

# 9<sup>th</sup> Annual Robert J. Huskey Graduate Research Exhibition

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## **The Two Paths of Awareness**

*Gloria Chien - Religious Studies*

Mind, the source of behavior, is mentioned as the main root of both suffering and happiness in Buddhist scriptures which describe the mind as a painter which can draw all worlds. What factors are in mind so they can influence our actions and relationships with others? For psychotherapy, the critical psychospiritual question is how to stop transplanting new content into old patterns and actually start experiencing things in a fresh way. How would it be possible to cultivate the mind in Buddhist practice so that it can give a fresh way to change old patterns which obstruct relationships and mental health? At the same time, how would it be possible to apply psychological skills to Buddhist practice so individuals can be more aware of the kind of mindset that results in certain habitual behaviors?

Instead of introducing theoretical or technical terms, I would like to bring in what I learned from a series of interactive seminars which originated in the States and were conducted in Taiwan. These seminars used games and specific practices combined with psychological theories. Both psychological seminars as the one I have attended and Buddhist approaches provide people with the tools that will allow them to be aware of specific reasons in these patterns. First, I presented how unconditional listening can improve our understanding and concentration on speakers. The Buddhist approach enables us to remain in the present so we may apply this listening skill more efficiently. In the second place, the conception of belief was explained to explore what elements drive our actions. This exploration needs a stable and a clear mind in order to be achieved. Buddhist mind cultivation facilitates this pursuit of belief. Third, I investigated people's attitude towards the value of existence, which is one important component in our belief. People's "being" of personal value determines how much "having" they want from the external world. Buddhist doctrines of detachment and emptiness can lead people not to be caught in a trap of "having." Finally, we can observe that The Buddhist practice neutralizes our judgment about our shadow. That assists us to be ourselves and to have better relationships with others. Both psychological skills and Buddhism guide people to know what motivates our daily actions. They are two paths of awareness so both of them extend opportunities for people to awaken the heart in this lifetime.

## **From the Mother of God to the Mommy Wars: Birth and the American Christian Mother**

*Ann Duncan - Religious Studies*

Leslie Morgan Steiner's 2006 book, *Mommy Wars: Stay-at-Home and Career Moms Face Off on Their Choices, Their Lives, Their Families* highlighted a perceived culture war among American mothers. Quickly picked up by popular talk shows such as Oprah and Dr. Phil, tensions between mothers committed to working outside the home or to staying at home, single mothers and traditional families, bottle feeders and breastfeeders have been examined and, perhaps, inflamed as a result of the media's attempts to pit mother against mother. Whether such culture wars between American mothers are real or products of media publicity, the popularity of these shows and Steiner's book demonstrate that these issues strike a real cord with American women.

Such diversity and ferocity of opinion arise from a new phase in the history of American motherhood and American feminism. With renewed options in controlling fertility, giving birth and infant feeding and greater choices in careers and work schedules, many women are returning to traditional roles of motherhood, despite or in addition to higher education and career advancement. This situation is particularly complex in the context of American Christianity. While American culture and mores have changed over time, certain Christian truths and doctrines about motherhood and the family have remained constant. Yet, on the topics of pregnancy, birth, infant care and the role of the mother in Christianity generally, Christians vary widely, even today.

Part of a larger dissertation project on American Christian mothers, this paper will be based on interviews with Quaker and Catholic women and will explore their choices in and reflections on the birth experience. Exploring the broad spectrum of choices made by these women in terms of birth plans, interventions, and the spiritual or religious significance of birth, this paper will use this hot topic as a lens into the reality of American Christian motherhood. In so doing, I will question the validity of the "Mommy Wars" thesis. By combining Christian history and historical theology with theological writings and statements from particular theologians and denominations of today with the experience of Christian mothers themselves, it will become clear that these women's decisions regarding the births of their children reflect deep seeded religious, spiritual and cultural beliefs about women's bodies, the birth process and the role of the mother in Christianity as a lived religion.

## **Visual Content, Authorial Purpose, and the “Pornographic Gaze”: Toward a Phenomenology of Pornography**

*Emily Gravett - Religious Studies*

Since the discipline of "phenomenology" came into vogue about a century ago, philosophical scholarship has expressed an interest in studying topics such as aesthetics, visual arts, eroticism, and love through a phenomenological lens. The controversial subject of pornography acts as an intersection point for many of these important issues and yet there are no phenomenological studies devoted solely to this ubiquitous, controversial, and titillating topic. Thus, this paper cannot help but wondering, how might the study of phenomenology deepen or add to our understanding of pornography and how might this innovative pairing help to clarify the myriad conversations that other disciplines, for example feminism, have been having about this issue?

This paper will thus investigate pornography from a fresh, phenomenological perspective. Before exploring its special contributions to the study of pornography, however, some important groundwork must be laid. After a brief explanation of some basic but key phenomenological concepts, the paper will then discuss the notions of visual content and authorial purpose (*vis-à-vis* a variety of exemplary images), attempting to clearly and firmly delineate what qualifies as pornography and what does not. Ambiguous artwork like "The Moaning Winds" by Auguste Rodin complicates the issue, however, because it is unclear how we are supposed to understand its subject matter. Is it pornography or not? These kinds of images, and the uncertainty involved in their labeling and interpretation, challenge one common view—"that the pornographic resides in the image, that it is a question of content rather than form"—and illustrate that the topic of pornography cannot be relegated simply to the domains of aesthetics, visual content, or authorial purpose alone.

Something else is at work with pornography. But what? In order to tackle this query, the paper will explain and explore the constitutive notions of "intention" and "gaze" in the study of phenomenology. Next, it will try to determine just what might constitute a "pornographic" gaze. This gaze proves to be quite a complex composite when viewed from a phenomenological perspective. Therefore, the paper will try to describe and define it using myriad modes. Essential will be the concepts of use and objectification in Augustine's theological *On Christian Teaching*; power and the inequality of gender relations from feminist Catherine MacKinnon's *Only Words*; and taboo and the allure of the forbidden, primarily from the psychoanalytic *Totem and Taboo* of Sigmund Freud, with accompanying explanations by anthropologist Mary Douglas and author Georges Bataille. These thinkers, heralding from different fields and utilizing different methodologies, will help this study to view the "pornographic" gaze from several angles and to move toward a first attempt at a phenomenology of pornography. Ultimately, this paper hopes to demonstrate that part of the difficulty American society has had with pornography (in defining, controlling, monitoring, extolling, enjoying, or ignoring it) is because of its interactions not only between visual content and authorial purpose, but also between the intentions of the viewer's gaze and the composition of that gaze— notions that the philosophical study of phenomenology in particular can help to illuminate.

## **Politicized Democracy: The Nixon Presidency and the Politics of Public Opinion Polling**

*Mark Nevin - American History*

My dissertation, "Politicized Democracy: The Nixon Presidency and the Politics of Public Opinion Polling," argues that an understanding of the Nixon presidency requires an analysis of the central role public opinion polls played within it. President Richard Nixon was not the first president to use polls, but it was Nixon who transformed polling into a crucial instrument of presidential campaigning and governance. Having ascended to the Oval Office at a time of declining executive authority and growing demands for more public involvement in governmental decision-making, Nixon developed an unrivalled polling and poll-related public relations capability that enabled him to enhance presidential power at the same time that he championed democratic choice through the manufacture and mobilization of public consent. Polling expertise gave Nixon an advantage over his political adversaries during an era when polls were rarely used and poorly understood. But Nixon's decision to tie his political fortunes so closely to the vicissitudes of public opinion was a risky one. Nixon's superior polling operation helped him win reelection in 1972, but, as knowledge of polls increased and other political interests, most importantly the news media, developed their own polling capabilities, Nixon lost his advantage in this esoteric field. Ironically, it was plummeting approval ratings, as a result of Watergate, that drove him from office.

In the more than three decades since Nixon's resignation public opinion polling has developed into the dominant method for expressing and assessing public attitudes in American politics. But surprisingly we do not have a good understanding of the historical origins of presidential polling or the process by which polling won acceptance as a legitimate part of the political order. Political historians have almost completely ignored polling in their studies of Nixon and more generally have failed to explore polling as an important political tool.

My dissertation aims to fill these holes in the existing scholarship on the Nixon presidency, while treating polling as an integral component of modern American political development with consequences for politics today. Notwithstanding polling pioneer George Gallup's enthusiastic promotion of the new technology as the "pulse of democracy," I show that polls can and have been used by political leaders to manipulate public opinion and thwart true democratic responsiveness. Nixon used polls as strategic and tactical tools for achieving his political goals, not as constraints on or guides to future presidential action. In his first major legislative battle, Nixon created his own private polling operation and used administration polls to build public and congressional support for his controversial Safeguard Antiballistic Missile System (ABM). Faced with public protests over ABM and Gallup Polls that indicated that there was little support for the program, Nixon commissioned his own private polls, which purported to show that an overwhelming majority of Americans supported Safeguard, and arranged for an outside group to run a series of full-page advertisements in national newspapers featuring the polls in an attempt to shape public opinion on ABM.

My investigation of the polling activities of the Nixon presidency draws upon a wide range of documentary materials from presidential archives, previously unpublished audio recordings, and other digital media to shed light on the historical roots of an important, though little understood, contemporary political institution and illuminate the changing nature of democratic representation in America.

**"...durch Unhygiene verwirrt." - Motives of consumption and cleanliness in Charlotte Roche's "Feuchtgebiete."**

*Gerrit Roessler - German*

Advocates and opponents of the allegedly feminist agenda of Charlotte Roche's 2008 novel "Feuchtgebiete" are focused on the crass language as well as on the drastic events framed in this language. In this paper I want to attempt a hermeneutic reading of the text to show that the current critical discourse ignores a significant number of text immanent aspects when it assigns a cathartic, even corrective social function to the text. I will focus on motives of consumption to show how the body constitutes not an allegory that presents the protagonist and narrator as a figure of sexual liberation but that it constitutes a means of communication; a failed speech act.

The striking crassness of the text's form and content tries to obfuscate a secondary layer of content which I believe is in addition to the divorce directly related to a traumatic experience: Helen's mother's suicide attempt, during which she also tried to kill her younger brother. Helen entertains a feeling of being left behind and wonders why her mother decided to take only her brother and what motivated her to take this step. Helen's mother's suffering remains as marginal an issue as Helen in her function as the narrator makes it. Instead she replaces it by her own suffering.

Although Helen wants to bring her parents back together, she describes them in terms that could not be more dyadic. Throughout the remainder of the story her mother is linked to a mystified notion of hygiene, whereas her father is associated with a rational, mainly scientific approach to it. She embraces her father's sense that the harmfulness of a lack of hygiene is exaggerated beyond its empirical dangers. On the other hand her mother's sense of cleanliness is dismissed as maternal paranoia. This paranoia is inscribed as particularly feminine and perpetuated through parental engendering. The maternal fear of her daughter's body is heightened by commercial exploitation of these fears which in turn further the idea that the feminine body is unclean by nature.

Helen uses blood, especially menstrual blood, to create a bond with the people in her immediate environment. It seals friendships and it makes others co-conspirators. In connection with bacteria it forces others sometimes wittingly but mostly unwittingly confront their anxieties about hygiene and foils precautionary measures to seal one's bodily boundaries. But Helen uses other bodily fluids also to exude an even more immediate power on the other.

As I hope to shown in my paper the protagonist of Charlotte Roche's novel "Feuchtgebiete" hides a conventional dyadic concept of gender under a veil of feminine self-realization. Consumption, physical experience and the reassessment of bodily boundaries are means to protest against hygiene, to passively control the socio-structural conditions and to assert her place in them.

Furthermore I hope to offer a reading that shows that "Feuchtgebiete" is by no means a descriptive and to an extend even prescriptive textbook representation of female sexuality. The author's claims to the contrary mystify rather than de-mystify female - and male - sexuality. Any discussion of the gender issues addressed in the novel needs to be framed by a discussion of the function the body as speech act has in the text.

## **Evangeline in Discourses - From 19th Century Romantic American Poetry to The Sims : A Set of Cultural & National Metaphors**

*Pierre Dairon - French*

What links Stowe's "Uncle Tom Cabin" (1852), the Quebecois writer and translator Pamphile Lemay (1865), the white Louisiana Creole Sidonie de la Houssaye's novel "Poupponne et Balthazar" (1885), a tourist guide inviting Bostonian to visit a "Land" in Nova Scotia (1894), the Cadian/Cajun Louisiana scholar, judge and writer Felix de Voohries (1907), the first Canadian (and lost) feature film (1913), the role played by Dolores del Rio in a Carewe's feature film (1929), two statues erected in tiny villages distant of thousands of miles – namely Grand-Pré in Nova Scotia and St. Martinville in Louisiana -, the only opera authored by Otto Luening (1932), William Faulkner's "Absalom Absalom!" (1936), the Acadian writer Antonine Maillet - first non-French winner of the prestigious Goncourt award (1979), a newspaper that was during almost a century the only daily French newspaper in the Canadian Maritime Provinces (1885-1981), the music band "The Band", a theme park in New-Brunswick, several museums in Canada and Louisiana, thousands of personal or institutional web pages and, more trivially, some soda, chocolate, coffee and bread brands?

The link between the elements of this heteroclitite list is a fictional character and story created 160 years ago by the American poet, language professor and scholar Henry Wadsworth Longfellow : "Evangeline".

## **Recovering the Art of the Oral Story**

*Dylan Goldblatt - German*

This paper discusses the unique literary status of Conrad Ferdinand Meyer's "The Marriage of the Monk" (Die Hochzeit des Mönchs, 1884) with regard to the tension between retelling and reprinting in the 19th century. This novella is noteworthy for its bizarre narrative content and the role that impromptu storytelling serves in the mediation of the literary influences of present and past. Meyer uses the novella to revive the notion of a live and participatory audience by eroding the boundaries which distinguish author and reader. To accomplish this, Meyer gives voice to literature's silent listeners and challenges an increasingly mute readership in a shift towards a model of oral sharing. This paper suggests that Meyer's work is designed to be retold and reshaped by both listeners and readers alike.

The tale of "The Marriage of the Monk" is one which C. F. Meyer submits to his readers. The audience is responsible for the selection of theme: "sudden career change, with good, bad, or ridiculous outcomes." With this, Meyer tests whether storytelling benefits from concessions to the audience. His listeners (and readers) find themselves enthralled as their namesakes, imagery and attitudes reflect in the surface detail of Dante's oral performance. Indeed, all of the sources for this book become inextricable from the Monk's tale itself.

But this novella is as much about its story as its teller. The fabric of this tale has many weavers, both textual and oral. For this reason, this paper includes an explication of Meyer's multiple audiences, authors, and sources. I argue that this tale is generated just as it is told. This presentation traces the manner in which the authors and audiences participate in this adventure. Finally, Meyer's tale presents oral storytelling as the solution to one of the key problems of textuality, namely, the isolation of the reader from the writer.

## **Making the Connections: Dietrich Bonhoeffer as Feminist Ethicist**

*Karen Guth - Religious Studies*

The German Protestant pastor Dietrich Bonhoeffer is widely celebrated as a theologian of resistance, a Christian martyr, and even a prophet. But for all the focus on Bonhoeffer as a "prophet of justice for the oppressed," very few have placed Bonhoeffer in conversation with feminist thought. In fact, in his study of Bonhoeffer, scholar Stephen Haynes places feminist theology at the "limits of the liberal Bonhoeffer," noting that "feminism...has proceeded with few approving references to Bonhoeffer."

But is this necessarily the case? Is it true that Bonhoeffer stands at the limits of feminist thought? Does Bonhoeffer present only problems for feminists, or might his thought offer resources for a feminist ethic of responsibility?

This paper examines Bonhoeffer's central ethical concept—responsibility—to identify possible problems and potentials for feminist ethics. It argues that although Bonhoeffer's ethic assumes the male as normative and poses substantial challenges for feminist thinkers, much of his thought resonates with feminist themes. Namely, both bodies of thought are marked by an effort to overcome dualism, emphasis on the nature of the self as relational and situated, attention not only to universals but to particulars, and an acknowledgement of the role of emotion and other skills in moral reasoning.

The paper also engages in a feminist project of retrieval, reading Bonhoeffer against himself to demonstrate that where his thought poses the most problems for feminists—his concept of the divine mandates—it also offers resources for the resolution of these problems. Bonhoeffer identifies the government, the church, and the family as divine mandates or realms of life instituted by God. While some argue that the mandates impose certain roles and a hierarchical order on human relationships, this paper evaluates theologian Robin Lovin's argument that Bonhoeffer's category of the "mandates" are not static, divinely instituted orders of relationship with fixed social roles and patterns of hierarchy but dynamic realms for "responsibility as reformation" to take place. The paper thus suggests that Bonhoeffer's thought provides a rich resource for the construction of a feminist ethic of responsibility.

Finally, in addition to filling gaps in the ethical literature by considering Bonhoeffer's relationship to feminist thought, the paper addresses a more general problem relevant to all fields of the humanities by challenging the isolating boundaries of academic disciplines. Feminist projects, in particular, are often thought of as works "by women, for women," but this limits their relevance to "women's issues." My approach attempts to reveal feminist potential in even the most "un-feminist" thinker, challenging the idea that feminist studies are relevant only to women. By placing Bonhoeffer and feminist thought in dialogue, I aim to blur the boundaries of "theological ethics" and "feminist ethics," cultivating rich ethical and theological thinking that avoids unproductive and isolating categories.

## **Encountering the Word: Theology and the Phenomenology of Scripture**

*Petra Harvey - Religious Studies*

In this presentation, I will argue that scripture, as the frame and medium of Revelation, affects both the constitution of the one who receives it, and also—as a result of this—the shape of their theological discourse. The reception of scripture occurs within the realm of human experience, and as such, falls under the purview of phenomenology. Consequently, this presentation will examine the relation between scripture and its receiver with a phenomenological lens, and also explore how the reception of scripture affects their theology.

Theology is speech about God. The possibility of this speech, however, rests upon the prior reception of Revelation. Revelation occurs “where an authority that is transcendent to experience nevertheless manifests itself experientially (Marion, *Veiled and Revealed* 2). Theology is the interpretation of that Revelation. However, although Revelation is an event that was originally experienced by those proximate to it, the primary access that one has to Revelation is now through the medium of scripture. Those who gain knowledge of the contents of scripture come to experience the Revelation that was originally given. The reception of scripture therefore serves as the vehicle by which a person receives Revelation, but in doing so scripture does not, in delivering the gift of Revelation, withdraw. Rather, accompanying it, scripture provides the words which ground that person’s expression of Revelation, so that in responding to Revelation, one is also responding to—and with—the scripture by which it was delivered. One is therefore modified as much by one’s encounter with scripture as one is by the reception of Revelation.

A sketch of scripture in phenomenological terms involves several steps. The first of these steps takes up Jean-Luc Marion’s understanding of the saturated phenomenon. Starting with scripture as a phenomenon, it quickly becomes clear that scripture gives itself to the receiver to excess. Whether read or heard, scripture remains, as a whole, inassimilable to consciousness. That is to say, although the receiver does receive and assimilate something of that which is given, scripture goes forth as an event whose particularities on a given occasion cannot be fully integrated by the receiver. More than that, scripture presents itself as something to which its receiver must return again and again, because of scripture’s incommensurability with the receiver. Connected with these is the unseeability of portions of that which is given, so that scripture, although it gives itself wholly, is thus not visible in its totality, e.g. in its connections with past interpretations of its text, etc. The depth of the text remains partially unseen. These elements of scripture reveal it as a phenomenon saturated with intuition, where intuition is the raw content of the phenomenon, and thus overwhelming to the receiver.

The overwhelmingness of scripture as a saturated phenomenon is a necessary outgrowth of its being saturated, but in Marion, this is accompanied by a summoning of the receiver in such a way that the receiver cannot elude that which is given. This is due in part to Marion’s understanding of the receiver as a construct which exists before the constitution of the transcendental ego, and thus the receiver is only rendered visible by the impact of the given. However, as I will argue, the reception of scripture requires a certain directionality on the receiver’s part, because in order to receive the text as scripture, one must approach it from a standpoint of faith, whether this standpoint is part of the receiver’s actual intentionalities or part of a persona which the receiver develops in order to understand the text. If this does not occur, the text is not received as a witness to Revelation, and is therefore not in the fullest sense scripture. When the receiver receives the given, then, the emergence of scripture as a saturated phenomenon depends upon her rendering explicit of the intentionality of faith. Thus, the phenomenon which is cast upon the receiver is given, even prior to its becoming phenomenal, a space made hospitable by the one receiving.

This alteration of Marion’s construal of the receiver, although it renders the receiver more fully visible even before the saturated phenomenon summons her to respond to it, does not thereby do damage to the

phenomenon, but in actuality allows it to show itself with greater richness. When the receiver is summoned—or called—by the given of scripture, her response to the given—wherein scripture is rendered phenomenal—includes within this response the recognition of that which is becoming phenomenal as pertinent to the act of faith. With this recognition in place, the initial impact of the given against the receiver may be reduced, but the phenomenalization of the given is augmented.

The placement of recognition in the receiver, however, does not thereby negate the given's effect on that receiver. Because the receiver's recognition takes the form of hospitality, the receiver is in actuality opening herself to the given, and thus allowing herself to be altered and rendered anew by that given. This alteration of the receiver by the given occurs in two stages. The first, wherein the given is rendered phenomenal, is simultaneously a rendering phenomenal of the receiver. Not that the receiver was not visible before, but after the encounter with the given, her visibility alters. She is changed by her encounter. This alteration brings forth a secondary response in the receiver, whereby the receiver expresses her relation to, and understanding of, the phenomenalized given. In relation to scripture, this secondary response could be termed theology, and as grounded in the intentionality of faith, is therefore a response which incorporates a reference to Revelation as that which is shown forth within scripture. This response is in essence a mediated speaking of and reflecting upon the Revelation which is given through Scripture, but the receiver's speech is littered with scripture because the receiver is herself first affected by scripture before she can speak of scripture and the contents of scripture.

The presentation concludes with an opening outward of theology toward phenomenology as a means of broadening the theological toolset, and gestures toward the understanding of theology as, ultimately, engaging in phenomenological discourse.

## **"Justification and Life for All": the Apostle Paul's Statement of Universal Salvation in Romans 5:18**

*Matt Munson - Religious Studies*

The debate over whether the Apostle Paul believed that all people would be saved (universalism) or that only certain people would be saved (particularism) has been simmering for well over fifty years. The central Pauline text for those who claim that Paul was a universalist is Romans 5:18. This text reads, "Therefore just as one man's [Adam's] trespass led to condemnation for all, so one man's [Christ's] act of righteousness leads to justification and life for all." This text certainly appears to support the claim that Christ's "act of righteousness" has the effect of bringing "justification and life" to every person. There are scholars, however, who deny that this is the case. One argument put forward is that, when Paul writes "all", he does not mean to refer to every individual person but every group of people, specifically both Jews and Gentiles. Such scholars support this position by rightly asserting that Paul, in Romans 1-5, argues that salvation is not only for the Jews but also for the Gentiles. On this reading, it seems plausible that "all" could simply mean that Christ's righteous act opened salvation up to those outside of Israel.

In my presentation, I will assert that Paul's argument in chapters 1-5 of Romans undercuts this proposition. In these chapters, Paul's primary purpose is to prove the universal need for the salvific action of God in Christ. A central part of this argument is Paul's proof that "all" are sinners. Paul's clearest statement of this comes in 3:9-10, which reads, "What then? Are we [Jews] any better off? No, not at all; for we have already charged that all, both Jews and Greeks, are under the power of sin, as it is written: 'There is no one who is righteous, not even one.'" If, in this context, one were to assert that "all" means "both Jews and Gentiles, but not necessarily every individual in these two groups," Paul's argument would have no force. Only by proving that, before Christ, every single person required salvation can Paul prove the necessity of God's action in Christ. Paul himself says as much in Galatians 2:21: "If justification comes through the law, then Christ died for nothing." So there can be no justification, no salvation, apart from Christ. It is therefore necessary to understand "all" in Romans 1-5 as referring to every single person.

In my presentation, I will closely examine Paul's argument in Romans 1-5, and especially his use of the word "all" in this argument, to prove that the most likely referent for "all" in Romans 5:18 is every individual. The texts I will use to prove this are Romans 3:9-10, 3:12, 3:23, and 5:12. These texts will prove, first, that "all" in Romans 1-3 refers to every individual and, second, that this understanding of "all" carries over into chapter 5. My paper will not claim that Paul is a universalist. Romans 5:18 is only one verse in the large corpus of the Pauline letters, which also contains many verses that clearly state that only some will be saved. I will claim, though, that in Romans 5:18 Paul envisions the salvation of every individual through the righteous act of Christ. Incorporating these findings into the flow of the greater Pauline corpus is work that I will complete in my dissertation.

## **Adolescent Self-Disclosure as a Protective Factor Against Subsequent Risky Sexual Behaviors: A 6-Year Longitudinal Study**

*Amanda Hare - Psychology*

For years, parental monitoring has been considered a primary protective factor against problem behaviors by adolescence researchers. However, more recently, studies have highlighted open parent-adolescent communication as the driving force in preventing problem behaviors, rather than the previously studied tracking and surveillance practices (Kerr & Stattin, 2000). In order to build on this line of research, the present study proposes to examine the link between open parent-adolescent communication and adolescents' subsequent risky sex behaviors using a longitudinal, multi-method, multi-reporter study. Longitudinal data on 184 adolescents were collected, with participants first participating in seventh and eighth grade (Mean age=13.3 years) along with their parents, and then again three years later. Results revealed that, after accounting for demographic effects, greater adolescent self-disclosure was significantly predictive of fewer subsequent risky sexual behaviors. More specifically, adolescents who exhibited greater self disclosure to their mothers when they were 13 waited longer to have sex, and those who exhibited greater self disclosure to their mothers when they were 16 were more likely to use protection when they did. Further, this association between self disclosure and age of sexual debut appears to be partially mediated by adolescents' attitudes about the age at which it's okay to start having sex. Mothers' reports of monitoring and control, on the other hand, were not significantly predictive of age of sexual debut or use protection during sex. In summary, the current data suggest that parental knowledge via open parent-adolescent communication, rather than just via parental monitoring and control, may indeed be considered an effective protective factor against adolescent externalizing problems. Results are interpreted as suggesting that adolescents who feel comfortable disclosing personal information to their parents may be more likely to develop the skills necessary to make sound decisions about important things like when it's appropriate to be having sex.

## **Age-based hiring discrimination as a function of equity norms and self-perceived objectivity**

*Nicole Lindner - Psychology*

Although legally protected, older adults experience pressure to retire and difficulty in both finding and keeping jobs (McCann & Giles, 2002), despite a lack of age-related declines in work performance (Salthouse & Maurer, 1996) and the unrealized economic benefits of a workplace with older, more experienced workers (Shea & Haasen, 2006). Thus, we tested two manipulations intended to reduce hiring discrimination. Previous research (Uhlmann & Cohen, 2007) found that individuals primed with a sense of personal objectivity are more likely to act on stereotypical beliefs. We investigated whether the opposite would also hold, so that recognition that one's judgments could potentially be non-objective would reduce hiring discrimination. Additionally, we manipulated the presence or absence of equity norms; it is common practice to establish equity norms for hiring new employees by stating non-discrimination statutes, but experimental research has focused on their effects on potential employees, rather than on employment decision-makers (Malinen & Johnston, 2007).

Participants were 1,588 consenting adults (age range = 18–80) who completed a 5-item questionnaire priming perceptions of self-objectivity (e.g., "In most situations, I try to do what seems reasonable and logical") or of self-biased (e.g., "My judgments are occasionally influenced by my own preconceptions, rather than just the facts.") either before evaluating a young or old job applicant or after (control condition). The hiring decision also manipulated the presence or absence of equity norms by reminding decision-makers of the legal prohibitions against discrimination "on the basis of age, disability, national or ethnic origin, race, religion, or sex." Participants evaluated the applicant's suitability for the job and then reported the perceived importance of various factors to their decision (e.g., age, expertise).

We found that hiring discrimination was highly context-sensitive, depending on the decision-maker's frame of mind (personal objectivity) and the proximal environmental norms (equity). Results indicated that we were less successful in inducing a sense of personal bias than of personal objectivity; agreeing that one is objective and disagreeing that one is biased had similar effects on hiring discrimination. Thus, in the control condition, the presence of equity norms increased enthusiasm for both young and old job candidates (Cohen's  $d = 0.23$ ). However, the equity statement had no effect when participants thought of themselves as objective ( $d = 0.08$ ) or as not biased ( $d = 0.05$ ). In those conditions, the younger job candidate was evaluated more favorably than the older candidate ( $d_s = 0.29, 0.21$ , respectively). Rather than decreasing age discrimination, the presence of equity norms increased post-decision perceptions of the importance of expertise, a normative factor, and decreased the perceived importance of age, a non-normative bias. This suggests that equity norms increased individuals' motivation to suppress prejudice without reducing the behavioral effects of bias. In fact, the positive relationship between hiring decisions and the perceived importance of expertise was significantly stronger in the control condition ( $\beta = .367$ ) than in the self-biased ( $\beta = .128$ ) or the self-objective ( $\beta = .177$ ) conditions. This suggests that when individuals already thought of themselves as being objective, they were less affected by environmental priming to be equitable. Although further research is needed, this suggests that when individuals perceive themselves to be objective, anti-bias interventions may be less effective.

Thus, although the presence of an Equal Opportunity statement increased enthusiasm for both candidates, it did not reduce age discrimination, at least when individuals thought of themselves as objective. Instead, the presence of equity norms increased casuistry (Norton, Vandello, & Darley, 2004) by affecting individuals' perceptions that their decisions had been more reliant on expertise and less reliant on age. This suggests that individuals were unable to adequately identify and correct for age biases (Wilson & Brekke, 1994).

## **Arousal and Extroversion: Enhanced Memory for Non-Aroused Introverts and Aroused Extroverts**

*Janet Palmer - Psychology*

From previous research and literature on the topic, we know that emotional arousal can enhance long term memory for events that occur close in time to that arousal; this effect is particularly pronounced for emotional stimuli as compared to neutral stimuli. However, this relationship between arousal and memory does not always hold true—in our own data from previous experiments, we have found a surprising lack of a main effect for arousal on long term memory. In a new experiment, we tested whether extroversion, a personality variable hypothesized to be important in arousal, could account for our lack of main effects.

We tested the effects of arousal, extroversion, and emotional stimuli on delayed memory in a false memory task. 123 female participants viewed 9 word lists. Each list consisted of 10 words all related to a central concept (called the "critical lure") that was never presented. Three lists involved negative concepts (kill, sad, and pain), three were neutral (sleep, chair, needle), and three were positive (happy, love, beautiful). Immediately after viewing each list, participants recalled all of the words they could remember from that list. After all 9 lists were completed, participants in the arousal condition immersed their left arm up to the elbow in ice water, whereas those in the non-aroused condition placed their arm in warm water. Participants also filled out several questionnaires, including a measure of extroversion. Two days later, participants were surprised with a free recall and then a recognition test.

Immediate false recall (recalling one of the non-presented critical lures) results indicated that there is a main effect of emotional stimuli, such that neutral lures were recalled more than emotional (both positive and negative) lures. An interaction with extroversion revealed that this difference is only significant for extroverts. For correct recall of presented words, a main effect of emotional stimuli indicated that neutral words were recalled more than emotional words, and a significant interaction with extroversion indicated that this difference between neutral and emotional words is greater for introverts. Delayed free recall results indicated that participants recalled more positive and neutral lures than negative. For delayed correct recall, an interaction of arousal and extroversion revealed that extroverts recalled more words than introverts when aroused, but fewer words than introverts when they were not aroused. Delayed recognition results indicated that there was a three way interaction between arousal, extroversion, and emotional stimuli for critical lures, such that introverts recognized more positive words than extroverts, but only for those who were not aroused. For correct recognition, there was a significant arousal and extroversion interaction, such that non-aroused introverts recognized the most words. Finally, a three way interaction indicated that introverts who were not aroused recognized more negative and neutral words than extroverts, with no difference for positive words. Aroused introverts, however, recognized more negative words, an equivalent number of neutral words, and marginally fewer positive words than extroverts. It is clear that extroversion moderates the relationship between arousal, emotion, and memory. These extroversion and arousal interactions can be interpreted as an arousal-related enhancement of memory when one is in an optimal arousal state; thus, introverts, who are normally more (energetically) aroused, are in optimum arousal when receiving warm water, and extroverts, who are normally less aroused, are in their optimum state when receiving ice water. Thus, non-aroused introverts and aroused-extroverts recall more words.

## **“I’m sorry but I can’t remember your name”: Preschoolers’ lexical access to proper names and common nouns**

*Ashley Pinkham - Psychology*

Researchers have shown that it is more difficult for adults to retrieve proper names than common nouns. This dissociation may occur due to the number and strength of semantic connections to a particular word rather than the word's lexical class (Grabowski et al., 2001). Because common nouns have multiple connections to semantic information, they are easier to retrieve and less vulnerable to decay than proper names, which typically have only a single connection (node structure theory; MacKay & Burke, 1990).

However, when proper names are semantically descriptive, adults' retrieval deficits disappear (McWeeny, Young, Hay, & Ellis, 1987). That is, adults recall semantically descriptive names, such as Mr. Farmer, more readily than they recall names that are not semantically descriptive, such as Mr. Jones. Moreover, adults recall descriptive proper names at rates comparable to their recall of common nouns. When proper names are rich with meaning, they maintain multiple connections within the semantic network, thus facilitating retrieval.

The aim of the present research was to investigate if preschoolers also experience greater difficulty in recalling proper names as compared to common nouns, and, if so, whether semantic descriptiveness facilitates their recall of proper names. If proper names are inherently subject to retrieval difficulties, then preschoolers should show an adult-like dissociation in their recall of proper names and common nouns. On the other hand, as compared to adults, preschoolers have relatively little experience with the world; they are still actively acquiring new knowledge and experiences. Given this, preschoolers may have yet to construct an elaborate semantic network. Consequently, the semantic connections to proper names and common nouns may be similarly limited and fragile, thereby resulting in poor retrieval regardless of lexical class.

In Experiment 1, 48 4-year-olds viewed four photographs of unfamiliar adults. There were three between-participants conditions. In the Descriptive Names condition, the photographs were each paired with a semantically descriptive surname (e.g., Mr. Farmer) and novel occupation (e.g., ryman). In the Descriptive Occupations condition, children heard a non-descriptive surname (e.g., Mr. Ryman) and familiar occupation (e.g., farmer) for each photograph. In the Descriptive Names + Occupations condition, children heard a descriptive surname and familiar occupation for each photograph. Following three exposures to the photographs and biographical descriptions, children were asked to free recall what they remembered about each individual. As predicted, there was a significant Type of Information x Condition interaction,  $F(2, 44) = 14.14, p < .0005$ . Children in the Descriptive Names condition recalled a greater proportion of surnames than occupations, whereas children in the Descriptive Occupations condition recalled a greater proportion of occupations than surnames. These results suggest that semantic descriptiveness has a greater affect on word retrieval than lexical class. In fact, children in the Descriptive Names + Occupations condition showed no significant difference in their recall of surnames as compared to occupations.

The results of Experiment 1 indicate that the descriptiveness of to-be-recalled information can influence preschoolers' memory for that information. However, a semantically descriptive name does not necessarily provide knowledge about an individual (e.g., Mr. Farmer may not be a farmer). Nicknames, by contrast, are both semantically descriptive and provide knowledge about the individual bearing the name (e.g., Speedy is probably fast). If both the number and strength of connections within the semantic network influence lexical retrieval, then children should recall names that are descriptive and informative about the bearer better than they recall names that are only descriptive.

To test this, in Experiment 2, 16 4-year-olds heard a nickname, familiar occupation, and possession paired with each of four photographs. As predicted, children recalled a significantly greater proportion of nicknames in Experiment 2 than surnames in the Descriptive Names conditions of Experiment 1,  $t(30) = 2.63$ ,  $p = .012$ , suggesting that children's recall of proper names can be strongly enhanced by providing both semantically descriptive information and information informative about the individual.

Experiments 1 and 2 demonstrate that preschoolers' lexical retrieval is already adult-like in some ways. First, they retrieved common nouns more readily than non-descriptive proper names, indicating that the proper name/common noun dissociation is evident in early childhood. Second, this retrieval deficit was eliminated when proper names were semantically descriptive, suggesting that successful word retrieval is influenced more by the semantic descriptiveness of an item than its lexical class. Third, semantic descriptiveness is not the only factor that influences proper name retrieval. As demonstrated in Experiment 2, semantically descriptive names that also describe the individual bearer are more readily remembered than names that are only semantically descriptive.

Importantly, the results of Experiments 1 and 2 suggest that children as young as age 4 have already started constructing an adult-like semantic system. Taken together, these results have broad implications for theories of children's memory and lexical development.

## **"Parenting Intentions and Desires Among Childless Lesbian, Gay, and Heterosexual Individuals"**

*Rachel Riskind - Psychology*

Parenthood is one of the most universally valued experiences of American adults, but the associations between sexual orientation and parenthood are not yet well understood. Although there are many lesbian and gay parents in the United States today, lesbian and gay adults are markedly less likely than heterosexual adults to become parents (Gates, Badgett, Macomber, & Chambers, 2007).

Why is this the case? Lesbians and gay men are much less likely than heterosexual men and women to experience unplanned pregnancy, but this is unlikely to be the whole story. Other reasons for childlessness could be explained by (a) less desire to become a parent, and (b) less intention to become a parent. Parenting intentions are especially important to assess because they are strong and consistent predictors of parenthood (Schoen, Astone, Kim, Nathanson, & Fields, 1999). The present research is the first to (a) assess parenting intentions among lesbian and gay individuals and (b) assess parenting desires in concert with other attitudes toward parenting and childlessness. The overarching goal of our research was to explore the reasons why lesbians and gay men are less likely than their heterosexual peers to become parents.

To accomplish these aims, we used data from the 2002 National Survey of Family Growth (NSFG), which included 12,571 respondents aged 15-44 years (female = 7,643). Data were based on a multistage area probability sample drawn from 121 areas across the United States. Our analyses focused on all childless lesbian women and childless gay men who participated in the 2002 NSFG. Each was matched with a childless heterosexual respondent of the same gender, age, race/ethnicity, and level of education. This resulted in a sample of 294 participants, who averaged 32 years of age. Responses were collected through computer-assisted interviewing. While the majority of questions were asked aloud by interviewers, some of the most sensitive questions were administered using Audio Computer-Assisted Self-Interviewing, which allowed the participant to enter responses privately. Survey items of principal interest included those focusing on parenting status, desires, and intentions, sexual identity, and attitudes toward childlessness and parenthood.

Consistent with previous findings, heterosexual male participants were 71% more likely than gay male participants to express parenting desires (95% Confidence Interval: 47 to 84%). Heterosexual female participants were 72% more likely than lesbian participants to express parenting desires (95% Confidence Interval: 32 to 89%). Of those who expressed parenting desires, heterosexual male participants were 77% more likely than gay male participants to express parenting intentions (95% Confidence Interval: 37 to 91%). However, of those who expressed parenting desires, heterosexual female participants were no more or less likely than lesbian participants to express parenting intentions. Interestingly, gay men and lesbians agreed just as strongly as their heterosexual peers that the rewards of parenting are worth it, despite the costs, with average responses in the "Agree" to "Strongly Agree" range for all groups.

Overall, gay men and lesbians were less likely than their heterosexual peers to express desire for parenthood. Gay men who expressed parenting desires were also less likely than their heterosexual peers to express intentions to fulfill these desires. However, gay men and lesbians valued parenthood highly, and many expressed both desires for parenthood and intentions to become parents. Our findings shed light on some reasons why gay and lesbian adults are less likely than their heterosexual peers to become parents. These data contribute to understanding of human development and family life among sexual minority individuals by clarifying the role of sexual orientation in family formation.

## **Predicting the 2008 Presidential Election**

*Colin Smith - Psychology*

In the months between July and October, leading up to the Presidential Election between Barack Obama and John McCain, we collected data on-line from 28,214 participants. In an initial data collection, we collected measures of explicit (i.e., self-reported) attitudes, and implicit (i.e., automatic, non-conscious) attitudes toward both Barack Obama and John McCain. Participants were self-selected visitors to an educational psychology website at <http://harvard.implicit.net>. In addition, we invited consenting participants back for two separate data collections, one of which took place in late September and the other which took place in late October. Finally, participants were contacted as polls closed in their state on the night of November 4th and we collected reports of voting behavior.

The primary goal of the current project is to understand the influence of non-conscious (i.e., implicit) attitudes and conscious (i.e., explicit) attitudes on voting behavior especially among voters who were undecided at the time that they contributed data. We assessed explicit attitudes using thermometer ratings of the warmth of participants' feelings toward each candidate. We assessed implicit attitudes using an Implicit Association Test (Greenwald, McGhee, & Schwartz, 1998) measuring associations between Barack Obama and John McCain and the evaluative attributes of "good" and "bad."

Implicit and explicit attitudes toward political candidates are among the most highly correlated of any attitude object (Nosek, 2005), so this is a particularly difficult test of our hypothesis that implicit attitudes will have a unique effect on predicting vote reports. Among the 4,432 participants who reported their voting behavior after the Presidential Election, explicit attitudes toward Barack Obama and John McCain were strongly predictive of their subsequent voting behavior, even among those participants who reported being undecided about their prospective vote. However, their automatic associations between the two candidates and the concepts of "good" and "bad" had unique predictive ability over and above their self-reported preferences.

## **Modifying Interpretations among Individuals High in Anxiety Sensitivity**

*Shari Steinman - Psychology*

Cognitive models of anxiety posit that a series of biases related to the way people process information, particularly information that may indicate threat or danger (such as biases in attention, memory, and interpretation), maintains and possibly causes anxiety disorders. In the current study, an experimental approach was used to modify interpretation biases in participants with high anxiety sensitivity. Anxiety sensitivity refers to a fear of symptoms related to anxiety (e.g., bodily sensations, such as heart racing or heavy breathing). High anxiety sensitivity is a vulnerability marker for multiple anxiety disorders, such as panic disorder, so reducing this sensitivity may be critical for reducing and preventing anxiety psychopathology. Further, this study tests whether interpretation biases are causally related to anxiety, as well as whether brief, cognitive training procedures can alter these unhealthy threat interpretations in anxious populations.

Participants with high anxiety sensitivity (N=75) were randomly assigned to a Positive training condition or one of two Control conditions (a Neutral training condition or a No training condition). During training, participants read and imagined themselves in a series of ambiguous scenarios related to anxiety sensitivity. In the positive training condition, participants learned to interpret ambiguous scenarios in a non-threatening manner, so they had to complete all scenarios with a positive outcome. In the neutral training condition, half of the scenarios were completed with a positive outcome and half with a negative outcome. All participants were then presented with novel, ambiguous scenarios related to anxiety sensitivity to test whether they had been trained to make more positive or negative interpretations. Participants were then asked to take part in behavioral tasks that elicit bodily sensations related to anxiety sensitivity in order to examine the effect of training on consequent anxiety (e.g., breathing through a thin straw, which brings on feelings of dizziness). Finally, participants completed a questionnaire measure of anxiety sensitivity.

It was hypothesized that Positive training would lead to more positive and less negative interpretations on novel ambiguous scenarios relative to the Control conditions. It was also hypothesized that Positive training would lead to lower levels of anxiety sensitivity as well as less distress and avoidance during subsequent behavioral tasks that elicit bodily sensations.

Results were mostly in line with hypotheses. In particular, following training, individuals in the Positive training condition endorsed more positive and less negative interpretations of novel scenarios than those in the Control conditions. These findings suggest that the interpretation styles of people with elevated anxiety sensitivity are malleable; they can be made less negative in one short session of cognitive training. Notably, Positive training not only modified interpretations, but also significantly reduced anxiety sensitivity. There was also some support for the effect of Positive training on reducing subsequent distress during the behavioral tasks that elicited bodily sensations (this effect was at the level of a nonsignificant trend).

Clinically, these findings are important because anxiety sensitivity is an important risk factor for the development of anxiety pathology and predicts response to treatment, so reducing anxiety sensitivity may help with both the prevention and treatment of anxiety disorders. Theoretically, these results are exciting because they provide evidence that modifying interpretation biases may be causally related to anxiety sensitivity. These results provide support for general cognitive models of anxiety and are a first step in the development of a model showing that interpretation biases are causally related to anxiety sensitivity. Overall, this study adds to the mounting evidence of the value of cognitive training, even in highly anxious samples.

## **Terminal Change in Cognition & Blood Pressure**

*Ryne Estabrook - Psychology*

A large and growing body of research, studied under the heading of terminal change, deals with the relationship between mortality and performance on cognitive and other psychological measures. This paradigm has found associations between mortality and the level and rate of change of cognitive declines in late life, as well as evidence of accelerated declines in cognitive abilities in the months or years immediately preceding death. The study of terminal change phenomena is of considerable importance in lifespan developmental research, as ignoring its relationship to performance can lead to misspecification of the size and shape of age-related changes in psychological constructs. To the extent that terminal change is related to specific conditions that negatively impact cognition and longevity, the study of terminal change could lead to early detection of these disorders.

Cardiovascular and cerebrovascular health is one of the more prominent theories of underlying constructs for terminal change in cognition. While some research has found that declines in cognitive function are stronger or even restricted to those who die from cardiovascular conditions like heart attack and stroke (Hassing et al., 2002; Macdonald, 2004; Small & Backman, 1997), others have found no relationship between terminal change and cause of death (Rabbit et al., 2004; Small, Fratiglioni, Strauss, & Baackman, 2003). The inconsistency of this effect may be due to the limitations in the way cause of death is measured. Assigning individuals to either cardiovascular or non-cardiovascular groups based on cause of death may oversimplify the relationship between cognition and cardiovascular health. Unlike other theorized causes of terminal change (i.e., dementia), cardiovascular health can be measured longitudinally, in vivo and without restriction to binary outcomes, allowing for more complex tests of the impact of cardiovascular health on terminal change. Blood pressure provides a simple way to incorporate cardiovascular information into the study of cognitive change.

This study utilizes data from a longitudinal study of cardiovascular and cognitive functioning to examine terminal change and test for the dependence of mortality-related cognitive changes on cardiovascular health as measured by blood pressure. Cognitive abilities are measured by the Performance and Verbal Scales of the Wechsler Adult Intelligence Scale (WAIS; Wechsler, 1955), which measure fluid (short-term memory, perceptual speed, problem solving) and crystallized (verbal abilities, long-term memory) abilities respectively. Two distinct approaches, each answering a different set of research questions, are followed in conducting the analyses. The first approach predicting mortality using longitudinal survival models. This approach uses mixed-effect models (alternatively called multi-level or growth curve models) to assign individuals initial levels (i.e., intercepts) and rates of change (slopes) to describe how individuals' cognitive and cardiovascular systems change over time. These intercepts and slopes are then input into a survival analysis, allowing us to test whether level and rates of change in cognitive abilities predict mortality and whether these effects are dependent on blood pressure. The second approach models cognitive performance directly as functions of either chronological age or distance-to-death (also referred to as "negative age" when age is centered on death rather than birth, or years until death). This approach can test for evidence of accelerated decline close to death by modeling cognitive variables over distance-to-death in the same way that traditional growth models analyze cognitive variables with respect to chronological age.

The results from the first approach show that levels of verbal abilities and blood pressure both predict mortality, and that their effects are dependent on one another such that cognitive abilities have smaller effects on survival when blood pressure is notably high. While declines in cognition or increases in blood pressure do not in and of themselves predict mortality, coincident declines in cognitive abilities and cardiovascular health show a strong relationship with impending mortality. Scores on the performance scale show similar effects when verbal abilities are excluded from the analysis; while there is an association between the abilities measured by the WAIS-Performance scale and mortality, this association

appears to be redundant with and weaker than the association between verbal abilities and impending death.

The second approach deals primarily with discerning the shape and pattern of cognitive declines as individuals approach death, and the impact of blood pressure on those declines. Verbal abilities can be expressed as a function of years until death without considering chronological age, while performance scores require both years until death and chronological age for adequate prediction. Neither of these effects show any relationship with blood pressure, demonstrating no evidence of either statistical mediation or moderation.

Taken together, these findings suggest that while considering blood pressure is an important part of mortality prediction and can improve and shape the predictive validity of cognitive abilities with respect to mortality, blood pressure does not appear to affect the rate of cognitive decline or provide a mechanism for terminal change. While future research should look to differing measures of cardiovascular and cerebrovascular health to fully explore this hypothesis, terminal change remains an important but unexplained phenomenon for lifespan developmental psychology.

## **Child and Parent Adjustment in Diverse Adoptive Families: Is Family Structure Important?**

*Rachel Farr - Psychology*

Across the country, heated legal and policy debates have surrounded the issue of whether the law should allow adoptions by lesbian and gay adults. Research on development of children adopted by lesbian and gay parents can inform debate on this controversy.

Overall, the research literature on children of lesbian and gay parents suggests that parents with differing sexual orientations rear well-adjusted children. However, there is little research on adoptive families. Studies to date have also often involved convenience samples. There is also less empirical research about gay fathers than about lesbian mothers.

We studied parenting and outcomes for adopted children (ages one to five years) reared by 50 heterosexual-, 28 lesbian-, and 28 gay-parented families. We recruited participants through domestic adoption agencies and collected data during visits to participants' homes. Child assessments included the Child Behavior Checklist, which measures internalizing, externalizing, and total behavior problems, and the Preschoolers Activities Inventory, which measures children's gender role behavior. Parent assessments included the Parenting Scale, which measures discipline styles, the Parenting Stress Index, which measures total parent stress, and Rusbult's Investment Model Scale, which measures couples' relationship satisfaction.

As expected, children with same-sex parents did not differ from children with different-sex parents with regard to their behavior problems (see Figure 1). Children of same-sex parents and children of different-sex parents also did not differ on gender role behavior. Lesbian and gay parents did not differ significantly from heterosexual parents in their approaches to parental discipline, parenting stress, or relationship satisfaction. In addition, children of gay fathers did not differ significantly from those of lesbian mothers.

Having found no group differences, we also explored individual differences. We found that, as expected, self-reported parenting stress and negative disciplinary techniques were associated with total child behavior problems. Relationship satisfaction was associated with child behavior problems. As expected, children whose parents reported more stress, less effective discipline techniques, and lower relationship satisfaction were described as having more behavior problems (see Table 1).

Consistent with earlier findings, children adopted by same-sex parents and children adopted by different-sex parents did not differ in behavior problems. Both groups of children demonstrated behavior and activities typical for their age and gender. Parents in same-sex and different-sex couples reported similar discipline styles, levels of parenting stress, and relationship satisfaction. Regardless of sexual orientation, parents experiencing more stress had children with more behavior problems. Parental sexual orientation was unrelated to reports of relationship satisfaction, disciplinary methods, and stress levels.

Overall, the findings support the existing body of literature indicating that children reared by lesbian and gay parents fare as well as those raised by heterosexual parents. Parents who experience greater stress, use less effective discipline, and experience less satisfaction in their relationships have children with more behavior problems, which suggests that family processes may be more important to child welfare than family structure. Children growing up in lesbian- and gay-parented adoptive homes appear to be as well-adjusted as those reared by heterosexual adoptive parents, suggesting that legalizing adoptions by lesbian and gay adults could benefit children.

## **Culture War Casualties: Moral Foundation Endorsement Predicts and Explains Intergroup Attitudes**

*Jesse Graham – Psychology*

title: Culture War Casualties: Moral Foundation Endorsement Predicts Intergroup Attitudes

Based on literatures in anthropology and evolutionary psychology, moral foundations theory posits five basic foundations of moral concerns: Harm/care, Fairness/reciprocity, Ingroup/loyalty, Authority/respect and Purity/sanctity. The theory depicts battles in the liberal-conservative “culture war” in the U.S. as moral oppositions between the first two and latter three foundations (Haidt & Graham, 2007). I summarize data from several large web surveys (N=~70,000) indicating that liberal morality is primarily concerned with Harm and Fairness, while conservative morality is similarly concerned with Ingroup, Authority, and Purity. These foundations show the same patterns of variation across the political spectrum when measured via abstract relevance assessments, judgments of particular moral statements, reactions to taboo values trade-offs (i.e., asking participants how much money they would need to be paid to violate the foundations in different ways), and text analyses of foundation-related word usage in the sermons of liberal and conservative churches (Graham, Haidt, & Nosek, in press).

The moral foundations also add to our understanding of attitudes toward social groups, both related and unrelated to culture war issues. A subset (N=1,979) of participants who took the Moral Foundations Questionnaire (MFQ) also took a scale measuring their attitudes to various social groups. They were asked to indicate their gut feelings about each group on a feeling thermometer going from very cold (strongly dislike) to very warm (strongly like). If one had to predict someone’s attitude toward a wide range of social groups they would do pretty well just knowing their political ideology, but I predicted that attitudes about many social groups are moral attitudes, based on perceptions that the group represents virtues or vices of one of the foundations. I thus investigated whether endorsement of the moral foundations could predict intergroup attitudes over and above political ideology.

Controlling for politics, the moral foundations significantly predicted web participants’ liking of a wide range of social groups: for instance, Harm scores on the MFQ predicted liking for nurses, pacifists, and environmentalists (those who care for the sick or for the earth, those committed to peace), and predicted disliking for hunters, while Authority scores predicted liking for police officers, US military, US government, and people who spank their children, and disliking for feminists and unwed mothers (groups going against traditional family structure or gender roles). I argue that these findings highlight the utility of the moral foundations in predicting intergroup attitudes above and beyond political orientation.

These data about social groups indicate that moral foundations theory can help predict attitudes about groups quantitatively. But it can also help understand intergroup attitudes qualitatively. I present narrative analyses of the foundational concerns expressed in two passages expressing intergroup hostility: Jerry Falwell speaking about homosexuals, and Virginia white supremacist Kevin Strom speaking about “racial hygiene.” These passages reveal the group-level moral underpinnings of intergroup prejudice, explicit or implicit, from concerns about maintaining group boundaries to beliefs about the chaotic decline of civilization to the role of disgust in motivating stereotypes and prejudice.

I conclude from this mixed-methods approach that morality is more than harm and fairness; human moral reactions can also be based on group-level concerns of loyalty, hierarchy and purity. The five foundations help predict attitudes about social groups, and can also help understand those attitudes. Finally, I argue that expanding our definition of morality to include group-focused concerns allows us to see that intergroup attitudes often are moral judgments. Understanding the nature of these moral judgments can help us understand the tenacity and persistence of group-based prejudices and stereotypes.

## **Political Ideology Moderates the Effect of Ingroup Specificity on Ingroup Favoritism**

*Carlee Hawkins - Psychology*

Introduction. Individuals readily identify with social groups and often prefer their groups to others. This ingroup favoritism contributes to virtues such as loyalty and patriotism, and vices such as prejudice and discrimination. As a consequence, ingroup favoritism has important implications for how individuals and groups perceive and interact with each other (Tajfel & Turner, 1979).

A single group membership may be broken down into several subgroup memberships. For example, a Baptist could describe her religious ingroup as "religious people," "Christians," or "Baptists" – each one a subset of the former. We refer to this range of general to specific description as ingroup specificity. Concepts related to ingroup specificity, including how distinctive the ingroup is (Jetten, Spears, & Manstead, 1998) and whether the group is a majority or minority group (Leonardelli & Brewer, 2001) contribute to ingroup favoritism. Groups distinct from others and smaller groups tend to elicit greater ingroup favoritism than less distinctive and larger groups. We tested whether ingroup specificity also predicts favoritism in a charitable giving context.

Individual characteristics such as personality and political ideology also affect ingroup favoritism (Sidanius, Pratto, & Bobo, 1996; Sidanius, Pratto, & Mitchell, 2001). Conservatives tend to value their ingroup more than liberals who may have a more global view of their ingroups. We hypothesize that people will favor their specific ingroups over their more general ones. In addition, we predict that conservatives will show more ingroup favoritism than liberals.

Method. 742 participants (68% female, 32% male) that were Baptist, Lutheran, Methodist, or Roman Catholic completed the study online at Project Implicit ([www.implicit.harvard.edu](http://www.implicit.harvard.edu)). To manipulate ingroup specificity, we asked people to contribute \$1000 to six charities. Five were "filler" charities and one was the relevant ingroup charity – the Community Service Center. We manipulated (between participants) the framing of the Community Service Center to reflect a more general or more specific religious ingroup. The Community Service Center charity was preceded by nothing, "Religious", "Christian", or the participant's specific religious denomination, such as "Baptist" or "Lutheran."

Results and Discussion. Conservatives ( $M_s = \$261, \$289, \$224$ ) gave more than liberals ( $M_s = \$193, \$175, \$166$ ) in the Religious, Christian, and specific denomination conditions. This supports the prediction that conservatives value their ingroups more than liberals and suggests that political ideology plays an important role in ingroup identification and favoritism.

Generally, conservatives contributed more money to their more specific ingroups, but the most specific religious ingroup was not favored by conservatives or liberals. Perhaps "Christian" is the optimal group identification for conservative Christians (Brewer, 1991) and the specific ingroup is too close to the self to be appealing for charitable work.

Liberals did not favor their religious ingroups and contributed most to the community group despite self-identifying as Christians ( $M = \$240$ ). This suggests that liberal Christians favor "community" over their own religious ingroup. This study suggests that liberals and conservatives favor their ingroups differently and future work will elaborate on the role political ideology plays in group relations.

## **Is it Close Enough to Count? Young Children's Sensitivity to the Extent of Informant Error**

*Robyn Kondrad - Psychology*

Much of what children know is learned from others; but sometimes, even unintentionally, informants provide inaccurate information. How do children evaluate what they are told, especially when given contradictory information? One tool for assessing others' claims is by keeping track of their past accuracy. Preschoolers are quite sensitive to this type of information: they prefer learning novel labels from an informant who has been right in the past than one who has been wrong (Koenig & Harris, 2005), even choosing to trust an accurate, same-aged peer over an inaccurate adult (Jaswal & Neely, 2006). Further, 4-year-olds prefer learning from someone who was right 75% of the time to one who had been right only 25% of the time (Pasquini, Corriveau, Meintz, & Harris, 2007). What remains unclear is whether an informant must provide accurate information (e.g., calling a comb a "comb"), or if being close (e.g., calling a comb a "brush") is enough to be marked as a reliable source. Here, we first ask whether children recognize two errors to be qualitatively different—one being almost right and the other being clearly wrong. We then ask whether children prefer learning new information from the almost right, rather than the clearly wrong informant.

Pictures of two women described as "grown-ups, just like your mom" were introduced to 3-, 4-, 5-, and 6-year-olds (N = 16 at each age). During the induction phase, the experimenter presented children with pictures of four familiar objects and reminded children of their conventional names: comb, car, fork, and crayon. She explained that one grown-up (the "almost right" labeler) referred to the objects as a brush, truck, spoon, and pencil, and the other (the "clearly wrong" labeler) referred to them as a thunderstorm, sneeze, dream, and cough.

Children then participated in four novel label trials: for each, the experimenter presented an unfamiliar object, explained that one grown-up called it, for example, a fip and the other called it a modi, and asked children to decide who was saying the right thing. To address whether children recognized that one adult's errors in the induction phase were less severe than the other's, children answered two explicit judgment questions. After being reminded of how each informant had referred to the four familiar objects, children at each age almost always agreed that both informants were wrong. Finally, children indicated which informant "was saying almost the right thing". Although 3-, 4-, 5-, and 6-year-olds easily identified the "almost right" informant, only 6-year-olds selectively endorsed this informant's novel labels.

In summary, 3-, 4-, 5-, and 6-year-olds readily agree that not all errors are equally egregious, but only 6-year-olds seem to expect a difference in the reliability of two differentially inaccurate informants. This study has implications for understanding the development of increasingly complex strategies for evaluating information, and provides a new perspective about how children learn from others.

## **On “Creation,” “M-A-N,” and “Folks” - Anthropologies of a “Black” Evangelical church community in Atlanta, Georgia**

*Todne Thomas - Anthropology*

This paper examines the theological anthropology popularized by “Martin Powers,” a Bahamian evangelist and founder of several Christian Brethren evangelical churches in the U.S. South. Emerging from the ethnographic and historical data compiled from weekly Bible study discussions, church historical records, and Powers’ life history are three themes incorporating his conceptualization of humanity: “creation,” “man,” and “folks.” While each idea speaks to the religious, political, and class locations of the church association’s African American and Afro-Caribbean memberships, all three components of Powers’ anthropology are infused with an ideology of egalitarian human brotherhood. Informed by doctrinal and cultural emphases of sibling relatedness, Powers’ relational anthropology colors the religious subjectivities of hundreds of church members and confronts the ethno-racial segregation of mainstream evangelicalism. Ever attentive to the project of human brotherhood, Powers’ theological motifs also offer a critique of cultural anthropological categories of analysis as potentially (re)producing social difference. Thus more than a secondary “folk” anthropology, Powers’ theological anthropology is also rendered through its reflexive engagement with the epistemology of cultural anthropology.

## **Perspective-Taking Changes Perceived Spatial Layout**

*Elyssa Twedt - Psychology*

Perception of spatial layout is affected by numerous non-optical variables. For example, people who are fatigued, in poor physical condition, or burdened by a heavy load perceive distances to be further and hills to be steeper than unencumbered people (Bhalla & Proffitt, 1999). In addition, fear can influence one’s perception of heights (Teachman et al., 2008), and being in the presence of a friend (i.e., social support) makes hills appear shallower (Schnall et al., 2008).

The present study investigated whether stereotypes and attitudes also influence perception of spatial layout. In particular, we tested whether priming participants with an elderly stereotype affects their imagined time-to-walk to a target. A common stereotype is that the elderly are less physically fit than young people, so it takes them more time to traverse a distance than a young person. Thus, participants primed with an elderly stereotype should have slower imagined time-to-walk estimates than participants primed with a young stereotype (neutral condition).

When examining the effects of priming, female participants in the elderly condition imagined that it would take longer to walk to a target, relative to males. A measure of implicit attitudes suggests that this gender effect is partially due to empathy: female participants, who have more positive and empathetic views towards the elderly, may be more likely to have slower imagined times-to-walk because they embody the behavior of the elderly. However, participants who harbor more negative views of the elderly may be less affected by the manipulation and may actually show behavior that contrasts with the primed social group. We are currently investigating whether this difference in imagined times is due to participants misperceiving the target distance as being longer or the walking speed as being slower. This research suggests that the ability to take another’s perspective can influence perception of spatial layout.

## **Constraining Fundamental Milky Way Parameters With Stellar Kinematics of Sagittarius Tidal Debris**

*Jeff Carlin - Astronomy*

The halo of our Milky Way galaxy is now known to be coursed with stellar tidal streams. These streams contain the remnants of dwarf galaxies tidally disrupted by our Galaxy's dark matter-dominated gravitational influence. Stars in the remnant streams from this process retain the orbital characteristics imparted to them at the time they were pulled from their host dwarf galaxy. They can thus be used as sensitive probes of the Galactic gravitational potential. The best-known and only widely agreed-upon case of a dwarf galaxy currently undergoing tidal disruption in the Milky Way halo is the Sagittarius dwarf. Line-of-sight velocities (i.e. radial velocities) of Sagittarius members have been determined at a few positions along the stream, providing, along with the spatial distribution, constraints on models of the Sagittarius-Milky Way interaction. The Sagittarius dwarf and its tidal debris thus provide both a means of understanding the internal dynamics of satellite galaxies under strong tidal influence, and a probe of the shape and strength of the (dark matter-dominated) Galactic gravitational potential due to which this disruption is occurring. However, no systematic survey has yet addressed the tangential velocities (derived from angular "proper motions" on the sky) of the Sagittarius tidal stream, leaving dynamical models of tidal stream production and evolution poorly constrained.

To study the tidal tails of the Sagittarius dwarf, I have been working to obtain full phase-space information (positions and full 3-D space motions) for a sample of stars in selected regions along the stream. The unique data set I'm working with is derived from matched photographic plate pairs taken nearly 100 years apart. This long time baseline provides unprecedented accuracy on the proper motions of stars in these fields. I find the signature of a common-motion population in the tangential motions of stars in these fields, as well as corresponding stellar excesses at blue colors. To uncover conclusive evidence that these faint stars are indeed debris from the disrupted Sagittarius dwarf galaxy, I've obtained follow-up spectroscopy of over 1000 candidate stream members with the Hydra multi-object spectrograph at the WIYN telescope in Arizona. Radial velocities derived from spectra of stars in this "excess" population confirm these faint stars as Sagittarius debris. These radial velocities will be combined with tangential motions from the photographic data to derive full space motions of stream members. With this orbital information, I will work to constrain fundamental dynamical properties of the Milky Way's dark matter halo, including its shape, and the rotation speed at the Sun's position in the Galactic disk (related to the dark matter-dominated mass profile within the solar orbit).

## **Do sea turtles cultivate their "garden" even when nutrients are limiting?**

*Kim Holzer - Environmental Science*

This study examines whether feeding by the green turtle (*Chelonia mydas*) on seagrass enhances plant re-growth and food quality, termed cultivation grazing, in both nutrient sufficient and nutrient limited scenarios. Green turtle grazing was simulated and nitrogen (N) plus phosphorous (P) was added to the sediment in 0.5 x 0.5 m turtlegrass (*Thalassia testudinum*) plots from May-September in Bermuda. Five replicates were assigned to four treatments consisting of 1) +turtles, no nutrients 2) +turtles, +nutrients 3) control, no nutrients 4) control, +nutrients. Our results show that trimming has different effects on foliar growth and nutrient composition in low compared to high nutrient conditions. In fertilized plots with trimming, seagrass growth rate (g DW m<sup>-2</sup> day<sup>-1</sup>) was enhanced by 60% compared to the control after 4 months and 40% after 12 months- even once the trimming and fertilization course ended. The positive growth response of nutrients plus trimming was still 40% lower than the fertilizer control after 4 months, but not statistically different after 12 months. In contrast, trimming alone did not modify areal productivity during the entire study. After 4 months, the interactive effect of trimming and nutrient addition produced leaves with 20% higher N and 40% higher P content than the control, which also significantly exceed the fertilizer control. On the other hand, after 4 months, trimming alone produced leaves with similar N content, but decreased P content by 30% compared to the control. Twelve months later, all treatment effects on P concentration were comparable, but trimming combined with nutrients did not maintain higher tissue N values, confirming that P not N limits seagrass productivity at our field site. The analysis shows that trimming only cultivates the garden in this subtropical carbonate system when P is added. These experimental data provide an important qualifier for the broader ecological concept of cultivation grazing and another thread in support of the important role that herbivores play in structuring marine plant communities.

## **The Calcium-Dependent and Calcium-Independent Membrane Binding of Synaptotagmin I: Two Modes of C2B Binding**

*Weiwei Kuo - Chemistry*

Ca-independent membrane binding of synaptotagmin 1 (syt1), which functions as the calcium sensor in neuronal exocytosis, is characterized using a combination of site-directed spin labeling (SDSL) and vesicle sedimentation. It is well-accepted that both soluble C2 domains of syt 1 bind to negatively charged phosphatidylserine (PS) containing membranes in a Ca<sup>2+</sup>-dependent fashion. Here, we show that the second C2 domain of syt 1, C2B, also binds to PC:PS bilayers in a Ca<sup>2+</sup>-independent manner with a lipid partition coefficient of approximately  $3.0 \times 10^2 \text{ M}^{-1}$ . A soluble fragment containing both C2 domains of syt1, C2A and C2B, has a similar affinity, but C2A alone has no detectable affinity to PC:PS bilayers in the absence of Ca<sup>2+</sup>. Although the Ca<sup>2+</sup>-independent membrane affinity of C2B is modest, it indicates that this domain will never be free in solution within the cell. SDSL was used to obtain bilayer depth restraints, and a simulated annealing routine was used to generate a model for the membrane docking of C2B in the absence of Ca<sup>2+</sup>. In this model, the polybasic strand of C2B forms the membrane binding surface for the domain; however, this face of C2B does not penetrate the bilayer, but is localized within the aqueous double-layer when C2B is bound. This double-layer location indicates that C2B interacts in a purely electrostatic manner with the bilayer interface. In the presence of Ca<sup>2+</sup>, the membrane affinity of C2B is increased approximately 20 fold, and the domain rotates so that the Ca<sup>2+</sup>-binding loops of C2B insert into the bilayer. This Ca<sup>2+</sup>-triggered conformational change may act as a switch to modulate the accessibility of the polybasic face of C2B, and control interactions of syt1 with other components of the fusion machinery.

## **Linking Terrestrial Biogeochemistry to Declining Rates of Origination in Middle and Late Devonian Seas**

*Michel Tuite - Environmental Science*

The biogeochemical transition to a more modern relationship between land and sea during the Middle and Late Devonian is evinced in the geochemical record of nutrient dynamics and the pattern of marine faunal diversity loss. The expanding areal extent of Devonian lowland forests, facilitated by periodic transgressive events, generated an increasing outwelling flux of organic matter and reactive nitrogen from rivers and estuaries as well as higher rates of wet and dry atmospheric reactive N deposition that resulted in elevated primary productivity and episodic high organic content black shale deposition in epeiric basins. Conversely, progressively deeper and more mature tropical soils may have retarded the weathering flux of phosphorus. Composition and isotope analyses of sediments at the Frasnian/Famennian boundary within the Appalachian Basin suggest that reactive N and terrestrial organic matter were abundant during the interval of elevated primary productivity corresponding to the globally-correlated dysoxic Upper Kellwasser horizon and that the P necessary to sustain high levels of productivity was remobilized from organic matter in anoxic sediments. However, while episodes of global oceanic dysoxia, such as the Upper Kellwasser, may have precipitated discrete episodes of widespread extinction, two-thirds of Devonian diversity loss was a function of diminished rates of origination. This pattern of diversity loss is best explained by the frequently observed unimodal relationship between diversity and productivity. The abundance of trophic resources in Middle and Late Devonian seas caused populations to increase in size and served to diminish origination rates because large populations are inherently more resistant to evolutionary innovation and consequent speciation.

## **Measurements of Dopamine in *Drosophila melanogaster* using Fast Scan Cyclic Voltammetry**

*Trisha Vickrey - Chemistry*

The purpose of this study is to develop a novel method to make real-time measurements of changes in extracellular dopamine concentration in a single nerve cord from a *Drosophila melanogaster* larva. *Drosophila*, the fruit fly, is homologous to mammals in basic neurobiology and therefore, could serve as a valuable model system for studying the dynamics of dopamine release and reuptake. However, the size of the brain is small, it is only 100  $\mu\text{m}$  wide and 8 nL in volume, and this previously precluded repeated measurements of real-time neurotransmitter release in an intact fly nervous system. We induced release by genetically modifying *Drosophila* to specifically express Channelrhodopsin2, a blue-light activated cation channel, in dopaminergic neurons. Blue-light induced extracellular dopamine release and clearance is measured with fast scan cyclic voltammetry at implanted carbon-fiber microelectrodes in isolated fly larval ventral nerve cords. Seven second long stimulations result in 100-200 nM average dopamine release, which is similar to evoked release in mammals. These stimulations can be repeated at 15 minute intervals for 1.5 hours. The evoked signal was also pharmacologically probed and the duration of dopamine is extended when the nerve cord is exposed to cocaine, an inhibitor of the dopamine transporter (DAT), which is responsible for dopamine clearance. This method allows us to make repeated measurements of endogenous dopamine in an intact fly nervous system. Because the fly is a genetic model organism of choice, the effect genetic and pharmacological manipulations on dopamine signaling can easily be studied.

## **Light-Emitting Boron Materials for Biomedical Sensing and Imaging**

*Guoqing Zhang - Chemistry*

Advances in biomedical engineering depend significantly on tools developed from chemistry and material sciences. The use of fluorescent dyes as imaging and sensing agents has become one of the most important ways to acquire information in contemporary bioscience. Since the basis for fluorescence microscopy is to identify suitable dyes, strategies to designing and preparing such luminescent molecules are critical. In this presentation, the design, synthesis, characterization, fabrication and biomedical application of luminescent boron biopolymers as imaging and sensing agents is presented.

Difluoroboron dibenzoylmethane (BF<sub>2</sub>dbm) is a known fluorescent molecule but its unusual room-temperature phosphorescence (RTP) was not discovered until we incorporated BF<sub>2</sub>dbm with polylactide (PLA), a biorenewable and biocompatible polymer. More surprisingly, the emission color of the boron-polymer conjugate, BF<sub>2</sub>dbmPLA, is dependent on the polymer molecular weight (MW). Our proposed model for the MW effect involves the alteration of singlet-triplet energy splitting in the excited states for the dye. In combination with MW and internal heavy-atom effects, we have devised a strategy to quantitatively control the ratio between fluorescence and RTP from a single-component molecule, which can be used in ratiometric or "turn-on" type of sensing merely depending on the polymer MW. This practical and yet simple design excels in current luminescent ratiometric measurements which often require multiple components and exact stoichiometry. The readily processable polymers may be conveniently employed where oxygen detection or measurements are involved, such as food packaging and aerodynamics.

When the boron light emitting materials are fabricated as aqueous nanoparticles, they exhibit outstanding performance in biomedical field. Since oxygenation plays a very important role in cell viability, tumor hypoxia, organ transplantation, and cardiovascular disease, reliable *in vivo* oxygen sensors are highly desired. Current oxygen detection methods suffer from either high invasiveness or low efficiency. With sufficient brightness, stability, and biocompatibility, boron nanoparticles (BNPs) serve as non-invasive and real-time oxygen sensor. For example, with our second generation boron PLA nanoparticles (BF<sub>2</sub>dbm(I)PLA), we have successfully obtained human breast cancer hypoxia optical images in a mouse window chamber model. By mapping the ratio between the intensity of oxygen dependent RTP and the intensity of invariant fluorescence from the single-component nanoparticle, the *in vivo* oxygen level distribution was acquired. And for the first time, we correlated these results with other tissue oxygenation detection methods such as hemoglobin saturation and hypoxia-inducible factor 1 (HIF-1- $\alpha$ ) induced green fluorescent protein (GFP) expression, confirming that the data was in good agreement.

In addition to hypoxia oxygen sensing, the fluorescence alone of the boron nanoparticles can be harnessed as a powerful tool to visualize cell trafficking. Using HeLa cells as a model study, our results suggest PLA nanoparticles undergo active cellular uptake via a caveolae mechanism. Real-time movie from confocal multi-photon microscopy is possible due to the high stability of the nanoparticles.

Currently, we are also collaborating to work on imaging and oxygen sensing for islet cells for organ transplantation in diabetes research, microcirculation in cardiovascular studies, and neural cell viability in tissue engineering projects. We are also trying to develop the third generation materials which involve the block polymer (e.g. PEGylation) and bioconjugation (e.g. biotin attachment) chemistry for better circulation, targeting, and delivery.

## **Van der Waals interaction in a cold Rydberg gas**

*Jianing Han - Physics*

Van der Waals interaction is the interaction between two or more dipoles. It has  $R^{-6}$  at large internuclear spacing, which can be calculated by the second order perturbation theory, and it has  $R^{-3}$  dependence at shorter internuclear spacing. Rydberg atoms have large dipoles, which are the best candidates for investigating this type of interaction. Moreover, van der Waals has been used to explain the plasma forming process and dipole blockade effects. However, no direct measurements have been made for such interaction. This presentation is designed to show the direct measurements of this interaction and study the effects induced by the dipole effects. It was found that the second order dipole-dipole interaction, van der Waals interaction, commonly exists between the atoms in our atomic sample, for instance, when we excite the atoms from  $ns$  to  $(n+1)s$  states using narrow band microwave pulse, an asymmetric broadening, which is attributed to the  $ns$  to  $ns(n+1)s$  molecular state transition, was observed. In the presentation, I will show that this broadening is directly resulted from the van der Waals interaction between two paired atoms. In addition, the first order dipole-dipole interaction has been observed and will be presented in this presentation. Furthermore, the van der Waals long range molecule is studied, which provides another way to study the two-body to multi-body transition.

## **Development of New Classes of Piperidines Starting from Pyridine**

*Daniel Harrison - Chemistry*

The development of methodologies that have the capability to chemically modify compounds in an atypical manner are of fundamental importance. They can lead to the design and synthesis of new compounds that are not easily synthesized by classical methods. The resulting compounds are of high interest due to their potential as new pharmaceuticals. We aim to discover small molecules classically inaccessible by other means. To this end, the Harman group has developed a system that is capable of acting as a protecting and modulating group for conjugated systems. In particular, readily available aromatic compounds, which are difficult to modify due to the high stability of their cyclic conjugated systems, can be chemically modified by the described system  $\{TpW(NO)(PMe_3)\}$ .

The work presented here will focus on the chemical modifications of pyridine in the development of small molecules falling into the class of important natural products known as piperidines. Previously, our group has demonstrated mild stereo- and regioselective nucleophilic additions to an isolated N-acetyl-pyridinium complex. Since then, other nucleophilic compounds have been successfully used to provide a full range of 1,2-dihydropyridines. Here, we explore addition reactions to this new class of dihydropyridines, which produce piperidines with multiple stereocenters.

Analysis of tandem electrophilic/nucleophilic additions has produced an important reversal (i.e. umpolung) of typical chemical reactivity, as compared to similar compounds that do not have a coordinated metal fragment (*vide supra*). Removal of the metal from the compounds should lead to the isolation of uncommon piperidine products. Additionally, we have found a common commercially available reagent that induces a chemical isomerization. These isomers, which differ from their original products only by the location of the metal, promise to provide reactivity patterns that vary dramatically from their precursors. Thus, two new classes of piperidines may be developed from a common pyridine origin.

## **Exploring the Organic Carbon Cycle in the Arctic Ocean**

*David Morris – Environmental Science*

The Arctic Ocean remains one of the least studied ocean basins. The Western Arctic is thought to be strongly influenced by the continents of North America and Asia. The coexistence of two pools for organic carbon inputs to the Ocean, one highly labile from marine primary production and the other largely from recalcitrant terrestrial sources, makes the Arctic Ocean possibly one of the most complex environments in which to study carbon cycling. The balance of terrestrial versus marine material is closely tied to climate variability via the hydrologic cycle, and ultimately, these signatures are preserved in sediments.

This project is an integrated, multi-proxy approach that will provide a robust means for evaluating spatial and temporal variations in climate through analysis of chemical and isotopic signatures of the different carbon pools. Molecular biomarkers and bulk and compound-specific stable carbon isotopes will provide the means for linking spatial and temporal organic carbon preservation with climate variability. Biomarkers allow for the assignment of sources to organic carbon inputs, and when coupled with bulk and compound specific isotope data, enable more specific evaluations of both the transport of terrestrial matter, source and paleoproductivity. Associated measurements of  $\delta^{18}\text{O}$  and radiocarbon age of foraminifera will provide the means for calculating the variability in sedimentation rates, temperature and ice cover for the Western Arctic Ocean.

## **Effects of Nutrient Enrichment on Seagrass Communities of Mozambique**

*Meredith Muth – Environmental Science*

Seagrass communities are widely considered one of the most productive ecosystems in the world. In addition to their trophic role, marine macrophytes perform a structural role by providing habitat and refuge for myriad organisms, decreasing wave energy, stabilizing sediment, and increasing water clarity. Light is a vital component in determining distribution of seagrass. As a result, seagrass beds are restricted to depths that permit photosynthetic processes. Temperature and salinity also play an integral role in seagrass distribution. When light, temperature and salinity are sufficient, nutrient availability may restrict marine macrophyte growth. Nitrogen (N) and/or phosphorus (P) are most often the primary limiting nutrient when nutrient limitation regulates primary productivity.

Ecological theory on resource limitation frequently employs Liebig's law of the minimum: the growth of an individual or a population is limited by the essential resource present in the lowest amount relative to demand. Thus, there is only one limiting resource at any given time. For seagrass communities, which are commonly found in shallow oligotrophic marine environments, nutrients are often the resource that most limits net primary production. Both nitrogen and phosphorus have been shown to affect seagrass growth directly, but also indirectly through the accumulation of epiphytes on the seagrass leaves. Concern has been raised regarding anthropogenic eutrophication and the status of seagrass communities around the world. Although many nutrient limitation and fertilization studies have been conducted in the Atlantic Ocean, few have focused on the extensive intertidal seagrass of the West Indian Ocean. We therefore have a poor understanding of how Indo-Pacific seagrass species may respond to nutrient enrichment.

Nutrient limitation is often inferred from stoichiometry found in leaf tissue, but experimental assays are the only way to support a limitation hypothesis: a system is considered nutrient limited if net primary production, and plant abundance, increases as a result of nutrient addition.

This project explicitly examines how nutrient enrichment affects seagrass ecosystems in the species-rich intertidal zones of Mozambique, East Africa.

## **The Birth of Super Star Clusters**

*Amy Reines - Astronomy*

Super star clusters (SSCs) are the most extreme star forming environments in the local universe. Packed with massive stars, these clusters have a major impact on the energetics and morphology of galaxies. Massive stars ionize the interstellar medium and power the infrared radiation of dust, and their stellar winds and supernovae release mechanical energy which can trigger further star formation. In addition, the most massive and dense SSCs are the likely progenitors of ancient globular clusters. For all of these reasons, there is wide-spread interest in the birth and evolution of SSCs. The goal of my research is to improve the current understanding of SSC formation and early evolution by combining observations of starburst galaxies spanning the radio to ultraviolet wavelength regimes. This work capitalizes on the unique capabilities of the Hubble and Spitzer Space Telescopes and the Very Large Array to probe the gaseous and dusty sites of star formation at high resolution.

## **Revealing the Origins of Young Star Outflows and the Upper Atmospheres of Extrasolar Planets**

*George Trammell - Astronomy*

The last several years have seen enormous observational and theoretical progress in our understanding of the star and planet formation process. The discovery of a wide variety of planets orbiting other stars has led to rapid developments in our picture of how these formation processes are connected. And the input physics that can accurately describe and explain these systems is also giving astronomers crucial insight into the origins of our own Solar System.

In the context of these highly active fields of astronomical research, I will present early results of my research on the nature of outflows of gas mediated by magnetic fields in two different astrophysical environments: (1) the gas disks that form around nascent stars (accretion disks), and (2) the upper atmospheres of recently discovered extrasolar planets (EPs). My study has consisted of both analytic calculations and large-scale numerical simulations, as well as detailed comparisons to space-based observations. While quite distinct astrophysical systems, the physical processes and methods used in each case are similar. Given recent discoveries with NASA's space-based instruments, such as the Hubble Space Telescope (HST) and the Chandra X-ray Observatory (CXO), a clearer physical picture of these astrophysical systems is desperately needed.

I seek to answer the following questions: what conditions are necessary for magnetic fields to drive outflows from disks around newly-formed stars? What impact do these outflows have on their surroundings, what is their role in star formation, and the co-eval process of planet formation? When a planetary atmosphere is bombarded with levels of high energy radiation many times higher than that experienced by any solar-system planet, how does the structure of the atmosphere change? Is "atmospheric escape" possible, and can outflows alter the composition and mass of the planet? For EPs orbiting very close to their host stars, how is the stellar atmosphere affected by the planet-star interaction?

Protostellar outflows are an integral part of the star formation process. Their interaction with the surrounding cloud of gas and dust acts as a feedback mechanism that can terminate further accumulation of material, and it determines the ultimate mass of the star. They also carry away angular momentum and contribute to the accretion rate and stellar rotation speed. But how can observations be used to shed light on the physics responsible for launching these winds? Previous investigators have elucidated the connection between the observational signatures of winds and the launching location associated with the buildup of magnetic field strength associated with the accretion process.

Despite the progress toward interpreting these observations, the detailed physical conditions and processes that drive and sustain the outflow are poorly understood. Which of the mechanisms involved in driving outflows has the most influence in determining the angular momentum transport, mass outflow rates, and velocity signatures at the scales currently accessible by observations? Discovering the role of outflows in star formation also has important implications for the dynamics of the accretion disks at the future sites of planet formation.

Another related problem that I wish to address involves the role of magnetically-driven outflows in the upper atmospheres of extrasolar giant planets. The discovery of gas giant EPs in tight orbits around their host stars (called "hot Jupiters") has provided a much needed laboratory for testing theories of their atmospheric structure and dynamics. These hot Jupiters orbit at distances where the radiation and stellar wind are ten-thousand times more intense than at their birth location much farther away from their star. Furthermore, the existence of an intrinsic planetary magnetic field and stellar wind parameters quite different from those at the locations of our solar-system planets could result in a new type of wind-planet interaction.

In addition to addressing these fundamental physical problems, my models will lay a solid theoretical foundation crucial for interpreting existing and future data from several NASA observatories: probes of EP upper atmospheres through transmission spectroscopy with HST; planet-induced heating of the host-star atmospheres observed by the CXO; and HST observations of protostellar outflows.

## **Implementation of a Bose-Einstein condensate gyroscope**

*John Burke - Physics*

Atom interferometers using Bose Einstein condensates have been demonstrated in linear geometries and have given promising results. These interferometers often use magnetic fields to confine the atoms and to support them against gravity. Here we demonstrate a two-dimensional interferometer in a harmonic magnetic trap. Such an interferometer can take advantage of the Sagnac effect for rotation and make gyroscopic measurements. Compared to free space interferometers, much larger interaction times and enclosed areas can in principle be achieved, since the atoms are not falling. In our implementation, we induce the atoms to oscillate along one direction by displacing the trap center. We then split and recombine the atoms along an orthogonal direction, using an off-resonant optical standing wave. The combination of the two motions produces an enclosed area. We observe interferometric contrast for areas up to 0.05 square mm, a value limited by the oscillation amplitude that we can reliably impart and by the coherence time of our linear interferometer.

## **Toward the Synthesis of Substituted Aminocyclohexenes from Anilines**

*Rebecca Salomon - Chemistry*

Anilines are aromatic molecules that contain a benzene ring with a nitrogen substituent. They are prevalent in nature and have been highly utilized commercially as dyes, and medicinally as analgesics. The chemistry of anilines is dominated by reactivity at the nitrogen or in the preparation of other aromatic compounds presenting a problem using them as synthetic precursors for therapeutics. Control of the position and geometry of additions is a particular problem. A route to saturated aniline compounds with specific geometries is desirable due to the likely applications in the development of potential pharmaceuticals.

One method that has been used to activate other aromatic compounds involves the dihapto ( $\eta^2$ ) coordination of the aromatic compound to an electron-rich metal fragment, resulting in a "dearomatization". Activation of aniline via such coordination presents a unique challenge because anilines are already among the most electron-rich aromatics and thus the most difficult to isolate as  $\eta^2$  complexes. Coordination and activation of substituted anilines to the  $\pi$ -basic metal fragment {TpW(NO)(PMe<sub>3</sub>)} is under investigation. We have found that using a mild acid, N,N-dimethylaniline binds to the metal and sequestered in a protonated form. This is the first example of a tungsten bound  $\eta^2$  coordinated aniline.

The use of the electron-rich metal and aromatic ligand results in an increased nucleophilicity of the  $\eta^2$  coordinated aniline, as compared to analogous anisole complexes. Reaction of TpW(NO)(PMe<sub>3</sub>)(2H-anilinium) with a base exposes a neutral  $\eta^2$  aniline complex which participates in S<sub>N</sub>2 reactions with mild electrophiles, including benzyl bromide and  $\alpha$ -bromobutanone. The electrophiles add to the para position of the formerly aromatic ring. Alternatively, if the base is omitted addition of electrophilic oxidants and heteroatomic nucleophiles results in tandem additions across the C3-C4 bond of the bound aniline, with electrophiles adding meta and nucleophiles adding para. This reactivity represents an umpolung, or reversal of reactivity, compared to uncoordinated anilines.

## **A Mid-Infrared Spectral Map of the Star-forming Region 30 Doradus**

*Geneviève de Messières - Astronomy*

The Large Magellanic Cloud, a satellite galaxy of the Milky Way, hosts 30 Doradus, the largest nearby star-forming region. 30 Doradus is well placed for observation, outside the confusion of the disk of the Milky Way, but much closer and easier to see than the enormous star-forming regions in distant galaxies. Furthermore, 30 Doradus has been well-studied at many wavelengths, making it the ideal laboratory to study the formation of massive stars, and a prime candidate for a detailed mid-infrared spectral map.

30 Doradus was once filled with the cold gas and dust from which stars are born, but in the core of the region, the intense light from young and hot stars is converting the nursery materials into hot gas. Conditions in 30 Doradus may be similar to the early universe, when small irregular star-forming galaxies like the Large Magellanic Cloud dominated the population of galaxies. Additionally, the dense core of 30 Doradus, called R136, is usually considered the nearest super-star cluster. Super star clusters in large galaxies are one of the most extreme environments of star formation in the universe. They play a major role in the formation of galaxies, and may be the progenitors of globular star clusters.

The mid-infrared bandpass is an important window into the processes of star formation. Stars only form in a cold, dark environment, generally dominated by solid particles of dust. The light that young stars emit at optical and ultraviolet wavelengths is easily absorbed by this dust, causing difficulty in estimating the rate of star formation. However, mid-infrared light is not absorbed by dust, and dust and cold gas warmed by young stars also emit mid-infrared photons which encode information about the amount of gas and dust, and the kind of light that is shining on it. Therefore, mid-infrared observations can pierce through the dark clouds and reveal the obscured heart of star-forming regions.

A spectrum is obtained by taking an image of a long, narrow slit of the sky, and then breaking the light into its component wavelengths with the use of a diffraction grating. Spectroscopy provides a wealth of information that cannot be derived from images. A spectral map is composed of multiple spectra, each at a different position in the sky. Requiring a great deal of observational time, a spectral map combines the advantages of spectroscopy and regular imaging.

We have used the Infrared Spectrograph aboard the high-sensitivity Spitzer Space Telescope to construct a dense spectral map spanning the central regions of 30 Doradus. The observations total 74 hours in length. I prepared the data and, with my advisor Dr. Rémy Indebetouw, performed preliminary analysis. From the spectral map, we have assembled maps of individual spectral features, making it easy to see how the dust and gas in the region are affected by the light from the young stars, and maps of physical parameters like the density of the gas, the degree to which it absorbs light, and the temperature of the stars. The spectral map will yield many more avenues of study to help understand the processes of star formation.

## **"Decreases in the U.S. "Transition" Frequency and a New Perspective on United States Climate Change"**

*David Hondula – Environmental Science*

The Spatial Synoptic Classification (SSC) (Sheridan, 2002) identifies six air mass types and a "transition" (TR) category that is designed to identify days in which a shift between air masses has occurred. Several studies have noted a significant decrease in annual transition frequency over the past fifty years over the continental U.S. (Sheridan, 2003; Knight et al., 2008). This research investigates the nature and causes of the decline.

A statistically significant decreasing trend is found for 40 of the 63 U.S. stations examined for the period 1951- 2007. The magnitude of the trends is highest in the winter months (DJF). Across the same network, a significant decrease in the TR indicator variables (daily dew point temperature range, daily pressure range, and daily wind shift) is observed at many stations. In the case of average daily dew point temperature range, a significant decline is evident at 42 stations where the annual average dew point temperature range has dropped by roughly 10% over the study period. Examination of six-hourly meteorological data reveals a possible shift in the daily dew point profile: morning (4 a.m. and 10 a.m.) dew point temperatures are, on average, increasing more rapidly than afternoon (4 p.m. and 10 p.m.) dew point temperatures. This profile shift has dampened the daily dew point range, decreasing the likelihood of TR classification for a given day. The changes in TR frequency and indicator variables may be linked to several causes, including shifts in continental-scale circulation patterns and anthropogenic forcings of the ambient environment.

## **Diurnal Variations in Nitrate Concentrations in Cobb Mill Creek, VA**

*Wendy Robertson – Environmental Science*

Nitrate is the most pervasive and ubiquitous global contaminant of ground and surface waters. Ninety percent of the anthropogenic input of nitrate in to the environment comes from fertilizer application, with the United States alone applying 12.5 million tons of fertilizer between 2003 and 2006. High nitrate concentrations in ground and surface waters can have a deleterious effect on both human health and on the ecological systems of impacted areas.

One microbially driven process by which nitrate is removed from the environment is denitrification, organic carbon oxidation coupled to nitrate as a terminal electron acceptor, a process which can occur in organic-rich streambed sediments. In low relief coastal watersheds, groundwater with high concentrations of nitrate (~20 mg/L nitrate as N) discharge to streams through the zone of denitrification in these streambed sediments. The resulting concentration of nitrate in the streamwater can vary dependent upon many factors including the residence time of the discharging groundwater in the zone of denitrification. Evapo-transpiration (ET) in the forested riparian zone surrounding the stream can potentially alter the water table gradient, which, in turn, causes the residence time of groundwater in the zone of denitrification to vary by 2 to 6 hours diurnally.

In the Cobb Mill Creek watershed, VA, multiple 72-hour field events were undertaken to monitor weather conditions, streamwater levels and streamwater chemistry in order to quantify the effects of ET in the riparian zone on the streamwater flow and chemistry. Estimates of potential evapo-transpiration (PET) for the riparian zone of Cobb Mill Creek have been calculated to be as much as 0.5-0.9 mm per hour between 11:00 and 15:00. During the June 2008 monitoring event, stream stage at the creek varied diurnally by an average of 6 cm, and nitrate concentrations varied diurnally by 2.7 mg/L nitrate as N, with a minimum nitrate concentration of 2.9 mg/L nitrate as N at 12:00 on the 26th of June, and a peak nitrate concentration of 6.5 mg/L nitrate as N at 00:00 on the 28th of June.

Diurnal variations in reactive contaminants such as nitrate can cause substantial difficulty in monitoring the flux of these contaminants through watershed systems. Common monitoring practices for contaminant concentrations often involve only random grab sampling of water samples for analysis. If the timing and magnitude of a diurnal variation in a contaminant concentration is not quantified for a system, then random grab sampling risks either over or under-estimating the flux of contaminants, like nitrate, in the system. Therefore, diurnal variations in streamwater nitrate concentrations can potentially have a significant effect on estimates of nitrate flux through watersheds based upon grab sampling techniques.

## **A genetic model of serotonin over-production and degeneration**

*Elizabeth Daubert - Neuroscience*

A common feature of many neurodegenerative diseases is the formation of protein aggregates. Currently, it is unknown whether these aggregates may be protective or destructive. Serotonergic neurons in particular are known to be prone to degenerative characteristics under conditions of neurodegenerative disease as well as toxin administration. This susceptibility may be due to the inherent character of serotonergic neurons and the neurotransmitter serotonin. We provide evidence supporting this notion in a *Drosophila* model of serotonergic neurodegeneration. When over-expressing the rate-limiting enzyme in serotonin synthesis, tryptophan hydroxylase, in serotonergic neurons large spheroid structures form along serotonergic neurites in an age-dependent manner. These structures resemble dystrophic serotonergic neurites observed in mammalian models of aging, oxidative damage and serotonergic toxin administration such as MDMA and fenfluramine. In our model this effect is specific to serotonergic neurons and the protein tryptophan hydroxylase. Over-expression of tryptophan hydroxylase triggers an event dependent upon serotonergic machinery involving canonical regulatory mechanisms and degenerative pathways including the ubiquitin proteasome and autophagic pathways. I will present data describing the structural changes in serotonergic neurons upon tryptophan hydroxylase over-expression as well effects on general behaviors throughout the life of the fly as well as the cellular mechanisms leading to the degenerative phenotype. These data will provide novel insight into the mechanism of degeneration of serotonergic innervation and its relationship to the neurotransmitter serotonin.

## **Loss of Nocturnin, a Circadian Deadenylase, Causes Altered Absorption of Dietary Lipid**

*Nicholas Douris - Biology*

Obesity often is the first step into what is called the "metabolic syndrome," including diabetes, cardiovascular disease, and certain kinds of cancers. Rates of obesity are escalating in today's society at an alarming rate and this increase is no longer limited to "Western" world, but also includes developing nations. Greater understanding of the mechanism can help manage this difficult disease. Here we report on a daily rhythmic or "circadian" gene, Nocturnin, which has a role in metabolic function and may potentially be a target for obesity therapeutics.

Nocturnin is a deadenylase that controls mRNA expression in a circadian manner by degrading the poly-A tail of target RNAs, leading to mRNA turnover or translational silencing. Previously we reported that a mouse lacking Nocturnin was resistant to diet-induced obesity and hepatic steatosis. The lean phenotype was not due to increased activity, decreased food intake or a higher metabolic rate. Transcript analysis in liver showed alterations in genes associated with lipid uptake and utilization. To investigate the mechanism behind this phenotype, we exposed WT and KO mice to various dietary challenges and also examined aspects of digestive tract function.

When on a standard mouse chow, the KO mouse exhibited lower circulating beta-hydroxybutyrate - a finding consistent with altered lipid availability in the KO. Moreover, this latter discrepancy in the KO is not due to hepatocyte malfunction as hepatocyte analysis showed normal rates of both lipid uptake and beta-oxidation.

Research into digestive tract function showed a faster transit time for lipid, but not water in the KO in a gut motility assay. Upon giving the mice a lipid bolus, KO mice formed larger lipid droplets within the small intestine. Further studies demonstrated decreased lipid uptake in a mouse model as measured in the blood, and these lipid included both triglycerides and cholesterol. The reduction of lipid uptake in the KO was mainly due to a significant decrease in their absorption via apoB-containing non-HDL lipoproteins. In Vitro primary enterocyte studies showed altered lipid trafficking as well, with the KO enterocytes absorbing more lipid and secreting less than their WT counterparts.

We propose that Nocturnin has a role in the absorption of dietary lipid in bowel, presumably by altering genes necessary for metabolism or digestion through circadian post-transcriptional modifications of targeted transcripts. We propose the rhythmic profile of Nocturnin is used to coordinate various cellular mechanisms and that this is energy efficient since all animals have periods of activity and rest, feeding and fasting. Living organisms can therefore use the biological clock to closely time and coordinate organ, tissue, and cellular processes to coincide with the availability of meals. While this synchronization for most living organisms to maximize their energy stores, for humans in an environment of excess calories, this function is deleterious to our health. A better understanding of the mechanisms of circadian regulation of metabolic function could lead to valuable therapies for managing obesity and the metabolic syndrome.

## **Repair/Regeneration of rat Achilles tendon using tubular scaffolds composed of non-woven electrospun PLAGA**

*Roshan James - Biomedical Engineering*

Increasing numbers of the general population are actively participating in various physical and recreational activities every year leading to an increased occurrence of soft musculoskeletal tissue injuries. Tendons undergo glide motion to transmit the force of muscle contraction to the bone enabling limb movement. A severe tendon injury involves partial or complete laceration and requires surgical intervention. The body's natural ability to heal these elastic tissues is very poor leading to significant patient morbidity which severely impacts their work, recreational activities and daily needs. The healing process is complicated by the need to provide appropriate and timely tension to the repair. Too little limb movement will promote adhesions with the surrounding tissues leading to friction and pain during movement. The regenerate tissue will be scarred and mechanically weak. Too much tension during the repair phase can cause rerupture and requires extensive corrective surgery. To ensure no adhesions and to restore the gliding motion which will transmit muscular forces to the bone a novel approach using tissue-engineering principles is explored. 1) Using a biocompatible and biodegradable polymer that may provide mechanical functionality to the injured tendon. As the polymer degrades, cells from the surrounding tissue would migrate in and synthesize an extracellular matrix (ECM). 2) By introducing a stromal population, the healing process could potentially be jump-started to affect a faster functional repair. 3) A therapeutic agent delivered in the necessary temporal and spatial pattern could drive the healing process leading to a well organized and functional tendon. Poly (DL-lactide-co-glycolide) (PLAGA) is an FDA approved polymer used in medical applications (sutures and bone graft) that demand a biodegradable and a biocompatible product. We have used PLAGA65:35 to fabricate fibers in the nano diameter range using electrospinning technique. These nanoscale fibers mimic the ECM topography seen in tendons. A 3D tube composed of nanodiameter fibers was fabricated with a lumen of 2-3mm, length 8mm and wall thickness of 1-2mm. The scaffold is 48% porous with a mean pore diameter of 14 $\mu$ m, and having an average Young's Modulus of 83MPa which is in the range of Achilles tendon of Fischer344 rat. The PLAGA65:35 nanofiber scaffolds degrade hydrolytically over a period of 2 months into non-toxic products such as lactic acid and glycolic acid. The scaffold properties can be readily altered to suit design specifications. Properties such as mechanical strength and degradation time can be custom fit. Stromal populations can be readily sourced from primary culture or during surgery from the patient and delivered into the lumen of the tube shaped scaffold. In vitro studies have shown significantly proliferation of fat derived stromal cells (ADSCs) on PLAGA nanofiber scaffolds over 21 days. The cells have infiltrated up to 30 $\mu$ m depth and extend cellular processes. Modulation of ECM, cell adhesion, and tendinogenic related genes of ADSCs seeded on PLAGA nanofibers were determined in response to stimulation with Growth/Differentiation Factor-5 (GDF5). GDF5 induces neotendon at ectopic sites. ECM and tendinogenic genes were significantly upregulated on treatment with 100ng/mL of GDF5 protein. GDF5 stimulates multipotent cell populations to differentiate down tendinogenic lineage. The increase in gene expression was dose dependent and inhibited cell proliferation at high doses. In vivo, GDF5 may modulate faster organization of ECM similar to native tendon. The regenerate tissue will remodel into bundles of aligned collagen fibrils giving tendon tissue its high tensile strength. When a scaffold alone is used in vivo cells will migrate to the repair site. These cells will adhere, proliferate and form the early tissue as the polymer degrades into non-toxic by-products. A stromal population delivered

on the scaffold may respond to stimuli from the scaffold and growth factors to yield a faster healing process. Materials and Methods: 3-D tubular scaffold of PLAGA65:35 was fabricated by electrospinning 16%w/v solution onto a grounded rotating rod. Nanodiameter size fibers can be obtained by largely modulating the voltage and distance the solution travels. Scaffolds are sterilized by a combination of 70% alcohol and UV. Unilateral tendinotomy was performed on the Achilles of female Fischer344 rats as per protocol approved by IACUC. The defect was bridged using the tubular PLAGA scaffolds. The control groups were lacerated and the stumps were allowed to retract and heal. The operated limbs were

immobilized for 10 to 14 days following which the animals were allowed unrestricted movement. Repair tissue was harvested at 4 and 8 weeks post-surgery and evaluated histologically and analyzed gene expression for tendon ECM components and tendinogenic markers with RT-PCR. Results: At 4 weeks postsurgery, the tendon stumps in the control group have established continuity with a disorganized union evident. There are gaps in the regenerate tissue and has formed adhesions with surrounding tissue. At 8 weeks, some degree of cellular organization is seen with a large number of gaps in the regenerate tissue. In tendon repair bridged with the tubular scaffold; at 4 weeks, the polymer is evident and the lumen is filled with new tissue. At 8 weeks post-surgery, the scaffold has completely degraded and replaced with tissue exhibiting significant cellular alignment. At 8 weeks, collagen III(Col III) gene expression was upregulated in animals that received the tubular scaffolds. There were no significant differences in Collagen I (Col I) gene expression at 4 weeks and 8 weeks post-surgery. Scleraxis (Scx) gene expression is significantly upregulated at both 4 and 8 weeks post-surgery in tissue bridged with the tubular scaffold. Tenomodulin (Tnmd) was significantly up regulated at 8 weeks post-surgery in the group bridged with the novel tubular scaffold. At 4 weeks, there was no significant difference in Tnmd gene expression between the groups. Discussion: Scx is a tenocyte specific marker and it positively regulates expression of Tnmd, a marker of tendon maturation and proliferation. The repair/regenerate tissue in the group bridged with the novel tubular scaffold is tendinogenic as measured with the significantly higher gene expression of Scx and Teno compared to control. The expression of Scx in cellular populations defines putative tendon progenitors as evidenced by studies in mouse and chick embryo. Scx is a protein of the basic-helix-loop-helix transcription factor family and modulates the transcription of the appropriate genes for cell fate determination and cellular differentiation. Scx is downstream of signaling cascades related to environmental and/or biological stimuli. Tnmd is a transmembrane glycoprotein which modulate maturation; characterized by changes in ECM composition with breakdown of Col III and synthesis of organized bundles of Col I. At 8 weeks post-surgery the increasing expression of tenomodulin would modulate the maturation of the neotendinous tissue by synthesis of more Col I. The histology shows complete replacement of the scaffold with new tissue, and significant alignment of the cells as evidenced by H&E staining. The neotendon tissue is devoid of gaps and the unorganized tissue mass seen in the control specimens. Ongoing mechanical testing will inform of the strength attributes of the repair/regenerate tissue. The delivery of stromal cells and/or GDF5 protein combined with the tubular scaffold may further enhance the tendon repair process by promoting matrix synthesis and faster healing rates. The scaffold offers mechanical strength and thus stabilizes the repair tissue which is very critical to prevent rupture during the early repair phase. The stromal population and growth factor stimuli may improve the healing rate to a functional repair.

## **The Role of Arf6 and Brag1 in Dendritic Spine Morphogenesis**

*Ken Myers - Cell Biology*

The human brain contains billions of neurons and well over a trillion synapses, or functional connections between neurons. It has long been thought that learning and memory are dependent on specific changes in the strength of individual synapses. Long-term potentiation (LTP) is a process by which individual synapses are strengthened to enhance neuronal communication. At the cellular level, LTP can be detected as increases in the number and efficiency of synaptic AMPA receptors, one of the main excitatory receptors found in neurons. AMPA receptors are most often found in excitatory synapses at the ends of small actin rich protrusions called dendritic spines. In addition to the increase in synaptic AMPA receptors, LTP also causes changes in the size and shape of dendritic spines, due in large part to effects on the actin cytoskeleton. Arf6, a member of the Ras superfamily of small GTP-binding proteins, is well known for its ability to regulate both actin cytoskeleton remodeling as well as the movement of receptors into and out of structures like the synapse. In order to better understand this process, we examined the role of Arf6 and one of its regulatory proteins, Brag1, in LTP. In hippocampal brain slices, we found that Arf6 activity is sharply reduced in response to the neurotransmitter NMDA. Treatment with NMDA induces a calcium influx which was found to affect the activity and distribution of Arf6 and Brag1, respectively. We also identified a calcium-dependent interaction between Brag1 and calmodulin, an intracellular calcium receptor important for synaptic function. Furthermore, in rat hippocampal neurons we found that the expression of a Brag1 mutant incapable of binding calmodulin causes a decrease in both the number and size of dendritic spines. These results suggest a role for Arf6 and Brag1 during LTP that may be important for our understanding of learning and memory.

## **Genome-wide impact of Mot1 on TBP Assembly and Transcription fidelity in Yeast**

*Kunal Poorey – Biochemistry & Molecular Genetics*

Understanding how organisms' function is crucial for the development of Life Sciences and Medical studies. Transcription generates RNA from DNA coding sequences, which is an essential step for functioning of a living organism. Transcription is initiated when certain stepwise modifications opens chromatin and Transcription factors binds DNA to initiate the process. TATA binding protein is the central component of the transcription machinery and its recruitment to promoters of the genes is one of the key steps for Transcription initiation. The recruitment of TATA-binding protein depends on co-activator proteins including TBP-associated factors (TAFs) etc. Yeast Mot1 dynamically associates with TBP to remove it from the promoter by ATP hydrolysis. However the global effect of TBP recruitment in determining the absolute and changing levels of Transcription across the Genome is not known. Genome wide high resolution ChIP on Chip of Transcription factors, Nucleosomes and Genome wide map of RNA in Mot1 mutants and WT strain in Yeast models give us an opportunity to study the global influence of TBP. With the help of Computational and Data mining models data of TBP recruitment over the promoters, the Nucleosome positioning and the global RNA expression is used in this study to explore what are the key factors affecting gene expression profiles and answer mechanistic question over the preinitiation complex formation.

High resolution ChIP on Chip was used to obtain the genome-wide recruitment of TBP, TFIIB, PolII, and Nucleosome positioning in WT and Mot1 Mutant *Saccharomyces cerevisiae*. Similarly RNA was mapped to the high resolution Tiling array to get the transcription maps. Computational techniques are used to analyze the Tiling array data with optimal sliding window method to get p-values and signal associated with the p-values for the array data. Computational methods were applied to reduce the noise related to array characteristics such as probe effects, non-specific binding, cross-hybridization etc. Robust peak finding model was developed to find TBP and TFIIB occupancy and associate with genes. To study the effects of Mot1 on Length change model was built to obtain the list of aberrant RNA length changes happening in the Mot1 Mutant.

Our study suggest that TBP is strongly correlated to transcription and TBP and TFIIB profiles suggest that Transcription machinery is poised by spurious TBP sitting in the wrong position in the genome. This is supported by the Transcription length changes observed in these cases. This study suggests that Mot1 plays a broad role in RNA synthesis and elongation synthesis affecting ~1100 genes with aberrant transcription which suggests that dynamic assembly of PIC influence the RNA synthesis.

## **Small $\beta$ -amyloid Oligomers Induce Tau-Dependent Microtubule Disassembly: A Primary Cause of Synapse Loss in Alzheimer's Disease?**

*Matthew Seward - Cell Biology*

Alzheimer's disease (AD) symptoms are caused by reduced synaptic function, and are associated with accumulation of amyloid plaques and neurofibrillary tangles in brain. Plaques and tangles differ in molecular composition, but their dominant structural features are insoluble, fibrous polymers. Plaques comprise  $\beta$ -amyloid ( $A\beta$ ) peptide fibrils, whereas tangles contain filaments formed by the neuronal microtubule (MT) associated protein, tau. A key unresolved issue about AD is how  $A\beta$ , tau, and the abnormal polymers they form contribute to synaptic dysfunction. It was recently demonstrated in cultured cell models that synthetic, pre-fibrillar  $A\beta$  induced tau-dependent MT loss, which was hypothesized to compromise MT-dependent axonal transport in vivo, and by extension, delivery to axon terminals of proteins essential for synaptic function (King, et al. 2006. *J CELL BIOL* 175: 541-546). Pre-fibrillar  $A\beta$  contained a complex mix of monomers and variably sized oligomers, and was active at  $\sim 1 \mu\text{M}$  total peptide, prompting the question of which  $A\beta$  species induced MT loss. To address this question, we assayed  $A\beta$  secreted by 7PA2 cells, a Chinese hamster ovary (CHO) cell line that stably expresses a mutant human  $\beta$ -amyloid precursor protein and overproduces  $A\beta$  (Podlisny, et al. 1996. *J BIOL CHEM* 270: 9564-9570). We now demonstrate that apparent dimers, trimers and tetramers, but not monomers of this biologically produced  $A\beta$  induce tau-dependent MT disassembly at  $\sim 1$ -10 nM total peptide. Treatment of tau expressing CV-1 cells with dimer/trimer and tetramer fractions depolymerized MTs within 90 minutes. MT loss was not observed in tau-positive CV-1 cells exposed to  $A\beta$  monomers or a dimer/trimer equivalent fraction secreted by wild type CHO cells that do not overproduce  $A\beta$ . Furthermore, MTs in tau-negative CV-1 cells were resistant to  $A\beta$  dimers/trimers and tetramers. These results raise the possibility that tau-dependent MT loss triggered by trace levels of very small  $A\beta$  oligomers is a primary cause of synaptic failure in AD.

## **The Unique Hypusine Modification of eIF5A Promotes Islet Inflammation and Dysfunction During the Development of Diabetes**

*Anthony Trace – Biochemistry & Molecular Genetics*

The hypusine-containing protein eIF5A is necessary for the maturation of antigen-presenting cells and facilitates pro-inflammatory cytokine production by immune cells. Because eIF5A is also expressed in pancreatic islets, we hypothesized that it may promote the inflammatory response in islets during the development of diabetes. To test this hypothesis, we depleted eIF5A in mice by RNA interference and observed that animals were resistant to beta cell degranulation and the development of hyperglycemia in the low dose streptozotocin diabetes model. The protection afforded by eIF5A depletion appeared to result acutely from impaired translation of the mRNA encoding the inflammatory enzyme inducible nitric oxide synthase (iNOS) within the islet. In rodent beta cells and human islets in vitro, cytokine-induced iNOS translation was dose-dependently reduced in the presence of inhibitors of hypusine synthesis, suggesting a role for the hypusine residue in mediating islet inflammation. We show that hypusine is required for the nuclear-to-cytoplasmic transport of iNOS mRNA and that this transport process involves interactions between hypusinated eIF5A, iNOS mRNA, and the export protein exportin1/CRM1. Mice treated with an inhibitor of hypusination displayed resistance to streptozotocin diabetes and a showed a block in iNOS production in islets. These studies identify the hypusine modification of eIF5A as a new target for preserving islet function in inflammatory states. These data detail, for the first time, a definitive in vivo mechanism for the ancient eIF5A protein and its unique post-translational modification suggesting applications for hypusine manipulation in other inflammatory states.

## **T cell-deficiency results in skewed pro-inflammatory meningeal immunity: Implications for Learning and Memory**

*Noel Derecki - Neuroscience*

Recent work has given empirical support to the contention that the immune system may be exerting a beneficial influence in the CNS and may play key roles in the general maintenance of healthy CNS function. In particular, our lab has demonstrated that the manipulation of the adaptive immune system yields significant changes in assays of learning and memory. For example, the performance of chronically immunodeficient (SCID) mice in the Morris water maze (MWM) task was shown to be inferior to that of genetically-matched WT mice. Interestingly, acute depletion of the adaptive immune system in adult WT mice resulted in cognitive decline analogous to that of SCID mice. Moreover, injection of exogenous T cells from WT mice into these chronically or acutely immunodeficient mice improved their performance in the MWM.

While the phenomenology demonstrating the connection between immune status and cognition is clear, the molecular mechanisms are not. However, a picture is beginning to emerge: we posit that key interactions occur in the meninges, involving populations of activated T cells and mononuclear cells, respectively. Here we show that meningeal T cells regulate the phenotype of meningeal myeloid cells. The chronic or acute depletion of T cells in the meninges leads to a pro-inflammatory skewing of the CNS immune milieu, which, in turn, affects production of thrombospondin (TSP) 1, an astrocyte-derived factor that is known to support synaptogenesis. We demonstrate both in vitro and in vivo that the pro-inflammatory cytokine tumor necrosis factor (TNF) -alpha inhibits expression of TSP1 in astrocytes, and leads to significantly reduced synaptogenesis. Furthermore, we show that the phenotype of impaired learning seen in SCID and irradiated mice is recapitulated in both TSP1-knockout mice and WT mice treated with FTY720, a compound that induces acute lymphopenia in the periphery.

## **Role of chemosensitive RTN neurons in mediating respiratory activation after the hypothalamic disinhibition**

*Michael Fortuna – Pharmacology/Molecular Medicine*

The hypothalamus is a complex brain region that is involved in regulation of numerous homeostatic processes, including body temperature, blood pressure and the sleep-wake cycle to name a few. The dorsomedial hypothalamus (DMH) and the perifornical area (PeF) lie within classically defined “hypothalamic defense area” that mediates defence-related behaviour and autonomic changes. Stimulation of neurons within this region produces an increase of respiratory activity, tachycardia and a marked pressor response. The descending neuronal pathway controlling the respiratory arm of this complex response is not characterized. The main neuronal network controlling respiratory motor output is located in the lower brainstem. Intrinsically pH sensitive retrotrapezoid nucleus (RTN) neurons are proposed to produce excitatory drive to the respiratory network (Central Pattern Generator or CPG). We sought to determine if stimulation of DMH/PeF area would result in an increased activity of chemosensitive RTN neurons, and to determine if this response is dependent on the CPG. RTN unit activity was monitored in adult, isoflurane-anesthetized rats *in vivo*. Here we report that pharmacological stimulation of DMH/PeF with the selective GABAA antagonist, gabazine, produced an increase in phrenic nerve activity (PNA) as previously reported. The stimulation was also accompanied by a marked increase of RTN unit activity. This effect was independent of the CO<sub>2</sub> level and respiratory modulation of the RTN cells in general was not affected. Moreover after silencing the CPG with morphine, the hypothalamic stimulation was still able to increase RTN activity, even before the respiratory network was reactivated. We also report that morphine exerted variable, however generally depressant effect on the RTN neurons. In addition hypothalamic stimulation resulted in marked increase of Fos expression in the RTN neurons, which was not observed in control conditions. Based on those results we propose that the descending pathway from DMH/PeF that activates respiration might be at least in part mediated through RTN chemosensitive neurons. In conclusion, this is a first study to show that apart from having properties of a “chemosensory integration center” RTN might also play an important role in mediating respiratory related information from higher brain structures.

## **Monthly versus Daily Antimicrobial Cycling: A Four Year Sequential Study**

*Tjasa Hranjec - Surgery*

**Background:** Cyclic use of antimicrobial agents has been proposed as a strategy for reducing microbial resistance to antibiotics, though results in the past have been mixed. We had previously used a daily cycling scheme to determine the empiric choice of antimicrobials with unimpressive benefits. Monthly cycles have been proposed as the ideal periodicity to optimize the benefits of class withdrawal yet minimize monotonous antimicrobial pressure. We hypothesized that the monthly cycling of empiric agents would result in less antimicrobial resistance than the heterogeneity gained through daily cycling.

**Methods:** The study occurred in a 16-bed surgical trauma intensive care unit. From 12/01/03 to 11/30/05 the day of the month determined the class of empiric antibiotic agent chosen for suspected infection, rotating through cefepime, ciprofloxacin, piperacillin-tazobactam, and meropenem for Gram negative infections and linezolid and vancomycin for Gram positive infections. Between 12/01/05 and 11/30/07, the same agents were cycled on a monthly basis. Using chi-square testing, rates for ICU-acquired infection, pathogen resistance and in-hospital mortality were compared between the two periods. Resistant Gram negative pathogens were those resistant to any of the four classes used for empiric therapy and resistant Gram positive bacteria included methicillin-resistant *Staphylococcus aureus* and vancomycin-resistant enterococci.

**Results:** 2636 general surgery and trauma patients were admitted to the ICU during the 4-year study period: 1262 patients during daily antibiotic cycling and 1374 patients during the monthly cycling regimen. Overall, the rate of ICU-acquired infection was lower during monthly cycling as compared to daily cycling (29/100 admissions vs. 40.5/100 admissions, p-value <0.0001). Additionally, there was a decrease in rates of bloodstream infection (6.8/100 admissions vs. 4.7/100 admissions, p = 0.0012) and pneumonia (15.0/100 admissions vs. 10.8/100 admissions, p = 0.0012). Monthly cycling was associated with a lower in-hospital mortality following all ICU-acquired infections (10.6/100 admissions vs. 6.3/100 admissions, p < 0.0001) and following pneumonia (3.57/100 admissions vs. 1.67/100 admissions, p-value=0.0022). No change was seen in the rates of infection with resistant pathogens.

**Conclusion:** Switching from a daily to a monthly cycling regimen resulted in significant decreases in the rates of all ICU-acquired infections, pneumonia, bloodstream infection, and infection-associated in-hospital mortality. Surprisingly, under these conditions, bacterial resistance was not affected with differential antibiotic cycling. These results corroborate recent in vitro data demonstrating significant effects of antimicrobial exposure on the expression of key pathogenicity factors of bacteria, and that these factors may be critical in the pathogenesis of infection independent of antimicrobial resistance.

## **Prior antibiotic therapy and risk of subsequent *C. difficile* infection in surgical patients: what are the roles of metronidazole and fluoroquinolones?**

*Rosemarie Metzger - Surgery*

Background: The United States has experienced a recent rise in the incidence of *C. difficile*-associated diarrhea (CDAD). Much of this rise is thought to be attributable to a new, more virulent strain of *C. difficile*. Both surgery and advanced age are risk factors for hospital-associated CDAD, making the problem especially pertinent to surgeons. Of equal importance, the Centers for Medicare and Medicaid Services has added CDAD to the list of healthcare-associated conditions for which Medicare will no longer pay at a higher weighted Medicare severity diagnosis-related group (MS-DRG). Accordingly, strategies for prevention are of paramount importance.

Currently, evidence-based methods for prevention of CDAD include barrier precautions, hand hygiene, environmental interventions using 10% sodium hypochlorite solution, and choosing antibiotic therapy for incident infections that minimizes the likelihood of developing CDAD. The role of preventive antibiotics is less well published, although often practiced clinically. Indeed, previously described as *O*early preventative therapy<sup>O</sup>, use of a CDAD therapeutic agent (metronidazole or vancomycin) during treatment of other infections to prevent the development of symptomatic CDAD has been employed clinically despite the absence of guidelines or documented evidence for this approach. To this end, further evidence is needed to determine the utility of this practice. It can be hypothesized that metronidazole, when used to treat infections with a potential anaerobic component, may have preventive effects against subsequent CDAD. Likewise, given the recent association of fluoroquinolone use and outbreaks of CDAD, avoidance of fluoroquinolones could be viewed as a preventative measure. The purpose of this research was therefore to explore the relationship between prior antibiotic use with metronidazole and fluoroquinolones and the risk of subsequent CDAD in surgical patients. We hypothesized that patients previously treated with metronidazole for infections likely to have an anaerobic component, or those not treated with fluoroquinolones, would be less likely to develop a *C. difficile* infection.

Methods: An 11-year dataset of consecutive infections treated in surgical patients at a single hospital was reviewed. All infections where treatment with metronidazole would have potentially been appropriate (intra-abdominal, surgical site, or skin/skin structure) were identified. Each was evaluated for antibiotic coverage and subsequent CDAD. Antibiotic usage was assessed using Chi-square analysis. Multiple logistic regression was used to determine whether preceding metronidazole or fluoroquinolone use were independently associated with CDAD.

Results: 4,178 intra-abdominal, surgical site, or skin/skin structure infections were identified. 98 of these infections were followed by CDAD. Metronidazole use preceded CDAD in 20 (20.4%) cases. Fluoroquinolone use preceded CDAD in 33 (33.7%) cases. Of the remaining 4,080 infections not followed by CDAD, 949 (23.3%) were treated with metronidazole and 1,506 (36.9%) were treated with a fluoroquinolone. In other words, 2.1% of infections treated with metronidazole went on to develop CDAD whereas 2.4% of infections not treated with metronidazole went on to develop CDAD ( $p = 0.51$ ). For fluoroquinolones, 2.1% treated with and 2.5% treated without went on to develop CDAD ( $p = 0.51$ ). Only age and APACHE II score were independently associated with CDAD by multiple logistic regression.

Conclusions: Use of metronidazole in surgical patients with intra-abdominal, surgical site, or skin/skin structure infections is appropriate for anaerobic coverage, but is not effective for *C. difficile* prevention. Additionally, fluoroquinolone use may not be associated with an increased incidence of CDAD in some subgroups of surgical patients.

## **Clustering of Syntaxin-1A in Model Membranes is Modulated by Phosphatidylinositol-4,5-bisphosphate and Cholesterol**

*David Murray - Molecular Physiology & Biological Physics*

The plasma membrane of eukaryotic cells is the site at which the majority of communications between one cell and another begin. The minimal machinery which orchestrates the fusion of vesicles with the plasma membranes is the highly-conserved, complementary set of proteins known commonly as SNAREs. In the case of synaptic vesicle fusion at the presynaptic membrane of neurons, three proteins make up the fundamental machinery for SNARE-mediated membrane fusion. Two of these are single-span integral membrane proteins, syntaxin-1A and synaptobrevin 2, which are located in the plasma membrane and vesicle membrane respectively. These proteins each contain a highly-conserved, helical cytoplasmic heptad repeat called the SNARE motif. The third SNARE protein in regulated exocytosis, SNAP25, is not an integral membrane protein, but is indeed associated with the plasma membrane of the cells via two palmitate linkers. SNAP25 contains two SNARE motifs. Together, these three proteins each contribute their SNARE motifs in a parallel fashion to form a tightly bound four-helix bundle responsible for the completion of fusion.

Fundamental questions as to the molecular mechanism of membrane fusion remain unresolved. In particular, the oligomeric state of syntaxin and synaptobrevin before and during a fusion event are not known. How many syntaxin are present at a fusion site? How does the membrane itself influence the oligomerization of syntaxin and SNARE-mediated membrane fusion? What role do specialized membrane lipids or cholesterol play?

Here, we show that the presence of cholesterol in an uncharged vesicle membrane results in a clustering of syntaxin. Comparison of liposomes with increasing amounts of cholesterol reveals that the ability to further cluster syntaxin becomes saturated at about 33 mol %, in line with the model that cholesterol forms transient 2:1 complexes with phospholipids. The clustering of syntaxin may be reversed by as little as 1% of the regulatory lipid PI-4,5-P2. We show that the interaction responsible for the dispersion of syntaxin by PI-4,5-P2 is specific and electrostatic, presumably mediated by the highly positive charge of the juxtamembrane domain of syntaxin. Only in the presence of cholesterol-mediated clustering do PI-4,5P2 and other acidic lipids show strong dispersive effects in our assays. Finally, we sought to determine whether PI-4,5-P2 forms its own clusters in our model membrane system, and show through lipid-lipid fluorescence self-quenching experiments that cholesterol does not have a clustering effect on PI-4,5-P2.

## **Active Sensing and Temporal Pattern Selectivity in Midbrain Electrosensory Neurons**

*Scott Pluta - Biology*

A basic function of the central nervous system is the extraction of sensory information pertinent to daily life. Among the animal kingdom, sensory acquisition most often occurs passively, through signals originating from external energy sources. However, among a few groups of vertebrates, including dolphins, bats, and weakly electric fish, sensory acquisition is an active process, involving the recognition of self-generated signals. These so-called active sensory systems have evolved specialized means of perceiving the environment through their uniquely designed information channels. The Kawasaki lab researches weakly electric fish as a model system for the integration of behaviorally relevant sensory information. Weakly electric fish actively sense their environment by recognizing pulses of electricity generated by a specialized electric organ in their tail. My current project focuses on testing how certain properties of the self-generated electric field are extracted by midbrain neurons of weakly electric fish *Brienomyrus niger*. This process of electric signal generation and reception is called active electrolocation.

Properties of the self-generated electric field are first encoded by cutaneous sensory organs called tuberous electroreceptors that are distributed throughout the body surface. The presence of a nearby object whose conductivity is different from the surrounding water causes a distortion in the electric field. Two resulting patterns of stimulation generally occur. 1. Objects more conductive than the surrounding water create a localized increase in transdermal electric field amplitude. 2. Conversely, non-conductive objects create a localized decrease in transdermal electric field amplitude. In the hindbrain lobe, there are two notable types of neurons involved in active electrolocation. There are (1) E-unit neurons that increase their firing rate to local amplitude increases in the center of their receptive field, and (2) I-unit neurons that increase their firing rate to amplitude decreases in the center of their receptive field. These two types of neurons in the hindbrain converge onto neurons in the midbrain.

In my current project, I am recording the intracellular membrane potential of midbrain tuberous neurons while the fish actively electrolocates fictive conducting and non-conducting objects. During the experiment, the fish is freely regulating the pulse rate of its electric field. In *Brienomyrus niger*, electric organ pulse rate can vary greatly, often displaying bouts of stereotyped temporal patterns that are considerably different from its “resting” state. By testing the interaction of excitation and inhibition in midbrain neurons, my research has uncovered basic properties of electrolocation as well as insight into the cellular mechanisms of temporal pattern selectivity, as dictated by the animal’s own sensing strategy.