forward and pecking at the ground, thus we simulated these behaviors to mimic an “uninterested” female (Figure 1).

Figure 1: Robot Females at the Lek



The leftmost panel (A) shows the robot in an up-right posture (or “interested” position) with the remote controller in the background; the middle panel (B) shows the robot with her body and head tilted down to the ground as if foraging (in an “uninterested” posture); and the rightmost panel (C) shows the robot on the lek with a courting male.

All robot movements were controlled from a blind positioned on the edge of the lek using a Futaba 8FGA Super 2.4GHz remote controller, which communicated with a Futaba R6108SB receiver inside the robot. Both robots were designed with four independently-rotating wheels, giving the driver the ability to pivot the robots to the left or right (Inertia Labs Ultralight Ant Chassis treaded drive base kit, with four IL-GMS100 100:1 SRV Drive Motors and Tamiya 70194 Spike Tires, controlled by a Sabertooth 2X5 R/C Regenerative Dual Channel Motor Controller). Both robots were capable of three axes of movement: (1) pivoting their body position upright or forward to simulate tilting toward the ground during foraging, (2) movement of the neck up and down to simulate pecking at the ground during foraging, and (3) head rotation side-to-side to simulate looking around. All three motions were controlled by servo motors (Futaba S3117 Micro High-Torque Servo for the head rotation and Futaba S3151 Digital sport BB Servos for other movements). Electronics were enclosed within the body of the robot, which was a hollow fiberglass cast of a taxidermy body mold (McKenzie GBF17 game chicken body mold, measuring 9 1/4" x 14 3/4"). Both robots had the same underlying design, but different exterior skins (taken from real sage-grouse females donated to the project). This allowed us to use a different robot during different experimental trials to avoid habituation and to control for robot ID.

In 2014, all robot trials were conducted between the end of the peak of the breeding season, defined as the time in the season when the maximum numbers of females were present, until the end of the mating period. Robot trials were conducted in the morning when no real females were present on the lek (between times 0622 and 0930) to avoid interference with any real mating events and to ensure the robot was the target of male courtship behaviors. There were a total of seven robot experiments conducted on Cottontail Lek over the course of the mating season. Each robot experiment consisted of four sampling periods and each

experimental trial lasted for approximately 22 minutes. Each trial began with a three-minute pre-trial period. During the pre-trial, male display behaviors were recorded to acquire a baseline for each male's display effort in the absence of a female stimulus. Following the pre-trial, a recording of a female vocalization was played to alert the males to the arrival of a female on the lek. Next, the female robot left the blind and approached a target location adjacent to two to three males' territories. Once the robot had reached the target location, one of two treatments were conducted on the lek: Treatment 1, the robot showed increasing interest by switching from uninterested to interested behavior; and in Treatment 2, a robot showed declining interest by switching mid-courtship from interested to uninterested behavior. These treatments involved a total of nine minutes of interaction between target males and the robot (with six minutes allocated for the first behavior in each treatment, and three minutes allocated for the second behavior). Once the robot treatment had been completed, the robot was driven off the lek and male behaviors were also recorded during a three-minute post-trial period.

Video Analysis

Video analysis was performed in the lab using *Cyberlink PowerDirector* video editing software (version 12 Ultra, CyberLink Corporation). Male behaviors were scored using an ethogram and annotations were added to the video file each time a behavior was observed. For each focal male, we measured male courtship intensity using the male's display output, or the number of struts the male performed controlling for male-robot distance. We also measured courtship persistence by quantifying his total display time, or the time until the last strut was performed by the male during the robot sampling period. In addition to scoring male courtship displays (strut behavior), we also recorded any aggressive interactions between males (e.g., facing-off encounters and fights). For each behavior scored, the male's location on the lek was also noted using the grid stakes on the lek as reference points. During the robot treatments, the robot's position on the lek was recorded every 15 seconds. Here, we present a preliminary analysis of seasonal changes in male courtship intensity (not corrected for robot-male distance) between two trials in response to Treatment 1 on Cottontail Lek; analyses of additional response variables, additional trials, and an additional lek are ongoing.

Statistical Analysis

Video footage from a total of two robot experimental trials were analyzed for this study. These experimental trials were conducted on March 28th, 2014, and April 22nd, 2014, respectively, allowing us to compare changes in male display performance from samples collected 26 days apart. The preliminary results presented here include male display behaviors collected from a three-minute pre-trial period and the first robot sampling period,

where the robot performed six minutes of uninterested female behavior. Strut counts collected from sampling period one were twice as large as the pre-trial strut counts. All means and standard deviations were calculated using EXCEL (version 2013, Microsoft). We used the statistical language R (version 3.1.0, R Development Core Team) to perform a three-way ANOVA. In this analysis, the number of struts males performed depended on: (1) the date of the observation, (2) the ID of the male observed, and (3) the type of sampling period (or treatment) observed. We used the results of this three-way ANOVA to determine whether male display performance differed between days, whether individual males differed from one another in their display effort, and whether males responded to the robotic stimulus by increasing their display effort when the robot was present.

Results

On average, observed strut counts in this preliminary analysis were higher for sample periods when the robot was present (i.e., sample period 1) compared to the pre-trial period (see Table 1). The results of the three-way ANOVA explain 66.46% of the variance in the observed strut counts by date, male identity and the presence/absence of the robot ($F_{5,10} = 3.963$, $P = 0.0305$). However, strut counts observed on different dates were not significantly different from one another ($F = 0.406$, $P > 0.05$), which does not support our prediction of seasonal changes in display effort. In addition, different males did not differ significantly in their display effort in this sample ($F = 2.573$, $P > 0.05$). However, strut counts observed during the pre-trial period (no robot or real females present) and sample period one (one uninterested robot present) were significantly different ($F = 11.689$, $P < 0.05$), suggesting that males increased their display rate in response to the presence of the robot on the lek (see Table 2).

Table 1: Mean strut counts organized by sampling period and date.

Sampling Period	Date	Mean	Standard Deviation	Sample Size (N)
Pre-trial	3/28/2014	2.00	2.16	4
Pre-trial	4/22/2014	0.50	1.00	4
Sample 1	3/28/2014	9.25	7.89	4
Sample 1	4/22/2014	8.00	6.48	4

During the pre-trial period, males were observed for three minutes when the robot and real females were absent. In contrast, a robot was present during sample period one (six minutes). The same four males were observed for each sampling period.

Table 2: Results of a three-way ANOVA

	Degrees of Freedom	Total Sum of Squares	Mean Square	F-value	P-value
Date	1	7.56	7.56	0.41	0.53817
Male ID	3	143.69	47.90	2.57	0.11248
Treatment	1	217.56	217.56	11.69	0.00656*
Residuals	10	186.12	18.61		

The strut count observed depends on the date of the observation, the ID of the male strutting, and treatment. There were two treatments: the pre-trial period, when the robot was absent, and sample period one, when the robot was present.

Discussion

In this study, we found a relationship between male strut count and the presence of the robot on the lek. Observations of male strut counts collected during the sample period 1 (in the presence of a female robot) were significantly higher than strut counts observed during the pre-trial (samples collected in the absence of a female). These data suggest that female presence has a large impact on how males allocate their display effort. Our results support findings from previous studies that suggest that males attend to the social context of courtship by increasing their display effort in the presence of females (Gibson and Bradbury, 1985; Gibson, 1996; Patricelli and Krakauer, 2010; Wiley, 1973). While males may still benefit by strutting when females are absent to attract females to the lek and advertise territory boundaries, these studies suggest that males invest more in strutting when females are present to assess displays.

However, we found no evidence in this preliminary analysis to support our hypothesis that the intensity of male display (overall strut count) was influenced by the passage of time (i.e., the day in the season that an individual's display behavior was observed). We also found that individual males did not significantly differ from one another in the number of struts that they performed, either during the pre-trial period or during sample period 1. There are several possible reasons why neither the time in the breeding season nor male ID were related to strut counts in this analysis. First, because the analysis of data from this experiment is ongoing, only two sample days (March 28th and April 22nd) were analyzed for this comparison. Second, our preliminary analysis also included a sample size of only four individual males. With a sample size this small, we had very little statistical power to detect an effect of seasonal change and male identity. Once data collection from the videos is complete, our final analysis will include twelve additional males on these two sample days, as well as five

additional sample days for Cottontail Lek and approximately eight additional males observed on seven sample days on a second lek. Our future analyzes will also need to address the distance between each male and the female robot (in meters). By including male-to-female distance as a covariate, we will be able to assess whether males closer to a female strut more often, or more intensely, than males that are further from the female (Hartzler, 1972; Wiley, 1973a, 1973b; Gibson and Bradbury, 1985). Though we did not find support for our predictions in this preliminary analysis, a final analysis on the complete data set is needed before we can draw conclusions.

In addition to strut counts, future analyses will also include the analysis of display persistence, measured as the duration of strutting bouts. To do so, we will analyze persistence during sampling periods with the female robot present (sampling periods 1 and 2) compared to the sampling periods where the female was absent (pre-trial and post-post trial). Only sample period 1 was analyzed in this study, so we do not yet have sufficient data to estimate persistence. Once the data set is complete, we predict that males will display at both higher intensity (strut count) and higher persistence (bout duration) in the presence of a robot than in the absence of a robot. Furthermore, we predict that the energetic cost of display will accumulate during the season. If males decline in their display effort over the season, we predict that males who are more persistent early in the season will decline faster than males who display less early in the season. Alternatively, if males that display at a higher rate early in the season are in better condition, these males may not show a seasonal decline despite their higher effort. Additionally, we will compare male display effort in Treatment 1, with the robot mimicking increasing female interest, and Treatment 2, with the robot mimicking decreasing female interest. The current preliminary data was only collected during Treatment 1, and therefore cannot address the role of female behaviors in determining male courtship effort.

Conclusion

Similar to previous studies, we found evidence that male sage-grouse increase their strut count in the presence of a female (Hartzler, 1972; Wiley, 1973a, 1973b; Gibson and Bradbury, 1985; Patricelli and Krakauer, 2010). However, we did not find a relationship between male strut count and time in the breeding season or significant variation in the strut counts of different males in this preliminary analysis. Our final analyses will have more power to detect such patterns if they exist, because we will include a larger sample of males, more sample periods, more sample days from across the season and data from an additional lek. In future analyses, we will also address seasonal changes in the persistence of male displays, which will provide more complete information on male display effort. While conclusions cannot be drawn until we complete the final analysis on the full data set, this

Ciara S. G. Main

Preliminary Analysis of Seasonal Changes

study is the first step toward addressing the relationship between sexual selection and seasonal changes in male display performance in male sage-grouse.

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Prolactin (Prl) in Anestrous Mares under Ambient Lights after Treatment with Recombinant Equine Follicle Stimulating Hormone (reFSH)



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Animal Science

Abstract

Generally, mares' ovaries shut down during deep anestrus when daylight decreases. Significant interest exists in hastening commencement of ovulation and cyclicity for breeding so foals are born earlier the following year. The typical treatment to do this has been the use of artificial lights. Both follicle stimulating hormone (FSH) and luteinizing hormone (LH) are known to rise as daylight increases, inducing follicular growth and the first ovulation of the year, but the role of prolactin (Prl) is unknown. Usually prolactin rises during the transitional period from winter anestrus to cyclicity. A previous study demonstrated that deep anestrous mares treated with reFSH ovulated early in the year without artificial lights and the surge of circulating estrogens from the growing follicles was high and prolonged.

The study showed that an increase in estrogen from growing follicles in mares increases Prl levels, suggesting a role for Prl in reproductive function. The goal of this research is to evaluate plasma levels of Prl by radioimmunoassay in the deep anestrous mares from the previous study in order to determine if changes in Prl correlate with estrogen profiles and ovulation. Plasma Prl concentrations were calculated per unit time and were graphed for both groups. These graphs are compared to graphs of LH, estradiol, FSH, and progesterone. Plasma Prl concentrations were not significantly different between control mares and mares treated with reFSH. Since reFSH treatment significantly increased plasma estradiol, progesterone, and FSH concentrations but not Prl, the correlations were found to be negative (opposite change). Whereas the correlations in the control group were found to be positive (similar change) since the hormone concentration did not change throughout the study period.

Introduction

Horses are seasonal breeders, going into anestrus beginning in October and do not return to estrus until March. During anestrus, the ovaries of the mare shut down due to the decrease in gonadotropins responding to decreased daylight.^{6,16,32,33,37} As daylight increases, the ovaries of the mare increase in activity due to the rise in gonadotropins.^{22,33}

Several hormones to induce ovarian activity in the mare earlier in the year have been tried unsuccessfully. For example, gonadotropin releasing hormone (GnRH), domperidone, and porcine follicle stimulating hormone.^{2,4,9,13,18,21,26,28} The most popular method to induce ovulation earlier in the year for mares has been the use of artificial lights to stimulate recrudescence. Artificial lighting systems utilize a light schedule characteristic of spring-time weather: 16 hours of light and 8 hours of darkness. This has been a successful technique because it functions in accordance with the natural stimulation of hormones in the spring time to induce ovarian function. Increase in light stimulates GnRH which in turn stimulates both FSH and LH inducing follicular growth and the first ovulation of the year.^{32,17} Estradiol is secreted by the granulosa cells of the growing follicles as a response to FSH and is important for oocyte meiosis and ovulation.^{12,29,31}

In the past few years, recombinant FSH and LH have been developed to control reproductive activity in humans.^{19,31} Recently, recombinant equine LH (eLH) and equine FSH (eFSH) have been developed to induce follicular development, and ovulation in the mare.^{15,20,23,24,36} In addition, recombinant eFSH, has been observed to hasten the commencement of the first ovulation of the year.²⁵ This involved administering reFSH intramuscularly twice a day. When the largest follicle reached 35 mm in diameter, reFSH treatment was discontinued and an injection of 2500 international units of human chorionic gonadotropin (hCG) was

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administered intravenously 36 hours later to induce ovulation. While previous artificial lighting systems induce ovulation in horses within two months of treatment, reFSH induces ovulation in horses within 6 days of treatment.

All of the hormones mentioned previously have been documented to play a crucial role in follicular development and ovulation in the mare. The role of prolactin in ovarian activity is unknown, although it has been demonstrated that plasma Prl levels increase during spring recrudescence.²⁷ Previous research observed a correlation between estradiol and prolactin during winter anestrus in the mare.¹⁷ If reFSH increased plasma concentrations of estradiol, then we hypothesized that plasma prolactin concentrations would increase as well.

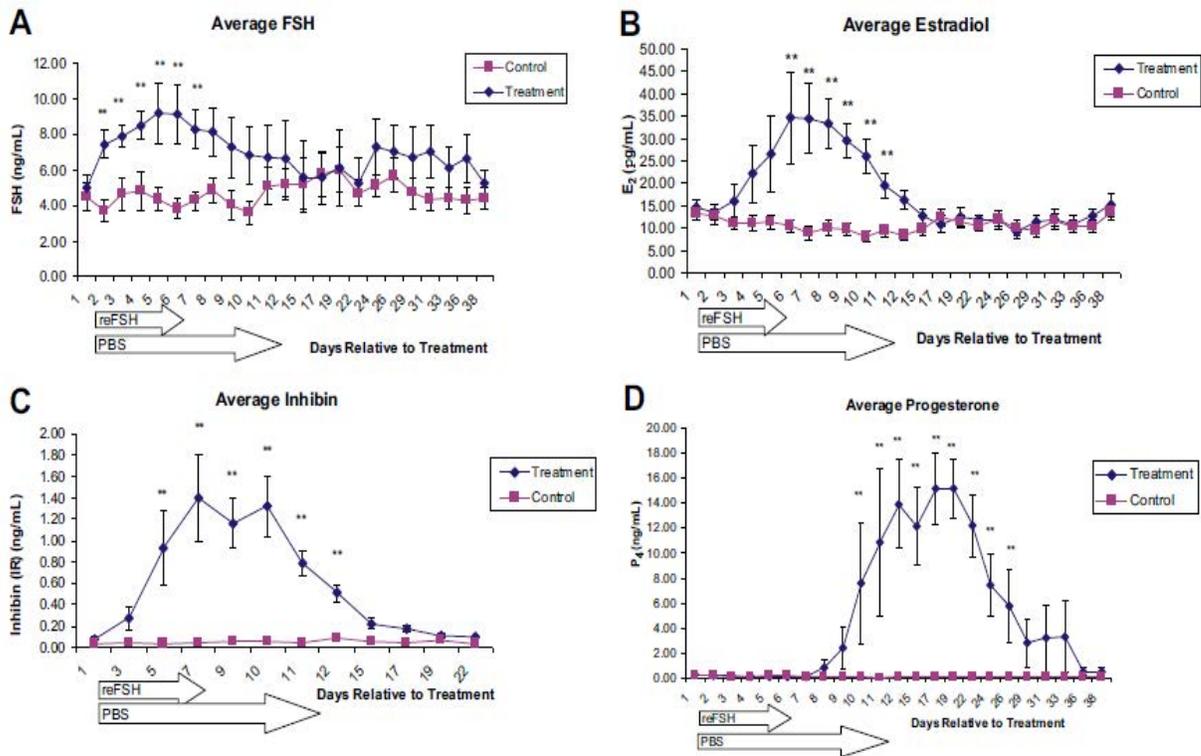
This paper evaluates the plasma prolactin concentrations by radioimmunoassay in the deep anestrus mares in order to determine changes in prolactin that may correlate with estrogen profiles and ovulation. This may reveal that prolactin is associated with follicular development and ovulation.

Methods and Materials

Animals

The study was conducted simultaneously using exactly the same protocol at three locations: University of California, Davis (UCD); Colorado State University (CSU); and University of Kentucky Gluck Centre (UKY). A total of 60 university-owned mares of light horse breeds in deep seasonal anestrus (20 mares per study site), maintained under ambient lights, were examined in the study. Mares were fed an alfalfa-grass hay diet with water available *ad libitum* at each location. Care and use of all animals conformed to the animal care and use standards set by United States Department of Agriculture Animal and Plant Health Inspection Service program.

Figure 1: Average FSH, Average Estradiol, Average Inhibin, and Average Progesterone of the Studies' Mares



Plasma concentrations of hormones in mares administered either reFSH (group A; n = 10) or a PBS placebo (group B; control, n = 10) beginning on January 31.²⁸ Blood samples were obtained daily during treatment and three times per week for 40 days after treatment. Each value represents the mean \pm SEM. A significant ($P < 0.05$) difference between plasma concentrations of FSH, E₂ and P₄ in the treatment group vs. placebo is indicated by an asterisk. No significant difference in plasma LH concentrations were observed between the treatment group and control group; data not shown.²⁸

Experimental Design

Mares were determined to be in deep anestrus if the maximum diameter of any ovarian follicle on either ovary was ≤ 20 mm, and serum progesterone (P₄) levels were ≤ 1.0 ng/mL when examined once per week for three consecutive weeks before the start of the study. Mares at each site were randomly allocated to one of two treatment groups of 10 mares each on January 31. Mares in group A received 0.65 mg of reFSH in 1.3 mL PBS intramuscularly (AspenBio Pharma, Inc., Castle Rock, CO., USA) twice daily (8 hours apart), whereas mares in group B received 1.3 mL PBS intramuscularly as a placebo twice daily (8 hours apart).

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Treatment period continued until (1) a mare developed one or more follicles ≥ 35 mm in diameter or (2) for a maximum of 15 consecutive days. Persons administering the treatments and evaluating the mares were blinded to the treatment groups.

Transrectal ultrasound examinations of the reproductive tract were performed at least three times per week during the 15-day treatment period. The diameter of the largest follicle and a diameter of all follicles ≥ 30 mm on each ovary were recorded during each ultrasound examination. Tone of the uterus and cervix were also recorded.

Mares that developed a follicle ≥ 35 mm in diameter during the treatment period with appropriate uterine turgidity and cervical relaxation were allowed to “coast” (i.e., no exogenous medications) for 36 hours and then subsequently administered 2500 international units of hCG (Chorulon; Intervet, Millsboro, DE, USA) to induce ovulation. Ultrasound examinations were subsequently performed once daily after administration of hCG to confirm the day and number of ovulations.

At the conclusion of the 15-day treatment period, placebo-treated mares (group B) at each study site were examined once per week until a follicle ≥ 35 mm in diameter was detected. Mares were then examined daily until the first spontaneous ovulation of the year was confirmed.

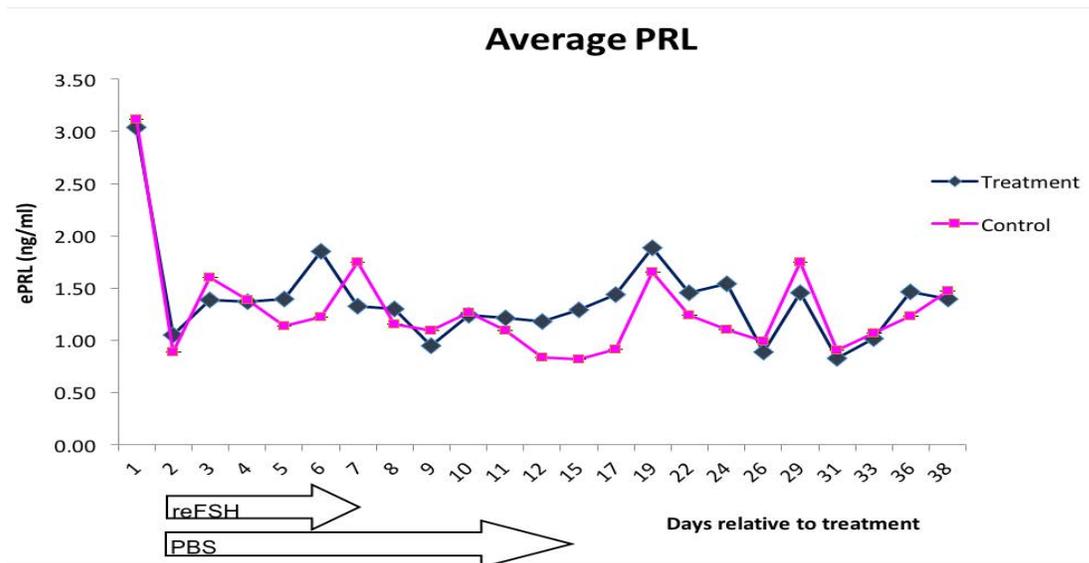
Mares treated with reFSH (group A) were monitored at all study sites (UCD, CSU, and the UKY) after the 15-day treatment period for subsequent follicular development to determine the date of the first spontaneous ovulation. An ovulation induction agent was not administered to any mares in each group after the 15-day treatment period. Results on ovarian activity can be found in the paper by Meyers-Brown et al.²⁵

Blood Collections²⁵

Jugular blood samples were collected in heparinized 10 mL tubes at UCD before treatment during the same time every morning. Blood collections continued daily until the end of treatment (or 15 days) and thereafter three times per week. Blood samples were centrifuged (1500 x g) for 15 minutes at 4°C, and plasma was aliquoted and stored in cryovials at -20°C until analyzed for hormones by validated radioimmunoassay (RIA). Results can be found in the paper by Meyers-Brown et al. and Fig 1.²⁵

Radioimmunoassay (Prolactin)

Figure 2: Plasma Concentrations of Prolactin (ng/mL) in Mares



Plasma concentrations of prolactin (ng/mL) in mares administered either reFSH (group A; n = 10) or a PBS placebo (group B; control, n = 10) beginning on January 31. Blood samples were obtained daily during treatment and three times per week for 40 days after treatment. Each value represents the mean \pm SEM. No significant differences in hormone values were observed between group A (reFSH) and group B (control).

The concentrations of plasma prolactin were measured by a validated RIA41. Highly purified pituitary-derived equine prolactin (Dr. A.F. Parlow, UCLA; Lot AFP-8794B) was used for both iodination and standards, which ranged from 0.06 to 32 ng/mL. The primary antibody was a rat anti-equine prolactin antibody (Parlow; AFP-361687R) used at a dilution of 1/38,000. The goat anti-rat antibody (G α Rat, Antibodies, Inc. 51-162) was used at 1/300 dilution. The sensitivity of this assay was 0.25 ng/ml and the intra- and interassay coefficients of variation were 2.72% (n=8) and 7.69% (n=3), respectively.

Statistical Analysis

The plasma concentrations of prolactin between the treated and control group were analyzed using a repeated-measure ANOVA followed by post-hoc comparisons with a significance level of $P < 0.05$. Hormone correlations within each group were conducted at a significance level of $P < 0.05$.

Results

Table 1: Correlations Between Hormones in the Treated Group

Treated Group Hormones	<i>Vs. Prolactin</i>
<i>Prolactin</i>	1.0000
<i>E2</i>	P = 0.02
<i>P4</i>	P = 0.05
<i>LH</i>	P = 0.41
<i>FSH</i>	P = 0.01

Plasma concentrations of prolactin were not significantly higher ($P < 0.05$) at any point in time in the reFSH-treated mares than the placebo group throughout the experiment (Figure 2). Average \pm SEM of plasma Prl concentrations were calculated per unit time and were graphed for both groups. These graphs are compared to the 2011 graphs of LH, estradiol, FSH, and progesterone (Fig. 1).

In the treatment group, there was a significant hormone correlation ($P < 0.05$) between Prl and E2, Prl and P4, Prl and FSH but not Prl and LH (Table 1). In the control group, there was a significant hormone correlation ($P < 0.05$) between Prl and E2, Prl and P4, Prl and FSH but not Prl and LH (Table 2). Since reFSH treatment significantly increased estradiol, progesterone and FSH but not Prl, the significance of the hormone correlations found between Prl, vs estradiol, progesterone and FSH was negative (opposite change) as opposed to positive (or similar change) in the control group. The correlation between Prl and LH were not significant and not different between the two groups.

Discussion

Prolactin did not respond to the reFSH treatment. Evaluation of the hormones altered by the reFSH treatment reveals that the reFSH treatment increased plasma concentrations of estradiol, progesterone and FSH. But plasma concentrations of LH did not increase (Figure 1). There was no significant correlation between Prl and LH.

The correlation between prolactin and LH has not been explicitly reported or studied in the horse, but it has been reported in the rat.^{5,14,35,36} It has also been reported that no obvious correlation between prolactin and LH exists in the rat.³ The correlation between LH and prolactin needs to be further studied across a variety of animals.

The lack of an LH response was thought to be because of the high increase in estradiol.^{7,8,10,11} Previous research shows that a short-term increase in concentrations of estradiol have a positive feedback effect on LH in mares.^{8,11} However, there is also research that describes a

negative feedback effect on LH if the concentrations of estradiol are high and prolonged in the mare.^{7,10}

Table 2: Correlations Between Hormones in the Control Group

Control Group Hormones	<i>Vs. Prolactin</i>
<i>Prolactin</i>	1.0000
<i>E2</i>	P = 0.01
<i>P4</i>	P = 0.02
<i>LH</i>	P = 0.19
<i>FSH</i>	P = 0.02

Such effect was observed in the reFSH treatment group where concentrations of estradiol were high and prolonged due to the number and size of the growing follicles secreting estrogens (Fig 1). This high and prolonged surge of estradiol may have had a negative feedback effect on LH, but whether the same effect occurred on Prl is unknown.

Estradiol has previously been shown to have a positive correlation with prolactin secretion during the spring transition in the mare.³ However, this was not observed and thus more studies on prolactin's effect on ovarian function needs to be conducted. This cannot be done until a recombinant equine prolactin (rePRL) is genetically engineered, cloned, and proven as efficacious as the endogenous hormone. The easiest experiment would consist of administering rePRL and observing its effect on ovarian function in the anestrous mare.

Conclusion

This study demonstrates that reFSH does not directly affect prolactin secretion. It also suggests that the unique high and prolonged surge of estradiol from reFSH may have a negative feedback effect on LH, but whether it has an effect on Prl is yet to be determined. Since Prl did not change in either the treatment group or placebo group, future studies are needed to determine a role of Prl in ovarian activity.

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Next to Kin: Administering a Strong Aggie Family at UC Davis



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Abstract

In the face of diversity, can unity be realized? If so, what must be done to make unity a reality? Looking at university organizational culture, specifically that of the University of California, Davis, this paper seeks to address these questions by tracing the use and applications of familial rhetoric within the US academy's broader historical legacy and its specific manifestations at UC Davis. Drawing from critical ethnic, feminist, and queer interventions into research and methodology, this paper seeks to examine the purposes of using family discourse within institutional spaces to better understand how family discourse interacts with and creates organizational culture. To accomplish this, this paper will perform close readings of UC Davis campus documents and publications as a means of interrogating what kind of 'work' evocations of family rhetoric perform for the UC Davis campus community. Broadly, this paper examines matters of unity and dissent within the interrelationships between academy, family discourse, and campus community. Specifically, this paper draws on a Foucauldian analysis to examine the contradictions of various roles

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within the UC Davis community, and the productive and positive dynamics created by said contradictions. Paying particular attention to the productivity of such contradictions, this paper looks at the complexities of assuming and constructing unity on the UC Davis campus through a family discourse heuristic.

Introduction

Our mission of education, discovery and public service is not possible without engendering a climate of mutual understanding and respect. The survey results released today represent an important milestone in our efforts to promote the values of our campus community. But there is only so much that we can do as a university. Ultimately the responsibility is an individual one among each of us. I invite all members of our campus community to consider ways that you can promote civility and respect among our Aggie family.

~Linda P.B. Katehi in “A Strong Aggie Family, Campus Community Survey Results”

In the face of diversity, can unity be realized? If it can, what must be done to promote it? Promoting unity can be conceptualized as promoting harmony, mutual respect, shared values, and stability. After all, even though there are differing embodiments of what promoting unity can be, surely there must be some overlapping features that can still facilitate the coherence sought by evocations of unity within community spaces.

With the noisy and zealous events planned annually on university campuses, UC Davis’ department of Student Housing works diligently to orient and prepare incoming students in the ways of the campus community, with little or no regard for their diverse cultural backgrounds. Parents, students, and friends are given stacks of resources, maps, and brochures that outline the various options available to students during their academic journey at UC Davis, as if to reassure these students and their parents alike that they will be in good hands at UC Davis, that the UC Davis community has their best interests in mind, and that there are multiple ways that students can express themselves within this campus community. These resources act as a roadmap and manual on how one can navigate and express oneself through the university; these orchestrated events function as a students’ housewarming to their newfound home. By providing these resources and thereby reassuring parents of the university’s custodial role, the university administration assumes an authoritative position—a position often conceptualized as inherent in one’s own kin and parents.

Although not always conceived this way, the Davis community has sometimes been called a Davis family. For example, in a letter addressed to “UC Davis Parents” (i.e. the students’ parents) sent on November 21, 2011, UC Davis’ Chancellor Linda Katehi reflected on a series of events that were particularly “trying for the UC Davis family”¹: the pepper-spraying of nonviolent student protesters and activists on the campus’ main quad just three days before.² By implying unity (read: coherence and stability) amongst the campus community through a direct and metaphorical use of the idea of family in reference to the Davis community, Chancellor Katehi appears to construct the UC Davis campus as a unified community that prizes, emulates, and simulates relations of kin.

Even in conceptualizing the campus community as a campus family, the kind of family created by an institutional discourse of family are not those that mirror or mimic ‘family’ completely. After all, official campus programs like the Aggie Parent and Family Association and the UC Davis Parents Fund function by maintaining particular cultural assumptions of what family means for UC Davis parents and UC Davis as an academic institution. The Aggie Parent and Family Association works by charging a \$100 membership fee for Aggies’ (read: actual) parents and family members.³ In this way, the campus administration’s use of ‘family’ seems not so much to be emulating an idealized family form but rather one that resides next to kin—a relationship that constructs the university as being like kin but not completely of it.

A recent email by Chancellor Katehi exemplifies one particularly illustrative example of the construction of the next-to-kin UC Davis family. On March 19, 2014, Chancellor Katehi sent a letter addressed to the UC Davis Community entitled “A Strong Aggie Family—Campus Community Survey Results.” In it, she declares her vision of creating a campus climate “where everyone can live, learn, and work in a supportive and respectful environment” and how UC Davis’ participation in the Campus Community Survey serves as a symbol for how important campus climate is to the realization of a Davis community. She goes on to describe the different initiatives that she hopes to implement and concludes her letter with an invitation, attached above, for the campus community “to consider ways that you can promote civility and respect among our Aggie family.”

¹ "Letter to Students' Parents." Recent Changes RSS. Davis Wiki, n.d. Web. 26 Sept. 2014.

² Augusto, Sarah and Julie Setele provide an account of the Pepper Spray Incident in their “Militant Privatization: The UC-Davis Pepper-Spray Incident”: “On November 18, 2011, police in full riot gear were called in by [UC Davis’] Chancellor Linda Katehi to disperse a peaceful student protest at the University of California-Davis. In what has now become international news, one officer used weapons-grade pepper spray at close range on seated students.”

³ "Cal Aggie Alumni Association." - Aggie Parent and Family Association. Cal Aggie Alumni Association, n.d. Web. 26 Sept. 2014.

If one believes that Chancellor Katehi's letter declares a well-intentioned narrative around the importance of having a supportive and respectful campus climate, Chancellor Katehi invocation of family as a unifying concept may seem appropriate. Placing this idealized vision in the context of some of the recent actions taken by the UC Davis administration, as well as an understanding of various student responses to these actions, leads one to begin to question what relationships and norms are constructed when Chancellor Katehi and other campus administrators adopt the language of family within their work. How have we come to deem the use of metaphors about family appropriate within institutional settings? Particularly, given the US's own histories of racialized and ethnicized stratification (which is always mediated through dynamics of gender, sexuality, ability, and nation), what does an evocation of a family mean in the face of difference?

Drawing from critical ethnic, queer, and feminist interventions into critical theory and research methodology, I examine the purposes of family discourse within institutional spaces to better understand how family discourse interacts with and creates organizational culture. Specifically, I want to understand what relationships the evocation of "a Strong Aggie Family" by campus administrators creates between members of the UC Davis campus community. In the following sections, I hope to tease out the interrelationships between dissent and consent at UC Davis by analyzing the meanings of family discourse to elucidate these themes. In looking at the Pepper Spray Incident of November 18, 2011, in relation to family discourse and the Principles of Community, I argue that evocations of the Principles of Community statement, with particular attention to the timing of these evocations, function as a justification for the creation of an obedient Aggie Family. Ultimately, I argue that 'family' has functioned within the university as a powerful rhetorical device that facilitates the administration of unity and construction of obedience within the campus community in the face of dissent and difference.

All in the Family: Productive Affairs Between Family and University

The relationship between family and university has had a much longer history. The adoption of *in loco parentis* established the university as an entity that would act as a surrogate parent to its students as early as 1650.⁴ Defined in various ways, the *in loco parentis* doctrine can be described as the doctrine "under which an individual" (or institution) "assumes parental rights, duties, and obligations without going through the formalities of legal Adoption"⁵—thereby, conceptualizing university authority as similar to that of parental authority and, by extension, university life as similar to family life. One example of how the power of *in loco*

⁴ Nuss, Elizabeth. "Development of Student Affairs in Student Services: A Handbook for the Profession." Ed. John H. Schuh, Susan R. Jones, Shaun R. Harper, and Susan R. Komives. *Student Services: A Handbook for the Profession*. San Francisco: Jossey-Bass, 2011. N. pag. Print.

⁵ "In Loco Parentis." *TheFreeDictionary.com*. N.p., n.d. Web. 26 Sept. 2014.

parentis was exercised can be found in Beth Bailey's book *Sex in the Heartland*, which broadly examines how the sexual revolution in the 1960s manifested within universities in Kansas. Bailey notes in her book that the doctrine of *in loco parentis* was often targeted by students on the basis of its gendered double standards during the 1960s at the University of Kansas. The amount of time men and women were allotted to stay out at night was governed by this patriarchal *in loco parentis* doctrine and were often considered unjust for women as their night curfews were much earlier than their counterparts (p. 7). Additionally, Bailey discusses the formal and informal ways that students organized politically to effect change around the university's institutional controls on their sexual behavior (e.g. institutionalized bed-checks and policies on acceptable levels of intimacy that, for example, construct hand-holding as acceptable, while "petting" as not).⁶

Similarly, the doctrine of *in loco parentis* was also exercised through punishment during moments of dissent in the 1960s. The *Dixon v. Alabama State Board of Education* case is one clear example of how this occurred. Catherine Prendergast and Nancy Abelmann write of this particular case in their article, "Alma Mater: College, Kinship, and the Pursuit of Diversity." As six African-American students protested segregation practices at the cafeteria, the University of Alabama attempted to expel these students by providing *in loco parentis* as a justification for why these students did not require due process. As a surrogate parent, the assumption goes that the university would have the ability to not only care for its students, but to exercise disciplinary measures when it saw fit without the need for a fair trial. When appealed in the federal circuit courts, the decision made in *Dixon v. Alabama* was overturned. This decision helped facilitate a decline of the *in loco parentis* doctrine; the federal circuit court maintained students' separateness from the university, which directly impacts the efficacy of conceptualizing the university as an extension to the family: "Students, the university was reminded, had families of their own, and moreover families that did not necessarily embrace the values of the university" (p. 40).⁷

Embedded within the use of *in loco parentis* is a particular relationship to power that again seems contradictory. *In loco parentis* is used as a justification for the accumulated authority within the university administration that can be exercised over its student body. If the doctrine was left unchallenged and deemed normal, the social structures that construct what it means to be in the university would relegate this authorizing of power to the university as legible and expected—as rightfully familial. However, with the political challenges to the school's authority as a surrogate parent (or what Prendergast and Abelmann call the "approximation of the normative family unit"⁸), the authority once afforded to the university

⁶ Bailey, Beth L. *Sex in the Heartland*. Cambridge, MA: Harvard UP, 1999. Print.

⁷ Prendergast, Catherine, and Nancy Abelmann. "Alma Mater: College, Kinship, and the Pursuit of Diversity." *Social Text* 24.1 (2006): 37-53. Web.

⁸ Ibid.

administration via *in loco parentis* seems to be dislodged. After all, gendered and raced critiques over the years have helped facilitate the formal disestablishment of *in loco parentis* amongst college campuses and there appears to be a simultaneous increase in the understanding of student rights on these university campuses. Thus, although the *Dixon v. Alabama* case facilitated the formal end of the *in loco parentis* doctrine, the informal and cultural pervasiveness of family within institutional spaces remains. In this way, conceptualizing our notions of power as purely one that is based in a simple status-based hierarchy does not seem to capture the subtle power dynamics that occur on university campuses regarding family discourse.

Rather, it appears that within the contradicting applications of *in loco parentis*, whether formally sanctioned or not, the language of family and the relationships created out of these familial associations are still produced within and by the university administration. Chancellor Katchi's email illustrates how UC Davis, too, is using familial rhetoric in its publications. What then of this contradiction? Jacques Donzelot, French philosopher, has commented on the positivity of contradictions in his book, *The Policing of Families*:

[sieve]-like concepts such as 'crisis' or 'contradiction' are inadequate... they blur the positivity of these transformations and obscure their efficacy. And because they lead one in the end to mistake for decisive breaks, for surfaces of confrontation (whether real or merely logical), what is in fact the emergence of new techniques of regulation.⁹

For Donzelot, understanding what is produced when one observes the contradictions between family and the social is of utmost importance in understanding the ways that people, individually and socially, have come to be regulated. Borrowing from Donzelot's conceptualization of the positivity (or the productivity) of contradiction, perhaps these contradictions in how family discourse functions within university spaces produce particular standards for good and bad student-subjects. As such, in the sections below, I examine the use of a statement about UC Davis' Principles of Community in order to tease out some contradictions in institutional logic around 'civility', 'respect', and 'safety', to understand how family discourse is still used within institutional spaces.

Whose University? Constructing Obedience in the Davis Community

If the past role of the university under *in loco parentis* was to discipline and punish students for behavior deemed deviant or out of line (e.g. protesting, embodying deviant sexualities)

⁹ Donzelot, Jacques. *The Policing of Families*. New York: Pantheon, 1979. Print.

and if the role of the university as *in loco parentis* has shifted due to formal legislation, then there must be other rationales and technologies that readily maintain and legitimize the university's parental authority over its campus community. The Principles of Community offer a rhetoric that can legibly dictate which student behaviors are acceptable and which are not; Chancellor Katehi's desire to "promote civility and respect among our Aggie Family" within her recent letter echoes the same values emphasized within a document that would later manifest in her Strong Aggie Family letter. As one works to promote civility and respect among our Aggie Family, a critical examination of what a common conceptualization of civility and respect looks like in the context of student dissent is vital to understanding the university's culture, and its implications for diverse and nonconforming communities within the institution. In this section I aim to tease out the contradictions within calls to civility, safety, and respect among the UC Davis campus community and argue that the Principles of Community function as one document that produces a false sense of unity at UC Davis.

Respect and civility are not new concepts to the UC Davis campus; the UC Davis administration has often affirmed and reaffirmed these principles through different campaigns. Among many initiatives over the years, the Principles of Community—first signed in April 1990, reaffirmed in 1996, and again in 2001—articulates a statement of community values for UC Davis. Its introduction reads:

The University of California, Davis, is first and foremost an institution of **learning** and teaching, committed to **servicing** the needs of society. Our campus community reflects and is a part of a society comprising all races, creeds and social circumstances. The successful conduct of the university's affairs requires that every member of the university community acknowledge and practice the following basic principles...¹⁰

Some of these basic principles include "inherent dignity," "climate of justice," "civility," as well as "courtesy, sensitivity, and respect"¹¹. As such, the Principles of Community, by establishing these values, delineates ways to become a good member of the campus community by inscribing conceptual markers like respect and civility as desirable behaviors.

When campus community members do not act in ways that adhere to these sanctioned behaviors, the Principles of Community are often invoked. Sunaina Maira and Julie Sze provide accounts of how dissent works with the Principles of Community in their article entitled "Dispatches from Pepper Spray University: Privatization, Repression, and Revolts." Maira and Sze describe that in the morning of November 18—the day of the

¹⁰ "Office of Campus Community Relations." *The Principles of Community*. Emphasis in the Original.

¹¹ Ibid.

Pepper Spray Incident—Chancellor Katehi told the Occupy UC Davis protesters to remove their tents “in the interest of safety, respect for our campus environment and in accordance with our Principles of Community.”¹² As described in their article, Maira and Sze situate Occupy UC Davis’ anti-privatization activist work within a broader history of student movements on the UC Davis campus. By evoking the Principles of Community in relation to student dissent, Chancellor Katehi’s message implies that the existence of tents on the main quad are against the interest of safety, are disrespectful for the campus environment, and are directly against the code of conduct expected for all community members on the UC Davis campus. In this way, the Principles of Community not only are a reminder of what is desired on the UC Davis campus, but what is also undesired. During the Occupy Movement at UC Davis, those protesters who refused to take down their tents experienced violence wrought by the UC Davis Police Department’s riot-gear. Those who did take down their tents avoided this direct instance of violence. Similarly, the same dynamic reifies a particular conceptualization of what ‘respect’, ‘safety’, and ‘civility’ must mean for students, especially dissenting students, on the UC Davis campus.

During Occupy UC Davis, questions of safety were often raised. One of the main arguments against the occupation of the main quad was that there were ‘outsiders’ or non-students who were occupying university space alongside UC Davis students in this movement.¹³ In the same email sent to these students requesting that they peacefully remove their tents, Chancellor Katehi stated that safety is another concern the university seeks to address. As she puts it,

While we have appreciated the peaceful and respectful tone of the demonstrations to date, the current encampment raises serious health, safety and legal concerns, and the resources we require to supervise this encampment cannot be sustained, especially in these very tight economic times.¹⁴

Without providing concrete reasons for why the encampment raises health, safety, and legal concerns (even though the encampment did not occupy most of the quad), the contents of this email seem to suggest that safety and dissent can only be maintained by members of the allotted campus community, without outside influence. Thus, what Chancellor Katehi wrote mirrors exclusionary evocations of security in times of duress within national and familial circumstances. Members within the Davis community are conceptualized as safe and unthreatening and those perceived as non-students and strangers immediately become

¹² Maira, Sunaina and Julie Sze. “Dispatches from Pepper Spray University: Privatization, Repression, and Revolts.” *American Quarterly* 64.2 (2012): 315-330. Web.

¹³ *Ibid.* page 316.

¹⁴ Katehi, Linda P.B. "Chancellor Linda P.B. Katehi.": *Chancellor's Message to Protesters on the Quad*. UC Davis, 18 Nov. 2011. Web. 27 Sept. 2014.

marked as the opposite: unsafe, threatening, others who fundamentally undermine the “successful conduct of the university’s affairs”¹⁵. Thus, creating a climate where safety is key through the reification of security, allows the campus administration to fulfill their promise set out by the Principles of Community by ensuring that students are not in danger (read: secure) and can therefore spend their time performing duties expected of students.

In addition to safety, themes like civility and respect were often used by the UC Davis administration to ensure proper campus flow in relation to and in the face of dissent. We can see a very similar dynamic occurring three days prior to the Pepper Spray Incident. On November 15, 2011, 50 protesters flooded Mrak Hall—UC Davis’ administrative building—and occupied the building overnight. During the night, some students erected tents within Mrak Hall and were asked indirectly to remove the tents (e.g. a student affairs staff member left a stack of fliers provided by the Assistant Vice Chancellor of Student Affairs that discussed the university’s campus policy prohibiting overnight encampment within campus facilities).¹⁶ Later in the night, the tents came down.

Former Vice Chancellor of Student Affairs, Fred Woods, compelled by what I believe he saw as the orderliness of the students and the student affairs staff, writes in an email “I am very proud of the student affairs staff for professionally asking [the students] to take [the tents] down. I am also proud of our students for responding well to the request.”¹⁷ *The Reynoso Task Force Report*, a document that narrates the events that led up to and followed the Pepper Spray Incident, describes in short detail that “Vice Chancellor Wood, who stayed at Mrak Hall on Tuesday night until 1:30 a.m., referred to the activists as ‘my children’ and said that in the morning they were ‘very polite; they were gathering their stuff, you know being sure they weren’t getting in the way of doorways and what have you.’”¹⁸ By relaying student behaviors to higher administrators in the language of civility and respect (e.g. politeness, responding well to demands, etc.), Woods assuaged any concerns held by higher administrators by describing the students’ adherence to desirable behaviors under campus policy. In addition, Woods conveyed to the campus administrators that, even in the event of this demonstration, students were behaving accordingly—that the Principles of Community in some sense was maintained. However, as mentioned above, the seemingly uncivil and disrespectful use of tents on the main quad three days later would merit the use of police force, arrests, and pepper spray with the Principles of Community, again, as the conceptual frame that was evoked when Chancellor Katehi requested campus police to remove the protesters’ encampment.

¹⁵ Office of Campus Community Relations. "The Principles of Community."

¹⁶ Reynoso, Cruz. "UC Davis November 18, 2011 "Pepper Spray Incident" Task Force Report." (2012): 39. Web.

¹⁷ Ibid.

¹⁸ Ibid.

Although the Principles of Community delineates what the UC Davis campus community values collectively, the Principles of Community's contradictory use in the face of dissent and disobedience seems to challenge the unity implied within such a document. On the one hand, the Principles of Community can be seen as a statement that seeks to unify UC Davis' own diverse community, given its many differing opinions and identifications, by creating a shared statement of expected behaviors and rewarding such behaviors accordingly. However, the evocation of the Principles of Community during the events that led up to and followed the Pepper Spray Incident paints not only an intolerance of differing opinions, but a disciplining of dissent. Both circumstances discuss and engage difference. Yet, both instances interact with difference in polarizing ways. Although this appears to be inconsistent with what is proclaimed and practiced in relation to the university's vision, this apparent contradictory use of the Principles of Community produces a dynamic that schools the wider campus community in how one should think, act, and behave. After all, in the events of the Pepper Spray Incident, the evocation of the Principles of Community did dissuade some students from keeping their tents in the campus quad and, as a result, to act in accordance with what the Principles of Community purports to require of them.

Thus, by actively constructing respect, civility, and safety through invocations of the Principles of Community, UC Davis administrators facilitated the image of what an ideal community would look like for a UC Davis campus community that is devoid of civil disobedience (read: seemingly negative embodiments of difference) and campus-police-inflicted violence (read: the power exercised to maintain campus administrative authority). It is with such constructions of a shared set of expected behaviors that the university administration can begin to conceptually render the UC Davis campus community as unified. Additionally, it is through similar constructions of desired traits on the campus that obedient and disciplined subjects are produced. As seen with the Occupy UC Davis moment, there were some protesters who readily obeyed and followed the established campus policy. Others did not. Both instances required the maintenance and construction of an ideal subject that exhibits ideal behaviors, thoughts, and actions so that the campus community can be civil (read: law-abiding), respectful (read: non-threatening) and safe (read: vulnerable). In this way, the creation of civility, respect, and safety through administrative evocations of the Principles of Community seem to not only create a shared sense of community values. It becomes a normalized goal that facilitates the effective policing of student behavior. Thus, the Principles of Community functions to facilitate students' decisions to regulate themselves to follow particular social norms. Conceptualized in this way, the Principles of Community mirror the dynamics created with the *in loco parentis* doctrine.

Although the *in loco parentis* doctrine has been formally abandoned, the university still tacitly assumes the role of surrogate parent by securing familial safety as well as instilling a

code of conduct for its family members that purports values of civility, respect, and safety (e.g. the Principles of Community). If we push the Aggie Family metaphor, the Principles of Community functions to create not only good Aggie children, it constructs Aggie children who respect the campus administration's authority and Aggie children who are obedient to the campus administration's expectations. Within this next section, I look at the Principles of Community as a document that actively justifies the language of family within the university.

Pepper-Spray University: Administrative Authority, Familial Justifications

To this point, I've shared and argued in this paper that the Principles of Community functions as a proclaimed ideal for how the university must work, but I examine an additional aspect to this conversation in this following section: the ways in which unofficial channels work to maintain university power. Although the formal creation of the Principles of Community outlined what is deemed good behavior as implicitly obedient, the real dimension these formal statements create are those that informally police behavior to regulate what is desirable for UC Davis, effecting a process of normalization. Norms formed almost spontaneously in relation to these formalized statements around campus community values, producing a dynamic that prescribes some behaviors as more desirable than others; these norms function to dictate what 'successful conduct', and by extension good subject-hood, looks like in the UC Davis community (e.g. "safety," "civility," "respect," etc.). As such, by drawing on familial notions of a shared campus community, which effectively produce just that, I argue that family discourse within the university provides a useful means to facilitate and simulate homogeneity within the UC Davis community.

Roderick Ferguson comments on the empty incorporation of difference within the university fabric when discussing the role of minority difference in the way that the university has come to manage its challenges. Interrogating the events of institutional reactions to "civil unrest" between 1954 and 1968, Ferguson observes the political restructuring on university campuses that reacted to calls for revolutionary changes (e.g. like those presented earlier in this paper by the University of Kansas' reactions to the sexual revolution and those presented by civil rights discourse at the University of Alabama). In his book *The Reorder of Things: The University and Its Pedagogies of Minority Difference*, Ferguson argues that difference (be that sexual, gendered, and/or racial) were incorporated into the university's structure as a means of controlling, regulating, and managing the students that have come to threaten the university. To accomplish this, Ferguson narrates that over time certain technologies were created to facilitate this incorporation. Often, this incorporation manifests itself in various student life centers on university campuses and academic departments that ostensibly support calls for social justice while navigating a privatizing and rapidly defunded public university

system. Thus, I believe by extension, particular campus initiatives and statements also became manifestations of the incorporation of difference.

Drawing from Ferguson's argument that difference has indeed been incorporated into the university for certain productive means, I argue that the Principles of Community and the use of family discourse function as tools that render legitimate the university's authority as protector and overseer. Even though the conceptualization of students, given their diverse cultural backgrounds, as children of the university parent has been deemed unpopular and formally shot down since the 1960s, the university structure needed to find a means to legitimate its authority over its campus community. The various student movements during the '60s, '70s, and '80s presented challenges to the campus authority and thus destabilized the fabric of what family means when evoked on university campuses as well as the way the university functioned. However, since then, the Principles of Community at UC Davis, as noted above, have come to inscribe values for how the campus community should behave in order for the university to function well. Perhaps, if power indeed works to incorporate difference, then the continual use of family discourse by the campus administration may be a manifestation of this incorporation of difference, the re-inscribing of values (via initiatives like the Principles of Community) challenged by student dissent and student disobedience in order to maintain authority. During the 1990s, with the creation of the Principles of Community at UC Davis, the campus administration would again find ways to ensure that the university functions well (read: university maintains authority and oversight).

Use of the Principles of Community functions both in intentional and unintentional ways to create good subjects under the campus administration. This facilitation of what good and bad subjects-students look like at UC Davis also legitimates and maintains the university's authority as overseer and protector of the campus community body. The university assumes a particular role with these moments—a relationship that appropriate ideals of family and kinship, thus creating options for the university administration to create and exercise disciplinary measures onto their student body (e.g. their children): the role of protector. We saw this earlier with the administration's concern with safety during the Occupy encampments. On the same email discussed earlier that told the Occupiers to remove their encampment, another concern was raised in relation to the student body: the university's role as being next to kin, as someone entrusted by the students' parents to take care of and to be responsible for its students. The letter reads:

However, we also have a responsibility to our entire campus community, including the parents who have entrusted their students to us, to ensure that all can live, learn and work in a safe, secure environment without disruption. We take this responsibility seriously. We are accountable for what occurs on our campus. Campus policies generously support free

speech, but do include limited time, place and manner regulations to protect health, safety and the ability of students, staff, and faculty to accomplish the University mission. If an unfortunate incident occurs as a result of violations of these limited regulations, we are all responsible.¹⁹

In this paragraph, Chancellor Katehi evokes UC Davis' role as the protector of the innocent and naïve student population in a way that is controlled, planned, and consensus-building.

We saw that even with the formal elimination of *in loco parentis*, the language of family persists whether implicitly through the assumed role of protector and overseer or explicitly by being next-to-kin. Again, the “university’s mission,” partly articulated in the Principles of Community, is used in this moment as well as the evocation of the university’s relationship as one next to the students’ kin to persuade students to act differently, to follow campus policy guidelines. Although this statement respects students’ different configurations of family (that of ones outside of the university next to kin relationship) and seems to respect what had been deemed illegitimate in the *Dixon v. Alabama* case, the use of family in relation to Occupy UC Davis’ encampment of the main quad masks the campus’ agenda to delay and contain students’ disobedience. When juxtaposed alongside Chancellor Katehi’s promotion of the Strong Aggie Family, this email’s use of family gestures towards the university’s strategic and flexible use of community values and family discourse—that both incorporates challenges from the past and constructs new configurations based on lessons learned from the past—in order to maintain authority. Seen in this way, campus administration’s use of family discourse becomes a strategic and flexible one, which allows different meanings and assumptions to be evoked and projected onto official statements.

Conclusion: A Disciplined Aggie Family

As we saw in this piece, the academic institution within which we reside is not without contradictory and (at times) violent realities. UC Davis, as mentioned by Maira and Sze, has a much longer history of political activism where students express their own grievances to the university and are met with violence. They mention the events of the 2009 demonstration as one key area in which this occurs as well as the protests at UC Berkeley a week prior to the events at UC Davis. Additionally, Dylan Rodriguez's analysis of the use of police officers within the UC Davis campus is one that stems out of a larger trend within the University of California system and within a larger regime of racist perceptions in regards to

¹⁹ Katehi, Linda P.B. "Chancellor Linda P.B. Katehi." : *Chancellor's Message to Protesters on the Quad*. UC Davis, 18 Nov. 2011. Web. 27 Sept. 2014.

violence wrought particularly on people of color by police officers. Locating his perspectives within his own place of work, UC Riverside, Rodriguez questions the perceptions of the Pepper Spray Incident, by identifying these within larger systemics of race, class, and discipline. Although UC Riverside students, in their own solidarity work with the Occupy Movement, were fired at with projectile guns, mainstream media did not pick up this story. Rodriguez argues then that UC Davis' perceived status as a university within a bucolic rural town helps appeal to a "liberal white sensibility" wherein militarized violence among communities that are already marked as violate-able are deemed normal while UC Davis is a place in which violence justified by the logics of militarism inspire shock and sympathy.²⁰ In this way, Maira, Sze, and Rodriguez all locate the Pepper Spray Incident at UC Davis within a systemic culture that prizes militarist, capitalist, and racist logics of control, policing, and discipline.

I would add that the use of community value statements as well as the use of family discourse are social technologies that work to buttress the gears that perpetuate these regimes of control, policing, and discipline. Although the family doctrine has waned, the metaphors and language of family persist albeit with different and conflicting understandings. We also saw how the shifting role of the idea of family within the academy has led to new and different forms of regulation via the formal end of *in loco parentis* and its replacement by a proliferation of diversity and community values statements. And finally, we have come to see how the Principles of Community statement functions to construct obedience within the Davis community through its discursive applications and its physical manifestations.

In the next part of my research, I aim to interview students of color on the UC Davis campus in order to understand how students are currently interpreting and reinterpreting notions of family in their social organizing and student sociality at UC Davis. If the discursive role of notions of the family has changed drastically over the years, what of students, as they interact with these shifting organizational cultural changes? Similarly, if the Principles of Community and discourses of family used by the institution have indeed facilitated discipline that favors obedient students, how has this dynamic impacted student sociality and student organizing? Lastly, what relationships are then created within UC Davis when students interpret similar dynamics of family?

Given the ways that the UC Davis administration sanctions violence inflicted on dissenting students on campus, the university's use of 'family' seems to function more as a masking of difference via incorporation than it is of unifying or creating an environment of 'respect' & 'civility'. As such, attention to how university students (re)imagine notions of family can help us understand other ways through which family discourse can be interpreted and

²⁰ Rodriguez, Dylan. "De-provincialising police violence: on the recent events at UC Davis." *Race and Class* 54 (2012): 99-109. Web.

reinterpreted. Examining student socialities in the context of these seemingly benign regimes of administrative university control (e.g. those articulated through community values and appeals to familiarity) then open up channels to conceptualize how students—especially those who occupy positions of relative difference—navigate, negotiate, and challenge educational institutions and their social surroundings through similar and different evocations of family, kin, and community.

Justin Phan
Next to Kin

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The Baggins End Collective Community: Conflicts, Resident Turnover and Institutions for Collective-action



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Abstract

Cooperation among unrelated individuals has widely been explained by evolutionary approaches that focus on altruism, altruistic punishment and kin selection, while other explanations have focused on the interaction between cultural and genetic transmission, such as pro-social and anti-social behavior, and social learning heuristics (Mathew and Boyd, 2011; Fehr and Gächter, 2002; Henrich, 2004). Others have focused on institutions for collective-action, the decision-making devices that individuals create and/or join to facilitate and manage a common pool resource (Ostrom, 1990). Collective-action problems describe the situation in which multiple individuals would all benefit from a certain action (i.e., managing common pool resources), but has an associated cost, making it implausible that any one individual can or will undertake and solve it alone. Other problems that arise include: free-riding (i.e., someone who benefits from goods without paying the cost of the

benefit), solving commitment problems, arranging for the supply of new institutions and monitoring individual compliance with sets of rules (Ostrom, 1990). Institutions are created with the aim of governing the behavior of a set of individuals within a given community by mediating the rules that govern decision-making. Given this fact, how effective are institutions with scale of community? Moreover, how do institutions facilitate the conflict-mediation process in transient communities? This research investigates whether the role of institutions for collective-actions are affected by resident turnover in cooperative (co-op) housing units in Davis, California. Specifically, this research focuses on the relationship between the transient nature of the co-ops and the institution that governs conflict mediation.

Background

The cooperatives in this study include: the Domes community, Sunwise co-op, J Street co-op and Cornucopia co-op. I will begin the background by first addressing what a housing cooperative is, followed by an examination of North American Students of Cooperation (NASCO) organization and Solar Community Housing Association (SCHA) non-profit, and lastly, I will be reviewing the various institutions at each of these four housing cooperatives. NASCO and SCHA are important because they facilitate and assist in institutional transfer and management of the co-ops. Co-op management relates to conflict because the availability of conflict mediation mechanisms is dependent on various sources that influence what institutions and choices can/will develop in each house.

Cooperatives: Principles in the 21st Century defines a housing cooperative as an autonomous association of persons united voluntarily to meet their common economic, social and cultural needs and aspirations through a jointly-owned and democratically-controlled enterprise (Zeuli and Cropp, 2004). A housing cooperative is a shared equity model; equity builds in the corporation through (1) user ownership, (2) user-control, and (3) proportional distribution of benefits. Cooperatives practice: (1) voluntary and open membership, (2) democratic member control, (3) member economic participation, (4) autonomy and independence, (5) cooperation among cooperatives, and (6) concern for community (Zeuli and Cropp, 2004). These principles have their roots with the Rochdale Principles, a set of ideals for the operation of cooperatives set out by the Rochdale Society of Equitable Pioneers, United Kingdom in 1844. This book is popularly referenced by North American Students of Cooperation (NASCO) member housing cooperatives. NASCO is a federation of housing cooperatives in Canada and the United States, started in 1968 (NASCO, 2014).

Traditionally, NASCO has been associated with student housing cooperatives, though non-student cooperatives are included in its network (NASCO, 2014). NASCO provides its member cooperatives with operational assistance, encourages the development of new

cooperatives and serves as an advocate for cooperatives to government, universities and communities (NASCO, 2014). The NASCO model facilitates the organization of co-ops in Davis, California, with topics concerning: meeting process, board roles and responsibilities, planning, staff relations, marketing, diversity awareness, conflict resolution, facilitation, consensus decision-making and organizational development for new cooperatives (NASCO, 2014). NASCO, like SCHA, assists in providing new governing institutions to member cooperatives.

SCHA is a Davis-based 501(c) (3) non-profit with the goal of providing environmentally-conscious and affordable housing (SCHA, 2014). Currently, SCHA owns and operates three cooperatives houses: Sunwise Co-op, J Street Co-op and Cornucopia Co-op; and also manages the Baggins End Collective Community (the Domes) at the University of California, Davis (UCD) (SCHA, 2014). Residents of the houses and the Domes maintain their living space and serve on the organization's board of directors (SCHA, 2014). In the co-ops, there is a hierarchical form of governance whereby houses create sets of rules within the bounds of the larger political institution, SCHA. Moreover, the rules that houses create are tailored to a long history of membership turnover; most of the bylaws under SCHA have been the same since its inception in 1979, and cater towards sustainability and low-income housing.

The Domes community opened in 1972. The Domes, unlike any other co-op, is especially transient due to the nature of their student-leases, which creates a high turnover rate of residents. Residents at the Domes are a self-selected group of university students (i.e., undergraduate and graduate). In 2010, Student Housing decided that the Domes were unsafe to live in and stopped signing leases in spring, 2011 (Domes Welcome Packet, 2014). In response to this closure, old, current and future community members rallied to create a plan for re-opening the Domes. During this time, a group of community members negotiated a new lease with the university that moved the Domes management from Student Housing to SCHA (Domes Welcome Packet, 2014). The Domes community adopted various institutional structures from SCHA houses and past cooperative community members. These institutional structures were meant to help in making the Domes a self-sufficient and autonomous cooperative at the end of the five-year lease with SCHA. The Domes is an interesting case. The population size is much greater than the other co-ops managed by SCHA; they currently have a population of twenty-six. The data available for this group is somewhat dysfunctional due to poor archival data. Therefore, I am omitting the Domes in the analysis, but I will discuss this bias in the 'Results' portion of the paper.

The first cohort to move into Sunwise co-op (est. 1978) also created SCHA to own and manage the property, to be directed by a board of the residents (SCHA, 2014). The first cohort from previous student cooperatives carried over various governance institutions into

Sunwise. What this does is help to provide an already existing structure for new institutions; the cost to make a new institution is higher than transferring one from a previous co-op. The house has held a population size ranging from twelve to seven throughout its years of operation since 1979.

It is believed the age of residents at Sunwise tended to be older comparatively to other properties. Although this belief has not been tracked quantitatively, qualitatively previous members regarded this house as the ‘graduate student’ house, due to its relative abundance of graduate students over the years (SCHA, 2014).

In 1992, SCHA began to move and renovate several buildings to a lot in east Davis to create a “homestead” of houses (SCHA, 2014). The properties were originally occupied in 1996 (SCHA, 2014). By 2006, it became clear that Federal funding requirements, the needs of single parents, and other challenges made the Homestead co-op a social and financial liability to SCHA (SCHA, 2014). The property was sold to the Community Housing Opportunities Corporation and Yolo Community Care Continuum to better serve the community (SCHA, 2014). This ‘failed’ co-op serves as an example of the transitional nature of cooperative communities, the complexities affecting these communities, and ways that cooperatives can become dysfunctional.

J Street co-op began operating on J Street in 1986. Across from this co-op, in 2010, another co-op opened called Cornucopia co-op. This is an interesting case where one co-op has established itself within the community while the other co-op is beginning to develop community within and around the co-op. Institutions will vary; they rely on population dynamics, input from other institutions within and outside the community, and time. Moreover, they’re much more complex, which makes generality a bit more difficult than I can analyze. This is because there are other dynamics that influence institutions such as the historical background of each member and challenges from interpersonal and structural violence.

Institutions for collective-action vary from house to house. They operate and change with time as a variable; moreover, these institutions influence behavior (i.e., promoting or constraining). The institutions in this study include: (1) wealth creation, (2) chore systems, (3) administration, (4) monitoring and policing, (5) conflict management, and (6) community building. Wealth creation refers to the structures regarding equity and resource distribution (i.e., monetary, food staples and produce). Chore systems refer to the distinctive patterns of routine tasks ranging from internal household chores to external SCHA chores. Administration refers to those coordinated structures regarding collective decision-making at group-level interactions (i.e., where consensus decisions would ideally be made). Monitoring and policing are instruments useful to curbing potential free-riders and maintaining house

goals. Conflict management is a mechanism useful in navigating negative aspects of conflicts and increasing group benefits from positive aspects of conflict. Community building is practices toward unifying and creating group cohesion and an opportunity to create common ideals among individuals within the community.

The following represents institutional diversity in each house; they vary accordingly with population dynamics: (1) Wealth creation – Domes: board payments (i.e., food and utilities), Domes bank reserves (i.e., short-term and long-term maintenance costs) and SCHA bank reserves; Sunwise: board payments (i.e., food and utilities), house bank reserves and SCHA bank reserves (i.e., long-term maintenance costs); J Street: board payments (i.e., food and utilities), house bank reserves and SCHA bank reserves (i.e., long-term maintenance costs); and Cornucopia: board payments (i.e., food and utilities), maintenance funds (i.e., short term), house bank reserves (i.e., long-term maintenance costs) and the cookie jar donation system; (2) Chore systems – Domes: monthly work parties, individual Domes chores and cook nights; Sunwise: monthly work parties, bi-weekly garden parties and cook nights; J Street: nine-person chore wheel, twenty semi-permanent chores and cook nights; and Cornucopia: nine-person chore wheel, monthly work party, eleven semi-permanent chores, watering the garden and cook nights; (3) Administration – Domes: SCHA representatives, weekly meetings, decision by consensus (i.e., relative to the people present at the decision-meeting), student liaison with the University of California, Davis, and house handbook; Sunwise: SCHA representatives, ‘tentative’ house meetings and decision by consensus; J Street: SCHA representatives, bi-weekly house meetings, decision by poll-taking and house handbook; and Cornucopia: SCHA representatives, bi-weekly house meetings, decisions by majority vote and house handbook; (4) Monitoring/policing – Domes: mandatory work parties and mandatory community meetings; Sunwise: action-tem list (i.e., ‘commitments’ to Sunwise); J Street: bi-weekly chore check-in; and Cornucopia: action-item list; (5) Conflict management – Domes: SCHA conflict mediator, domes conflict mediator and community conflict resolution model; Sunwise: SCHA conflict mediator and conflict resolution process sheet; J Street: SCHA conflict mediator and conflict resolution binder; and Cornucopia: SCHA conflict mediator; (6) Community building – Domes: house retreats and fall quarter community development meetings; Sunwise: house retreats, house dream list and dinner plans list; J Street: house retreats; and Cornucopia: house retreats.

Research Questions

In order to understand institutions for collective-action in cooperative houses, I am focusing on how the transient nature of the co-op community affects the conflict mediation process and whether conflicts can arise from this. Therefore, the following research questions will be asked: (1) Are institutions for collective-action affected by resident turnover in co-ops? (2) Does resident turnover predict conflict? (3) Does conflict predict resident turnover? (4) Does

conflict create group cohesion after an initial purge of “conflicting” members? (5) What is the average rate of conflict in each house? What is the average rate of resident turnover in each house? How do they compare across houses?

Literature Review

In *Micromotives and Macrobehavior* (1978), Thomas Schelling explores the relationship between the behavior characteristics of the individuals who comprise some social aggregates, and the characteristics of the aggregate. Schelling tries to figure out what intentions or modes of behavior of separate individuals could lead to the pattern we observed (Schelling, 1978). In co-ops like in Schelling’s description, people are responding to an environment that consists of other people responding to their environment, which consists of people responding to an environment of responses (Schelling, 1978). This is important to co-ops because in these houses, a group of non-related individuals form and govern one another in aggregate from dissimilar backgrounds of problem solving. What makes this evaluation interesting and difficult is that the entire aggregate outcome is what must be evaluated, not merely how each person behaves within the constraints of their own environment (Schelling, 1978). For discipline and enforcement, it will usually matter whether individual choices or only the aggregates or percentages can be monitored (Schelling, 1978). In co-ops, this matters because what people actually adapt to is sometimes not the number of choices one way or the other, but the consequences (Schelling, 1978).

Fehr and Gächter suggest that altruistic punishment of defectors is a key motive for the explanation of cooperation (2002). In their study, they explain that altruistic punishment by all cooperators helps facilitate cooperation; this is distributing the punisher role. Fehr and Gächter find that free-riding causes strong negative emotions and that most people expect these emotions (2002). They suggest that emotions are a proximate mechanism for punishing from above-average contributors imposed on below-average contributors (Fehr and Gächter, 2002). This is important to my research because within the meeting minutes and the community meetings that I’ve attended, I’ve noticed a great amount of emotional investment by various co-op members in the household maintenance process, although this is not true for every member. Though, unlike what Fehr and Gächter found, I don’t believe that punishment triggered by emotions is necessarily the cause of punishment in my case study. Despite that, human groups maintain a high level of sociality despite a low level of relatedness among group members (Gintis, 2000).

Gintis conducted experiments in many different research groups that consistently showed that people tend to behave prosocially and punish antisocial behavior at a cost to themselves, even if the probability of future interactions is extremely low or zero (Gintis, 2000). The author calls this “strong reciprocity” because it is robust in the face of changes in the

probability of future interaction (Gintis, 2000). Gintis' research is important to my study because within various communities, there are several aspects of pro-social behavior and trust, which seem to be facilitated by institutions for collective action. Strong reciprocity is evident in the propensity of humans to engage in episodic collective action towards transforming social norms and political regimes (Gintis, 2000). Gintis' results speak to the power of positive assortment, getting like type with like dispositions or similar intentions. It may be that without communication or institutional mechanisms to stop the downward cascade (i.e., disintegration) of collective-action groups, eventually only the most determined conditional cooperators continue to make positive contributions (Ostrom, 2000). This is what seems to be the case in the co-ops in Davis, California.

Elinor Ostrom's work with institutions for collective-action is important to my research because she provides a structural basis for the decision-making devices that groups use to facilitate management of a resource. This is vital to understanding my study because in the co-ops you find various institutions, such as chore systems and others, that individuals engage in to redistribute workload. I will be using the framework that Ostrom developed to understand collective groups. In addition, I will look further into one aspect of her design principles for institutions in relation to the transient nature of the co-ops in Davis, California. The design principles that Ostrom outlines are: (1) clearly defined boundaries, (2) congruence between appropriation and provision rules and local conditions, (3) collective-choice arrangements, (4) monitoring, (5) graduated sanctions, (6) conflict-resolution mechanisms, (7) minimal recognition of rights to organize, and (8) nested enterprises (Ostrom, 1990).

This research project will focus on design principle (6): conflict-resolution mechanisms. Conflict resolution proposes that appropriators and their officials have rapid access to low-cost local arenas to resolve conflicts among appropriators or between appropriators and officials (Ostrom, 1990). This framework is of great value because the collaboration, organization, and management of the commons, like co-ops, follow similar design principles and collective-action problems outlined by Ostrom. In order to understand the design principles better, I will be examining the conflict resolution principle as dictated by the available data in the co-ops. Moreover, I will be examining the relationship between the transient nature of the co-ops (i.e., resident turnover) and conflict.

Methods

Preliminary qualitative data was taken from household meetings and SCHA and NASCO meetings during September 2013 through April 2014. This approach was first taken to gain more perspective and explore different ways of doing research and looking at different

concepts. What makes this qualitative data rich is that I lived in the Cornucopia co-op for nine months (i.e., when I began the study) and later moved into the J Street co-op, where I am currently housed. Additionally, I participate as a 'Board Representative' for SCHA where we discuss budgets, financing, SCHA long-term plans, and SCHA's property projects. Board decisions are most often decisions that can impact the organization as a whole, or that involve money derived from rents or donations. As part of the J Street co-op and the SCHA board, I am also involved in SCHA committees. These committees are fluid and they form on the community's needs; also, they can include members from within SCHA properties and external to SCHA properties (i.e., Davis community members may join).

The initial data collecting came from archival meetings' minutes of the Domes property since 1972; the objective was to track membership, but the meeting minutes were not used because many were missing. Sunwise co-op, J Street co-op and Cornucopia co-op meeting minutes and lease information were used to track membership (there weren't available leases from the Domes property to track this membership). These minutes were then coded under the following associative values: (1) conflict: (a) group conflict, (b) clique conflict, and/or (c) individual conflict; (2) consensus: (a) group consensus, (b) clique consensus, and/or (c) individual consensus; (3) solutions (changed from 'punishment'): (a) prevention, (b) restoration by community, (c) restoration by clique, (d) restoration by individual, (e) education-internal, (f) education-external, and/or (g) denunciation; (4) chore actions: (a) group reminder, (b) clique reminder, and/or (c) individual reminder; (5) problem-solving: (a) group problem-solving, (b) clique problem-solving, and/or (c) individual problem-solving; and/or (6) community building: (a) present or (b) not present ('not present' title was omitted). 'Conflicts' and 'consensus' was assigned to group, clique, and/or individual because it represents size of group when 'conflicts' and/or 'consensus' occur. 'Solutions' was originally termed as 'punishment', although the title was changed because 'punishment' did not describe a means of solving the problem; rather, 'punishment' described an imposition of a penalty and did not describe the problem-solving aspect of the behavior. 'Chore actions' describes the task reminders of the house, clique, or individual who has yet to accomplish the work. 'Problem-solving' describes the various methods for finding solutions to dealing with issues related to each property. 'Community building' explains whether an event directed toward the creation or enhancement of community among individual has occurred.

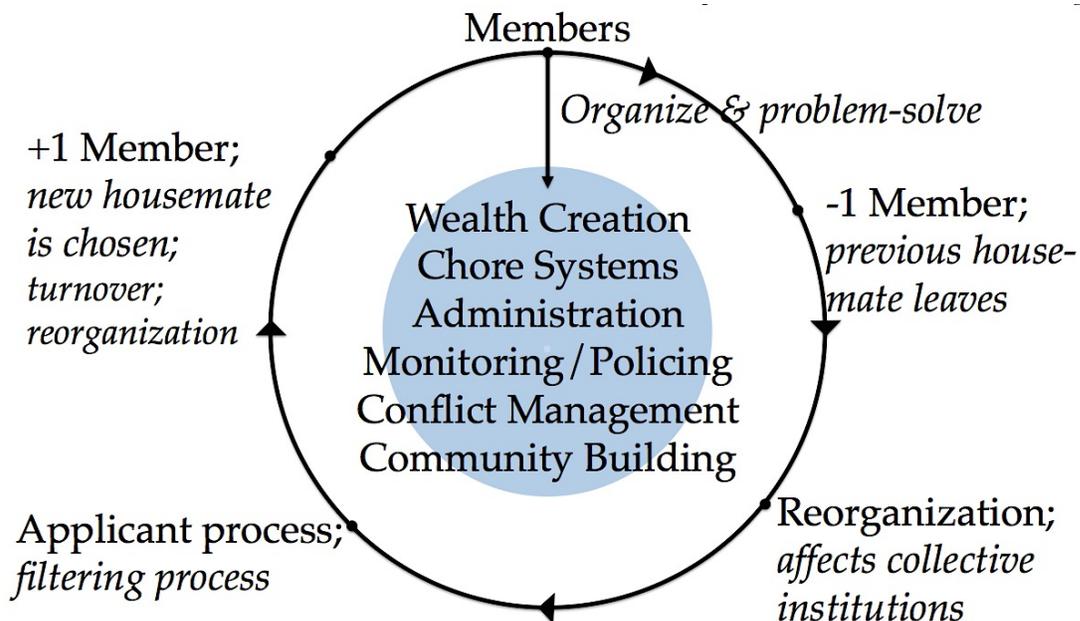
The lease information from Sunwise co-op, J Street co-op and Cornucopia co-op were used to construct population graphs of the cooperatives. Domes co-op data was omitted because of lack of data to reliably track population change over time. The coded data from the meetings minutes were cross-referenced with lease information to show a trend in turnover: (1) residents entering the co-op, (2) residents exiting the co-op, and (3) conflicts. The questions asked are as follows: (1) Does community turnover predict conflicts? (Prediction: high turnover precedes conflicts); (2) Does conflict predict community turnover? (Prediction:

conflicts precede high turnover); (3) Does conflict create group cohesion after an initial purge of conflicting members? (Prediction: after conflict, there will be high turnover, then an amount of little to no members entering/exiting); and (4) What is the average rate of conflict across houses? What is the average rate of turnover across houses? Lag variables were used to show variables correlated with values of another variable at later times or earlier times. This regression analysis was used to estimate the relationship among: 'Entrances', 'Exits' and 'Conflicts.' Standard deviations were also used to show mean: 'Entrances,' 'Exits,' and 'Conflicts'. This descriptive model will be used to cross-compare Sunwise co-op, J Street co-op and Cornucopia co-op.

Results

The results do not include the Domes, which may overestimate or underestimate some aspect of the analysis. This sampling bias creates a smaller sample size that makes the analysis too vague to conclude with any defining results.

Image 1: Conceptual Graph Illustrates the Question: Are institutions for collective-action affected by resident turnover in co-ops?



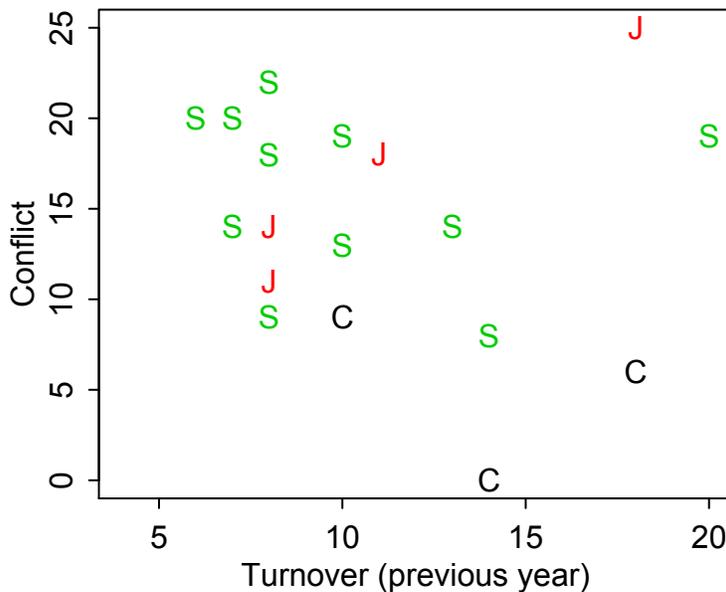
In this graph, members organize and problem solve within the various institutional arrangements at each house. Here, they have been generalized to: (1) wealth creation, (2) chore systems, (3) administration, (4) monitoring/policing, (5) conflict management, and (6) community building. When one member leaves, institutional memory leaves as well,

specifically the collection of experiences and ‘know-how’s’ that the individual gains. This affects the collective institution directly, and there is a reorganization of the various institutions within the house. Once the members find that there are insufficient numbers for their co-op, there is an applicant process that is also a filtering process. The decision-making device is useful to police new member entrance and find members that would benefit the house. When a new member moves in, there is turnover and reorganization. In turn, this affects the institutions directly as the new member’s preferences must fit within the already existing group members’ preferences. The following quantitative results do not show measurements for impact on institutions because I did not code for it. I did code for conflict, but I did not examine quantitatively whether and how it affects the conflict resolution mechanisms. Though, in the ‘Discussion’ portion of this study, I will discuss the interplay between the turnover, conflict, and conflict resolution mechanisms.

Figure 1 represents the question, (1) Does community turnover predict conflicts (prediction: high turnover precedes conflicts)? Figure 2 represents the question: (2) Does conflict predict community turnover (prediction: conflicts precede high turnover)? If the effects are there, (1) they are not powerful, or (2) maybe there is not enough resolution in the data to see them.

Considering Figure 1, does yearly lag turnover (i.e., sum of entrance and exits) predict conflicts count?

Figure 1: Does Yearly Lag Turnover Predict Conflicts Count?



The answer is: not very well. The model results are shown in Table 1.

Table 1: Model results Turnover Lag

	Mean	Standard Deviation	2.5%	97.5%
(Intercept)	2.816	0.178	2.468	3.164
Turnover_lag	-0.014	0.015	-0.044	0.017

The model results for Figure 1 indicate that the change in expected number of conflicts per additional turnover is -0.014 (McElreath, 2014). The standard error (standard deviation) is 0.015 (McElreath, 2014). I multiplied the standard error by 2 and added and subtracted it from the estimate to get a 95% confidence interval (McElreath, 2014), which resulted in about -0.044 to 0.017 (McElreath, 2014). This confidence interval spans zero by quite a lot, so it is difficult to argue that turnover has any strong relationship with conflict in these data (McElreath, 2014).

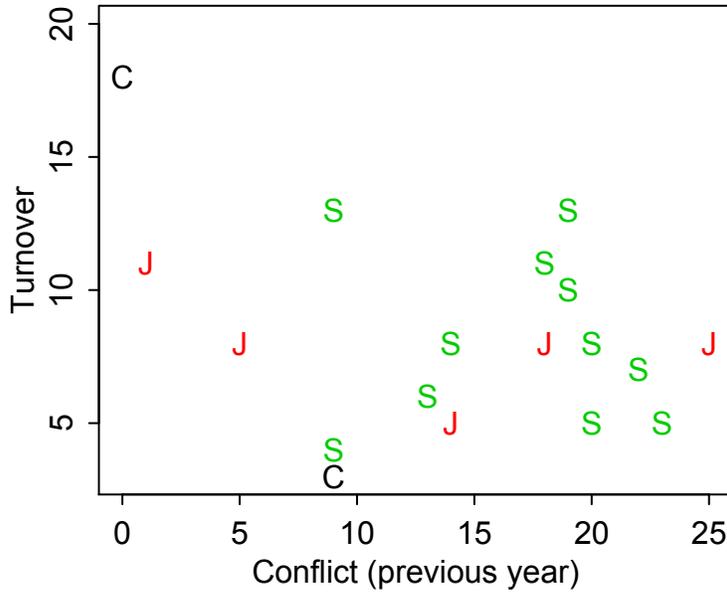
Adding house to the analysis allows any relationship to be specific to each house (McElreath, 2014).

Table 2: Results by House

	Mean	Standard Deviation	2.5%	97.5%
(Intercept)	2.64	1.10	0.49	4.80
Turnover_lag	-0.08	0.08	-0.23	0.08
J Street	-0.60	1.16	-2.86	1.67
Sunwise	0.25	1.12	-1.94	2.44
Turnover_lag J Street	0.14	0.09	-0.02	0.31
Turnover_lag Sunwise	0.06	0.08	-0.10	0.23

The action is with J Street, which shows a strong positive relationship, but based on only four data points. This is easy to see on Figure 1, but could easily be a fluke arising from sparse data and special aspects of one particular high turnover and high conflict year (McElreath, 2014).

Figure 2: Predicting Turnover with Conflict



There are many sources of exit/entrance other than conflict, so this result is naturally weak (McElreath, 2014). The data are sparse, so there is not necessarily enough information to measure the weak result, but that does not mean there is not a result. It just means we cannot measure it with these data (McElreath, 2014).

Table 3: What is the Average Rate of Conflict Across Houses, and What is the Average Rate of Turnover Across Houses?

House	Entrance Mean	Entrance Standard Deviation	Exits Mean	Exits Standard Deviation	Conflicts Mean	Conflicts Standard Deviation
Sunwise (1979)	0.44267	0.21592	0.43022	0.22676	1.28236	0.45344
J Street (1986)	0.46028	0.25108	0.37933	0.24463	0.98686	0.67067
Cornucopia (2011)	0.78025	0.37324	0.4475	0.20825	0.623	0.6463

It is important to notice here that the Cornucopia co-op has seen higher entrances, exits and conflicts in relation to the other co-ops since its inception. From living in Cornucopia and from previous house meeting minutes, the Cornucopia co-op also shows this. I will discuss

further below some reasons why Sunwise, J Street and Cornucopia co-op show varying results in terms of turnover and conflicts.

Discussion

Simply to reiterate the premise, any group that attempts to manage common pool resources for optimal sustainable production must solve a set of problems to create institutions for collective action. This research investigates whether the role of institutions for collective-actions are affected by resident turnover in co-ops in Davis, California. Specifically, this research focuses on the relationship between the transient nature of the co-ops and the institution that governs conflict mediation.

The dilemmas people face are complex, both in terms of the range of choices available, and the dynamics of interaction over time. These dynamics rely on institutions that facilitate a culture of cooperation. Ostrom describes that for institutions which create collective-action, conflict resolution proposes that appropriators and their officials have rapid access to low-cost local arenas to resolve conflicts among appropriators or between appropriators and officials (1990).

In regards to the transient nature of the co-ops, quantitatively there is a weak signal between the rate of turnover and the amount of conflicts that arise. This transience is an important characteristic of the co-ops, and membership turnover is an important marker of institutional memory and design. Thus, it could be argued that groups must overcome problems that arise from collective-action problems. While conflicts arise, as this research shows, it may not be a consequence of turnover.

However, qualitative data suggests otherwise. Members in co-ops have stated the issue that arises from high turnover and upholding household processes. In some cases, not having household stability might signal an increase in conflict due to organizational volatility. The solutions to this issue are complex, though it seems that a possible resolution for conflicts might be to allow household institutions to be dynamic. This dynamism should allow for new members to give input into the organizational and problem-solving aspects of the house.

In regards to the conflict resolution mechanisms at each house, these might be deficient in that they might not be able to facilitate and resolve problems of members in co-ops. Moreover, the static nature of the conflict resolution mechanisms should not be the greatest focus of the houses. The other institutions: (1) wealth creation, (2) chore systems, (3) administration, (4) monitoring and policing, (5) conflict management, and (6) community building, should be reevaluated because they matter and they should be aligned with

individual and organizational goals. Conflicts that arise from houses should be used as a measurement of household processes and interactions. Moreover, this measurement could possibly be used to examine the static nature or fluidity of household institutions in response to conflict.

Future work should examine how filtering mechanisms change and/or facilitate how institutions form and/or change over time. This aspect examines the various group formulation procedures that co-ops use to police membership and organization. This is important to understand because it may shed light on the stability of groups that attempt to solve collective-action problems.

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Role of the DNA Damage Sensor, ATR in Meiotic Chromosome Segregation in *Caenorhabditis elegans*



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Abstract

The ataxia telangiectasia and Rad3 related (ATR) kinase is an essential DNA damage sensor in eukaryotes. While null mutations in ATR in mammals are lethal, in Caenorhabditis elegans, ATR (atl-1) mutants are viable but infertile, providing a unique opportunity to study the function of ATR in a multicellular organism. ATR is suspected to contribute to the formation of chiasmata where genetic information is exchanged between homologous non-sister chromatids during meiosis. Defects in chiasmata formation lead to chromosome errors and the resulting gametes are aneuploid, which is fatal to the embryo. To study the potential role of ATL-1 in chiasmata formation, the number of chromosomes in diakinesis-stage nuclei from wild type and atl-1 mutant worms was analyzed. After collecting sufficient data, a statistical t-test revealed that there was a significant increase in the mean number of chromosome bodies in diakinesis-stage nuclei from atl-1 mutant worms compared to wild-type worms, suggesting that ATL-1 contributes to meiotic chromosome segregation. ATL-1 could function to directly affect chiasmata formation or more generally in recombinational

repair through the homolog and/or sister chromatid. To test for a role in recombinational repair through the homolog versus the sister chromatid, RNAi was used to knockdown the function of ATL-1 in syp-1 mutants, which blocks repair through the homolog, and in wild-type worms and the number of chromosomes was analyzed. The results from these studies will help to further understanding of how ATR functions during meiosis with implications for human reproduction.

Introduction

ATR (ataxia telangiectasia and Rad 3 related) is a highly conserved DNA damage sensor in eukaryotes and functions as a cell-cycle checkpoint kinase. It controls and contributes to genome integrity and functions to ensure that the genome is correctly replicated and transmitted from one cell to the next during mitosis (Garcia-Muse et al, 2005). In mammals, complete absence of ATR results in early embryonic lethality. Hypomorphic mutations, which cause a partial loss of function of ATR, or mutations that cause a change in the function of ATR, result in serious diseases such as Seckle Syndrome or Autosomal-Dominant Oropharyngeal Cancer Syndrome, respectively (Tanaka et al, 2012).

ATR on its own and in conjunction with ATM (ataxia telangiectasia mutated) responds to various forms of DNA damage. ATR alone responds primarily to DNA lesions in the form of single stranded DNA that result from UV damage or stalled replication forks (Zou, 2013). In addition, ATR functions with ATM in response to double strand breaks (DSBs). These DSBs are first resected to generate long single stranded DNA overhangs. This single stranded DNA then recruits ATR and initiates repair through various mechanisms including homologous recombination (Garcia-Muse et al, 2005). Although DNA breaks are normally detrimental, in some cases they can be beneficial. One such case is the process of meiosis in which DSBs are essential and purposely induced.

In many organisms, including humans, meiosis is essential for the formation of haploid gametes for sexual reproduction. During meiosis, DNA is replicated, followed by an extended prophase where homologous chromosomes pair and DSBs are induced. These breaks are an important part of meiosis because they allow homologous chromosomes to undergo crossover recombination to form chiasmata, which creates genetic variability and is essential for correct chromosome segregation (Libuda et al, 2013). Failure of the chromosomes to segregate properly results in many genetic diseases in humans such as Down syndrome. In some cases, chromosome segregation errors can be lethal. Therefore, it is important to understand the genes that control and contribute to meiotic chromosome segregation.

Since DSBs are purposely induced to form crossovers during meiosis and ATR is previously known to play a role in the repair of DSBs through homologous recombination in mitosis, the research presented in this paper aimed to study the function of ATR in meiosis. To do this, *Caenorhabditis elegans* was used to study ATL-1, the ATR ortholog, and its function in meiotic chromosome segregation. Since null mutations in ATR in mammals are lethal, *C. elegans* provides a unique opportunity to study the function of ATR in a multicellular organism since *atl-1* null mutants from heterozygous mothers can develop into adult worms but are infertile (Garcia-Muse et al, 2005). To better understand chromosome segregation in human meiosis, it is important to determine the role of ATR in meiosis. I hypothesized that ATR functions in meiosis by mediating the repair of DSBs through homologous recombination and thus contributes to meiotic chromosome segregation.

Methods and Materials

Strains and Culture Conditions

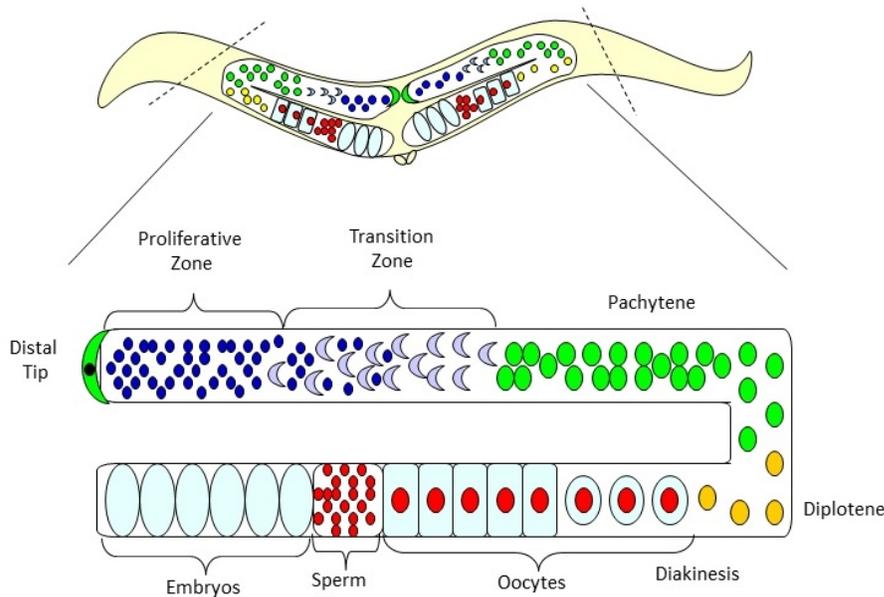
C. elegans strains were cultured and maintained using standard procedures. Strains were kindly provided by Professor JoAnne Engebrecht, PhD, from the University of California, Davis. These strains included wild-type Bristol N2 (Brenner, 1974), *atl-1* (Aoki et al, 2000), and *syp-1* (MacQueen et al, 2002). Worms were maintained on *E. coli* OP50 as a food source on NGM plates. RNA interference (RNAi) depletion of *atl-1* was performed by the feeding method: maintaining worms on an *E. coli* strain that either contains the vector that creates dsRNA to knock down *atl-1* on NGM plates or contains an empty vector that serves as the control (Ohkumo et al, 2008).

Dissection of *C. elegans* Gonads

L4 larvae were staged the day before dissections. For dissections, ten worms were placed in 30 μ l of 1x egg buffer, which was made with 0.1% Tween on a 22x22 glass cover slip. These worms were dissected by cutting off the head and the tail near the ends of the worm so that the gonad was not damaged and could be extruded from the body (Figure 1). After worms were dissected, 15 μ l of 1x egg buffer was removed, and 15 μ l of 2% paraformaldehyde (PFA) was added and mixed with the remaining 1x egg buffer on the cover slip. 15 μ l of the liquid was removed and a superfrost plus microscope slide was placed on top of the cover slip. After incubating for 5 minutes, the slide was immersed in liquid nitrogen, the cover slip was quickly removed, and the slide was immediately placed in -20°C methanol for 1 minute. Afterwards, the slide was washed three times for five minutes each in PBST (1x PBS, 0.1% Tween). This dissection process was repeated for all the different strains of worms and the different treatments until there was at least one slide of each treatment and strain

combination. After washing, the slides were partially dried, 20 μl of 2 $\mu\text{g/ml}$ DAPI in water was added, and the slides were incubated in the dark for 5 minutes. Afterwards, the slides were washed in PBST for another 5 minutes before being mounted with 8 μl of glycerol with DABCO using a 22x22 glass coverslip. These slides were then analyzed under a fluorescent microscope (Jaramillo-Lambert, 2010).

Figure 1: Cartoon of the *C. elegans* Hermaphrodite Germ Line



This image shows a cartoon of the *C. elegans* germ line that was analyzed for the experiment. The dotted lines show where the *C. elegans* body was cut, allowing the gonads to protrude out of the body. The areas I was interested in analyzing are the oocytes in red near the bottom of the gonad (Jaramillo-Lambert, 2010).

Generation of RNAi Plates

A strain of *E. coli* containing the vector with *atl-1* sequences and a strain of *E. coli* containing an empty vector L4440 were pulled from the freezer (-78°) and streaked onto separate LB+Amp+Tet plates. These plates were incubated at 34°C overnight to allow the bacteria to grow. The next day, a single bacterial colony was picked from each plate and placed in separate test tubes containing 2.0 mL of LB+Amp broth. A bacterial colony was not added to one of these tubes so that it could be used as a control. These were incubated overnight in a shaker at 37°C . The next day, the three test tubes were removed and checked

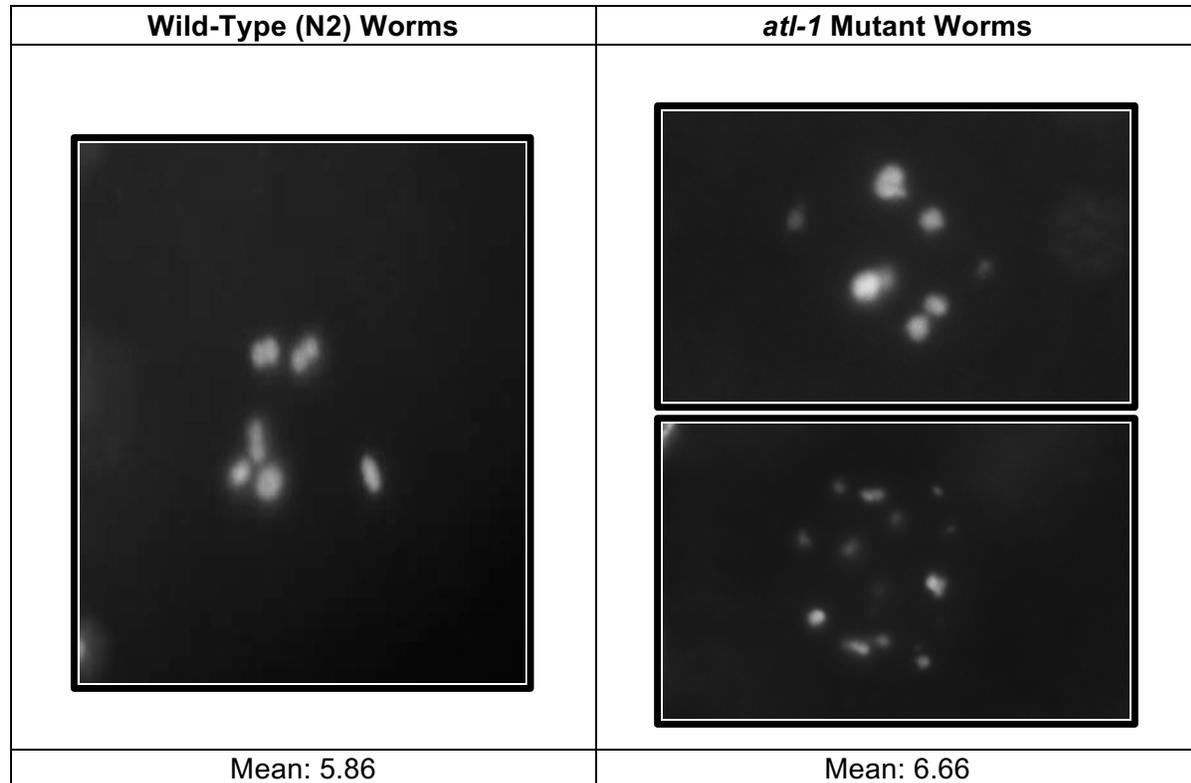
for contamination. The test tube without a bacterial colony should appear clear while the other two test tubes should appear cloudy. If the control was also cloudy, that meant the broth was contaminated. If the test tubes passed, the control was discarded and 0.4mL of each broth was plated onto separate RNAi plates. The resulting products were five RNAi plates containing the L4440 bacteria and five RNAi plates containing the *atl-1* RNAi bacteria (Ohkumo et al, 2008).

RNAi of *C. elegans*

Strains of wild-type Bristol N2 worms and *syp-1* heterozygous worms were used. Twelve N2 and eighteen *syp-1* L4 larvae were transferred to separate plates containing *E. coli* OP50 as a food source. The next day, these worms were transferred to the RNAi plates: three N2 worms were placed onto each plate for two L4440 control RNAi plates and two *atl-1* RNAi plates while three *syp-1* heterozygous worms were placed onto each of the remaining plates and incubated at 20°C for 3 days (Ohkumo et al, 2008). L4 larvae progeny that grew up on the RNAi plates were staged and the next day, dissections were performed as described above and analyzed under a fluorescent microscope.

Results

Figure 2: Comparison of Oocytes Between N2 and *atl-1* Mutants



The number of DAPI-stained bodies per oocyte was compared between N2 wild-type worms and *atl-1* mutant worms. Wild-type worm oocytes contained 6 DAPI-stained bodies, representing the 6 bivalents. Oocytes from *atl-1* mutant worms on average contained more than 6 DAPI-stained bodies, suggesting that ATL-1 plays a role in meiosis.

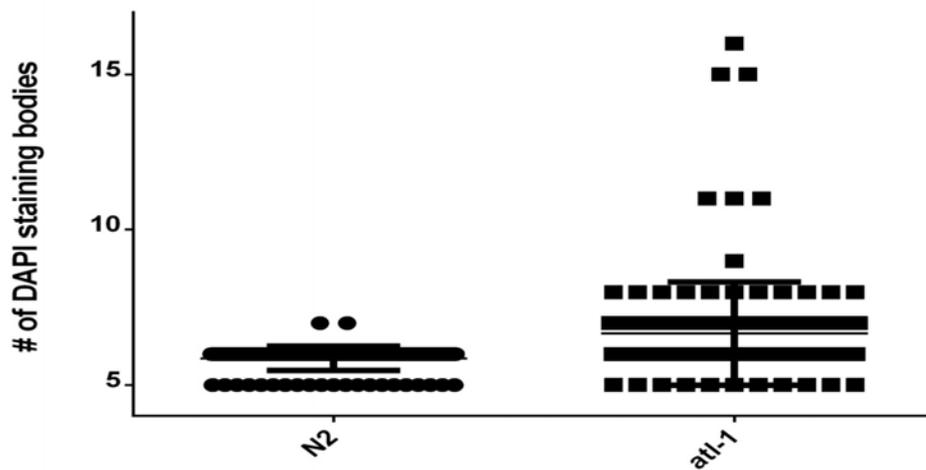
The Absence of ATL-1 Results in Defects in Meiosis

Through dissections of hermaphroditic worms, which aimed to release the gonad from the body, and staining with DAPI, which caused the DNA to fluoresce under a fluorescent microscope, I counted the number of DAPI-stained bodies in diakinesis-staged oocytes. I defined a DAPI-stained body as any individual fluorescent particle. In wild-type worms, the mean number of DAPI-stained bodies was 5.86, representing the 6 bivalents or paired homologous chromosomes connected by chiasmata (Figure 2). For the *atl-1* mutant worms, the majority of the oocytes had 6 DAPI-stained bodies; however, many oocytes contained 7-8 DAPI-stained bodies, while a few oocytes had more than 12 DAPI-stained bodies (Figure 2). As a result, the mean number of DAPI-stained bodies for *atl-1* mutants was 6.66. After collecting data from 135 *atl-1* mutant worms and 135 N2 wild-type worms, a t-test was

performed to compare the two sets of data and resulted in a P-value of $2.397e-7$ ($P < 0.001$) (Figure 3). From this, I conclude that the data supports my hypothesis that ATL-1 plays a role to ensure proper chromosome segregation during meiosis.

$\mu_1 = 5.86$	$\mu_2 = 6.66$
$\sigma_1 = 0.389$	$\sigma_2 = 1.67$
$t = 5.42$	$P\text{-value} = 2.397e-7$

Figure 3: Number of DAPI-Stained Bodies for N2 vs. *atl-1*



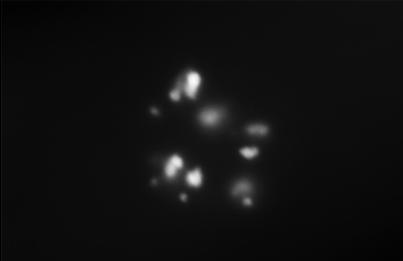
This graph plots the data collected on the number of DAPI-stained bodies per oocyte between wild type and *atl-1* mutant. Comparing the means and performing a statistical t-test showed that there was a statistically significant difference in the mean number of DAPI-stained bodies between oocytes from wild type and *atl-1* mutant. This data supports my hypothesis that ATL-1 functions in meiosis.

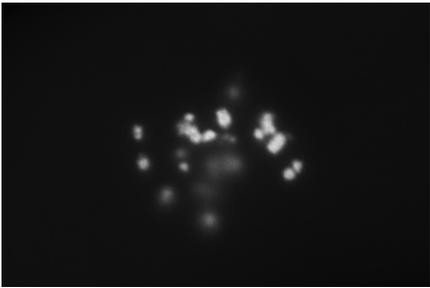
ATL-1 Functions in a Different Pathway than SYP-1

From the previous experiment, I discovered that ATL-1 does indeed play a role in meiosis. To explore the exact role that ATL-1 plays in this process, I used two strains of worms, wild type (N2) and *syp-1* mutants. Since SYP-1 is an essential synaptonemal complex component that is required for stabilizing associations between homologous chromosomes and promoting crossovers, *syp-1* mutants fail to repair DSBs through homologous chromosomes for chiasmata formation (MacQueen et al, 2002). I performed RNAi to knock down *atl-1* in both wild type and *syp-1* mutants as well as L4440, which is the empty RNAi vector, to serve as the control for both wild type and *syp-1* mutants. At first, the RNAi was not effective; however, after changing the bacterial strain I used for the RNAi, I was able to deplete ATL-

1. I dissected about 20 oocytes from each treatment and strain combination and gathered preliminary results (Figure 4). Comparing the mean number of DAPI-stained bodies of the double mutant, *syp-1* mutants on *atl-1* RNAi, to *syp-1* mutant on L4440, the means appear to be different. However, because the sample size was not large enough, a statistical t-test could not be performed to assess the data's level of significance.

Figure 4. Comparison of Oocytes for *atl-1* RNAi Knock Down

Worm Strain	RNAi Treatment	Oocyte Image	Mean number of DAPI-stained bodies
Wild Type (N2)	L4440		6.0
Wild Type (N2)	<i>atl-1</i>		8.06
<i>syp-1</i> mutant	L4440		12.0

<i>syp-1</i> mutant	<i>atl-1</i>		13.71
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This is a visual representation comparing the mean number of DAPI-stained bodies between the four treatment and strain combinations. Comparing the two treatment groups for the N2 wild-type worms suggest that the RNAi worked well. This allowed me to examine and compare the two treatment groups for the *syp-1* mutant. Comparison of the *syp-1* single mutant to the *syp-1* mutant on *atl-1* RNAi suggest that ATL-1 functions in a different repair pathway than SYP-1.

Discussion

The Absence of ATL-1 Results in Defects in Meiosis

To determine whether ATR plays a role in meiosis, I analyzed the phenotype of the *atl-1* mutant. I used *C. elegans* as a model organism because they are easy to work with: they are small in size, have a fast generation time, and are easy to maintain. In addition, their whole genome is sequenced and they share many orthologs with humans, including ATL-1, the *C. elegans* ortholog of ATR. Most importantly, while null mutations in ATR in mammals are lethal, in *C. elegans*, ATL-1 null mutants are viable but infertile, providing a unique opportunity to study the function of ATR in a multicellular organism.

In this study, I was interested in examining the role of ATR in the germ line because germ cells are arranged in a spatial-temporal order: as you move through the germ line (space), you are also progressing through the stages of meiosis (time). Within the germ line, I analyzed the number of DAPI-stained bodies within the oocytes. This is because DSBs are induced and resolved through crossovers during pachytene. If these DSBs are not correctly processed during pachytene, it will result in oocytes with the wrong number of chromosomes as monitored by DAPI-stained bodies. Therefore, by looking at the oocytes, I was able to indirectly observe what is happening with the formation of crossovers.

For wild-type worms, the majority of the oocytes contained 6 DAPI-stained bodies. This is what I expected since these DAPI-stained bodies represent the 6 bivalents or paired homologous chromosomes connected by chiasmata that would normally be present at that stage. The mean number of DAPI-stained bodies for wild type is 5.86, which is slightly less than 6. This is most likely due to DAPI-stained bodies overlapping and covering one another and not due to oocytes missing chromosomes.

For *atl-1* mutant worms, the majority of the oocytes also contained 6 DAPI-stained bodies. However, there were a number of oocytes that contained 7-8 DAPI-stained bodies, while a few oocytes contained more than 12 DAPI-stained bodies, which suggests that there was chromosome fragmentation. This resulted in a mean number of DAPI-stained bodies of 6.66 for *atl-1* mutants. These numbers suggest that ATL-1 does serve a role in meiosis, but the validity of this observation must be tested. To do that, a statistical t-test was performed to compare the two sets of data. I tested the following hypotheses:

H₀: The mean number of bivalents between wild type and mutant worms is the same.

($\mu_1 = \mu_2$)

H_a: The mean number of bivalents between wild type and mutant worms is different.

($\mu_1 \neq \mu_2$)

This test resulted in a P-value of 2.397e-7 ($P < 0.001$). At the 0.01 level of significance, since the p-value $< \alpha$, I can reject H₀: $\mu_1 = \mu_2$. Therefore, the data provides sufficient evidence (P-value = 2.397e-7) at the 0.01 level of significance to conclude that the mean number of DAPI-stained bodies between wild type and mutant worms is different. From this, I conclude that the data supports my hypothesis that ATL-1 plays a role during meiosis.

ATL-1 Functions in a Different Pathway than SYP-1

Since the previous experiment suggested that ATL-1 contributes to meiotic chromosome segregation, the next step was to understand the function of ATL-1 in this process. I approached this by using the mutant, *syp-1*, in which crossovers cannot be formed and repair between homologous chromosomes is impossible. This is because SYP-1 is an essential synaptonemal complex component that is required for stabilizing associations between homologous chromosomes and promoting crossovers (MacQueen et al, 2002). As a result, *syp-1* mutant worms have oocytes that contain 12 DAPI-stained bodies, representing the 12 univalents or unpaired homologous chromosomes not connected by chiasmata. I used either wild type (N2) or *syp-1* mutants, and performed RNAi to knock down *atl-1* in both N2 and *syp-1* mutants as well as L4440 as the control. By comparing the *syp-1* mutant on the *atl-1* RNAi to the *syp-1* single mutant on the L4440 RNAi, I could analyze the double mutant phenotype to provide insight into how ATL-1 functions. If the double mutant looks like the

single mutant, we could conclude that ATL-1 could be working in the homologous chromosome repair pathway, similar to SYP-1. Conversely, if the double mutant looks worse than the single mutant, we can conclude that ATR could be working in another repair pathway besides, or in addition to, the homologous chromosome repair pathway, such as the sister chromosome repair pathway.

After completing the first set of RNAi and dissections, I noticed that the double mutant looked like the *syp-1* single mutant, suggesting that ATL-1 functions in the homologous chromosome repair pathway, similar to SYP-1. However, another way to interpret this result is that the RNAi was not effective. To test for this, I performed various independent experiments to assess how well the RNAi worked. This included progeny inviability tests, looking at nuclei in the mitotic end of the gonad, and comparing the number of DAPI-stained bodies in oocytes of N2 on L4440 to N2 on the *atl-1* RNAi. For the progeny inviability test, if the RNAi worked, the N2 on *atl-1* RNAi worms would have been infertile and the progeny of those worms would have been inviable. However, after performing the test, I observed that the progeny were alive, which suggests that the *atl-1* RNAi did not work. The next test I performed was to look at the nuclei in the mitotic end of the gonad; if the RNAi worked, the nuclei would be in many different shapes and sizes, not all uniform. However, I observed that the nuclei were all very uniform in shape and size, also suggesting that the RNAi did not work. Lastly, I compared the number of DAPI-stained bodies in the oocytes between the N2 on *atl-1* RNAi and on L4440 RNAi. This showed that the RNAi did not work because there was no significant difference in the number of DAPI-stained bodies between the two treatments. Therefore, after assessing the results of all three tests, I concluded that the RNAi did not work.

I subsequently used a new strain of *atl-1* RNAi bacteria. After performing RNAi with this new strain of bacteria, I redid the three tests mentioned above, which showed that the RNAi had worked. Next, I examined and compared the oocytes for the *syp-1* single mutant and the *syp-1* mutant on the *atl-1* RNAi. However, because of the limited amount of time, I was only able to gather some preliminary results.

I collected data from 20 oocytes for each strain and treatment combination. Comparing the number of DAPI-stained bodies in oocytes from N2 worms between the two treatments, I saw that there was an increase for N2 worms on *atl-1* RNAi with a mean of 8.06 DAPI-stained bodies compared to 6.00 on the control, suggesting that the RNAi worked. I next examined the *syp-1* mutant on the two treatments. The double mutant had on average 13.71 DAPI-stained bodies per oocyte while the single *syp-1* mutant has 12.0, suggesting that the double mutant is more impaired than the single *syp-1* mutant. In addition, the *syp-1* single mutant had 12 DAPI-stained bodies that were uniform in size and shape, representing the 12 univalents or unpaired homologous chromosomes not connected by chiasmata. The *syp-1*

mutant on the *atl-1* RNAi, on the other hand, had DAPI-stained bodies that not only were not uniform but also existed in many different shapes and sizes, signifying chromosome fragmentation. Although I was not able to perform a statistical test to assess if these two means were statistically different since the sample size was not large enough, they appeared to be different. This suggests that ATR could be working in another repair pathway besides the homologous chromosome repair pathway, such as the sister chromosome repair pathway.

Conclusion

Through this project, I hoped to better understand chromosome segregation in human meiosis by studying the possible role of ATR in meiosis. I hypothesized that ATR functions in meiosis by contributing to the repair of double strand breaks (DSBs) through homologous recombination, and thus is important for meiotic chromosome segregation. By analyzing and comparing DAPI-stained bodies from oocytes of both wild type and *atl-1* mutant worms, I was able to establish that ATL-1, the ATR homolog in *C. elegans*, does play a role in meiosis. Using RNAi, I was able to compare the *syp-1* mutant to the *syp-1* mutant on *atl-1* RNAi. The number, size, and shape of the DAPI-stained bodies of the double mutant signify severe chromosome fragmentation. This, when compared to the *syp-1* mutant, suggests that ATR could be working in another repair pathway besides the homologous chromosome repair pathway, such as the sister chromosome repair pathway. However, I was not able to perform any statistical tests to confirm this idea since there was not enough time to compile a large enough sample size.

ATL-1 could function more generally in recombinational repair through the homolog and/or sister chromatid, or to directly affect chiasmata formation. In future projects, I hope to understand its role in recombinational repair. I will continue performing the *atl-1* RNAi with the *syp-1* mutant and gather more data to increase my sample size so that my results will be statistically significant. To test for recombinational repair through the sister chromatid, I will be working with *rec-8*, which blocks both sister and homologous chromosome repair (Stoop-Myer, 1999). To determine whether ATL-1 directly affects chiasmata formation, worms carrying the COSA-1:GFP transgene, which has a green fluorescent protein linked to the crossover binding protein COSA-1 (Yokoo, 2012), will be used to analyze the number of chiasmata in the presence or absence of ATL-1. Hopefully, the results from these studies will help us understand how ATR functions during meiosis and will further our understanding of chromosome segregation and the things that contribute to and mediate human reproduction.

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Nitric Oxide Synthase Role in Heart Arrhythmias



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Abstract

Heart failure is the leading cause of death in the United States; about 4 million people in the U.S. die each year due to cardiac arrhythmias. Cardiac arrhythmia is the 'out of rhythm' abnormal beating of the heart; ventricular arrhythmias can cause sudden cardiac death and atrial arrhythmias often lead to blood clots, leading to a heart attack or a stroke. Hence, it is important to understand the molecular mechanisms that play vital roles in the heart function and diseases. The research in our lab centers on how mechanical stress affects the biochemical reactions within cardiac muscle cells to alter the heart function and cause diseases, a process called mechano-chemo-transduction. We specifically focus on the pathway when the physiologic stretch on heart cells rapidly activates Nitric Oxide Synthase to produce nitric oxide (NO). NOS located and sensitizes nearby ryanodine receptors (RyRs) in the sarcoplasmic reticulum (SR). The more sensitive RyRs trigger a burst of Ca (2+) sparks, the elementary Ca (2+) release events in the heart. Although this stretch-dependent "tuning" of RyRs increases Ca (2+) signaling sensitivity in healthy cardiomyocytes, in

disease, it enables Ca²⁺ sparks to trigger arrhythmogenic Ca²⁺ waves, which can lead to arrhythmias.

Introduction

Nitric Oxide (NO) is a highly reactive, free radical signaling molecule that is constitutively released in cardiomyocytes. Single channel studies have been performed with the ryanodine receptor exposed to various NO donors, and under these conditions, NO appears to have a stimulatory effect on channel open probability (Popen), the process termed S-Nitrosylation [1]. The ryanodine receptor in cardiac muscle plays a central role in the Ca²⁺ signaling that controls cardiac excitation-contraction (E-C) coupling. During contraction of heart cells, the ryanodine receptor is the channel that is responsible for the release of calcium (Ca²⁺) [2]. Increasing the probability of the ryanodine receptor being open can produce arrhythmogenic Ca²⁺ release, which can lead to heart arrhythmias. Thus, studying the production and regulation of NO in the heart is extremely important.

NO is synthesized by the enzyme NO synthase (NOS). This paper will focus on two distinct isoforms of NOS, endothelial NOS (eNOS) and neuronal NOS (nNOS). These isoforms are characterized by regions of high homology, namely the oxygenase and reductase domains [3]. Previous research has shown that when NO comes in close proximity to a ryanodine channel, the probability of the ryanodine receptor opening increases, a process called S-nitrosylation. This causes an elevation of spontaneous Ca²⁺ release by the sarcoplasmic reticulum (SR). Ca²⁺ is the key mediator of the heart muscle contraction, while eNOS and nNOS signaling will aid in understanding how the heart functions [4]. Due to the short-lived nature of NO diffusion, we think the location of eNOS and nNOS will give us information on which isoform affects the ryanodine receptor [5]. We are starting to pinpoint the particular enzymes that are involved in the cause of heart arrhythmias, aiding in finding preventive treatment for heart arrhythmias.

In this study, we chose to analyze the locations of NOS enzymes by using antibody labeling of wild-type mice. We completed this objective by utilizing antibody labeling wild-type mice cardiac myocytes for the two NOS groups and RYR. Then, we imaged the cells using Structure Illumination Microscopy to measure the distances between these two proteins of interest.

Methods and Materials

Cell Isolation

The Wildtype and Familial Hypertrophic Cardiomyopathy (FHC) mice were purchased and anesthetized with sodium pentobarbital (100 mg/kg injected IP, 4000 u/kg heparin) After the suppression of spinal cord reflexes, the hearts are removed via midline thoracotomy. A standard enzymatic technique procedure is followed in accordance with the National Institutes of Health guidelines and protocols approved by Institutional Animal Care and Use Committee to isolate the ventricular myocytes.

Antibody Labeling of Isolated Cells

The following methods were used for both wild-type and FHC ventricular myocytes. Freshly isolated ventricular myocytes were fixed in 1% paraformaldehyde PBS solution for 5 minutes and washed twice with cold (4°C) PBS. Then cells were permeablized with 0.1% Triton X-100 for 5 minutes and washed once in cold PBS. Next, cells were incubated in two primary antibodies (1:100 dilution), a solution containing 5% bovine serum albumin (BSA), 3% goat serum 0.01%, and 0.01% Triton X-100 in PBS for 2.5-3 hours at room temperature. Afterwards, the cells were washed twice in cold PBS. Dual labeling of primary antibodies used specific labeling of RyR with anti-RyR mouse monoclonal, Thermo Scientific MA3-916. For specific labeling of Nnos, we used anti-nNOS Rabbit polyclonal and Millipore AB1632. After the cells were washed, they were incubated in Alexa Fluor goat anti-mouse 2mg/mL 546nm and Alexa Fluor goat anti-rabbit 2mg/mL 488nm conjugated secondary antibody (1:100 dilution) solution overnight in a 4°C refrigerator. Cells were then washed and placed in PBS until imaging. Steps were then repeated for the dual labeling of RyR and eNOS, using specific labeling of Ryr, the same previous antibody, and eNOS as anti-eNOS Rabbit, polyclonal, and Millipore AB1632.

Confocal Microscopy

Confocal images were obtained using a BioRad (Hercules, Ca) Radiance 2000 confocal microscope with a water emersion objective 63X numerical aperture 1.2 corrected for thickness of the No. 1 glass coverslip. The pixel dimensions are 0.2µm in the focal plane, and z-sectioning interval was 0.2µm. The focal plane was placed in the middle of the cell sample. The cells were then randomly scanned for ventricular myocytes with the longitudinal axis oriented in parallel to the microscope's focal plane.

Structured Illumination Microscopy

We used a DeltaVision OMX V3.0 Blaze system (Applied Precision Inc.) to acquire the fluorescence images of antibody-labeled cardiomyocytes. The system uses 488- and 532-nm lasers as the light source for illumination. A grating in the beam path generated three

coherent beams that created 3D structured illumination patterns in the sample. The antibody-labeled cells were immersed in the ProLong Gold antifade reagent with a 1.47 refractive index (RI), and fluorescence emission was collected with a 60× oil immersion objective with 1.514 RI, 1.42 NA. Fluorescence of different colors was separated by a dichroic mirror and filtered by bandpass emission filters before being collected by two fast sCMOS cameras (PCO-TECH Inc.). To acquire 3D images, the sample was moved along the z-direction at a step size of 125 nm. Acquired raw images were processed with a proprietary software package (softWoRx v5.0, Applied Precision Inc.) to reconstruct super-resolution 3D images. Reconstructed images of different colors were registered using custom-built software to correct for any chromatic aberration, which is the failure of a lens to focus all colors to the same convergence point. Before the experiments, the system and the color registration software were calibrated using multicolor polymeric beads of 0.1 μm (TetraSpeck beads, Molecular Probes). The spatial resolution of the system was ~110 nm for the focal planes and ~250 nm for the z-axis. The color registration error was smaller than a pixel (40 nm). A 3D rendering of the SIM images was performed with Volocity Visualization package.

The localization of nNOS or eNOS with RyR was analyzed using Volocity Quantitation (PerkinElmer), implementing the standard Pearson's colocalization analysis. A user-defined threshold was set to separate signal from background and objects having a volume smaller than 0.00189 μm³ (which might arise from photon noise) were excluded. The nearest-neighbor distance between NOS and RyR clusters was measured as the smallest pairwise distance between the center of mass of the respective molecular clusters.

Results

Figure 1: Confocal (upper) SIM (lower) Image of eNOS (blue) and RyR (red) in Wild-Type Mice

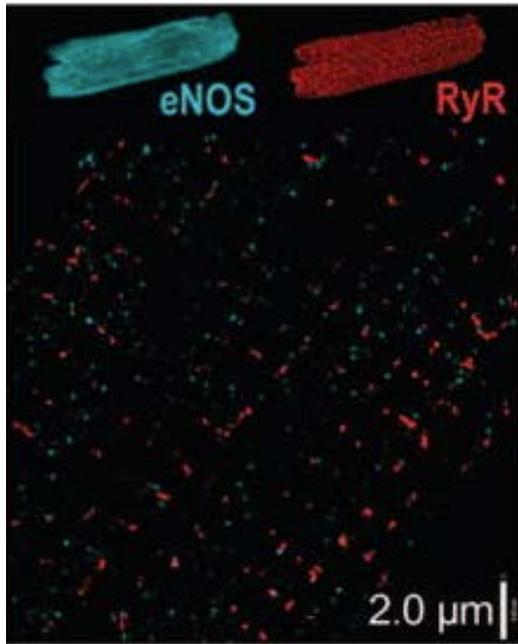


Figure 2: Confocal (upper) SIM and (lower) Image of nNOS (green) and RyR (red) in Wild-Type Mice

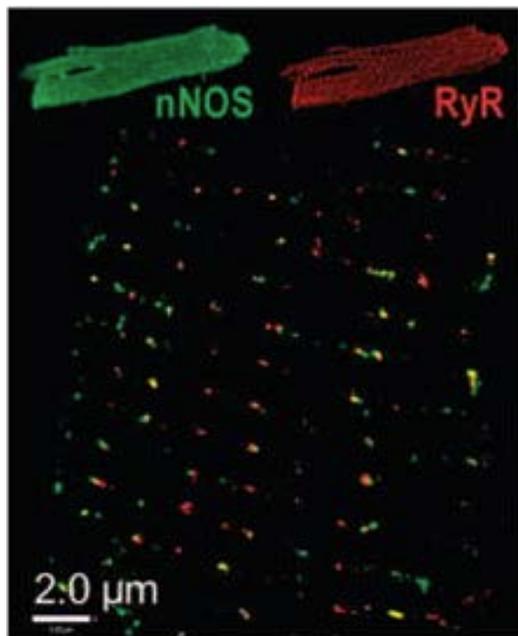


Figure 3: Histogram of nNOS and eNOS Distance to RyR in Wildtype Mice

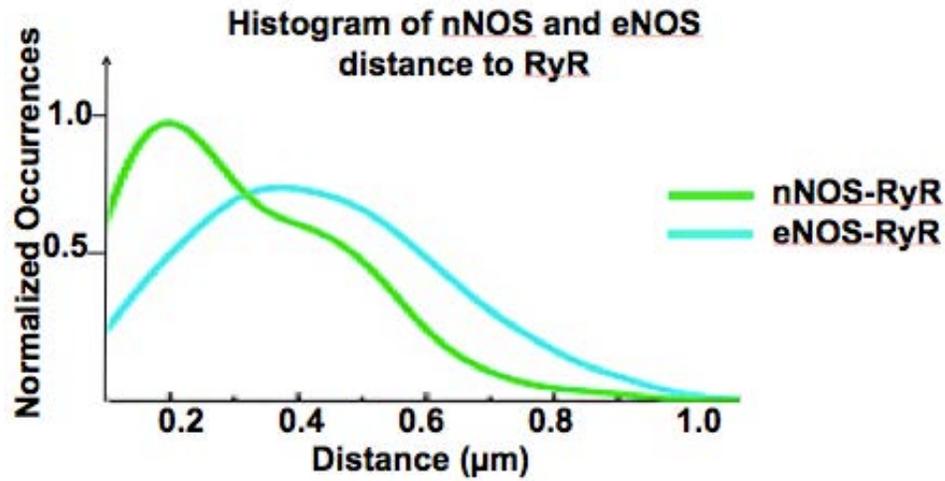
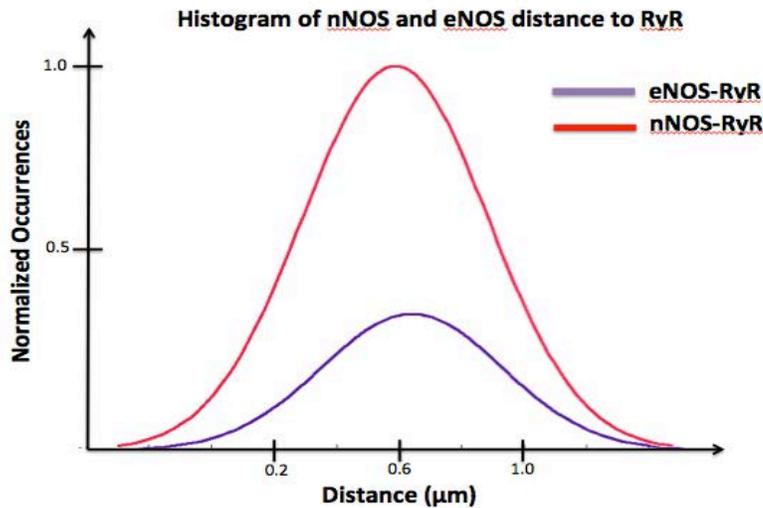


Figure 4: Preliminary Data Histogram of nNOS and eNOS Distance to RyR in Familial Hypertrophic Cardiomyopathy (FHC) Mice



nNOS and eNOS Distance to RyR in Wild-Type and Familial Hypertrophic Cardiomyopathy (FHC) Mice

Through antibody labeling of the wild-type mice, we were able to analyze the distances of eNOS and nNOS to RyR using Structured Illumination Microscopy. Because NO is a short-lived local signaling molecule, the distance gives an idea which enzyme has a stronger role on monitoring the ryanodine receptor. Since confocal resolution cannot resolve these distances (seen in the upper portion in Fig. 1 and Fig. 2), we used super-resolution structured

illumination microscopy (SIM) to quantify the colocalization of RyR with nNOS and eNOS (seen in the lower portions of Fig. 1 and Fig. 2).

For the wild-type mice, the nearest neighbor distance histogram (Fig. 3) showed significantly different patterns in the NOS isoforms, with nNOS-RyR distance peaking with most occurrences at $0.19\ \mu\text{m}$ and eNOS-RyR distance at $0.37\ \mu\text{m}$, a twofold increase. The Mann-Whitney test was used to compare the nNOS-RyR and the eNOS-RyR distance histograms, and the difference was significant at $P < 0.0001$. The effective NO signaling range is expected to be influenced by the distance of diffusion, the amount of NO produced by the different isoforms of NOS, the buffering capacity, the degradation and removal, and the target modification kinetics. The twofold increase in signaling distance for eNOS would translate to fourfold slower diffusion time and eightfold reduction in NO concentration at the target site.

In the Familial Hypertrophic Cardiomyopathy, the preliminary data provides that the nearest neighbor distance histogram (Fig. 4) showed significant patterns comparing the NOS isoforms with nNOS- RyR distance peaking with most occurrences at $0.54\ \mu\text{m}$ and eNOS-RyR distance at $0.63\ \mu\text{m}$, a $.9\ \mu\text{m}$ increase. However, the amount of eNOS occurrences decreased significantly with a less than a quarter of the nNOS occurrences. Work is still being conducted on the familial hypertrophic cardiomyopathy mice.

Conclusion

Overall, the experiment was a success; the Structured Illumination Microscopy allowed for the resolution necessary to measure the distance between NOS and RYR. The divergent effects of nNOS and eNOS on modulating RyR might be explained by highly localized NO signaling; super-resolution imaging data suggested that the intracrine NO signaling was within submicrometer range in the cardiomyocytes. Our study has provided supporting evidence that nNOS might predominantly modulate RyR because of its closer proximity to the SR. This narrows down the enzymes that are involved in relating RYR. Further research is still needed to be done to understand other factors of the enzyme kinematics of nNOS and eNOS. For instance, how much NO are they respectively producing when the pressure increases in the heart? The distance is not the sole factor that affect which enzyme is modulating RYR.

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Neuronal recovery following oxygen and glucose deprivation in Syrian Hamster hippocampi is greater than in rat hippocampi



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Abstract

Characterized by disruption in blood flow to portions of the brain, stroke is a leading cause of death in the USA. Hibernating mammals undergo substantial drops in metabolism and body temperature during hibernation that are also accompanied by greatly diminished blood flow. Hibernating species can undergo numerous bouts of deep hibernation without apparent neural pathology, suggesting that they may have mechanisms that protect their neurons from reduced blood flow seen in hibernation. In fact, in brain slice experiments in obligatory hibernators (those that generally hibernate only in winter) have been demonstrated to have greater resistance to damage from exposure to hypoxia, ischemia, and oxygen plus glucose deprivation (OGD) than do non-hibernating mammals. In addition, we previously found that hippocampal slices from the Syrian hamster a facultative hibernator (which can hibernate any time of the year) could tolerate oxygen deprivation better than

hippocampal slices from rats, a non-hibernating species. However, tolerance to oxygen and glucose deprivation (OGD), a stroke-like condition, has not been studied functionally in facultative hibernators. Thus, my experiments focus on Syrian hamsters and test two hypotheses: (1) hamster hippocampi exhibit greater neuroprotection against OGD than do rat hippocampi, and (2) recovery of hippocampal neurons from both species is greater at lower temperature. To test my hypotheses, I chose Syrian hamsters from our colony and Sprague Dawley (Charles River) rats aged 6-8 months. Both animal groups were housed at 22±2°C and 14:10 hour light: dark photoperiod for at least 3 weeks. Hippocampi were sliced using a McIlwain tissue chopper and incubated in a temperature-controlled water bath for one hour before being placed into the recording chamber where they were perfused with 95% O₂/5% CO₂ artificial cerebrospinal fluid with glucose (O₂aCSF) until a fifteen-minute stable baseline period was obtained. The perfusing solution was then changed to 95% N₂/5% CO₂ gassed aCSF (artificial cerebrospinal fluid) without glucose (N₂aCSF) for 10 minutes before changing back to O₂aCSF. A stimulating electrode was placed in the Schaffer collateral nerve bundle, and the evoked responses were recorded in the CA1 pyramidal region at 25°C, 30°C, and 35°C. The results showed that the hamster slices had greater recovery from OGD than did rats at 25°C and 30°C. Also, recovery was significantly greater at lower temperatures in both hamsters and rat slices. These data support my hypotheses that facultative hibernating species recover from OGD to a greater degree than non-hibernating species, and that neuronal recovery from OGD is greater at lower temperatures.

Introduction

In deep torpor, hibernating animals lower their body temperature and metabolism to conserve energy, leading to reduction in cerebral blood flow and diminished oxygen and glucose supply in the brain. However, hibernators can undergo numerous bouts of hibernation without apparent neural damage, indicating a degree of neuroprotection against low oxygen and glucose levels, at least in combination with cold and depressed metabolism. In the past, obligatory hibernators were shown to exhibit a degree of neuroprotection against oxygen and glucose deprivation (OGD, a model for studying stroke) *in vitro* when compared to rats, a non-hibernating species [2]. Recent work using a facultative hibernator, the Syrian hamster (*Mesocricetus auratus*), and neuronal excitation during oxygen deprivation [1] and using histology and OGD [3] suggest that both obligatory and facultative hibernators share resistance to stroke-like conditions. The advantage of using facultative hibernators, hamsters in particular, is that they can hibernate any time during the year, whereas obligatory hibernators hibernate seasonally. What is not known is if the Syrian hamsters are functionally neuroprotected against OGD. To determine if Syrian hamsters are a useful model for studying mechanisms that provide functional neuroprotection against OGD, I

tested the following hypotheses: (1) Syrian hamsters exhibit greater neuroprotection against OGD than do rats; and (2) recovery of neurons is greater at lower temperature across both hibernating and non-hibernating species.

Methods

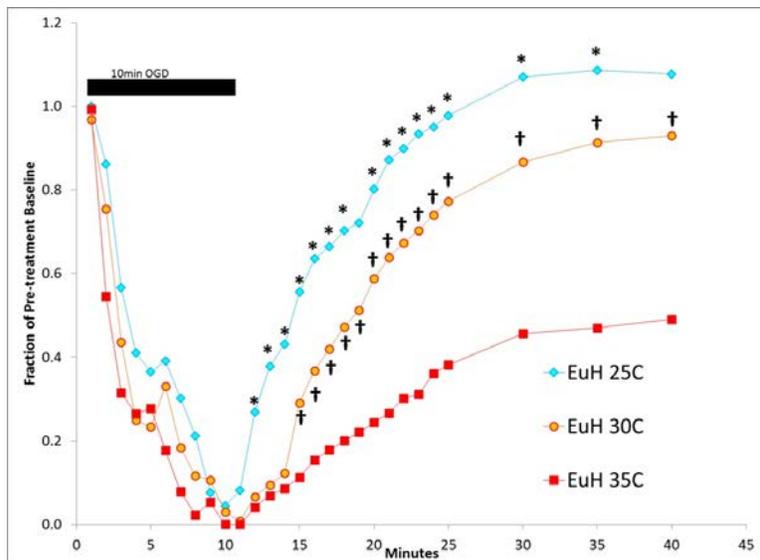
Experimental protocols were approved by the UC Davis Animal Care and Use Committee in compliance with Animal Welfare Act and the Public Health Service Policy on Humane Care and Use of Laboratory Animals. Sprague-Dawley rats (Charles River Laboratories, Wilmington, MA) and Syrian hamsters (from our colony), aged 6-8 months, were housed at $22^{\circ}\text{C} \pm 2^{\circ}\text{C}$ on a 14:10 hour light: dark cycle. Hippocampi were dissected and sliced with a McIlwain chopper to 400 μm thick, incubated for 30 minutes at 30°C in high sucrose artificial cerebrospinal fluid (aCSF) oxygenated with 95% O_2 /5% CO_2 containing (mM final concentration): 62 NaCl, 2.5 KCl, 2 CaCl₂, 1.5 NaH₂PO₄, 2 MgSO₄, 26 NaHCO₃, 124 sucrose, and 10 dextrose. Slices were then moved to a chamber containing oxygenated aCSF (O₂aCSF) containing (mM final concentration): 124 NaCl, 2.5 KCl, 2.5 CaCl₂, 1.5 NaH₂PO₄, 1.5 MgSO₄, 26 NaHCO₃, and 10 dextrose for at least 60 minutes before being placed in the recording chamber perfused with O₂aCSF. Tungsten electrodes were used to stimulate the Schaffer collateral nerve bundle on the hippocampal slice. The evoked responses amplitudes (ERA) were recorded with glass electrodes filled with 3M NaCl and placed in the CA1 pyramidal cell layer. Baseline responses were recorded each minute (two 30-second periods were averaged) for fifteen minutes of stable baseline while the slice was perfused in oxygenated O₂aCSF. The perfusate was then switched to N₂aCSF with no glucose for 10 min, after which the perfusate was switched back to O₂aCSF for 30 minutes of recovery. Each slice was tested at one of three temperatures (25°C , 30°C , 35°C). Data were analyzed by Student t test when only two groups were compared and by Analysis of Variance followed by a Tukey post hoc test when more than two means were compared. Statistical significance was set at $P < 0.05$.

Results

During the recovery period (the period in Fig. 1 following the 10 minute OGD insult), the neurons in the hippocampal slice regained their ability to respond to afferent signals, and the amplitude of the evoked response (ERA) steadily increased. Figure 1A shows that neuronal recovery was significantly greater ($P < 0.05$) at lower temperatures (25°C vs. 30°C vs. 35°C) in hamster slices. Figure 1B shows that recovery in rat slices is significantly greater at 25°C vs. 30°C and 25 vs. 35°C , but not 30 vs 35°C . Thus, in both hamster and rat hippocampal slices, ERA recovered more quickly and fully at lower temperatures.

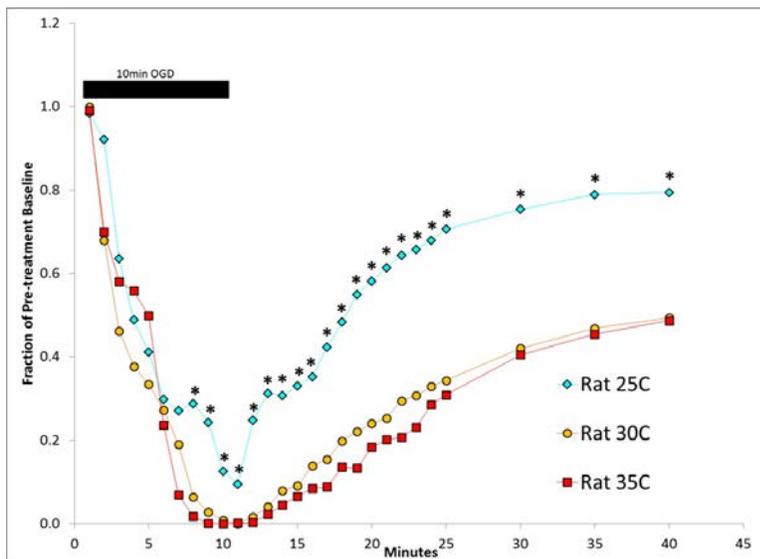
Notably, at the two lower temperatures, the degree of recovery was greater in hamster slices compared to rat slices (Fig. 2A, 2B and 2C). Specifically, at 25°C, hamster slices recovered to 108% (n=19, slices) of original baseline vs. 80% (n=16) for rat slices (P<0.05), and at 30°C, euthermic hamster (EuH) slices recovered to 93% (n=19) vs. 49% (n=18, P<0.05) for rat slices. Moreover, Figure 2C shows that there was no statistical difference in recovery for hamster vs. rat slices at 35°C. These data support my hypotheses that neuronal recovery is greater at lower temperatures and that hippocampi from hibernating species recover from OGD to a greater degree than hippocampi from non-hibernating species.

Figure 1A: Fraction of Pre-treatment Baseline vs. Time



ERA averages taken over 10 min OGD and 30 min recovery periods for slices at 25°C, 30°C, and 35°C for hamster (n=19, 25°C; n=19, 30°C; n=16, 35°C) slices. Significant (p<0.05) differences in recoveries between temperatures are indicated by asterisks (25°C vs. 30°C) or blades (30°C vs. 35°C).

Figure 1B: Fraction of Pre-treatment Baseline vs. Time



ERA averages taken over 10 min OGD and 30 min recovery periods for slices at 25°C, 30°C, and 35°C for rat (n=16, 25°C; n=18, 30°C; n=19, 35°C) slices. Significant ($p < 0.05$) differences in recoveries between temperatures are indicated by asterisks (25°C vs. both 30°C and 35°C).

Figure 2A: Evoked Response Amplitudes (ERAs) Averaged Over a 15-min Baseline Period in Hamsters and Rats at 25°C

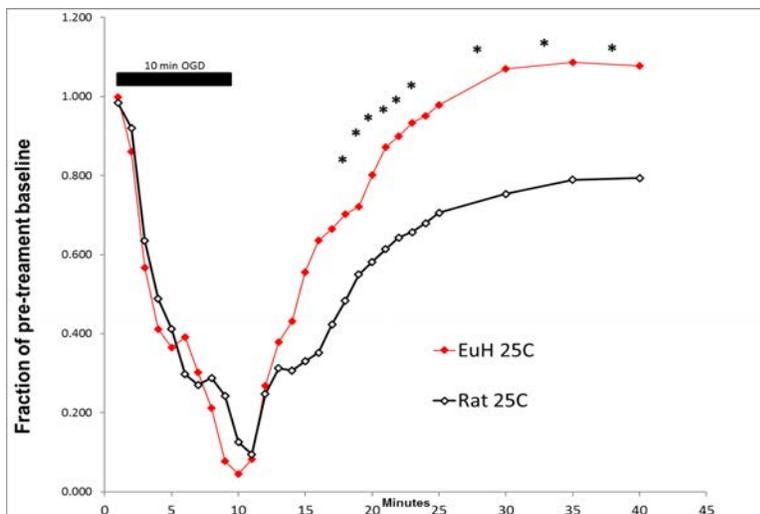


Figure 2B: Evoked Response Amplitudes (ERAs) Averaged Over a 15-min Baseline Period in Hamsters and Rats at 30°C

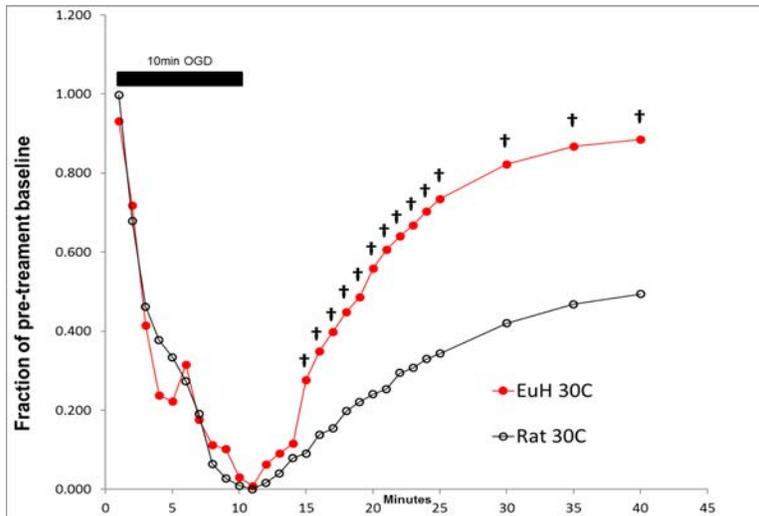
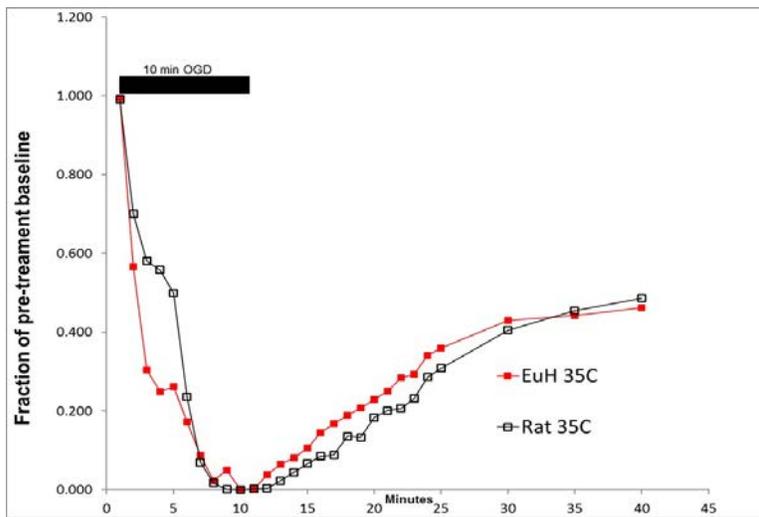


Figure 2C: Evoked Response Amplitudes (ERAs) Averaged Over a 15-min Baseline Period in Hamsters and Rats at 35°C



This value was set to 1.0 for each slice (BL). The fraction of BL throughout the treatment (10 min OGD) and recovery period (30 min) was recorded. Asterisks (hamster vs. rat, 25°C) or “blades” (hamster vs. rat, 30°C) represent significant ($p < 0.05$) differences in recovery (for hamsters, $n = 19$, 25°C; $n = 19$, 30°C; and $n = 16$ slices, 35°C) and rat ($n = 16$, 25°C; $n = 18$, 30°C; $n = 19$, 35°C).

Summary

In summary, the study demonstrated that recovery of hippocampal CA1 neurons from OGD exposure was greater ($P < 0.05$) at lower temperature (25°C vs. 30°C vs. 35°C) in the hamster and in the rat slices between 25°C and 30°C, and 25°C and 35°C, but not between 30°C and 35°C, supporting (in general) the hypothesis that neurons recover better at lower temperatures. Also, the hamster slices recovered from OGD to a greater degree than did those from the rats at 25°C and 30°C, supporting the hypothesis that facultative hibernators recover better from OGD than do non-hibernators. The results of the study suggest that Syrian hamsters exhibit a degree of intrinsic neuroprotection. Because others have shown that the state of hibernation can enhance various forms of neuroprotection (1, 2), it is possible that preparation for hibernation may further enhance neuroprotection in hamsters (our next experiment). Hibernation is also associated with tolerance to hypothermia. Similarities exist between the effects of OGD and hypothermia. These effects include alterations of metabolic regulatory enzymes, loss of ion homeostasis, disruption of membrane structure, and disturbance of receptor and transport functions (4, 5, 6). Understanding the naturally occurring mechanisms underlying neuroprotection in mammalian hibernators can inform us about how these mammals survive environments hostile/lethal to non-hibernators, and may also lead to strategies for mitigating stroke damage.

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