

THE COLLEGE OF NEW JERSEY



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Preface

By virtue of its mission as a highly competitive institution, The College of New Jersey “prepares students to excel in their chosen fields and to create, preserve and transmit knowledge, arts and wisdom.” This third volume of *The College of New Jersey Journal of Student Scholarship* testifies to what talented and hard-working undergraduate students can achieve when challenged vigorously in the context of a supportive learning community.

The articles included in this volume are the result of students and faculty working together collaboratively. Although students participate in many kinds of learning activities during their course of study at TCNJ, this kind of collaborative work exemplifies learning at its best. No other kind of learning is as intensive or transforming, which is why student-faculty collaborative scholarship is the hallmark of graduate education in most disciplines. The nature of original research fosters student initiative, independent thought, analytical problem solving, and an ability to pose meaningful questions in light of a larger thesis. Incorporating problem-solving and discovery into the learning process increases the level of challenge and interest. For example, although science students routinely participate in laboratory experiences as part of their major, these prescribed activities differ fundamentally from a research experience that is original and open-ended. Experience shows that working on a significant project of one’s own choosing enhances understanding, increases confidence, and generates enthusiasm that can last a lifetime.

Faculty at TCNJ believe in “the transformative power of education.” Consistent with this belief is their commitment to the high ideal of professor as teacher-scholar. As teachers, the faculty are also still learners, for one cannot impart a passion for learning if one is not still passionate about learning.

As a learning community, we take great pride in our individual scholars—faculty and students alike. The papers presented in this volume celebrate this shared endeavor.

Stephen R. Briggs
Provost and Vice President for Academic Affairs

A Message from the Editor

The work contained in this volume exemplifies the spirit of intellectual collaboration among students and professors that distinguishes the pursuit and creation of knowledge at The College of New Jersey. Moreover, the essays in this volume proudly embody the mission of The College to cultivate the potential of each individual member to produce work of extraordinary merit for the enrichment and benefit of the community, state, nation, and world in which we live.

I wish to thank the many people who have contributed to Volume III of *The College of New Jersey Journal of Student Scholarship* beginning with the students (and the professors who encouraged them), whose overwhelming response to the call for papers made the editor's final selections for publication both a joy and a challenge. I would also like to extend my gratitude to those faculty members who generously served as advisers and sponsors for each paper submitted. The administration of President R. Barbara Gitenstein and Provost Stephen R. Briggs graciously provided moral and financial support and release time, without which this volume would not have been possible. The staff of the Office of Academic Affairs, including Robert Cobb, Monica Frascella, and Nancy Freudenthal, has been kind, patient, and helpful with a variety of concerns and inquiries. My dealings with Vice President Jesse Rosenblum and Anthony Marchetti of the Office of College Relations and Lisa Angeloni, Director of the Office of Admissions, have also been a pleasure. I offer special thanks to the members of the editorial board of the *Journal* for lending their time and expertise to the reviewing of papers in the midst of many other responsibilities. Barbara Boyle, formerly of the Department of English, now of the Office of Records and Registration, kindly and expertly created and updated the Web site of the *Journal*. To my editorial predecessors, Professor MaryAnn Baenninger and Professor William DeMeritt, I owe thanks for helping to make the transition from one editorial regime to another smooth and uneventful. Finally, I would like to thank Associate Editor Romulo Ochoa for his wise and generous advice and assistance throughout this enterprise. As these acknowledgements indicate, this volume has been the product of a community effort.

For information about the *Journal*, including submission procedures, format requirements, and application forms, please telephone the editor at 609/771-2155 or contact him by e-mail at dventura@tcnj.edu; or, visit the *Journal* Web site at: <http://sjournal.intrasun.tcnj.edu>.

Now, I invite you to turn to the essays contained in this volume, and to read and enjoy them.

Professor David Ventura
Editor

Contents

VOLUME III

	PAGE
William Connolly	
Stealing the Microphone: Du Bois, Rap, and the Black Aesthetic	3
Brian Alspach	
Reflection and Recreation: Some Thoughts Concerning the Fundamental Metaphysical Opposition Between the Critical Theories of Samuel Johnson and Samuel Taylor Coleridge	14
Matthew Sorrento	
The "Arson" of Emotion: Psychological Self-Violence in Bernard Cooper's <i>Truth Serum</i> ...	17
Melissa Mink and Jennifer Puma	
Nationwide Newspaper Coverage of the Repatriation of Elián González: A Community Structure Approach	23
Neil Albert	
Why Argue with Albert Einstein about Mathematical Reasoning? An Investigation of the Role of Spatial Abilities in Mathematical Reasoning	35
Helma G.E. de Vries	
Bar Duration as a Measure of Memory Organization: Exploring Skilled Memory in a Concert Pianist	46
Richard Brodsky	
Salt-Induced Conformational Changes of DNA and the Chiral Selectivity to Polymers ..	57
Gregory V. Cesarone	
Model Membrane Rod Photoreceptor Fusion Demonstrated by ANTS/DPX Contents Mixing Assays with Peripherin/rds Peptides	62
Jacqueline Perry	
Cervical Vertebra Dredged from the Inner Continental Shelf off Central New Jersey ..	67
Neil Aaronson	
An Explicit Solution to the Problem of the Relativistically Moving Gravitational Lens. ...	71
Karl Strohmaier	
Distances in a Universe Dominated by Vacuum	74
Conference Proceedings—Abstracts of Student-Authored Papers Presented at Refereed Conferences and Bibliographic Citations of Published Work.	78

Stealing the Microphone: Du Bois, Rap, and The Black Aesthetic

William Connolly
The College of New Jersey

Faculty Sponsor:
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In the early 1970s, rap music emerged from the South Bronx of New York City as one part of hip-hop, an African-American youth culture consisting of break dancing, graffiti, and rap. At that time, cities across the nation were losing federal funding for social services, service corporations were beginning to replace industrial factories, and corporate developers were buying up real estate and converting it into luxury housing. The result left working class citizens with diminishing social services, a shrinking job market, and limited housing opportunities.¹ These postindustrial conditions were felt particularly in the South Bronx. Urban renewal projects brought bulldozers into neighborhoods and forced people to relocate; perhaps the most vivid example of this was Robert Moses' Title I Slum Clearance program that forced the relocation of some 170,000 people.²

The transformations in the economic topography of the city put a premium on access to public space and resources. Urban residents not only had to find alternative dwelling spaces, they also had to find new places to socialize. The urban youth responded by searching out and utilizing social space in the city's parks and streets in a much more remarkable, and urgent, style.³ Here, in the parks and streets of the South Bronx, hip-hop culture was born.

Hip-hop used the postindustrial experience to manufacture art and a discursive cultural medium. It was the extension of a sound system culture imported from the Caribbean and pioneered by disc jockeys (DJs)

that cut and mixed records and sounds from their immediate urban environment. The DJ was in charge of taking elements of tonality and rhythm and focusing them into a collage of auditory stimuli that could be danced to or, at least, marveled at. Eventually, as the hip-hop culture flourished and expanded from block parties and school dances, masters of ceremonies (MCs) began to gain attention. The lyrical layers of rhymes and boasts that MCs traditionally used to hype the crowd for the DJ became new focal points for the culture; rap was born when MCs used the microphone to steal the spotlight from the DJ.

Rappers add their voices to the excess of urban life by fusing a personal narrative with music constructed from postindustrial technology. Rap, according to Henry Allen, "humanizes technology and makes it tactile. In hip-hop, you make the technology do stuff that it isn't supposed to do, get music out of something that's not supposed to give you music quite that way."⁴ By harnessing the very technology that ushered in the postindustrial experience, rap musicians embrace and transform the technology into a vehicle for expression rather than a vehicle that oppresses. The suggestion here is that marginality is more than a site of deprivation; it is a "site of radical possibility, a space of resistance."⁵

Rap is, both literally and figuratively, the loudest voice in hip-hop. It produces cohesion in hip-hop by linking the varying art forms of the culture through a soundtrack built from the streets. It takes various experiences

from the contemporary urban environment and liquefies them into a narrative flow that transcends the urban black experience and distills it for consumption by individuals both inside and outside the community. Rap is not an exclusive narrative; the popularity of rap amongst white, suburban listeners suggests that the themes of alienation in the music are generational as well as racial.⁶ Nevertheless, this does not distinguish rap from previous black oral and music traditions. As Tricia Rose has remarked, "black culture in the United States has always had elements that have been at least bifocal—speaking to both a black audience and a larger predominantly white context."⁷

The evolution of hip-hop and rap created a black cultural form that elucidates the black, urban, postindustrial experience. Instead of relying on abstraction to explain a complex socioeconomic environment, rappers use a variety of personal narratives to connect the effects of crime, violence, and racism in their own experiences. While "the use of first person narratives is rooted in a long tradition of black aesthetic practices, the use of 'I' to signify both the personal and communal allows rappers to isolate experiences and suggest that they can be overcome."⁸

The personal narratives of rappers often provide stark images that reflect their understanding of African-American life. Frequently, the image provided by the rapper is not a positive one. Rappers often choose words, phrases, and subjects that shock as much as they testify. Rap has, in a curious way, become a commodified means of expressing the black experience in language—sometimes violent, sexist, and self-destructive—that highlights negative portrayals of the black community. In so doing, rap is often criticized for reinforcing the very notions of oppression that rappers hope to subvert.

Critics often present polarized opinions on the merit of rap. It is either highlighted for its ability to provide testimony or decried for its equal penchant to be vulgar. Indeed, rap is often characterized as being a positive

or negative force in black culture; rarely is it analyzed for its elements of both. What must be realized is that rap, like all popular culture, provides opportunities to escape the parochialisms and prejudices of the personal world, while at the same time it undeniably extrudes the elements of life that plague us, as a society and individuals, the most.⁹

While the music may purport to critique reality, it also is destined to reflect the very failures and contradictions of that reality.

The personal narratives dominant in the music provide glimpses into the experience of life on the frayed edges of America. Although the music may not align itself completely with the aesthetic criteria espoused by black intellectuals such as W.E.B. Du Bois, Addison Gayle Jr., and Hoyt Fuller, rap carries on an important tradition by providing voices of hope and truth to individuals that are usually ignored by mainstream society. Rap's power is derived from its ability to encourage listeners to confront a legacy of racism, sexism, and violence that has all too often plagued the African-American community. It looks not to black bourgeois culture for redemption, but, instead, searches for an alternate forum. Rap's focus on an unconventional channel of communication, through musicality and verbal dexterity, attempts to locate a new outlet for expressing pain and searching for answers.

For these reasons, I would propose that rap music does not align itself with sentiments shared by many black intellectuals and those expressed in the Black Aesthetic. However, rap champions the ethos of a black aesthetic tradition that strives to portray truthfully the contemporary black experience, no matter how messy the images may be.

Du Bois and Negro Art

In his essay, "Criteria of Negro Art," W.E.B. Du Bois put forth an urgent call to action for the production of black art as an uplifting force in American society. In many ways, this anticipated the Black Aesthetic movement that was championed during the Black Nationalist and cultural revolutions of the

1960s and 1970s. In the essay, Du Bois asserted that "all art is propaganda and ever must be, despite the wailing of the purists."¹⁰ Art, according to Du Bois, could not and should not be divorced from politics.

Du Bois did not accept the premise that art existed for art's sake, a belief of many black intellectuals of the 1920s. He stated, "I do not care a damn for any art that is not used for propaganda. But I do care when propaganda is confined to one side while the other is stripped and silent."¹¹ He looked toward black artistic production as a point of leverage for the future. A consistent ethic needed to be developed and embraced that would establish positive notions of black art that would raise the estimation of blacks in the minds of everyone, including whites and racists.

Du Bois stressed that black art had to express ideals that framed blacks as positive agents in society. It had to state the positivity of "we": there was no notion of "I" in his art. Individual expressions were directly extrapolated into messages and testaments of the community. He believed blacks had unlimited creative potential as individuals, but this potential was expected to express a communal notion of truth, goodness, freedom, and beauty.¹²

Du Bois' writing was in accord with modernity. His proposition of a "race uplift theory of social change" expressed a sense of confidence in progressive development.¹³ His view of history centered on the unfolding of values and ethics, not simply of patterned or even disconnected events. Du Bois questioned and many times lamented the development of Western modernity, mostly because of the recognition that white racism developed in step, yet he still expected and longed for the improvement of the black's condition in America.¹⁴

Du Bois believed that blacks were in the natural position to make expressions of beauty, growth, and longing. He believed the proper expressions of language and culture were important ways of promoting their

freedom. Carol Blackshire-Belay, in *Language and Literature in the African-American Imagination*, notes that African-American language has traditionally been directly opposed to spheres of oppression in a constant push for liberation and justice.¹⁵ Du Bois, it seems, was making an early appeal for this same objective.

Intellectuals such as Du Bois "thought of black expressive culture as a reservoir from which a quintessentially Afro-American spirit flowed...an eternally transformative impulse that converts desire not only into resonant and frequently courageous sound but also into ceaseless motion."¹⁶ If this impulse was funneled into art, the prospects for the social and economic improvement of blacks in American society would increase greatly. The walls of racism would be torn down by a proper enactment of black rhetoric and aesthetic potential.

Du Bois desired to galvanize black art into a science of improvement. While he stressed the freedom of individual artistic production, Du Bois' art explicitly had to show images of blacks contributing to and improving society. While Du Bois did not see a dearth of positive, progressive images in black culture, he did not see this being openly promoted. Most of the popular depictions of blacks showed images of the destitute Negro, the image of the Negro's "worst side" that only confirmed the popular stereotypes of black existence in the late nineteenth and early twentieth century.¹⁷

Du Bois wanted more popular depictions of lifestyles similar to his own, lifestyles of a prosperous, progressive, modern black bourgeoisie. He was concerned with the fact that too much attention was paid to lower class life by artists, as if that was the only kind of life to be found among urban blacks. As a result, Du Bois viewed this concentration as contributing to white racism, by providing ample room for stereotyping.¹⁸ While he urged artists and writers not to idealize the portraits of black life, "he often admitted bewilderment that [they]...never wrote about the decent, hard-working Negroes in their own families."¹⁹

Du Bois' essay, "Criteria of Negro Art," encompasses a great deal of his intellectual philosophy toward politics and the representation of blacks. Nevertheless, he did not clearly define or delimit his theory. Rather than explicitly describing his criteria for beauty and truth, he merely provided broad sketches of artistic worthiness that remain vague and debatable to this day.²⁰ Even with this flaw, his work framed a model of politicized black artistic development and foreshadowed the Black Aesthetic movement of the 1960s and 1970s.

The Black Aesthetic

In the 1960s, partly as a result of the Black Nationalist and Civil Rights movements, cultural studies programs exploded onto the academic scene as individuals discovered interests in power structures that underpin everyday social and cultural existence. Out of this cauldron of cultural introspection and critical inquiry came the Black Aesthetic movement. Addison Gayle Jr. and his aptly titled book, *The Black Aesthetic*, spearheaded the philosophical development.

Gayle's book promoted a sense of militancy in artistic production. This element was much more aggressive than Du Bois' call for propagandized art. Gayle writes,

*The serious black artist of today is at war with the American society as few have been throughout American history. Too often, as Richard Wright noted, the black [artists] "...entered the court of American public opinion dressed in the knee pants of servility, curtsying to show that the Negro was not inferior, that he was human, and that he had a life comparable to other people." They waged war not against the society but against the societal laws and mores that barred them from equal membership.*²¹

Gayle suggested the black artist in America had acceded to white demands too much in the past. He asserted that the creation of art must not be muted by concerns over the reception of art by white America; to do so would yield a watered-down creation, "an artistic creation filled with half-truths... works always seasoned with the proper amount of anger...and condescension."²²

At bottom, Gayle and other black intellectuals were grappling with the paradox of African-American identity. Du Bois' own comments about "double-consciousness" fed the movement—Black Aestheticians were trying to reconcile notions of the Negro and the American. Gayle suggested that the black in America was unique and should therefore use this identity to construct new models of thought, evaluation, and art. In this sense Gayle argues, "the Black Aesthetic...is a corrective—a means of helping black people out of the polluted mainstream of Americanism, and offering logical, reasoned arguments as to why he should not desire to join the ranks of a Norman Mailer or William Styron."²³

Langston Hughes supplemented Gayle's comments by criticizing the dual, conservative tensions in the black art of the past: "'Oh, be respectable, write about nice people, show how good we are,' say the Negroes. 'Be stereotyped, don't go too far, don't shatter our illusions about you, don't amuse us too seriously. We will pay you,' say the whites."²⁴ According to these interpretations, art had to liberate both the minds and souls of blacks. The production of black art was indirectly linked with morality as blacks were given a duty to use their experience to shape their expressions in ways that would challenge the past failures of America.

Other writers used the historical events of the 1960s to support these arguments. Hoyt Fuller, for example, linked the rebellious outbursts in American inner cities during the 1960s to the maturation of the black self-conscious spirit. He applauded young black men and women who were finally experiencing a "liberating shock of realization" and rediscovering a "strength which has enabled them to endure and, in spirit, to defeat the power of prolonged and calculated oppression."²⁵ The riots that erupted in places like Newark and Detroit were "the black ghetto's response to the vast distance between the nation's principles and its practices," Fuller proclaimed.²⁶

Fuller's contribution to the Black Aesthetic paralleled Gayle's. He encouraged a system

of black cultural reinforcements that would assert the sentiment "black is beautiful" and soothe the psychology of black people.²⁷ Both writers supported the development of a network of black artists deeply ingrained in Afro-centric and Afro-American cultural productions. Their efforts centered on developing the authenticity and authority of black artistic production in order to form cohesion in the black community. In doing so, much of the Black Aesthetic movement continued to embrace the tenets of modernity through its emphasis on sharpening the ideological cognizance of the black community to a fine point.

The rhetoric of the Black Aesthetic movement, however, has not gone without serious criticism. This criticism tends to take two different forms: First, the assertion of the authenticity and authority of Black Aestheticization attempts to create timeless, ahistorical notions of artistic and cultural production. Second, notably argued by Henry Louis Gates Jr., the embrace of the Black Aesthetic position has left little room for intellectual criticism of artistic forms as a result of a narrow-minded focus on race.²⁸ Both criticisms suggest that the imposition of cultural standards bound black art to either fixed notions of time or "blackness," thus stunting its ability to relate notions of truth, goodness, and beauty. Art, these remarks suggest, needs to be liberated, not labeled and politicized, in order to actualize.

A final criticism that often is not adequately addressed concerns the issue of gender. Commonly, critics note that the Black Aesthetic was promoted mainly by men and generally called for positive, masculine images of black artistic production. Although the Black Aesthetic movement was not completely male, as the example of Gwendolyn Brooks indicates, it was still a philosophical approach firmly grounded in patriarchy. Virtually all of the major black writers of the late nineteenth and early twentieth century, including Du Bois, were supportive of patriarchy and spoke of healing the wounds

of white supremacy through the assertion of the black male.²⁹

Yet, this analysis does not deny a female voice in the Black Aesthetic tradition, even during Du Bois' musings in the 1920s. In fact, women played a prominent role in the Black Aesthetic tradition by inspiring leaders such as Du Bois, Fuller, and Gayle. During Du Bois' time with *The Crisis* and the NAACP, for example, women were often the driving forces in establishing a black cultural dialogue that could garner political significance.³⁰ Thus, when considering the Black Aesthetic, one should not focus on the exclusion of female voices, but rather how these voices are distorted, muted, or attacked by patriarchal assumptions.

In many senses, the Black Aesthetic movement helped to elaborate the type of ideas first related by Du Bois. It reasserted traditional notions of modernity by de-emphasizing fracture in the black community. The Black Aestheticians, much like Du Bois, did not attempt to recollect the voices from the margins of America or the working class, for fear of bringing negative images to light.³¹ There was still a rigid divide between high and low culture. In the years following the movement, however, the decentralized voices of postindustrial America would grab the microphone of cultural production and demand to be heard.

Stealing the Microphone

As emphasized above, rap places the voice of the community in the hands of a single orator. The individual literally grabs the microphone to tell his or her story of joy, frustration, or marginalization. Listeners are implored to take into account how life appears to this individual through a sort of street ethnography of racist practices and experiences.³²

The orator relies on structures of communication that emphasize postmodern aesthetics. Tricia Rose identifies three key attributes of the music—flow, rupture, and layering—that place hip-hop well within the postmodern context.³³ The high levels of repetition,

reflexivity, and intertextuality in the rapper's narrative are merged with a soundtrack of postindustrial decay consisting of snippets of street noise, disembodied samples, and dense, processed rhythmic sections. The music's interplay of voice and technology, coupled with a scrapbook technique of borrowing and reassembly, suggests a fragmentation of musicality and communal identity that evokes Fredric Jameson's description of late capitalism and the postmodern.³⁴

It is important to note that some commentators have highlighted rap's modern tendencies of engendering communal meaning and support.³⁵ Yet, these critiques underestimate the functions of cut and mix, pastiche, importation and recycle, and the exploitation of postindustrial decay that have dominated the form since its inception. Although these elements might contribute to modern testaments of meaning, holism, and progress for the community, they are grounded in notions of postmodern aesthetics that encourage a reinscription of the existing modern environment and/or the establishment of a new, decentralized mode of communication. Simply because individuals have used rap to create identity and a sense of community does not mean they are reverting to modern aesthetic practices. Rap's success as a cultural form is based on its appropriation of postmodern techniques, not by reconfiguring modern identity.

Also, rap music explicitly promotes a counterdominant narrative through its assertion of marginalized voices. In rap, the experience of the individual is more important than the supposed reality of any macro-scale social grouping. Rap has grown because the individual voices of the street have not been silenced. Even with the advent of gangsta rap from Los Angeles in the late 1980s, Ice T tells us that,

*what you heard initially was my voice yelling about South Central. People thought, "That shit's crazy," and ignored it. Then NWA came and yelled, Ice Cube yelled about it. People said, "Oh that's just kids making a buck." They didn't realize how many niggas with attitude there are out on the street. Now you see them.*³⁶

By increasing the visibility of the marginalized participants in society, rap indirectly focuses attention on the experiences, struggles, and oppression of urban life. This preoccupation with oppression is by no means unique to hip-hop. It is quite common to hear songs, poems, and various expressions of oppression in black culture. The narrative in hip-hop attempts to address how the *individual* is crushed by socioeconomic pressures. Rather than focusing on the community as a whole, this tactic suggests the strength of the community can never be addressed until individuals have their own voices heard.

Some contend the multiple voices and experiences make rap seem too pluralistic or, even, egotistic.³⁷ Yet, that is the greatest source of the music's strength. Chuck D. has remarked that this pluralism has kept hip-hop's message in a constant state of evolution: "One thing that's helped us [stay original] is that we study different regions in rap. Rap has different feels and different vibes in different parts of the country."³⁸ Dialect is applauded here; the universality of an overarching Black Aesthetic would actually stunt its ability to relay its message. Similarly, Ice Cube observes that individualism is actually a cohesive force in rap: "two rappers are alike in that we all have different ways of getting our points of view across, different ways of helping young people get it together. But we're all together in soul."³⁹

Interestingly, the gaps in cohesion created by multi-voiced narratives are often filled by its instrumental and rhythmic components. The essence of the beat, the lyrical flow, and the technological tonality keep diverging expressions linked at the hip. Rhythm conveys the notion of communal balance. The experiential narrative is often best transmitted not via the direct language of the song, but through its relation of rhythm.⁴⁰ Rhythm, through its ability to recreate time and experience, can be used to negotiate the varied narratives of hip-hop.

In stealing the microphone for the marginal representatives of America, rap inverts

the traditional structure of public discourse. Rap and hip-hop not only steal the voice of black America from the intellectuals and members of the black middle class, they amplify the voices of the decentralized participants in postindustrial America. Here is where rap often turns ugly; many times the microphone spews the very unpleasant truths that Black Aestheticians want to keep out of the arena of black artistic expression.

Spewing the Trash?

Hip-hop attempts to put the individual's stamp on lived experience, even when society says one cannot. Tricia Rose has noted how two of the main features of hip-hop, graffiti and rap, "asserted the right to write—to inscribe one's identity on an environment that seemed Teflon-resistant to its young people of color; an environment that made legitimate avenues for material and social participation inaccessible."⁴¹ The narrative of rap often attempts to portray real life on the street through the testimony of a witness to systems of oppression.

In attempting to do so, the rapper often relays a nightmarish version of reality—violent imagery, harsh, often brutal language, and misogyny often emanate from even the most mainstream records. At best, rap provides an illustration of the collapse of urban social networks and a glimpse of a more just order. However, as Ernest Allen Jr. has commented, "all too frequently these youthful assertions of social identity and envisioned social order degenerate into a malevolent disparaging of other groups, based upon differences rooted in gender, ethnicity, or sexual preference."⁴²

This is perhaps the deepest concern critics and fans have about rap's position in contemporary American society. So often, when speaking from the margins of society, rappers attempt to subvert other populations in order to rid themselves of marginal positioning. Reverting to binary oppositions divides communities and turns relations from "different from" into "better than." Perhaps most importantly, they provide a surrogate sense

of domination over others as a cure for their own pain or marginalization.⁴³ Many rappers distort their own social commentary by relegating it to forms of neighbor-bashing. This element is, in turn, often recycled into dominant narratives about black youth. Instead of rap helping to become a liberating voice in postindustrial America, it often reinforces many of the negative stereotypes of blacks as being violent, dirty, aggressive, uncouth, abusive, and threatening.

The contribution to stereotyping is what the Black Aestheticians and Du Bois were attempting to counteract with their critiques and proposals for Negro art. Rap's self-defeating nature is probably its greatest enemy, next to the racist institutions it decries. The question still remains about how to keep rap's critical narrative alive while also maintaining its stark social commentary. The commodification of misogyny and underclass representation can provide some insights into this dilemma.

Negative Commodification

It is obvious that rap is filled with misogynist imagery and language. This is not a localized reflection, but is indicative of larger social issues of patriarchy and commodity. The feminist bell hooks has stated, "rap is part of the antifeminist backlash that is the rage right now. When young black males labor in the plantations of misogyny and sexism to produce...rap...capitalist patriarchy approves the violence and materially rewards them."⁴⁴ The degradation of women in rap cannot be merely attributed to the often oppositional views on life, marriage, family, and sex between black males and females.⁴⁵ In attempting to assert strong, assertive notions of black masculinity, the black male rapper often debases women to expand his notion of communal power.

It should be recognized that rap is not a masculine cultural production, exclusively. Houston Baker's claim that "rap's emergence was a resentment of disco culture and reassertion of black manhood" renders the female presence in hip-hop invisible and/or

impossible.⁴⁶ There is, indeed, a strong female voice in rap that attempts to counterbalance the often sexist and misogynist lyrics that skew hip-hop culture in negative directions. By working with and challenging misogynist claims, female rap often works as a counterbalance and directly translates into feminist rap. In addition, public displays of physical and sexual freedom by female rappers intrinsically challenge patriarchal views about feminine display.⁴⁷

Still, female rappers are a minority in rap. Although they may lack a dominant presence in terms of numbers, they provide a very important voice in the expression of rap's cultural message. Female rappers directly undercut attempts at commodifying black misogyny. By enforcing a feminist dialogue through an assertive stage presence, they bracket misogyny as a harmful force in hip-hop culture. Female rappers contribute to the resistive elements of hip-hop culture by challenging the sexism of male rappers while still maintaining dialogue with them.⁴⁸ Consequently, they turn a critical eye toward detrimental practices that are not exclusive to the hip-hop world, but the larger society.

Today, rap is no longer characterized as a local Bronx subculture, but rather a multi-billion-dollar industry that is heard around the world. Its popularity has not only celebrated the inhabitants of the margins of American society, the black urban underclass, but it has actually brought it into a prominent position in cultural dialogue.⁴⁹ It has helped highlight the need for a critical re-evaluation of the conditions of poverty and urban life, but has also risked stereotyping blacks as prisoners of such conditions. Paradoxically, rap has brought us back to the very aesthetic concerns Du Bois expressed in "Criteria of Negro Art."

Specifically, the advent of MTV in the 1980s helped expand rap's acceptance in America and the world by increasing "the presence and intensification of black bodies across the global popular culture landscape."⁵⁰ The constant recycle of rap videos on MTV

has visualized, commodified, and glorified elements of underclass "reality" that threaten to render the black population of cities as stereotypical figures of violence and depravity. Bakari Kitwana summarizes this argument:

Although some advance it as a musical art form whose artistic, political, and social implications have yet to be thoroughly critiqued or completely understood, rap music's firmly entrenched dual role as a corporate business and cultural artform demands that artists primarily project stereotypes of young Black men as reality. Within the music industry the belief persists that images of Black men as gun-toters, drug users, drug sellers, irresponsible fathers, and violent misogynists are not only authentic representations of Black men, but Black men at their best.⁵¹

By commodifying black marginality, rap becomes a tool of continued oppression, instead of liberation. Assuredly, much of the content of rap is subject to negative appropriation. Talking about oppression, violence, and various other "real" experiences of the urban environment has created a commodified version of rap that reeks of negativity and stereotyping. Also, individuals, both black and white, have capitalized on this and made large sums of money. But, if this is an inherent element in the production of hip-hop, why bother praising the more positive elements of marginal voicing and social criticism that rap also strives for? If people are going to consume rap for its inventory of bitches, hoers, guns, glocks, and drugs, then what's the point?

The answer lies in creativity, expression, and dialogue. These three elements were at the heart of the Black Aesthetic and still remain at the heart of rap. Hip-hop has given voices to individuals that were already severely oppressed; commodifying the negative voices in hip-hop might promote certain stereotypes, but it also promotes an inversion of traditional notions of power in the culture. If black marginal expression is drawn toward the center of cultural dialogue, there will inevitably be more opportunities for individuals to subvert the hierarchy and combat racism and oppression. Marketing and delivering black culture to white people is not an

inherently evil proposition. By providing access to a more centrist position in society, we are also providing new opportunities to reap rewards only available to those at the center. Black entrepreneurs, such as Russel Simmons, are given access to resources that normally would not be available to them from the margins.⁵²

Rappers, one hopes, will use the power of their medium wisely and constructively. Admittedly, this calls for a sense of confidence to be placed in blacks, a confidence in black folk that Du Bois predicted and expected. Black rappers and entrepreneurs should embrace these new circumstances and use them to forge more positive relationships both within the black community and larger society, without losing their critical tone.

Commodification does not have to be negative. After all, "if these children could create an industry where there was none, surely we can give them some hope in their future that doesn't depend on their participation in the destruction of their own communities in order to make it in the white world."⁵³ Rappers should take advantage of the new opportunities afforded by commodification; indeed, they should colonize commodified structures of our culture in ways that will accelerate the downfall of oppressive cultural institutions.

Dissonance needs to remain a stark component of rap's message. If rap does not retain a caustic, irreverent attitude toward systems of oppression, then the voices from the margins are lost in mere whining sessions of the unskilled. The freshness of rap is embodied in its unconventional display of protest. Much of rap attacks not only white racist institutions, but also bourgeois black institutions that do not address issues of social calamity well enough.⁵⁴ By promoting a form of social protest that operates outside the channels of conventional institutions, rap adds to the cultural dialogue by reminding us that "something is wrong here." Although rappers should critically evaluate the images they put forth, they should not

tone them down for the sake of the critics. The one thing they should do is recognize the power of their medium, on both themselves and the dominant culture. "Rap artists...have long understood that art is a reflection of reality. What rap artists have underestimated is that the images go both ways. Art can and does influence reality."⁵⁵

Conclusion: Fragmenting

The Black Aesthetic

Hip-hop and rap are not expressions of a unified Black Aesthetic. First, rap music does not share the tenets of modernity: rap and hip-hop are postmodern art forms that challenge the very notions of cohesion, propagandized art, and black cultural expression that were asserted by both W.E.B. Du Bois and Black Aestheticians. Rap is too decentralized to be accepted by critics looking to define and improve black cultural and social positioning in America. Second, rap reeks of negative imagery; although this negative imagery attempts to relay the truth of the racial and social marginalization of postindustrial urban life, it does so through forms, structure, and modes of expression that often threaten to confirm many of the worst stereotypes of black youth. Finally, rap and hip-hop do not promote change and social improvement through sanctioned channels. Rap attempts to subvert the very channels that are supposed to help black society by pointing out their corruption and impotence. Rap creates its own channels of expression that threaten many parties in the social structure.

Instead, rap music is an expression of postmodern black aesthetics, not of a singular Black Aesthetic. In this sense, black aesthetics are tools of expression that justify and testify to a certain part of the black experience in America. These aesthetics, I would propose, do not have to have a distinct political agenda. As long as they work for the benefit of a significant portion of the black community, then they promote the essences of multi-discourse "truths" that abound in such communities. This notion of a black aesthetic is "grounded in the idea of a post-Emancipation

and post-colonial, black identity which... thrives in black communities where artistic creativity and performance are the basic cultural currencies."⁵⁶

Black culture is much too varied and diverse to represent and boil down into a singular Black Aesthetic. Attempts at doing so might have a high moral purpose, but they disregard the realities of fragmentation in the black community. Rap and hip-hop have their roots in traditional black cultural expressions of orality, music, narrative, and criticism. However, the wide diversities of black life—differing notions of class, sexual identity, gender, and geography—should all find representation in art and expression.⁵⁷ In tune, hip-hop culture and rap music should be embraced, although not freed from criticism, and examined fully for their resonant images and voices of distinct black aesthetic practices.

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- ⁵² This argument might verge on notions of "black capitalism." While I do not intend to invoke this argument precisely, I do think that having the ability to exert control over both the production and consumption of hip-hop provides a very positive opportunity to shape dominant representations of black identity. In this sense, hip-hop as mass culture has much more potential than as a localized, "popular" culture. For relevant examples, see "Nightline's Hip-hop Series," *Nightline*, ABC Television, 6-8 September 2000.
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Reflection and Recreation: Some Thoughts Concerning the Fundamental Metaphysical Opposition Between the Critical Theories of Samuel Johnson and Samuel Taylor Coleridge

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Of those thinkers who regard esthetics as a branch of philosophy, few, if any, regard it as a primary one. Many thinkers are of the opinion that a philosopher's or literary critic's views on the subject of art will be profoundly influenced by his views on the more fundamental branches of philosophy, such as metaphysics and epistemology. It is fruitful, I think, to approach a comparison of the critical theories of Samuel Johnson and Samuel Taylor Coleridge from this perspective. In this essay, I will identify the differing views of Johnson and Coleridge on a basic metaphysical/epistemological issue: the relationship between man's consciousness and reality. I will then briefly discuss how this important difference relates to a fundamental difference in the esthetic thought of these two critics.

Questions surrounding the nature of the relationship between the mind of a human subject and the rest of reality (the objects of perception) are among the most ancient and complicated in all of philosophy. Coleridge, in the *Biographia Literaria*, frames the issue this way:

All knowledge rests on the coincidence of an object with a subject.... [f]or we can know that only which is true: and the truth is universally placed in the coincidence of the thought with the thing.... During the act of knowledge itself, the objective and subjective are so instantly united, that we cannot determine to which of the two the priority belongs. There is here no first, and no second: both are coinstantaneous and one.
(476. *Emphasis Coleridge's.*)

Coleridge understands the issue well. To rephrase the question in a number of different

ways: what is the relationship between subject and object? Which has a *metaphysical* priority? Which is first *epistemologically*? What is the nature of the *knowledge of something*? Johnson and Coleridge articulate, the former implicitly and the latter more explicitly, two archetypal answers to these questions.

Johnson's view is almost certainly the more "commonsensical" position of the two. It can be extrapolated from Johnson's praise of Shakespeare as "the poet of nature: the poet that holds up to his readers a faithful mirror of manners and of life" (321). At first, this statement may seem somewhat innocuous and devoid of deep philosophical content. Yet it is vital to appreciate the underlying view of knowledge inherent in it. Johnson maintains that as an author, Shakespeare is first an *observer of reality*. He gains knowledge of the world by observing objects independent of his consciousness. He then uses his mind to identify general principles about life and the world, which he then embodies in his work. Therefore, works of art are great and pleasing, insofar as they are "just representations of general nature" (321). On Johnson's view, knowledge—either held in the mind of a subject or embodied in a work of art—is predicated upon an *awareness of external reality*, and that truth in knowledge consists of correspondence to this external reality. Consequently in esthetics, "there is always an appeal open from criticism to nature" (323).

Coleridge articulates his views on the subject more directly, though perhaps in a sense more cryptically. In Chapter XIII of

the *Biographia Literaria*, Coleridge divides human imagination into two parts. Coleridge's "secondary imagination" corresponds roughly to the faculty that we refer to today as "*the imagination*": it is a creative faculty under conscious control that "struggles to idealize and unify" various mental contents (478). Coleridge describes the other part of the imagination, the "primary imagination," in this way:

The primary imagination I hold to be the living power and prime agent of all human perception, and as a repetition in the finite [i.e., human] mind of the eternal [i.e., divine] act of creation in the infinite I am. (478. Emphasis Coleridge's.)

It is of great significance that Coleridge characterizes the "prime agent of all human perception"—and consequently all human knowledge—as a *creative* faculty: particularly if one notes the influence of the thought of Immanuel Kant on Coleridge (Popkin, 576). Kant divided the universe into two realms: the *neumenal* world, or the world of things as they actually are, and the *phenomenal* world, or the world as experienced by a human consciousness. While Kant believed that the *neumenal* world existed, he claimed that human beings could have no knowledge of it. All human knowledge, he argued, is of the *phenomenal* world. This world is constructed by and in the mind of human beings automatically from sensory stimuli and "categories" that are built into our brains and serve to organize sensations into intelligible mental contents (Audi, 399-403).

A Kantian view of the universe, such as the one articulated by Coleridge, transforms the primary act of human consciousness from the awareness of reality to the creation of a reality. Just as God (the "infinite *I am*") is purported to have created the infinite universe, each man's consciousness creates, automatically, its own finite universe inside the mind. For Coleridge, all knowledge is of the universe as created by a human subject.

But what is the relationship between these basic principles and the broader thought of each of the critics presently under discussion?

The effects of these fundamental views of reality are best evidenced in each thinker's conception of the effects of art on man and the nature of the esthetic experience. For Johnson, "the end of writing is to instruct; the end of poetry [i.e., artistic writing] is to instruct by pleasing" (323). The esthetic experience, therefore, entails a pleasurable increase in knowledge. If literary art mirrors an external reality, as Johnson suggests, then it is reasonable to infer that such art will contain lessons of a sort about the nature of the very reality that it mirrors.

Johnson's praise of Shakespeare where others have criticized him clearly evidences this view of art. Johnson notes that Shakespeare has been criticized for intermingling tragic and comic scenes in his work where they ought, according to the ancient rules, to be kept separate. But according to Johnson:

the mingled drama may convey all the instructions of tragedy or comedy... because it includes both... and approaches nearer than either to the appearance of life, by shewing how great machinations and slender designs may promote or obviate one another, and the high and the low cooperate in the general system by unavoidable concatenation. (323)

Johnson's suggestion is an intriguing corollary of his views of knowledge. The "mingled drama" is more true-to-life than either the tragic or the comedic view. Consequently, experiencing such a drama can better educate us about our world by showing us how the forces inherent in tragedy and comedy (e.g., "the great and slender" and "the high and low")—and presumably in human life—relate to one another *in reality*. We see in Johnson's praise of Shakespeare an appeal to external reality: an appeal to the reader to observe in Shakespeare many principles that have important repercussions for human existence.

Coleridge, on the other hand, conceives of the esthetic experience differently. While the appreciation of art gives us pleasure, this pleasure, *qua* esthetic enjoyment, is "immediate" and "without intervention, therefore, of any interest, sensual or intellectual" (Coleridge, 475). The esthetic experience is,

therefore, divorced from an intellectual evaluation of the work of art. Indeed, Coleridge describes our awareness of the beauty of a work of art as an "intuition" that precedes and is independent of our rational evaluation of the work or its utilitarian value (475). In fact, it is this intuitive status that allows Coleridge to distinguish between the "beautiful" and the "good," the former term being applicable to esthetic judgements, the latter to rational evaluations (475).

Note the similarities between Coleridge's view of the esthetic appearance and his views on the nature of the human mind and "primary imagination." The primary imagination is a faculty, independent of our will or conscious judgement, that shapes, for each one of us, our reality. Similarly, our enjoyment of a work of art is not dependent upon our will and results from some sort of unconscious and pre-rational evaluation.

Throughout his writings, Coleridge persistently ascribes value to the pre-rational over the rational. The pre-rational "beautiful" is considered preferable to the rationally evaluative "good." The imaginative faculties are preferred over the "fancy" (478). A philosophical understanding of Coleridge's basic views helps to shed light on this preference. We have seen that the pre-rational primary imagination (and by extension, the secondary imagination) is a creative faculty that operates in a manner similar to that of the divine creative faculty of God (478). The imagination strives to "idealize and to unify": to deal with the universal and approach the divine, unlike the fancy, which deals with "fixities and definites" (478). It is reasonable to infer that Coleridge regards the faculty of esthetic appreciation as approaching the divine as well, insofar as it, like the very imaginative force that drives the human mind, is pre-rational and will-independent.

This essay only begins to discuss the relationship of the basic principles of each of these thinkers to their esthetic thought. But it is evident from this brief discussion how even a single foundational principle comes

to bear in a profound and central way on the *very conceptions of art and esthetic experience* articulated by both Johnson and Coleridge. Ultimately, these primary differences are reflected in the central conflict between the two thinkers: Johnson's characterization of the esthetic experience as a rational activity versus Coleridge's conception of it as an almost mystical one.

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The “Arson” of Emotion: Psychological Self-Violence in Bernard Cooper’s *Truth Serum*

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ABSTRACT

This article discusses the symbolism of destruction in Bernard Cooper’s memoir “Arson,” which appears in his collection, *Truth Serum*. Cooper’s memoir deals with his struggle in early adolescence to accept his homosexuality. The language used to describe the physical destruction of the author’s male pornographic magazines, through which he attempts to destroy his homosexual desires, symbolizes the psychological violence that the protagonist inflicts upon himself. As the author describes the nature of this incident, the language of the memoir illustrates his psychological struggle. Other incidents in the memoir surrounding the central “burning” episode further emphasize Cooper’s emotional predicament.

INTRODUCTION

Aside from his fascinating portrayal of memory captured in ebullient language, Bernard Cooper’s most impressive talent lies in his ability to present his experiences as symbolic, through metaphors that highlight what certain events in his life have meant to him. While some critics have challenged this element of Cooper’s memoirs as evasive, accusing him of “over-fictionalizing” his experiences, Cooper holds that modification of “truth is inherent in all acts of memory” (Bronski). Cooper thus evokes the truth through his creative process: he modifies his own memories into metaphors, which, by capturing his emotional state, become the essential truth. In *Truth Serum*, a collection of

previously published essays that deals with memories which range from the author’s experiences in youth and adolescence to his mature relationships, Cooper’s metaphorical language highlights his own emotional responses to his manifold life experiences. Beyond merely relating his experiences in group make-out sessions, psychiatric treatments, time spent in the gym, etc., within each essay Cooper presents his own poetic perspective of the events, thus successfully embedding the former in the latter. Cooper’s prose contains a “truth” that goes beyond the static experience: his reevaluation of an event through memory allows him to present the truth of his emotional state. Throughout these memoirs, the author’s struggle to accept his gay sexuality becomes a prevalent theme, and Cooper delivers his most ambitious use of metaphor to express vividly the pains of this struggle.

In *Truth Serum*, the memoir “Arson” appears to be Cooper’s greatest—and most obvious—success at this. As the author situates his memoirs in a loosely-framed chronological order—in a progression that focuses on his entire sexual development, from his first homoerotic feelings to his mature gay relationships—this essay on his early adolescence works to explore it as an important stage of sexual development. The title establishes the destructive tone, as the essay deals with the author’s attempted destruction of his homosexual desires through the burning of his gay pornographic magazines. Cooper’s metaphorical language presents the related events of his self-repression that led

to violence against his emotions, the self-induced distress that he experienced in adolescence; thus the central burning episode becomes profoundly symbolic. More than merely relating the factual evidence, the burning of the magazines in "Arson" symbolizes his own psychological self-violence in trying to eradicate his homosexuality.

The memoir begins with Cooper recollecting his adolescent desire to throw a "come-as-you-are party." Here the mature author, while imagining a variety of potential guests, muses about what it would have been like if he had fulfilled this fantasy. As the author creates this situation in his mind—and naturally brings it to the page—we see a form of wish fulfillment. This poses a situation that highlights Freud's theory of creative writing. In "Creative Writers and Daydreaming," Freud holds that a writer's works are a manifestation of dreams and fantasies, the results of a universal human need to daydream (712). Moreover, Freud develops a similar theory to analyze dreams in the chapter on "Dreams as Wish Fulfillment" in his seminal work, *The Interpretation of Dreams*. While Freud stresses the revelation of the unconscious through creative writing, Cooper's process addresses wish fulfillment openly by imagining his childhood unrequited love for "come-as-you-are parties." Moreover, the unconscious eventually comes through as the memoir progresses, as we learn of young Bernard Cooper's intentions to destroy his desires and how the author treats this dilemma through language as he looks back on the experience.

Through this wish fulfillment, Cooper articulates his motive for having these parties: "I desperately wanted to glimpse into the privacy of others" (65). His desire to learn about the secrets of others is a reaction to the desperation he feels toward his own desires, about which the reader eventually learns through the descriptions of his magazines. He needs some form of release, and the revelation of the secrets of others will be psychologically soothing for him. This need

for a psychological release, however, highlights the vulnerable state of young Cooper, who is susceptible to drastic measures for transforming—or more accurately, annihilating elements of—his emotional being. As Cooper shifts from an exploration of his desire for some sort of revelation of others' secrets to a narrative focusing upon his secret stash of male pornographic magazines, any self-revelation seems a faraway hope. The guilt he feels about lusting for these magazines overcomes him and leads to fear: "The dread of being discovered even seeped into my dreams" (66). Here Cooper relates a dream—that is somewhat comical—in which he encounters a policeman only to realize that he finds himself wearing his *Pony Boys!* magazine as a form of clothing. As a Freudian dream symbol, the policeman works as an image of young Cooper's desires—a strong masculine image—as well as a masculine authority figure, who seemingly would not condone male homosexuality: thus, the police officer in his dream becomes a paradox. As the author revisits this dream through his writing, he shows that any desire he would have felt for this man would have been overcome by his consciousness of the policeman's societal authoritative role. In essence, the revelation of Cooper's homosexuality to the cop through his clothing is not the random illogic of a dream, not a blurred moment of phantasmagoria. This juxtaposition of this dream-symbol policeman's roles, one of which is the result of societal norms, stresses that Cooper's subconscious—his socially structured superego—finds that his homosexual desires cannot be acceptable.

This domination of his superego forces Cooper to subdue his unwonted desires, the product of the id. Thus, young Bernard Cooper decides to hide these magazines in a house which Cooper the narrator describes as *ours*, reflecting the attitudes of his parents and authority. He chooses to put them *behind* the bottom drawer of a bureau built right into the wall. When Bernard decides to

abandon the drawer itself for another and more secretive hiding place, he goes beneath the surface of the wall, behind the built-in bureau. Here Cooper presents a physical interior that becomes symbolic of his own mind. When he pulls the drawer out of the bureau, the inner core of the house blooms into a full surreal image. His metaphorical description even names parts of the house as body parts: he pulls back the "skin" of the house to reveal the "bones" and "organs" within (67). Further, when he sees an exposed water pipe he depicts its sound as a "rush of breath," an image illuminating his desperation as the author inspects his own psyche. As Cooper explores his own interior, he gains full understanding of his secret desire: "I saw the darkness at the core of our house and suddenly doubted the white walls, the tidy rooms in which we lived" (67). His sexuality gains some validity as he sees the truth of the interior, a metaphor of the calm of his consciousness of his desires, which contrasts with the sterile exterior. This exterior of the walls parallels what Cooper feels he must present: a false image in extreme contrast to the dark, haggard truth that is the house's interior, where the magazines, which symbolize his now buried desires, lie.

Although Cooper's masturbation to the magazines works as a method to reach composure, his masturbation acts as a form of psychological self-torture, for he uses the act itself in a futile attempt to soothe the anguish he feels as the result of it. In Cooper's description of his masturbation to the magazines, we see the threatening aspect of the ordeal. As his orgasmic climax comes, "the mass and shadow of the [magazine] model's physique seemed to bloom in three dimensions, and my own body, in a fever-dream of want, became more real along with his" (69). As this intense desire makes the model on the page become real to young Bernard, his emotions become threatening as he sees his own gay sexuality becoming real, truly substantial, in his mind. Cooper's recognition forces him to try to obliterate his desire for men,

attempted through destroying the source of his sexual pleasure, his pornography. Here the narrative structure parallels young Cooper's reaction to this new reality: the episode that focuses on the central conflict of the memoir—the protagonist's taking action against his "abnormality" by destroying his magazines—follows right after the masturbation episode, in which the truth of Cooper's sexuality manifests itself.

When his parents go out for the day, fourteen-year-old Bernard Cooper seizes the opportunity to rid himself of his magazines by burning them in the garage, since, to him, "The whole outdoors seemed too...overt" (71). He fears scorn and ridicule if he burns them outside, so it must be done secretly, hidden in a physical interior that symbolizes his subconscious, as does the wall's interior earlier in the memoir. Here Cooper uses the dark garage to represent his own psyche—a counterpart to the interior of the wall—where he has kept his homoerotic tendencies secured for fear of self-disclosure. Just as he could not be open about his passion for men, he feels unsafe ridding himself of his magazines out in the open. Thus it is within his own mind—amidst strong emotions—that he must destroy his passion for men by burning the magazines.

Furthermore, Cooper stresses the absence of his father's car in the garage. His parents have left for the day, and the car's absence is physical evidence that his conscience is free of his father's influence. As the male role model, the father represents a threat of masculine hegemony and therefore becomes the influence the author is concerned with here. In "The Construction of Masculinity and the Triad of Men's Violence," a sociological study that explores the nature and sources of men's violence, Michael Kaufman argues that a young male learns gender responsibilities from his father, and that this learned masculinity must maintain control over gender codes. Thus, men's fear of weakness—"femininity" Kaufman terms it—creates an inner struggle to reinforce masculinity. This

mental unrest produces a constructed, fragile masculine code. Within the context of this psychological profile, it becomes apparent why young Bernard cannot declare his powerlessness to his father—the male authority figure—by disclosing what Cooper believes to be his abnormality, his lust for men, a very non-masculine trait society has told him. If he exposes his “weakness,” his homosexual desires, he fears this sense of “femininity” will result in his submission to his father’s—and all other males’—hegemonic power. Bernard must conduct this ceremony without his father’s presence lurking in his conscience so as to keep his fragile masculinity safe from the possible domination of the hegemonic masculinity his father represents.

While the burning of the magazines is an act of destruction, Cooper’s use of fire has another symbolic connotation. In the images of fire, the reader acknowledges Cooper’s psychological violence toward himself; the fire, however, also has a passionate quality, highlighting the author’s desire for the magazines as he burns them: “Touching the match to the first magazine, I felt a sense of profound relief I wouldn’t know again until years later when I actually touched a man” (72). Cooper’s narrative makes the act of burning the magazines analogous to the first homosexual experience that he will eventually have by comparing the sense of “relief” that both actions cause. However, as he feels relieved by the magazines’ burning, his mind experiences the same sensation he felt when he became homosexually active. Thus, we see his passion for men juxtaposed with the destruction of his desire for them, another paradox that highlights his conflicted conscience, the source of distress. The destructiveness of the fire correlates to Kaufman’s depiction of “men’s violence against themselves.” As mentioned earlier, Cooper’s repressed desire is a “passivity”—emotions that would make him seem weak to other men. His emotions are stifled with the “repression of discharge mechanisms,” which would soothe the mind, and “are transformed into anger

and hostility” (Kaufman 13). Cooper suffers from a suppression of his powerful emotions for men, and therefore he becomes “a pressure cooker” (Kaufman’s term) and reacts by attempting the violent destruction of his own desires through burning the magazines.

Moreover, this action is characteristic of another element of Kaufman’s triad of men’s violence—against other men. Here Kaufman holds that an outlet for homoerotic attraction does not exist in our society (11). Consequently, men have no way of expressing this emotion—it turns to feelings of anger against other males. While all men possess this tendency, Cooper has strong feelings for men, more than just a slight homoeroticism; and since these homosexual desires are fully manifested, his instinctual reaction to his suppressed feelings may very well result in violence that would be all the more greater than heterosexual men’s. Thus, Cooper’s sense of homophobia forces him to burn these images of men, a violent metaphorical murder to purge them from his own desires.

Cooper’s use of lighter fluid on the magazines signifies aggression that he must put into his destroying them:

*The magazines were burning to pieces, and the pieces, lifted on sudden updrafts, were raining everywhere[...]
When it finally dawned on me that things were getting worse instead of better, I leapt in and out of the fire in a sorry effort to stomp it out (73).*

In this slapstick-like scene, the images of the men become fragmented into body parts. As young Cooper now sees “legs” and “buttocks”—“in a flurry of glowing male flesh” (74)—these “de-personified” erotic images become even more sexual to him. The bits of magazine pages fly from the ground into nooks and crannies in the walls: with his attempt at destroying them they have turned into carnal sex symbols and have spread, all to places where the author is painfully aware of them. His desire for men becomes anything but obliterated: it has been intensified and now permeates his consciousness, in spite of the fire that could consume it. In essence, his passion is indestructible; the

conflagration only intensifies it. Moreover, as young Bernard stamps on these media images of his sexual desires, his aggression heightens his desire for them: "The more I stomped on the hot spots, the more the bodies multiplied, a flurry of glowing male flesh" (74). As he attempts to stop the raging fire, he is inflicting violence upon the violence (burning) that the images are already undergoing. Thus, Cooper's language during this episode highlights an undertone of the norms of "male gazing" as described by Steve Neale in his essay "Masculinity as Spectacle." Neale holds that the element of sadomasochism in male genres of media makes the heroes' bodies into suitable objects of male gazers (8). The physical punishment of the male body in media permits male gazers, since these actions make such a spectacle acceptable for men. Further, this sadomasochism works as a punishment for the male viewer for watching and liking it. A tone of greater attraction becomes prevalent in Bernard when the bodies seem to "multiply" through his aggressive attempts to extinguish the fire, but the burning exists as a duality: the images become "glowing" (74) male flesh, burning and therefore violently destructive, but also illuminating and attractive.

After he finally puts out the fire and opens the garage door, Cooper emphasizes the intensity of his personal anguish. As smoke leaves the garage, we see his inner anguish evaporate in a complacent outside world. The reader recognizes his pain through the juxtaposition of the dark, flaming, smoke-filled encasement with the bright, sunny exterior: "Throwing open the double doors, I half expected to see fire trucks arriving, or the neighbors lined up in a bucket brigade" (74). Bernard's inner struggle is so intense that, upon leaving the garage, which symbolizes his psyche—the superego battling the id—he imagines the whole world coming to put out the means of his attempted destruction of desire. He cannot make sense of his fears as they exist in a complacent world. For his fear remains and has intensified; he has

created more evidence—smoke-infested clothing, an incriminating grocery bag that held the pornography—in attempting to get rid of his magazines.

Throughout this episode, young Cooper's fear forces him to hide his emotions with rationality. In "The Approach-Avoidance Dance," a study which scrutinizes institutionalized gender codes for men and women (412), Lillian B. Rubin argues that fears, emotions, and fantasies—the latter is strikingly prevalent in Cooper's case—are a sign of weakness that men keep hidden behind a veneer of rationality in order to maintain an image of strength. This rationality overcomes Cooper's desires, for he chooses to attempt to destroy them because it is the rational, masculine thing to do. In essence, he subjugates his emotions by means of his domineering rational consciousness. This is reiterated through other characters, after young Cooper's failed "come-as-you-are" party in a narrative movement at the closing of the memoir, when all the boys reject the slumber-party activities Cooper suggests and end up walking the streets in a group, a more typical young-masculine activity. Cooper makes his work cyclical with this ending: he begins with the desire for the party as an opportunity and closes with the broken-up festivity as proof of what he believes to be his secret abnormality. This episode near the closing of the memoir further stresses the struggle in "Arson": the denial of his own gay masculinity.

The framework of the essay, which is built on the central "arson" episode, depicts Cooper's progression toward his goal of destroying his desire, inflicting violence on his emotions. Amidst trials of denial and repression that lead to the attempted destruction, the central episode is representative of the emotional self-violence that Cooper experiences as he struggles to accept his sexual orientation. As a grown man, and a powerful memoirist, reflecting on his struggle to accept his sexuality requires of Cooper a certain use of language. Cooper thus transforms his memory into metaphor, which is often

paradoxical as we have seen, and which results in writing that some have criticized as an "over-fictionalized" treatment of memoir. However, his approach captures the intensity of his emotional struggle far beyond the possibilities of factual history. The author's method becomes one of discourse, illustrating the potentials of autobiographical narrative that lead into the realms of "truth" within the manifestation of memory.

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Nationwide Newspaper Coverage of the Repatriation of Elián González: A Community Structure Approach

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INTRODUCTION

On November 25, 1999, while millions of Americans celebrated Thanksgiving with family and friends, five-year-old Elián González was found floating in an inner tube off the coast of Fort Lauderdale, Florida. His journey to the United States had begun three days earlier when the boat that carried his mother, stepfather and ten other passengers overturned, an event which has since become an international controversy.

While Cuban officials demanded the return of the five-year-old boy, many Americans were determined to keep him within the protective confines of the United States. The controversy that ensued was multi-dimensional by challenging the political, social, and legal ideologies of two countries with vastly different governments. A 1994 accord provides for the return of Cuban refugees found at sea. This agreement, however, is undermined by the 1966 Cuban Adjustment Act, which allows Cubans who have reached U.S. shores to receive automatic residency. Legally, the United States government was obligated to return Elián González to his father in Cuba. For the anti-Castro movement, however, the circumstances surrounding the boy's discovery at sea made him a poster boy for its cause.

While the Cuban government, American officials, and anti-Communist activists determined the fate of Elián González, newspapers across the country had the responsibility of providing accurate information to a diverse American population. This study examines U.S. city news coverage of this international

custody battle in relation to the demographics of 15 cities across the United States, a methodology that is called the "community structure approach." Building on past research, which has found a strong correlation between newspaper coverage of high-profile news stories and the social structure and demographics of a community, this study examines variations in media portrayals of the plight of Elián González.

Communication Literature: Bridging the Gap

The media have had a significant role in the framing of events concerning Cuban-American relations in the post-Cold War era. Newspaper coverage of the controversy surrounding the return of Elián González serves as a focal point to examine the media's role in framing tumultuous relationships between two distinct and ideologically hostile political systems. An extensive search for literature revealed three articles concerning media coverage of Cuban-American relations since 1988: Deneen (1992) analyzes the *Miami Herald's* coverage of issues relating to the Cuban population; Pollock, Shier, and Slattery (1995) study U.S. newspaper coverage of the open door policy via the community structure approach; and Soderlund (1998) compares image consistency between American and Canadian television news coverage. From a broader perspective, Salwen and Matera (1997) discuss agenda setting in the news media with regard to illegal immigration and the Hispanic population.

Although the communications field has

produced few recent analyses of how Cuban-American relations are reported by the U.S. and industrial world media, a search of several social and political science databases yielded significantly different results. Lenart and Targ (1992) discuss media framing with regard to *The New York Times* coverage of Cuban relations in the 1980s. In addition, Soderlund (1997) investigates *The New York Times* image of Fidel Castro from 1953 to 1992. In the period after the Cold War, Soderlund notes that staff writers shifted their attention from Castro's negative attributes as a political leader to a negative review of his personal character. Finally, the works of Entman (1991), Gamson (1989), and Iyengar (1991) outline four distinct media frames that have been employed by news journalists when reporting on international affairs involving Cuba and the United States. First, they can maintain the negative Cold War frame of conflict. Second, they can frame Cuba as an emerging nation and Castro as a passionate leader, working for his country's best interests. Third, they can separate negative opinions about Castro from their portrayal of Cuba as an emerging nation. Fourth, they can link Castro's leadership with the economic and social problems faced by Cuba today.

Todd Gitlin (1980, p. 42) contends that our place as a world power has been founded on basic hegemonic beliefs that are "embedded in U.S. media frames and broadly accepted by the populace." The research of Herman and Chomsky (1979), Parenti (1986) and Gitlin (1980) asserts that media reinforce the hegemonic beliefs that validate capitalism, the national security of the state, and a class structure that is defined by its upper echelon. From this critical perspective, media frames employed by journalists are inherently guided by the hegemonic principles posited by Gitlin; their presence is marked by contextual cues and imagery that purposefully elicit public opinion (Lenart & Targ, 1992).

The presence of media framing has been shown to affect public attitudes differently

according to age. Wilson (1996) noted that children exposed to the media coverage of the civil rights movement have markedly stronger attitudes regarding racial equality than those born after 1970. Earlier, Karl Mannheim (1952) had noted that significant historical events occurring during an individual's formative years correlate to topic-related attitudes. His theory of generations suggests that social and political landmarks, such as the Cuban Missile Crisis and the Bay of Pigs military excursion, solidify the attitudes exhibited by a particular generation.

Considering the media's tendency to link Cuba with illegal immigration, political oppression, crime, and welfare, it is reasonable to suppose that news coverage of Elián González would not be neutral in the United States. It is of great importance for communication scholars to examine the contributing factors that influence media frames in newspaper coverage. What journalistic model dominated news coverage of Elián González in the United States? Had individual city characteristics affected newspaper reporting on Elián González? Did newspaper coverage of the Elián González controversy sustain the forty-year grudge against Cuba and its political leader? To understand the methodology used to answer these questions, it is necessary to outline the tenets and rationale of the community structure approach.

The Community Structure Approach: Comparing Coverage Variation

A community structure perspective could be useful in explaining any newspaper variation in the coverage of the Elián González incident. Building on the work of Tichenor, Donohue, and Olien (1968; 1980; 1985); Stamm (1985); Smith (1984a; 1984b); Dearing and Rogers (1992); Pollock and Robinson (1977); and Pollock, Murray, and Robinson (1978); this approach suggests that community or city characteristics (using aggregate data and demographics) have a great deal to do with reporting on critical events (such as the repatriation of Elián González) that affect the nation.

The community structure approach enhances traditional theoretical perspectives when examining coverage from either individual or organizational viewpoints. The main reason a community structure approach has merit in the study of the Elián González controversy is that, compared to other approaches, it is relatively sensitive to systematic coverage variation.

Individual Level Analysis

Some studies of individual journalists confirm that they appear to be better educated and more "liberal" than the population in general (for example, see Johnston et al., 1976). Foreign correspondents also share "better-educated," relatively "liberal" perspectives (see Pollock, 1981). Yet however the individual life histories and political perspectives of journalists differ from the public's in the aggregate, newspapers are also businesses requiring the sale of product to stay in operation. Perspectives that stray too far from public viewpoints would be economically disadvantageous for newspapers.

To the extent that individual journalist differences matter, any coverage variation uncovered might be expected to approximate a random pattern. Since journalists, especially foreign affairs journalists, often come from similar educational and economic backgrounds (Pollock, 1981), any variation caused by individual background differences might be associated with personality and therefore yield random rather than patterned coverage variation.

Organization Level Analysis

Like individual perspectives, organizational perspectives on reporting are probably better at documenting similarities across newspapers in news coverage than in tracking reporting variation. Perspectives such as occupational incentives in the news-gathering profession (Sigal, 1973) or the organization of newsrooms (Tuchman, 1972; 1978) impart a great deal about the news-gathering process. But what they uncover reveals more about what distinct newspaper organizations have in common than how they differ.

A focus on the news-gathering patterns in foreign affairs, for example, might note that editor and journalist decision-making might depend a great deal on what wire service material is available to reporters. Since most reporters at major papers will have access to similar wire material, there is every reason to expect that reporting on foreign affairs issues will generally reflect similar perspectives from one paper to the next. An organizational analysis of news making, therefore, is more likely to yield homogeneous than varied reporting perspectives.

Market and Community Level Analysis

Both market and community structure perspectives are useful in analyzing coverage variation across different newspapers. It is possible that reporting may differ according to variations in the market profiles of newspapers—some papers targeting relatively upscale audiences, some targeting less upscale markets. This perspective is worth pursuing on other occasions. However, in the case of foreign-affairs reporting, it is likely that broad differences in community structures make a difference, including such factors as percent of the workforce in manufacturing or in services, education level, percent in high-status occupations such as professions, percent with economic privilege (such as participation in stock and bond activity or annual family income over U.S.\$100,000), or educational privilege (percent with four or more years of college). Communities differ along these structural dimensions, and such differences may give different communities "stakeholders" in different foreign-policy issues. These stakeholders may be reflected in reporting on those issues in major papers serving those communities.

Tichnor, Donohue, and Olien, for example, see newspapers as "mechanisms for community social control that maintain the norms, values, and processes of a community, and... their functions necessarily fit into a pattern that varies predictably according to size and type of community" (Tichnor, Donohue, & Olien, 1980, pp. 102-3). The

community structure approach has been used successfully to compare the effects of such factors as racial composition, religious involvement, and poverty level across several cities in reporting on crucial events such as *Roe vs. Wade* (Pollock, Robinson, & Murray, 1978); the 1971 prisoner uprising at Attica; a 1976 high court abortion decision; and a Dade County (Miami) referendum revoking the right of homosexuals to non-discrimination in housing (Pollock & Robinson, 1977). Reporting on Dr. Jack Kevorkian's activities also varies with the characteristics of different communities (Pollock, Coughlin, Thomas, & Connaughton, 1996), as does coverage of Magic Johnson's HIV announcement (Pollock, Awrachow, & Valentino, 1994).

In addition, scholarly work on AIDS has just begun to reflect the same sensitivity to the relation of media and dominant groups in communities. A study of the way AIDS became part of news media agendas during the 1980s concluded, "mass media organizations are far from autonomous actors in the determination of which issues become news. Media agendas, which are highly and positively correlated among media organizations, are determined by a host of endogenous and exogenous variables" (Dearing & Rogers, 1992, p. 190).

The same analysis found that although *The New York Times* played a special role in setting a national agenda for AIDS stories; and although the Rock Hudson and Ryan White stories in 1985, in particular, elevated media interest in AIDS to new levels (Dearing & Rogers, 1992, p. 183), "outside variables may have been more influential in determining the importance of AIDS on mass media news agendas. Thus, in the determination of what is news, mass media organizations are highly interdependent with their environment[s]" (Dearing & Rogers, 1992, p. 190).

The authors conclude that: "Research on media agenda setting should conceptualize the output of mass media organizations as being closely responsive to the perceived

attitudes and values held by efficacious groups of people within their relevant environment... Interpersonal networks of concerned individuals, governments, community groups, scientific findings and political leaders stand out in the present case as important determinants of news coverage about AIDS" (Dearing & Rogers, 1992, p. 191).

In general, media scholars have viewed newspapers as closely linked to the communities they serve (Smith, 1984a). In a structural-functionalist paradigm, long popular in the social sciences, "media may be viewed as prominent subsystems within the larger social systems of the community; thus they tend to reflect the values and concerns of the dominant groups in the communities they serve" (Smith, 1984b, p. 260).

This focus on community structure and critical events is similar to Lance Bennett's exhortation to researchers to join policy formulation and socially relevant research by "discovering what conditions join people, politicians and the press in open, critical public debates about the uses of power" (Bennett, 1993, p. 180). The series of case studies of different "issue-situations" proposed by Bennett can embrace a wide range of circumstances (foreign, domestic, technical, and moral issues with or without interest groups). To examine domestic issues, the issue-situation, content-analysis focus suggested by Bennett can be married to an approach that compares comparable census, demographic, and marketing data for different cities to explore how and why city newspapers might portray the event differently.

HYPOTHESES

After reviewing communication and social science literature, six cluster groups were found to warrant examination in studying news coverage of Elián González and the community structure approach: privilege, generation/age, ethnicity, acculturation, stakeholder status, and media access.

Privilege/Buffer Hypothesis

A person's level of education can combat blind acceptance of the mediated reality created by the press. The work of Salwen and Matera (1997) asserts, "People who actively attend to the news with preconceived agendas of issue importance are less likely to adopt the media's agenda than those who passively attend to the news." In essence, educated individuals are able to form arguments that challenge the information presented in news coverage.

H¹: The higher the percentage of college graduates living within a city, the more favorable the coverage of the return of Elián González.

Although education is thought to have a liberalizing effect on attitudes, many Americans exhibit a strong adherence to the hegemonic myth. White-collar professionals and managers tend to support the political assertions outlined by the hegemonic myth. The absence of economic uncertainty further endorses the capitalistic principles embedded in the hegemonic myth, and citizens of privilege will accept traditional political values, such as granting asylum to Cuban refugees.

In *Investigating Communication*, Frey, Botan, and Kreps acknowledge a relationship between a city's socio-economic privilege and favorable newspaper coverage of human rights claims, a theory known as the *buffer hypothesis*. This theory, developed by Pollock and colleagues, asserts that the greater the status advantages within a city, the more favorable the coverage of social change and human rights issues.

As a democratic nation, the United States inherently supports the hegemonic myth; therefore, the media often frame the enemy in the form of organizations or individuals that threaten to violate the values that are embedded within our culture. Since privilege indicates support for oppressed minorities, the buffer hypothesis asserts that human-rights claims—that a child belongs with his natural father—override any previously existing hostility between the United States and Cuba. Using the buffer hypothesis, Pollock, Shier,

and Slattery (1995) found a significant link between social privilege and favorable newspaper coverage, which supported the maintenance of an open-door policy toward Cuban refugees seeking political asylum. In addition, Pollock, Johnson, Jenson, and Clark (1997) found that high-income cities highly correlated with negative coverage of the Hong Kong handover to the People's Republic of China. Finally, Pollock, Kreuer, and Ouano (1994) found a link between occupational privilege and negative coverage of China's bid to host the 2000 Olympics.

H²: The higher the percentage of those employed in professional/technical operations within a city, the more favorable the coverage of the return of Elián González.

H³: The higher the proportion of those with annual household incomes over \$100,000 in a city, the more favorable the coverage of the return of Elián González.

H⁴: The higher the percentage of homeowners within a city, the more favorable the coverage of the return of Elián González.

Generation/Age

Sociologist Karl Mannheim has asserted that attitudes exhibited by a generation are influenced by exposure to political and social events that occur during the formative years. Critics and historians agree that the Cuban Missile Crisis of 1962 represented the greatest threat of nuclear war between the U.S. and the U.S.S.R. (Blight, Nye, & Welch, 1987). Cuba's role as a military ally during this conflict, combined with the previously existing U.S. hostility toward Fidel Castro's domestic policy, undoubtedly had a significant effect on the attitudes of the American public (Bernell, 1994). Thus, people born before 1945 may continue to harbor hostility toward Cuba for its contribution to the threat of nuclear war. As a result of this tumultuous relationship between the United States and Cuba:

H⁵: The higher the percentage of citizens over the age of 55, the less favorable the coverage.

Ethnicity

It has been projected that within two decades, Hispanic Americans will constitute the U.S.'s largest ethnic minority (Campbell, 1994).

Therefore, race and ethnicity are important variables in the analysis of newspaper coverage of Elián González in the United States. De la Garza (1992) found that two-thirds of Hispanics maintain stronger, more conservative viewpoints on foreign policy issues—such as tightening immigration laws. However, it is likely that those of Hispanic descent will support the fostering of relations between the United States and Cuba. Many Hispanics may feel that the return of Elián González will encourage Cuba and Fidel Castro to improve that country's human rights record. Also, Hispanic Americans are likely to possess an understanding of beneficial cultural traditions and advantages that exist within one's homeland. Their own, personal connection with their cultural background will result in the support of Elián's return to his father in his native country. Similarly, Hispanics and foreign-born individuals are more likely to exhibit tolerance for differences in politics and lifestyles. As a result of this tolerance, cities containing large populations of Hispanics and foreign-born individuals will be more forgiving of what the U.S. perceives as Cuba's infringements upon human rights.

H⁶: The higher the percentage of the Hispanic population within a city, the more favorable the coverage.

H⁷: The higher the percentage of foreign-born individuals within a city, the more favorable the coverage.

Acculturation

We cannot, however, discount the liberalizing effects of acculturation. Generally, nativity and language competence can result in the formation of more conservative viewpoints with regard to immigration and social responsibility. Hood, Morris, and Shirkey note that, "Hispanics who were born in this country and who recognize the importance of adopting certain strategic traits like learning English, may develop more conservative attitudes toward foreign policy" (1997, p. 630). Language competence appears to be a defining factor in the formation of attitudes. Hispanic immigrants are often limited in

their language ability, and use Spanish in every facet of their lives. Since the American media use English as their primary language, individuals who speak only Spanish have limited access to outlets of information, which impairs their ability to make educated decisions. On the other hand, individuals who are bilingual have assimilated to the mainstream American culture, but retain their sense of cultural identity through their language. This *acculturation theory* asserts that as individuals become more assimilated to a culture they will adopt more traditional, mainstream perspectives with regard to controversial foreign policy issues. Therefore:

H⁸: The higher the percentage of the population that does not speak English, the less favorable the coverage of the return of Elián González.

H⁹: The higher the percentage of the population that speaks Spanish at home, the more favorable the coverage of the return of Elián González.

Stakeholder Hypothesis

Since the controversy surrounding the return of Elián González revolves around a human-rights claim, it is important to examine the influence of the stakeholders within the community. It is reasonable to assert that the stakeholders' agenda within a community will influence media coverage to coincide with their own interests (Frey, p. 239). With regard to the *stakeholder hypothesis*, Pollock, Robinson, and Murray (1978) found a strong correlation between the percentage of Catholics within a city and negative coverage of *Roe vs. Wade*. In addition, Pollock and Dantas (1998) revealed a relationship between the size of the gay population and favorable coverage of the legalization of same-sex marriage. In the case of Elián González, families with children living at home will empathize with the human-rights claim of the father, demonstrating a favorable trend in newspaper coverage. Therefore:

H¹⁰: The greater the percentage of families with children between the ages of 5 and 7, the more favorable the coverage.

H¹¹: The greater the percentage of families with children under the age of 12, the more favorable the coverage.

H¹²: The greater the percentage of single-parent families, the more favorable the coverage.

H¹³: The greater the percentage of families with children living at home, the more favorable the coverage.

Media Access

As noted by Tichenor (1980), the abundance of media outlets within a city radius promotes the plurality of ideas and viewpoints. The exchange of ideas through a variety of media outlets overpowers negative perceptions of controversial social and political issues. With regard to the plight of Elián González:

H¹⁴: The higher the number of cable television stations in an area, the more favorable the coverage.

H¹⁵: The higher the number of AM radio stations in an area, the more favorable the coverage.

H¹⁶: The higher the number of FM radio stations in an area, the more favorable the coverage.

METHODOLOGY

This study analyzed coverage of the repatriation of Elián González in 15 newspapers across the country. The points of inflection for this analysis spanned from Thanksgiving Day 1999, the date of Elián's discovery at sea, to February 29, 2000, shortly after the INS's decision to send him back to Cuba and the Florida court's decision to grant the Miami family temporary custody.

Newspapers were included in the study to provide geographic diversity, as long as they covered Elián González's story and they were available on the DIALOG Computer Information Program. The final selection of newspapers included: *The Times Union* (Albany), *The Atlanta Journal/The Atlanta Constitution*, *The Boston Globe*, *The Charlotte Observer*, *The Denver Post*, *The Detroit Free Press*, *The Fresno Bee*, *The Houston Chronicle*, *The Lexington Herald-Leader* (Kentucky), *The Commercial Appeal* (Memphis), *The Times-Picayune* (New Orleans), *The Philadelphia Inquirer*, *The Arizona Republic/The Phoenix*

Gazette, *The Seattle Post-Intelligencer*, and *The St. Louis Post-Dispatch*.

Measures and Dependent Variables

From the 15 previously mentioned newspapers, 267 articles were obtained. These articles were coded for two kinds of information. The first was an attention score, which considered an article's placement, headline size, article length (in words), and presence of photographs (captions optional). The total possible scores ranged from 3-16. Articles with a higher number of assigned points were considered to have received more attention.

The second score assigned to the article indicated the direction of coverage—favorable, unfavorable, or neutral. This directional score was a nominal measurement, based on article content, and was defined as follows:

Favorable Coverage: For the purposes of this study, an article is deemed favorable if its coverage advocates the return of Elián González because it would not only show that the legal obligation of the United States overrides any previous negative press coverage regarding Cuba, but it would support the human-rights claim that the child belongs with his father. The bond between biological parents and their children transcends previous hostility toward Castro and Cuba. Although the United States' hegemonic principles may not coincide with those of Cuba and its dictatorial government, the media would still support Elián's return to his father.

Unfavorable Coverage: Unfavorable coverage would include those articles that condone keeping Elián in Florida with his extended family. This point of view would ignore the human-rights claim and reinforce the role of the United States as protector and policeman. Additionally, this would further support previous negative newspaper coverage of Cuba by asserting that the nature of Cuba's government overrides a father's parenting ability.

Neutral/Balanced Coverage: Articles that follow neither model are categorized as maintaining a neutral or balanced perspective.

These articles use "non-inflammatory" language that reports both sides of the story equally. These articles do not place blame and use qualifiers sparingly. Both parties' perspectives are treated with equal importance, neither enforcing hegemonic principle nor criticizing Cuba for its politics and culture.

The articles were read by two researchers, each of whom provided an independent directional score. By avoiding collaboration, the researchers avoided bias. The two directional scores were then used to test the intercoder reliability of the study. For the 267 articles, the researchers agreed on the direction of 242, creating a Holsti's Coefficient of Intercoder Reliability of 91.0%.

Coefficient of Imbalance

The attention and directional scores were combined to calculate a Janis-Fadner Coefficient of Imbalance for each newspaper. Combining the two scores created a measure of newspaper coverage that is more sensitive to subtle editorial decision-making than using either an attention or a directional score alone. Thus, the likelihood that readers would be exposed to material on Elián González (attention scores) and an evaluation of article content (directional scores) yielded a highly sensitive score (Janis-Fadner Coefficient of Imbalance) for each newspaper's overall coverage of the Elián González controversy across the sampling period.

The resulting statistics fall between +1.00 and -1.00. The coefficient of imbalance allowed quantitative comparisons of each newspaper's coverage of the Elián González story. Scores between zero and +1.00 indicated favorable coverage and scores between zero and -1.00 indicated unfavorable coverage of Elián's plight. Articles using the Janis-Fadner Coefficient of Imbalance in communication research have been accepted for publication in such journals

as *Comparative Politics, Society, Journalism Quarterly, Mass Communication Review, Newspaper Research Journal* (two articles), *The New Jersey Journal of Communication*, and the edited, refereed collection of the *Communication Yearbook*. (See respectively Hurwitz, Green, & Segal, 1976; Pollock & Robinson, 1977; Pollock, Murray, & Robinson, 1987; Pollock, 1995; Pollock, Coughlin, Thomas, & Connaughton, 1996; Pollock, Kreuer, & Ouano, 1997; Pollock & Whitney, 1997; and Pollock & Guidette, 1980.) See Table 1.

Table 1: Single-Score Content Analysis: Calculating Coefficient of Imbalance Definitions

f = sum of the attention scores coded "favorable"
u = sum of the attention scores coded "unfavorable"
n = sum of the attention scores coded "balanced/neutral"
$r = f + u + n$
If $f > u$ (or if the sum of the "favorable" attention scores is greater than the sum of the "unfavorable" attention scores), then use the following formula:
Coefficient of Favorable Imbalance
$C(f) = \frac{(f^2 - fu)}{r^2}$ (answer lies between 0 and +1)
Coefficient of Unfavorable Imbalance
$C(u) = \frac{(fu - u^2)}{r^2}$ (answer lies between 0 and -1)

RESULTS

Varied Coverage, Mostly Positive

The coefficients of imbalance of individual newspapers were ranked from most to least favorable in their coverage of the Elián González story by their coefficient of imbalance. Pearson correlations and significance tests were calculated to test the relationship between distinct city characteristics and variations in reporting on Elián González.

The coefficients of imbalance ranged from +0.273 to -0.221, demonstrating that newspaper coverage of this issue varied throughout the nation. Of the 15 cities studied, nine papers exhibited positive coverage, while six papers scored negatively. The coefficients of imbalance are as follows:

Table 2: Janis-Fadner Coefficients of Imbalance

City	Newspaper	Coefficients of Imbalance
15. Denver	<i>The Denver Post</i>	0.273
14. Charlotte	<i>The Charlotte Observer</i>	0.193
13. St. Louis	<i>The St. Louis Post-Dispatch</i>	0.160
12. Houston	<i>The Houston Post</i>	0.158
11. Boston	<i>The Boston Globe</i>	0.111
10. Albany	<i>The Albany Times Union</i>	0.081
9. Memphis	<i>The Commercial Appeal</i>	0.070
8. Lexington	<i>The Lexington Herald Leader</i>	0.015
7. Philadelphia	<i>The Philadelphia Inquirer</i>	0.006
6. Phoenix	<i>The Arizona Republic/Phoenix Gazette</i>	-0.003
5. Seattle	<i>The Seattle Post Intelligencer</i>	-0.058
4. Atlanta	<i>Atlanta Journal-Constitution</i>	-0.068
3. New Orleans	<i>The New Orleans Times-Picayune</i>	-0.113
2. Detroit	<i>The Detroit Free Press</i>	-0.140
1. Fresno	<i>The Fresno Bee</i>	-0.221

A Pearson correlation analysis (shown in Table 3) was used to determine whether city characteristics could be linked to differences in reporting. The results yield a strong correlation linking positive newspaper coverage of Elián González with one specific variable—the percentage of individuals raising children between the ages of 5 and 7 ($r = 0.488$; $p = 0.033$). Additionally, the percentage of college-educated individuals ($r = 0.158$; $p = 0.158$) and the number of AM stations ($r = -0.338$; $p = 0.109$) produced correlations that border on directional significance. No other significant correlations were found during the course of this research.

Table 3: Pearson Correlations and Significance Levels

Variable	Pearson Correlation	Significance
Children Aged 5 to 7	0.488	0.033
# of AM Stations	-0.338	0.109
College-Educated	0.278	0.158
Professional/Technical	0.203	0.233
# of FM Stations	-0.154	0.292
Single Parent w/ Children	-0.145	0.303
Over 55	-0.118	0.337
Children at Home	-0.112	0.345
Children Under 12	-0.105	0.355
Homeowners	0.087	0.379
Speaks Only Spanish	0.082	0.385
# of Cable Stations	-0.082	0.395
Speaks Spanish at Home	0.039	0.445
Foreign-Born	0.036	0.449
Income Over \$100,000	0.035	0.451
Hispanic	-0.005	0.493

ANALYSIS AND DISCUSSION

Overall, the trend in newspaper coverage favored the return of Elián González to his father in Cuba. The course of our analyses revealed one statistically significant result.

The percentage of children aged 5 to 7 is linked to favorable coverage of returning Elián to his father, thus supporting the stakeholder hypothesis. A Pearson correlation analysis confirmed our hypothesis: the higher the percentage of children aged 5 to 7 within a city, the more favorable the coverage.

Populations with Children Aged 5 to 7 Linked to Favorable Coverage: Continuing Support for the Stakeholder Hypothesis.

The percentage of households with children aged 5 to 7 revealed significant findings ($r = 0.488$, $p = 0.033$). Newspaper coverage for cities with higher percentages of children within this age range tends to support the return of Elián González. In addition to percentages of children aged 5 to 7, several other similar variables were tested, though none revealed significance. Single parents with children at home ($r = -0.145$; $p = 0.303$), families with children at home ($r = -0.112$; $p = 0.345$) and families with children under the age of 12 ($r = -0.111$; $p = 0.347$) demonstrated a trend toward negative coverage of the return of Elián to his father.

The precision of this finding indicates the sensitivity of newspapers to the demographic characteristics of their communities. For individuals who are raising children between the ages of 5 and 7, the human-rights claim is that Elián belongs with his natural father. Parents raising children who are approximately the same age as Elián may empathize with the father's plight and support his son's return. The bond between biological parents and their children transcends all other issues surrounding this controversy.

Privilege produces varied results with little significance.

College education was the only variable that showed promise for directional significance ($r = 0.278$; $p = 0.158$) within the privilege cluster group. A possible explanation for this is that college-educated individuals can distinguish between the United States' legal obligations and the personal issues involved in this case. Thus, cities with a higher percentage of

college-educated individuals were more likely to favor the return of Elián to his father. Although professional/technical employment ($r = 0.203$; $p = 0.233$), income level ($r = 0.451$; $p = 0.451$), and home ownership ($r = 0.379$; $p = 0.379$) indicate a trend toward favorable coverage of Elián's return to Cuba, their influence revealed little significance.

Media Access indicates slight significance, but wide variety of reporting.

The number of AM radio stations ($r = -0.338$; $p = 0.109$) within a city revealed a correlation that bordered on directional significance. Consistently, the numbers of FM radio ($r = -0.154$; $p = 0.292$) and cable stations ($r = -0.082$; $p = 0.395$) were minimal indicators of negative coverage. The trend of negative reporting discounts the idea that cities with more media outlets will promote the plurality of interests through positive newspaper coverage. Cities with more media may focus on the "want to know" news that dramatizes the plight of Elián González as a custody battle embroiled in a thirty-year international grudge match in order to obtain ratings.

Ethnicity, Acculturation, and Age demonstrate little variety with no significance.

The fact that ethnicity and acculturation revealed no significance demonstrates that the primary issue is a human-rights claim, and is not rooted in cultural disparities. The Hispanic ($r = -0.005$; $p = 0.493$) and foreign-born ($r = 0.036$; $p = 0.449$) populations indicated little variety; Hispanics were slightly inclined toward negative coverage, while foreign-born populations demonstrated a tendency toward positive coverage. Similarly, language competence did not significantly correlate with news coverage of Elián González. Communities with large percentages of individuals who speak only Spanish ($r = 0.082$; $p = 0.445$) and the bilingual population ($r = 0.039$; $p = 0.445$) were minimal indicators of positive coverage. In addition, the percentage of the population over the age of 55 revealed a low correlation

in favor of negative coverage, but was not significant ($r = -0.188$; $p = 0.337$).

CONCLUSION

Communities with a high percentage of children aged 5 to 7 supported the return of Elián González. A study of 16 hypotheses regarding newspaper coverage of the Elián González controversy established that this issue is a human-rights claim. The media has portrayed Juan González as a doting parent who played an active role in raising his child. Amid the international custody battle lies a core American value—the idea that natural parents who have played an active, attentive role in the rearing of their offspring have a right to their children. As the divorce rate continues to rise within the United States, this idea remains important to individuals who are raising children the same age as Elián González. Cities with large populations of individuals raising children within Elián's age group have demonstrated a significant trend of positive newspaper coverage that supports the return of the youngster to his natural father.

The community structure approach is worthy of attention in exploring controversial events. The community structure approach has proven to be a useful strategy in investigating differences in newspaper reporting in the United States. As a medium that has the power to set the public agenda, newspaper reporting should consistently remain neutral. Unfortunately, this is not always the case. City characteristics, such as the percentage of individuals raising children between the ages of 5 and 7 significantly correlate to positive coverage of Elián González's return to his father. The community structure approach can broaden an area of study. Demographic city characteristics can be explored as indicators of differences in newspaper coverage throughout the nation.

The community structure approach is a perspective of research that can easily be employed and is readily available. Easy

accessibility to newspaper databases, such as Lexis-Nexis and DIALOG, combined with informational directories makes this strategy an efficient method of research. Further, the simplicity of this technique has the potential for far-reaching results. This approach is useful to those who lack the resources to invest in more expensive forms of research, such as surveys.

New perspectives. Since many communications scholars study the media's influence on individual behaviors, the community structure approach allows for an introspective investigation of an audience's influence on media coverage. Newspaper publishing is, in fact, a business whose primary function is to earn money through advertising. Therefore, it is necessary to examine the influence of the community on newspaper coverage of controversial events. The significant findings found within this study amplify the importance of the community structure approach as a perspective of communication research.

This study found a significant relationship between city characteristics and favorable newspaper coverage of the Elián González custody battle. Content analysis should be expanded to include a wider representation of cities. In addition, specific points of inflection can be identified throughout the unfolding of events and information pertaining to this international custody battle. The coverage produced between these turning points should be analyzed and compared to note potential changes in reporting perspectives. Additionally, newspaper reporting of the Elián González story could be compared to coverage of other controversial events concerning a parent's right to custody, such as the "Baby M" trial of the 1980s, to analyze changes in exposure over time.

The hypotheses presented within this study should also be expanded in further research. College education and the number of AM radio stations have the potential to be directionally significant should the research be modified or expanded. Further,

the stakeholder hypothesis, which was statistically verified, should be expanded to include divorce rates and children who are enrolled in school or daycare. By broadening the spectrum of newspapers and cities and narrowing the time frame of coverage, further studies may reveal further correlations between city characteristics and newspaper reporting.

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Why Argue with Albert Einstein about Mathematical Reasoning? An Investigation of the Role of Spatial Abilities in Mathematical Reasoning

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ABSTRACT

This study examined the role that spatial abilities play in mathematics. Although a great deal of research has demonstrated sex-linked differences in measures of these abilities, significantly fewer experiments focus on potential relationships between the two. Within this sample, there were no observations of sex-linked differences in past spatial experiences as a whole, although several differences existed on specific items within the 81-item measure. Men in this sample outperformed women on a standardized composite of three measures of spatial ability. Men were also significantly more likely to enroll in Calculus or Pre-Calculus instead of Statistics or Foundations of Mathematics or no mathematics course. This difference existed despite an absence of any significant difference in the number or difficulty of high school mathematics course enrollment. Interestingly, when gender or sex-linked differences in past spatial experiences were controlled for, sex-related differences in collegiate mathematics enrollment were mitigated.

INTRODUCTION

Albert Einstein, certainly one of the most prolific mathematicians of the twentieth century, reported that all of his mathematical thought was based upon visualization (Hadamard, 1945). PsycINFO (a psychology search engine) lists more than 1,600 items published since 1967 involving sex or gender differences in mathematics; over 1,400 items have been published on gender

differences in spatial abilities. However, only 100 publications, barely over 3%, incorporate both differences into one study, and far fewer investigate the relationship between the two. It seems odd that so little research has combined these two areas; each area has included reports of sex-linked differences favoring men, presenting a seemingly obvious need for research investigating the relationship between these cognitive abilities. The current body of literature is plagued by definitional debates, so definitions for the ambiguous terms sex, gender, and spatial abilities must be established at the onset. This is done for the ease of the reader, not to incite debate.

The difference between sex and gender must be defined. Sex, within the confines of this paper, will refer to a biological construct and gender will refer to a social construct. This social construct is based on a composite of the exhibition of particular behaviors or acceptance of certain attitudes popularly deemed masculine or feminine. Sandra Bem (1974) and Spence and Helmreich (1978) have assessed these constructs and incorporated them into measures of gender. These measures, the Bem Sex Role Inventory and the Personal Attributes Questionnaire, were used in this experiment. Within this framework, past research reports of gender differences will frequently be considered reports of sex-linked differences, unless an assessment of gender is used.

According to Linn and Petersen (1985), spatial ability is the "skill in representing,

transforming, generating, and recalling, symbolic nonlinguistic information" (p. 1482). The necessity of compartmentalization of spatial abilities, for measurement and investigation, was argued by Linn and Petersen (1985) and Voyer, Voyer, and Bryden (1995). Linn and Petersen (1985) subdivided spatial abilities into (a) spatial perception abilities, (b) mental rotation abilities, and (c) spatial visualization abilities. Spatial perception is used in reference to tasks requiring the participant to "determine spatial relationships with respect to the orientation of their own bodies, in spite of distracting information" (Linn & Petersen, 1985, p. 1482). Linn and Petersen (1985) define mental rotation as "the ability to rotate a two- or three-dimensional figure rapidly and accurately" (p. 1483). Spatial visualization is broadly used to encompass the many tasks that incorporate multi-dimensional constructions or manipulations, defined by Linn and Petersen (1985) as "complicated, [multi-step] manipulations of spatially presented information" (p. 1484). These definitions, which were later reiterated by Voyer et al. (1995), have come to be the generally accepted definitions of spatial perception, mental rotation, and spatial visualization, and they have been used consistently to differentiate spatial abilities.

Past research on sex-linked differences in spatial abilities has included biological theories (e.g., Casey, Nutall, & Pezaris, 1999; Newcombe & Dubas, 1992), social attributions (e.g., Casey et al., 1999; Baenninger & Newcombe, 1995), the role of non-curricular experiences (e.g., Baenninger & Newcombe, 1995; Baenninger & Newcombe, 1989; Newcombe, Bandura, & Taylor, 1983), and the role of formal education (Baenninger & Newcombe, 1995). Similarly, past research on sex-linked differences in mathematics has also considered many issues within the broad spectrum from biological theories (e.g., Benbow, 1988) to social attributions (e.g., Baenninger & Newcombe, 1995), and from the effects of non-curricular experiences (e.g., Baenninger & Newcombe, 1995)

to the differential implications of aptitude test performance (e.g., Stumpf & Stanley, 1996; Kimball, 1989).

Elementary Education:

Preschool through Grade 8

Robinson, Abbott, Berninger, and Busse (1996) demonstrated one of the earliest sex-linked differences in mathematics performance, based on the performance of 300 children labeled as high achieving on measures of intelligence and the assessment of mathematical ability. It should be noted that there were far more boys than girls originally enrolled in this study, and later the sample was further diminished to create more proportional groups. This is noteworthy in its own right, as it demonstrates that boys are viewed as more capable in mathematics than girls early on in education. The results of this study demonstrated a highly significant sex-linked difference in mathematics performance (Robinson et al., 1996), based upon assessments of numeration and basic mathematical concepts. Although it is difficult to make any inferences as to future mathematical ability since there are so many events that could alter development from such an early age, these results do establish the framework for an abundance of experiments with similar findings for older participants.

According to Fennema and Carpenter (1981), at age 9 there are neither sex-linked mathematics achievement differences nor sex-linked numeration performance differences; however, the method of assessment used by Fennema and Carpenter in this experiment was unclear. On the other hand, Fennema and Carpenter (1981) found that, as early as age 9, boys outperform girls on assessments of the more spatially dependent mathematical subjects of geometric knowledge, skills, understanding, and applications, as well as "measurement" knowledge, skills, and applications.

According to Manger and Eikeland (1998), the magnitude of sex-linked differences in mathematical performance increases with task difficulty. This could be the result of

greater dependence upon spatial visualization abilities as difficulty rose. At this early age, there were no significant sex-linked differences in spatial visualization abilities. As demonstrated in Table 1, Linn and Petersen (1985) found that there was an extremely small effect size for sex-linked differences in spatial visualization at any age. Additionally, Voyer et al. (1995) found that sex-linked mental rotation and spatial perception differences with a small but significant effect size do exist among people under the age of 13; the latter was supported by Linn and Petersen (1985). These differences establish the pattern of increases in magnitude throughout development.

Table 1. Effect sizes for sex-linked differences in spatial abilities

Age Group	Voyer, Voyer, & Bryden (1995)			Linn & Petersen (1985)		
	Spatial Perception	Mental Rotation	Spatial Visualization	Spatial Perception	Mental Rotation	Spatial Visualization
All ages	0.44*	0.56*	0.19	0.44*	0.73*	0.13
Under 13	0.33	0.33*	0.02	0.37	N/A	N/A
13-18	0.43*	0.45*	0.18	0.37*	N/A	N/A
Over 18	0.48*	0.66*	0.23*	0.64*	N/A	N/A

Note. * $p < 0.05$ (Adapted from Voyer et al., 1995).

Voyer et al. (1995) found that, by the age of 13, the sex-linked difference in spatial abilities had grown to a moderate effect size for mental rotation and spatial perception, and there was a small increase in the effect size for spatial visualization. This clearly shows the trend that sex-linked differences in mathematics performance and all subgroups of spatial ability grow greater with age. Thus, it is possible that the sex-linked differences in these abilities have a common cause, or one of these two abilities is reliant upon the other. Based upon Einstein's assertion that mathematical reasoning is, for him, dependent upon a visuo-spatial thought process (Hadamard, 1945), the most intuitive assumption would be that differences in spatial abilities account for the differences in mathematics performance.

The past literature has consistently partitioned age groups at 13, which is significant for two reasons. First, this is a period of great biological change and physical development, as girls have already begun going through

puberty, and boys are just beginning to do so (Dworetzky, 1996). Second, this is the point just prior to the time at which students enter high school, where they may begin to have some limited control over course selection. These two factors may interact with one another. That is, the insecurity most people experience during their early teen years, coupled with the popular belief that women are less capable in mathematics, may combine to lead girls to attempt conformity by opting out of optional mathematics courses or enrolling in less difficult mathematics courses.

Secondary Education: Grades 9-12

If sex-linked differences emerge as early as 5 years of age and increase through childhood and puberty, one can make a relatively logical assumption that, as a child enters adolescence and makes the transition to high school, the framework for a sex-linked difference in secondary and higher education is already present. This is supported by an abundance of empirical evidence in the form of independent experiments and meta-analyses.

Fennema and Carpenter (1981) demonstrated that 17-year-old boys increasingly outperformed girls on measures of mathematical knowledge, skills, understanding, and applications, clearly an indication of the positive relationship between sex-linked differences in performance and task difficulty. Hyde, Fennema, and Lamon (1990) demonstrated in their meta-analysis that young men outperformed young women on mathematical problem-solving tasks with a relatively small effect size ($d = 0.29$), while computation and conceptual tasks produced no notable effect sizes. This is similar to the findings in younger samples, in that boys only marginally outperform girls, and these differences are present only on the most difficult tasks and are most prominent in highly select populations.

As further evidence of the sex-linked difference in mathematics prevalence amongst the academically talented, Benbow (1992) demonstrated that men outperformed women on several tasks.

Based upon percentages of top mathematical performers, sex-linked differences existed in performance in advanced mathematics classes with a small effect size ($d = 0.18$), performance on College Board Achievement Tests (currently referred to Scholastic Assessment Tests II: Subject Tests) with a large effect size on both the Level 1 and Level 2 Tests ($d = 0.75$ and $d = 0.96$, respectively), and the percentage of those top performers participating in math contests with a moderate effect size ($d = 0.46$). These results are supported by the findings of the more recent study published in 1996 by Stumpf and Stanley. As demonstrated in Tables 2 and 3, Stumpf and Stanley showed that as the sample became less select over time, the effect size for the Advanced Placement Calculus BC Exam increased from 1984 to 1992, and there was a similar increase in the effect size of the SAT II: Mathematics Level 2 Test from 1982 to 1992. It should be noted that this is at least partially the result of the increase in the number of women taking these tests. The Calculus BC Exam registrants went from 30% young women to 35% young women from 1984 to 1992, and the SAT II: Mathematics Level 2 registrants went from 34% young women to 42% young women from 1982 to 1992. It is also worth noting that men performed significantly better than women on the SAT I: Math ($d = 0.40$) in 1985 (Hyde et al., 1990). This demonstrates an increased interest in mathematics among women, which one can presumably anticipate will necessarily precede a decrease in differences in mathematical performance between men and women at the secondary and collegiate levels.

Table 2. Changes in sex-linked difference effect sizes for Advanced Placement Tests

Subject	1984			1992		
	N	% Male	d	N	% Male	d
Calculus AB	30,115	60%	0.17	74,919	55%	0.17
Calculus BC	9,315	70%	0.20	15,395	65%	0.26
Physics	3,543	79%	0.47	11,725	69%	0.37
Physics: Mechanics	2,748	85%	0.42	6,960	78%	0.45
Physics: Electricity and Magnetism	1,900	87%	0.36	3,805	80%	0.28

Note. All effect sizes are performance-based and men scored higher than women in all cases. (Adapted from Stumpf & Stanley, 1996)

Table 3. Changes in sex-linked difference effect sizes for Achievement Tests

Subject	1982			1992		
	N	% Male	d	N	% Male	d
Mathematics I	145,227	50%	0.39	128,205	45%	0.37
Mathematics II	37,603	66%	0.37	63,918	58%	0.42
Physics	15,991	71%	0.58	19,213	75%	0.62

Note. All effect sizes are performance-based and men scored higher than women in all cases. (Adapted from Stumpf & Stanley, 1996)

It should be noted, as was mentioned earlier, that high school is the time when students begin exercising some control over their course selection. Sherman (1983) noted that "among students taking the College Board Examination [also referred to as the Scholastic Assessment Test], 73% of boys and 57% of girls had taken seven or more semesters of math" (p. 273). This suggests that boys elect to continue mathematics when it is no longer required, and thus may take a more advanced mathematics course in their final year. According to Sherman (1981), spatial visualization is the most significant predictor of mathematics enrollment when measured during the senior year; however, Sherman (1983) showed that spatial visualization ranked sixth amongst the predictive variables when the assessment occurred during the participant's junior year. It is interesting to note that geometry is usually taken during the sophomore year; thus, the more time that transpires after taking geometry, the more significant visual spatial abilities become, and the less important attitudes and motivation become. This change could possibly be the result of both a change in attitudes toward spatial tasks since completing geometry, and some increase in spatial abilities that results from non-traditional spatial experiences.

Past spatial abilities research has shown significant sex-linked differences with moderate effect sizes from the ages of 13 to 18 on rotation tasks and spatial perception tasks (Voyer et al., 1995). It should be noted that this is when the difference in spatial visualization most consistently emerges according to the meta-analysis of Voyer et al. (1995). This further supports the logic of the use of spatial abilities in mathematical reasoning. Once

again, as both the difficulty in mathematics and the sex-linked differences in spatial ability increase, so do the sex-linked differences in performance in mathematics. Also, there is a clear pattern of young men choosing more mathematical challenges than young women, as well as performing better, on average, than young women despite being a less select sample. Thus, it again seems that spatial ability differences are related to sex-linked differences in mathematics. The patterns in mathematics course selection and performance establish the foundation for college education, in which the role of men in mathematics is far greater than that of women.

Post-Secondary Education and Beyond

Although there has been a great deal of research on college students, there seems to be a gap in the work that will be quite apparent by the end of this section. In their meta-analysis, Hyde et al. (1990) demonstrated that 19- to 25-year-old men outperform women on problem-solving tasks with a somewhat small effect size ($d = 0.32$); no differences were reported for computational or conceptual measures of mathematics because such data were not collected for this age group. When including all studies of mathematics, there was almost a moderate effect size ($d = 0.41$) differentiating the performance of men and women (Hyde et al., 1990).

Benbow (1992) found several interesting relationships in a sample of students labeled as high achieving mathematics students in middle school. Following the precedent of Keating and Stanley (1972), Benbow restricted the sample to those whose SAT-M scores ranked in the top 1% amongst seventh and eighth graders taking the SAT. Benbow (1992) focused on the comparisons between the top and bottom quarter of this highly selective sample after 10 years had passed. There were 250 men and 62 women in the top quarter, while the numbers were essentially equal in the bottom quarter. Sex differentiated the top one percent of mathematical performers on the number majoring in math or science ($d = 0.65$) and the number of mathematics or

science courses in college ($d = 0.43$), while there was no significant difference in mathematics and science grade point average. This could result from men taking more difficult courses as they continued to study mathematics, since continued enrollment in a subject nearly always entails increasing difficulty, or a ceiling effect of the grading system as such a select sample is used. Men also worked on more research projects ($d = 0.16$), participated in more math or science contests ($d = 0.36$), and received more awards in mathematics or science ($d = 0.34$) than did women. This sets the framework for graduate study; more men attended graduate school than women ($d = 0.24$). Furthermore, more men attended graduate school specializing in math or science than women ($d = 0.42$), and more men than women had a career goal in mathematics or science ($d = 0.33$).

Thus, men and women have been differentiated through their mathematical experiences within the educational system, thereby differentiating them as they go on to graduate study or the workplace. The danger is that these gaps in education between the sexes have not yet been mitigated, and as a result, mathematics-related fields have become dominated by men. Since there is little which biologically differentiates men and women in an intellectual environment, society has essentially diminished potential mathematics scholars and mathematical advances.

Spatial Abilities' Role in Mathematics: The Theoretical Basis

There have been dozens of studies, summarized by three meta-analyses, demonstrating that men score higher than women on two of the three subcomponents of spatial abilities, increasing in magnitude with age and the selectiveness of the sample (e.g., Voyer et al., 1995; Linn & Petersen, 1985). There have been similar findings within the realm of performance of mathematics (e.g., Benbow, 1992; Hyde et al., 1990). These findings lead to the question: does the sex-linked difference in spatial abilities cause the sex-linked difference in mathematics?

Although there have been studies to the contrary (e.g., Fennema & Tarte, 1985), the predominant view is that spatial abilities are a significant component of mathematics performance. Casey, Nutall, Pezaris, and Benbow (1995) demonstrated that the difference between the measured mental rotation ability of men and women could account for the disparate performance of high-ability college-bound men and women on the mathematics component of the Scholastic Aptitude Test (recently renamed the Scholastic Assessment Test). Thus, sex-linked differences in performance on measures of mental rotation ability are indicative of mathematics performance. However, this does not mean mental rotation ability differences are responsible for the difference in mathematics performance; rather, it demonstrates that spatial abilities are a vital element of mathematical abilities.

Casey, Nutall, and Pezaris (1997) clarified the role of mental rotation ability in mathematical reasoning; while mental rotation task performance accounts for only 26% of the variance in SAT-mathematics scores ($r^2 = 0.264$), mathematical self-confidence and performance in geometry account for 57% ($r^2 = 0.567$) and 35% ($r^2 = 0.348$), respectively. Evidently, there is a complicated relationship present, and predicting mathematics performance solely based upon spatial abilities may be impossible. Essentially, spatial abilities are a necessary component of mathematical reasoning; however, social norms are likely to serve as an influence upon motivation, thus confounding any inter-sex attempts at predicting mathematical performance.

Trends in Course Selection and Their Significance

The logical extension of sex-linked differential mathematics course enrollment seems quite apparent. Clearly, the relationship between spatial abilities and mathematical performance will be accentuated by differential formal training favoring men. Thus, by further training one group, while neglecting another, a self-accentuating cycle will occur, creating increasingly robust differences over

time. By recruiting a sample with essentially equal past curricular experiences, it is possible to investigate why men and women choose disparate mathematical paths. Furthermore, it is also possible to attempt to find what differentiates their mathematical involvement as they begin their career paths with the start of college.

The logic of this argument is as follows: throughout development, the magnitude of sex-linked spatial abilities differences increases, and, since spatial abilities are necessary for advanced mathematical reasoning, as mathematics becomes increasingly abstract, the effect size in mathematical performance increases. This difference in mathematical performance leads to differential motivation and enrollment in advanced mathematics courses, leading to the previously discussed sex-linked differences in the sheer number of academics specializing in mathematics. This leads to a popular belief that men are inherently better at math, and thus boys receive more encouragement to participate in mathematics than girls do, just as boys receive more encouragement than girls do to participate in spatial activities, continuing the self-perpetuating cycle. It is most likely that this cycle may be most easily broken as people enter secondary school and college, since at this level they have more freedom to choose courses. By finding the cause of the difference in collegiate course selection, one can refine future educational strategies by mitigating the cause of sex-linked differential course selection.

The study presented here is an initial investigation of whether there were any sex-linked differences in (1) spatial ability as a standardized composite of its subcategories; (2) each of the subcomponents of spatial ability; (3) past non-curricular spatial experiences; (4) high school mathematics course enrollment; or (5) current collegiate mathematics course enrollment. Finally, if any difference is found in mathematics course selection, can any other sex-linked differences account for the difference in course selection?

METHOD

Participants

The 71 participants in this study included 47 women and 24 men, all of whom were students at The College of New Jersey during the Fall 1999 semester. Participants were recruited from a variety of psychology and mathematics courses, only some of whom received extra credit in an academic course for their participation. Attempts were made to secure extra credit for all participants; however, this attempt was unsuccessful in some cases. Some professors who allowed recruitment of their students did not have a grading policy that incorporated credit for research participation. To mitigate the potential effects of this difference, all participants were entered in a drawing for \$50, after which, refreshments were served. All participants needed to be available during one of the 10 two-hour data collection sessions that were held weekly.

Measures

Group Embedded Figures Test (GEFT).

Oltman's, Raskin's, and Witkin's (1971) Group Embedded Figures Test is, according to Linn and Petersen (1985) and Voyer et al. (1995), a measure of spatial visualization with a large dependence upon spatial perception. This three-section test includes one practice section and two scored test sections, which require participants to locate and trace a geometric model within a more complicated geometric figure, made up of lines and shaded regions, without requiring any manipulation of the model. Since the task is absent of any manipulation of the to-be-located model, the task does seem to fit more closely to the currently accepted definition of spatial perception.

Mental Rotations Test (MRT). Vandenberg's (1971) Mental Rotations Test, with revised instructions by Crawford (1979), has long been the most commonly used test of Mental Rotation Abilities. This two-part, 20-item test consists of a task during which the participants are required to select which two of

four, two-dimensional figures represent the same three-dimensional object as the model two-dimensional presentation of a three-dimensional object.

Differential Aptitude Tests: Space Relations Subtest (DAT-SR). This 60-item subtest of BenNET's, Seashore's, and Wesman's (1947) Differential Aptitude Tests is, according to Voyer et al. (1995) and Linn and Petersen (1985), a measure of spatial visualization. This test requires the participant to decide which one of four two-dimensional presentations of a three-dimensional object can be formed by the model pattern presented to his or her left. This is used as a measure of spatial visualization even though it may incorporate spatial perception and mental rotation tasks, since it allows for the use of diverse creative problem-solving strategies independent of spatial perception and mental rotation.

Bem's Sex Role Inventory (BSRI). Sandra Bem's (1974) assessment of gender categorizes participants as masculine, near masculine, androgynous, near feminine, or feminine based upon their responses on this 60-item questionnaire. This questionnaire breaks down into 20 masculine items, 20 feminine items, and 20 unscored control items.

Composite scores of masculinity and femininity are calculated based upon participant responses on a five-point likert scale, and then combined to assess gender as a continuous variable, which can be assigned one of five categorical labels based upon how an individual's responses compare to the population at large. This measure was employed because it creates more categories of gender than does the Personal Attributes Questionnaire.

Personal Attributes Questionnaire-Short Form (PAQ-SF). Spence's and Helmreich's (1978) assessment of gender is comprised of 24 items divided amongst three scales: (1) an assessment of masculinity, (2) an assessment of femininity, and (3) an assessment of opposing masculine and feminine tasks. The responses are scored on a scale from zero to four in which polarized attributes are presented at zero and four (i.e., very passive to very active).

The example was used to assess masculinity with very active representing the masculine pole. Within the assessment of masculinity and femininity, the absence of masculinity does not imply the presence of femininity, and vice versa. The two scales see masculinity and femininity as exclusive, whereas the components of the masculinity-femininity scale use attributes for which this would be true. This measure was used because of its acceptance of masculinity and femininity as non-polarized concepts, and its use of gender as a continuous variable.

Spatial Activities Questionnaire—Revised (SAQ-R). Baenninger and Breland (1997) revised Newcombe's, Bandura's and Taylor's (1983) Spatial Activities Questionnaire to an 81-item assessment of spatial experiences. These activities are broken down into 9 sub-categories: competitive team sports; single or pairs sports; outdoor activities or sports; athletic skill activities; arts and crafts; model building and related activities; puzzles, games, and brain-teasers; household, repair, and skilled activities; and other activities. Participants respond to their level of involvement in these activities both through high school and since completing high school.

Demographics Questionnaire. This measure was designed specifically for this experiment to collect descriptive data, including participants' age, sex, class status, major, second major, minor, race, high school mathematics curriculum, future plans involving mathematics, past mathematics and statistics courses taken at The College of New Jersey, mathematics and statistics courses currently being taken at The College, future mathematics course selection plans, and motivations for such future course selection plans.

Procedure

Several recruitment announcements were made in various mathematics and psychology classes with the permission of the course instructors. All participants were informed that their non-participation in this study would have no bearing on their course grade, and that they might be offered extra credit

in the psychology courses in which they were currently enrolled for their participation. Participants were also encouraged to participate by their entry into a lottery for \$50 and food following testing. Participants signed up for one of 10 sessions that were held weekly. Participants were informed that their grades might be provided to the researchers; however, it would be done without any student researcher's knowledge of their names, by means of a self-selected participant number. This was all thoroughly explained in the informed consent.

Upon arriving at the designated testing room, all participants read and, if they agreed with the conditions of the experiment, signed the informed consent. Following this, participants removed the GEFT from a packet of testing material. The same procedure was followed for the administration of the MRT, DAT-SR, PAQ, SAQ, and a demographics questionnaire. Students were given a brief break between the completion of each measure and the administration of the next. Upon the completion of their participation, refreshments were offered to the participants and they were given an opportunity to learn more about the tests they completed. This feedback completed the test battery. Student records were never accessed and grades were never recorded. For further explanation, see the discussion section.

RESULTS

The results of this study partially confirmed the initial hypotheses. First, men in this sample did perform significantly better than women on a composite measure of spatial ability comprised of each of the spatial subtests, $F(1, 69) = 5.081$, $p < 0.05$. Standardizing the scores on each of the spatial measures, and then combining them since they each measured one of three complementary sub-components of spatial abilities, formed the spatial composite. There was also a highly significant sex-linked difference favoring men on the mental rotations test, $F(1, 69) = 11.085$, $p < 0.001$. This was expected since the Mental

Rotations Test has frequently been shown to have the greatest sex-linked effect size.

There were no significant differences in past spatial experiences as a whole; however, men were significantly more involved than women in team sports, $F(1, 69) = 13.629$, $p < 0.001$ and individual or pair sports, $F(1, 69) = 5.244$, $p < 0.05$ as adults. As children, the women in this sample reported significantly greater participation in arts and crafts than the men, $F(1, 69) = 9.396$, $p < 0.01$, and men reported significantly greater participation in building models and other objects than the women, $F(1, 69) = 10.084$, $p < 0.01$. These results are to be expected as the men were more involved in the masculine activities, and women were more involved in the feminine activities. It should be noted that the construction of models is most likely a contributor to mental rotations ability.

Table 4. Performance on spatial measures by sex.

Measure	N	M	SD
MRT			
Men	24	21.08	7.92
Women	47	15.14	6.66
DAT-SR			
Men	24	13.67	4.08
Women	47	12.53	4.96
GEFT			
Men	24	41.47	13.58
Women	47	35.81	12.54

Note. The only significant difference occurred on the MRT, $F(1, 69) = 11.085$, $p < 0.0001$.

Subsequent analyses found that when partialing sex-linked differences in past spatial experiences out of the spatial composite, the significance of the relationship between sex and spatial ability is mitigated, $r(65) = -0.1901$, $p > 0.10$. Thus, differences in non-curricular spatial activities can account for differences in spatial ability.

There were no sex-linked differences in the number of these students who took calculus or pre-calculus in high school, and there were no sex-linked differences in the numbers of years enrolled in mathematics courses during high school. Yet, there were significant sex-linked differences in college course enrollment, $F(1, 69) = 9.064$, $p < 0.01$; significantly more men than women enrolled in the more

demanding calculus courses in order to fulfill their general education mathematics course requirement. College course enrollment had three levels (no mathematics, statistics or foundations of mathematics, and calculus or pre-calculus). This difference could not be mitigated by partialing out performance on the mental rotations test and/or the composite spatial score; however, it was mitigated by partialing the four non-curricular spatial experiences which contained sex-linked differences that were listed above from the relationship between sex and college mathematics course enrollment, $r(65) = -0.2227$, $p > 0.05$.

Analyses based upon gender revealed that the sex-linked difference in college mathematics enrollment failed to persist when gender was controlled for, $r(65) = -0.2011$, $p > 0.10$. Although this theoretically genderless person could never exist, it does present a clear possibility for gender having an effect on behavior, and such differences are distinct from sex-linked differences.

DISCUSSION

Several issues must be raised regarding the results of this experiment. There are several potential confounds to an investigation of this type, the most apparent of which are the differential requirements of certain majors. One might suggest that the differences in college course enrollment were not the result of the participants' choices, but rather dependent upon the specific major. Another potential confound is this institution's use of a placement exam for determining the most appropriate level of mathematics along the calculus track, and those students choosing not to take the calculus placement exam were restricted to courses in statistics or foundations of mathematics.

As valid as these criticisms are, it should be noted that these phenomena are actually indicative of motivation to pursue mathematics education. Those students who see the importance of mathematics are more likely to go to additional lengths to enroll in more

advanced mathematics courses. As to the criticism that these differences are based upon academic major selection and the requirements of each specific major, this is indicative of women selecting careers which are less mathematics- and science-dependent, as was demonstrated by Hyde et al. (1990).

There may also be an effect resulting from advisers encouraging students not to take calculus and to lighten their academic load by taking less demanding mathematics courses to fulfill their general education requirement. Although there is no empirical or observational evidence of such occurrences, it is another possible component of the sex-linked mathematics enrollment difference, as advisers can have an effect on their advisees' eventual course enrollment.

It is also worth noting that these results might not have been statistically significant if the sample were from a student body at a less selective academic institution. Past research has demonstrated that the differences in spatial ability and mathematics increase as the population becomes increasingly select, and as an institution with increasingly strict admissions criteria, The College may enjoy a difference somewhat above that of the population at large. It would be interesting to compare these results with those of the same experiment conducted at an institution with an open admissions policy. One might expect these differences not to be significant, suggesting that stricter selection standards might have a greater social normalizing influence, as it is the norm for men to pursue math and science and women not to be so inclined. It may also be a function of biases of an admissions office at more selective academic institutions.

The relative insignificance of gender, as compared to sex, could be attributed to several different phenomena. The largest problem is the measuring of a social construct using a measure that dates back three decades, as the social definitions of

masculinity and femininity have changed a great deal within the last three decades. Having used both continuums of masculinity and femininity (e.g., the PAQ-SF) and a discrete categorization of gender (e.g., the BSRI), nearly all statistical approaches were possible, and yet no consistent gender-linked differences were found, despite sex-linked differences. Adding to the confound of time-lagged measurements of gender, the relative uniformity of the student body from which this sample was recruited created little variance to be accounted for by other variables, thus limiting the power for correlation between gender and spatial abilities. It should be noted that there were no significant differences between men and women on the standardized composite of spatial ability after partialing out the effects of gender, as measured by the PAQ-SF. This theoretically genderless person is not a potential reality; however, it does demonstrate that gender can account for the sex-linked differences in spatial ability found within this sample.

Future investigations may want to focus on the predictors of mathematics course selection used by Sherman (1981, 1983) with high school students (e.g., achievement in mathematics, attitude toward success in mathematics, confidence in learning mathematics, views of utility of mathematics, motivation to pursue mathematics, and views of mathematics as a field dominated by men) and collect such data from college students who have virtually absolute freedom of course selection. These components, combined with spatial abilities and past spatial experiences, as measured within this experiment, significantly and almost fully account for the sex-linked differences in mathematics course enrollment. From this experiment, it is clear that differences in spatial ability and high school preparation are not sufficient for explaining differences in college mathematics course selection.

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Bar Duration as a Measure of Memory Organization: Exploring Skilled Memory in a Concert Pianist

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ABSTRACT

While learning J. S. Bach's *Italian Concerto* (*Presto*), a concert pianist (Gabriela Imreh) recorded her first three attempts to play the piece from memory, as well as her final performance of the piece without the score. Bar durations were measured for each recording. Durations were longer for bars that contained features of the formal structure and features of the piece that the pianist attended to during performance, suggesting that these features served as cues for retrieving the music from memory. Like other forms of expert memory, pianistic memory appears to be based on the use of a well-learned, hierarchically organized retrieval structure that allows meaningful encoding of novel material as well as rapid retrieval of information from long-term memory.

INTRODUCTION

During most of the history of the European concert tradition, concert pianists were not expected to perform from memory. Memorization of large works was attained only in the second half of the 19th century, when Franz Liszt and Clara Schumann first demonstrated that such a feat could be achieved (Chaffin & Imreh, 1997). Soon, the ability to play from memory became a requirement for any pianist seeking to attend a conservatory, pass an examination, win a competition, or play a recital. Playing from memory during a piano performance is challenging. In longer pieces, pianists must play for up to 50 minutes without pause,

producing notes at a rate of more than 1,000 per minute (Chaffin & Imreh, 1997). Additionally, performance tends to elicit anxiety and distractions that can provoke memory lapses. To proceed beyond such obstacles, it is important that performers have many easily accessible recovery routes. Thus, the creation of multiple, flexible retrieval systems is an important component of a concert artist's preparation of a piece for performance. The present study seeks to find evidence suggesting how analogous the retrieval structures used by musicians are to those used by expert memorists in other domains.

Expert Memory

Experts in many realms are characterized by their exceptional memory for domain-related material (Chase & Simon, 1973; Ericsson & Smith, 1991). So what differentiates the memory organization used by experts from that of amateurs, and how do these schematic differences promote experts' adeptness in encoding domain-related material? Expert memory has been explained in terms of three principles of skilled memory: meaningful encoding of new information, use of a well-organized and highly practiced retrieval structure, and rapid retrieval of information from long-term memory (Chase & Ericsson, 1982; Ericsson & Kintsch, 1995; Ericsson & Oliver, 1989).

The first principle asserts that experts' knowledge of their area of expertise has already been stored in memory and thus can be used when encoding novel information (Chase & Ericsson, 1982). In piano playing,

the previously acquired knowledge structures include chords, scales, arpeggios, phrases, and harmonic progressions (Chaffin & Imreh, 1997). The learning of these structures is an integral component of professional training. Professional training lasts a minimum of 10 years and includes at least 10,000 hours of focused practice (Ericsson & Charness, 1994; Ericsson, Krampe, & Tesch-Römer, 1993; Simon & Chase, 1973). Through attentive and extensive practice, knowledge structures become present in semantic memory. When new material is presented, previously acquired knowledge can be used to help recognize new information as a variation of more familiar, previously acquired material. As a result, experts sort their knowledge into larger chunks, recognize and remember large amounts of information more quickly, and make quicker decisions about new information (Chase & Simon, 1973; Ericsson & Smith, 1991).

According to the second principle, expert memory requires well-learned, hierarchically organized retrieval schemes to provide cues that are associated with novel material during encoding (Ericsson & Oliver, 1989). Retrieval structures are frequently used during practice. Previously acquired knowledge is used to determine retrieval cues. The retrieval scheme relies upon the hierarchical organization of the cues. When new information must be remembered, it can be encoded in relation to its classification within previously used retrieval schemes. The hierarchical organization within a new retrieval scheme is in large part provided by the structure of previously used schemes. When encoded material needs to be recalled, cues used for classification during encoding can be used to aid retrieval.

The third principle asserts that experts' extensive practice, during which retrieval schemes are frequently used, greatly increases the rate at which the retrieval cues can be accessed when information needs to be retrieved from long-term memory (Ericsson & Kintsch, 1995). Recall is often a part of

practice, and thus retrieval schemes are frequently practiced. Through repetitive use of retrieval cues, retrieval schemes become present in long-term memory. By practicing recall, the retrieval rate is improved. When compared to non-experts', experts' knowledge is not just more extensive but also more quickly accessible (Ericsson & Smith, 1991).

Motor and Conceptual Memory

The use of motor memory appears to be much more important for musicians than it is for most other kinds of expertise, e.g., chess. Although it develops easily and rapidly, motor memory is not very reliable during performances. As one movement is a retrieval cue for the next movement, once a distraction or memory lapse halts movements there is almost no hope for a recovery unless the musician starts over at the very beginning of the piece, an action the audience would regard with disdain. It is thus necessary that professional pianists develop more reliable retrieval systems. If, for example, a musician's retrieval cues are based upon the formal structure and performance features of the composition, then the musician can simply move ahead to a new starting point, making recovery more successful. After using one conceptual cue, the musician could again rely on motor memory until the next conceptual cue occurred. Since motor memory is less reliable than conceptual memory over an extended period of time, passages that are more reliant upon motor memory are more often forgotten during long-term retrieval.

Besides helping a performer recover from a memory lapse and improve long-term recall, having a conceptual representation of the piece that includes elements of its formal structure could help a musician play through a work without unintentionally repeating or omitting a section. Likewise, a conceptual representation that includes elements of the composition's performance dimensions could also help the musician to play the notes correctly, give the interpretation intended, and express the emotions desired. Consequently, the use of a conceptual representation of the

music that is similar to the hierarchical retrieval structure that has been observed in use by other expert memorists would be advantageous to a performer.

Pianistic Memory

The work used in the present study was well suited to examine the operations of the second and third of these principles. The third movement, marked *Presto*, of J. S. Bach's *Italian Concerto* has a complex hierarchical structure. The purpose of the study was to look for evidence that the pianist relied upon the formal structure in retrieval. As shown in Figure 1, the *Presto* was composed using a variation of the Italian Rondo form, giving the formal structure of the composition unique character. The Italian Rondo form typically contains a theme, A, repeated six times, with minor variation, separated by five sections that each consist of different musical material: A1, B, A2, C, A3, D, A4, E, A5, F, and A6. In the *Presto*, most sections are divided into subsections, resulting in a total of 37 sections and subsections, all between four and 20 bars in length, as the piece is played through. To ensure that a section of the piece is not inadvertently repeated or omitted, the composition's formal structure must be salient in a pianist's thoughts during encoding and retrieval.

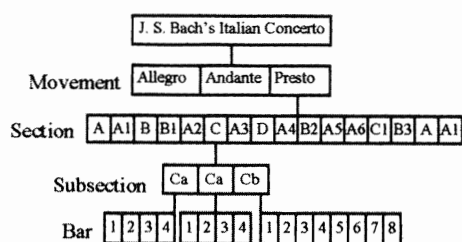


Figure 1. The hierarchical organization of the formal structure of J.S. Bach's *Italian Concerto* (*Presto*).

While learning and performing a composition, a pianist must also attend to performance features that ensure that the correct notes are played, the intended interpretation of the music is given, and the planned emotions are conveyed (Chaffin & Imreh, 1996). Locations in the score where attention must

be paid to fingering, technical difficulties, conceptual units, phrasing, dynamics, pedal, and tempo provide natural features to serve as retrieval cues for the composition. Thus, these features may serve as the bottom level of the large-scale organization of a retrieval scheme.

Other studies that have been conducted in the domain of pianistic learning indicate that pianists' practice segments corresponded with sections of the pieces they were learning (Gruson, 1988; Miklaszewski, 1989, 1995). The work of Chaffin and Imreh (1997) during earlier phases of this study demonstrated more specific empirical evidence that practice segments were more likely to start and stop at boundaries in the formal structure and that recall was best at the beginnings of sections in the formal structure. By reporting data on starts, stops, and repetition during practice as well as recall during long-term retrieval of 32 bars of the piece, their study showed the pianist's reliance upon the formal structure during encoding and retrieval.

Data analyzed in earlier phases of the study of the pianist learning the *Presto* confirmed that the pianist attended to the formal structure as well as to other features of the composition while learning and recalling it (Chaffin & Imreh, 1996, 1997; Chaffin, Imreh, Konik, & Dougert, 1998). During six of seven stages of learning, practice segments were more likely to start at boundaries of the formal structure than at other locations in the score, and similarly, during four of the seven stages, they were also more likely to stop at boundaries (Chaffin & Imreh, 1997). Further, problem-solving and decision-making during practice were affected by performance features, showing that the pianist was attending to and practicing these features (Chaffin & Imreh, 1996, 1997; Chaffin, Imreh, Konik, & Dougert, 1998).

Later in the study, the pianist's long-term retrieval of the notes in the first 32 bars was measured. After 27 months, recall was 79% for the treble clef and 52% for the bass clef (Chaffin & Imreh, 1997). Over time, the power of retrieval cues to elicit memorized

information declines. The last to go is the information most closely linked to retrieval cues, i.e., the information in the bar where the cue occurs. Bars that follow are less tightly linked and are lost sooner. When first memorizing, the pianist must practice making these links between the retrieval cue and the notes in the bar in which the cue occurs. Initially, they do not work fast enough and thus cause hesitations (principle 3). As practice continues, these links strengthen and hesitations disappear. Twenty-seven months later, it is just these places where this work has been done that are best recalled.

The Present Study

Another type of evidence for the hierarchical retrieval schemes in pianistic memory is provided by the small hesitations a pianist makes when first practicing a piece from memory. During recall of a composition, retrieval difficulties occur at locations where retrieval cues fail to initiate the production of the correct chunk. If the large-scale organization of the retrieval system is based upon certain features in the formal structure or performance dimensions, then retrieval difficulties should occur predominantly at locations containing such features. When motor memory is well established, performance of a chunk, once it has begun, is typically rapid and accurate. Thus, I investigated pianistic memory by examining the relationship between the locations of hesitations and the location of features in the formal structure and performance features. The pianist's first three runs through the piece without the score all occurred after motor memory had been well set but before conceptual memory was firmly established. The present study provides the first report of an elite pianist's hesitations when playing without a score at different stages of memorization.

The pianist recorded her practice sessions and her performance of the piece. The four recordings examined in this study consist of the first three times the pianist played through the piece without the score, in addition to a fourth recording, her performance

of the piece on a CD (Imreh, 1996, track 13). Bar durations were measured. In the practice runs, hesitations or decreases in tempo indicate retrieval difficulties or intentional interpretive effects. Thus, retrieval difficulties were accompanied by a concurrent increase in bar duration, while effective recall was associated with shorter bar length.

The first practice run from memory was the pianist's initial encounter with the composition when playing without a score, and accordingly, her progression through it proceeded in spurts and included many hesitations. During the later two practice runs, the pianist proceeded through the piece with surprising fluency, considering that these runs were only her second and third runs through the piece without a score. Although these runs included few incorrect notes, they did contain many hesitations. The CD performance was, of course, fluent, and it was played at a much faster tempo than the practice runs.

Bar length was expected to be longer on bars containing features that served as retrieval cues and that were not yet being performed up to speed. Decreases of tempo during the CD performance were interpreted as intentional expressive effects rather than as retrieval difficulties. Since the pianist also tried to play expressively during practice, those effects found in the three practice runs that also occurred in the performance could be ascribed to expressive effects instead of practice effects. To assess expressive effects during practice, bar durations for each bar of the CD performance were subtracted from bar durations in each practice run. Effects that appear in these adjusted durations, as well as in the unadjusted duration are more likely to be practice effects than expressive effects. However, hesitations during practice may indicate exaggerated interpretation. Adjusted bar duration may not adequately account for this factor.

METHOD

The Pianist

Gabriela Imreh, the pianist, studied classical music with Harald Wagner and Nina Panieva at the Gheorge Dima Academy of Music in Cluj-Napoca, Romania. At age 16, she made her debut with the Romanian State Philharmonic Transylvania Orchestra. Later, Imreh studied with Gyorgy Sebok, and at present, she performs as a concert artist. During the 10-month time span that data was collected for this study, Imreh gave approximately 30 concerts, using two different recital programs. Concurrently, she also prepared a third set of recital pieces for recording. Additionally, Imreh performed five concerti with orchestra, two of which she had never performed before. The pianist was a research associate, helping the research group formulate a hypothesis. The pianist's awareness of the postulated existence of retrieval cues may have affected her practice.

The Music

When choosing the piece of music to be studied, it was necessary for pragmatic purposes to select one of the pieces that the pianist intended to learn in the coming year. When the pianist was asked to anticipate which piece would be demanding to learn, she selected the third movement (*Presto*) of J.S. Bach's *Italian Concerto*, which she intended to prepare for the recording of an all-Bach CD (Imreh, 1996, track 13). Despite having given guidance to a student learning the *Italian Concerto* three years earlier as well as having played Bach throughout her studies and professional career, Imreh never played the piece herself until the start of this study.

The *Presto* consists of 210 bars and almost 2,800 notes. The recording of the piece that is on the CD spanned 3 minutes and 14 seconds, and thus an average of 14.4 notes were produced during each second (Chaffin & Imreh, 1997). The *Presto* is challenging because it must be executed rapidly and does not give the pianist any natural "rest stops"

because there are no locations where the pianist is required to pause or sustain notes. Just as is true of much of the other music that Bach composed for keyboard instruments, the conceptual and motor patterns in this piece do not adhere to those often found in the work of other composers. When learning the piece, the pianist most frequently had to learn measures or even half measures independently before juxtaposing them (Chaffin & Imreh, 1997). When judging the demands of the piece relative to the other pieces prepared for the CD, the pianist rated the *Presto* as being moderately difficult but less difficult than the other pieces (Chaffin & Imreh, 1997).

The pianist provided detailed information about her understanding of the features in the formal structure and performance features to which she attended. As shown in Table 1, every bar in the piece was assigned a value for each of four variables that were used to represent the location of the bar in the formal structure. Two variables account for boundaries in the formal structure of the piece, representing whether a bar occurred as the first bar of a section or subsection (beginnings of sections) or the last bar (ends of sections). A bar's position within each section or subsection was represented by its serial position from the beginning of the section. If a section was subdivided, then the bars within the subsection were assigned position numbers that corresponded to their position within the subsection. For example, subsection Cb, shown in Figure 1, consists of 8 bars, so the last bar in that subsection would have been assigned the value 8. A fourth variable, switches per bar, denoted the number of switches in each bar. As illustrated in Figure 2, switches are locations within the piece where the same material repeats, except for a small variation. If this dissimilarity has not been well rehearsed, it is easy accidentally to recall a subsequent or preceding version of a bar, resulting in the repetition or omission of portions of the composition.

Table 1. Dimensions used to represent position in the formal structure.

Term	Description
Beginnings of sections	1 = a bar that is the first bar in a section of the piece, 0 = any other bar
Ends of sections	1 = a bar that is the final bar in a section of the piece, 0 = any other bar
Serial position	Serial position of a bar within a section (in each section, there is a serial progression: bar 1, bar 2, bar 3...)
Switches per bar	Number of switches in a bar

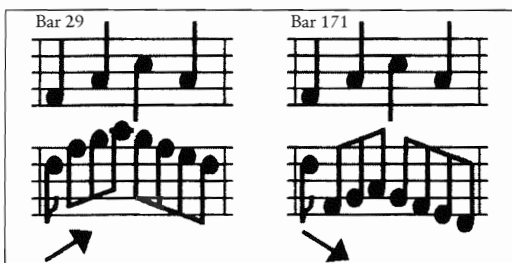


Figure 2. An example of a switch. The treble clef of both bars is identical, while the bass clef differs only in that bar 171 jumps down an octave on the second note. Within both bars, this location is a switch. Choices of octave determine whether the pianist is in bar 29 or 171.

Ten dimensions were used to represent the musical and performance features in each bar. As a part of earlier studies (Chaffin & Imreh, 1996, 1997; Chaffin, Imreh, Konik, & Dougert, 1998), the pianist provided a detailed description of her decisions about the piece on each dimension. For each variable, every bar was assigned a value equivalent to the number of locations it contained where decisions concerning that dimension had to be made. Table 2 summarizes the nature of each dimension. To execute the notes correctly, attention must be given to basic dimensions. To interpret the piece as intended, interpretive dimensions must be attended to. Besides these two types of dimensions, emotions expressed to the audience must also be attended to during performance. Thus, to perform the piece with the correct notes, the intended interpretation, and the desired presentation, performance dimensions must be attended to. Besides the performance dimensions, the number of notes that occur in each bar must also be attended to during practice and performance.

Table 2. Musical and performance dimensions of a piece that a pianist must attend to and make decisions about while learning and performing.

Basic dimensions: Locations in the score that must be attended to in order to play the correct notes

Term	Description
Fingerings	Locations in the score where decisions must be made about fingering
Technical difficulties	Locations in the score where attention must be paid to motor skills (e.g., jumps)
Conceptual units	Locations in the score that contain familiar patterns (e.g., scales, arpeggios, chords, rhythms)

Interpretive dimensions: Locations in the score that must be attended to in order successfully to convey interpretive qualities of the composition

Term	Description
Phrasing	Locations in the score where notes must be grouped together to form musical units
Dynamics	Locations in the score where there are variations in loudness
Pedal	Locations in the score where the pedal is used
Tempo	Locations in the score where there are variations in speed

Performance dimensions: Aspects of the music that require conscious attention during performance

Term	Description
Basic	Locations in the score where fingering, technical difficulties, and conceptual units need attention
Interpretive	Locations in the score where phrasing, dynamics, pedal, and tempo need attention
Emotional expressiveness	Locations in the score where emotion (e.g., surprise) is conveyed to the audience and must thus be attended to
Notes per bar	Number of notes in a bar

Recording Procedure

From the very first time that the pianist played the piece until it was recorded for the CD, the pianist recorded her practice sessions. Three of the recordings used in this study were on videotape, and in all these recordings, a tripod

was used to position a camcorder so that the pianist, the keyboard, and the music stand were all in the field of view. All three of these recordings occurred during the pianist's first learning period, over a time span of three weeks (Chaffin & Imreh, 1997). This period contained 12 practice sessions, with a mean session length of 57 minutes (Chaffin & Imreh, 1997). During this learning period, the pianist played the piece three times from memory. During the eighth practice session, the pianist first demonstrated the extent of her memorization. This recording (labeled *run 8*) contained many retrieval difficulties; however, the pianist managed to proceed to the end of the composition. Though parts of the score were open before her, the pianist did not look at the score until after having a retrieval difficulty. Retrieval difficulties during which the pianist skipped a note, played an incorrect note, stopped, or looked up at the music were almost always paired with a retrieval difficulty that increased bar duration (e.g., slowing down, hesitating). The second and third times the pianist played the piece without the score both occurred during the 12th practice session, when the pianist played through the piece twice, consecutively, to show that memorization was almost complete. During these two runs, there was a marked decrease in the size and number of retrieval problems the pianist encountered. Additionally, nearly all retrieval difficulties involved tempo changes or hesitations rather than mistakes. The earlier recording was labeled *run 12A*, while the recording played immediately after was labeled *run 12B*. Since *run 12B* immediately followed *12A*, recall may have become more fluent because of the preceding practice. The fourth recording used in this study was taken from the CD that the pianist recorded (Imreh, 1996, track 13) and was labeled *CD performance*.

Data Collection

The output from the video recordings was transmitted directly from a video cassette recorder's audio output jack to a computer's audio input jack. The compact disc recording was conveyed almost identically, except the

output jack used during transfer was located on a compact disc player. Using a commercially available software package (Sound Forge, 1998), the output of the recordings was recorded in four wave files.

For every bar in each recording, start and end times were noted and used to compute the duration of each bar. During some bars, the pianist started to play the bar, stopped before the bar was completed, and started over in a previous bar. During other bars, the pianist would hesitate or stop during the bar, return to the beginning of the same bar, and then progress to the end of the bar. Thus, to account for retrieval difficulties yet maintain consistency, every bar's duration was measured the first time the pianist played it all the way through, without playing another bar between the time that the bar was started and the time that it was completed. If, for example, the pianist returned to an earlier section of the piece before completing the bar, then the bar duration would not be measured at that location because the pianist had played other bars before returning to the bar. If the pianist stopped in the middle of the bar and then returned to the beginning of the bar before completing it, then the bar duration would include the time it took the pianist to play the first notes of the bar, hesitate, and replay the entire bar.

The end time of a bar was measured by repetitively adding 0.01 seconds to the end time of a selection and then playing it. As soon as the first notes of the following bar could be heard during a selection, the end time was reduced by 0.01 seconds. If the first notes of the bar were inaudible when the selection was played using this end time, then the end time was recorded as the end time of the bar. By determining the time when one bar ended and the following bar began, the end time was also recorded as the start time of the next bar. On the rare occasion that one bar's end time was not equal to the next bar's start time, the same technique was used to determine the start time. To determine the end time of the very last bar in the composition, the period succeeding the end of the recording was played

repetitively, and during each play through, 0.01 seconds were subtracted from the start time, until the last notes of the piece could be heard. Then, 0.01 seconds were added to the start time, and if the last notes of the composition were no longer audible, then this start time was recorded as the end time of the last bar of the composition.

Data Analysis

Linear regression analyses were performed for the CD performance and all three practice runs, using log bar durations as the dependent variable. Additional analyses were performed for adjusted bar durations for the practice runs (8, 12A, and 12B). Predictor variables were the four measures of position in the formal structure and the 11 musical and performance dimensions. Many variables were correlated; even results statistically significant at the 0.05 level should be regarded with skepticism.

RESULTS

Table 3. Mean Regression Coefficients: Effects of Formal Structure and Musical and Performance Dimensions on Bar Durations for the CD performance and Runs 8, 12A, and 12B

Effect	Performance	Practice			Practice - Performance		
	CD	8	12A	12B	8	12A	12B
Formal Structure							
Beginnings of sections	-0.074 **	-0.008	0.074	0.010	0.007	0.139	0.107
Ends of sections	0.064 **	0.369 **	0.102	0.043	0.849 *	0.206	-0.075
Serial position	0.001	-0.017 *	0.001	0.001	-0.041 *	-0.003	-0.000
Switches per bar	0.009	-0.170 **	0.056	0.005	-0.343 *	0.132	-0.032
Basic and Interpretive Dimensions							
Fingering	-0.011 *	-0.017	-0.041 *	-0.007	-0.046	-0.066	0.001
Technical difficulties	0.002	0.067	0.008	0.009	0.190	-0.008	0.028
Conceptual units	0.008	0.002	0.020	0.005	-0.037	0.041	-0.012
Phrasing	-0.005	-0.003	-0.029	-0.023 **	0.020	-0.055	-0.027
Dynamics	-0.002	-0.119 **	-0.052	-0.029	-0.263 *	-0.070	-0.024
Pedal	0.062 ***	-0.024	-0.035	-0.014	0.037	-0.165	-0.104
Tempo	0.143 ***	0.233	0.177	0.071	0.059	0.131	-0.104
Performance Dimensions							
Basic	0.013	0.268 ***	0.107 *	0.104 ***	0.589 ***	0.211 *	0.141 **
Interpretive	-0.003	0.160 *	0.111 *	-0.010	0.325	0.198	-0.061
Emotional expressiveness	0.014	0.031	-0.004	0.059	0.032	-0.054	0.125
Notes per bar	-0.008 **	0.044 **	0.010	0.006	0.125 **	0.025	0.026 *

Note. The CD Performance and Practice bar durations are logarithm transformed. Practice - Performance bar durations are adjusted by subtracting performance bar durations from practice bar durations.
* $p < .05$. ** $p < .01$. *** $p < .001$.

Performance

Table 3 shows the regression coefficients for log bar durations during performance. During the CD performance, increased bar durations (positive regression coefficients) occurred more frequently during bars located at the ends of sections, bars containing use of the pedal, and bars containing changes of tempo. Conversely, decreased bar durations (negative regression coefficients) were more frequent during bars located at the beginnings of sections, bars containing more fingering decisions, and bars containing larger numbers of notes.

Practice

Of the three practice runs, effects of the formal structure occurred only in run 8, the earliest practice run. Bar durations were longer for bars located at the ends of sections, became shorter as the pianist progressed through each section, and were shorter for bars containing switches. After being adjusted for expressive effects, all of these effects in run 8 continued

to be statistically significant.

In bars containing features of the basic and interpretive dimensions, bar durations were shorter for bars containing more fingering decisions (run 12A), bars containing more different phrases (run 12B), and bars containing more dynamic changes (run 8). After being adjusted for expressive effects, bars containing dynamic changes (run 8) continued to have significantly shorter durations.

For the performance dimensions, bar durations were longer for bars containing large numbers of basic performance dimensions (runs 8, 12A, and 12B) and bars containing large numbers of interpretive performance dimensions (runs 8 and 12A). Also, bars containing larger

numbers of notes were longer (run 8). After being adjusted for expressive effects, bars containing large numbers of basic performance dimensions (runs 8, 12A, and 12B) and bars containing larger numbers of notes (run 8) continued to have significantly longer durations. Additionally, for run 12B, after adjustment for expressive effects, bar durations were significantly longer for bars containing larger numbers of notes.

DISCUSSION

CD Performance

Effects in the CD performance were interpretive. Thus, significantly shorter durations for the first bars of sections and significantly longer durations for the last bars of sections indicate an intentional slowing down and speeding up at section boundaries. The change in tempo may facilitate listener consciousness of musical themes by emphasizing boundaries.

Longer durations also occurred during bars containing use of the pedal and bars containing variations of tempo. It is therefore possible that bars containing use of the pedal often contain variations of tempo; a decrease of tempo may be used to help promote the perception of individual notes within groups of notes sustained by the pedal.

Bar durations were shorter during bars containing more fingering decisions and during bars containing larger numbers of notes. Fingering is often used to aid a pianist in successfully playing long strings of notes so that they are smoothly connected to each other. It is likely that these types of bars were purposely played quickly to facilitate the smooth execution of large groups of notes.

Since neither the effect of the basic performance dimensions nor the effect of the interpretive performance dimensions were found for the CD performance, there was no intentional tempo change during bars containing these features.

Practice

The effect of the formal structure of the piece differed according to the stage of practice.

During run 8, bar durations were significantly shorter as the pianist approached the ends of sections, but significantly longer for the last bars of sections. These data suggest the existence of retrieval difficulties during the last bar of each section, when the pianist must recall the first bar of the following section in order to progress through the piece. Alternatively, the slower tempo may be an expressive effect. During the CD performance, bar durations were significantly shorter during the first bars of sections and longer during the last bars of sections, exhibiting a pattern similar to the effect found in run 8. However, after being adjusted for expressive effects, bar durations during run 8 continued to be significantly shorter as the pianist progressed through the section and significantly longer on the last bars of sections. Thus, the effects found for run 8 may reflect retrieval problems in addition to an expressive effect or a larger expressive effect during run 8 than in the CD. During run 8, the decrease in bar durations as the pianist progressed through sections and the increase in bar duration at the ends of sections may indicate retrieval difficulties at boundaries in the formal structure. Accordingly, once retrieval difficulties have been bypassed, recall should be easier and thus faster.

During run 8, bar durations were significantly shorter for bars containing switches. There were no effects of switches in the CD performance, and after being adjusted for expressive effects, bar durations during run 8 continued to be significantly shorter for bars containing switches. This result and the fact that the effect was observed only during run 8 suggest that the effect was caused by special attention being given to these passages at this early stage of the learning process. Switches are locations within the piece where the same material repeats, except for a small variation. The different sections can be distinguished from each other only by using that dissimilarity. The effect in run 8 suggests that the pianist had learned efficiently to retrieve and execute these passages by run 8. The absence of the effect in run 12 and in

the CD performance suggests that the faster tempo for these bars in run 8 may have been the result of the pianist paying more attention to these bars as she played from memory for the first time. If switches are encoded as cues during this early stage of memorization, as is suggested, then the hierarchical organization of retrieval cues during early encoding has a high level of specificity.

Bars that contained larger numbers of notes had significantly shorter bar durations during the CD performance, but significantly longer bar durations during run 8. This effect in run 8 may be accounted for by pragmatic motor challenges posed by the rapid execution of many notes during the early stages of learning. Also, retrieval cues during early learning may not yet have been adequately encoded, and expressive effects may have been more intense during performance. The effect of the CD performance may be attributed to passages with more notes being more expressively intense. The increase in tempo at these points serves to heighten the intensity.

Both basic and interpretative performance features had a significant impact upon retrieval during encoding. Bar durations were significantly longer for bars containing a greater number of basic performance dimensions (runs 8, 12A, and 12B). These effects remained even after being adjusted for expressive effects (runs 8, 12A, and 12B). Basic dimensions were apparently strong retrieval cues, and the cues were functioning too slowly in all three runs. Bar durations on bars containing a greater number of features affecting interpretation were significantly longer during runs 8 and 12A. Since run 12B was played immediately after run 12A, during run 12B, retrieval cues that had been accessed recently should have been retrieved with less difficulty. Run 12B's lack of a significant increase in bar length during bars containing more features affecting interpretation could be explained using this reasoning. Additionally, as neither the effect of the basic performance dimensions nor the effect of the interpretative

performance dimensions were found for the CD performance, decreases in tempo during practice at locations containing such features were apparently not expressive effects.

Bar durations were significantly shorter on bars containing more locations where decisions had to be made about unusual fingerings (run 12A), more elements of phrasing (run 12B), and more variations in dynamics (run 8, both with and without adjustment for expressive effects). This increase in tempo or decrease in hesitations during bars containing certain features may be accounted for by well-encoded retrieval cues for these features during early stages of practice. Also, practice that focuses on playing such bars correctly at a quick tempo or with greater motor dexterity thanks to practice may explain these data.

Conclusion

To succeed professionally, concert pianists must perform from memory. Although pianists rely heavily upon motor memory, during a performance they must also use conceptual memory. Conceptual representations of the composition help pianists play the correct notes and express the intended interpretation and emotions without inadvertent omitted sections, repeated sections, or stops. Pianists' reliance upon motor memory distinguishes them from other types of memorists, but their performance on tasks requiring memorization of domain-related material is comparable to that of other experts. Thus, they provide an interesting test of the principles of expert memory.

The present study suggests that pianists use conceptual representations similar in organization to the representational systems used by other expert memorists (Chase & Ericsson, 1982; Ericsson & Kintsch, 1995; Ericsson & Oliver, 1989). The pianist in the current study formed a retrieval system whose large-scale organization was based upon features in the formal structure and performance dimensions of the composition. During initial runs without the score, retrieval difficulties occurred more frequently at locations where retrieval cues had been

inadequately encoded. After extensive practice, retrieval cues were well encoded. During performance, there were minimal expressive changes in bar duration at locations containing these features. Since these conclusions are based upon observations of a single concert artist, more pianists need to be observed. If replicated, there is reason to expect observations to reflect the use of formal structure and performance dimensions in hierarchical retrieval schemes.

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Salt-Induced Conformational Changes of DNA and the Chiral Selectivity to Polymers

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ABSTRACT

The purpose of the experiment was to study conformational changes of DNA induced by salt and dehydrating agents (e.g., ethanol) and their influence on the chiral discrimination of DNA toward certain polypeptides. DNA probes were synthesized using either ultra-sonication of calf thymus DNA for various periods of time leading to smaller DNA fragments, or by using biosynthesis through *E-coli* cultures. A specific ampicillin-resistant plasmid was grown in such cultures and then chemically extracted. UV spectra of the DNA probe/polypeptide complex, taken at different salt concentrations, indicated that at 0.8M NaCl and 20% ethanol, DNA undergoes a conformational change.

INTRODUCTION

Nucleic acids are biopolymers composed of nucleotides. The nucleotides consist of a phosphate group, a pentose sugar, and a purine or pyrimidine nitrogenous base. The sequence of nucleotides in DNA is the repository of all genetic information carried by chromosomes. All sugars in nucleic acids have the D-stereoisomeric configuration. The directional sense of the sugar to phosphate linkages constitutes the backbone of DNA and RNA. The bases are planar structures with no possibility for stereoisomerism.

DNA is a right-handed double helix in which two polynucleotide strands are wound around each other so that there are ten base pairs for each turn. The double helix has a diameter of 20 Å and exhibits both major

and minor grooves. The two chains are held together in part by hydrogen bonding, with each amino group in a very weak connection to a keto group (i.e., adenine to thymine, guanine to cytosine, etc.). The glycosidic bonds joining each base of a pair to a sugar-phosphate backbone are located at the same distance apart for each pair (10.85 Å) and are symmetrically related about a two-fold axis located in the plane of the pair. The planes of the adjacent base pairs are 3.4 Å apart. Each base pair is rotated 36° relative to its neighbors and each full turn has a length of 34 Å (pitch of the helix). According to the number of residues per turn, there are numerous alternative forms of DNA, including A-DNA, B-DNA and Z-DNA. A-DNA contains about 11 residues per turn. The planes of the base pairs in this right-handed helix are tilted 20 degrees away from the perpendicular of the helix axis. It is formed by the dehydration of the B-DNA. B-DNA contains 10 residues per turn. The planes of the base pairs in the right-handed helix are perpendicular to the helix. Certain sequences of DNA have the propensity to undergo conformational transitions to a left-handed form referred to as Z-DNA. Z-DNA is a left-handed antiparallel zigzag double helical form of DNA containing about 12 residues per turn.

When long linear DNA molecules are exposed to dehydrating agents at relatively high ionic strength conditions, they undergo a cooperative conformational transition into highly compact forms. The resulting structures are characterized by conspicuous optical

anomalies that are observed as non-conservative circular dichroism (CD) bands whose magnitudes are significantly larger than those revealed by fully dispersed DNA molecules (Fig. 1A). Both the non-conservative shape and the unusual size of the CD signals indicate that the DNA condensation process is accompanied by formation of ordered tertiary species in which long-range couplings between nucleotide chromophores are induced. It has been suggested that under such conditions, DNA molecules collapse into cholesteric-like aggregates in which the DNA helix is organized into parallel arrays that fold back and forth into a rod-shaped structure. These arrays are packed tightly enough to allow efficient interhelical chromophore couplings. When combined with a salt concentration-dependent twist between the contiguous DNA segments (Fig. 1B), these couplings result in anomalous ellipses. The handedness of the long-range cholesteric-like twist is indicated by the sign of the circular dichroism signals exhibited by the chiral assemblies; positive non-conservative CD maxima have been shown to indicate a right-handed organization whereas negative signals correspond to a long-range left-handed twist. Thus, at relatively low ionic strength, a right-handed cholesteric-like DNA packaging is induced, which turns into a long-range left-handed organization as the salt concentration is gradually increased. The salt-induced right-to-left transition is assumed to proceed through a non-chiral "nematic-like" structure (Minsky, 1998).

In the current research, we studied the influence of ionic strength (e.g., NaCl

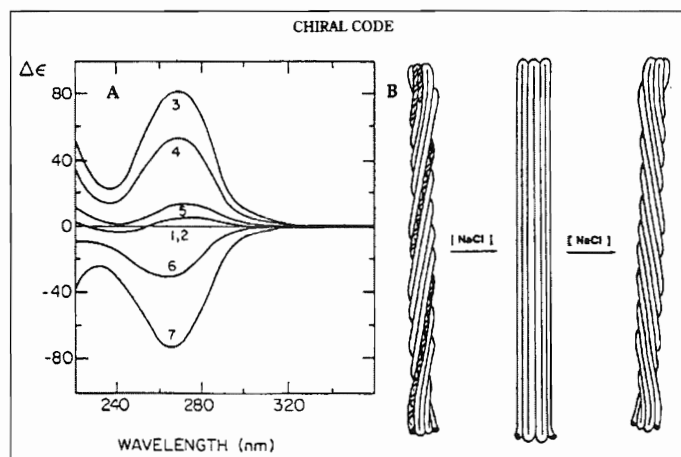


Figure 1.

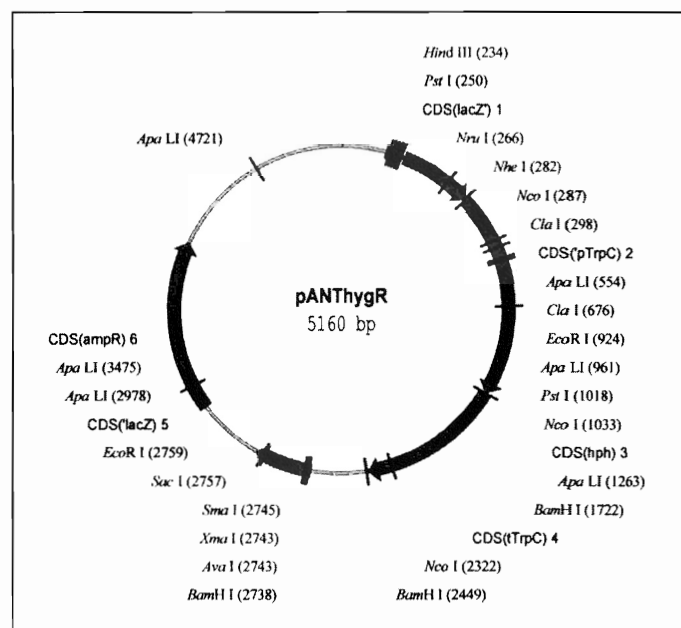


Figure 2. pANThygR

concentration) and dehydrating agents (e.g., ethanol) on the spectral properties of linear DNA (approximately 6,000 bases). These properties were associated with conformational changes of DNA. Further attempts were made to link these changes to the chiral discrimination power of DNA toward D- and L-polylysine using capillary electrophoresis.

Materials and Methods

The DNA used in these studies was prepared in two ways. First, cultures of *E. coli* containing the plasmid pANThygR (Fig. 2) were

grown using LB medium in the presence of ampicillin and/or carbonicillin antibiotics at 37°C. The closed circular plasmid (5,160 bases) was then extracted from the cells using the QIAGEN Qiafilter Midi Kit. Confirmation of the plasmid was done using Hind III (1 cut) and Bam H 1 (3 cuts) restriction enzymes along with agarose gel-electrophoresis (Fig. 3). When this DNA was required to be linearized, the plasmid was digested using Hind III.

The second method of preparation utilized calf thymus DNA (Sigma), dissolved in 1X Tris-EDTA buffer at a concentration of 1mg/mL. The solution was sonicated using a Fisher Model 60 Sonic Dismembrator and the samples of DNA fragments containing no more than 6,000 bases were selected using agarose gel electrophoresis (Fig 4).

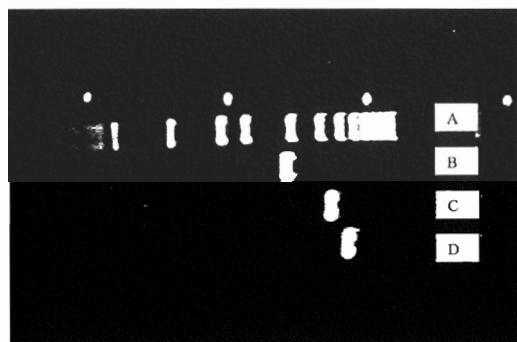


Figure 3. Agarose gel of digestion of pANThygR DNA. A: 1 KB DNA ladder used for comparison with other DNA strands. B: Uncut length of pANThygR. The closed circular plasmid moves faster than its linear counterpart. C: Digestion using Bam H 1 cutting the plasmid into three linear segments. D: Digestion of pANThygR by Hind III cutting the plasmid into a singular linear strand (5160bp).

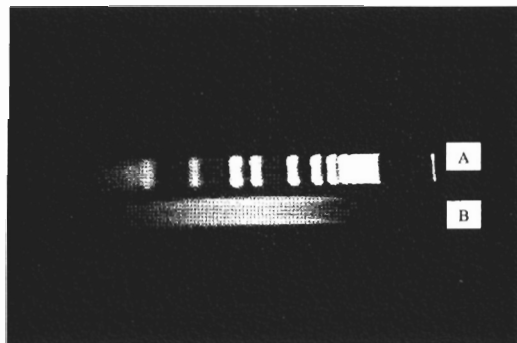


Figure 4. Sonicated calf thymus DNA. A: 1 KB DNA ladder used for comparison. B: Sonicated DNA ranging from 6kb to small fragments.

Purification and precipitation of both types of samples of DNA were preformed using phenol-chloroform extraction in combination with Phase Lock Gel Microfuge Tubes (Three-Prime-Five-Prime). The precipitation of the DNA was achieved using ethanol and sodium acetate. Precipitated DNA was concentrated by centrifugation at 15k times gravity, after which the supernatant was drained. The resultant DNA pellets were dried by vacuum and resuspended in 1X Tris-EDTA buffer.

The capillary electrophoresis experiments were performed on an HP capillary electrophoresis. The total length of the capillaries was 80 cm (25 μ m ID). The effective length was 72 cm.

High-performance capillary electrophoresis is a process used for a variety of separations involving factors, including electric charge and size. Because of this, it is capable of separating a wide variety of compounds ranging from a simple amino acid to a complex enantiomeric supra-molecule. The system includes a fused-silica capillary (inside diameter ranging from 25 to 75 μ m) ending in two buffer reservoirs and is attached to a power supply and a detector.

When an electric current is applied over a length of the capillary filled with an electrolyte, it creates a phenomenon known as the electro-osmotic flow (EOF). This flow is a steady migration of the electrolytic buffer from one reservoir to the other. It also carries with it whatever compound is injected into the system. Depending upon the charge or the size of the tested molecules, the sample will either run ahead of the EOF, in the case of negatively charged molecules, or lag behind, as in the case of a positive charge or a very large molecule. Because of their distinct properties, different molecules will have different flow rates and will therefore be separated and identified with a UV detector.

RESULTS AND DISCUSSION

QIAGEN QIAfilter Midi Kit was implemented on *E-coli* cultures containing the ampicillin-resistant plasmid pANThygR. These

cultures were grown overnight in LB broth medium with ampicillin or carbonicillin antibiotics at 37°C and with constant shaking. The results for six separate batches of DNA are presented in Table 1.

Table 1

Batch number	Concentration	Volume (mL)	Total DNA
56-211-3 (91852-8)	375 µg/mL	0.75	280 µg
91852-13	253 µg/mL	1.35	343 µg
91852-16	425 µg/mL	1.00	425 µg
91852-18	500 µg/mL	1.60	800 µg
91852-19	425 µg/mL	1.60	680 µg
91852-21	500 µg/mL	1.65	825 µg

The concentration of the DNA was checked by UV absorption at a 260 nm wavelength. The specific properties of DNA at this wavelength dictate that a 1.0 absorption unit is equivalent to 50 µg/mL concentration.

From previous studies reported in the literature (Weinberger, 1998), it is evident that in the presence of increasing amounts of NaCl and ethanol, DNA undergoes a conformational change. At the same time, CD spectra reported in the presence of D- and L-polylysine showed changes in the sign (positive and negative) of the spectra. In this study we compared the UV spectra of the DNA (prepared according to the experimental section) in the presence of increasing concentration of NaCl and ethanol with the UV spectra of the complex of the DNA with the polylysine. The wavelength and the absorbance were recorded. These results were compared with the results in the absence of the polylysine, and the shift in the wavelength and absorbance were recorded (Fig. 5). The DNA solutions showed a maximum at 260 nm and 210 nm. Similarly, polylysine showed a maximum at 225 nm. The combined solutions showed a shift in the wavelength as well as a broad band at ~300 nm.

As the concentration of sodium chloride increases, the shift in the wavelength increases until 0.8 M (Fig. 5B). This is followed by a decrease as the concentration of NaCl increases beyond this point. At the same time, the absorbance of the solution decreases until 0.8 M followed by an increase as the concentration of NaCl

increases. These results are consistent with the results reported earlier in the literature (Weinberger). Such results clearly indicate that a complex between DNA and polylysine occurs. It is also interesting to note that when the concentration of salt reaches 1.6 M the broad band at ~300 nm does not occur. Based on these results, solutions of DNA dissolved in 0.8 M NaCl and 20% ethanol were used as supporting electrolyte in capillary electrophoresis. Since the interaction between the polylysine and DNA is based on charged interactions, it was expected that part or all of the charge would vanish upon the complex formation. At the same time, upon increasing the ionic strength of the buffer, the electro-osmotic flow will be dramatically diminished. As a consequence, the migration of the complexed lysine through the capillary also will be slowed down. Indeed, upon introducing polylysine into the electrophoretic system, the experiment did not produce any appearance of a peak even after six hours.

CONCLUSIONS

The experiments demonstrated that the complexation of the polylysine with the linear DNA in the presence of salt and dehydrating agents occurs through a conformational change that is likely the result of a liquid crystal transition. UV spectra indicated for the first time that the interaction between the polylysine and DNA is accompanied by a change in absorbance, a shift in the 260 nm maxima and a broad band at ~300 nm. This further demonstrates, with a new technique, that such a complex can be formed under the correct conditions and is subject to changes in NaCl concentration.

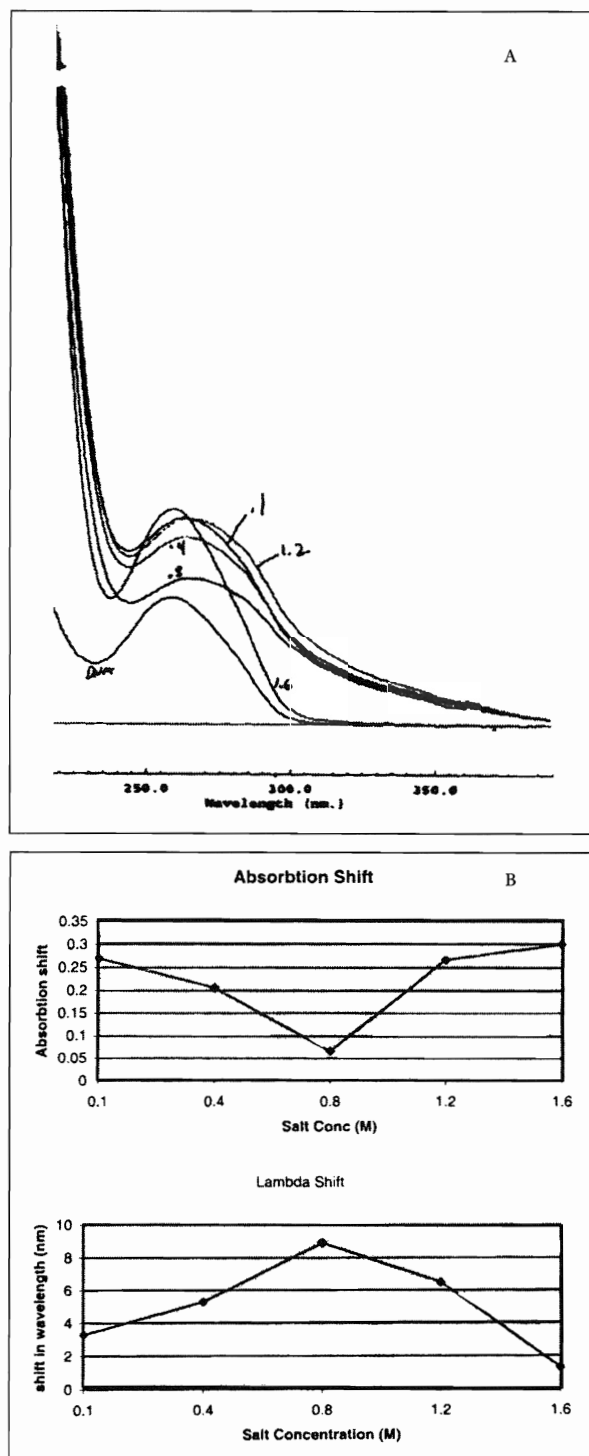


Figure 5. A: UV spectra of DNA with equal volume of L-Polylysine (7mg/ml) and varying molarity of NaCl. NaCl concentrations are as indicated: No salt, 0.1M, 0.4M, 0.8M, 1.2M and 1.6M. B: The absorption and lambda shifts of the 260nm peak at varying levels of salt (NaCl) concentration.

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Model Membrane Rod Photoreceptor Fusion Demonstrated by ANTS/DPX Contents Mixing Assays with Peripherin/rds Peptides

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ABSTRACT

The protein peripherin/rds has been shown previously to promote membrane fusion in the outer segment of rod photoreceptor cells. In the absence of this fusion event, normal disk shedding does not occur. The native polypeptide fusogenic sequence and two mutated polypeptides were incorporated into ANTS/DPX fluorescence assays to determine their effect on the fusion event. When fusion occurs, the ANTS fluorophore is quenched by DPX providing a method to measure the rate of fusion. The native sequence has an α -helical amphiphilic character, and is in an active homotetrameric complex during the normal fusion event. The first mutant is an amphiphilic breaker that has been shown to prevent the fusion event by an inactive heterotetrameric complex. The second mutant, a helix breaker, serves as a control for the amphiphilic breaker and does not affect the fusion event by allowing the formation of the homotetrameric complex. This homotetrameric complex affects the rate of fusion in a concentration-dependent manner. In the fusion assays, increases in concentration of the amphiphilic breaker did not promote an increase in the initial rate of fusion. The native fusogenic sequence and the helix breaker promoted an increase in the initial rate of fusion when each was added in separate assays in an increasing concentration-dependent manner.

INTRODUCTION

The fusion process between membranes often takes place in the presence of a fusion protein. There are a series of steps in membrane fusion, namely adhesion of opposing lipid bilayers, destabilization, and depolarization. In the absence of fusion, the charge on each side of the membranes is balanced by the flow of Na^+ , Ca^{2+} , and K^+ ions. When fusion occurs, there is an imbalance in the charge when the inside of the membranes becomes hyperpolarized and thus depolarization must occur to correct the charge imbalance. In this research, the main interest is to understand the biochemical mechanism of photoreceptor-specific membrane fusion. The protein that facilitates this fusion process is peripherin/rds. This research is also aimed at identifying disease-linked mutations within the fusion protein, peripherin/rds, which is localized to the rim region of disk membranes in the rod photoreceptor cell. It is in this region that the fusion with the plasma membrane occurs. In the absence of this fusion event, normal disk shedding will not occur. The normal shedding acts as a form of renewal for the rod photoreceptor cell whereby new disks are able to form once old disks are shed and undergo phagocytosis.

There are a number of common characteristics of fusion proteins. The main role of fusion proteins is to create close contact between particular membranes that will fuse (3). Fusion proteins promote hydrophobic interactions, which require energy levels

above those in membranes at normal conditions. These proteins are usually anchored in the membranes they help to fuse, where the hydrophobicity index ranges from .50 to .70 (4). Generically, the fusogenic sequence of amino acids numbers 16-25 residues in length, and is found in either the N-terminus or C-terminus. Only one gene is needed to code for a particular fusion protein. Without the specific fusogenic 16 amino acid sequence in peripherin/rds, there is a marked decrease in the initial rate of fusion.

The fusogenic region in the C-terminus of peripherin/rds has been termed peripherin/rds polypeptide-5 (PP-5) by Boesze-Battaglia. Depolarization of disk membranes and vesicle aggregation show an increase with higher concentrations of PP-5. Two mutant peptides of PP-5 were used to determine if the intrinsic amphiphilic and α -helical characteristics are necessary for membrane fusion to occur in the rim region of disk membranes. The PP-5 amphiphilic breaker (PP-5AB) has two amino acid substitutions that alter the distribution of hydrophilic and hydrophobic residues (1). The first substitution is a tyrosine for a phenylalanine at amino acid 318, and the second is a glutamic acid for a valine at amino acid 322. It is PP-5AB with PP-5 in an equal mixture forming an inactive heterotetramer that inhibits depolarization, hence inhibiting the destabilization of the membrane (1). The other mutant, PP-5 helix breaker (PP-5HB) has a proline substitution for a leucine at amino acid 316. It serves as a control for PP-5AB since PP-5HB has no effect on depolarization before membrane fusion. The fusion assays performed suggest that PP-5 and PP-5HB increased the initial rate of fusion in a concentration-dependent manner while PP-5AB did not increase the initial rate of fusion.

MATERIALS AND METHODS

Combination of Phospholipids

Phospholipids used in this experiment were from Avanti Polar Lipids. Two samples of phospholipids made up of N-methyl

dioleoyl phosphatidylethanolamine (N-methyl DOPE) and phosphatidylserine (PS) were weighed out. In total, 5% of the phospholipids were PS and 95% were N-methyl DOPE. They were hydrated with chloroform and then dried with argon gas to prevent oxidation. Further drying was done by freeze-drying for one hour. Then each sample was resuspended with buffer by pipetting. One sample contained the buffer 10mM Glycine, 45mM NaCl, and 25mM 1-aminonaphthalene-3,6,8-trisulfonic acid (ANTS), while the other sample contained the buffer 10mM Glycine and 90mM p-xylene-bis-pyridinium bromide (DPX). Each buffer had a pH of 9.5.

Formation of Vesicles

The ANTS and DPX samples were freeze-thawed five times with liquid nitrogen in order to form large multilamellar vesicles. Then the vesicle populations became large unilamellar vesicles (LUVs) by extrusion through Nuclepore extrusion apparatus at 20-30 Psi using nitrogen gas. Each sample was extruded three times through a 47mm-polycarbonate membrane with 0.1mm pores. Following extrusion, the vesicles were then put through G-50 sephadex columns eluted with the 100mM NaCl, 10mM Glycine, and 0.1mM EDTA buffer in order to separate the vesicles with encapsulated ANTS and DPX probes from unencapsulated fluorescent material. A visible light detector using a beam at a wavelength of 254nm was attached to the columns in order to determine when the encapsulated material had come through the columns. A phosphate assay was performed to determine the phospholipid concentration of the ANTS and DPX vesicle populations so as to bring each population to a 1mM mixture.

Fusion Assays with Vesicles

Fusion assays were performed with a Perkin Elmer LS-50B spectrofluorimeter in combination with a VWR 1165 Refrigerated Constant Temperature Circulator. The fluorescence intensity was measured at an

emission wavelength of 510nm, and an excitation wavelength of 380nm with the emission and excitation slits both having a width of either 10 or 15nm. The system, made up in 4mm quartz cuvettes, was a 9:1 ratio of DPX:ANTS vesicles; 100 μ l 1mM CaCl₂, 10mM Hepes; then filled to 3mL with 100mM NaCl, 10mM Glycine, and .1mM EDTA buffer (pH 9.5). The system was brought to 37°C by incubating for five minutes. The fluorescence intensity was read for 30-50 seconds before adding 25-50 μ l of 4M acetic acid buffer, lowering the pH from 9.5 to 4.5. The drop in pH initiated fusion that allowed the quenching of the probe ANTS by the probe DPX.

The slope was calculated by the decrease in fluorescence intensity, and the duration of the assay was five minutes. Membrane depolarization indicative of destabilization was measured by fluorescence. Once the fusion assays above suggested the ANTS and DPX vesicles were fusing, additional assays were performed. PP-5, PP-5AB, and PP-5HB, where the mutants were in equimolar mixtures with normal PP-5, were added in a concentration-dependent manner before incubation. Assays were completed in triplicate for each concentration until the vesicle populations no longer yielded accurate results. The concentrations used were determined by calculating a ratio between one of the peripherin/rds polypeptides to total phospholipid used (e.g., PP-5/PL (total)). The ratios for PP-5 were .02, .05, .10, .25, .38, .50, and .60. Then for PP-5-PP-5AB they were .018, .046, .09, .24, .38, .49, and .59. Finally, the ratios for PP-5-PP-5HB were .01, .02, .05, .12, .19, .25, and .30. Ratios for PP-5-PP-5HB are one half the PP-5 and PP-5-PP-5AB ratios because the number of vesicles for PP-5-PP-5HB assays was doubled. The vesicles in the PP-5-PP-5HB assays were doubled because the concentration of vesicles was .05mM instead of 1mM as described above.

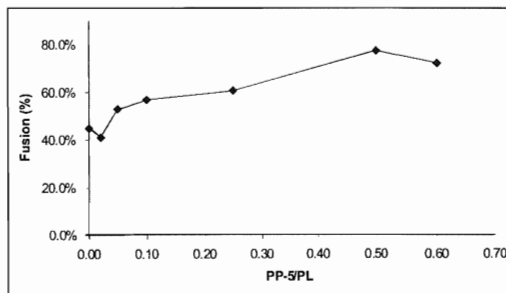


Figure 1. IRF vs. PP-5/PL

RESULTS

The fusion assays for PP-5 show an increase in percentage fusion as the concentration of PP-5 increases (Figure 1). An average was taken at each concentration of all assays performed. The slope at each increasing concentration became less gradual suggesting the rate at which fusion occurs is increased.

Assays performed for the equimolar mixture of PP-5-PP-5AB did not show a significant increase in percentage fusion as concentration of the mixture was increased (Figure 2). The calculated slopes did not increase or decrease, suggesting the rate of PP-5 concentration-dependent fusion remained the same. Only one set of assays was performed using an equimolar mixture of PP-5-PP-5HB. The results obtained correlate with those of PP-5 alone, i.e., there is an increase in percentage fusion with an increase in concentration of the equimolar mixture of PP-5-PP-5HB (Figure 3).

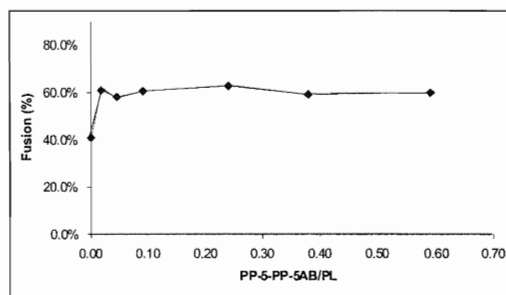


Figure 2. IRF vs. PP-5-PP-5AB/PL

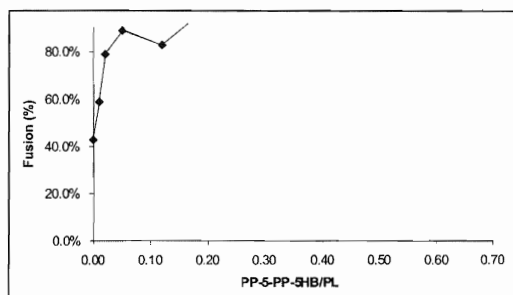


Figure 3. IRF vs. PP-5-PP-5HB/PL

DISCUSSION

The maintenance of disks in the rod photoreceptor cell is essential to its ability to function properly. The disks are made daily at the base of the rod's outer segment. They move up to the tip of the cell by the tenth day after initial formation. This turnover of new disks allows the cell to maintain the same length while replacing old disks. Peripherin/rds is located on the outer edges of the disks. The fusogenic sequence causes the fusion event by promoting aggregation, depolarization, and hence destabilization between disk membrane and rod outer segment membrane. This delineates that the end breaks off the disk, and the disk falls apart. Because of the nature of lipids, the pieces become vesicular in an aqueous medium.

In previous work by Boesze-Battaglia (2), it has been shown that PP-5 promotes vesicle aggregation and membrane destabilization. Peripherin/rds polypeptide-5 has α -helical and amphiphilic characteristics. Two mutants, a helix breaker and an amphiphilic breaker, were used to determine the importance of helicity and amphiphilicity. Only the equimolar mixture of PP-5 with PP-5AB inhibited depolarization while PP-5 with PP-5HB acted similarly to PP-5 alone. Vesicle aggregation, measured by the amount of light scattering, was unaffected. With PP-5AB, depolarization was inhibited because it was determined PP-5AB formed a heterotetramer, which is nonfunctional, with PP-5. Peripherin/rds polypeptide-5 HB only formed a dimer by itself leaving PP-5 to form its own homotetramer. Vesicle aggre-

gation was unaffected here also. The mutants PP-5AB or PP-5HB alone did not promote vesicle aggregation. This suggests that an amphiphilic α -helix is needed for aggregation. These characteristics are common among other fusion peptides (5, 6).

In the current work, the effect of PP-5 alone, PP-5 with PP-5AB, and PP-5 with PP-5HB on fusion was studied. Peripherin/rds polypeptide-5 in the form of a homotetramer increases the initial rate of fusion in a concentration-dependent manner. Since PP-5 has the amphiphilic α -helical characteristics and it promotes aggregation and destabilization, this suggests that it would also promote depolarization and then fusion of membranes in its homotetrameric form.

Peripherin/rds polypeptide-5 in an equimolar mixture with PP-5AB forms a heterotetramer made up of a PP-5 dimer and a PP-5AB dimer. This heterotetramer does not inhibit aggregation, but does inhibit destabilization; therefore, it correlates that membrane fusion would be inhibited. The amphiphilic characteristic seems to be needed in order for the fusogenic property of PP-5 to be present.

The equimolar mixture of PP-5-PP-5HB does not form a heterotetramer like [PP-5-PP-5AB](4). Rather, PP-5HB forms a dimer that does not combine with dimers of PP-5. There is an increase in the initial rate of fusion in a PP-5 concentration-dependent manner. The PP-5HB dimer alone does not promote aggregation. Since destabilization occurs after aggregation in the membrane fusion process, it follows that membrane fusion will not occur with just PP-5HB dimers. The PP-5 dimers will become homotetramers in this mixture. The data provided from PP-5 alone suggests that homotetramers of PP-5 in this equimolar mixture are what cause increased fusion, not the PP-5HB dimer by itself. While the single set of assays performed with the PP-5-PP-5HB mixture suggests an increase in the initial rate of fusion in a concentration-dependent manner, further assays should be performed in order to confirm the HB data.

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Cervical Vertebra Dredged from the Inner Continental Shelf off Central New Jersey

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ABSTRACT

Dredging for Atlantic surf clams, *Spisula solidissima* and deep-sea scallops, *Placopectin magellanicus*, off the central New Jersey coast, commercial shellfishers recently recovered a single cervical vertebra probably belonging to the extinct elk-moose, *Cervalces scotti*. This report describes and identifies a cervical vertebra which was discovered 40 kilometers southeast of the Manasquan Inlet in 40-45 meters of water at approximate latitude 39° 45' and longitude 73° 30'. Radiocarbon dating yielded an age of 23,530 ± 170 years BP for the vertebra which is consistent with the known age range of this species. Additionally, anatomical comparison between the recovered cervical vertebra and vertebrae found on a complete *Cervalces scotti* skeleton (PU 10648) are almost identical. Although uncommon, discovery of Pleistocene terrestrial mammal fossils such as *Cervalces scotti* along the submerged northeast continental shelf reflects habitat reduction associated with glacioeustatic sea level rise related to the retreating Wisconsinian glaciation.

INTRODUCTION

For over the last three-quarters of a century, commercial shellfishing operations along the northeastern continental shelf have infrequently recovered rare fossil assemblages reflecting glacioeustatic sea level cyclicity (e.g., Dall, 1925; Uchupi, 1964; Wigley, 1966; Whitmore et al., 1967; Gallagher, 1989; McDonald and Ray, 1990; McDonald and Ray, 1993). These operations characteristically

target Atlantic surf clams, *Spisula solidissima* and deep-sea scallops, *Placopectin magellanicus*, through the use of various sea floor dredging techniques. These techniques commonly catch anthropomorphic materials, and in more rare instances, fossils.

Ranging out to a depth of about 120 meters, which reflects the maximum seaward migration of the ancient shoreline in the northeast Atlantic Ocean during the Pleistocene (Whitmore et al. 1967), a large and diverse assemblage of marine and terrestrial mammal fossils has been recovered. Marine mammal examples include members from the genera: *Phoca* and *Odobenus* as well as various cetaceans, while terrestrial mammals include members of the genera: *Mammut*, *Mammuthus*, *Rangifer*, *Tapirus*, *Cervalces*, *Symbos*, *Bison*, and *Megalonyx* (Dall, 1925; Uchupi, 1964; Wigley, 1966; Whitmore et al., 1967; Parris, 1983; Gallagher, 1989; McDonald and Ray, 1990; McDonald and Ray, 1993).

This report describes and identifies a cervical vertebra recently recovered by commercial shellfishers 40 kilometers southeast of the Manasquan Inlet in New Jersey. The vertebra was recovered along with three indeterminate species of cetacean vertebrae at a depth of 40-45 meters at approximate latitude 39° 45' and longitude 73° 30'. Anatomical comparison to skeletons at the New Jersey State Museum and fossil literature suggest the most probable origin of the cervical vertebra is from an extinct Ice Age mammal known as *Cervalces scotti*, an elk-moose.

Discoveries of *Cervalces scotti* in New Jersey

The New Jersey fossil record has two almost entirely complete skeletons of *Cervalces scotti* discovered in post-glacial bogs. The first of these skeletons, PU 10648, was described by Scott (1885) and was found in Mt. Hermon, Hope Township, Warren County. Parris (1983) states that this skeleton is considered to be the finest and most complete in existence. The second skeleton, I11286, was discovered in Columbia, Warren County (Harrington, 1984). Additional New Jersey *Cervalces scotti* discoveries include: 1) NJSM 264, a major portion of a skeleton found in Knowlton Township, Warren County; 2) NJSM 12109, an antler fragment found along Big Brook, Marlboro Township, Monmouth County; and, 3) PU 16342, the right metacarpal originally identified by Whitmore et al. (1967), and figured and described by Gallagher et al. (1989); (Fig. 1). The origin of this specimen was cited by Whitmore et al. (1967) as coming from the Hudson Canyon off the New Jersey coast from a depth of 160 meters.

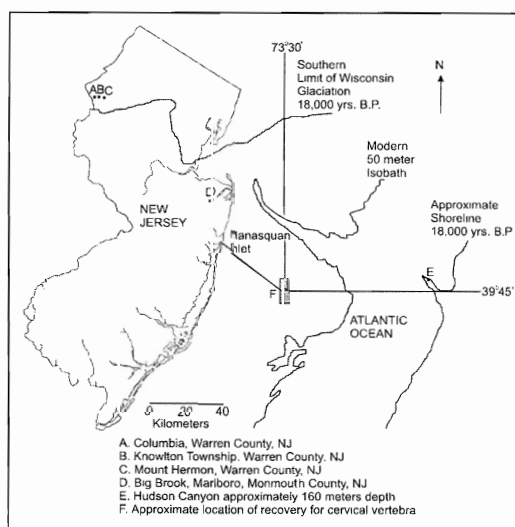


Figure 1. Location map identifying *Cervalces scotti* discoveries in New Jersey. Letter (F) is the approximate location for recovery of the cervical vertebra described in this report.

Description and Age of the Cervical Vertebra

The cervical vertebra is missing most of the neural spine and right posterior zygapophysis. Additionally, a minor amount of the left pleurapophysis and nearby bone directly adjacent to the transverse foramen is missing. Small encrusting bryozoans occur scattered throughout the specimen along the neural canal and portions of the zygapophyses and pleurapophyses. The overall specimen appears to be well permineralized and its surface has yellow-brown iron staining consistent with the mineral limonite. Sea floor sediment is lithified in the transverse foramens and throughout many of the exposed osteocytes.

The specimen weighs 596 g and is approximately 10.5 cm across the length of the centrum. The posterior portion of the centrum is approximately 4.0 cm in diameter and the neural canal is approximately 3.0 cm in diameter (Fig. 2). A small piece of the vertebra with mass 12.6 g was drilled from the centrum of the vertebra and sent to Geochron Laboratories in Cambridge, Massachusetts, for C-14 absolute age dating analysis. Geochron Laboratories analyzed the sample and reported an absolute age of $23,530 \pm 170$ years BP.

DISCUSSION AND CONCLUSIONS

Churcher and Pinsof (1988) describe *Cervalces scotti* as a moose-like animal that resembled *Libralces* sp. in retention of long nasal bones and an average size slightly less than *Alces latifrons*. However, palmation in *Cervalces scotti* antlers is unique and highly complex. The internal part of the antlers is directed upward and bipartite, terminating in several tines, while the outer part curves backward and upward and may carry one or more tines (Kurten and Anderson, 1980). Fossil remains of *Cervalces scotti* are noted to be difficult to distinguish from *Alces latifrons* (Churcher and Pinsof, 1988).

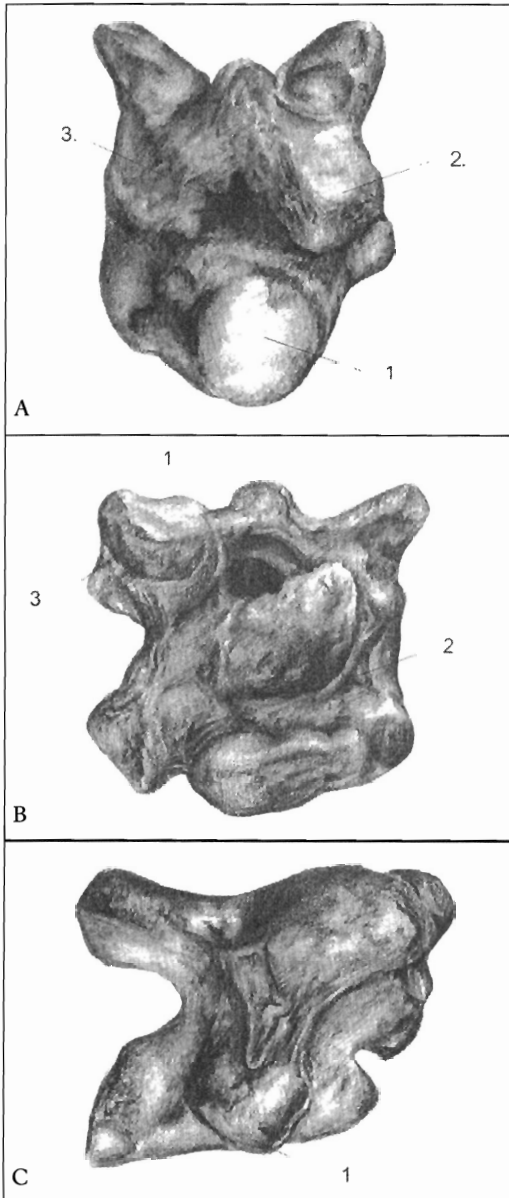


Figure 2. Three views of cervical vertebra described in text.

A. Posterior: (1) centrum; (2) anterior zygapophysis; (3) neural canal

B. Anterior: (1) neural arch (mostly missing); (2) posterior zygapophysis; (3) transverse foramen

C. Lateral: (1) pleurapophysis

Although complete, confident identification of a discovered cervical vertebra is typically based on diagnostic antler or limb bones (Chucher and Pinsof, 1987), we believe our cervical vertebra is likely to be from *Cervalces scotti* based on the following criteria: *Alces latifrons* is not noted to occur in New Jersey and is common in the mid-Pleistocene faunas of northern Eurasia and occurs in deposits of Alaska and the Yukon Territory. Additionally, no discoveries of *Libralces* sp. have ever been documented in the Pleistocene mammal record of New Jersey (Parris, 1983 and Gallagher et al., 1989). *Cervalces* sp. is thought to date between 34,000 and 10,000 years BP and is noted to have a restricted geologic range that includes New Jersey. Our radiocarbon age analysis of $23,530 \pm 170$ years BP is consistent with these interpretations. Moreover, anatomical comparison of the discovered neck vertebra to the neck vertebrae from *Cervalces scotti* (PU 10648) is almost a perfect match, making a strong argument for a *Cervalces scotti* identification for this Pleistocene fossil (Fig. 3). Finally, our fossil elk-moose cervical vertebra discovered approximately 40 kilometers off the present New Jersey shoreline would be consistent with paleoenvironmental conditions associated with Wisconsinian sea level lowering and a seaward-extended habitat known to contain terrestrial mammal fossils.

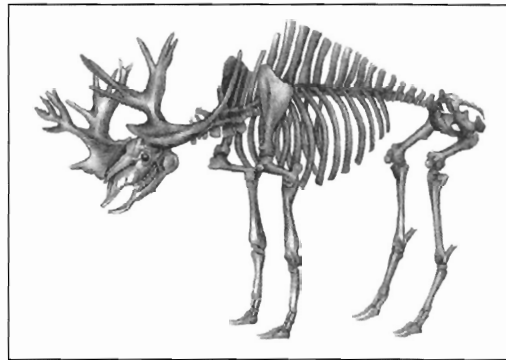


Figure 3. Sketch of *Cervalces scotti* (PU 10648) discovered in a post-glacial bog in Mount Hermon, New Jersey. The skeleton is considered to be one of the finest examples of *C. scotti* and is on display at the New Jersey Museum.

ACKNOWLEDGMENTS

The following people deserve acknowledgements for their assistance with this manuscript: David Parris and William Gallagher of the New Jersey State Museum assisted in the identification of the vertebra. Kristy DeFlores, an art major at TCNJ, provided the sketches of the vertebra and of the elk-moose (PU 10648) on display at the New Jersey State Museum.

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An Explicit Solution to the Problem of the Relativistically Moving Gravitational Lens

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ABSTRACT

Stars can produce multiple images of more distant stars. This effect is gravitational lensing. The problem in gravitational lensing of situations where there is a moving gravitational lens (a star passing in front of another star) cannot be solved explicitly in a classical framework. By employing Einstein's relativity, we show that a full relativistic treatment of the problem does yield explicit solutions to this problem. The solution is unique and can be used to deduce masses of intervening stars in massive astronomical searches.

INTRODUCTION

When an intervening mass, known as the lens (for example a star), is in close proximity of the line of sight of a more distant astronomical object (more remote star or a galaxy), multiple images of the latter occur. In general, these images' intensities are amplified. Einstein (Schneider et al., 1992) was the first to predict this astrophysical phenomenon, known as gravitational lensing. The lensing is caused by the bending of light in the close vicinity of the lens itself thanks to its own gravitational field. Gravitational lensing or simple lensing has many astrophysical applications. Recently, astronomers have realized that the method can be employed to detect unseen matter in the universe. Lensing of a large number of stars in the Large Magellanic Cloud, for example, can be used to detect dark matter clumps moving in the halo of the Milky Way (Paczynski, 1986). Such an analysis yields an independent, quite elegant way of

measuring the amount of dark matter in our galaxy—an outstanding puzzle in astronomy today. However, the method is not terribly accurate, as the problem of a moving lens has not been solved explicitly (Paczynski, 1987).

We will show that the gravitational lensing caused by a rapidly moving lens with respect to the line joining the observer to the source, known as the optic axis, can be explicitly solved in the context of general relativity.

THEORY

We shall use the formalism developed by Wickramasinghe et al. (Wickramasinghe et al., 2000). The general geometry of the gravitational lensing problem under consideration is depicted in Figure 1.

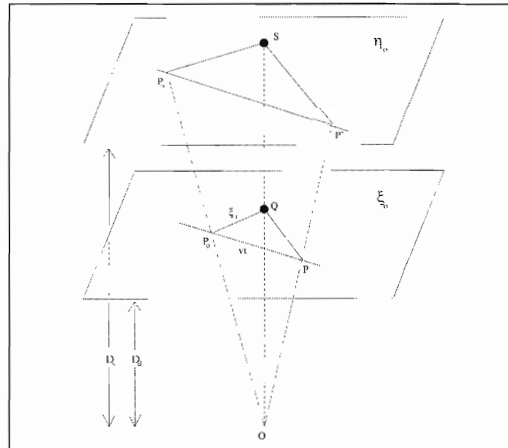


Figure 1. The general geometry of the lens. The lens is moving on the lens plane along P_0P . The impact parameter, at the closest approach of the lens to the optic axis, occurs at P_0 . D_s and D_l are the angular diameter distances of the source and the lens respectively. ξ_0 is a characteristic length scale on the lens plane. The corresponding length on the source plane is η_0 . $SP'/D_s = QP/D_l$; $\eta_0/D_s = \xi_0/D_l$; $x = QP/\xi_0$; $y = SP'/\eta_0$; $x_0 = \xi_1/\xi_0$.

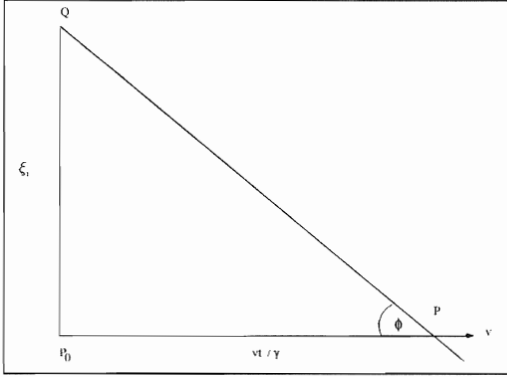


Figure 2. The motion of the lens on the lens plane. The optic axis is passing through Q . The motion of the lens is in the direction of P_0P . As the lens sees, P_0P is contracted because of the relativistic speed of the lens. $P_0P = vt/\gamma_v = vt\sqrt{1 - v^2/c^2}$

The relativistically moving lens, with a speed comparable to the speed of light, is moving on the lens plane with a speed, v , as seen by the observer, O . Following the notation in Figure 1, we see that the lens intercepts the optic axis, OS , at a distance of ξ_i . This motion is shown in Figure 2.

The observer, O , is at rest in the lab frame of reference. Following the notations of Figure 2, we see that the lens sees the length P_0P as contracted by a factor of $\gamma_v = 1/\sqrt{1 - v^2/c^2}$. Therefore,

$$P_0P[\text{as seen by the lens}] = \frac{vt}{\gamma_v}$$

where t is the time measured from P_0 . PQ is the distance measured from the optic axis at time t . Thus, it is the distance which is relevant for the bending of light in the vicinity of the lens. Wickramasinghe et al. (Wickramasinghe et al., 2000) proved that the lensing equation for such a moving lens, following Figure 1 and its notation, is given by

$$y = x - \frac{1}{x(1 - \beta^2)^{\frac{3}{2}}}$$

where $\beta = [\text{speed of lens toward the optic axis}]/[\text{speed of light}]$. The geometry is shown in Figure 2. The lensing equation in this case is easily derived to be

$$y = x - \frac{1}{x(1 - \beta_{v \cos \phi}^2)^{\frac{3}{2}}}$$

where $\beta_{v \cos \phi} = v \cos \phi / c$. The above equation can be written as

$$y = x - \frac{f_{v \cos \phi}}{x}$$

Where $f_{v \cos \phi} = (1 - \beta_{v \cos \phi}^2)^{-3/2}$. In many astronomical situations, the images cannot be resolved. Instead, a composite, largely amplified image results. The total amplification, μ_p of the composite image is given by (Schneider et al., 1992)

$$\mu_p = \frac{y^2 + 2f_{v \cos \phi}^2}{y\sqrt{y^2 + 4f_{v \cos \phi}^2}}$$

Following Figure 2 and its notations, we have

$$\cos \phi = \frac{vt}{\gamma_v \sqrt{\xi_i^2 + v^2 t^2 / \gamma_v^2}} = \frac{\lambda t \sqrt{1 - \beta_v^2}}{\sqrt{x_0^2 + \lambda^2 t^2 (1 - \beta_v^2)}}$$

where $\lambda = v/\xi_0$ and $x_0 = \xi_i / \xi_0$. We can now calculate $\beta_{v \cos \phi}$ easily.

$$\beta_{v \cos \phi} = \frac{\beta_v \lambda t \sqrt{1 - \beta_v^2}}{\sqrt{x_0^2 + \lambda^2 t^2 (1 - \beta_v^2)}}$$

Equations (3), (4), and (6) give us the required amplification for the relativistic lens.

Please refer to equation at end of article.

The characteristic length scale ξ_0 in the lens plane is conventionally chosen to be

$$\xi_0 = \sqrt{\frac{4GM}{c^2} \frac{D_s - D_d}{D_s D_d}}$$

The angular diameter distances of the source and the lens are given by D_s and D_d , respectively. The mass of the lens is M .

RESULTS AND CONCLUSIONS

Our results are shown in Figure 3. The lowest curve occurs when the lens has a very small speed. In this case, we see that the distant source, S , gets amplified only *once*. However, for large speeds, the light curves are remarkably different from that for slow motion. The symmetric double peaks on either side of the y -axis show that the object gets amplified twice, and these amplifications are equal in amplitude. Furthermore, it is seen that the peaks occur at equal times before and after the closest approach of the lens to the optic axis. This is a clear manifestation of the lens.

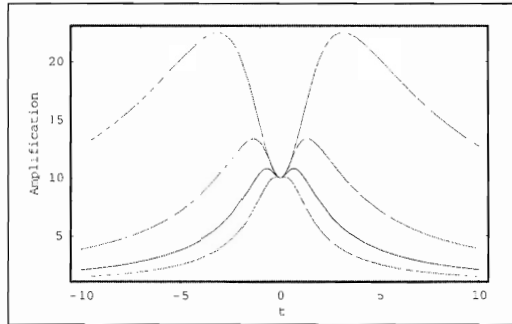


Figure 3. Amplification $\mu_p(x_0, \lambda, \beta_v, t)$ is plotted against time, t . The bottom curve is for $\beta = 0.6$, $\beta = 0.7, 0.8$, and 0.9 in ascending order for the other curves.

The distance between two peaks is calculated to be $2x_0\sqrt{(3\beta^2-1)/[\lambda(\beta^2-1)]}$. This is a very interesting result in itself as it shows that if the speed of the lens is such that $\beta = v/c < 1/\sqrt{3}$, then there cannot be two peaks. In this case, the two peaks are degenerate and only a broad peak results. If $\beta < 1/\sqrt{3}$, that is, when the speed of the lens exceeds about 60% of the speed of light, then the two peaks are well separated and the source is amplified twice at two times.

Equation (7) shows that the light curve is described by the three parameters, x_0, λ, β_v . Therefore, it is clearly seen that a successful fitting process to real light curve data would yield three parameters independently of each other, solving the lensing problem explicitly.

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$$\mu_p(x_0, \lambda, \beta_v, t) = \frac{x_0^2 + \lambda^2 t^2 (1 - \beta_v^2) + 2 \left[(x_0^2 + \lambda^2 t^2 (1 - \beta_v^2)) / (x_0^2 + \lambda^2 t^2 (1 - \beta_v^2)^2) \right]^3}{\sqrt{x_0^2 + \lambda^2 t^2 (1 - \beta_v^2)} \sqrt{x_0^2 + \lambda^2 t^2 (1 - \beta_v^2) + 4 \left[(x_0^2 + \lambda^2 t^2 (1 - \beta_v^2)) / (x_0^2 + \lambda^2 t^2 (1 - \beta_v^2)^2) \right]^3}}$$

Distances in a Universe Dominated by Vacuum

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ABSTRACT

Current theoretical and observational studies in cosmology show that our universe is vacuum dominated—more than 60% of mass of the universe is in the form of free space. Therefore, the calculation of the luminosity distance D_L , the most fundamental distance measure in cosmology, is highly desirable. The current practice of obtaining D_L has been to invoke a series of numerical integrations, which is extremely inefficient and time-consuming. We show that this distance can be calculated in a purely analytical way. Our method has been determined to be very fast and efficient.

INTRODUCTION

Our present understanding is that the universe is dominated by vacuum (Ostriker & Steinhardt, 1995). This in turn means that most of the energy of the universe is in its free space. The energy density of this free space, known as the vacuum, is calculated to be $\rho_{vac} = \lambda c^2 / 8\pi G$, where λ is the cosmological constant, G the gravitational constant, and c the speed of light (Narlikar, 1983).

The critical density of the universe is given by $\rho_{cr} = 3H_o^2 / 8\pi G$, where H_o is the Hubble constant, the rate of expansion of the universe. Present observations show that $\rho_{vac} = \rho_{vac} / \rho_{cr} \sim 60\%$; that is, more than 60% of mass of the universe is in the form of free space. Already, several projects are underway to measure this energy density using the concept of luminosity distance (Perlmutter et al., 1997).

The luminosity distance of an object having a luminosity L is given by $D_L^2 = L / 4\pi F_o$, where F_o is the observed flux of the source (Narlikar, 1983). Thus D_L contains information about the nature of the global spacetime of the universe itself. The traditional method to calculate D_L is to implement a series of numerical integrations. This method is very slow and inefficient.

We show that a very efficient analytical treatment can be established to carry out the calculation of D_L . We find that our method is exceedingly efficient and easy to implement and has a negligible error, which even decreases with the distance.

THEORY

Current observations show that the universe is spatially flat; that is, $\rho_{cr} = \rho_o$, where ρ_o is the present mass density of the universe. Thus, $\rho_o = \rho_{vac} + \rho_m$, where ρ_m is the matter density. Therefore the observed mass density parameter Ω_o is given by

$$\Omega_o = \frac{\rho_o}{\rho_{cr}} = \frac{\rho_{vac}}{\rho_{cr}} + \frac{\rho_m}{\rho_{cr}} = \Omega_v + \Omega_m$$

Equation 1

At any cosmic epoch t , the distance between any two points in the universe is proportional to the scale factor $S(t)$. In a vacuum-dominated universe, this is given by (Narlikar, 1983)

$$\left(\frac{dS}{dt} \right)^2 = H_o^2 \Omega_v S^2 + H_o^2 \Omega_m \frac{S_o^3}{S}$$

where $S_o = S(t)$ evaluated at the present cosmic epoch t_o . Letting $A = H_o^2 \Omega_v$ and $B = H_o^2 \Omega_m$, we write the foregoing equation as

$$\left(\frac{dS}{dt}\right)^2 = AS^2 + \frac{B}{S}$$

Equation 2

Assuming a big bang model $S \rightarrow 0$ and $t \rightarrow 0$, the equation above is readily integrated to

$$t = \int_{S=0}^S \frac{dS \sqrt{S}}{\sqrt{AS^3 + B}}$$

Thus,

$$AS^3 = \frac{B}{2} [\cosh(3t\sqrt{A}) - 1]$$

Substituting for A and B , we get

$$\left(\frac{S}{S_o}\right)^3 = \frac{1}{2} \frac{\Omega_m}{\Omega_v} [\cosh(3H_o t \sqrt{\Omega_v}) - 1]$$

Equation 3

The spacetime of the universe is given by the Robertson-Walker metric (Peacock, 1999)

$$ds^2 = c^2 dt^2 - S^2 \left[\frac{dr^2}{1 - kr^2} + r^2(d\theta^2 + \sin^2 \theta d\phi^2) \right]$$

Equation 4

where $k = 0$ represents a flat universe and (r, Θ, Φ) are the comoving coordinates of a point in space. Considering a point at r and taking our vantage to be at $r = 0$, we get from Eq. (4)

$$r = \int_0^r dr = - \int_{t_o}^t \frac{cdt}{S}$$

Equation 5

Eqs. (3) and (5) yield

$$rS_o = \frac{c}{H_o} \frac{1}{3 \Omega_v^{\frac{1}{6}} \Omega_m^{\frac{1}{3}}} \int_x^{x_o} \frac{dx}{\left[\sinh \frac{x}{2}\right]^{\frac{2}{3}}}$$

Equation 6

where $x = x(t) = 3\sqrt{\Omega_v} H_o t$, $x_o = x(0)$ and $x_o > x$
Letting

$$\Psi(x) = \int_x^{\infty} \frac{dx}{\left[\sinh \frac{x}{2}\right]^{\frac{2}{3}}}$$

Equation 7

where the constant $\epsilon \approx 0$. The luminosity distance $D_L = rS_o(1+z)$ is therefore given by

$$D_L = \frac{c}{H_o} \frac{1+z}{3 \Omega_v^{\frac{1}{6}} \Omega_m^{\frac{1}{3}}} [\Psi(x_o) - \Psi(x)]$$

Equation 8

Eq. (7) can be evaluated analytically. A straightforward but tedious calculation yields (Arfken, 1985)

Please refer to Equation 9 at end of article.

where the hypergeometric function ${}_2F_1(a, b, c; x)$ in Pochhammer symbol is given by

$${}_2F_1(a, b, c; x) = \sum_{n=0}^{\infty} \frac{(a)_n (b)_n}{(c)_n} \frac{x^n}{n!}$$

In this definition, $(a)_n = (a+n-1)!/(a-1)!$

Using the above definition, Eq. (9) can be expanded in a series to obtain

$$\Psi(x) = a + 3 \cdot 2^{\frac{2}{3}} x^{\frac{1}{3}} \left[1 - \frac{x^2}{252} + \frac{x^4}{21060} \right]$$

where a is a constant.

Let us now define a new function T as

$$T(x) := x^{\frac{1}{3}} \left[1 - \frac{x^2}{252} + \frac{x^4}{21060} \right]$$

Equation 10

Then,

$$\frac{\Psi(x_o) - \Psi(x)}{3 \cdot 2^{\frac{2}{3}}} = T(x_o) - T(x)$$

Equation 11

Because of the expansion of the universe, light from distant sources appears to be red shifted. The redshift z is related to S via $1 + z = S_0/S$. Now, Eq. (3) with $x=3\sqrt{\Omega_v} H_0 t$ gives

$$x = \cosh^{-1} \left[2 \frac{\Omega_v}{\Omega_m} \frac{1}{(1+z)^3} + 1 \right]$$

Equation 12

Combining Eqs. (1), (8), (11), and (12) we obtain the luminosity distance as

$$D_L = 2^{\frac{2}{3}} \frac{c}{H_0} \frac{1+z}{\Omega_v^{\frac{1}{6}} (1-\Omega_v)^{\frac{1}{3}}} [T(x_0) - T(x)]$$

Equation 13

where $\Omega_v + \Omega_m = 1$ as previously taken.

CONCLUSIONS

Our location is at $z = 0$. The redshift of an object increases as its distance increases. The popular Einstein-de Sitter model (ED) of the universe can be obtained by setting $\lambda = 0$ in our model. We see from Figure 1 that our model is in excellent agreement with the ED model.

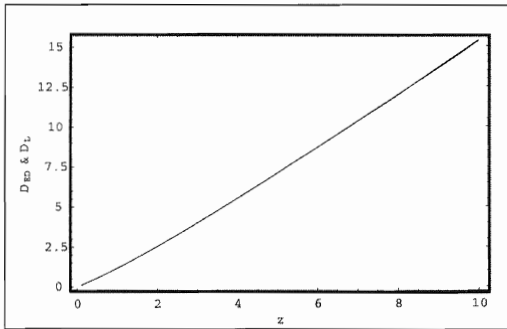


Figure 1. Plotted here is the luminosity distance D_L against redshift z . The luminosity distance in the Einstein-de Sitter universe is D_{ED} . Here D_L is our model in the limit of $\Omega_v \rightarrow 0$. The two curves are plotted and they are indistinguishable from each other showing the validity of the model.

Of course, the analytical result in Eq. (13) is an excellent approximation to the more exact numerical result. The percentage error in the analytical result can be expressed as $100(\delta - 1)$, where

$$\gamma(\Omega_v, z) = \frac{3 \cdot 2^{\frac{2}{3}} [T(x_0) - T(x)]}{\int_x^{x_0} \frac{dt}{[\sinh \frac{t}{2}]^{\frac{8}{3}}}}$$

Equation 14

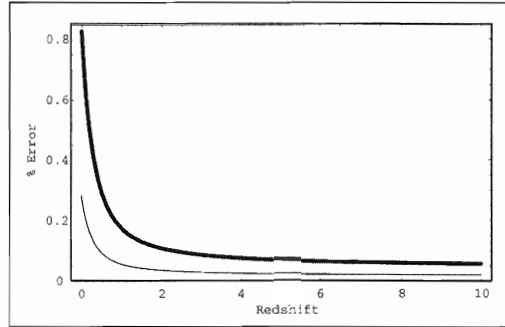


Figure 2. The percentage error of our result is $100(\delta - 1)$. It is plotted as a function of the redshift z . The thicker curve is for $\Omega_v = 0.8$ and the other is for $\Omega_v = 0.7$.

Figure 2 indicates that the relative error with respect to the exact numerical answer is less than 0.1% and rapidly approaches 0 at large distances (large redshifts).

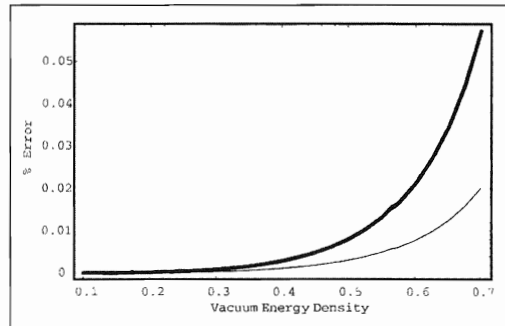


Figure 3. The percentage error of our result is $100(\delta - 1)$. Here, it is plotted against Ω_v . The thicker curve is for $z = 1$ while the other is for $z = 10$.

Figure 3 shows that the relative error in the analytical expression slightly increases with Ω_v . However, the maximum value for Ω_v is constrained to about 0.6 from other astronomical observations. Thus, the percentage error in our method is much less than 0.1% at any practically significant redshift. The error in the analytical result becomes indistinguishable at any redshift larger than unity giving an extremely efficient method to evaluate D_L . We tested the analytical method against the numerical algorithm on a Sun SPARC station and found that ours runs much faster.

$$\Psi(x) = \frac{2 \cosh \frac{x}{2} {}_2F_1\left(\frac{1}{2}, \frac{5}{6}, \frac{3}{2}; \cosh^2 \frac{x}{2}\right) \left(-\sinh^2 \frac{x}{2}\right)^{\frac{5}{6}}}{\sinh^{\frac{5}{3}} \frac{x}{2}} - \frac{2 \cosh \frac{\epsilon}{2} {}_2F_1\left(\frac{1}{2}, \frac{5}{6}, \frac{3}{2}; \cosh^2 \frac{\epsilon}{2}\right) \left(-\sinh^2 \frac{\epsilon}{2}\right)^{\frac{5}{6}}}{\sinh^{\frac{5}{3}} \frac{\epsilon}{2}}$$

Equation 9

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Conference Proceedings

Listed below are abstracts of student-faculty collaborative work presented at regional, national, and international conferences.

Nikki Renella, Amy Romanowsky, and Chrystie Onorato

The College of New Jersey

(Blythe Hinitz, The College of New Jersey, and JoAnn Hoffman, Rutgers Cooperative Extension, Faculty Sponsors)

A Journey through Trenton

Presented at the Community Connections Conference, New Brunswick, NJ, April 19, 2000

This workshop demonstrated portions of a 10-lesson unit entitled, "A Journey Through Trenton," which was designed to emphasize the importance of communities. Lessons within the unit were developed to help children learn what a community is, why it is important, and how people affect the culture of a community. Each lesson incorporated writing, visual arts, and public speaking skills within language arts, social studies, and science content. All lessons contributed to the children creating a functioning Welcome Center about their community to share what they have learned with others. Many community agencies offered their services to this project. Sally Lane from the Trenton Welcome Center provided brochures, packets, and general information about the city of Trenton, and Isles, an environmental education agency, sponsored an informative field trip to Caldwell Park and the Delaware-Raritan Canal. This unit was piloted in a third-grade classroom in a Trenton elementary school. It can be adapted to grades three through eight.

Blythe Hinitz, Cathleen Hayden, Jill Maiorano, Jo Ann Moscarello, and Malinda Wolfgang

The College of New Jersey

(Blythe Hinitz, Faculty Sponsor)

Embracing the Diversity of Children:

Native American Creative Arts

Presented at the Annual Conference of the Delaware Valley Association For the Education of Young Children (DVAEYC) and Philadelphia Interagency Coordinating Council (PICC), Philadelphia, PA, February 11-12, 2000

Attendees of the DVAEYC and PICC annual conference held on February 11-12, 2000, at the Pennsylvania Convention Center, were given the opportunity to attend a hands-on workshop entitled Embracing the Diversity of Children: Native American Creative Arts. This workshop was led by future TCNJ graduates in coordination with Professor Blythe Hinitz. Attendees were introduced to some underlying principles of Native American creative arts and began to develop initial aesthetic and educational understandings of, and appreciations for, these principles. Attendees developed skills and strategies for the inclusion of meaningful Native American (American Indian) arts experiences in their curriculum and for sharing these experiences with children. TCNJ student Cathleen Hayden presented Native-American storytelling. Through dramatization of an original story of the Chickasaw Indians, *Baby Rattlesnake*, as retold by Lynn Moroney, attendees saw the importance of stories as

teaching tools, showing children what happens when you get something before you are ready for it. Presenter *Jill Maiorano* led a creative arts activity during which attendees were able to make Native American blankets. Different aspects of art that Native American tribes from the Southwest incorporate into their blankets were discussed. Photographs of real blankets were displayed and discussed. TCNJ student *Jo Ann Moscarello* created and discussed handmade rain-sticks with all participants. The materials used provided a distinctive sound and opportunities for individual creativity. All enjoyed their musical instruments and used them during the dramatic storytelling. Attendees learned from TCNJ student *Malinda Wolfgang* about button blankets that members of many Northwest Coastal tribes still create today. Because the designs on the blanket have personal meaning to its wearer, attendees designed personal button blankets to represent their own personality, preferences, and family. The workshop concluded with a large group-sharing of creations and dramatization of the poem, *Navajo Prayer*. All attendees of this conference were able to join in activities and develop lessons appropriate for young children (pre-kindergarten through grade three).

MaryAnn Baenninger and Neil Albert
The College of New Jersey
 (MaryAnn Baenninger, Faculty Sponsor)

Why Men Won't Ask for Directions: Gender and Way-Finding

Presented at the Annual Meeting of the Eastern Psychological Association, Baltimore, MD, March 23-25, 2000

Why do some men refuse to ask for directions when they appear to be hopelessly lost? This study investigated the hypothesized gender differences in way-finding strategy, competence, confidence, and effectiveness. Surprisingly, men's and women's way-finding and orientation performance did not differ. What did differ was their own

self-perceptions of competence. Men reported significantly higher levels of competence and efficacy than did women.

John C. Pollock, Adrian Castillo, Adam Solomon, Kathy Griffiths
The College of New Jersey
 (John C. Pollock, Faculty Sponsor)

Nationwide Newspaper Coverage of a Patients' Bill of Rights: A Community Structure Approach

Presented at the Annual Conference of the National Communication Association, Seattle, WA, November 2000

The Patients' Bill of Rights Act, approved by the House of Representatives on October 7, 1999, is a bill set forth to revolutionize the nation's health care system. The bill would promote more medical rights such as: universal coverage, access to specialists, continuity of care, access to emergency care, and allowance of appeals. Furthermore, the bill would allow patients the right to sue their health maintenance organizations (HMOs) if there is reason to believe that health insurance coverage is inadequate or responsible for pain, injury, or death to the patient. Opponents of the bill believe that the Patients' Bill of Rights will only increase health insurance premiums, and that it is unnecessary for medical decisions to be tried in a courtroom. This controversy has led to extensive debate over the critical issues of patients' rights and health care legislation.

In this study, primary research was conducted to investigate how newspapers from different cities in the United States reported on the Patients' Bill of Rights. The study compared hypotheses on different city characteristics and newspaper coverage of the Patients' Bill of Rights using the "community structure approach," tested in earlier versions in Minnesota by Tichenor, Donohue, and Olien (1973, 1980) and elaborated in nationwide studies by Pollock and others (1977, 1978, 1994-2000), suggesting that certain demographic structures of a community

are systematically linked to newspaper reporting on critical issues.

A national cross-section sample of 21 newspapers was selected from the DIALOG newspaper database, and a sample of the longest articles in each newspaper on the Patients' Bill of Rights was drawn from January 1 to October 31 of 1999. The resulting total of 387 articles was analyzed using content analysis. A single score, the Janis-Fadner Coefficient of Imbalance, was calculated to combine attention given to each article as well as reporting direction (favorable, balanced/neutral, or unfavorable). Pearson correlations, regression analysis, factor analysis, regression of factors and public opinion data were used to link different city characteristics to coverage of a patients' rights bill. The coefficients of imbalance (ranging from -.034 to .504) demonstrated clear national variation, and two city characteristics had a significant relationship to newspaper coverage: a measure of "media access"—number of AM radio stations ($r = -.445$; $p = .022$); and a measure of "vulnerability"—percent city residents below the poverty level ($r = .372$; $p = .048$). Factor analysis of multiple city characteristics and regression analysis of the factors revealed results consistent with significant Pearson correlations. The factors of "media access," "economic vulnerability," and "political partisanship" (with high percentages of Democrats linked to support for, and Republicans to opposition to, a Patients' Bill of Rights) are the three clusters of significant or nearly significant results in the Pearson correlations and the three highest factor regression results, accounting for 47 percent of the variance in their relation to favorable or unfavorable reporting. Finding a negative relationship between number of AM (and directionally FM) radio stations and reporting supporting new economic or social "rights" for citizens contradicts previous studies on media coverage of critical public issues and deserves further examination.

John C. Pollock and Spiro Yulis

The College of New Jersey

(John C. Pollock, Faculty Sponsor)

Nationwide Newspaper Coverage of Physician-Assisted Suicide: A Community Structure Approach

Presented at the Annual Conference of the International Communication Association, San Francisco, CA, May 1999

The debate over physician-assisted suicide continues to grow at a vigorous rate, yet few studies seek to explore this highly charged topic as a communication issue. Unlike other studies exploring the impact of media on society, this investigation examines the impact of society on media, specifically linking city characteristics to systematic content analysis of newspaper coverage of physician-assisted suicide.

Specifically, this study maps the way newspapers from a national cross-section of cities across the United States differ in their coverage of physician-assisted suicide. The community structure approach initiated by Tichenor, Donohue, and Olien (1973, 1980), and tested nationwide by Pollock and others (1977, 1978, 1995-2000), suggests that certain demographic structures of a community are systematically linked to newspaper reporting on critical issues. This approach was used to test a set of hypotheses exploring the correlation between city characteristics and newspaper reporting on physician-assisted suicide (a similar study of coverage of Dr. Jack Kevorkian was published in *Newspaper Research Journal* by Pollock, Coughlin, Thomas, & Connaughton, 1996).

A sample of the longest newspaper articles printed on the topic that were over one paragraph in length (up to 20 for each of 15 newspapers) was drawn from a DIALOG newspaper database, collected from the four-year period of January 1, 1993, through January 1, 1997. The resulting 288 articles were then analyzed using both content and a variety of statistical analyses. Content analysis was accomplished by combining the amount of

attention an article received (placement, headline size, story length, presence of photos) and overall article direction (favorable, unfavorable, or balanced/neutral) to yield a single score, a Janis-Fadner Coefficient of Imbalance, for each newspaper.

Using Pearson correlations, factor analysis, and multiple stepwise regression, two city characteristic factors emerged as substantially significant in their association with widely varied newspaper reporting on physician-assisted suicide. A major "stakeholder" factor, age (percentage of a city population over 75) is associated strongly with relatively *unfavorable* coverage of physician-assisted euthanasia ($r = -.491$; $p = .000$). Conversely, the "access" factor—combining access to media (large newspaper circulation, number of cable stations, FM or AM stations) and access to health care (larger number of health care facilities, number of physicians per 100,000 population)—is linked to relatively *favorable* newspaper coverage of the issue ($r = .472$; $p = .000$). The age "stakeholder" factor and the "access" factor, taken together, account for 46.3 percent of the variance. This study, part of a continuing series exploring the relation of city characteristics to newspaper coverage of "critical events" such as Anita Hill's testimony, Magic Johnson's announcement, or same-sex marriage legalization proposals, confirms the strong association nationwide between community structure and media alignment with political and social change.

John C. Pollock, Heather Morris, Ralph Citarella, Melanie J. Ryan, Spiro G. Yulis
The College of New Jersey
 (John C. Pollock, Faculty Sponsor)

The Louise Woodward "British Nanny" Trial: Nationwide Newspaper Coverage of the Eappens: A Community Stakeholder Approach

Presented at the Annual Conference of the National Communication Association, Chicago, IL, November 1999

The United States was shocked in February 1997 when it was reported that an English nanny stood accused of killing the nine-month-old baby in her care. Matthew Eappen, of Middlesex County, Massachusetts, was declared dead at Children's Hospital five days after his nanny, Louise Woodward, allegedly shook him so hard that it caused him to stop breathing. The story of Woodward's ensuing trial, conviction, and overturning of her conviction sparked a hot debate about childcare in the United States. Unlike other studies exploring the impact of media on society, this investigation examines the impact of society on the media, linking city characteristics to systematic content analysis of newspaper coverage of the Eappen family.

Specifically, this study maps the way newspapers from a national cross-section of cities across the United States differ in their coverage of the Eappens. The community structure approach developed by Tichenor, Donohue, and Olien (1973, 1980), and elaborated by Pollock and others (1977, 1978, 1995, 1996, 1997, 1998), suggests that certain demographic structures of a community are systematically linked to newspaper reporting on critical issues. This approach was used to test a set of hypotheses exploring the correlation between city characteristics and newspaper reporting on the Eappens.

A nationwide, 15-city sample of the longest newspaper articles printed on this topic that were over one paragraph in length (up to 20 for each of the newspapers) was drawn from a DIALOG newspaper database, collected from February 4, 1997, through October 31, 1997. These articles were then analyzed using both content and a variety of statistical analyses. Content analysis was accomplished by combining the amount of attention an article received (placement, headline size, story length, presence of photos) and overall article direction (favorable, unfavorable, or balanced/neutral) to yield a single score, a Janis-Fadner Coefficient of Imbalance, for each newspaper.

Using Pearson correlations and regression analysis, four city characteristic factors emerged as substantially significant in their association with widely varied newspaper reporting on the Eappens. A relatively high percentage of a city population of women in the workforce ($r = .450$), and a high percentage of African Americans ($r = .356$) in a city are strongly associated with *favorable* coverage of the Eappens. These two factors alone account for 46.1 percent of the variance. Conversely, newspaper circulation in a city ($r = -.229$) and the percent of the city population with 16 or more years of schooling ($r = -.221$) are associated with *unfavorable* coverage of the Eappens. These four factors, taken together, account for 51.1 percent of the variance. This study, part of a continuing series exploring the relation of city characteristics to newspaper coverage of "critical events" such as Anita Hill's testimony, Magic Johnson's announcement, or same-sex marriage legalization proposals, confirms the strong association between community structure and the media's coverage of emerging social and political issues.

John C. Pollock, Kim Richards, Michael Dudzak, Sara Norton, Ruth Miller, Spiro Yulis

The College of New Jersey

(John C. Pollock, Faculty Sponsor)

Comparing City Characteristics and Nationwide Newspaper Coverage of Human Cloning: A Community Structure Approach

Presented at the Annual Conference of the International Communication Association
Acapulco, Mexico, June 2000

"Human cloning may be the most difficult moral dilemma posed by science since the splitting of the atom" (Powers, 1998, p. 58). In February of 1997, two figures were added to daily life: Dolly, a cloned sheep, and her maker, Scottish scientist Ian Wilmut. Their story could be found in newspapers, on television, across the Internet, and in conversations.

Since the ability to clone humans has become a reality, there has been a media frenzy sparking many a debate among a variety of publics: scientists, lawyers, ethicists, religious leaders, government representatives, and others.

This study tracks news coverage from different regions of the United States sampled systematically in 22 newspapers throughout the nation during the period of January 1997 through December 1998. This time frame included both coverage on Dolly, the first sheep cloned, and Richard Seed, the person who announced he had the ability to begin cloning humans. Previous studies suggest that variations in community or city characteristics (using aggregate data and demographics) have a great deal to do with variations in reporting on critical issues. This community structure perspective may help account for newspaper variation on this subject (Tichenor, Donohue, & Olien, 1968, 1980, 1985; Pollock & Robinson, 1977; Pollock, Robinson, & Murray, 1978; Pollock, Awrachow, & Kuntz, 1994; Pollock 1995, 1996, 1997, 1998, 1999).

The DIALOG Classroom Information Program national newspaper database was used to collect 380 articles over one paragraph in length. Each of the articles was read and coded for two kinds of information: a "display" or "attention" score (ranging from 3 to 16 points based on article placement, headline size, article length, and presence of photographs, captioned or not) and a directional score (legitimizing/favorable, delegitimizing/unfavorable, and balanced/neutral). These in turn were used to calculate the Janis-Fadner Coefficient of Imbalance for each newspaper.

The newspaper coverage of human cloning varied as predicted; the Coefficients of Imbalance ranged from $+.0872$ to $-.2672$ revealing diverging opinions among city newspapers. The most significant correlations and regression findings revealed strong nationwide links between three key city characteristics, the number of AM radio stations, percent women in the workforce, and

percent professionals—together accounting for 42 percent of the variance—and more favorable (or less unfavorable) news coverage of human cloning. Each of these findings confirms previous research suggesting a broad relation between media access (number of AM radio stations), proportion of “stakeholders” (percent women in the workforce) and the proportion of relatively privileged or “buffered” city residents (percent professionals) and reporting relatively receptive to political and social change. In particular, the “stakeholder” findings about the link between women in the workforce and reporting on cloning challenge the “guard dog” hypothesis of reporting, which suggests that media primarily mirror the interests of powerful, established interests in each city.

John C. Pollock, Tiffany Tanner, and Mike Delbene

The College of New Jersey
(John C. Pollock, Faculty Sponsor)

Nationwide Newspaper Coverage of Social Security Reform: A Community Structure Approach
Presented at the Annual Conference of the Association for Education in Journalism and Mass Communication, Phoenix, AZ, August 2000
Utilizing the community structure approach developed by Tichenor, Donohue, and Olien (1973, 1980) and elaborated by Pollock and others (1977, 1978, 1995, 1996, 1997, 1998, 1999), a set of hypotheses were tested to discover the relationship between city characteristics and newspaper reporting on Social Security reform. This approach suggests that certain demographics within a community are systematically linked to newspaper reporting on critical issues. Using content analysis of a national newspaper database, as well as correlational, regression and factor analysis, three “factors” emerged as significant in their association with reporting relatively favorable toward some degree of privatization for Social Security, specifically higher proportions of:

“stakeholders” in a city (combining percent population between the ages of 18 and 34 and percent attending cultural or artistic events); percent “privileged” (combining percent college educated and percent with professional occupations); and levels of media “access” (combining number of FM radio stations and number of AM radio stations). The “stakeholder” and “privileged” factors are especially powerful, together accounting for 34 percent of the variance.

John C. Pollock, Jeff Fogliano, Jason Geipel, Lee Abrams, Jamal Glover, Jackson Shellenberger, Jennifer Fagerty

The College of New Jersey
(John C. Pollock, Faculty Sponsor)

Nationwide Newspaper Coverage of Post-Columbine Gun Control Legislation: A Community Structure Approach
Presented at the Annual Conference of the National Communication Association, Seattle, WA, November 2000

Opposing sides have contested the issue of gun control legislation for years, arguing for and against the second amendment countless times. Now, with schoolyard shootings, such as the tragic Columbine massacre, on the rise, the issue of gun control legislation has once again surfaced on media and political agendas. Curiously, however, few systematic studies have sought to explore gun control as a communication issue. Unlike other studies exploring the impact of media on society, this investigation examines the impact of society on media, linking city characteristics to systematic content analysis of newspaper coverage of gun control legislation.

Specifically, this study maps the way newspapers from a national cross-section of cities across the United States differ in their coverage of gun control legislation. The community structure approach developed by Tichenor, Donohue, and Olien in Minnesota (1973, 1980), and explored nationwide by Pollock and others (1977, 1978, 1994-2000), suggests that certain demographic structures of a

community are systematically linked to newspaper reporting on critical issues. This approach tested hypotheses exploring the relation between city characteristics and newspaper reporting on gun control legislation.

A nationwide, 15-city sample of the longest newspaper articles printed on this topic over one paragraph in length (up to 20 for each of 15 newspapers) was drawn from a DIALOG newspaper database, collected from January 1, 1999, through November 1, 1999. The resulting 297 articles were then analyzed using both content and a variety of statistical analyses. Content analysis was accomplished by combining the amount of attention an article received (placement, headline size, story length, presence of photos) and overall article direction (favorable, unfavorable, or balanced/neutral) to yield a single score, a Janis-Fadner Coefficient of Imbalance, for each newspaper.

Using Pearson correlations and regression analysis, two city characteristics measuring "privilege" emerged as substantially significant in their association with widely varied newspaper reporting on gun control legislation. A high percentage of citizens with household incomes over \$100,000 ($r = .69$; $p = .003$) in a city, or a high percentage of citizens with a college education in a city ($r = .67$; $p = .007$) are strongly associated with relatively *favorable* coverage of gun control legislation. These findings confirm a "violated buffer" hypothesis advanced by Pollock and associates, suggesting that since Columbine, privileged groups understand that gun violence can occur in privileged, suburban schools, and that it is now clear everyone's children are at risk. Further regression analysis of individual variables, factor analysis, and regression of the four major factors reveal that two factors combined, "privilege" and "vulnerability," account for 45 percent of the variance. High poverty levels (in the "vulnerability" cluster) are linked to negative coverage of gun control, indicating the need for further study of the link between city characteristics and reporting on political change.

John C. Pollock, Lauren Spina, Michael Dudzak, Michelle Lemire
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 (John C. Pollock, Faculty Sponsor)

City Characteristics and Nationwide Coverage of the 1997 UPS Strike
 Presented at the Annual Conference of the National Communication Association, Seattle, WA, November 2000

Although the power of labor unions had been in steady decline for many years, on August 4, 1997, the International Brotherhood of Teamsters called a strike against the United Parcel Service. The strike sparked a lengthy public debate about the issues involved, a discussion given substantial coverage in mass media. Using systematic content analysis and aggregate data on city demographics, this investigation explores the ways distinct city characteristics are linked to newspaper coverage of the UPS strike.

Specifically, this study maps the way newspapers from a national cross-section of cities across the United States differ in their coverage of the UPS strike. The community structure approach initiated in Minnesota by Tichenor, Donohue, and Olien (1973, 1980) and elaborated by Pollock and others (1977, 1978, 1995, 1996, 1997, 1998), suggests that certain demographic structures of a community are systematically linked to newspaper reporting on critical issues. This approach was used to test a set of hypotheses exploring the correlation between city characteristics and newspaper reporting of the UPS strike.

A nationwide, 15-city sample of the longest newspaper articles printed on this topic (over one paragraph in length) was drawn from a DIALOG newspaper database, collected from the year 1997. The articles read covered what led to the UPS strike, the strike itself, and terms agreed upon by both sides. The articles were then analyzed using both content and a variety of statistical analyses. Content analysis involved combining the amount of attention an article received (placement, headline size,

story length, presence of photos) and overall article direction (favorable, unfavorable, or neutral/balanced) to yield a single score, a Janis-Fadner Coefficient of Imbalance, for each newspaper.

Using Pearson correlations and regression analysis, five city characteristics emerged as clearly associated with widely varied newspaper reporting on the UPS strike. A relatively high percentage of self-employed in a city ($r = -.464$; $p = .041$) was significantly associated with negative coverage of the UPS strike. Conversely, a high number of FM stations ($r = .456$; $p = .044$) was significantly associated with favorable coverage of the strike. Among the directional findings were percent women in the workforce ($r = -.35$; $p = .10$), linked to negative coverage of the strike, and linked to positive coverage, TV stations ($r = .407$; $p = .067$), and percent professionals ($r = .254$; $p = .18$). After conducting regression analysis, two factors emerged as of primary significance. These were percent self-employed and percent professionals in cities. Together, they accounted for 36.7% of the variance. This study, part of a continuing series exploring the relation of city characteristics to nationwide newspaper coverage of "critical events," such as Magic Johnson's HIV announcement or same-sex marriage legalization proposals, confirms the strong association between community structure and the media's coverage of emerging social and political issues.

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