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Preface

Student writing is in vogue at The College of New Jersey. A new curriculum is taking shape, based on the premise that students will take (and teachers will teach) fewer but more intensive courses. At the heart of this transformation is the equation articulated by Richard J. Light, who finds a direct relationship between the amount of writing required for a course and the amount of student "engagement" in it. In short, "the more writing required, the more time students commit"— and the more they gain from their courses (*Making the Most of College: Students Speak Their Minds,* Harvard University Press, 2001, pp. 55-56).

Powerful evidence suggests that students at The College are well prepared to embrace a new writing-oriented curriculum. The volume that you now hold in your hands contains striking examples of undergraduate writing. Typically too, these essays also bear witness to a rigorous research agenda—identifying a key gene that leads to abnormal ear growth both in mice and in humans; closely reading the works of John Milton, Samuel Johnson, or Toni Morrison; analyzing the geology of Monmouth County; and exploring means to make multinational corporations more socially responsible.

Each of these essays also testifies to one of the most precious features of a high-quality college experience: the close interaction between a particular teacher and an individual student. The best educational experiences cannot be mass-produced or replicated in cyberspace. One-on-one nurtures the type of work contained in the pages that follow.

It is my privilege to salute the talented student contributors to Volume V of *The College of New Jersey Journal of Student Scholarship.*

Daniel W. Crofts
Chair, Department of History
President, Faculty Senate

A Message from the Editor

The sophistication and maturity of student scholarship contained in this volume underscores the remarkable intellectual collaboration of students and professors, which is central to the mission of The College of New Jersey. The essays in this volume testify to the readiness of The College's students to embrace the new, enhanced curriculum to be implemented over the 2003-04 and 2004-05 academic years. Indeed, these essays reflect the intellectual excitement and dedication that comes with The College's ongoing commitment to premiership among the nation's public undergraduate colleges.

I wish to thank the many people who have contributed to Volume V 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 Ellie Fogarty and Nancy Freudenthal, has been kind, patient, and helpful with a variety of concerns and inquiries. I would also like to thank two former members of the Office of Academic Affairs, Robert Cobb, now assistant director of departmental services, and Monica Frascella, for their help. I also extend thanks to Vice President Jesse Rosenblum and Anthony Marchetti of the Office of College Relations. For consultation on production matters, I thank Lisa Angeloni, director of admissions. 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. Paulette LaBar of the Department of English kindly and expertly assisted in the editing of the essays printed in this volume and periodically updated the Web site of the *Journal*. To Professor Daniel W. Crofts, chair of the Department of History and president of the Faculty Senate, I owe thanks for his contributing the preface to Volume V. Finally, I would like to thank Associate Editor Romulo Ochoa for his wise advice and generous assistance throughout this enterprise. As these acknowledgements indicate, this volume is the product of a community-wide 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 dventuro@tcnj.edu; or, visit the *Journal* Web site at http://sjournal.intrasun.tcnj.edu.

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

David Venturo,
Editor
Associate Professor and Graduate Coordinator,
Department of English

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VOLUME V

Nationwide Newspaper Coverage of Homosexuals in the Boy Scouts of America: A Community Structure Approach

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Abstract

Using a "community structure approach," tested in nationwide studies by Pollock and colleagues (1977, 1978, 1994-2002), this study explores systematic links between community demographic characteristics and newspaper reporting on homosexuals in the Boy Scouts of America (BSA), especially the Supreme Court decision permitting gay exclusion.

All articles over 150 words on the topic published between January 1, 1998, and March 1, 2001, were selected from a national cross-section sample of 21 newspapers, yielding 322 articles. A single score, the "Media Vector," was calculated to combine article "prominence" as well as reporting direction (favorable, balanced/neutral, or unfavorable). "Media Vector" coefficients (from .256 to -.188) demonstrated clear national variation.

Four major hypotheses were confirmed, the first three most strongly by subsequent regression and factor analysis: 1) A *buffer* hypothesis, predicting that high percentages of privileged groups in a city correspond with reporting favorable to human rights claims—of gays in this case [% family income over $100,000 (r = .671; p = .000); % college educated (r = .593; p = .002)]; 2) a *stakeholder* hypothesis [gay market index (r = .599; p = .002); political partisanship—Democrats (r = .596; p = .002), Republicans (r = -.602; p = .002); religious involvement—Bible/devotional readings (r = -.588; p = .003), Catholics (r = .492; p = .012)]; 3) a *media access* hypothesis [newspaper circulation (r = .477; p = .014); number of cable stations (r =.426; p =.027)]; and 4) a *vulnerability* hypothesis [% below the poverty line (r = -.474; p = .015)]. Factor analysis regression found the first three hypothesis clusters accounted for 56% of the variance.

Introduction

> *On my honor I will do my best*
> *to do my duty to God and my country*
> *and to obey the Scout Law;*
> *to help other people at all times;*
> *to keep myself physically strong,*
> *mentally awake, and morally straight.*
> —*Boy Scout Oath*

For years, the Boy Scouts of America have lived by this oath. In July 1990, Eagle Scout and Scout Master James Dale received word that his lifestyle did not comply with the oath of the Boy Scouts of America because he was homosexual. In August 1999, Dale took his case to the New Jersey Supreme Court. He won, on the grounds that the BSA had discriminated against him based on his sexual orientation. The Boy Scouts of America appealed the case to the United States Supreme Court. Regardless of evidence that Dale had previously devoted 11 honorable years of his life to the Boy Scouts, the U.S. Supreme Court decided on June 28, 2000, that the Boy Scouts had the right to restrict membership if a person's actions contradicted the organization's set of moral standards.

The issue of allowing gays in the Boy Scouts can be framed in several ways. Newspaper articles positively framing the

issue favor allowing homosexuals to remain members of the Boy Scouts of America. Generally, those holding a positive view believe that banning gays from the BSA is discriminatory and violates one's civil rights. Articles framing the issue negatively express the view that homosexuality is morally wrong, and that gay scout leaders would not make good role models for young scouts. These negatively framed articles may also emphasize that private organizations have a right to restrict membership. Therefore, according to this view, the BSA, a private organization, can set membership standards that their scouts and leaders must be "clean" and "morally straight."

The U. S. Supreme Court decision in *Dale vs. The Boy Scouts of America* warrants extensive media coverage because the opposing sides hold such strong opinions and because the Boy Scouts is a long admired institution. With increasing focus on hate crimes based on sexual orientation, illustrated dramatically with the murder of Matthew Shepard, one could argue that this Supreme Court decision discriminates against Boy Scouts and leaders because of a lifestyle choice. On the other hand, the conservative majority of Supreme Court justices argue that a private, non-profit organization has the right to set its own moral standards. Because the Boy Scouts of America believes that homosexuality is immoral, it has the right to exclude someone from its organization if he does not represent its moral values.

Since there are such strong opposing viewpoints on this issue, the study will explore the differences in media coverage in different cities focusing on variations in voting patterns, religious affiliations, lifecycle position, family values, and other relevant factors. Another factor possibly affecting media coverage is the percentage of families with primary school age children in a given city. These parents may represent interested "stakeholders" because of parental concern, which may be linked to newspaper coverage unfavorable to gays in the Boy Scouts. Cities with higher proportions of organizations marketing to gays, by contrast, may reveal relatively favorable coverage of gays in the Boy Scouts. This study will explore the link between different community configurations and the issue of whether or not homosexuals should be permitted to hold membership in the Boy Scouts of America.

Literature Review

Since many communication journals as well as online databases were searched for articles concerning the issue of gays in the Boy Scouts, it was disconcerting that little or no information had been published regarding this important issue. Because the Boy Scouts of America affects the lives of so many young boys and their families all over the country, it is surprising that there is such a lack of information about this issue.

Ebscohost is an online database that provides access to more than 2,100 electronic journals from 1996 to the present. A search of Communication Abstracts, an authoritative listing of scholarly communication articles, using key terms such as "boy scouts and gay," "scouts and homosexual," and "boy scouts and supreme court" was conducted, but only four articles were found. When broadening the search with general subject headings such as "gay" or "boy scout," only 10 articles surfaced. These dealt mainly with different aspects of homosexual issues, such as gays' portrayal on television and gays in the military. One article entitled "Journalism and News Media" dealt with a study that "analyzes the way in which television news organizations selected and used unofficial sources in covering the 1992-1993 controversy over homosexuals and military service" (Steele, 1997, 537).

CommIndex is another online database that provides complete bibliographic information for approximately 31,500 articles from 70 international journals and annals from the communication field. Using key terms such as "homosexual and scout," "gay and boy scout," and "supreme court and gay," again little or no relevant information was

found. Using the same subject headings, other communication journals were searched, including *Political Communication,* and *Journalism and Mass Communication Quarterly,* resulting in little relevant information.

It is possible that the lack of information in communication journals results from the recentness of the case, which made headlines only a few years ago. The rights of both homosexuals and private organizations should be topics of interest in the field of communication. The Supreme Court's decision to permit the Boys Scouts to choose whom they will or will not allow to become members sends a strong message to those the Boy Scouts of America dismiss, especially those in the gay community. The case not only involves a "deep-rooted conflict" regarding acceptance of gays within communities, but also a serious dispute concerning people's basic constitutional rights (*The Economist,* 2000, p. 29).

Although the case was ignored in communication journals, articles concerning gays in the Boy Scouts, and gays in particular, were easily found in social science sources such as Sociological Abstracts and Political Science Abstracts. Using the subject "gay" under Sociological Abstracts, 3,091 articles were found. Using other headings such as "homosexual and scout," "gay and rights," and "Supreme Court and homosexual," many more articles appeared than in the communication journals. Under the subject "homosexual and scout," there were two relevant articles entitled "Culture War Against the Boy Scouts" (Donohue, 1994) and "The Boy Scouts Under Siege" (Salzman, 1992). Both articles were written before the Supreme Court case, indicating that there is indeed interest in this issue and that it is an important topic. In "The Boy Scouts Under Siege," the author examines the defensive position that the Boy Scouts took in the 1990s. The article points out that the Boy Scouts "refuse to permit atheists, homosexuals, and girls to become members based on their interpretation of the oath, and they feel legally entitled to exclude them because they are a private organization" (p. 594).

Further searches of literature suggest interest concerning gays in the television industry. An article entitled "Prime-time television in the gay nineties," explores the thinking behind the networks' desire to attract a new audience. The author states that debates over gay rights, which include the gays in the Boy Scouts debate, are a reason for this interest by the television industry. The author believes that incorporating homosexual material into lineups will attract a more liberal, college-educated, intellectual audience (Becker, 1998, p. 45).

After extensively researching several communication databases and journals, it is clear that little has been done so far by communication scholars to discuss the issue of gays in the Boy Scouts. Considering that the issue of gays in the Boy Scouts has warranted a Supreme Court decision, it would seem that this is an essential issue for communication scholars. Finding relevant information in sociological and political journals suggests a gap between the communication field and other social sciences. By studying differences and similarities in newspaper coverage of gays in the Boy Scouts across the United States, it is possible to illuminate various city characteristics associated with varying opinions in the reporting.

A Community Structure Approach

This study examines the link between city demographics and newspaper coverage by applying the community structure approach. The *community structure approach* is defined as "a form of quantitative content analysis that focuses on the ways in which key characteristics of communities (such as cities) are related to the content coverage of newspapers in those communities" (Frey, Botan, and Kreps, 2000). This approach was initiated in Minnesota by Tichenor, Donohue, and Olien (1973, 1980, 1995) and elaborated by Demers (1996a, 1996b) and others. Tested in nationwide studies by Pollock and colleagues (1977, 1978, 1994–2001), the community structure approach studies the link between city

structure characteristics and demographics and newspaper reporting on critical events.

The community structure approach can accomplish at least three important goals. First, the community structure approach provides insight into topics that have received little attention in scholarly communication studies literature. The research concentrates on the "antecedents" of newspaper content (Riffe, Fico, & Lacy, 1998, pp. 8–10). Second, this approach attempts to connect theory with data collection, a practice seldom used by scholars relying on analysis methodologies (Shoemaker, P., 1987; Shoemaker & Reese, 1990, 1996; Riffe & Freitag, 1996). In this paper, the community structure approach will use an incremental, *ground-up paradigm building*, a process recommended by Lance Bennett to construct practical theories (Bennett, 1993, p. 182).

Third, initially concerned with the relationship of community structure to social and political control, scholars have urged that community structure researchers begin to focus more on political and social change. Newspapers could be seen as being linked, in many aspects, not only to individual readers, but also to the communities that they serve, a view long held by sociology of communication scholars. According to K. A. Smith (1984), "the 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 dominant groups in the community they serve" (p. 260). In an innovative study by Tichenor, Donohue, and Olien (1980), newspapers from Minnesota cities of different sizes were compared. The evidence fostered the conclusion that newspapers were "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" (pp. 102–3).

A vast amount of the research on community structure and media has stressed that "mainstream mass media are agents of social control for dominant institutions and value systems" (Demers & Viswanath, 1999, p. 419). Yet, there needs to be a shift in research from the assumption of media molding public opinion to the rarely explored notion of public opinion shaping media coverage. As Demers and Viswanath explain it, "We in the communication field... need to give more consideration to processes of social change, especially secular social change and public policy. Only then will it be possible to initiate structural or cultural changes that will enable mass media to be more responsive to the needs and goals of disadvantaged and repressed groups" (1999, p. 424).

Issues that invoke group mores and norms also affect newspaper coverage. Supreme Court regulation of homosexuals in the Boy Scouts may be viewed differently by citizens in various cities across the nation. It is reasonable to expect the court ruling may be reported and described differently in the newspapers of different cities. Cities with a significant homosexual population may have a different view from cities with large numbers of families of Boy Scout age. By recognizing that many demographic factors might influence change on controversial issues and by incorporating the community structure approach, this study examines the possible relation between city characteristics and media coverage of homosexuals in the Boy Scouts.

HYPOTHESES

Using the community structure approach, several umbrella hypotheses emerge. Eighteen individual hypotheses can be placed into four cluster groups including the stakeholder hypothesis, buffer hypothesis, vulnerability hypothesis, and access to media hypothesis.

Stakeholder Hypothesis

Previous research using the community structure approach has revealed that the greater the proportion of recognized stakeholders in a city, the more newspaper coverage is likely to vary accordingly to their concerns

(Pollock & Castillo, et al., 2000). When trying to find a correlation between stakeholders in a city, and how that city covers gay rights issues, it seems obvious that the number of gays and lesbians residing in that city should be taken into account. However, the difficulty of measuring gay and lesbian presence has posed a problem.

Pollock and Dantas have found significant results by creating a "gay market index." Using an encyclopedia of gay resources in the United States, the 1995-96 national edition of the Gayellow Pages, data for the study was collected (Gruber, 1995). Fashioning a "gay market index," it was found that the greater the proportion of businesses or organizations marketing to the gay community in a city, the more likely city newspapers were to report favorably on efforts to legalize same-sex marriage (Pollock & Dantas, 1998). Using the 1999-2000 Gayellow Pages, the gay market index was updated for this study. Therefore:

H^1: The higher the number of gay businesses and organizations owned wholly/partly by gays and/or lesbians, or welcoming a primarily gay and lesbian clientele in a city, the more favorable the expected coverage of gays in the Boy Scouts (Gayellow Pages, 2000).

The United States military generally holds a conservative view on homosexual issues. Currently, the military maintains a "Don't ask, Don't tell" policy. It is reasonable to expect that individuals holding positions in the United States military will hold similar views concerning gays in the Boy Scouts. According to Sarah Wildman in a recent issue of *Advocate*, six years after President Clinton implemented "Don't ask, Don't tell," and even after the more recent "Don't harass," the Army remains an uncomfortable—indeed, dangerous—place to be gay, lesbian, or bisexual (2000). Thus:

H^2: The greater the percentage of people holding positions in the U. S. military in each city, the less favorable the coverage of gays in the Boy Scouts (County & City Extra, 2000).

Table 1: Gay Market Index* (Updated by DuRoss, Moscatello, & O'Rourke, 2001)

Cities	Accomodations Hotels, B&Bs	Bars, Clubs Discos	Bookstores	Religious Groups	Organizations Resources	AIDS/HIV Health Care	Gay Publications	TOTAL
San Francisco	26	69	10	14	69	19	13	220
Seattle	7	32	12	6	52	11	2	122
Boston	11	16	10	4	65	7	2	115
Fort Worth	4	37	2	8	47	8	3	109
Philadelphia	6	18	4	7	46	13	6	100
Atlanta	5	40	3	11	26	10	3	98
Denver	4	29	4	6	29	10	3	85
San Diego	10	26	3	5	29	9	3	85
Tampa	6	34	3	5	19	8	3	78
Detroit	0	30	2	6	25	6	3	72
Phoenix	5	29	2	10	20	5	1	72
Pittsburgh	2	18	3	8	28	9	2	70
Milwaukee	0	22	5	4	31	4	2	68
St. Louis	3	23	5	5	19	7	4	66
Buffalo	1	11	3	4	23	4	2	48
Memphis	0	20	0	4	14	2	1	41
Cincinnati	1	14	4	3	15	1	0	38
Albany	2	12	2	3	12	6	0	37
Albuquerque	7	7	4	4	7	2	4	35
Charlotte	0	12	4	3	12	4	0	35
Omaha	0	9	2	2	11	0	2	26
Wichita	0	10	0	4	7	3	1	25
Dayton	0	11	1	3	5	0	2	22
Lexington	0	4	2	2	8	1	0	17
Baton Rouge	1	6	1	4	3	1	0	16
Fort Wayne	0	5	1	3	3	2	0	14
Columbia	0	6	1	3	3	0	0	13
Fresno	0	5	1	0	7	0	0	13
Tallahassee	0	3	0	1	2	1	1	8

* Copyright Dantas & Pollock, 1998-2001

Political Partisanship

Broad political identities and voting preference may be linked to views about gays in the BSA. In a recent study conducted by Pollock, Castillo, and colleagues on a Patients' Bill of Rights (2000), it was found that the greater the proportion of Republicans in a city, the less favorable the coverage of the issue. Similarly, the greater the proportion of Democrats in a city, the more favorable the coverage of a Patients' Bill of Rights (2000). These results show a correlation between partisanship and nationwide newspaper coverage of an issue. It is logical, then, to assume that partisanship will be associated with the coverage of homosexuals in the Boy Scouts of America. Members of both the Democratic and Republican parties hold strong opinions regarding gay rights. The Clinton adminstration proposed the "Don't ask, Don't tell" policy as a compromise to the Republican party's position banning gays from the military. According to Sue Kirchhoff in the July 1998 issue of *CQ Weekly,* top congressional Republicans have taken an increasingly tough stance against homosexual rights (Kirschhoff, 1998). Thus:

H^3: The higher the percentage of Republicans in each city, the less favorable the coverage of gays in the Boy Scouts (County & City Extra, 2000).

H^4: The higher the percentage of Democrats in each city, the more favorable the coverage of gays in the Boy Scouts (County & City Extra, 2000).

Religious Affiliation

It is also clear that churches and religious organizations have been forced to deal with gay rights, and often taken strong stances on the issue. According to *The New York Times,* "the Vatican calls homosexual practice a serious moral disorder" (Niebuhr, 1996, p. A1). 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*. It seems logical, then, that certain religious beliefs would play a large role in the newspaper coverage of *Dale vs. The Boy Scouts of America*. Therefore:

H^5: The greater the proportion of Catholics in each city, the less favorable the coverage of gays in the Boy Scouts (Catholic Almanac, 2000).

H^6: The greater the percentage of families participating in Bible/devotional readings in a city, the more likely the coverage will be unfavorable (Lifestyle Market Analyst, 2000).

Position in Lifecycle

Since homosexuals "coming out" in the Boy Scouts is a relatively new issue, and the older generation seems to be more conservative when it comes to such a controversial issue, it is reasonable to assume that there will be a link between age and reporting on gays in the Boy Scouts. A study conducted by Pollock and Whitney hypothesized that "older citizens are more likely to hold relatively rigid, stereotypical, and ethnocentric views because more traditional perspectives were more common when such people were younger and may be retained as the older generation reaches maturity" (1997). Similarly, because homosexuality has not been openly discussed until recently, it is logical to assume that older individuals may still feel that homosexuality is immoral. Thus, the older an individual is, the more likely he or she will agree that the Boy Scouts of America has the right to ban openly homosexual individuals from its organization. Therefore:

H^7: The greater the percentage of citizens 65 years of age or older in each city, the less favorable the coverage of gays in the Boy Scouts (World Encyclopedia of Cities, 1994).

A recent study conducted by Mink and Puma on the custody battle over Elián González found that nationwide newspaper coverage generally supported the rights of natural parents who play an active, attentive role in the rearing of offspring (2001). It seems reasonable, then, to assume that families with young children would be most concerned with the safety and morality of the Boy Scouts of America. Therefore:

H^8: The greater the percentage of families with children ages 12 and under (of Boy Scout age), the less favorable the coverage of gays in the Boy Scouts (Lifestyle Market Analyst, 2000).

Ethnic Identity

Though one may assume that minorities, who often suffer from oppression and prejudice, would strongly support gay rights, seeing homosexuals as allies in a civil rights battle, some evidence suggests otherwise. Some African-Americans have expressed resentment toward gays and lesbians, arguing that ethnic identity is a cause for equal rights, unlike homosexuality, which in their eyes is a lifestyle choice (Pollock & Tobin, 2000). According to John Sibley Butler, in the November/December 1993 issue of *Society*, "Comparing homosexuals to blacks is comparing a lifestyle with a race: an achieved characteristic with one that is ascribed; a choice in expressed lifestyle with one that is by and large not a choice" (1993). Therefore:

> *H^{9}: The greater the percentage of African-Americans in each city, the less favorable the coverage of gays in the Boy Scouts* (Lifestyle Market Analyst, 2000).

A study conducted by Pollock and Tobin yielded directional findings that negatively correlated Hispanics and same-sex adoption. This finding revealed that "minority groups may harbor resentment toward gays who make a decision to live the life in the manner chosen" (2000, p. 30). Thus:

> *H^{10}: The greater the percentage of Hispanics in each city, the less favorable the coverage of gays in the Boy Scouts* (County and City Extra, 2000).

Buffer

> *H^{11}: The higher the percentage of people with a college education, the more favorable the coverage of gays in the Boy Scouts* (Lifestyle Market Analyst, 2000).

> *H^{12}: The higher the percentage of population in a city with professional or technical status, the more likely the coverage of gays in the Boy Scouts will be favorable* (Lifestyle Market Analyst, 2000).

> *H^{13}: The higher the percentage of families with an income of $100,000 or more in a city, the more likely the coverage of gays in the Boy Scouts will be favorable* (Lifestyle Market Analyst, 2000).

In *Investigating Communication*, Frey, Botan, and Kreps observe that, "The 'buffer hypothesis' expects that the higher the proportion of privileged groups in a community, the greater the favorable media coverage of those making human rights claims" (Frey, Botan, & Kreps, 2000, p. 329). Developed by Pollock and colleagues, the expectations of this hypothesis are illuminated by Keith Stamm in *Newspapers and Community Ties: Toward a Dynamic Theory* (1985). Stamm's work supports the position that cities with a higher quality of life will more likely have newspapers evaluating new issues from a variety of perspectives. The buffer hypothesis is useful when considering indicators of privilege such as the percentage of the population with professional/technical occupational status, the proportion of city residents with annual family incomes of $100,000 or more, and the number of people who have obtained a college education. The buffer hypothesis has been confirmed in a study conducted by Pollock and Killeen in 1995 on the Clarence Thomas-Anita Hill hearings as well as Pollock's, Shier's, and Slattery's study of the Open Door Policy toward Cuba in 1995. It is possible that there may be a relationship between these city characteristics and favorable newspaper coverage of gays in the Boys Scouts.

Vulnerability

It is reasonable to expect that those in a community who are below the poverty level will have negative views on gays in the Boy Scouts. Those living below the poverty line tend to be less educated and financially stable, and therefore less open to social change. Therefore:

> H^{14} : *The higher the percentage of citizens living below the poverty line in a city, the less likely the coverage of gays in the Boy Scouts will be favorable* (County and City Extra, 2000).

Access to Media

In examining media access, it is important to consider previous studies. Some studies have shown that there is an association between access to many different media outlets and openness to new ideas. A series of studies

done by Tichenor, Donohue, and Olien in Minnesota has shown that a city with numerous media outlets can be expected to accept a variety of advance positions, attitudes, and thoughts regarding important events (1973, 1980).

Other studies, moreover, link the number of media outlets not simply with a plurality of viewpoints, but more explicitly with media viewpoints accommodating political or social change. Concurring with these observations, Hindman argues that the more society has access to information and knowledge, the greater the ability for social actors to initiate projects that promote social change or challenge those in power (Hindman, 1999, pp. 99–116). It seems as though the greater the number of media or the greater the media "reach," the more effectively media shape public opinion or even threaten the interests of powerful groups. A proposition articulated by Emanuel and Cecilie Gaziano asserts that collectivities acquiring relatively more knowledge through the media can be expected to be more effective in challenging elite groups and in using power to effect change that benefits them (Gaziano & Gaziano, 1999, pp. 117–136). In addition, Dunwoody and Griffin in their studies of community structure suggest that the more pluralistic the community, the greater the potential for the media to challenge the prevailing power structure (Dunwoody & Griffin, 1999, pp. 197-226). Moreover, in *Newspapers and Community Ties: Toward a Dynamic Theory* (1985), Keith Stamm claims that cities with high quality of life will be more likely to have newspapers that evaluate new issues from a plurality of perspectives.

Dennis and Pease (1995), in their book *Radio: the Forgotten Medium,* contend that radio is still "the world's most ubiquitous medium, certainly the one with the widest reach and greatest penetration" (p. xvi). Radio remains an excellent media source, as it is accessible to almost everyone, inexpensive, and portable. Specifically, talk radio offers an exchange of ideas that is not present in other forms of media. According to a 1993 survey of 1,507 randomly selected Americans by the Times Mirror Center for the People and the Press, "talk radio represents the widest window on the world of politics and issues for the vocal minority" (Dennis & Pease, 1995, p. 46).

In a study conducted by Pollock and Dantas, a positive correlation was revealed between access to FM stations in a city and favorable coverage of same-sex marriage (1998). Therefore:

> *H^{15}: The greater the number of FM radio stations in a city, the more favorable the coverage of gays in the Boy Scouts* (Gale Directory of Publications and Broadcast Media, 2000).

Since AM radio stations tend to broadcast mostly conservative material, cities with more exposure to AM stations would show more negative coverage of gays in the Boy Scouts. The AM conservative coverage hypothesis was confirmed in a study conducted by Pollock and Castillo, revealing unfavorable coverage concerning the Patients' Bill of Rights in cities with a relatively large number of AM radio stations (2001). Thus:

> *H^{16}: The greater the number of AM radio stations in a city, the less favorable the coverage of gays in the Boy Scouts* (Gale Directory of Publications and Broadcast Media, 2000).

Newspaper circulation can reveal the relationships between media access and positive coverage of an issue. If the newspaper has a vast circulation size, then it is reasonable to assume that people from varied cultural, social, economic, and political groups are likely to read it. It is possible that large newspapers provide a variety of perspectives on news or emerging issues to appeal to as many readers as possible. Newspaper circulation was found linked to coverage favoring social change in studies of newspaper accounts of Ryan White (the hemophiliac boy who contracted HIV from transfusions in the late 1980s) as well as legalization of same-sex marriages (respectively, Pollock, et al., 1996; Pollock & Dantas, 1998). Accordingly:

H^{17} The larger a newspaper's circulation size, the more likely the coverage of gays in the Boy Scouts will be favorable (Gale Directory of Publications and Broadcast Media, 2000).

The same assumption can be applied to cable television stations as well. If the number of media outlets in a city can be considered a measurement of the role of media in a community, then one can argue that the greater the role of media in a community, the greater the stimulation of social capital and political pluralism (Friedland & McLeod, 1999, pp. 197–226). This assertion is supported by a recent study of coverage of environmental issues, concluding that the more diverse a community, the greater the opportunity media had to challenge the legitimacy of the existing power structure (Dunwoody & Griffin, 1999, pp. 139–158). By extension, the greater the access to cable television in a city, the more likely newspapers will report favorably on social change. Therefore:

H^{18}: The greater the number of cable television stations in a city, the more likely the coverage of gays in the Boy Scouts will be favorable (Gale Directory of Publications and Broadcast Media, 2000).

Methodology

Sample Selection

Employing a community structure approach, this study tracks coverage of gays in the Boy Scouts systematically in 21 major newspapers throughout the nation, representing a geographic cross-section of the United States. All articles over 150 words in length printed in each newspaper were sampled from the period of January 1, 1998, to March 1, 2001, a time frame when debate over gays in the Boy Scouts surfaced and developed. The resulting newspaper articles were collected from the DIALOG Classroom Information Program newspaper database and Lexis-Nexis Academic Universe, both available to college libraries. The 21 newspapers included *The Times Union-Albany, The Boston Globe, The Charlotte Observer, The Cincinnati Post, The Fort Worth Star-Telegram, The Phoenix Gazette, The Pittsburgh Gazette, The Philadelphia Inquirer, The San Francisco Chronicle, The Seattle Times,* and *The Wichita Eagle.* Neither *The New York Times* nor *The Washington Post* was selected for analysis because both papers are considered to be, in many ways, "national" newspapers reflecting the views of national decision-makers as well as local concerns.

Measures and Dependent Variables

Article Attention

After each of the articles was read, it was assigned two scores. The first was an attention or display score. This numerical rating, ranging from 3 to 16 points, was based on the following criteria: prominence (front page of first section, front page of inside section, inside prominent, or other); headline word count, length of article word count, and presence or absence of photograph or graphic. Those articles with a higher number of assigned points were considered to have received more attention (the resulting "attention scores" were used to calculate a dependent variable described below).

Table 2: Attention Score* (for coding databases)

Dimension	4	3	2	1
Prominence	Front page of first section	Front page of inside section	Inside first section	Other
Headline Size (in nbr. of words)	10+	8-9	6-7	5 or fewer
Length (in nbr. of words)	1000+	750-999	500-749	150-499
Photos/Graphics	Two photos or graphics	One photo or graphic		

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Article Direction

A second score assigned to each article was the directional score. This score is derived from an evaluation of the article content, using the entire article as a sampling unit. The nominal measurements of favorable, unfavorable, or balanced/neutral toward gays in the Boy Scouts were assigned to each article by two different coders.

Coverage *favorable* to allowing gays in the Boy Scouts included articles which considered this decision a violation of one's civil rights. These articles stress that a group such as the Boy Scouts of America should promote

a tolerance of all types of people. Favorable articles were directly opposed to the verdict of *Dale vs. BSA*, claiming that such a decision was discriminatory.

Coverage deemed *unfavorable* to allowing gays in the Boy Scouts includes those articles that consider homosexuality to be immoral, and therefore against the moral code of the BSA that boy scouts should be "morally straight" and "clean." Articles deemed unfavorable also emphasize that private organizations have a right to restrict their membership. In many cases, these articles assume that homosexuality is a lifestyle or personal choice, not an innate quality, thereby stressing the right of the Boy Scouts to exclude this group of people on moral grounds.

Balanced/neutral coverage included the articles that recorded both sides of the debate over homosexuals in the Boy Scouts in approximately equal measure, or revealed a disinterested, unbiased outlook about the issue. Finally, articles that dealt solely with James Dale or other individual homosexual members of the Boy Scouts and did not render a clear opinion on the more general topic of homosexuals in the Boy Scouts were deemed balanced/neutral.

A total of 322 articles were analyzed using content analysis. After articles were assigned their directional scores, the researcher coded a systematic sub-sample of the articles. This produced a Holsti's Coefficient of Intercoder Reliability of .89.

Media Vector Calculation

After each article was assigned an attention and a directional score, these were then combined using the Janis-Fadner Coefficient of Imbalance to calculate a "Media Vector" for each newspaper. The resulting coefficient is called a "Media Vector" because it resembles a vector in physics, a concept that combines both magnitude (in this case, "attention") and direction to arrive at a measure of "impact" or "thrust." The "Media Vector" concept, therefore, measures media "thrust." The resulting statistic, which can vary from +1.00 to -1.00, permitted quantitative comparisons of each newspaper's coverage of gays in the Boy Scouts. Scores between zero and +1 indicated favorability and scores between zero and -1 indicated unfavorability toward allowing gays to be members of the Boy Scouts of America. Articles using the "Media Vector" in communication research have been accepted for publication in journals including *Society, Journalism Quarterly, Mass Communication Review, Newspaper Research Journal* (two articles), *The New Jersey Journal of Communication,* and the edited, refereed collection *Communication Yearbook.* (See, respectively, Pollock & Robinson, 1977; Pollock, Murray, & Robinson, 1978; Pollock, 1995; Pollock, Coughlin, Thomas, & Connaughton, 1996; Pollock, Kreuer, & Ouano, 1997; Pollock & Whitney, 1997; and Pollock & Guidette, 1980.)

Table 3: Calculating the Media Vector*

f = sum of the attention scores coded favorable
u = sum of the attention scores coded unfavorable
n = sum of the attention scores coded neutral/balanced
r = f + u + n

If f > u (the sum of the favorable attention scores is greater than the sum of the unfavorable attention scores), the following formula is used:

FAVORABLE MEDIA VECTOR: (Answers lie between 0 and +1)

$$FMV = \frac{(f^2 - fu)}{r^2}$$

If f < u (the sum of the unfavorable attention scores is greater than the sum of the favorable attention scores), the following formula is used:

UNFAVORABLE MEDIA VECTOR: (Answers lie between 0 and –1)

$$UMV = \frac{(fu-u^2)}{r^2}$$

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PROCEDURES

An exploration of the relation between the city characteristics described in the hypothesis section and the two dependent variables, direction and "Media Vector," was carried out using four statistical procedures. First, Pearson correlations were run to measure which city characteristics were most strongly associated with each dependent variable. Second, the city characteristics were subjected to regression analysis in order to isolate a few key city dimensions that might provide the highest degree of explanatory power in their association with coverage of homosexuals in the Boy Scouts. Third, factor analysis clustered city characteristics into distinct,

key city dimensions to improve the explanatory power of the independent variables linked to coverage of gays in the Boy Scouts. Fourth, the regression of factors correlated the significant dimensions of the factor analysis with the Media Vectors. All four procedures demonstrate clearly the strong association between specific city characteristics and coverage of the issue.

Results

The newspaper coverage of gays in the Boy Scouts from January 1998 to March 2001 varied as predicted. The coefficients of imbalance ranged from .256 to -.188, revealing divergent opinions among city newspapers.

Table 4: Media Vector Coefficients

City	Newspaper	C/I
San Francisco	San Francisco Chronicle	0.256
Philadelphia	Philadephia Inquirer	0.221
Boston	Boston Globe	0.217
Denver	Denver Post	0.211
St. Louis	St. Louis Post-Dispatch	0.137
Atlanta	Atlanta Journal	0.122
Albany	Times Union-Albany	0.121
Buffalo	Buffalo News	0.092
Dayton	Dayton Daily News	0.070
Charlotte	Charlotte Observer	0.038
Seattle	Seattle Times	0.033
Tallahassee	Tallahassee Democrat	0.033
Pittsburgh	Pittsburgh Post-Gazette	0.024
Cincinnati	Cincinnati Post	0.019
Fort Worth	Fort Worth Star-Telegram	0.006
Wichita	Wichita Eagle	-0.007
Columbia	Columbia State	-0.009
Phoenix	Phoenix Gazette	-0.014
Memphis	Memphis Commercial Appeal	-0.015
Milwaukee	Milwaukee Journal Sentinel	-0.078
Lexington	Lexington Herald-Leader	-0.188

The newspapers were ranked according to each city's "Media Vector," and then Pearson correlations were run to explore the association between city characteristics and variation in reporting on gays in the Boy Scouts.

Six of 18 hypotheses tested resulted in a significance level of .01 or better. Four out of the 18 hypotheses tested resulted in a significance level of .05 or better.

Table 5: Significant/Directional Pearson Correlations

Hypothesis	Correlation	Probability
Income over $100,000	671	000
Gay Market Index	599	002
Democratic	.596	002
Republican	602	002
College Education	593	002
Bible/Devotional Readings	588	003
Catholic	492	012
Newspaper Circulation Size	477	014
Below Poverty Line	474	015
Cable Stations	426	027
Military	217	172
AM Radio	214	176
Children 12 and Under	198	195
FM Radio	.187	.208
Hispanics	.170	.230
65 Years and Older	-.127	.291
African-Americans	.044	.425
Professional/Tech Status	.040	.432

* Significant at .05 level, one-tailed
** Significant at .01 level, one-tailed

Buffer Hypothesis Supported

The buffer hypothesis expected more favorable coverage of gays in the Boy Scouts in direct proportion to the percentage of citizens in a city who are more privileged economically, educationally, and professionally. Indeed, results show that higher percentages of a population with family incomes over $100,000 correlate strongly with more favorable newspaper coverage of homosexuals in the Boy Scouts ($r = .671$; $p = .000$). Similarly, there was a strong positive correlation between the percentage of population with a college education and favorable coverage of gays in the Boy Scouts ($r = .593$; $p = .002$). These results pertaining to the buffer hypothesis support previous research by Pollock and Miller, which showed the higher the percentage of privileged individuals in a city, the more favorable the coverage of the tobacco industry's Master Settlement Agreement (2001). Furthermore, research conducted by Pollock, Kreuer, and Ouano in 1997 on China's bid to host the 2000 Olympic Games also supported the buffer hypothesis.

Stakeholder: Gay Market Index Hypothesis Supported

This study also strongly confirms the expectation that the higher the total number of businesses owned by or serving the gay and lesbian community in a city, the more favorably newspapers will cover the issue of gays in the Boy Scouts ($r = .599$; $p = .002$). These

results suggest that the presence of gays and lesbians in a city, as determined by a "gay market index," have an influence on print media. According to HKR, a research firm working on gay and lesbian marketing projects, the reason mainstream businesses, and possibly the media in general, recognize gay and lesbian consumers is that gay men and lesbian women show their gratitude to marketers who have the courage to serve them. In return for what they see as acceptance and respect, gay consumers will go out of their way to patronize these companies. Furthermore, they will actively spread the word through an amazingly efficient network that circulates not only through word of mouth, but through 200 electronic bulletin boards and 105 local and national publications dedicated to America's gay and lesbian population (Kahan, 1995, p. 46).

It is reasonable to suppose that newspapers, by covering the issue of homosexuals in the Boy Scouts in a more positive light in cities where a visible gay and lesbian market is present, show their support for a readership composed of gays and lesbians, in part to benefit from this powerful and faithful market.

These results confirm previous research conducted by Pollock and Dantas on same-sex marriages (1998) and Pollock and Tobin on same-sex adoption (2000). Each set of results showed a correlation between a high gay market index score and favorable newspaper coverage of gay rights issues.

Stakeholder: Political Partisanship Hypotheses Supported

It was expected that cities with larger populations voting Democratic would have more favorable coverage of gays in the Boy Scouts, while cities with greater Republican populations would have less favorable coverage. Both correlations proved very significant, as Democratic voting corresponded with favorable news coverage ($r = .596$; $p = .002$), while Republican voting corresponded with negative news coverage ($r = -.602$ $p = .002$). This partisan finding confirms previous research conducted by Pollock and Castillo, showing that the greater the percentage of Democrats in a city, the more favorable the coverage of the Patients' Bill of Rights, whereas the greater the percentage of Republicans in a city, the less favorable the coverage (2000).

Stakeholder: Religious Involvement Hypotheses Significant

Both religious involvement hypotheses, concerning percentage of Catholics and percentage of people engaging in Bible/devotional readings, proved significant. The greater the percentage of individuals in a city participating in Bible/devotional readings, the less favorable the coverage of gays in the Boy Scouts ($r = -.588$; $p = .003$). Strikingly, however, the percentage of Catholics in a city correlated positively with the coverage of gays in the Boy Scouts ($r = .492$; $p = .012$).

This result directly contradicts the hypothesis that a greater percentage of Catholics in a city would result in negative newspaper coverage, because the Catholic Church takes a strong stance against homosexuality. Regarding same-sex marriage, Pope John Paul II not only reiterates the Church's refusal to recognize same-sex unions, but calls on Catholics to oppose the legal recognition of such marriages on the grounds that they are "a serious threat to the family and society" and "inappropriately conferring an institutional value on deviant behavior" (Eskridge, 1996). For these reasons, a positive correlation of percentage of Catholics and favorable coverage of a gay rights issue is surprising. Perhaps these results suggest that as with birth control, U. S. Catholics tend to be more open to change than official church doctrines might suggest. It is also possible that the clergy are still holding strong to their beliefs while the congregation has become more liberal.

Access to Media—Newspaper Circulation and Cable Stations Significant

It was expected that with greater access to media in a city, the more favorable the coverage of gays in the Boy Scouts would be. As expected, the greater the newspaper

circulation size of a city's leading newspaper, the more favorable the coverage of homosexuals in the Boy Scouts was (r = .477; p = .014). Similarly, the number of cable stations in a city correlated positively with favorable coverage of gays in the Boy Scouts (r = .426; p = .027). These results confirm research conducted by Pollock and Yulis, finding that the greater number of cable stations and the greater newspaper circulation size correlated positively with the coverage of physician-assisted suicide (2000). Taking a positive stand on allowing homosexuals in the Boy Scouts as well as being in favor of physician-assisted suicide are both more liberal viewpoints. Surprisingly, there were no correlations found between the number of FM or AM radio stations and the coverage of gays in the Boy Scouts, despite previous research on gay rights issues which found significant correlations.

Vulnerability—Poverty Line Significant

As hypothesized, it was found that the greater the percentage of individuals living below the poverty line in a city, the less favorable the coverage of gays in the Boy Scouts (r = -.474; p = .015). This supports the expectation that vulnerability is linked to negative perspectives on social change. These findings support the study conducted by Pollock and Tobin, which found that the greater percentage of individuals living below the poverty line, the less favorable the coverage of same-sex adoption. However, these findings are contrary to a previous study utilizing the community structure approach, focusing on *Roe vs. Wade,* which revealed that city poverty levels were linked to relatively favorable newspaper coverage of the U. S. Supreme Court decision legalizing abortion (Pollock, Robinson, & Murray, 1978).

Regression Analysis

Upon running a regression of the variables, it was discovered that two variables—percentage family income over $100,000 and percentage Catholic—accounted for 57.5 percent of the variance in their association with the "Media Vector." Specifically, the percentage of families with income greater than $100,000 has a correlation of .671, accounting for 45 percent of the variance, illustrating the strongest relationship, as shown in Table 6.

Table 6: Regression Analysis

Model	R	R Squared	R Squared Change	F Change	Sig. F Change
Income over $100,000	.671	.450	.450	15.522	.001
Income over $100,000 and Catholic	.758	.575	.125	5.316	.033

Factor Analysis

To refine results further, a factor analysis of city characteristics isolated clusters of city characteristics that occur frequently together. Factor analysis of city characteristics for the 21 cities sampled yields five factors, all with component Eigenvalues of 1.00 or greater. The five factors are labeled as follows: privilege/access, political partisanship, Catholics/professional status/percentage over 65, African-American/FM radio, military/AM radio. Beneath each factor heading in Table 7 are its specific variable components.

Table 7: Factor Analysis

Factor 1: Privilege/AccessComponent	Factor Loading
Newspaper Circulation Size	.847
Income Over $100,000	.825
Gay Market Index	.725
Number of Cable Stations	.695
Number of College Educated	.632
Factor 2: Political Partisanship	
% Republican	.923
% Democrat	.917
Factor 3: Catholics/Professional Status/Percentage Over 65	
% Catholic	.780
Number of People >65	.779
% with Professional Status	.776
Factor 4: African-American/FM Radio	
% African-American	.860
Number of FM Stations	.810
Factor 5: Military/AM Radio	
Number of those Holding Military Jobs	.886
Number of AM Stations	.827

Regression of the Factors

The five factors were themselves subjected to further stepwise multiple regression against the "Media Vector" with results shown in Table 8, yielding two significant factors collectively accounting for 56 percent of the variance: "privilege/access" (composed of college educated, income over $100,000, gay

market index, newspaper circulation, and number
of cable stations), 33 percent of the variance; and "political partisanship" (Republican, Democratic), 23 percent of the variance.

Table 8: Regression of the Factors

Model	R	R Squared	R Squared Change	F Change	Sig. F Change
Privilege/ Access	.574	.329	.329	9.331	.007
Privilege/Access plus Political Partisanship	.750	.563	.233	9.599	.006

Regional Newspaper Coverage Consistent with Variations in Public Opinion

The following chart, Table 9, compares average "Media Vectors" for each of four regions—reflecting level of favorable or unfavorable newspaper coverage of gays in the Boy Scouts—and regional comparisons of public opinion relatively favorable to gays in the BSA. Our findings suggest that average "Media Vectors" coincide closely with regional public opinion.

Table 9: Regional Comparison Between Media Vectors and Public Opinion

REGION	Average Media Vector for region	% Having friends who are gay or lesbian	% Who feel strongly about the issue of gay rights as a political issue in a presidential election
East	.135	31	25
South	-.002	23	21
Midwest	.028	19	34
West	.122	27	20

The strongest correlation between negative reporting and public opinion on gays in the Boy Scouts is found in the Midwestern region of the United States. The first public opinion question, based on a Harris poll national survey of 1,248 people ages 18 and older, conducted in October 1992, was: "How strongly do you feel about the issue of gay rights as a political issue in a presidential election?" The results of this poll show that the Midwest feels the strongest about the issue of gay rights. Consistently, the Midwest also has a low average "Media Vector," revealing that newspaper coverage in this region tends to be unfavorable toward gays in the Boy Scouts. These results, along with the average "Media Vectors," tend to confirm the conventional wisdom of a more conservative South and Midwest and a more liberal East and far West. These findings also coincide with the results of the 2000 presidential election, in which the South and Midwest tended to vote for the more conservative Republican candidate.

The second public opinion question, based on a Harris survey conducted in October 1992 of 1,248 people ages 18 and older, was: "Do you have any close personal friends who are gay or lesbian, or not?" These results indicate that the Midwest's low average "Media Vector" (.028) correlates with a low percentage (18.6%) of Midwesterners polled having close friends who are gay or lesbian. Whatever the reason, regional comparisons suggest some degree of congruence or correspondence between regional newspaper reporting perspectives on gays in the BSA and regional public opinion regarding the issue.

Conclusion and Implications for Further Research: The Utility of the Community Structure Approach

The most significant finding was confirmation of the "buffer" hypothesis: the higher the proportion of privileged groups in a city, the more favorable the coverage of human rights claims. Initial regression analysis suggests that family income over $100,000 and percentage Catholic are linked to favorable coverage of gays in the Boy Scouts. The factor analysis and regression of the factors further support the findings, with family income over $100,000 showing the most significant finding in each statistical process. Pearson and regression correlations also strongly confirm the "stakeholder" hypothesis: the greater the proportion of those who perceive a stake in an issue, (such as political partisans), the more favorable the media coverage of their concern. These results confirm the utility of the community structure approach.

Comparison of Primary and Secondary Newspapers: Not Statistically Useful

If the community structure approach is a powerful explanatory tool, then both leading newspapers and other significant newspapers

would align themselves with city demographics. In order to test that expectation an effort was made to go beyond the leading paper to identify the paper with the second highest circulation.

Table 10: Newspaper Statistics

City	Primary Paper	Circ. Size	Secondary Paper	Circ. Size
Albany	Times Union	247,074	The Evangelist	57,300
Atlanta	The Atlanta Journal & Constitution	2,052,569	Atlanta Voice	133,000
Boston	Boston Globe	1,641,201	Boston Herald	620,936
Buffalo	Buffalo News	536,205	Buffalo Beat	50,000
Charlotte	Charlotte Observer	533,788	The Catholic News & Herald	45,000
Cincinnati	Cincinnati Enquirer	935,669	Cincinnati Post	135,710
Columbia	The State	274,948	Columbia Star	2,500
Dayton	Dayton Daily News	692,732	Oakwood Register	7,000
Denver	Denver Post	1,006,518	Rocky Mt. News	956,146
Fort Worth	Fort Worth Star-Telegram	1,039,342	North Texas Catholic	25,400
Lexington	Lexington Herald-Leader	497,552	Kentucky Kernel	17,000
Memphis	Commercial Appeal	NOT REPORTED	The Memphis Flyer	55,000
Milwaukee	Milwaukee Journal Sentinel	1,009,679	Catholic Herald	71,713
Philadelphia	Philadelphia Inquirer	1,551,339	Philadelphia Daily News	232,509
Phoenix	The Arizona Republic	1,493,111	Phoenix New Times	130,979
Pittsburgh	Pittsburgh Post- Gazette	882,888	Tribune Review	90,000
St. Louis	St. Louis Post-Dispatch	781,679	The Riverfront Times	102,133
San Francisco	San Francisco Chronicle	877,427	San Francisco Examiner	185,441
Seattle	Seattle Times	943,698	Seattle Post- Intelligencer	836,683
Tallahassee	Tallahassee Democrat	113,789	Elder Update	73,000
Wichita	Wichita Eagle	429,036	Active Aging Publishing, Inc.	45,500

As Table 10 reveals, the circulation sizes for the second largest papers are so small that they cannot be construed to represent city demographics. Since with few exceptions, (for example *The Denver Post* {circ. 1,006,518} and *The Rocky Mountain News* {circ. 956,146}) the leading and second leading newspapers are not truly comparable in scope or market, statistical comparisons of such papers in each city are not recommended because they are not expected to yield useful results.

Locally Owned Papers More Open and Accepting of Gays in the Boy Scouts

Conventional wisdom would speculate that there is a distinct difference between reporting from corporate newspapers and reporting from local newspapers. One would expect corporate, non-locally owned newspapers to be relatively conservative in terms of social and political change. Local newspapers in contrast would be less concerned with bottom line profit and more concerned with newspaper content. That expectation has been confirmed by David Demers in his empirical work comparing locally owned and chain owned newspapers (Demers, 1996a). However, in this study it seems to be just the opposite. A t-test comparing "Media Vectors" of locally owned and chain owned papers found that local papers are more conservative about the issue of gays in the Boy Scouts, and the chains seem to be more liberal.

Table 11: Locally Owned and Chain Owned Newspapers: T-Test

Local	Chain	Significance
Mean Media Vector .113	Mean Media Vector -.010	+3.07 Significance <.005
N = 11	N = 9	(one-tailed)

[8] Gale's Directory, 2001

Because the Boy Scouts are such a local institution, that may account for the more liberal view of local papers. The Boy Scouts are an intrinsic part of essentially every local community.

Gays in the Boy Scouts has only recently arrived as a prominent topic on the media agenda. The issue of gays in the Boy Scouts, however, transcends previous issues such as same-sex marriage or same-sex adoption. Decisions made involving this case will affect all families with children involved in the Boy Scouts and private organizations setting membership standards. As times change and more incidents involving homosexuals in the Boy Scouts arise, and as media coverage increases, further research will be needed. Further studies of different religious groups, such as Baptists, on this subject may provide useful results. Many religious groups do not agree with the lifestyles homosexuals live, and this could significantly influence the way newspapers cover the issue. Because the results show surprisingly that the percentage of Catholics correlates positively with gays in the Boy Scouts, further research is needed to determine possible implications. This may perhaps be an

indication that the views of the Catholic laity, if not the Catholic clergy, are changing.

Another issue for further research falls under the "access to media" hypothesis. The number of FM radio stations almost always correlates positively with gay rights concerns, as seen in studies conducted by Pollock and Dantas (1998) on same-sex marriage and Pollock and Tobin (1999) on same-sex adoption. Yet, for coverage of gays in the Boy Scouts, a much broader set of city characteristics is linked to coverage, including privilege, media access, and stakeholders. Further research will help illuminate how the gay rights issue has "broadened" from coverage linked mainly to the number of FM radio stations and the gay market to those wider demographic constructs such as relative privilege in a city, media access broadly defined, and stakeholders such as religious groups. The community structure analysis of city characteristics and newspaper coverage of gays in the Boy Scouts provides evidence that this supposedly "gay" issue is more "mainstream" than ever before.

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Compelling Social Responsibility in the Global Economy: An Examination of the Current Regulatory Mechanisms for Multinational Corporations

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Abstract

Multinational corporations (MNCs) have been able to capitalize on the opportunities offered by the globalization phenomenon. The revenues of the top MNCs now exceed the national GNPs of many of the developing nations in which they operate, giving them a power that often exceeds that of the national government charged with regulating them. This environment creates the opportunity to lower costs by engaging in labor practices that violate human rights. Yet, because host nations lack the power, and often the legal infrastructure, necessary to impose liability on MNCs for these violations, they are essentially borderless entities that are above the law. The challenge then becomes to find other mechanisms for compelling MNCs to abide by socially responsible behavior. The currently available mechanisms include the international legal framework, home nation regulation, and internal codes of conduct. Each has shortcomings, however, that must be rectified in order to provide adequate regulation for multinational corporations.

Introduction

Since the 1970s, the world has witnessed the incredible integration of markets and capital that has come to define the globalization phenomenon (Bonacich & Appelbaum (A), 2000, p. 4). Positioned in the center of this phenomenon is the multinational corporation (MNC). No longer restricted by the national borders that once confined them, these corporations are now able to operate in a market with seemingly limitless boundaries. Many MNCs now base their corporate headquarters in developed countries while moving manufacturing activities to developing countries to take advantage of lower labor costs and less stringent economic and labor regulations. This type of "border hopping" raises questions regarding which legal and regulatory entities have the ability to oversee the activities of MNCs, particularly in the areas of labor and human rights standards. If developing countries are either unwilling or unable to regulate MNCs operating within their borders, then the obligation must be met by alternative institutions. This paper will examine the current mechanisms available for imposing liability on MNCs that fail to adhere to socially responsible practices.

The Need for Corporate Accountability

Globalization was not caused by multinational corporations, but there can be no doubt that MNCs have been able to capitalize on the trend and secure a particularly powerful position in the globalized world. Corporations operating internationally have accumulated remarkable wealth. Indeed, they are often wealthier than the governments of the countries in which they operate. Of the top 100 world economies, 51 are corporations; General Motors Corporation's revenues roughly equal the economies of Ireland, New Zealand, and Hungary combined ("Corporate Globalization Fact Sheet," 2001, para. 1). This wealth translates into power; especially when one considers that most of these MNCs (99 out of the top 100)

are based in developed countries such as the United States, Japan, and Western European nations ("Corporate Globalization Fact Sheet," 2001, para. 1). Non-industrialized nations look covetously on the capital to be acquired by enticing foreign corporations to invest in their countries.

Thus, nations compete ferociously for foreign direct investment (FDI) and the economic benefits that such investment provides. Since developing countries often have little to offer an MNC in comparison to more developed countries also seeking FDI, they use low wages and relaxed legal standards as a source of competitive advantage in attracting investment (Macek, 2002, p. 103; Frey, 1997, p. 160). Essentially, governments offer to turn a blind eye to excessive hours, employee abuses, low wages, unsafe working conditions, environmental damage, and other questionable practices that lower the cost of operations for the prospective corporate investor (Ayoub, 1999, p. 397). For example, Nike paid its Vietnamese workers $1.60 *per day*, in accordance with Vietnam's legally required minimum wage. Yet, this minimum wage did not cover the $2.10 it costs to secure three basic meals every day. Also at a Vietnamese plant, a supervisor forced women employees to run laps around the perimeter of the factory for failing to wear regulation shoes to work (Toftoy, 1998, pp. 905-6). Corporations seeking to maximize profits have an incentive to take advantage of opportunities to lower costs. Thus, human rights prove to be too expensive for either party to consider; governments seeking FDI can't afford to make or enforce labor demands while corporations rarely seek the highest human rights standards at the expense of profits.

In addition to the internal incentives to ease regulation, there is an external pressure on developing countries to liberalize their markets for international trade. This pressure comes from the World Trade Organization (WTO), International Monetary Fund (IMF), and World Bank, the institutional framework within which international trade operates. As will be discussed further in the following section, the WTO has historically set policies most favorable to corporations and free trade at the expense of human rights (Duke, 2000, pp. 355-56; "Globalization Impact," 2000, para. 15). Similarly, the IMF and World Bank have structured loan agreements to developing countries to include obligations that countries make their markets more hospitable to free trade; again, human rights are relegated to the position of a secondary concern ("Globalization Impact," 2000, para. 21).

The problem with relying on developing nations to provide the legal oversight for MNCs thus becomes evident. Corporations operating in developing countries are able to engage in practices that violate labor and human rights standards while remaining within the technical boundaries of a legal system that has neither the incentive nor the power to restrain them (Hedley, 1999, para. 39). The remainder of this paper will discuss other mechanisms currently available for imposing liability on MNCs and examine their effectiveness in compelling adherence to human rights standards.

Multilateral Regulatory Mechanisms

Multilateral regulatory mechanisms can be described as super-national institutions that derive authority from the combined will of multiple nations. It has been suggested that these international mechanisms can set forth and enforce universal human rights standards, thereby succeeding where national regulation has failed (Hedley, 1999; Kelley, 2001; Macek, 2002).

International Trade Institutions

The institutional framework within which MNCs operate includes the WTO and the two Bretton Woods institutions, the World Bank and the IMF ("Globalization Impact," 2000, para. 8). While the IMF and World Bank, by conditioning loans on market restructuring, have contributed to the environment that enables human rights violations by MNCs, it is the WTO that can potentially serve as a regulating mechanism

for corporations. The WTO, which developed from the General Agreement of Tariffs and Trade (GATT) in 1994, is the agency that manages international economic activity and trade policy. It exerts the most direct control over MNCs because it has the power to sanction unfair trade practices. Fair trade notions allow the WTO to prevent what is known as "dumping," which occurs when corporations realize profits from unscrupulous trading activities (Baltazar, 1998, p. 704). The WTO is, thus, in an ideal position to extend the definition of "unfair trade practices" to include human rights violations by MNCs as a "social dumping" (Baltazar, 1998, pp. 703-4; Duke, 2000, p. 358).

Yet, neither the WTO Agreement nor the provisions of GATT contain specific obligations to protect human rights. The only reference to human rights in the WTO Agreement is an indirect phrase in the preamble about "raising standards of living" ("Globalization Impact," 2000, n37). So far, the WTO has declined to expand its mandate to encompass human rights obligations; indeed, it seems to have adopted the pro-corporate view that its purpose lies chiefly in the promotion of free trade, open markets, and tariff reduction ("Globalization Impact," 2000, para. 13, 15; Toftoy, 1998, p. 910).

Pressure from human rights activists at the 1999 Ministerial in Seattle, WA, forced the WTO to acknowledge that its trade policies have serious human rights implications when they allow MNCs to operate in unregulated liberalized markets (Duke, 2000, p. 355). It maintains, however, that its primary goal is to foster economic growth in a way that protects "core labor rights" rather than elevated, universal human rights standards (Duke, 2000, p. 356).

It has been suggested that even if the WTO is not in itself an agency concerned with human rights violations, its sanctioning powers could still be used to enforce international human rights obligations like the International Labor Organization's (ILO) guidelines (Baltazar, 1998, p. 704; Toftoy, 1998, p. 926). The reasoning is that a country's permissiveness toward labor and human rights violations by MNCs unfairly reduces the cost of its products, putting law-abiding countries and companies at a disadvantage (Baltazar, 1999, p. 704). The connection between unfair trade practices and labor violations has yet to be applied, although the WTO did state its support of the ILO: "We renew our commitment to the observance of internationally recognized core labor standards. The [ILO] is the competent body to set and deal with these standards" (Baltazar, 1998, pp. 705-6). This remains an untested option for reducing the profits to be gained from human rights violations.

The institutional framework for MNCs has helped contribute to the environment of legal permissiveness in the developing countries where human rights violations are most frequent. The WTO, which serves as a regulating mechanism for international trade violations of MNCs, has yet to extend its regulating authority to include socially irresponsible behavior.

International Legal Framework

Mechanisms for holding MNCs accountable within the existing international legal framework fall into two categories: traditional international law (comprising treaties and customary international principles) and multilateral agreements emerging from international governing bodies.

In the first category, the most discussed mechanism for regulating MNCs is the United Nations' (UN) International Bill of Human Rights. This framework includes the 1948 Universal Declaration of Human Rights (UDHR), the 1976 International Convention on Civil and Political Rights (ICCPR), and the 1976 International Convention on Economic, Social, and Cultural Rights (ICESCR) (Kelley, 2001, p. 505). Together these treaties form a comprehensive international human rights framework that, if applied to the exploitative activities of MNCs, would render them in violation of several of the treaties' principles. The relevant articles in

the ICCPR include provisions that ensure freedom from torture (Article 7), right to humane treatment (Article 10), freedom of assembly and association (Articles 21/22), and protection of children (Article 24) (Joseph, et al., 2000, pp. 645-53). The UDHR and ICESCR also have comparable clauses. The UDHR has several provisions that are particularly relevant to MNC activity. Article 23 guarantees the rights to "favorable conditions of work," "equal pay for equal work," and "the right to form and to join trade unions for the protection of its interests"; Article 24 guarantees reasonable working hours and holidays; Article 25 guarantees a living standard that is "adequate for the health and well-being of [the individual] and of his family" ("Universal Declaration of Human Rights"). The ICESCR also guarantees safe and healthy working conditions and equal pay for equal work (Baltazar, 1998, p. 697).

While the aforementioned provisions are relevant to the activities of MNCs, there are several procedural and jurisdictional problems associated with international treaties that have thus far hindered their usefulness as regulatory mechanisms. The first, and most commonly cited problem, hinges on the fact that traditional international law imposes obligations only on "*state /actors/* to treat persons under their jurisdiction according to certain minimum standards" (Kelley, 2000, p. 50—emphasis added). MNCs are required under Articles 29 and 30 of the UDHR and Article 5(1) of both the ICCPR and the ICESCR to uphold the provisions of the treaties, but enforcement of that requirement is accomplished through obligations imposed on the state in which they operate (Ayoub, 1999, p. 415; Frey, 1997, p. 163). The argument has been made that MNCs' vast wealth and power liken them to state actors, but international law has not recognized them as such (Kelley, 2000, p. 506).

The necessity of national-level enforcement leads to additional difficulties. First, international law is not a universal framework applicable to all nations. Nations are responsible only for upholding principles that have become part of customary international law and legally binding treaties to which they are a party. The UDHR was created as a set of guidelines rather than a legally binding treaty, but some argue that it has become binding by being adopted into customary international law (Hannum, 1995/96, p. 319). The ICCPR and the ICESCR, in contrast, are legally binding treaties, but have been ratified by only a few nations. The U.S., for example, is not a party to the ICESCR (Ayoub, 1999, p. 414). Developing countries are especially critical of universal human rights standards, claiming that developed countries are trying to undermine their area of advantage in attracting FDI (Baltazar, 1998, p. 696). The jurisdictional and procedural complexities cause traditional international law to be an inconsistent regulatory mechanism.

The second category within the international legal framework is multilateral agreements. These agreements take the form of guidelines, codes, and compacts between the international governing body and the nations that sign on as parties to the agreements. Perhaps the most recognized of these bodies is the International Labor Organization (ILO), which sets international labor standards for its 174 member nations. The ILO sets labor guidelines through the ratification of conventions that are binding upon all parties who ratify them. Conventions relevant to the regulation of MNCs include the Abolition of Forced Labor Convention of 1957, which prohibited forced labor; the Child Labor Convention of 1973, which set a minimum age of 15 for workers; and the Minimum Wage Fixing Convention of 1970, which obligates state parties to consider living expenses when setting the minimum wage (Ayoub, 1999, pp. 417-19). Like traditional international law, the obligation to uphold these conventions falls upon the member nation rather than the MNC operating within that nation. These guidelines have been largely ineffective because developing nations will not hold MNCs in their borders accountable for violating them and the ILO itself lacks the

authority either to force compliance or to punish non-compliant member states (Baltazar, 1998, p. 701). It is for this reason that there is pressure to tie ILO guidelines to the sanctioning power of the WTO. Presently, the ILO can try to influence violators only through negative publicity and embarrassment (Baltazar, 1998, p. 690; Toftoy, 1998, p. 910).

Similar efforts have been undertaken by the Organization for Economic and Cooperative Development (OECD), which established Guidelines for Multinational Enterprises in 1976. These guidelines addressed labor issues, but were limited in their human rights scope. What's more, the guidelines are voluntary and are thus even less capable of imposing liability than the ILO guidelines (Meinties, 2000, pp. 91-2). Between 1995 and 1998, the OECD also attempted to pass a Multilateral Agreement on Investment (MAI), which would directly regulate FDI practices by corporations. The original draft failed, in part, because it did not impose human rights obligations on MNCs engaging in foreign investment (Kelley, 2001, p. 497). Some see this failure as an opportunity for the creation of a more "balanced" MAI that would be highly effective in compelling socially responsible behavior from MNCs (Kelley, 2001, p. 485).

The UN has also made efforts directly to address the issue of corporate responsibility by MNCs. In 2000, it instituted the Global Compact, which consists of nine principles regarding human rights, labor, and environmental obligations designed to promote corporate citizenship (Macek, 2002, p. 122, "The Global Compact," 2001). Corporations are asked to report once a year on progress they have made in achieving the principles. Like other efforts in this area, the compact is weak as a regulatory mechanism in that its provisions are voluntary and it lacks a means of enforcement. The other initiative undertaken by the UN was the formulation of a Code of Conduct on Trans-National Corporations. Work on the code began in 1977, but a draft wasn't submitted until 1990 primarily because developed and developing nations could not agree on which human rights should be included. By 1990, the amount of compromise had reduced the human rights obligation of MNCs to this statement: "[MNCs] shall respect human rights and fundamental freedoms in the countries in which they operate" (Meinties, 2000, p. 91). Despite this, an agreement still has not been reached, so the code remains an unrealized regulation tool.

The jurisdictional problems with traditional international law and the difficulties in forming and enforcing multilateral agreements leave the international legal framework as a mechanism that has potential to regulate MNCs if the structural flaws are addressed.

Unilateral Regulatory Mechanisms

Rather than turning to the nebulous international framework as an alternative to host-nation municipal regulation, some have suggested subjecting MNCs to the more developed legal systems of their countries of origin. Since many of the largest MNCs are based in the United States and for the sake of simplicity in looking at unilateral mechanisms, key aspects of the American regulatory structure will serve as an example for the analysis in this section.

As multilateral mechanisms have done, the United States has attempted to link human and labor rights to trade by holding *nations* responsible for violations. It does so through the use of a Generalized System of Preferences (GSP) that provides duty-free tariffs to developing countries that recognize or are taking steps to recognize specified labor rights, including the right to collective bargaining, minimum wages, and protection against forced labor (Toftoy, 1998, p. 911). The president can withdraw the country's trade benefits if it fails to enforce the necessary labor rights. Though the GSP does not contain a specific clause requiring the nation to monitor MNCs, it does give both the nation and the U.S. corporation incentive to recognize the rights through the threat of increased trading costs. The main problem with the GSP is that the U.S. has been hesitant to enforce it because

of the ruinous financial effects it could have on the developing country. Indeed, rather than alter China's trading status because of human rights violations, President Clinton designed a set of Model Business Principles aimed at procuring human rights commitments from MNCs operating in China (Frey, 1997, p. 172). These principles were voluntary and were not backed by any sanctioning or enforcement authority.

The U.S. has also sought to impose human rights liability directly on MNCs through use of the Alien Tort Claims Act (ATCA), which evolved from Section 9 of the Judiciary Act of 1789. Though legislative intent is not clear and there is little precedent upon which to analyze this act, its purpose seems to have been to provide a remedy for aliens (especially ambassadors) who were mistreated on U.S. soil (Sacharoff, 1998, pp. 937-38). In 1992, Congress deemed that the ATCA permitted lawsuits to be filed against MNCs for violations of customary international standards and norms (Kieserman, 1999, pp. 896-97). Since international law applies only to state actors, the limitation on MNC liability is that their acts must constitute "state action." Two cases illustrate this limitation. In *Beanal v. Freeport-McMoRan, Inc.,* Freeport-McMoRan, a company with mining operations in Indonesia, used both Indonesian troops and private security personnel to patrol its mine. The private security forces allegedly abducted and tortured tribesmen on corporate property. The court acknowledged the interaction with state actors, but dismissed the claim because the plaintiff (a tribal leader) failed to prove the joint action of the state and the corporation in this incident (Kieserman, 1999, pp. 912-13). In *John Doe I. v. Unocal Corp.*, Unocal joined with the Myanmar government to work on a natural gas pipeline. The government tortured and raped citizens who stood in the way of the pipeline, and though Unocal committed no violations, the court attached tort liability to Unocal because it benefited from the state abuses (Kieserman, 1999, pp. 919-922). It is clear that questions of jurisdiction and scope still remain, but ATCA presents a powerful tool for regulating MNC action, especially if it is eventually expanded to include wholly private MNC activities.

What the United States has refused to do, thus far, is to extend the Fair Labor Standards Act, which includes child labor, maximum hour, and minimum wage provisions, to MNCs operating abroad. MNCs are exempt from this act when operating abroad because the U.S. has recognized that standards that are appropriate in America would make it impossible for U.S. MNCs to compete in developing markets (Ayoub, 1999, p. 425). In fact, this is one of the main problems with unilateral regulation as opposed to (effective) multilateral regulation. Universal obligations of social responsibility do not put any group of MNCs in a situation of inherent competitive disadvantage. A second problem facing the U.S. if it attempts to set unilateral standards for its corporations is the likelihood of these efforts being declared trade violations by the WTO. It has already exhibited such a pattern with U.S. environmental regulations. In 1996, it ruled that a cleaner gas initiative from the EPA represented a form of trade discrimination against countries that were not able economically to meet the standards (Sweeney, 2000, p. 255).

Voluntary Corporate Codes

The final mechanism for imposing obligations for corporate responsibility takes the form of internal voluntary codes. A number of MNCs have adopted voluntary codes of conduct, including giants such as Nike, Levi-Strauss, and Starbucks. Levi-Strauss was one of the first U.S. corporations voluntarily to hold itself to higher human rights standards. Its code not only contains obligations to uphold labor rights and employment conditions, but also has an extensive procedure for picking appropriate countries in which to operate. It also employs a monitoring program that includes questionnaires and surprise visits to determine if guidelines are being followed. If they are not, Levi-Strauss will terminate the contract with the supplier

(Baltazar, 1998, pp. 718-19). Nike, in response to increasing publicity about its human rights violations abroad, actually formed a Labor Practices Department to establish and enforce standards of socially responsible behavior in its foreign manufacturing plants. Nike's system of monitoring includes review by the accounting firm of Ernst and Young, daily inspections by production managers, and monthly inspections of the safety and health conditions in and around the factory (Toftoy, 1998, pp. 920-21). Similarly, Starbucks adopted a code of conduct addressing conditions on the plantations from which it purchases its coffee beans. It became "the first U.S. company [to] address the human rights issues associated with sourcing practices for a major agricultural commodity" (Frey, 1997, p. 177).

The chief criticism of voluntary corporate codes of conduct is the lack of independent monitoring to insure that the company is actually abiding by its own standards. Nike's monitoring practices, in particular, have been ridiculed as ineffective and self-serving. The accounting firm that they employ works for Nike, so its ability to pass independent judgment has been called into question (Toftoy, 1997, p. 923). Nike violations have persisted, leading skeptics to believe that the company is more committed to improving its public relations than to improving its labor practices (Toftoy, 1997, p. 924).

The effectiveness of voluntary codes as regulatory mechanisms increases if the MNC is accountable to an independent agency that monitors adherence to the code. Non-Governmental Organizations (NGOs) and other human rights watch groups are often pointed to as the proper agencies to assume this role. They have experience in uncovering attempts to hide violations, and they have vast access to the news media and consumers (Duke, 2000, pp. 346-47; Schilling, 2000, p. 232). Consequently, NGOs can affect consumer purchase patterns, which hits corporations where it hurts the most—their pocketbooks. Gap's experience is a perfect example of how effective corporate codes can be when paired with appropriate monitoring agencies. In 1995, Gap agreed to work with the Interfaith Center on Corporate Responsibility and the National Labor Commission to develop an independent monitoring system for a supplier in El Salvador that had been particularly troublesome in terms of labor violations. They formed an independent monitoring group composed of respected international and local NGOs to insure that the supplier was adhering to Gap's code of conduct. When the supplier still resisted, Gap threatened to cancel the contract (Schilling, 2000, pp. 228-30). The combined efforts of top corporate management and independent monitoring groups gave Gap's code an influence it might not otherwise have obtained. Thus, corporate codes, combined with the right monitoring system, can contribute to effective regulation of corporate activity.

Meeting the Need for Independent Monitoring

It is beyond the scope of this paper to address the numerous means for improvement that have been suggested for the existing regulatory framework. However, several organizations have recently been formed to achieve the heightened accountability that should accompany an independent monitoring system. One such organization is the Fair Labor Association (FLA). The FLA was formed in November 1998 as part of the Clinton administration's Apparel Industry Partnership program. It brings consumer and human rights groups together with a number of major corporations (Nike, Reebok, Levi-Strauss, etc.) to ensure that companies are abiding by labor and human rights standards specified by the Association ("About the FLA"). Companies that sign on to the FLA must abide by its Workplace Code of Conduct and submit to a random inspection by accredited monitors of 30% of its factories for the first three years and 10% in subsequent years. If the company complies with the requirements, it receives FLA certification that it operates using responsible labor standards ("About the FLA").

The FLA has been widely criticized as nothing more than a means for corporations to purchase an honest public image. Critics note that corporations sit on the board of directors for the FLA and claim that this gives them too much control over which factories get inspected and which monitors conduct the inspection; such a system, they argue, cannot be considered independent monitoring (Bonacich & Appelbaum (B), 2000, para. 12). As a result of these shortcomings, students at a number of universities established the Worker Rights Consortium (WRC). This organization also developed a code of conduct to protect labor rights, but rather than working with corporations, the WRC takes the role of an external supervisor. It asserts that conducting surprise factory inspections and working directly with employees to empower them to take action is the only way truly to provide an independent assessment of an MNCs' activities (Bonacich & Appelbaum (B), 2000, para. 17-24).

A third effort can be seen in the UN-associated SA8000 system that was developed by the Council on Economic Priorities Accreditation Agency (CEPAA). Like the FLA, SA8000 seeks to certify corporations that abide by specified standards (similar to the ILO guidelines). Monitoring is conducted by accredited entities that are trained to conduct certification audits ("Overview of SAI," para. 14). Thus far, the majority of these entities have been corporations, subjecting SA8000 to the same criticisms that plague the FLA. Efforts are currently being made to encourage NGOs and other such groups to seek accreditation.

It its still unclear what impact these and similar organizations will have if their sphere of monitoring is extended to encompass direct supervision of company-structured codes of conduct or multilateral agreements. They may yet offer a possible solution to the enforcement problems that threaten the effectiveness and credibility of current regulatory efforts.

Conclusion

The three categories of mechanisms discussed each have their strengths and weaknesses. Multilateral mechanisms have the advantage of applying universal standards so that no group is disadvantaged. In practice, however, jurisdictional and formative problems make it difficult consistently to utilize and enforce them. Unilateral mechanisms are varied in type and offer the possibility of attaching liability directly to the MNC rather than to its host nation. Yet, these regulatory mechanisms may reduce the ability of the corporations bound by them to compete in the world market. Voluntary corporate codes are effective mechanisms provided they have the genuine commitment of top management and are not merely public relations devices. It is difficult to be confident in the assertions that the code is being adhered to when those assertions come from monitors employed by the corporation. For this reason, MNCs that are committed to the implementation of an effective code must make use of independent monitoring agents. These independent organizations may also improve the effectiveness of multilateral efforts. To date, however, one has yet to emerge that can truly regulate a globalized MNC. The world has yet to strike a balance between liberalized global expansion and social responsibility. Efforts must be made to fill the regulatory gaps and strengthen the weak areas of the mechanisms. If not, MNCs will remain legal entities that exist beyond the realm of effective legal control.

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Fallen Men Rise: Weak Men/ Strong Women in Toni Morrison's Novels

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Abstract

"Fallen Men Rise" focuses on relationships between weak men and strong women in three of Toni Morrison's novels: *Song of Solomon, Beloved,* and *Tar Baby.* The relationship between a weak man and a strong woman differs from other Morrison relationships, the majority of which are harmful or hurtful to one or both parties. The weak man/strong woman relationship is positive and beneficial; it allows the man to heal, learn, and grow as a person under the protection of a strong woman. The weak men discussed—Milkman, Paul D, and Son—are all central characters who, in times of great need, meet strong women. The women are agents of safety, comfort, and healing, allowing the men to undergo significant character transformations.

Introduction

It is surprising that of all the scholarship on relationships in Toni Morrison's novels, very little focuses on man/woman relationships, but rather on mother/daughter or other familial bonds. While family relationships occur in all the novels, and are important thematically, Morrison has said herself that "the search for love runs through most everything I write" (Micucci 278). Indeed, romantic relationships are as present as familial ones throughout the novels. The great majority of Morrison's intimate relationships are not positive, lasting, or beneficial. Husbands leave or cheat on their wives, women are abused, or things just do not work out. It is a special Morrison relationship that is positive and beneficial to both man and woman.

A subcategory of this group of special, positive relationships occurs when a weak man turns to a strong woman for comfort, shelter, and strength. This relationship between a weakened man and a nurturing woman occurs in several novels. Three important examples are Milkman and Sweet in *Song of Solomon*, Paul D and the weaver lady from Delaware in *Beloved*, and Son and Jadine in *Tar Baby.* Milkman, Paul D, and Son are all central male characters in the novels. Their journeys are essential to the development of these narratives, which is illustrated by the fact that all three novels end with the focus on the male protagonist and his final dilemma or critical decision.

Milkman, Paul D, and Son seek comfort from women when they are downtrodden, weary, frightened, and most of all, alone. They come to the women in great need, and are met with open arms. The women are havens to them, providing shelter, food, intimacy, warmth, and love. The men's fears are alleviated, their hunger is assuaged, their loneliness is replaced with intimacy, and their exhaustion, with rejuvenation. At these critical points in their lives, it is a woman who rescues Milkman, Paul D, and Son. Morrison suggests that a woman can be a sanctuary for a man in need, and that this relationship is necessary for the healing and ultimate growth of the man.

Sweet Love in Song of Solomon

The protagonist in Toni Morrison's third novel, *Song of Solomon*, is a rare Morrison central character—a man. It can be argued that *Song of Solomon* is essentially Milkman's story; it is the story of his journey back to his roots and his growth into an independent man. Many factors contribute to Milkman's growth from a childlike, immature character, to a strong, independent male. Gary Storhoff, in his article "'Anaconda Love': Parental Enmeshment in Toni Morrison's *Song of Solomon*," discusses the factors which lead to Milkman's growth. Storhoff argues that Milkman must form his own identity, an "identity differentiated from the image imposed upon him by his parents for their own emotional purposes" (9). In addition to learning about his ancestors, and repenting for his treatment of his cousin and lover, Hagar, Milkman's "domestic harmony with Sweet" is described by Storhoff as an important element leading to the protagonist's ability to form his own identity (9). Storhoff, however, does not elaborate upon this transformation in Milkman's character. Sweet, and her relationship with Milkman, play a crucial role in the transformation of the main character.

Milkman arrives in Shalimar, Virginia, floating on air. He is finally on his own, one step closer to finding out the truth about his Aunt Pilate's journey and the gold. Five minutes after arriving in Shalimar, however, a storm breaks out and Milkman plummets back down to earth. After offending the local men, Milkman is attacked with a knife, and has only a broken bottle for his defense. Fortunately for Milkman, who "probably would have had his throat cut," two women come in to break up the fight (268). For the time being, his life is out of danger, but "with blood streaming down" his face, he realizes how alone he is. People stand around staring at him, but "nobody came toward him, offered him a cigarette or a glass of water" (269). He is alone, frightened, and angry at the world, but the knife fight is not the last attempt on Milkman's life in Shalimar.

In the woods in Blue Ridge country, Milkman realizes again how very alone he is. Too tired to keep up with the hunting party, he stops to rest under a tree. Alone with his thoughts, he recognizes that "there was nothing here to help him—not his money, his car, his father's reputation, his suit, or his shoes" (277). Alone in the woods, no material possession can save him from the hunter. He must rely on himself, and his instincts, as he does in the moment before Guitar, his best friend, throws a wire around his neck. Milkman manages to shoot at Guitar, but his misdirected shots do not scare the would-be assassin away—it is only the baying of the dogs running toward them that frightens Guitar into fleeing.

Twice in one day Milkman's life is threatened. He is alone in a strange town, he has been attacked with a knife, and his own best friend has tried to murder him. He is in a desperate situation, and Omar, one of the hunters, senses that he needs "a nice lady," "real pretty" and tells Milkman "she'd be proud to take you in" (285). The lady Omar has in mind is a local woman named Sweet. While Sweet is a minor character, appearing in only a few short scenes, she should not be overlooked as a mere romantic distraction for Milkman. As a strong woman, ready and willing to assist Milkman, she serves a crucial function in the novel.

As Omar predicts, Sweet is pleased to help Milkman. He comes to her bloody and dirty, and Sweet not only offers her tub, but also bathes him herself. With Sweet, Milkman discovers pure pleasure: "what she did for his sore feet, his cut face, his back, his neck, his thighs, and the palms of his hands was so delicious he couldn't imagine that the lovemaking to follow would be anything but anticlimactic" (285). One bath by this woman, and Milkman is swearing to "walk on hot coals with a quart of kerosene," and "walk every railroad tie from here to Cheyenne and back" for Sweet (285). These

are bold statements coming from Milkman, who has never lifted a finger for anyone in his life. Magdalene, called Lena, describes her brother, Milkman, as a "sad, pitiful, stupid, selfish, hateful man," but suddenly, for this woman, he is willing to give up his own life (216). After they make love, Milkman is astonished to an even greater degree, and decides "he would crawl" to Cheyenne and back for her (285).

Sweet is Milkman's savior. She is the ideal woman—strong and confident, yet loving and gentle. She takes him in, cleans him, and makes love to him in ways so beautiful they exceed his imagination. As a recipient of her salvation, he becomes a new man. He moves beyond the hypothetical coal walking to actually doing things for her in the present. Milkman, who as of a few weeks ago had "yet to wash [his] own underwear, spread a bed, wipe the ring from [his] tub, or move a fleck of... dirt from one place to another" is suddenly Sweet's domestic servant (215). He bathes her "until her skin squeaked and glistened like onyx... he washed her hair... he straddled her behind and massaged her back ... he made up the bed... he washed the dishes," and he even "scoured the tub" (285). Lena would have been shocked to see her brother so radically changed.

Milkman has a different type of relationship with Sweet than he has ever had with anyone. He feels connected to her, "as though there was some cord or pulse or information they shared" (293). He genuinely cares what she thinks about him, unlike Hagar, whom he has "conquered" (293). Sweet gives Milkman the feeling of belonging, which is novel to him, as he is an outsider in his family and community. The day after their first night together is another tiring, yet exciting day for Milkman, and at its conclusion he returns to Sweet. His haven welcomes him and he "slipped into Sweet's bed and slept the night in her perfect arms" (299). She protects him and her warmth and love envelop him throughout the night. In her arms, he dreams he is flying "alone in the sky, but somebody was applauding him, watching him and applauding" (298). He is safe and free with Sweet, safe enough to dream about the ultimate freedom—flying high in the sky.

The first person Milkman goes to after learning the truth about his ancestors is Sweet. He runs to her house and in his excitement "almost broke her door down" (326). He shouts to her "'I want to swim!'... 'Come on, let's go swimming. I'm dirty and I want waaaaater!'" (326). Sweet offers her porcelain tub, but Milkman is thinking big: "'I need the whole entire complete deep blue sea!'" (327). He is finally free because he knows his roots. He is free and he wants to experience everything the world has to offer, starting with "the deep blue sea." He knows the story of Solomon and he wants the world to hear it from him, "'He could fly! You hear me? My great-granddaddy could fly!'" (328).

Milkman is ecstatic, probably the happiest he has ever been in his life, and he has chosen to share the moment with Sweet. He is playful and loving with her at the lake. He grabs her and kisses her, ending the kiss "with a determined effort to pull her under the water" (328). Sweet does not want to get wet, but Milkman cannot get enough of the water. He submerges himself over and over again, cleansing the dirt and his insignificant past in his baptismal-like rebirth. Sweet is the only witness to Milkman's transformation, and the first to benefit from his newly discovered identity. Soon after swimming, Milkman departs for home, but Sweet harbors no hard feelings. There were no expectations between them. Sweet simply took him in and cared for him until he was well enough to be on his way.

At the end of the novel, we see Milkman come to terms with his identity and manhood, as he does in Sweet's arms. He does not need Sweet anymore, but the lessons he learns from her are crucial to the rest of his life. With Sweet, Milkman learns to surrender himself to a greater force—a woman. Milkman may learn the lesson of surrendering from his experience with Sweet, but it is

in the final moments of the novel that he is fully tested. When Milkman leaps at the end of the novel, he knows what Shalimar knew, that "if you surrendered to the air, you could *ride* it" (337). As Milkman surrendered to Sweet, and was lifted up, he surrenders to the air, trusting that he will fly.

Paul D's Manhood is Sewn Together in *Beloved*

Although few of Morrison's male characters are as central as Milkman, Paul D is a fully developed, complex male character in *Beloved*. Paul D arrives at 124 Bluestone Road, Sethe's house, after 18 "walking every one of em" years (7). Throughout the intertwining fragments of time and space in *Beloved*, we learn Paul D's history and we witness his growth into a man. Paul D is a dynamic character, and many factors contribute to his growth from a slave to a free man. Scholars, including Deborah Ayer Sitter in her article, "The Making of a Man: Dialogic Meaning in *Beloved*," have commented on Paul D's "love for Sethe," and on many other factors which allow him to reach an attainable ideal of manhood (2). However, there is a lack of critical commentary on Paul D's relationship with the weaver lady from Delaware. This relationship plays a significant role in Paul D's ability to put his past behind him and obtain a lasting, loving relationship with Sethe.

When Paul D arrives at the apple orchard that turns out to be in Delaware, he is running from slavery—and the only life he has known. "Crawling out of the woods, cross-eyed with hunger and loneliness," Paul D knocks on the back door of the weaver lady and is offered a haven (131). He wants to work for food, but instead, she immediately feeds him and then offers "white cotton sheets," which elicit tears from Paul D, who has slept on "soil, grass, mud, shucking, leaves, hay, cobs, seashells," but never sheets (131). After a dinner of pork sausage, and a night of making love, Paul D "vowed that... he would never leave her" (131).

The weaver lady provides shelter, food, and comfort, easing Paul D's loneliness at a very critical point in his life. He is not only in a weak, debilitated physical condition, but he is mentally unstable and his manhood has been utterly compromised. At Sweet Home Plantation, Paul D has to endure the worst evils of slavery, which contribute to what Susan Bowers describes as "the systematic destruction of his manhood" (34). Like many slaves, Paul D is forced to wear a bit in his mouth, but as he tells Sethe, it was not the bit that got to him and changed him. It is the feeling of inferiority to a common yard animal—a rooster—that drives Paul D crazy. Paul D explains how he felt when Mister, a rooster, looked at him wearing the bit: "'Mister was allowed to be and stay what he was. But I wasn't allowed to be and stay what I was... wasn't no way I'd ever be Paul D again, living or dead. Schoolteacher changed me. I was something else and that something was less than a chicken sitting in the sun on a tub'" (72).

Before Paul D arrives in the kitchen of the Delaware lady, he experiences one final and excruciating debilitation. The chain gang in Alfred, Georgia, is perhaps the worst thing Paul D has endured. After trying to kill the man schoolteacher sold him to, Paul D is sent to work in a chain gang. Like an animal, he is "chained up" and put into a "box" with a "cage door" (107). Pamela E. Barnett, in her article "Figurations of Rape and the Supernatural in Beloved," discusses the sexual horrors of Alfred, Georgia, "where prisoners are forced to fellate prison guards" (200). Every morning, the prisoners are forced to line up, and kneel, and wait "for the whim of a guard, or two, or three. Or maybe they all wanted it" (107). The guards taunt the prisoners with comments such as "Want some breakfast nigger?" and "Hungry, nigger?" Forced to reply, "Yes Sir," the prisoners become pawns in this sadistic drama (107, 108). Barnett argues that "by forcing the prisoners to express homosexual desire, the guards symbolically 'castrate' them" (200). Castration can be viewed as the physical act of taking away a person's manhood, so by accepting the symbolic castration

theory, Paul D's manhood is further stripped by the prison guards. Even if one questions the castration theory, however, the rape serves to strip Paul D of his humanity.

At the critical point when Paul D arrives at the home of the Delaware weaver woman, he harbors secrets within himself that eventually become locked into the "tobacco tin lodged in his chest" (113). Eighteen years later, when he arrives at another woman's door—at 124 Bluestone—the memories of "Alfred, Georgia, Sixo, schoolteacher, Halle, his brothers, Sethe, Mister, the taste of iron, [and] the sight of butter," are hardened and locked tightly in the tin that substitutes for his heart (113). The amazing thing about Paul D is that in the end he is able to release the lock and let the memories pour out, which allows him to open himself to Sethe and permanently reclaim his manhood.

The Delaware weaver lady, and Paul D's relationship with her, are critical factors which allow this process to occur 18 years later. The fact that Morrison's only name for the woman who reaches out to Paul D is the "weaver lady" highlights the importance of, and the symbolism inherent in, her occupation. The weaver lady is a domestic artist. Her home is crucial to her inherently artistic occupation, for she labors and creates within her residence. Morrison, having most likely studied many of Virginia Woolf's domestic artist characters for her dissertation on Woolf and Faulkner, would be familiar with the function of a domestic artist in a novel. In "The Hostess and the Seamstress: Virginia Woolf's Creation of a Domestic Modernism," Geneviève Sanchis Morgan explores two of Woolf's domestic artists, Clarissa Dalloway in *Mrs. Dalloway* and *Nurse Lugton in Nurse Lugton's Golden Thimble*.[1] Clarissa is a hostess and Nurse Lugton, a seamstress; as hostess to Paul D, and a weaver, the Delaware lady may be understood as a union of these two characters.

Morgan claims that "through her recurrent depiction of domestic artists, figured alternately as the hostess and the seamstress, Woolf's works argue for a poetics of domesticity" (91). Likewise, through her depiction of the Delaware lady as a hostess and a weaver, Morrison argues for "a poetics of domesticity." The weaver lady's life is centered around her home, and it is into her home that she invites Paul D and cares for him. Paul D is in desperate need of a home, a place of comfort, safety, and shelter, and it is in this home—this "domestic sphere," that the healing process begins (Morgan 92). According to Morgan, "Woolf saw the home as the locus of all great aesthetic, social, and political change" (92). Morrison agrees, as it is in the home of the weaver lady that Paul D begins to change. He allows a woman to care for him, and in the process, for the first time, he becomes "grateful to a woman" (131). Eighteen years later, in Sethe's bed, he remembers the weaver lady and is "grateful a second time" (131).

Paul D's relationship with the weaver lady occupies only a few paragraphs and a couple of references in the text, while his relationship with Sethe is an integral focus of the novel. The fact that Morrison alludes to his relationship with the weaver lady in reference to his relationship with Sethe proves the importance of the textually minimal, yet highly significant, early relationship. When Paul D arrives at 124 Bluestone, he is again a weary, lonely, and weak man. Sethe and the house are another refuge, or haven, for him. Although the relationship does not work out initially because Paul D is unable to handle the knowledge that Sethe murdered her baby to protect her from slavery, he is able to come to terms with his own identity and manhood, which allows him to accept Sethe and her actions. At the end of the novel, Paul D remembers how his friend Sixo described his relationship with the Thirty-Mile Woman: "She is a friend of my mind. She gather me, man. The pieces I am, she gather them and give them back to me in all the right order" (272-73). Paul D understands that like the weaver lady, who gathered the broken pieces of him, Sethe has done the same, and is a genuine "friend of [his] mind." Paul D has returned to his second gatherer

and friend, and he is ready "to put his story next to hers" (273).

Opposites Attract in *Tar Baby*

While *Tar Baby* was written immediately after *Song of Solomon* and immediately before *Beloved*, it is discussed last in this paper because it represents a more complex example of the weak man/strong woman relationship. Critics often find *Tar Baby* itself to be a problematic novel, because of its drastic break from Morrison's previous novels. Though *Tar Baby* features white characters in a non-United States setting, the themes of the search for love and identity are easily recognizable. Jadine, the strong woman analyzed in this section, is a major character, unlike Sweet and the weaver lady. Like Milkman and Paul D, Son is a major male character; however, his relationship with Jadine is multifaceted, and occupies a great deal more of the text than the previous relationships discussed.

Son's and Jadine's relationship is the most complex because, throughout the novel, they are alternately weak and strong, and they have differing weak and strong characteristics. Son's and Jadine's weak and strong characteristics illustrate how opposite they are. Jadine is an orphan, without black cultural roots, while Son has close ties to his family and black heritage. Scholars are quick to comment on how Jadine and Son are opposites, and some even note that "they are people who need each other" (Coleman 65). No one has argued, however, that through Jadine, Son is able to gain the strength and knowledge he needs to grow as a person and make his choice at the end of the novel.

Like Milkman and Paul D, when Son first lays eyes upon Jadine, he is alone and frightened. After abandoning his ship, he sneaks onto a boat occupied by two women. When they dock the boat, Son does not consciously follow the women, as the narrator emphasizes, but he does follow the path of the women back to their house, L'Arbe de la Croix. Morrison suggests that he is drawn to the women by a force more powerful than his own free will. He does not mean to follow the women, but he does, and indeed, he must. Son has no choice but to follow the women because he is an outlaw; he is starving, alone, and has nowhere to turn.

L'Arbe de la Croix and the scraps of food he finds around its perimeters are a safe haven, but he does not linger around the property for weeks for the meager food. Unconsciously, Son is drawn to the house, but as soon as he lays eyes upon Jadine he is trapped. He looks into her room, meaning "to look but not to watch and not to stay because he had not followed the women," but soon he spends whole nights "gratified beyond belief to be sitting on the floor" watching her sleep (138). Again, he has no control; he does not want to watch her, but he is drawn to her and cannot escape. Son is at a critical point in his life, and only a woman, in this case Jadine, can provide true shelter and refuge for him.

Son is a solitary man, a "man without human rites: unbaptized, uncircumcised, minus puberty rites or the formal rites of manhood" (165-6). As a solitary man, he does not want to be attached to Jadine. In fact, he insults her by insinuating she had to give sexual favors to become a rich model, and by calling her "white girl" just "to keep her unhinging beauty from afflicting him and keeping him away from home" (121, 168). Although he initially does not know why, Son needs Jadine. Just as he was drawn to the house and to her room every night, he is drawn to her and cannot help trying to impress her and make her think of him. Indeed, to make her think fondly of him, Son cleans himself up, so when she sees him "he was gorgeous" (156).

To spend some time with her, Son invites Jadine to go on a picnic at the beach. During the picnic, he starts learning from Jadine what changes he needs to make in his life. She asks him a very pointed question, "'What do you want out of life?" to which he responds, "'My original dime'" (169). Son has a very romantic view of life, money, and Eloe, the all-black town in which he was born and raised. He cannot comprehend that there is

more to life than moment-to-moment existence, and that working and earning money for a living can lead to a very honorable existence. He also does not see the value of education, partly because "there were no grades given in his school," so there was no incentive to work hard to pass (166). Jadine and Son are very different people, and they never will live their lives according to the same principles. Notwithstanding, Son can and does learn and benefit from Jadine's knowledge. Jadine is a strong, assertive woman, and she does not hold back her advice from Son:

> Hold your head still and stop making excuses about not having anything. Not even your original dime. It's not romantic. And it's not being free. It's dumb. You think you're above it, above money, the rat race and all that. But you're not above it, you're just without it. It's a prison, poverty is. Look at what its absence made you do: run, hide, steal, lie. (171)

Son disagrees with her, of course, but Jadine's ideas are implanted in him and they begin to take effect on his feelings and actions.

The honeymoon period of Son's and Jadine's relationship occurs in New York City, after they leave the island. Son has changed already, as he has fallen in love with Jadine. He realizes for the first time that he has a clear future with this woman. With her there is "a reason for hauling ass in the morning. No more moment to moment play-it-as-it-comes existence" (219). He will do anything to protect her and keep her happy. He recognizes she has two sides, one rock-hard, assertive, and aggressive, but the other is as fragile as a "wind chime" (221). Son makes it "his duty to keep the climate mild for her, to hold back with his hands if need be thunder, drought and all manner of winterkill" (220). Just as Milkman is willing to "walk on hot coals" for Sweet, Son will do anything for Jadine. Son's life has changed; he has a purpose and a reason for living. He thinks if he loses her "he would surely lose the world," so he does everything he can to hold onto her.

Son's and Jadine's "honeymoon" does not last long, and after a trip to Eloe to visit Son's friends and family, they fight constantly. After Jadine leaves Son, he has another profound recognition. While in Eloe, Jadine takes pictures of many of the town's women. Before she departs their New York City apartment, she leaves the pictures in a manila envelope, most likely for Son to find. Prior to meeting Jadine, the most stabilizing memory Son had was of "ladies minding the pie table" in Eloe, so we expect him to look fondly at Jadine's pictures. Quite the contrary, the women Son sees in the picture "all looked stupid, backwoodsy, dumb, dead" (272-3). Jadine may have shattered Son's romantic notions of his past, but she instills in him a desire for a future—for something more than Eloe or the pie ladies can give him. This is a turning point for Son. In an interview, Morrison describes her characters' turning points. She says "the characters have revelations, large or small, which might not have happened but for the preceding information in the book" (McKay 149). Jadine is the source of Son's revelation in New York City, and his immediate thought is to find her and reconcile their differences.

In this scene, which parallels his first arrival on the island, Son does not have a choice but to follow and try to win back Jadine. When Son's friend on the island, Gideon, tries to convince him to forget about her, Son tells him there is no other choice: "'There's nothing else for me to do. You think I'd choose this if I had a choice?'" (302). It is Thérèse, the blind woman, who uses her vision to give Son a choice. Instead of taking him directly to L'Arbe de la Croix, as Son requests, she takes him to the back of Isle des Chevaliers, where the blind horsemen gallop through the rainforest. She wants him to join the blind horsemen, and she directs him to crawl from rock to rock until he reaches the land, "where [he] can make a choice" (305). She encourages him to forget about Jadine because "she has forgotten her ancient properties" (305).

Son did not see the choice, but after Thérèse hands it to him, he takes it and it becomes his own. He makes his choice and leaves the boat to crawl to shore in the heavy

fog. Morrison provides an ambiguous ending, describing Son as rising from his crawling position, becoming ever more steady, and finally running into the trees, "looking neither to the left nor to the right. Lickety-split. Lickety-split. Lickety-lickety-lickety-split" (305). What to make of the ending, whether Son is captured by, or joins, the blind men, or whether he makes it across the island to L'Arbe de la Croix, is pure speculation. We do know, however, that Morrison intended the ending to be positive. She says she wanted the ending "to suggest that this journey is Son's choice" (McKay 150). The ending also has "the sound of the Tar Baby story, which is a lickety-split toward or away from or around the briar patch" (McKay 150). Whether Son is running toward or away from Jadine, his Tar Baby,[2] is unclear, but Morrison clarifies that the lickety-split "has a movement of some confidence" so we are assured that Son is making a confident decision (McKay 150).

Jadine gave Son something he never had before—hope for a structured, meaningful future. He acknowledges her weaknesses, but he is drawn to her strengths, her "temper [and] energy" and the fact that she has "ideas of her own" and that she "fought back" (298). Jadine's strengths are transferred to Son, helping to make him a whole person. In the end of the novel, he may or may not return to Jadine, but whatever choices he makes, they are his own, they have meaning, and they will propel him toward a successful future.

Conclusion

Milkman, Paul D, and Son, three of Morrison's most prominent male characters, share striking similarities. They all struggle through weaknesses and hardships, but in the end they emerge as confident, fearless, and strong. In his time of weakness, each man finds a strong woman, and relies on her strengths to nurture him, teach him, and rescue him. She builds him up and helps him to see his potential as a lover, a provider, a friend, and a man. These are special Morrison relationships; they are positive and beneficial to both parties. They do not need to be lasting, or even to work out in the end, but the effects are long lasting on the individual characters.

Like all of Morrison's characters, Milkman, Paul D, and Son are forced to make arduous choices. In her own words, Morrison places the characters "deliberately under enormous duress in order to see of what they are made" (McKay 143). Milkman, Paul D, and Son all make positive, confident decisions at the end of their novels, and are able to do so because of what they learned from the women in their lives. Milkman learns to love and respect the elements of his life, most importantly his past, his family, and women, and with his new knowledge he is able to fly. Paul D learns to surrender himself and open up to a woman. He learns a woman can be a "friend of his mind," which enables him to forgive Sethe and return to her. Finally, Son learns to hold onto the past while moving toward a future, which allows him to run confidently into the choice he did not know he had. The pattern of weak man/strong woman relationships in Toni Morrison's novels demonstrates the author's belief that a weak man can heal and grow within the sanctuary of a strong woman.

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NOTES

[1] *Nurse Lugton's Golden Thimble* is a children's story written by Woolf as a part of *Mrs. Dalloway,* but which did not appear in the published book.

[2] A *Tar Baby* is "a situation or problem from which it is virtually impossible to disentangle oneself." The term comes from "Bre'r Rabbit and the *Tar Baby,*" an Uncle Remus story by Joel Chandler Harris. In the story, Bre'r Fox uses a *tar baby,* a doll smeared with tar, to try to capture Bre'r Rabbit. (*The American Heritage Dictionary of the English Language,* Fourth Edition. 2002. www.bartleby.com)

Toni Morrison's Signature Endings: A Supernatural Opening for the Reader

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Abstract

In "Toni Morrison's Signature Endings: A Supernatural Opening for the Reader," the endings of four of this author's novels are analyzed. *Beloved, Song of Solomon, Tar Baby,* and *Paradise* each utilize the element of the supernatural so ambiguously, one can only guess which conclusion Morrison intends. This essay explores the different possibilities the ambiguous endings suggest, while recognizing that the task of deciphering the conclusion of Morrison's novels is not an easy one.

Introduction

In *Writing Trickster: Mythic Gambols in American Ethnic Literature*, Jeanne Rosier Smith argues that for "readers expecting resolution, cohesion, and closure, *Tar Baby's* ambiguous ending appears frustrating and unsatisfying" (Smith 141). While Smith focuses primarily on the open-endings of trickster tales, it is the ambiguous and mystical world of the supernatural that allows Toni Morrison to create her provocative open-endings. In *Beloved, Song of Solomon, Tar Baby,* and *Paradise*, Morrison challenges the reader to fill in the missing pieces of a seemingly "unfinished" plot by forming his own ideas and opinions regarding the outcomes of the novels. In actuality, the supernatural leaves an ambiance of a multivalent story; the endings of these four novels present the possibility that the unbelievable and the fantastic are, indeed, real, and, at the same time, figments of the imagination.

The reader's doubts about the existence of the supernatural are reinforced when even the characters of the novel are unsure of what has happened. For example, in *Beloved*, although the entire novel is based on the existence, the actions, and the words of Beloved, by the end of the novel, Sethe, Paul D, and Denver question whether or not she was ever a part of their lives: "They forgot her like a bad dream. It took longer for those who had spoken to her, lived with her, fallen in love with her, to forget, until they realized they couldn't remember or repeat a single thing she said, and began to believe that, other than what they themselves were thinking, she hadn't said anything at all" (Morrison 274). Although up until this point the existence of Beloved is assumed by the reader, Sethe, Paul D, and Denver begin to reconsider, acknowledging Beloved's existence as more like a dream than a reality. The seemingly definitive case Morrison makes for Beloved's existence becomes blurred by her complete disappearance from not just 124 Bluestone Road but also from Sethe's, Paul D's, and Denver's memories.

Ambivalence and doubt in the ending of the novel are also created by the entire town's involvement in the exorcism of Beloved and its ultimate dismissal of her memory. Up until the end, the town purposefully ignores and avoids 124 Bluestone "like the plague." It is not until Ella becomes sympathetic to Sethe's situation and organizes 30 women to help exorcise the evil spirit out of Sethe and 124 Bluestone that the town fully acknowledges the supernatural presence in the house. Everyone present witnesses "the shape of a

pregnant woman, naked and smiling" in the doorway of 124 (Morrison 261). They see how small, skinny, and weak Sethe is as a result of how healthy, fertile, and beautiful Beloved has become. Beloved is fully present to them and yet, after the different versions of the story died down and no one continued to spread any more rumors or gossip concerning the exorcism, the town could not even recall her name.

Without the main characters' and the townspeoples' conviction that Beloved did indeed exist, the presence of Morrison's supernatural element leaves the reader, by the final pages of the novel, unsure of what to believe. Margaret Atwood acknowledges that "students of the supernatural will admire the way the twist is handled" and that Morrison's treatment of the supernatural keeps the reader guessing (Atwood 2). Morrison simultaneously makes the disbeliever consider the possibility of the existence of the supernatural by putting a main character in the role of a ghost, while forcing the believer to question the validity of the supernatural by producing characters that doubt her *bona fide* presence in their lives. Just as Beloved "manages to be many things to several people," the element of the supernatural in this novel offers many different options to different types of readers: Beloved as a ghost, a real person, or a whimsical dream.

In *Beloved*, ambiguity centers on the question of a character's existence, but in *Song of Solomon,* doubt results from the question of what happens to the protagonist. In the final pages of *Song of Solomon,* Milkman leaps off of a cliff and his fate remains unknown. His last thoughts are with a man he has never met, his great-great-grandfather, Shalimar: "For now he knew what Shalimar knew: If you surrender to the air, you could ride it" (Morrison 337). Subtly and delicately, Morrison suggests that something supernatural is occurring; that like his great-great-grandfather, Shalimar, Milkman has been given the ability to fly. From the beginning of the novel until the very end, Morrison has prepared the reader for this moment by giving every detail of Milkman's search for his roots.

For example, the reader bears witness to Milkman's lifelong obsession with flying. In chapter 12, Milkman's dream of flying over a large body of water obviously points to the larger meaning of something, but like him, the reader doesn't understand what it symbolizes until the end of the novel. The reader also encounters the children's song about Solomon, who "whirled about and touched the sun," and just as Milkman is curious about the lyrics, so is the reader. When Susan Byrd finally reveals Milkman's full ancestry to him, the reader celebrates along with him and is also given one more piece of the puzzle. Through Susan Byrd's voice, at this point in the novel, Morrison tells the folk story of the flying Africans, providing plausibility for a supernatural ending.

The possibility that Milkman does fly away at the end is reinforced as Susan Byrd reveals that his grandfather, Jake, was "one of those flying African children," suggesting to Milkman that he has inherited this same fantastic skill (Morrison 323). The storyline of Milkman's great-great-grandparents eerily mirrors his own experiences with Hagar. Jake's father, Shalimar, for example, was believed to have taken flight one day when slavery became too much for him to bear. Susan Byrd describes how his wife, Ryna, went crazy when Shalimar left her alone with their children; that she was "the kind of woman who couldn't live without a particular man" (Morrison 323). When Milkman leaves town to discover his family's lineage, he leaves Hagar behind. His absence is too much for Hagar to tolerate because she had grown so intensely dependent on him. Her strange death suggests that her insanity is similar to Ryna's, when Shalimar took his own journey without her.

With the strong connection Milkman and Hagar have with Shalimar and Ryna, it seems almost natural that Milkman will fulfill his ancestor's tradition of flying. Just as the reader now feels a certain connection

with Milkman for having followed him through his journey, so at the end of the novel, Milkman feels a connection not only with his ancestors, but with the whole African-American community as well, since the ancient story of the flying Africans is part of the African-American oral tradition.

By regarding the story of the flying Africans as part of Milkman's identity and family history, the possibility of his flight becomes more plausible. His flight, however, is different from Shalimar's. Instead of flying away to escape his problems, Milkman flies toward a greater understanding of his identity and his roots. Marilyn Sanders Mobley argues that Toni Morrison "subverts the temptation to repeat the tradition of flight as escape" with "[her] folk aesthetic [giving] substance to her novel, while the mystic impulse gives it form" (Mobley 132). As a result of one's learning the history of the flying Africans story, the supernatural possibility of Milkman's flight is no longer so fanciful. Milkman, after all, has discovered some secrets of his ancestry, which make his flight seem like the next logical step in his quest. However, because Morrison recognizes that it is human nature to doubt that an ordinary person can fly, she allows the reader either to accept the myth as Milkman does, or to withhold belief and regard the story as fiction.

Like *Song of Solomon, Tar Baby* employs the supernatural in an open-ended conclusion to suggest certain possibilities of what happens to Son. Moreover, as in *Song of Solomon,* Morrison so develops the plot and characters that by the end of the novel, the supernatural ending, as odd and unfinished as it is, seems almost practical and logical. For example, Son's first arrival on the Isle de Chevaliers foreshadows his final return to the island, as do numerous other sections of the novel.

In the prologue to the novel, Morrison describes Son as seeing "the shore of an island that, three hundred years ago, had struck slaves blind the moment they saw it" (Morrison 8). The blindness of the horsemen at the end of the novel is justified here; however, the reader cannot use this information to explain the possible supernatural events at the end of the novel until the myth is developed further in the plot.

The supernatural element of the shores of this mystical island increases when Son goes to buy more gasoline for the car, and Jadine is left alone to observe her surroundings. She describes this locale as the "ugly part" of the island, "the part she averted her eyes from whenever she drove past" (Morrison 181). Like the slaves who had to shelter their eyes when they left the immense darkness of the slave ship and were confronted by the blinding sun, Jadine averts her eyes whenever she drives past this place. Although the question of *why* is not explained here, the reader simply stores away this information until it will become useful in interpreting the ending of the novel.

Son introduces the myth of the naked, blind horsemen by providing the first clear and concrete description of them. In a gentle effort to tease Jadine about her accident in the swampy water, Son playfully asks if she saw any of the "swamp women" that lived there. Despite Jadine's deliberate efforts to ignore him, Son continues to describe women who "mate with the horsemen up in the hills" (Morrison 184). In *Folk Roots and Mythic Wings in Sarah Orne Jewett and Toni Morrison,* Marilyn Mobley draws a connection between the horsemen, the swamp women, and slavery: "They combine myth and folk legend... [B]ecause the horsemen in the myth are blind runaway slaves, they are history as well as legend" (Mobley 163). The connection between blindness, slavery, and these sexually free horsemen is not yet apparent to the reader; however, Son's description prepares the reader for later acceptance of the supernatural.

Just as Morrison prepared the reader for Milkman's possible flight in *Song of Solomon* by giving bits and pieces of information about the horsemen, so the reader can assent to Therese's explanation of them in the final pages of the novel. By persuading Son to forget his love for Jadine and move on, Therese

provides an enticingly mysterious description of the horsemen; according to her, they are "naked," "blind," have eyes with "no color," and ride their horses "like angels all over the hills where the rainforest is, where the champion daisy trees still grow" (Morrison 306). This mystical description of the supernatural, naked, blind horsemen is appropriate to the setting Morrison creates. Therese, a blind old woman, miraculously leads Son through a very thick and dense fog where, he believes, he'll find the answer to his happiness in the person of Jadine. But Therese urges him to "Forget [Jadine]" for she has "forgotten her ancient properties" (Morrison 305). Son's "ancient properties" are discovered through the possibility of his becoming part of this race of blind, naked horsemen.

It is not the myth of the horsemen that is difficult to accept; rather, it is the ambiguity of Son's choice of actions that interferes with determining with certainty the conclusion of the novel. In an interview with Charles Ruas, Morrison emphasizes Son's "mythical choice between roaming around looking for Jadine and putting himself in danger that is not dignified, versus the possibility of joining these rather incredible men in the rain forest" (Taylor-Guthrie 107). Morrison admits to leaving Son's choice purposefully open-ended through his questioning of their location in the water and his safety on the island (Taylor-Guthrie 107). For example, Son repeatedly asks Therese if she is sure about the location of the island, reflecting his own personal anxiety about choices being offered to him. Although from Therese's viewpoint Son's continuing search for Jadine seems pointless and also damaging to his spirit, the option of stepping onto the island is obviously unsettling for Son.

This hesitation is also shown through his unsure movements onto the island, which resemble those of a toddler taking his first few steps. First he crawls and then steadies himself, upright, onto the rocks. Then suddenly, it seems as if Son has made his decision, and off he runs, "lickety-split, lickety-split" into the midst (Morrison 306). Morrison notes that "there is a strong possibility that he joins or is captured by the horsemen"; however, his confident run could also be toward the other end of the island, to begin his search for Jadine again. Son's troubled questions to Therese and his reluctance about setting foot on the island suggest that the supernatural horsemen do take over and allow him to escape from the obsessive love for Jadine; on the other hand, Son's "lickety-split" sprint could also represent his devotion and dedication to finding his love again. Either way, it is unmistakable that the supernatural element lends itself to both the possibilities.

The possibility of a supernatural occurrence exists in *Paradise* as in *Beloved*; just as the characters in *Beloved* question whether or not Beloved was real, the inhabitants of Ruby in *Paradise* cast doubt on the survival of the women of the Convent. Two "official" versions of the fate of the Convent women are provided by the people of Ruby:

> One, that nine men had gone to talk to and persuade the Convent women to leave or mend their ways; there had been a fight; the women took other shapes and disappeared into thin air. And two (the Fleetwood-Jury version), that five men had gone to evict the women; that four others—the authors—had gone to restrain or stop them; these four men were attacked by the women but had succeeded in driving them out and they took off in their Cadillac; but unfortunately, some of the five had lost their heads and killed the old woman. Pat left Richard to choose for himself which rendition he preferred. (Morrison 297)

These accounts were created to relieve the murderous men of any responsibility and to account for the lack of bodies. The first version represents Ruby's opinion that the Convent women were actually witches all along, with the ability to disappear whenever need be. The second version claims that the women escaped in their Cadillac. Although the truth of what occurred when the men broke into the Convent is obviously left ambiguous, the actual fate of these women remains a mystery to the town of Ruby as well as to the reader.

Morrison begins to employ the supernatural when Richard and Anna decide to visit the Convent to draw their own conclusion. After touring the house and discussing their own opinions of what happened, the couple experiences an eerie feeling: "It was when he returned, that they saw it. Or sensed it, rather, for there was nothing to see" (Morrison 305). Both attribute the shiver they feel to an open door or window; however, they immediately leave the Convent because of the discomfort they experience. Instead of discussing the possibility of a supernatural presence left over by the women, Richard and Anna discuss whether it was an open door or an open window—"anything to avoid reliving the shiver or saying out loud what they were thinking" (Morrison 305).

The reader is given the opportunity to interpret this scene as either supernatural or natural since the event is brief and common to real life; however, the final pages of the novel increase in ambiguity, leaving the reader with more than two different interpretations from which to choose. Perhaps the most ambiguous of all of Morrison's novels, *Paradise*'s ending can be interpreted in numerous ways; for example, the ending suggests a supernatural voice speaking from beyond the grave, or Connie simply reflecting back on the events of the novel, or as a suggestion of a resurrection of these women. At the end of the novel, there are four "sightings" of women who used to live in the Convent. However, Morrison poses doubt in the reader's mind about these sightings, and, in a move similar to the ending of *Beloved,* the characters themselves question what is real and what is illusion. For example, Jean explains that the girl she encounters in the parking lot is a girl she knew when she lived in a housing project in Woodlawn, but Jack remembers differently and corrects her by saying that there were never any projects in Woodlawn.

With so much left unsure, the reader may begin to question whether the Convent itself ever actually existed. The possibilities of the fate of the Convent women seem endless; however, the final page of the novel will make even the most level-headed reader unsteady. The poetic language and supernatural tone of this final passage soars, with lyrical phrases such as, "the unambivalent bliss of going home to be home." (Morrison 318). The final sentence, moreover, alludes to the title of the novel but also suggests a supernatural element that cannot be ignored: "Now they will rest before shouldering the endless work they were created to do down here in paradise" (318). Are they angels sent from God to do their work for Him on earth? Can paradise be found on earth? These possibilities are immediately linked to the supernatural but again, as Barbara Christian observes, "like the endings of Morrison's other novels, there is no closure, leaving an open space for the reader to interpret these resurrections" (Christian 10).

Morrison's use of the supernatural to create ambiguous, open-ended conclusions to her novels clearly "unsettle[s] rather than soothe[s] us by supplying questions rather than answers" (Smith 149). Since the supernatural raises doubt in the characters of her novels, as well as in her readers, it is apparent why Morrison chooses to use this ambiguous element to create her endings. Morrison explains that the "wide-open nature of the ending of [her] books" exists because she "[doesn't] want to close it, to stop the imagination of the reader, but to engage it in such a way that [the reader] fulfills the book in a way that [Morrison doesn't]" (Taylor-Guthrie 108). Morrison's readers, like many of the characters in her books, may be unsettled by this lack of closure and the inevitable uncertainty that leads to the possibility of the supernatural, but Morrison has admitted, in an interview, that she is "very happy to hear that [her] books haunt. That is what [she] works very hard for" (Smith 150). The reader, to meet the challenge, must work as well.

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Milton's Examination of the Boundaries of Human Language and Knowledge in Lines 349 to 356 of *Paradise Lost*

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Abstract

Linguists have long questioned how accurately the arbitrary system of human language can represent reality. One theory is that as language becomes subject to an accumulation of human manipulations, fundamental certainties become more profoundly distorted. In *Paradise Lost,* and specifically in the Miltonic period comprising lines 349 to 356, Milton relates to Christian doctrine the inability of human beings in their present state to express reality through language. Adam intuitively knows the name that corresponds to the essence of each animal in God's kingdom before Eve precipitates the fall of man by yielding to the temptation to gain knowledge not meant for her. Furthermore, he understands the nature of God, who ranks above Adam in the universal hierarchy, and recognizes that no human words have the capacity to express such a phenomenon. Man's fall and subsequent loss of fundamental intuitive abilities leads Milton to recognize two implications: one, that the science of his day, aimed at discovering the secrets of the universe, will ultimately prove itself a futile endeavor; and two, that in explaining man's linguistic shortcomings, he must be as stylistically direct and concrete as possible.

Introduction

In his essay, "Speech and Phenomena," Jacques Derrida asks, "What does the value of originary presence to intuition as source of sense and evidence, as the *a priori* of *a prioris*, signify?" (Kamuf 13). He goes on to propose that it signifies a "certainty" (Kamuf 13) that the arbitrary and conventional nature of human language cannot provide. As a system of mere representations, language can never convey a definite, inflexible meaning.

For John Milton though, language was not always plagued by the ambiguities that Derrida describes. In lines 349 to 356 of the eighth book of the epic poem, *Paradise Lost,* Milton writes of a time when words corresponded exactly with existence and human perception. A belief in one original, undistorted language was a commonly held theological tenet in the 17th century (Fish 113), but what is uniquely Miltonic about the poet's assertion regarding a pre-lapsarian language is its implication that 17th-century society suffers from delusions of pride in its quest for knowledge that cannot possibly be attained by inferior post-lapsarian powers of human observation.

As Adam watched the birds and beasts approach him, he "named them, as they passed" (8.352). Initially, Adam evokes the image of a camouflaged birdwatcher, crouching beside a tree, furiously leafing through the pages of the Audobon Society handbook in an effort to identify the Olive Warbler flying overhead. However, Adam's advantage over the modern nature enthusiast lies in his lack of need for a manual; he intuitively knows each creature's name because "with such knowledge God endued / [his] sudden apprehension" (8.353-54). According to John Leonard in "Language and Knowledge in *Paradise Lost,*" "Adam doesn't just follow—

or even institute—a conventional usage: he recognizes the inherent appropriateness of a certain name to a certain creature" (131). After the fall, however, man loses his linguistic purity along with his moral purity. Once Eve eats the apple, all language becomes arbitrary and "conventional" (Leonard 131).

Although language related to earthly phenomena comes easily to Adam, he arrives at a loss for words as he confronts the nature of divinity. The animals, "cowering low," (8.350) fall below Adam on the universal hierarchy. Milton writes, "With blandishment, each bird stooped on his wing" (8.351). This form of flattery indicates that the animals acknowledge their inferiority to the first human being. Adam can easily understand their essences because they lack human reason, but because his cognitive abilities in turn remain inferior to those of God, Adam, like the animals, recognizes that he should also maintain a sense of humility with regard to a superior form of cognition. Leonard writes, "Adam cannot name or know God as easily as he had 'named...and understood' the animals, and yet his very inability to name here brings him the greatest recognition of all" (133). No "sudden apprehension" (8.354) follows Adam's consideration of God, because God is pure essence, which no human word can appropriately signify.

So far Milton has shown that not only are our symbols for terrestrial experiences merely inaccurate representations, but also that our understanding of the divine is beyond any linguistic capabilities we possess now or ever possessed, even before the fall. As Stanley Fish explains in *Suprised by Sin: the Reader in* Paradise Lost, "By using language to point up the distortion that results whenever fallen man attempts to make sense of the world around him, Milton passes judgement on the scientific and linguistic optimism of his own century" (107). With the blessing of the Monarchy, an institution at odds with Milton in the first place, England spent valuable time and money on scientific discovery during the Restoration. To Milton, many of these scientific endeavors were simply futile attempts to know what one can never know. Just as Eve eats the apple in hopes of gaining knowledge not meant for her, Restoration scientists also display excessive pride. Stanley Fish observes that "humility is what [Milton] seeks to instill in his readers by exploding the promise of a terrestrial Paradise which they may have accepted in the name of a secular faith" in response to the lack of humility demonstrated by the Royal Society (128).

In this same vein, Milton chooses to be fair to his readers. Since science, like language, is based on empirical observations and succeeds in producing metaphors that, at best, merely represent the truth, Milton, in much of *Paradise Lost,* and especially in lines 349 to 356 of Book Eight, refrains from the use of literary metaphor. Christopher Ricks, in *Milton's Grand Style,* admits that "the very nature of the epic will discourage metaphor" (48). Although *Paradise Lost* remains a masterfully crafted work of art, Milton clearly states that his primary intent in writing it is "to justify the ways of God to men" (1.24). Aware that the linguistic capabilities of fallen man already obscure meaning, Milton strives to use the most direct language possible to eliminate any extra confusion or distortion. In the Miltonic period with which this essay is concerned, the reader can envision a clear picture of animals coming in pairs toward Adam. Additionally, we are told of his intuitive awareness of the "nature" of each creature. As a point of contrast, John Donne, in *Holy Sonnet XIV,* compares the innate capacity of human reason to a "viceroy" (7). In the metaphysical poetry of Donne, such ornamented language is appropriate, but in Milton's epic, a similar metaphor would "seem pert or distracting" (Ricks 48).

Just as Milton believed certain formal elements inconsistent with the purpose of his epic poem, so, too, did he believe that society should shift its focus away from scientific pursuits fraught with imprecision. For Milton, man must achieve a level of communion with God equal to that of Adam's before the fall in

order to be able to describe accurately any of his *a priori* intuitions. Lines 349 to 356 of Book Eight are designed to give the most accurate depiction possible of the "certainty" that Adam felt as he intuitively named the animals. To Milton, this "originary presence" is very real, and he hopes to make the readers of *Paradise Lost* aware of it.

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"Too Sacred for Fiction": Religious Expression in the Works of Samuel Johnson

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Abstract

"'Too Sacred for Fiction': Religious Expression in the Works of Samuel Johnson" examines British author and critic Samuel Johnson's beliefs about the nature of religious experience, as expressed in his writings. The paper examines the reasons behind Johnson's reluctance to discuss religious issues in his works, and considers how this reluctance plays itself out in his writings. By examining three of Johnson's most noteworthy works — the poem, *The Vanity of Human Wishes,* and the moral tales *The Vision of Theodore, Hermit of Teneriffe* and *Rasselas*—the paper seeks to analyze the nature of Johnson's religious beliefs, and to explore how Johnson indirectly infuses his literary works with his religious principles.

Introduction

Samuel Johnson was, if the accounts given of him by friends and contemporaries are to be believed, a man of very strong and decided opinions on a great many subjects. This picture of Johnson's character seems to be confirmed when one examines his writings: throughout his *oeuvre*, Johnson expresses his (very emphatic) opinions about contemporary political, social, and literary issues with great clarity and great force. Yet, in Johnson's public writing, one finds very few opinions expressed about the issue which seems to have been most often in his private thoughts — religion. This significant silence arises, I think, from two of Johnson's religious beliefs. Because of his conviction that the nature of God and the conditions of Christian afterlife were fundamentally unknowable, Johnson felt that he could not address such religious questions with any efficacy in his works. Also, doubts about his piety and moral worth made Johnson regard himself as fundamentally unworthy of directly addressing theological subjects in his writings. In Johnson's great poem, *The Vanity of Human Wishes,* and in his moral tales, *The Vision of Theodore, Hermit of Teneriffe* and *Rasselas*, the reader can see a conflict played out between Johnson's belief in the written word as an important means of conveying religious truths, and his own reluctance openly to discuss religious topics. In all of these works, Johnson relies on indirect, rather than straightforward, means to convey his beliefs about God, piety, and the afterlife.

Throughout his life, Johnson believed in the influence that the written word could have on the lives of individuals. Though he was no denigrator of aesthetic beauty in works of literature, he stressed that a work of art primarily drew its value not from its loveliness, but its *usefulness.* As he writes in the preface to his edition of *The Plays of Shakespeare,* "it is always a writer's duty to make the world better."[1] Thus, in his eyes, as Blanford Parker has observed, "poetry was...[nothing more than] a heightened and morally uplifting amusement."[2] In other words, although Johnson believed that writing ought to be pleasing, he thought that its main purpose was to instruct—to guide people through an often treacherous and difficult world. Johnson was convinced that writing

should be, above all else, spiritually uplifting and morally pure. One can see this principle at work in much of Johnson's criticism in his *Lives of the Poets*. Often Johnson faults an author, not for inelegant writing or poorly drawn characters, but for voicing some impious belief or immoral sentiment. Johnson clearly believed that people could learn a great deal about the nature of good and evil from pleasing, well-written, inconspicuously pious works of literature. As Robert DeMaria, Jr., has observed, "[Johnson] favours an analytical representation of human life that will serve as a training manual for those not yet skilled in dealing with the moral complexities of the real thing. Virtue and vice must be carefully distinguished."[3] In his own writing, Johnson strove to convey his ideas about goodness and charity, godliness and piety, in the hopes of inspiring and encouraging people to lead better lives. According to Robert Voitle, "Johnson's aim [in writing] is not to serve some principle, but to achieve some practical result."[4] Johnson had a "resolute belief that the tangled mess of human nature is not beyond help."[5] He believed that the written word had a great deal of power to shape people's conduct and form their spiritual ideals; to help them keep their faith, and find comfort in times of crisis. This may explain why in much of Johnson's work, as Gwin J. Kolb astutely notes, "the moral is the principal object, and the story is a mere vehicle to convey the instruction."[6]

But here it is important to make a distinction in Johnson's writing between the simply *moral* and the explicitly *religious*. In many of his periodical essays (which appeared chiefly in *The Rambler* and *The Idler*), Johnson directly addresses some of the moral ills of his day. In *The Rambler*, for example, Johnson addresses parental tyranny, capital punishment, and prostitution. In *The Idler*, he tackles debtors' prisons, war, and European oppression of the native people of the New World. Clearly, these are all moral issues—issues concerning the right, and the wrong, way to behave in the world. It was *religious* questions—questions which did not deal specifically with the earthly consequences of human conduct, which Johnson shied away from discussing. When it came to questions about the nature of God, the possibility of an afterlife, and the nature of sin and its punishment, Johnson regarded himself as both unable and unworthy to make any direct statements.

Despite Johnson's broad theological knowledge, he was extraordinarily reluctant to discuss religious issues in print. As one critic notes, Johnson "had read widely in theology and could have said much. Piety explains this hesitation."[7] Johnson was convinced that "[p]iety itself, the deepest and most private affection of the soul, is beyond art."[8] Johnson's unwillingness to speak directly about religious issues comes, in part, from his belief that these topics were too sacred for fiction. As Johnson puts it, "[r]eligion is not the Club, nor is it a proper subject for the periodical essay, prose fiction, biography, or poetry."[9]

Johnson's sense that he was personally unworthy to discuss religious subjects also helps to account for his failure to address religious questions directly in his works. When it came to religion, Johnson was seized by a "conviction of his own unworthiness."[10] Throughout his life, notes Richard B. Schwartz, Johnson had "religious struggles, of skepticism, of doubt, of uneasiness, and of fear."[11] Johnson believed that he was unworthy to address religious issues because he was afraid he was not a good Christian. He felt that he was, in many ways, a sinful man, beset by "uncontrolled appetites and passions, evil habits, indolence, melancholy, pride, rationalism, intemperance."[12] Johnson was haunted by the Bible's Parable of the Talents and felt, for most of his life, that he had made very poor use of his very great gifts. His private writings are full of remorseful reflections over time he had wasted in inactivity, time that he felt he should have used in God's service: "so much of my life has stolen unprofitably away... I can descry by retrospection scarcely a few single days properly and vigorously employed."[13]

Johnson shrank away from writing about eternity and the afterlife, partly because he was beset with "frequent doubt about his own salvation."[14] Yet this sense of unworthiness is only part of the reason for Johnson's reluctance to discuss theological questions in his writings. Though the term had not yet been coined in Johnson's era, in many ways, Johnson subscribed to a type of religious thinking known today as fideism. "Fideism," explains Blanford Parker, "exists whenever God is perceived as an absence."[15] Throughout his life, Johnson longed for a sense of closeness with God, for a sense of His presence in the world, for concrete proof of His existence. Yet despite this longing, Johnson always felt that God was distant from him. Yet this belief (bleak as it is) is not at all nihilistic. Instead, according to the tenets of fideism, "[God's] empirical (and sometimes moral) absence from the world seems to be a strong proof of His presence in another."[16] As fideism conceives God as an absence, it is not surprising that in *The Vanity of Human Wishes, The Vision of Theodore, Hermit of Teneriffe,* and *Rasselas*, the fideistic Johnson would make his religious points by emphasizing what man lacks on earth, rather than on what he will gain in the hereafter.

One of Johnson's most thoroughly (if indirectly) religious works is his poem *The Vanity of Human Wishes.* Throughout the poem, Johnson takes great pains to distance himself personally from the religious issues being discussed. One means that Johnson uses to achieve this distance is to make the poem an imitation of Juvenal's Tenth Satire, rather than a simple statement of personal belief. As David Venturo has argued, "Johnson's relative ease in dealing with the sacred subject of prayer in *The Vanity of Human Wishes* is probably the result... of his using Juvenal's Tenth Satire as a 'screen' so that he does not have to speak in *propria persona*... [C]lassical language and clear literary models provide a buffer separating Johnson from the exposure of mere self-expression."[17]

Johnson spends the first nine-tenths of *The Vanity of Human Wishes* detailing all the different kinds of ambitions and desires which consume men and women. And, quite systematically, Johnson proves them all hollow; he shows that all earthly things ultimately leave people "panting for a happier [heavenly] seat."[18] Johnson demonstrates that worldly power is ultimately unsatisfying, with those who hold it growing less content the more that they gain: "conquest unresisted ceased to please,/And rights submitted left... none to seize."[19] Johnson shows the scholarly life to be unhappy, plagued by "[t]oil, envy, want, the patron, and the jail."[20] Military glory and fame are also shown to be unfulfilling, with all gains ultimately lost, and all heroes, forgotten. Johnson writes of "[w]reaths which at last the dear-bought right convey/To rust on medals, or on stones decay."[21] Furthermore, a long life leads to nothing more than disillusionment and discontent with all earthly things. In *The Vanity of Human Wishes,* the person who grows old "views, and wonders that [the things of the earth] please no more/Now pall the tasteless meat and joyless wines."[22] The possession of physical beauty, too, leads to nothing but misery and despair: "[n]ow Beauty falls betrayed, despised, distressed,/And hissing Infamy proclaims the rest."[23] In *The Vanity of Human Wishes*, all human endeavors are shown to leave people unhappy, longing for something beyond what they have. This view of the human condition may, at first glance, seem rather bleak. But in fact the poem is surprisingly hopeful. Proving that human beings can never find true happiness on earth is the fideistic Johnson's way of demonstrating his belief that they must find true happiness elsewhere — in the afterlife, in heaven. In the last lines of the poem, Johnson makes it clear that it is only through prayer, self-reflection, and a focus on the hereafter that people can find what peace and happiness they can on earth. As Johnson writes, "With [prayer] celestial wisdom calms the mind,/And makes the happiness she does not find."[24] This sense of peace and "celestial wisdom" which comes to people

through prayer, is, for Johnson, clearly a portent of the peace which is to come later — in the afterlife, with God. Yet despite the fact that religion is excluded from the vanities for which people pray, the poem leaves the nature of God and his actions deliberately obscure. Throughout *The Vanity of Human Wishes,* "Johnson never mentions God directly."[25] As a fideist, he keeps his ideas about the nature of God and the afterlife deliberately vague.

The Vision of Theodore, Hermit of Teneriffe is, like *The Vanity of Human Wishes,* a work which is at once intensely religious and studiously indirect in its statements about the nature of religious experience. As in *The Vanity of Human Wishes,* in *The Vision of Theodore, Hermit of Teneriffe,* Johnson expresses his most important beliefs about the nature of faith not by what he includes in the text, but rather by what he leaves out of it.

In *The Vision of Theodore, Hermit of Teneriffe,* as in *The Vanity of Human Wishes,* all earthly goods are shown to be ultimately unsatisfying. Early in the story, the narrator, Theodore, explains to the reader that "I was once what thou art now, a groveller on the earth, a gazer at the sky; I traffick'd and heaped up wealth together, I loved and was favoured, I wore the robe of honour, and heard the musick of adulation; I was ambitious, and rose to greatness; I was unhappy, and retired."[26] With this one sentence, Johnson dismisses material wealth, human love, political power, and worldly glory as being incapable of bringing human beings any real, lasting happiness. Theodore tells the reader that even when he possessed all the good things that earth had to offer, he was still discontented; that he still yearned for something beyond what he had. Throughout *The Vision of Theodore, Hermit of Teneriffe,* Johnson makes it clear that true happiness is an impossibility on earth. In this text, the pilgrims struggling to make their way to the top of the Mountain of Existence are constantly plagued by all kinds of difficulties — by Appetites, Habits, Passions, Ambition, Avarice, Tyranny, Lust, Vanity, Pride, Intemperance, Indolence, Melancholy, and Despair. These vices and desires all promise the pilgrim happiness, but each is shown to lead ultimately to misery. Theodore notes, for example, the promises that Ambition makes to the pilgrims. Ambition "was perpetually pointing to stately palaces on eminences... recounting the delights of affluence, and boasting the security of power."[27] Of course, in the end, those who follow Ambition do not find happiness, but disillusionment. Followers of Ambition are finally "delivered over to Avarice, and enlisted by her in the service of Tyranny, where they continued to heap up gold till their patrons or heirs pushed them headlong into the caverns of Despair."[28] Throughout the story, Johnson makes it clear that the only thing that can help human beings in their journey through life is religion. Thus, the character of Reason warns her followers that although "'[t]he path now seems plain and even... there are asperities and pitfals over which Religion only can conduct you."[29] Theodore reminds his reader that only faith can bring true, lasting happiness to human beings: "'Religion placed him in the direct path to the temple of happiness.'"[30]

Yet just what this ultimate happiness is, which lies at the end of life, is left obscure. While climbing the Mountain, one pilgrim remarks, "I stood terrified and confused; above were tracts inscrutable, and below was total vacuity."[31] It is clear that human beings cannot see or comprehend what awaits them in the afterlife, neither the exalted heights of heaven nor the blank depths of hell. When looking up toward the top of the Mountain, the narrator notes that "the summit... the human eye could never reach."[32] Both heaven and hell are acknowledged, but Johnson's descriptions of them serve only to show that they are fundamentally unknowable. The clearest description of heaven which the reader is given occurs in the statement: "'Look upward, and you perceive a mist before you settle upon the highest visible part of the

mountain, a mist beyond which my [Reason's] prospect is terminated, and which is pierced only by the eyes of Religion. Beyond it are the temples of Happiness, in which those who climb the precipice by her [Religion's] direction, after the toil of pilgrimage repose forever.'"[33] In *The Vision of Theodore, Hermit of Teneriffe,* Johnson emphasizes that only a religious life makes it possible for human beings to achieve the bliss and peace of heaven—but he steadfastly refuses to describe this heaven.

Rasselas is a work which demonstrates both Johnson's sense of the importance of religious issues, and his extraordinary reluctance to address these issues directly and explicitly. The result of this combination of opposing forces makes *Rasselas* a work that, on first reading, is rather puzzling. Initially, it is difficult to get a sense of what Johnson is trying to say. One early reader of *Rasselas*, Hester Mulso, stated that all she could conclude, after reading the story, was "that human life is a scene of unmixt wretchedness, and that all the states and conditions of it are miserable."[34] The religious messages in *Rasselas* are, at most, "obliquely suggested."[35] There is, as Donald Greene emphasizes, "a good deal of ambiguity" in the work.[36] Yet, despite its seeming ambiguity, *Rasselas* is, paradoxically, deeply religious.

In *Rasselas*, Johnson makes many of his religious points by negative example rather than by positive statements of belief. In the tale, the titular prince and his sister, Nekayah, try a great many different modes of living—amongst pleasure-seeking youth, learned philosophers, simple shepherds, men of wealth, men of political authority, hermits, scholars, couples, families, and single people, seeking to find the walk of life that brings lasting happiness. To the travelers' dismay, they find that all modes of life are full of trouble and distress and that everyone is ultimately dissatisfied and unhappy. A life spent in the pursuit of pleasure leads only to boredom, misery, and premature death: "Perpetual levity must end in ignorance; and intemperance, though it may fire the spirits for an hour, will make life short or miserable."[37] A life of poverty entails envy and suffering: "[the poor's] hearts were cankered with discontent ... they considered themselves as condemned to labour for the luxury of the rich, and looked up with stupid malevolence toward those that were placed above them."[38] Yet the rich and powerful are shown to be just as unhappy with their lot in life—as one rich man the travelers encounter puts it, "'[m]y condition has indeed the appearance of happiness, but appearances are delusive.'"[39] Living alone is sure to bring unhappiness: "'[t]he life of a solitary man will certainly be miserable.'"[40] Yet the domestic life of marriage and children is also shown to be a rather bleak one, in which "the house is filled with artifices and feuds."[41] Altogether, the impression left by the observations that Rasselas and Nekayah make is that "'[h]uman life is a state in which much is to be endured, and little to be enjoyed.'"[42] As W. J. Bate has remarked, *Rasselas* teaches that "the world offers nothing that can long or deeply satisfy."[43] Consequently, the story leads one to conclude "that the world is to mortals no proper house or habitation."[44] Yet for Johnson, who thought of the world in fideistic terms, this proof of the world's emptiness may actually provide consolation to his readers. Indeed, as one critic argues, "[f]or the pious Johnson, the satiric lesson of the emptiness of things of this world points not to nihilism but to the existence of meaning in another realm."[45]

What is the immediate cause of humankind's inability to achieve happiness on earth? Throughout *Rasselas*, Johnson makes it clear that it is people's imaginations—their ability to dream, and to wish, that makes them incapable of sustained contentment. In *Rasselas*, the poet Imlac discusses "'that hunger of imagination which preys incessantly upon life, and must always be appeased by some employment.'"[46] Some might regard this insatiable imagination as negative and destructive, but for Johnson

the imagination, if properly controlled by reason, is perceived as positive. In *Rasselas*, the character of the mad astronomer illustrates the dangers of imagination untempered by reason. This character's powerful imagination, which has clearly overpowered his senses, has convinced him that he controls the weather. Yet, when properly governed by reason, imagination is our chief motivating faculty. The very fact that the human imagination is always working, always aspiring after something higher, keeping people hungry and discontented, is, for Johnson, an indication that that restless hunger will one day be satisfied—by God in the afterlife. In Johnson's view, writes one critic, "when God gave men the capacity to wish, He did so as a testimony that man's wishing would eventually be satisfied in heaven. The infinite emptiness of worldly wishes thus serves... as strong evidence of an unseen Infinity."[47] As Johnson himself writes, in a rare statement of religious belief in *Adventurer* No. 120, "It is scarcely to be imagined that the infinite Benevolence [of God] would create a being capable of enjoying so much more than is here to be enjoyed... if he was not designed for something nobler and better than a state... in which he is to be importuned by desires that can never be satisfied."[48] Paradoxically, "[Johnson] insists that the very impossibility of satisfying our desires in this world implied the existence of a spiritual realm in which our wishes ultimately will be fulfilled."[49] One of the religious lessons of *Rasselas*, obliquely and indirectly presented, is that "the human species, despite its present craving and searching for lasting contentment, is fated to enjoy only ephemeral happiness on earth and must consequently look to eternity ... for permanent felicity."[50]

This is not to say that Johnson believed that the way in which people spend their time on earth is of no consequence. Quite the contrary—Johnson devotes much of *Rasselas* to showing the reader which ways of life are—and are not—the most pious and worthy. Throughout *Rasselas*, Johnson emphasizes the importance of living in, and contributing to, the world, and not on wasting one's time daydreaming. Imlac warns Rasselas, "'It seems to me ... that while you are making the choice of life, you neglect to live.'"[51] Rasselas himself urges his friends to focus on acting in the present, rather than holding back in fear of future ills: "'Let us cease to consider what, perhaps, may never happen.'"[52] This message of a moral *carpe diem* occurs again and again: "'Let us therefore, at length, cease to dispute, and learn to live.'"[53] Indeed, *Rasselas* is filled with "Johnson's criticism of that habit of abstraction from daily life."[54]

Johnson also explicitly connects the worthiness of one's way of life on earth and the happiness promised to a person in the hereafter. Though in *Rasselas,* Johnson is generally critical of those who withdraw from intercourse with the world, he does seem to approve of men who dedicate their lives to God by becoming monks. Monks are worthy of praise in Johnson's eyes because they live according to a disciplined routine, never losing sight of eternity: "'[t]heir [the monks'] devotion prepares them for another state, and reminds them of its approach, while it fits them for it.'"[55] The monks are even able to find some measure of contentment on Earth, because they have the sense that they are working for God, and for a happy eternity: "'their toils are cheerful, because they consider them as acts of piety by which they are always advancing towards endless felicity.'"[56] Johnson seems to suggest that a life lived with eternity constantly in mind, and a fixed determination to do good in the world, is the best. As Nekayah says, "'May not he [the person living out in the world] hope for future happiness who converses openly with mankind, who succors the distressed by his charity, instructs the ignorant by his learning, and contributes by his industry to the general system of life?'"[57] The most pious and godly life, Johnson implies, is one spent in the world, seeking to do good: "'[i]t is our business to

consider what beings like us may perform; each labouring for his own happiness, by promoting within his circle, however narrow, the happiness of others.'"[58] Yet this desire to do good in the world means nothing, unless it is combined with an awareness that the things of the world are not at all important, compared with God. Nekayah has clearly reached this awareness by the end of the story when she remarks, "'[t]o me... the choice of life is become less important; I hope hereafter to think only on the choice of eternity.'"[59]

Samuel Johnson was an author who could not help but convey a great deal of himself—of his personality, his opinions, and his beliefs, in his works. It is therefore hardly surprising that, despite all his doubts and fears and worries, Johnson could not help but delineate some of his religious principles in his writings. Though he felt comfortable discussing religious matters only in a decidedly oblique way, and did not believe that any human being could truly comprehend the nature of God, in works such as *The Vanity of Human Wishes, The Vision of Theodore, Hermit of Teneriffe,* and *Rasselas*, Johnson managed to convey, indirectly but distinctly, something of what he thought about God, the afterlife, and the pursuit of a pious life.

NOTES

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[13] Samuel Johnson, *The Major Works* (New York: Oxford University Press, 2000) 777.
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[15] Parker 190.
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[18] Frank Brady and W. K. Wimsatt, eds. *Samuel Johnson: Selected Poetry and Prose* (Berkeley: University of California Press, 1977) 67.
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[21] Ibid 62-3.
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[24] Ibid.
[25] Venturo 132.
[26] Johnson, *Rasselas and Other Tales* 195.
[27] Ibid 210.
[28] Ibid.
[29] Ibid 204.
[30] Ibid 195.
[31] Ibid 198.
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[33] Ibid 204.
[34] Ibid lvi.
[35] Samuel Johnson, The History of *Rasselas, Prince of Abissinia* (London: Oxford University Press, 1968) xx.
[36] Donald Greene, *Samuel Johnson* (New York: Twayne Publishers, 1970) 139.
[37] Johnson, *Rasselas and Other Tales* 69.
[38] Ibid 77.
[39] Ibid 79.
[40] Ibid 83.
[41] Ibid 95.
[42] Ibid 50.
[43] Bate 280.
[44] Parker 241.
[45] Venturo 106.
[46] Johnson, *Rasselas and Other Tales* 118.
[47] Venturo 131.
[48] Voitle 161.
[49] Venturo 107.
[50] Johnson, *Rasselas and Other Tales* xliii.
[51] Ibid 111.
[52] Ibid 103.
[53] Ibid 82.
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Developmental, Sex, and Gender Differences in the Worries of Third to Fifth Grade Children

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Abstract

Developmental, sex, and gender differences in the number, frequency, and content of children's worries were investigated in a sample of 107 third, fourth, and fifth grade students. Contrary to the existing body of literature, no sex or gender differences were evident in the number and frequency of worries. Comparisons across grades revealed no differences in the number of worries reported. However, developmental differences were present for worry frequency, with third graders reporting the lowest frequency of worry. A primary purpose of the study was to investigate the previously unexplored area of sex and gender differences in the content of children's worries. Significant Sex x Grade interaction effects were present for worries about school competence, rejection, and harm to home. A Sex x Gender Flexibility interaction was present for worries about harm to family and friends. In addition, children with traditional gender roles reported the lowest proportion of worries about school competence. Implications of these findings for the future study of children's worries are discussed.

Introduction

Worry is the process of repeatedly thinking about the possible negative outcomes of a threatening situation (Borkevic, 1994; Muris & Merckelbach, 2000; Vasey, Crinic, & Carter, 1994). Much is known about the process of worry in adults, but researchers have not examined worry in children until recently. To understand the process of worry in children, it is helpful to take a developmental perspective, that is, to examine the process of worry in the context of normal development.

Between the ages of 2 and 4, the cognitive capacity to anticipate future events emerges (Perrin & Last, 1997). Thus, even young children have the basic capacity to think about negative outcomes that characterize worry. However, the frequency and content of children's worries change with age. After age 7, children experience a significant increase in worry (Muris & Merckelbach, 2000; Vasey, Crinic, & Carter, 1994). In addition, the content of children's worries changes with age. Children aged 4-6 are more likely to worry about physical harm to themselves, separation from loved ones, and imaginary creatures (Muris & Merckelbach, 2000). Older children report fewer of these types of worries, but report more worries about behavioral competence, test performance, social evaluation, psychological well-being, and global issues (Gottlieb & Bronstein, 1996; Muris & Merckelbach, 2000; Vasey, Crinic, & Carter, 1994).

These changes in worry may be explained by Piaget's theory of cognitive development. According to Piaget, children in the preoperational stage (ages 2-7) are limited to thinking about what is immediately in front of them and are prone to magical thinking (Beilin, 1992). This explains the low frequency of worry and the prominence of worries concerning the self and imaginary creatures reported by children under age 6. During the concrete operations stage (ages 7-11),

children are able to reason logically, understand cause and effect, and anticipate the outcome of future events. These abilities contribute to the process of worry. During the formal operations stage (ages 11+) children develop the capacity for abstract reasoning, which is necessary to think about problems one has not encountered personally. This explains why older children report the greatest number of worries concerning global issues (Gottlieb & Bronstein, 1996). However, cognitive attainments at this stage do not explain why children aged 10-12 report a decrease in overall worrying (Muris & Merckelbach, 2000). It may be that children worry less at this stage because they are able to employ logic to evaluate the likelihood of potentially worrisome outcomes. Gottlieb and Bronstein (1996) offer an alternative explanation. They theorize that reported worrying decreases because emotional control and courage are signs of maturity in American society. Therefore, children suppress or mask their worries to avoid social stigmas.

Researchers have also revealed sex differences in children's worries. Specifically, more girls report worrying than boys (Gottlieb & Bronstein, 1996; Silverman, La Greca, & Wasserstein, 1995; Vasey, Crinic, & Carter, 1994). Muris and Merckelbach (2000) found that the sex gap in reported worries changed with age. Four- to 6-year-old girls and boys reported comparable frequencies of worry. The gap emerged in the 7- to 9-year-old group in which 89% of girls reported worrying, compared to 67% of boys. The gender gap decreased in the 10- to 12-year-old group, in which 79% of girls and 73% of boys reported worrying.

Although a difference in the frequency of boys' and girls' worries has been established, there is mixed evidence concerning sex differences in the content of children's worries. Muris and Merckelbach (2000) found that girls reported more worries about being kidnapped than boys, whereas boys worried more about being punished. Silverman, La Greca, and Wasserstein (1995) reported that girls had more worries about school, classmates, future events, and appearance. However, Vasey, Crinic, and Carter (1994) failed to find sex differences in the content of children's worries. Research on adolescents' worries revealed differences in the content of males' and females' concerns as well (Gallagher & Millar, 1998; Kaufman, Brown, Graves, Henderson, & Revolinski, 1990). Perhaps the instruments used to assess the content of children's worries, typically structured interviews or paper and pencil tests, are not sensitive enough to detect differences. Structured measures may impose the authors' ideas of what children worry about upon respondents, thereby biasing results. Using a free response measure and grouping responses into conceptually similar categories may eliminate this bias.

Although the available body of research indicates that there is a sex difference in the frequency and possibly content of children's worries, there is no research concerning the cause of this difference. It may be that boys do not actually worry less than girls. Instead, boys may not report their worries as readily as girls. The notion that boys are reluctant to admit worry is supported by research on emotional disclosure, which indicates that boys are less likely to disclose their emotions with friends and parents than girls (Balding, 1992; Papini, Farmer, Clark, Micka, & Barnett, 1990). This difference is consistent with current gender-role stereotypes (Gottlieb & Bronstein, 1996). While it is acceptable for girls to disclose their emotions and fears, boys are reinforced for being strong and fearless. Thus, boys may be more reluctant to report worrying because it is not consistent with the male gender-role stereotype.

Because gender roles may influence the process of worry, a discussion of gender-role knowledge development is relevant. Whereas sex is biological, gender is a social construct that refers to the masculinity and femininity of one's attitudes and behaviors (Anselmi & Law, 1998). For example, a boy can have both

feminine and masculine traits. Children are influenced by gender roles even as infants. By age 3, most children can sort photographs by sex and use gender labels for themselves and others (Weinraub et al., 1984). Although knowledge concerning sex-typing of objects and activities increases through middle childhood, children become less dependent on gender-stereotyped information as they get older (Berndt & Heller, 1986). Cognitive development allows children to be less absolute and more flexible in their thinking about gender roles. Even though gender-role flexibility increases with age, gender-role flexibility is low overall (Serbin, Powlishta, & Gulko, 1993). This may be because children are rewarded both subtly and overtly for gender-appropriate behavior. Also, evidence suggests that sex-role development proceeds differently for boys and girls. Overall, boys tend to be more sex-typed than girls (Antill, Russell, Goodnow, & Cotton, 1993; Brown, 1956; Downs & Langlois, 1988; Huston, 1983). That is, boys tend to think and behave in ways consistent with the male gender-role. Girls, however, are more flexible. They think and behave in ways not only consistent with the feminine gender role, but with the male role as well. Serbin, Powlishta, and Gulko (1993) found that girls' trait flexibility increased through third grade and remained somewhat stable through fifth grade, but boys' trait flexibility decreased after third grade. In addition, both boys and girls showed an increased preference for the male role with age; however, girls did not show an increased preference for the female role (Huston, 1983).

The purpose of the present investigation was to expand knowledge of the relationship among worry, gender, and development. Three areas were of interest: the frequency, number, and content of children's worries; children's sex-typing flexibility; and the relationship between these variables across age and gender. Three hypotheses were tested concerning developmental differences in worry frequency and content: (1) The number and frequency of worries increases with age. Because young children's cognitive capacities are limited, children below the age of 7 will report the lowest frequency and number of worries. (2) The content of children's worries changes with age. Children aged 5-6 will report the greatest number of worries about physical harm and separation from family members. The number of children reporting these worries will decrease with age. The number of worries concerning behavioral competence, test performance, and social evaluation will be lowest among 5- to 6-year-olds, increase among 7- to 9-year-olds, and remain at a comparable level among 10- to 11-year-olds. (3) Children's sex-typing flexibility will also increase with age. Two hypotheses regarding sex differences and worry were evaluated: (1) Girls will report a higher number and frequency of worries than boys. (2) The content of boys' and girls' worries will differ. Two hypotheses regarding worry and gender were evaluated: (1) Traditionally sex-typed boys will report the lowest frequency and number of worries. Boys who demonstrate sex-typing flexibility will report a higher frequency and number of worries than boys with traditional sex-typing attitudes. Flexible girls should report a higher frequency and number of worries than flexible boys, and traditional girls should report the highest frequency and number of worries. (2) There may be differences in the content of traditionally sex-typed and flexible children's worries.

METHOD

Participants

Participants were 107 third, fourth, and fifth graders (57 girls and 50 boys) attending a predominantly white, middle-class, suburban elementary school. The author had planned to include first and second graders in the sample; however, this could not be accomplished because consent to conduct the study could not be obtained from the superintendent of schools.

Measures

The measures used in this study were developed based on a review of the literature on children's sex typing and children's worries. Because sex-typing is a multi-dimensional construct, it is important to avoid making generalizations based on a single measure of sex-typing (Antill, Russell, Goodnow, & Cotton, 1993; Downs & Langlois, 1988; Huston, 1983). Therefore, two measures of sex-typing assessing different domains were employed in this study.

Adjective flexibility measure. The adjective flexibility measure is based on the measure employed by Serbin, Polishta, and Gulko (1993), which assesses sex-role flexibility through children's knowledge of gender-stereotyped personality traits at ages 5 through 12. Serbin and colleagues (1993) adapted the Sex Role Stereotype Measure (SSM) developed by Williams, Bennett, and Best (1975). In the SSM, children are presented with brief descriptions of gender-stereotyped character traits and pairs of line drawings of men and women. They must decide whether the trait describes the man or the woman. In the measure used in this study, children were presented with descriptions from the SSM for each of three undesirable masculine traits, three desirable masculine traits, three desirable feminine traits, and three undesirable feminine traits. It is important to include both desirable and undesirable gender-stereotyped traits because of children's tendency to attribute positive characteristics to their own sex (Huston, 1983). To make the task more concrete, children were presented with black and white photographs of men and women rather than line drawings. The pictures selected were carefully matched for age, race, and facial expressions and randomly assigned to each item. Items were placed in random order. Scoring for the adjective flexibility measure followed the procedure outlined by Serbin and colleagues (1993). The scores range from 0 to 12 with a score of 0 indicating no flexibility and a score of 12 indicating maximum flexibility.

Toy flexibility measure. In the past, researchers have used children's tolerance of peers engaged in cross-sex-typed activities as a measure of sex-typing flexibility (see Antill, Cotton, Russell, & Goodnow, 1996; Katz & Boswell, 1985). The measure employed in the present study was based on a measure of tolerance toward adults engaged in sex-inconsistent activities employed by Katz and Boswell (1985). Katz and Boswell (1985) presented third graders with pairs of drawings of an adult engaged in a sex-consistent activity, and the same adult engaged in a sex-inconsistent activity. Children were instructed to select the picture they preferred. In the present study, children were presented with eight items, each consisting of a drawing of a child engaged in a sex-consistent activity (e.g., a boy playing with a truck) and the same child engaged in a sex-inconsistent (e.g., the same boy playing with a doll). The activities selected were determined to be either sex-consistent or sex-inconsistent for boys or girls in middle childhood based on the Sex Role Learning Inventory (Edelbrock & Sugawara, 1978), the Toy Preference Test developed by DeLucia (1963), and the sex-typed interests described by Antill, Russell, Goodnow, and Cotton (1993). Sex-consistent activities for males included playing with cars, hammering, playing with a truck, playing football, using a shovel, playing basketball, playing with a toy airplane, and sawing wood. Sex-consistent activities for girls included pushing a baby stroller, playing with a dollhouse, playing with a baby doll, sewing, ironing, jumping rope, baking, and playing the piano. Half the items pictured girls and half pictured boys. Participants were told to circle the picture of the child they would rather have as their friend.

Initially, the measure was scored following the procedure described by Katz and Boswell (1985). Selecting the picture of the child engaged in the sex-appropriate activity earned a score of 0 points, whereas selecting the picture of the child engaged in a non-traditional activity earned a score of 1. The

scores for each item were added together resulting in a total score ranging from 0 to 8. However, while scoring the measure, the author noticed a distinct pattern in boys' responses. That is, boys consistently selected the child playing with an activity appropriate for boys, despite the sex of the child in the picture. According to the initial method of scoring, boys' scores would be higher, indicating more flexibility. However, the pattern of responses evidenced by boys does not indicate greater flexibility. Instead, it indicates boys' rigidity in choosing children playing with toys appropriate for boys. In light of this, a new method of scoring the toy flexibility measure was developed. Each item was scored based on whether the subject selected the picture of the activity appropriate for his or her sex. Thus, each choice reflecting an activity appropriate for the sex of the respondent received a score of 0. Each choice reflecting an activity not consistent with the respondent's sex received a score of 1. The scores on each item were combined resulting in a total score ranging from 0 to 8.

Combined Sex-Role Flexibility Score. At the outset of the study, the author planned to combine adjective flexibility scores with toy flexibility scores to obtain a combined sex-role flexibility score. However, analysis revealed toy flexibility scores may have been dependent on sex. Therefore, gender flexibility status of participants was assessed based on their adjective flexibility scores, which unlike toy flexibility scores, appeared to be independent of sex. The scores on the adjective flexibility measure ranged from 1 to 10 and were uniformly distributed. Participants were divided into three groups based on their adjective flexibility scores: high flexibility, medium flexibility, and traditional flexibility. A traditional flexibility score indicated that the child held traditional sex-typing attitudes, whereas a high flexibility score indicated sex role flexibility.

Projective measure of worry content. A projective measure was employed to determine the content of children's worries. The worry content measure consisted of a color photo of a child; girls received surveys with a photo of a girl and boys received surveys with a photo of a boy. The following was written underneath the photo: "This boy (girl) is worried that something bad will happen to him (her). Write down all the things he (she) could be worried about." Participants were informed that they had five minutes to write down all the worries they could think of.

For the purposes of analysis, conceptually similar responses were grouped together into categories similar to those used in previous measures of children's worries (see Gottlieb & Bronstein,1996; Muris & Merckelbach, 2000; Vasey, Crinic, & Carter, 1994). The following categories were developed for use: school, school competence, school other, friends, rejection, getting hurt, being punished, harm to family/friends, harm to home, imaginary things, moving, appearance, and competence. An "other" category was also created for worries that did not fit into one of the categories described. Scores were converted to proportions to control for differences in the number of worries children wrote. The proportion was obtained by dividing the number of worries in each category by the total number of worries reported. All responses were transcribed and scored independently by two raters. Raters scored a random sample of surveys and resolved disagreements by reaching a consensus. Solutions to disagreements were used to clarify the coding system. Inter-rater agreement was established at 90%.

Worry frequency measure. The worry frequency measure consisted of one question rated on a Likert-type scale of four points. The scale ranged from 1 (never) to 4 (all the time). To make the task concrete, participants were shown line drawings of drinking glasses filled with varying amounts of liquid corresponding to the points on the scale.

PROCEDURE

Prior to testing, letters explaining the purpose and procedure of the study and requesting consent were sent home to parents. Children

whose parents gave consent were invited to participate. The project was explained to children and they were told that participation was voluntary and they could withdraw at any time. Surveys were administered during the school day only to students for whom consent was obtained. The measures were assembled into one survey packet and administered to each grade during the school day. Boys and girls received separate packets, the only difference being the photo on the projective worry measure. The measures were assembled in the following order: adjective flexibility measure, toy flexibility measure, projective worry measure, worry frequency measure. Prior to completing each measure, the instructions for each instrument were read aloud. To ensure children understood the directions, an example was shown for each measure on an overhead projector. The experimenter circulated through the classroom to answer any questions.

RESULTS

Descriptive statistics of study variables are presented at the end of the paper on p. 65 in Tables 1-3.

Worry

A 2 x 3 (Sex x Grade) MANOVA was used to examine the main and interaction effects for number of worries and frequency of worries. Contrary to prediction, multivariate analysis showed no interaction effect and no main effect of sex. However, MANOVA results approached significance for the main effect of grade, $F(4, 202) = 4.00$, $p = .051$. Univariate analysis showed a significant main effect of grade on worry frequency, $F(2, 101) = 3.347$, $p = .039$. Post hoc tests revealed that fourth graders worried more frequently than third graders, $t(75) = -2.388$, $p = .019$.

Sex-Role Flexibility

Originally, adjective flexibility scores and the toy flexibility scores were to be combined to yield an overall flexibility score. However, a Pearson correlation revealed that these two measures were not significantly correlated. When the correlations were performed separately for boys and girls, the correlation between adjective flexibility scores and toy flexibility scores approached significance for boys, $r = .271$, $n = 50$, $p = .057$, but not for girls, $r = -.035$, $n = 57$, $p = .797$. Because the two scales measure different aspects of sex-role flexibility, the scores were not combined, but analyzed separately.

A 2 x 3 (Sex x Grade) MANOVA of adjective flexibility scores indicated no significant interaction effect, but significant main effects for grade, $F(4, 202) = 3.296$, $p = .012$, and sex, $F(2, 100) = 36.8$, $p = .000$. It was predicted that there would be a main effect of grade on both measures of sex-role flexibility. However, univariate tests revealed that the main effect of grade was significant only for the adjective flexibility measure, $F(2, 101) = 6.554$, $p = .002$. Post hoc tests revealed fifth graders had marginally higher adjective flexibility scores than third graders ($t(61) = -1.888$, $p = .064$. It was also predicted that significant sex differences would be present for both measures of sex-role flexibility. However, univariate analysis showed that the main effect of sex was only significant for the toy flexibility measure, $F(1, 101) = 73.674$, $p = .000$, with girls having higher flexibility scores than boys.

Worry and Sex-Role Flexibility

To test the hypothesis that traditionally sex-typed boys worry least frequently and report the lowest number of worries, a 2 x 3 (Sex x Gender Flexibility) MANOVA of worry frequency and number was conducted. Contrary to prediction, no interaction effect and no main effects were indicated.

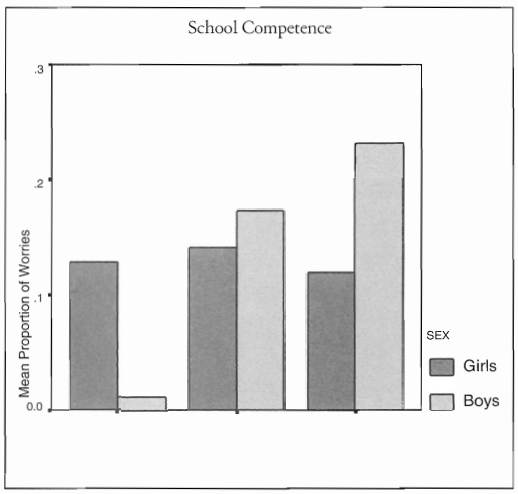
Worry Content

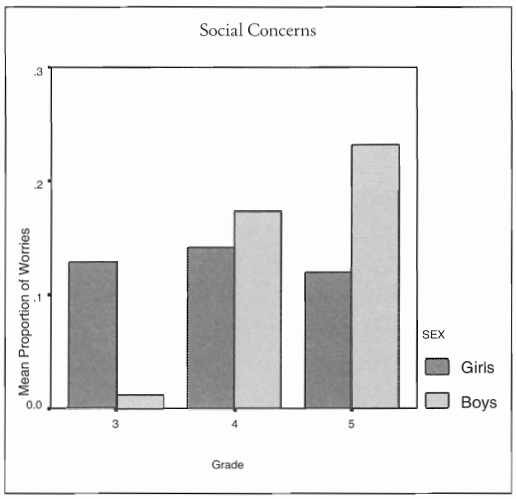
Children reported the greatest proportion of worries about getting hurt (20.4%), social rejection (15.9%), school competence (13.7%), and harm to family/friends (11.7%).

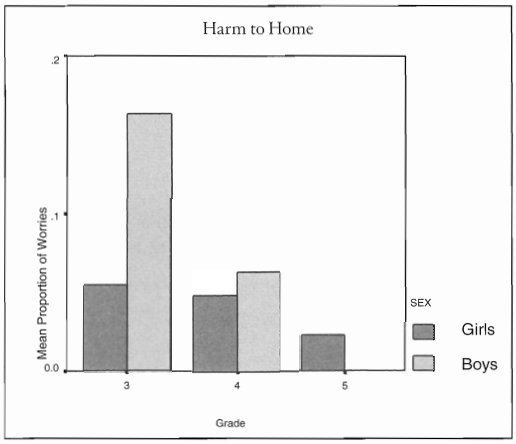
Sex and Grade Effects

A 2 x 3 (Sex x Grade) MANOVA of 15 worry categories was performed. Although multivariate analysis showed no significant

Figure 1. Sex x Grade Level Interactions for worries about school competence, social concerns, and harm to home:







interaction effect, univariate tests revealed significant Sex x Grade interactions for school competence, $F(2, 101) = 3.777$, $p = .026$; social concerns, $F(2, 101) = 4.304$, $p = .016$; and harm to home, $F(2,101) = 3.073$, $p = .051$ (see figure 1).

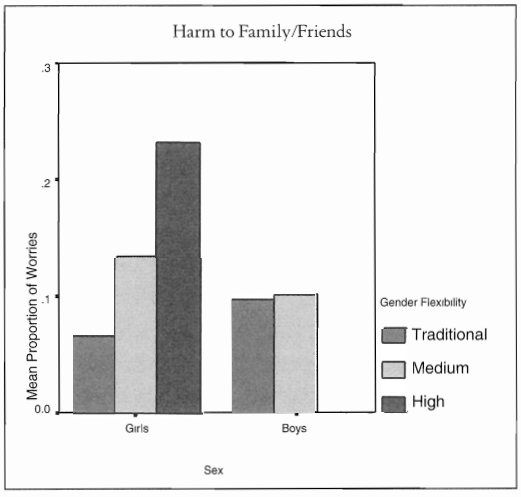
Multivariate tests showed no significant main effect of sex, but the univariate analysis revealed significant differences in the content of boys' and girls' worries as hypothesized. A significant main effect of sex was found for worries about harm to family/friends, $F(1, 101) = 4.147$, $p = .044$; appearance, $F(1,101) = 4.192$, $p = .043$; and competence, $F(1,101) = 4.484$, $p = .037$. The main effect of sex on rejection approached significance, $F(1, 101) = 3.692$, $p = .057$. Because there were very few worries in the friends category and both the friends and the rejection category can be conceptualized as worries about social concerns, the friends category and the rejection category were collapsed into a new category named social concerns. When these categories were combined, univariate analysis showed a significant main effect of sex on social concerns, $F(1,101) = 4.347$, $p = .040$.

As predicted, multivariate analysis showed a significant main effect of grade, $F(2, 32) = 1.760$, $p = .012$. Univariate analysis revealed the main effect of grade on worry category was significant for several variables. There was a main effect of grade on school competence, $F(2, 101) = 3.700$, $p = .028$. Post hoc tests showed that fifth graders had a significantly higher proportion of school competence worries than third graders $t(61) = -2.103$, $p = .040$. Also, there was a main effect of grade on harm to home, $F(2, 101), 6.245$, $p = .003$. Third graders reported a greater proportion of worries about harm to home than fifth graders, $t(61) = 3.042$, $p = .003$. Furthermore, the increase in worries about harm to home from fourth to fifth grade approached significance, $t(72) = 1.969$, $p = .053$. Finally, the main effect of grade on social concerns approached significance, $F(2, 101) = 2.968$, $p = .056$. Post hoc tests showed that fifth graders reported a greater

proportion of worries about social concerns than third graders, t (61) = -2.427, p = .018.

Gender effects. To determine sex and gender differences in worry content, a 2 x 3 (Sex x Gender Flexibility) MANOVA of worry content categories was performed. There was no significant interaction effect and no main effect of gender. There was a main effect of sex on worry content, F (14, 88) = 2.189, p = .014, for which significant differences resulted in the areas of social concern, family, and appearance as reported earlier. When univariate analysis was performed, a gender difference in the content of children's worries was found in the competence category, F (2, 101) = 3.817, p = .025. Post hoc tests revealed that children with low flexibility reported a smaller proportion of worries about competence than children with high flexibility, t (39) = -2.713, p = .010. Finally, when univariate analysis was performed, a significant Sex x Gender Flexibility interaction effect was found for worries about harm to family/friends, F (2, 101) = 4.181, p =.018 (see figure 2).

Figure 2. Sex x Gender Flexibility interaction effect for worries about harm to family/friends.



Discussion

Results provide limited support for the hypothesis of developmental differences in the number, frequency, and content of children's worries. Contrary to the findings of Vasey, Crinic, and Carter (1994), there were no differences in the number of worries children reported at each grade level. However, the frequency of children's worries did change with grade level. A non-linear trend emerged showing that fourth graders worried significantly more than third graders, but fifth graders did not worry significantly more than either third or fourth graders. Muris and Merckelbach (2000) reported a similar trend with no significant difference in the percentage of 8- to 12-year-olds reporting worrying and the percentage of 7- to 9-year-olds reporting worrying.

Differences between grade levels emerged for the following worry content categories: school competence, harm to home, and rejection. Although there appear to be developmental trends, the strength and direction of these trends differed for boys and girls. Fifth graders expressed more school competence worries than third graders. However, only boys evidenced increasing school competence worries. Whereas boys showed a sharp decrease in the proportion of worries about harm to home, girls did not. The proportion of worries about rejection nearly doubled in fourth grade for girls, but remained consistent for boys. Even so, the relative proportion of worries about rejection remained high for both sexes. Vasey, Crinic, and Carter (1994) theorize that the rising prominence of worries about rejection is caused by the increasing importance of social comparisons in the formation of children's self-concepts. Indeed, children become capable of employing social comparisons in the formation of their identity and are increasingly aware of others' evaluations after age 8 (Secord & Peevers, 1972).

One purpose of this investigation was to explore the under-researched area of sex differences in the content of children's worries. Differences were expected for worries about

kidnapping and punishment (Muris & Merckelbach, 2000) and worries about school, classmates, future events, and appearance (Silverman, La Greca, and Wasserstein, 1995). As hypothesized, sex differences in the content of children's worries were found. In this investigation, girls worried more about harm to family/friends and appearance, whereas boys worried more about competence. Although a sex difference in worries about appearance was reported by Silverman, La Greca, and Wasserstein (1995), girls may have expressed more worries about appearance because the girl pictured in the projective worry measure given to girls was wearing glasses. However, the boy pictured in the measure given to boys was not wearing glasses. Thus, the picture may have prompted girls to generate more worries about appearance. The majority of the worries in the competence category were concerned with winning a sports match. This may result from the importance the male gender role places on accomplishments in sports. The proportion of worries about competence reported by boys considered together with the increase across grades in worries about school competence may reflect the emphasis the male gender role places on overall achievement.

In addition, previous literature suggested that girls would report a greater number of worries and worry more frequently than boys (Gottlieb & Bronstein, 1996; Muris & Merckelbach, 2000; Silverman, La Greca, & Wasserstein, 1995; Vasey, Crinic, & Carter, 1994). However, no such differences were found. In addition, the degree of children's gender-role flexibility did not influence the number and frequency of children's worries. Boys and girls reported the same level of worry regardless of the degree of their gender-role flexibility. One possibility is that the projective measure obscured real sex differences detected by earlier measures. It is also possible that gender-role stereotypes did not prevent boys from expressing worry as previously hypothesized (Gottlieb & Bronstein, 1996). Perhaps boys felt more comfortable disclosing their worries because the projective measure allowed them to attribute their worries to someone else.

Another purpose of this investigation was to explore whether the level of children's gender-role flexibility influences the content of worries reported. Whereas girls with high flexibility scores reported the greatest proportion of worries about harm to family/friends, boys with high flexibility scores reported the least proportion of worries about harm to family/friends. In addition, gender differences were present in the area of competence. Children with traditional gender roles reported the least number of worries concerning competence. Perhaps such children need not worry about the possibility of failure because they adhere to the scripts prescribed by their gender roles. This explanation is supported by the results of Sanguinetti, Lee, and Nelson (1985) who found that expectations for success on a motor task were higher when that task was appropriate to the individual's sex.

Although a sex difference was evident on the toy flexibility measure, no such difference was found on the adjective flexibility measure. This supports the wealth of research showing that boys demonstrate a higher overall degree of sex-typing (Antill, Russell, Goodnow, & Cotton, 1993; Brown, 1956; Downs & Langlois, 1988; Edelbrock & Sugawara, 1978; Katz & Boswell, 1986). In addition, scores on the adjective flexibility measure were more closely related to scores on the toy flexibility measure for boys than for girls. It appears that both toy selection and knowledge of personality traits may be highly influenced by sex-role stereotypes for boys, but not necessarily for girls. This supports the wealth of research showing that sex-typing is most prominent in children's interests and activities (McHale, Crouter, & Tucker, 1999). It is also consistent with the multidimensional model of sex-typing development described in other research (Antill, Russell, Goodnow, & Cotton, 1993; Brown, 1956; Downs & Langlois, 1988; Edelbrock &

Sugawara, 1978; Katz & Boswell, 1986). Furthermore, boys demonstrated a strong preference across grade levels for the children playing with toys appropriate for boys. This may be related to the way in which boys form their friendships. Because boys choose their friends based on issues of mastery and shared activities (Buhrmeister, 1996), they selected the pictures of children engaged in the activities they enjoyed most. As expected, those activities were highly sex-typed.

The hypothesis that sex-role flexibility increases with age was only partially supported. Grade level affected scores on the adjective flexibility measure, but not the toy flexibility measure. However, the data show a non-linear trend with flexibility scores decreasing slightly in fourth grade and then increasing in fifth grade. Similarly, Serbin, Powlishta, and Gulko (1993) found that children's trait flexibility scores decreased from third to fourth grade and increased steadily thereafter. However, the authors offered no explanation for this trend.

In order to interpret the results, it is necessary to discuss the limitations of the present study. The worries generated in response to the projective measure may not reflect children's actual worries. However, this does not seem likely considering that the worries generated here fit into the categories described in other literature. In addition, the small number of children in the low and high flexibility classifications limits conclusions that can be drawn about the effects of gender-role flexibility on the number and frequency of children's worries. In spite of small cell sizes, a gender difference did emerge in the area of worries about competence. Use of a larger sample would enable investigation of sex, gender, and grade differences in the content of children's worries.

Because worry is a normative phenomenon, it is important to conduct research in this area. In the majority of previous research, children's worries were assessed via structured interviews or questionnaires. However, these types of measures impose the researchers' conceptions of what children should be worried about on participants. A free response measure, such as the one employed in this investigation, eliminates this bias and allows children to report what they really worry about most. The worries generated in the free response measure were similar, with two exceptions, to those presented in other structured measures. However, other structured measures included items about imaginary creatures and global issues, which were only sometimes reported by children in this study. Therefore, the findings in the present study lent some support to the content of structured questions used in other investigations. In addition, the present study contributed to the knowledge of sex differences in the content of children's worries. Previous research showed sex differences in worries about school, classmates, future events, kidnapping, punishment, and appearance. Results of the present study also revealed sex differences in areas not found in previous research, including worries about family and friends, and competence. Finally, although it was hypothesized that sex roles were in part responsible for sex differences in children's worries, no research had been done to confirm this. In the present investigation, results showed that sex roles only influenced worries about competence. In the future, research with larger sample sizes and representative populations should be performed to replicate these results.

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Table 1. Means and Standard Deviations for Responses to Flexibility and Worry Measures

	3rd						4th						5th					
	Boys (n=13)		Girls (n=20)		Total (n=33)		Boys (n=25)		Girls (n=19)		Total (n=44)		Boys (n=12)		Girls (n=18)		Total (n=30)	
Measure	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Flexibility Adjective	4.8	2.5	5.3	1.8	5.1	2.1	4.2	1.7	4.5	1.5	4.3	1.6	5.6	2.0	6.2	1.4	6.0	1.7
Toy	.62	.77	3.3	2.6	2.2	2.4	.44	.79	4.1	2.3	2.0	2.4	.58	.79	3.4	2.0	2.3	2.2
Worry Number	6.2	2.3	6.6	3.3	6.5	2.9	6.6	3.9	8.4	4.0	7.4	4.0	7.2	2.8	8.0	3.7	7.7	3.3
Frequency	1.9	.64	2.2	.37	2.1	.50	2.4	.65	2.3	.67	2.4	.65	2.2	.58	2.2	.43	2.2	.48

Table 2. Means and Standard Deviations by Sex and Grade for Proportions of Worries

	3rd						4th						5th					
Worry	Boys		Girls		Total		Boys		Girls		Total		Boys		Girls		Total	
Category	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
School	.021	.047	.025	.046	.023	.047	.013	.038	.011	.080	.012	.034	.012	.041	.024	.801	.019	.067
School Competence	.011	.040	.128	.199	.082	.166	.173	.231	.141	.115	.159	.188	.231	.138	.119	.129	.231	.138
School Other	.023	.060	.042	.079	.035	.072	.045	.088	.083	.143	.062	.115	.021	.050	.023	.056	.022	.053
Friends	.049	.104	.051	.069	.050	.083	.017	.052	.039	.081	.027	.066	.028	.075	.022	.066	.024	.068
Rejection	.058	.115	.089	.143	.077	.132	.063	.087	.241	.267	.139	.205	.175	.162	.148	.119	.159	.136
Getting Hurt	.324	.322	.172	.275	.232	.2999	.227	.248	.166	.157	.200	.213	.153	.222	.198	.277	.180	.254
Punished	.038	.088	.035	.070	.035	.076	.038	.071	.032	.066	.035	.068	.070	.078	.068	.094	.068	.086
Family	.103	.137	.183	.264	.152	.204	.089	.125	.068	.092	.084	.111	.061	.120	.183	.128	.134	.137
Home	.163	.166	.054	.113	.097	.145	.062	.133	.047	.079	.056	.112	.000	.000	.010	.028	.006	.023
Imaginary	.000	.000	.010	.045	.006	.035	.042	.119	.026	.054	.053	.096	.000	.000	.010	.029	.006	.023
Moving	.013	.046	.033	.062	.025	.056	.023	.053	.000	.000	.013	.041	.000	.000	.009	.039	.006	.030
Appearance	.000	.000	.026	.071	.016	.056	.006	.029	.042	.087	.022	.063	.023	.055	.079	.199	.057	.159
Competence	.046	.100	.058	.132	.053	.119	.059	.111	.040	.072	.051	.095	.199	.232	.045	.105	.106	.181
Other	.104	.226	.089	.137	.095	.174	.083	.093	.045	.088	.066	.092	.027	.064	.045	.082	.038	.074

Table 3. Means and Standard Deviations by Gender Flexibility and Sex for Proportions of Worries

	Traditional						Medium Flexibility						High Flexibility					
	Boys (n=14)		Girls (n=8)		Total (n=22)		Boys (n=29)		Girls (n=37)		Total (n=66)		Boys (n=7)		Girls (n=12)		Total (n=19)	
Worry Category	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
School	.009	.033	.000	.000	.006	.027	.014	.043	.022	.041	.018	.042	.028	.054	.028	.096	.028	.081
School4 Competence	.111	.129	.118	.087	.113	.113	.152	.225	.130	.161	.140	.190	183	.173	.137	.164	.154	.164
School Other	.015	.038	.115	.200	.051	.129	.049	.090	.045	.079	.047	.083	.008	.020	.020	.048	.016	.040
Social Concerns	.068	.142	.275	.125	.143	.167	.113	.118	.174	.237	.147	.195	.230	.176	.212	.160	.219	.161
Getting Hurt	.322	.287	.173	.167	.268	.256	.211	.263	.198	.259	.204	.259	157	.217	.118	.219	.132	.213
Punished	.019	.048	.073	.108	.038	.077	.056	.088	.030	.065	.041	.077	.052	.073	.069	.085	.063	.079
Family	.098	.134	.066	.142	.086	.134	.101	.131	.134	.125	.120	.127	.000	.000	.007	.044	.004	.019
Home	.093	.139	.016	.044	.065	.119	.060	.134	.059	.101	.059	.116	.093	.164	.008	.029	.039	.106
Imaginary	.020	.135	.025	.071	.042	.115	.011	.062	.016	.042	.014	.051	.000	.000	.007	.044	.004	.019
Global	.006	.134	.000	.000	.041	.101	.013	.056	.009	.031	.011	.043	.000	.000	.008	.026	.005	.021
Moving	.014	.053	.000	.000	.009	.043	.017	.046	.022	.054	.020	.050	.008	.020	.000	.000	.003	.012
Appearance	.008	.030	.047	.093	.022	.062	.011	.040	.041	.099	.028	.079	.000	.000	.072	.216	.045	.072
Competence	.008	.030	.000	.000	.005	.024	.114	.169	.052	.108	.114	.169	.149	.204	.067	.124	.097	.158
Other	.091	.217	.094	.186	.091	.217	.063	.083	.062	.096	.063	.090	.094	.123	.031	.061	.054	.091

The First Record of Otoliths from the Lower Navesink Formation (Upper Cretaceous) in the Northern Coastal Plain, Monmouth County, New Jersey

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Abstract

This paper documents the first record of otoliths or "ear stones" in the fossil record of the Navesink Formation in the Northern Coastal Plain, Monmouth County, New Jersey and the importance of this discovery. Also examined are the reasons for the scarcity of otoliths and why they are important to our understanding of the oceans of the upper Cretaceous. There is great potential for the identification of new genera through analysis of our specimens. The findings presented here are the beginning of an extended research project in which we hope to identify accurately and understand the specimens collected thus far through an intense review of local and regional literature and conferences with otolith experts from North America and Europe.

Introduction

Almost a century ago, the first occurrence of fossil otoliths was reported from Haddonfield and Mt. Laurel, New Jersey (Fowler 1911, p. 108 fig. 61, 1-8). Fowler (1911) indicated that these otoliths were recovered from upper Cretaceous sediments, but provided no stratigraphic information. Since this report, little documentation exists in local and regional literature on upper Cretaceous otoliths. Otoliths or "earstones" are small bony structures, typically less than one centimeter, found within the inner ear of osteichthians. These bony structures function as auditory sensors in addition to assisting in balance, orientation, and mobility. Within the inner ear canals along both sides of the head, three otoliths can be found that consist of the saggittis, asteriskis, and lapillus. Studies characteristically focus on the saggittis, the largest of the three otoliths and the easiest to analyze (e.g., Nolf and Dockery 1990; Stinton 1972).

Both modern and fossil otoliths are species-specific and allow for identification and classification of individuals. Moreover, otoliths grow during an individual's lifetime as a series of irregular accretionary rings, recording detailed information about an individual osteichthian and its environment. Study of such rings shares many common elements to dendrochronology. To date, a wealth of information has been obtained from fossil and modern otoliths. Examples of this information include but are not limited to: 1) identification of fossil species in deposits where no other skeletal remains exist (Nolf and Stringer 1996); 2) regional biostratigraphic correlation of fossil deposits (Stinton 1972); 3) construction of historical El Nino records based on isotopes of oxygen O18/O16 ratios recorded in otoliths recovered from deep-sea drilling core projects in the Pacific (Andrus et al. 2002); 4) monitoring health and growth of both wild and farm-raised fish stocks (Pannella 1980); and 5) the carrying capacity of the aquatic environment based on the size of growth rings (Secor and Dean 1989).

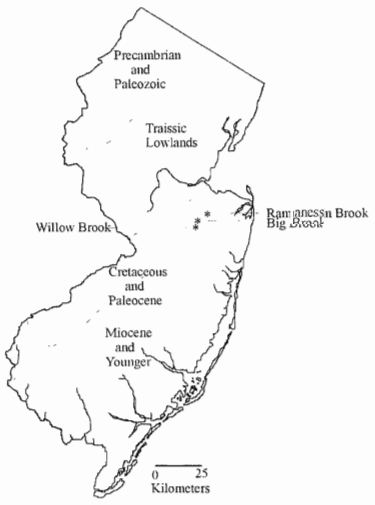
As a result of over 10 years of studying and collecting the Wenonah-Mt. Laurel and Navesink Formations in Monmouth County, New Jersey, we have recovered a small assemblage of osteichthian otoliths

discussed in this paper. This report documents preliminary findings and details the future plans of the recovered otolith assemblage. Most recently, additional specimens of equivalent aged otoliths were recovered from the debris mounds of red ant nests in north-central South Dakota (Becker et al., 2002, *in press*). These recovered specimens will serve as comparative material to assist in the forthcoming identification and classification of the New Jersey specimens.

Geologic Setting, Materials and Methods

The study area, located in the north coastal plain of New Jersey, records a sea level transgression that inundated the Monmouth County area during the late Cretaceous, approximately 75 million years ago. Erosion of the Appalachian Mountains provided the sediment, which was transported by river systems to the coastal plain, reworked, and then deposited by cyclical fluctuations of a retreating late Cretaceous Atlantic Ocean (Owens and Gohn, 1985). Cross-sections of these upper Cretaceous marine deposits can be accessed along Ramanessin, Willow, and Big Brooks. These brooks expose sediments of the lower Navesink Formation where our otoliths were recovered (Fig. 1).

Figure 1. Location Map of New Jersey



The base of the lower Navesink Formation is marked by an erosional disconformity and contains a pebbly, muddy, medium to coarse quartz sand with glauconite, organics, and apatite. This lithofacies is extremely fossiliferous and contains abundant steinkerns of pelecypods, gastropods, cephlopods, and brachiopods as well as teeth from reptilian, chondrichthian, and osteichthian representatives (Becker et al., 1996; 1999; 2002 *in press*). Otoliths were recovered along with other vertebrate and invertebrate fossils from this horizon. Because of the small size of otoliths, field collection and analysis are not possible. Five-gallon buckets of the lower Navesink Formation were collected and brought back to the lab for sieve separation and binocular microscope analysis. The recovered otoliths were the result of bulk sampling approximately 1,000 kilograms of sediment.

RESULTS

To date, we have recovered approximately 20 fossil otolith specimens that contain many of the complex and diagnostic anatomical features seen in a modern otolith (Figure 2). Sketches of our recovered specimens are compiled in Figure 3 for comparison. We are currently in the process of identification of the individual species to which these otoliths belong through comparison to the limited upper Cretaceous literature on otoliths as well as consultation with otolith experts in North America and Europe. This research is the first to report the recovery of otoliths from the upper Cretaceous of the northern coastal plain of New Jersey. Excellent potential for naming a new species of osteichthian from our specimens exists based on preliminary findings.

Figure 2. A Right Saccular Otolith (Redrawn from: Nolf 1996)

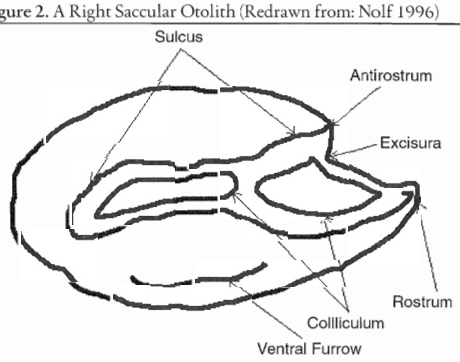
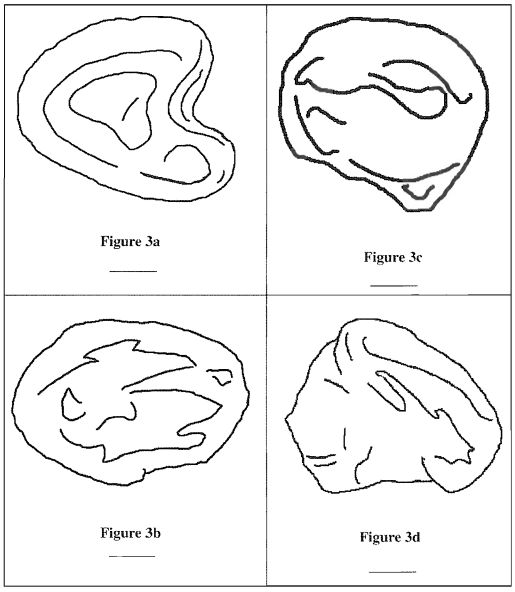


Figure 3a-d: Otoliths recovered from the lower Navesink Formation, Monmouth County, NJ. Figures 3a-b: Right saccular otoliths. Figures 3c-d: Left Saccular Otoliths. Line drawings by the author. Scale line is 1.0 mm.



Discussion and Conclusions

A review of the known upper Cretaceous osteichthians based on teeth, scales, and skeletal elements for the New Jersey Coastal Plain by Gallagher (1993) identified the following species: Suborder: Acipenseroidei: *Acipenser* sp.; Family Lepisostidae: *Atractosteus* sp. and *Lepisosteus* sp.; Family Pycnodontidae: *Anomaeodus phaseolus*; Family Ichthyodectidae: *Xiphactinus audax*; Family Albulidae: *Albula* sp.; Family Phyllodontidae: *Paralbula* casei; Family Enchodontidae: *Enchodus ferox*; Family Trigonodontidae: *Stephanodus* sp. To date, otoliths for the New Jersey individuals cited by Gallagher (1993) are unknown.

In other deposits similar in age to that of the lower Navesink Formation along the Atlantic Coastal Plain, a limited otolith data set exists for comparative analysis. Lauginiger (1984) conducted an extensive survey of upper Cretaceous fish fauna from the Campanian, Marshalltown Formation in Delaware. Although a diverse assemblage that included seven different genera of osteichthian was recovered, this survey indicated otoliths to be very rare and contained no figured specimens. Huddleston and Savoie (1983) reported the occurrence of eleven osteichthian families based on otoliths from the Maastrichtian, Severn Formation in Maryland. The sea catfish (Ariidae) *Vorhisia* sp. and members of the cardinalfishes (Apogonidae) dominated recovered otoliths. With the exception of Albuloidei, none of the recovered otolith families as indicated by Huddleston and Savoie (1983) are known from the upper Cretaceous of New Jersey.

We currently attribute the scarcity of recovered otolith specimens in the upper Cretaceous of New Jersey to the fact that: 1) otoliths and other fish fauna accumulated as part of a lag deposit and reflect extensive reworking across a regressive-transgressive third-order sea-level cycle at the boundary between the Marshalltown and Navesink Depositional Sequences; 2) otoliths and their corresponding fish become dissociated during fossilization; 3) diagnostic anatomical features may have been lost because of reworking and taphonomic processes making otoliths indistinguishable from the host sediment or other bony fragments; and 4) partial carbonate composition of otoliths makes them susceptible to dissolution by slightly acidic groundwater flow. A similar conclusion was reached by Nolf and Stringer (1996) regarding acidic dissolution in the Cretaceous fish otolith record for North America.

Our investigation into otoliths from the lower Navesink Formation in Monmouth County, New Jersey, is in its early phases. We are currently analyzing approximately 200 kilograms of additional sediment recovered from the deposit and anticipate more discoveries to confirm and advance our initial findings. Additionally, we have begun to confer with otolith experts to obtain accurate identifications and broaden our understanding of these extremely rare and scientifically significant microfossils.

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Downstream Regulation of *Hmx3* and *Pax2* by *Tbx1*, a Velocardiofacial Syndrome/DiGeorge Syndrome Gene, During Mouse Ear Development

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Abstract

Velocardiofacial syndrome/DiGeorge syndrome (VCFS/DGS) is an autosomal dominant developmental disorder that has been characterized by a variety of phenotypic defects including ear abnormalities, facial dysmorphology, cleft palate, cardiovascular anomalies, hypoplasia of the thymus and parathyroid glands, learning disabilities, and psychiatric problems. Most sufferers of VCFS/DGS possess partial deletions in the q11 band of chromosome 22 (22q11). This deleted region is speculated to contain approximately 30 genes. Recent mouse models have referred to Tbx1, one of the deleted genes, as the VCFS/DGS candidate gene. In mice with the *Tbx1* null mutation, expression has been detected by whole mount *in situ* hybridization in the inner ear and derivatives of the pharyngeal arches, specifically the heart, thymus, and parathyroid glands. Our objective was to investigate how the reduction in *Tbx1* dosage produced the ear defects present in developing embryos. To accomplish this, we evaluated the expression patterns of potential downstream gene targets and their possible regulation by *Tbx1* in knockout mice. *Hmx3* and *Pax2* were selected as candidates because they were both expressed in the developing inner ear. To examine the *Tbx1* regulatory pathway and subsequently to understand the ear defects of VCFS/DGS sufferers, the spatial and temporal expression patterns of *Hmx3* and *Pax2* were studied in the inner ear of *Tbx1* knockout mice.

Introduction

Velocardiofacial syndrome/DiGeorge syndrome (VCFS/DGS) affects approximately 130,000 people in the United States and occurs at a frequency of 1 in 4,000 births. This disease is responsible for over 30 symptoms that are variable in each VCFS/DGS individual. The symptoms are thought to vary as a result of each patient having undergone unique deletion, translocation, or rearrangement events. However, the majority of VCFS/DGS patients have been identified through haplotype analysis to contain a 1.5Mb or 3Mb deletion of chromosome 22 in the q11 region. The deletions resulted from errors in intra- and inter-chromosomal homologous recombination mechanisms (Edelmann et al., 1999). The chromosome 22q11 rearrangements have also been observed in other congenital anomaly disorders, such as cat-eye syndrome and der (22) syndrome (Edelmann et al., 2001).

Many genetic disorders have been studied using animal models that express homology with the human genome. Homologous genes were targeted in animals to produce mutations that closely mimic the symptoms of a human genetic disease. Previous researchers have used mouse models to analyze the genetic basis of VCFS/DGS (Jerome et al., 2001). Mouse chromosome 16 has been shown to be comparable to human chromosome 22. When deletions were introduced on the murine chromosome, the resulting embryos possessed many of the defects present in VCFS/DGS patients. The deletions

were then examined to determine the exact gene responsible for this syndrome. However, with more investigation it was realized that the deleted region comprised several genes that may contribute to the etiology of VCFS/DGS. As of yet, mouse studies have concluded that a deletion of *Tbx1*, a gene that codes for transcription factors, is the cause of VCFS/DGS cardiovascular defects (Jerome et al., 2001). *Tbx1* has been expressed through murine models in the inner ear, thymus, heart, and parathyroid glands. A *Tbx1* null mutation in mice caused many of the abnormal phenotypes that were observed in human VCFS/DGS patients, including cleft palate, ear defects, cardiovascular problems, and hypoplasia of the thymus and parathyroid glands. However, all of the defects of VCFS/DGS were not represented in *Tbx1* null mutants. The implications of this discovery allowed us to propose three hypotheses. First, we speculate that there are other genes located in the deleted region causing the other phenotypes of VCFS/DGS that have not been discovered. Second, we propose that *Tbx1* has undergone regulation by other gene(s) to produce VCFS/DGS. Finally, we hypothesize that *Tbx1* regulates downstream gene targets in a genetic pathway causing this disorder.

Our investigation focused on the third hypothesis to elucidate the *Tbx1* regulatory pathway. A specific defect of VCFS/DGS was then identified to understand its genetic basis and potentially develop a therapeutic technique for sufferers. VCFS/DGS patients suffered from hearing loss caused by mutations that affect ear formation and auditory ability. Consequently, we focused on ear development processes in *Tbx1* null mice to understand the basis for the anomalies observed in human patients. *Tbx1* knockout mice exhibited some of the human ear defects, but we speculate it was not the sole gene responsible for those mutations in ear development. Therefore, *Pax2* and *Hmx3* genes were identified as possible candidates in the *Tbx1* pathway because they encode transcription factors that have expression patterns in the human and mouse ear during development. We propose that these genes are essential in the *Tbx1* genetic mechanism and when they are mutated may be the cause of the ear abnormalities in VCFS/DGS.

To investigate the *Tbx1* pathway we studied the expression patterns of *Hmx3* and *Pax2* genes in the mouse ear as formerly presented in scientific literature. This information highlighted the specific locations and developmental stages when these genes were active in mouse embryos. Our investigation utilized the organs of *Tbx1* knockout mice that were bred to produce wild type, heterozygous, and homozygous mutants in classic Mendelian ratios. Those organs would be used as the source of DNA and RNA for PCR and RT-PCR studies, respectively. The amplified *Hmx3* and *Pax2* gene expression patterns would then be determined based upon their specific binding locations in *Tbx1* knockout embryos, through the whole mount *in situ* hybridization procedure.

The analysis of the spatial areas and temporal stages of the genes' activity will provide valuable answers in the exploration of the *Tbx1* genetic pathway. By studying *Hmx3* and *Pax2* expression patterns in *Tbx1* null mutants, we hope to illuminate the genetic background of ear malformations and hearing problems in VCFS/DGS.

MATERIALS AND METHODS

Breeding of mice and embryo genotyping

Tbx1 knockout mice were generated previously with gene targeting techniques (Merscher et al., 2001). Mice from a FVB background were bred to obtain wild type, heterozygous, and homozygous embryos in Mendelian frequencies. The mothers were sacrificed and embryos were dissected into PBS during days E9.5-13.5, with noon of the plug date recorded as E0.5.

DNA was isolated from the yolk sacs of dissected embryos and pup tails using the DNeasy Tissue Kit by Qiagen. In this protocol,

samples were incubated overnight in a buffer solution containing proteinase K to ensure complete tissue lysis. The lysate was then added to a DNeasy mini column and centrifuged in a series of buffer solutions. The bound DNA (3ml) was purified and finally eluted through the membrane.

Mice were genotyped by PCR analysis. (Refer to Table 1 and Table 2 for a complete listing of PCR reagents and primers.) Using previously designed primers for *Tbx1*, the wild type, heterozygous, and homozygous genotypes were identified. The PCR amplification required 3 µl of DNA template and was completed under these conditions: 94°C for 10 min., one cycle; 94°C for 1 min., 55°C for 1 min., and 72°C for 1 min. (30 cycles); 72°C for 10 min., one cycle. The PCR results were analyzed on a 2% agarose gel with ethidium bromide staining.

Table 1. Listing of Primers for all PCR and RT-PCR experiments.

Table of Primers	
Primer	Sequence
Tbx1 Wild-type Forward	TTGGTGACGATCATCTCGGT
Tbx1 Wild-type Reverse	ATGATCTCCGCCGTGTCTAG
Tbx1 Knockout Reverse	AGGTCCCTCGAAGAGGTTCA
Hmx3 Forward	TTCCACACGCGAAGGATCAG
Hmx3 Reverse	TTTTTTGCCTTCCTCCGAGT
Pax2 Forward	TGACACACAATCAGCGTGG
Pax2 Reverse	AGTGACGTCTTCCTCTAGC

Table 2. Listing of reagents used in PCR experiments of *Tbx1*, *Hmx3*, and *Pax2* genes. Total volume of *Tbx1* was 25µl, while *Pax2* and *Hmx3* total volumes were 50µl.

Table of PCR Reagents										
Gene	Water (µl)	10x (µl)	NTPx (µl)	Mg (µl)	DMSO-10%(µl)	Taq (µl)	Forward (µl)	Reverse (µl)	Mutant (µl)	DNA (µl)
Tbx1	0	2.5	4	3	2.5	0.4	5	2.5	2.5	3
Hmx3	10.5	5	8	5	5	1.5	5	5	0	5
Pax2	10.5	5	8	5	5	1.5	5	5	0	5

Hmx3 and *Pax2* Primer Preparation and PCR Analysis

Using the genomic sequence of *Hmx3* (GenBank Accession number NM008257) two primers (Table 1) were generated to amplify a 364-base pair DNA segment. There was not a suitable nonrepetitive genomic sequence for *Pax2* (GenBank Accession number X55781), so a 362-bp mRNA region was initially targeted for amplification. To test the primers' functional ability, PCR was performed using mouse-tail DNA. The conditions for those reactions were 5µl DNA at 94°C for 10 min., one cycle; 94°C for 1 min., 53°C for 1 min., and 72°C for 1 min. (35 cycles); 72°C for 10 min., one cycle.

RNA Isolation and RT-PCR

RNA was extracted from mouse organs and embryos for reverse-transcriptase PCR to generate cDNA from an RNA transcript. RNA isolation was performed using RNase free lithium chloride/urea and trizol reagents (1ml per 50-100mg of tissue). Approximately 100mg of tissue were homogenized in these solutions, separated into an aqueous phase with chloroform (0.2ml), precipitated with isopropyl alcohol (0.5ml per 1ml trizol), washed with 75% ethanol for RNA pellet formation, and finally eluted for storage at -80°C. The optical density was then found to determine the success of the RNA isolation and its concentration in solution. Finally, the RNA was quantified on a 1.2% agarose gel stained with ethidium bromide.

The RT-PCR was completed with the Titan one-tube reaction kit (Roche) and Gibco's multistep kit for complementary DNA amplification. The Titan kit completed first strand synthesis of cDNA using 10µg of RNA template, reverse transcriptase enzyme, RNase inhibitor and 2µl of the cDNA product. The program was 50°C for 20 min., one cycle; 94°C for 2 min., one cycle; 94°C for 30 s., 58°C for 30 s., 68°C for 45 s. (30 cycles); 68°C for 7 min. The Gibco procedure carried out the aforementioned reactions separately using 5µg of RNA and 5µl of the cDNA product.

Plasmid Preparation

Pax2 DNA segments with *Eco*R1 and *Bam*H1 linkers were subcloned into the vector pZErO-2. The vector and DNA were subsequently digested with restriction enzymes EcoR1 and BamH1. Using 0.5µl of phage T4 DNA ligase, the segment was inserted into the plasmid. Then 2µl of the ligation product were prepared for transformation into *E. coli* cells on LB medium containing 50µg/ml kanamycin. After overnight incubation

(37°C), only bacterial colonies that contained the *Pax2* plasmid were observed. Positive clones were analyzed by culturing 20 colonies overnight in LB/kanamycin medium. Plasmid DNA was purified from the harvested cells following the plasmid MiniPrep protocol. The plasmid was sequenced and compared for accuracy to the *Pax2* human genomic sequence recorded in GenBank (www.ncbi.nlm.nih.gov/BLAST/).

Histological Preparation

For future preparations of whole mount *in situ* hybridization experiments, E9.5 embryos were removed in PBS (DEPC treated) and fixed overnight in 4% paraformaldehyde. The embryos were washed in PBS with 0.1% Tween-20, dehydrated in a methanol series (25%, 50%, 75%, 100%), and stored at -20°C.

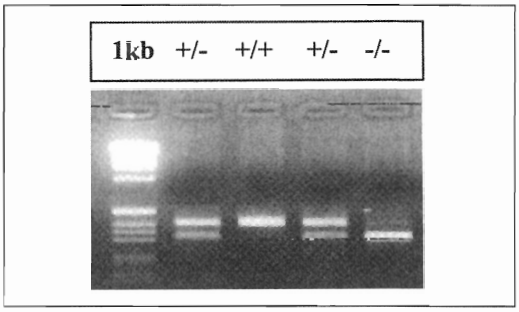
RESULTS

Mouse *Tbx1* PCR Analysis

The initial objective was to identify the genotypes of embryos that were *Tbx1* null mutants. By determining these knockout mice, *Pax2* and *Hmx3* expression patterns could be examined to determine if *Tbx1* regulated their spatial or temporal activity. Mice were bred in Het/Het (+/-, +/-) matings to form homozygous mutants (-/-) in Mendelian frequencies. Mice with the homozygous genotype contained mutations that resulted in death during gestation or death shortly after birth with subsequent cannibalization by the mother. Therefore, the DNA for *Tbx1* PCR analysis was extracted from the yolk sacs of developing embryos to ensure that homozygotes were not omitted because of their decreased viability.

The genotypes were analyzed using the protocol previously described in Materials and Methods. Figure 1 details the genotypes of Het/Het (+/-, +/-) offspring. The gel electrophoresis revealed two distinct bands. The upper band represented the wild type allele, while the lower band represented the homozygous allele. From left to right, the genotypes are as follows, heterozygote (+/-), wild type (+/+), heterozygote (+/-), and homozygote (-/-).

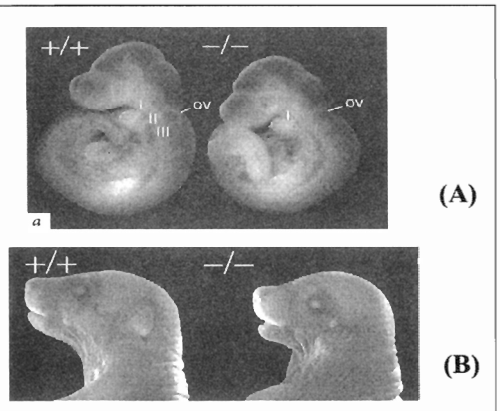
FIGURE 1. Tbx1 PCR results using DNA from mouse embryos (1kb ladder). The first and third wells represented Tbx1 heterozygous (+/-) embryos, the second well denoted wild type (+/+) embryos, and the fourth well characterized a Tbx1 homozygous (-/-) mutant embryo. Tbx1 gel results provided by Jun Liao, graduate student in the Morrow laboratory.



Tbx1 Phenotypic Defects in Null Mutants

In order to evaluate the effect of *Tbx1* deletions on *Pax2* and *Hmx3* activity, we studied the phenotypic characteristics of *Tbx1* expression. *Tbx1* mutations have been shown to cause abnormal development of the ear, thymus, parathyroid glands, and outflow tract anomalies of the heart. Figure 2 displays the effects of a reduction in *Tbx1* gene dosage and the variation in expression patterns that occur in wild type and homozygous mutants (Jerome et al., 2001). The *Tbx1* (-/-) mice are clearly underdeveloped as a result of anomalous pharyngeal arch formation (Figure 2A). The pharyngeal arches are bilaterally symmetrical structures that develop in a segmental fashion along the anterior and posterior axis and are derived from all three embryonic germ layers. The arches ultimately form the pulmonary artery, mature aortic arch, neck muscles, and skeletal structures of the craniofacial organs. Figure 2 specifically highlights the abnormal ear formation of *Tbx1* homozygous mutants. In part A, the otic vesicle, denoted as ov, is malformed in the mutant embryo (E9.5) where the *Tbx1* gene was deleted. In addition, as observed in part B of Figure 2, the size of the ear in the mutant *Tbx1* pup is noticeably smaller than the wild type pup.

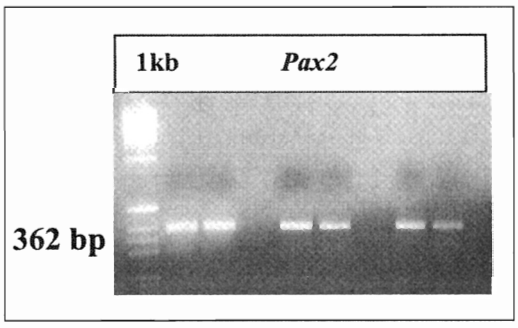
Figure 2. (A) Whole mounts of wild type (+/+) and Tbx1 (-/-) mutants at E9.5. The three pharyngeal arches are represented as I, II, and III, and ov is the otic vesicle. (B) Whole mounts of the external ear defects in neonate pups. Note the malformed ears and smaller cranial size in the homozygous mice (Jerome et al., 2001).



Pax2 PCR Analysis

After the examination of *Tbx1* expression patterns, we initiated steps to analyze *Pax2* activity in knockout embryos. *Pax2* detection in *Tbx1* knockout embryos was achieved by generating probes that would hybridize to their sites of expression in whole mount *in situ* hybridization experiments. *Pax2* expression would be analyzed for comparison in wild type, heterozygous, and homozygous embryos. Amplifying a *Pax2* DNA segment completed the first objective in this process. The gel electrophoresis results of the *Pax2* segment are presented in Figure 3. This 362-bp segment contained *EcoR1* and *BamH1* linkers that were added for cloning into vector pZErO-2.

Figure 3. *Pax2* PCR results using DNA extracted from six wild type mouse tails (1kb ladder).



Hmx3 RNA and RT-PCR Results

In a similar method to *Pax2*, *Hmx3* genes were prepared to amplify a DNA sequence that would be used to hybridize to *Tbx1* embryos. Initially, *Hmx3* was targeted to amplify a genomic segment using mouse-tail DNA. However, the *Hmx3* PCR results were inconclusive because of primers that were not suitable for the specific coding sequence. Therefore, RNA was isolated from wild type embryos and prepared for amplification by RT-PCR. Those results were also indeterminate as a result of an *Hmx3* primer malfunction. The primers were then redesigned to amplify a different non-repetitive sequence, but unfortunately the negative results persisted. The control for this RT-PCR experiment showed positive results, allowing us to conclude that there were problems associated with the amplification of the *Hmx3* gene (results not shown). This may stem from low expression levels of *Hmx3* at the stage of embryonic development selected for RNA isolation. *Hmx3* expression will be further investigated successfully to generate a DNA segment that will be suitable for hybridization to *Tbx1* embryos.

Vector pZErO-2 Insertion

While the *Hmx3* gene was unable to be amplified, the *Pax2* sequence was created successfully and prepared for probe formation. The vector pZErO-2 was selected because colonies form only if the *Pax2* segment is successfully transformed into the vector. The vector will be used in future whole mount *in situ* hybridization studies to observe *Pax2* expression abilities in *Tbx1* wild type, heterozygous, and homozygous embryos.

Discussion

VCFS/DGS is a developmental disorder that is caused by deletions in the region of chromosome 22 that contains the *Tbx1* gene. The other genes located in the deletion have not been identified and may also contribute to the etiology of VCFS/DGS in addition to the null mutation for *Tbx1*. Because the precise genetic basis of VCFS/DGS is unknown, we speculated that other genes, namely *Hmx3* or *Pax2*, were integral to this disorder. We narrowed

our hypothesis to focus on the ear defects present in both humans and mice as a result of microdeletions on their respective chromosomes (16-mice, 22-humans). VCFS/DGS patients commonly suffer from hearing loss caused by low-set ear placement, missing pinnae, or malformation of the middle ear ossicles (Jerome et al., 2001). To investigate the genetic pathway of VCFS/DGS, *Hmx3* and *Pax2* genes were selected because, like *Tbx1*, they encode transcription factors with high levels of expressivity in the mouse ear.

Hmx3 is a gene of ancient origin that is preserved in a variety of species, most notably studied in *Drosophila*. It is a member of the homeobox family of genes that encodes a helix-turn-helix motif that regulates transcription. In mice, *Hmx3* is located on chromosome 7 and is composed of 3 exons and 2 introns (Wang et al., 2000). The *Hmx* gene family is active in the central and peripheral nervous system, uterus, and pharyngeal arch development. Specifically, *Hmx3* deactivation caused infertility in females and inner ear problems that may result in abnormal circling behavior (Wang et al., 2000). This abnormal behavior caused some mice to circle at rates of 176 revolutions per minute in extreme cases. *Hmx3* expression was initially detected at E8.5 (E0.5 plug date) in the mouse otic vesicle and pharyngeal arches (Wang et al., 2000). In previous mouse studies, null mutants for the *Hmx3* gene did not exhibit different external ear traits in comparison to wild type mice (Wang et al., 1998). This indicated that an *Hmx3* deletion does not contribute completely to inner ear defects. For this reason, we hypothesize that during this embryonic stage *Tbx1* may be the instrumental determinant of the spatial and temporal patterns of *Hmx3*.

The second candidate gene in the *Tbx1* regulatory pathway was *Pax2*, a member of the Pax family of genes that function in sensory organ development. *Pax2* expression has been cited in the mid-hindbrain area, eye, and inner ear (Torres et al., 1996). *Pax2* was regionalized to be active in the same area of the inner ear as *Hmx3* and *Tbx1* gene activity. It was also functional during the initial stages of ear development in the ventral half of the otic vesicle (Torres et al., 1996). When *Pax2* was abnormal in mice studies it disrupted the differentiation rates of the auditory section of the inner ear and could contribute to the hearing loss associated with human VCFS/DGS patients.

The intensity and regions of activity for these genes varied with embryonic development stages. *Pax2*, *Hmx3*, and *Tbx1* expression has been delineated in different ear structures in mouse models. The significant information that led us to consider *Tbx1* as the regulatory molecule of *Hmx3* and/or *Pax2* expression was their known sites of activity. For example, *Pax2* contributed to initial cell differentiation of the saccular and vestibular regions of the ear. However, *Pax2* was most essential in the development of the cochlear portions of the ear for auditory ability. It is a principle gene that acted early in ear development and existed in a complementary manner with *Hmx3* in the otic vesicle (Torres et al., 1996). *Hmx3* was focused primarily in the vestibular parts of the ear, an area that formerly showed *Pax2* expression (Wang et al., 1998). Toward the end of mouse embryogenesis (E13.5), *Hmx3* had its strongest expression in the rostrodorsal portion of the vestibular region of the otic vesicle, while *Pax2* was restricted to the cochlear region. A mutation in *Hmx3* disrupted the vestibular portion and was responsible for the circling behavior observed in mice. The variable sites and intensities of expression at different days of gestation for both genes suggested possible regulation by other genes. *Tbx1* may be the candidate gene or one of an aggregate of genes that direct the expression of *Hmx3* and *Pax2* in mouse ear development.

Our attempt to find a common pathway where these genes are active will be completed in the future using whole mount and possibly radioactive *in situ* hybridizations that show their respective expression patterns in mouse embryos. This investigation has initiated some important preliminary steps in

the overall process that will provide information about the *Tbx1* regulatory pathway and its pivotal role in Velocardiofacial syndrome/DiGeorge syndrome.

ACKNOWLEDGEMENTS

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Genotyping the CYP2C19*2 Polymorphism Using Two Novel Techniques Involving Primer Extension

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Abstract

Single nucleotide polymorphisms (SNPs) are base-pair mutations strongly believed to have an impact on drug effects in individuals. The study of pharmacogenomics focuses on genotyping SNP sites of drug metabolizing enzymes, drug targets, and drug receptors in individuals for the purpose of revealing a relationship between certain SNPs and specific drug reactions. There are many existing genotyping techniques, of which primer extension methodology is simple and direct. Here, two techniques utilizing primer extension methodology were evaluated by genotyping the CYP2C19*2 polymorphism of 15 donors. Results from this study indicate that Applied Biosystems's SNaPshot™ ddNTP Primer Extension Kit presents a more robust and reliable genotyping technique than does Pyrosequencing AB's marketed Pyrosequencing™ technology. The SNaPshot™ assay offered reproducible positive results while the Pyrosequencing™ assay indicated the need for extensive primer preparation because of consistently negative results. Evaluations such as this will aid scientists in choosing the most cost-effective, robust, high-throughput technique for genotyping purposes as well as move the study of pharmacogenomics along the path to personalizing medicine.

Introduction

Studies have shown that there are inter-individual differences with respect to all aspects of drug efficacy and toxicity. Some people metabolize certain drugs more slowly than the majority of the population while others may metabolize the same certain drugs faster than most. There is no single reason for this phenomenon, but scientists believe that genetics plays a major role in inter-individual differences, especially since each person is different from one another based on his or her inherited genetic code. From this supposition, the field of "pharmacogenomics" has emerged (Marshall 1997). Pharmacogenomics is the application of large-scale systematic approaches of genomics, to speed the discovery of drug response markers, specifically genetic polymorphisms, whether they act at the level of the drug target, drug metabolism, or disease pathways. It involves "genotyping" an individual for a specific mutation in his or her DNA that may be related to his or her reaction to a certain drug. Pharmacogenomics stems from the study of pharmacogenetics, which is the study of genetic variation underlying differential response to drugs (Kleyn and Vesell 1998), and paves the way to shifting the field of medicine to a more personalized level of health care and drug administration.

Of the genetic polymorphisms that may exist in an individual, the study of pharmacogenomics is directed toward single nucleotide polymorphisms (SNPs). SNPs are single base-pair substitutions. Because they are numerous (SNPs occur about once in every 500 base pairs (bp)), involve only a single variation, and may have an effect on protein products, SNPs are the main focus of genotyping studies (Klyne and Vesell 1998).

Because pharmacogenomics is meant to be "large-scale," it is important to find genotyping methods that are robust enough for high-throughput analysis of SNPs. Primer extension is a genotyping method that permits exact base identity determination of a polymorphic locus without direct sequencing (Applied Biosystems, 2000) and entails the amplification of a specific polymorphic site with subsequent annealing of a primer to a template strand that is extended by the addition of nucleotides. Two techniques utilizing primer extension methodology are SNaPshot™, which is an analysis kit produced by Applied Biosystems, and Pyrosequencing™, which is a technology produced by Pyrosequencing AB.

With the combined use of the SNaPshot™ ddNTP Primer Extension Kit and the ABI Prism® 310 Genetic Analyzer, the identity of a homozygote or heterozygote candidate SNP can be interrogated with the use of capillary electrophoresis. The identity of an SNP is revealed when the 3' terminus of an unlabeled oligonucleotide primer is extended by a single fluorescently labeled dideoxynucleotide triphosphate (ddNTP). This type of primer extension is similar to the methodology behind Sanger Sequencing, which uses ddNTPs as well. ddNTPs are important for this application because they lack the 3' hydroxyl group essential for DNA polymerization. Therefore, the DNA polymerase stops and falls off the template strand each time it incorporates a ddNTP into the sequence. Because the primer is designed to anneal directly adjacent to the variant base of interest and the reaction does not include deoxynucleotide triphosphates (dNTPs), incorporation occurs only at a single site (Applied Biosystems, 2000). GeneScan®, the analysis software used with SNapShot™, identifies the fluorescence, which is recorded by a charge-coupled device (CCD) camera, and represents the intensity as a peak. Homozygotes are identified as single peaks of a specific color while heterozygotes are identified as doublet peaks of two different colors at half the intensity of a homozygote.

Pyrosequencing™ is unique in that it utilizes an enzyme-cascade system to produce light whenever a dNTP is incorporated into the DNA template strand that has the annealed primer upstream of the SNP site (Pyrosequencing AB, 2000). Each time a dNTP is added to the reaction (for each dispensation, an amount enough for five incorporations of the nucleotide is added), pyrophosphate (PPi) is released in a quantity equimolar to the amount of nucleotides incorporated into the strand. ATP sulfurylase quantitatively converts PPi to ATP in the presence of adenosine 5' phosphosulfate, which then drives luciferase to convert luciferin to oxyluciferin. This generates visible light in amounts proportional to the amount of ATP, which is then detected by a CCD camera and seen as a peak in a pyrogram™. Theoretically, each light signal is proportional to the number of nucleotides incorporated, and as the process continues, the complementary DNA strand is built up and the nucleotide sequence is determined from the signal peak in the pyrogram. It is important to note that dNTPs are added one at a time in the presence of apyrase, which degrades each dNTP before the next one is added. Also, deoxyadenosine alpha-thio triphosphate is used instead of dATP since the DNA polymerase efficiently uses it, but it is not recognized by the luciferase (Pyrosequencing AB, 2000). Pyrosequencing™ is an innovative technology that eliminates the need for gels, dyes, and specific labels, allowing for accurate and high-throughput analysis of SNPs under interrogation.

To assess the robustness of these two techniques for genotyping purposes, a polymorphism of the drug-metabolizing enzyme CYP2C19, which is known as the CYP2C19*2 polymorphism, was genotyped using both techniques in a set of 15 human donors. The CYP2C19*2 polymorphism is a G ‡ A mutation occurring at the SmaI restriction site which produces an aberrant splice site and results in a truncated, nonfunctional protein that lacks the heme-binding

region. The aberrantly spliced mRNA lacks the first 40 base pairs of exon 5, which produces a premature stop codon (Goldstein and Blaisdell 1996). Genotyping methods have shown that the genotypes of individuals can be homozygous G (G/G), homozygous A (A/A), or heterozygous (G/A) (Morais and colleagues 1994). In this study, the resulting genotypes called by each technique were compared to the known genotypes of the 15 donors, which had already been characterized by other methods, and the overall robustness of each method was compared in a side-by-side evaluation. Genotyping is an invaluable tool to science, and techniques such as these may soon provide the information doctors need to prescribe the right drug to the right patient. Although it may seem a lengthy task to undertake, performing analyses such as these may provide the answers to reducing drug efficacy liabilities in the future.

MATERIALS AND METHODS

DNA extraction. Genomic DNA was extracted from the whole blood of 15 human donors using the QIAamp™ DNA Blood Mini Kit (Qiagen, Valencia, CA). Two spin columns were used for each donor to extract a total of 400 µL of DNA, which was stored in buffer at -20°C.

Oligonucleotide Primers. Primers to amplify the CYP2C19*2 polymorphism were chosen based on work done by Goldstein and Blaisdell (*Methods Enzymol.* 272: 210-218). The forward primer (5'-CAG AGC TTG GCA TAT TGT ATC-3') was used for both techniques. The reverse primer (5'-GTA AAC ACA CAA CTA GTC AAT G-3') was ordered unmodified for genotyping the SNP site with SNaPshot™, but was ordered HPLC-purified with biotin attached to a spacer arm on the 5' end for genotyping with Pyrosequencing™. The HPLC-purified primer to be used in the extension reactions (5'-CAC TAT CAT TGA TTA TTT CCC-3') involved in both techniques was designed to sit directly upstream of the site of interrogation (SNP site).

*PCR of the CYP2C19*2 Polymorphism.* A similar Master Mix required for the polymerase chain reaction of the CYP2C19*2 polymorphism was used for both techniques. The PCR reagents were included in the GeneAmp™ PCR Reagent Kit (Applied Biosystems, Foster City, CA). For each donor, the following was added to 5µL genomic DNA: 5µL 10X PCR buffer (with 25 mM MgCl2), 4µL dNTP mix (500µM per dNTP), 33.5µL RNase-free water, 0.5µL Taq polymerase (5 U/µL), 1 µL forward primer (from a 10µM working solution), and 1µL reverse primer (from a 10µM working solution) for a total of 50µL for each reaction. The same forward primers were used for both techniques, but the biotinylated reverse primer was used to create PCR products to be used for Pyrosequencing™ while the unmodified reverse primer was used to create PCR products for SNaPshot™. The PCR protocol used for both techniques was similar to that used by Goldstein and Blaisdell. The initial denaturation was carried out at 94°C for 5 minutes, then 37 cycles (45 cycles for Pyrosequencing™) were performed with denaturation at 94°C for 20 seconds, annealing at 53°C for 10 seconds, and extension at 72°C for 10 seconds, and then the products were extended for an additional 7 minutes at 72°C.

SNaPshot Assay. The SNaPshot™ assay required the SNaPshot™ ddNTP Primer Extension Kit (Applied Biosystems, Foster City, CA) and was performed using the ABI Prism® 310 Genetic Analyzer (Applied Biosystems, Foster City, CA) with GeneScan® Analysis Software (Applied Biosystems, Foster City, CA).

Following amplification of the CYP2C19*2 polymorphism, the PCR products were purified using the QIAquick™ PCR Purification Kit (Qiagen, Valencia, CA). Then, using reagents included in the SNaPshot ddNTP Primer Extension Reaction Kit (Applied Biosystems, Foster City, CA), the purified PCR products underwent the primer extension reaction. For each donor, the following was added to 1µL purified PCR product:

5μL SNaPshot™ Ready Reaction Premix, 1μL extension primer (0.15 mM working solution), and 3μL deionized water to make a total of 10μL. For 25 cycles, each tube was run under the following PCR conditions: denaturation at 96°C for 10 seconds, annealing at 50°C for 5 seconds, and extension at 60°C for 30 seconds. To prohibit interference of any unincorporated fluorescently labeled ddNTPs, 1.0 U of calf intestinal phosphatase (CIP) (NEB, Beverly, MA) was added to each donor tube and incubated at 37°C for 1 hour followed by incubation at 72°C for 15 minutes. Prior to running on the Genetic Analyzer, 8μL of formamide, 1μL of sample, and 2μL of GeneScan® -120 LIZ™ size standard (Applied Biosystems, Foster City, CA) were heated at 95°C for 5 minutes. In addition, a no-template control was prepared as all the donor samples were prepared but RNase-free water replaced the volume of template, and a formamide-only control was prepared by mixing 9 μL of formamide and 2μL of size standard prior to heating.

The samples were run according to a modified protocol created for convenience. Although GeneScan® software recommends Performance-Optimized Polymer 4 (POP4™), our samples were run on POP6™. Because of this, the running conditions were altered as well. The injection time was set for 10 seconds, the injection and run voltages were set for 15.0 kV, the run temperature was set for 50°C, and the run time was set for 24 minutes. The analysis was complete in about one day.

Pyrosequencing Assay. According to the standard Pyrosequencing™ protocol (Pyrosequencing AB, Uppsala, Sweden), 15 μL of the biotinylated PCR product was immobilized onto 120μg streptavidin-coated super paramagnetic beads (Dynabeads M280; Dynal, Oslo, Norway) in 25μL 2X binding-washing buffer (10 mM Tris-HCl, 2 M NaCl, 1 mM EDTA, 0.1% Tween 20, pH 7.6) by heating the samples for 30 minutes at 65°C. Following immobilization, the samples were transferred to the first of four Luc96™ plates. The samples were then transferred to a second plate of 50μL 0.5 M NaOH (denaturing agent) for 1 minute. The immobilized strand was washed in a third plate containing 100μL 1X Annealing buffer (20 mM Tris-Acetate, 5 mM MgAc2, pH 7.6). Finally, the immobilized strand was annealed with sequencing (extension) primer in the final plate containing 44 μL 1X Annealing buffer and 1μL primer at 95°C for 2 minutes followed by cooling slowly at room temperature for 10 minutes prior to the Pyrosequencing™ reaction.

To assess any self-interaction of the PCR product, a control was set up as all the donor samples were set up, but was transferred to a well in the final Luc96 plate containing 45 μL 1X Annealing buffer and no sequencing primer. To assess the degree of interaction the primers have with themselves, a sequencing primer alone control and a biotinylated primer alone control were set up by having 2 separate wells containing 44μL 1X Annealing buffer and 1 μL sequencing primer, and 44.1μL 1X Annealing buffer and 0.9μL biotinylated primer (equivalent to the amount used for the PCR reaction) in the final Luc96 plate, respectively. A fourth control, set up similarly to the second and third controls, was the sequencing primer + biotinylated primer control to assess the interaction the two primers may have with each other.

Following sample preparation, the reagent cartridge of the PSQ96™ was filled with enzyme, substrate, and dNTPs according to the Pyrosequencing™ SNP Reagent Kit protocol (Pyrosequencing AB, Uppsala, Sweden). The final Luc96 plate, upon cooling, was placed in the instrument and the run was started. The analysis took approximately 10 minutes to complete.

RESULTS

SNaPshot™ Assay. Each ddNTP present in the SNaPshot™ extension reaction has a specific dye attached to it, which when incorporated into the complementary template strand, fluoresces at particular wavelengths and is recorded as different colored peaks by the data collection software of the Genetic

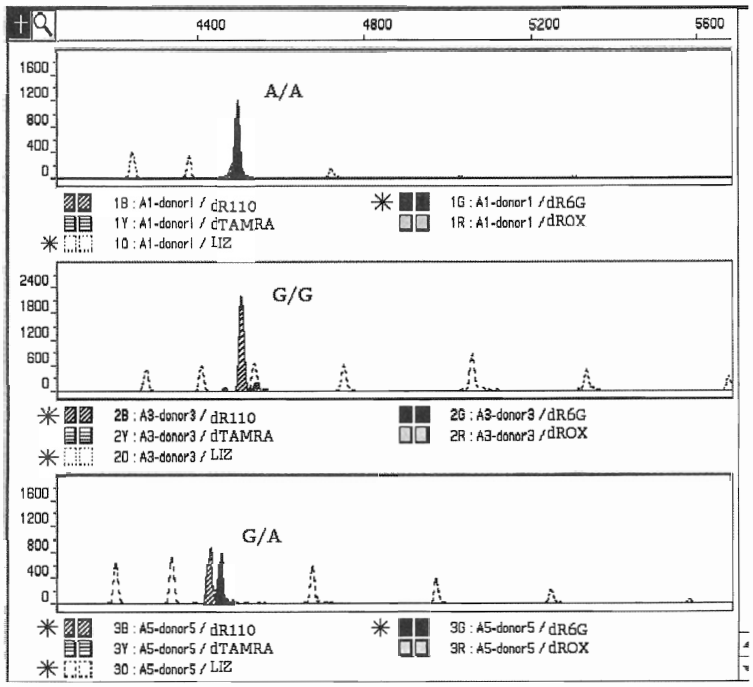
Analyzer. Table 1 represents how the analyzed data presented by the GeneScan® software is displayed. Based on these dye and peak color assignments, all 15 donors were genotyped correctly using the SNaPshot™ assay (Fig. 1). Note that because of publication constraints, the colors associated with the particular dyes have been altered to patterns of black, white, and gray. The results show that the peaks of the samples came off the capillary in the same vicinity and the size standard reveals that the ddNTP incorporation peaks occur between 20 and 25 bp (between the second and third size-standard peaks), which is about the size of the extension primer with extended fluorescently labeled ddNTP. In addition, the no-template control and formamide-only control revealed no considerable background (figures not shown).

Table 1. Dye and peak color assignments for ddNTPs present in extension reaction and size standard run with samples.

ddNTP	Attached Dye	Peak Color
G	dR110	blue
A	dR6G	green
C	dTAMRA	black
T	dROX	red
GS –120 size standard	LIZ	orange

Pyrosequencing™ Assay. Because Pyrosequencing™ involves sequencing by synthesis, a dNTP dispensation order was created based on the sequence of the template strand downstream of the annealed extension (sequencing) primer. The sequence to be analyzed in the PCR product was G/AGGAACCCATAA, where G/A is the SNP site. Based on this sequence, the instrument dispenses the following: A, G, A, C, A, T, A. For ease of representation, the instrument dispenses a C before and after the SNP site. As mentioned before, the instrument dispenses enough of each dNTP for five incorporations at a time and whatever is not incorporated into the template strand is degraded by apyrase. Following the creation of a dispensation order, the instrument displays three theoretical histograms of possible outcomes (one for each genotype). The PSQ96™ decides what to call the genotype of a sample based on the theoretical proportions of the histogram compared to the actual recorded signal peaks of incorporated dNTPs from the reaction (Fig. 2a).

Figure. 1. Analyzed GeneScan® images of three genetically different donors. The top panel represents a homozygous A donor (peak), the middle panel represents the homozygous G donor (peak), and the bottom panel represents a G/A donor (and doublet peak). Note the heterozygous doublet peak is about half the intensity of the single homozygous peaks. The peaks represent the signal of the size standard.



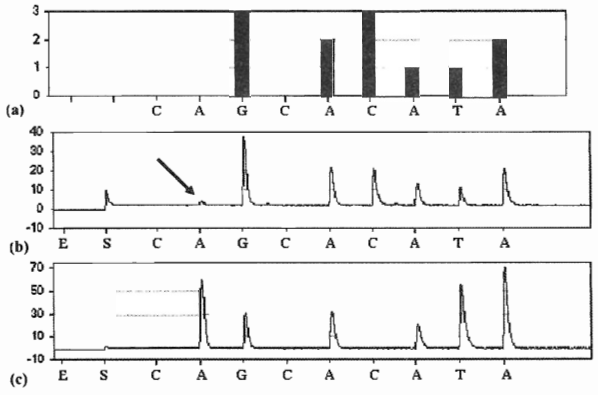


Figure 2. Pyrosequencing. (a) The theoretical histogram of a homozygous G donor. The numbers on the Y-axis correspond to the number of nucleotides incorporated. The letters on the X-axis correspond to the specific dNTP incorporated. (b) The resulting pyrogram™ of a homozygous G donor. The numbers on the side correspond to the intensity of the light signal recorded from the incorporation of each dNTP. The arrow is pointing to a dATP incorporation that should not be present based on the theoretical histogram of a homozygous G donor in (a). (c) Background from the sequencing + biotinylated primers due to secondary structure and/or dimer formation. The strong signal denotes considerable interaction. Note that the pyrogram of the template-only control (not shown) revealed no incorporations of dNTPs.

Following the runs of the 15 donors, it was evident that the PSQ96 was unable to call genotypes of samples correctly with confidence (Fig. 2b). The resulting pyrograms™ of the controls revealed that there was considerable background caused by the formation of secondary structures of primers as well as by primer-dimer formation (Fig. 2c).

Discussion and Conclusions

The combination of Sanger dideoxy sequencing and fluorescent sequencing has made possible SNP detection systems such as the SNaPshot™ ddNTP Primer Extension Kit. The results of the SNaPshot™ method in this case were positive and clear. In Fig. 1, the single black peak of the top electrophoregram represents a homozygous A donor. The peak is actually recorded by the data collection software as green, which is the color that represents the dR6G dye that is attached to the ddATP, as shown in Table 1. Because there is a single peak, this indicates that only ddATP was incorporated into the template strand. The middle electrophoregram of Fig. 1 shows a single striped peak (actually recorded by the data collection software as blue) that represents the signal given off from dR110, the dye attached to ddGTP. Again, because there is only one peak of a single color, only ddGTP was incorporated into the template strand during the SNaPshot™ extension reaction. The doublet striped and black peak in the bottom electrophoregram of Fig. 1 represents a heterozygote donor. There are two colors represented because both ddATP and ddGTP were incorporated into the template strand of the donor DNA. Note that the intensity of the single homozygous peaks range between 1,600 and 2,000 units while the intensity of the heterozygous doublet peak is around 1,000 units. This is roughly half the intensity of the homozygous peaks. This is so because the SNaPshot reaction involves template strands from each chromatid of pairs of chromosomes. Homozygote donors have a single specific ddNTP added to each allele of the chromosome while heterozygote donors have two different ddNTPs added. The peak intensity is split between the two different ddNTPs, which if added together, would equal the intensity of a homozygous peak.

An interesting component to the SNaPshot™ analysis is the size standard. Fig. 1 shows that the black and white dashed peaks of the size standard (actually recorded by the data collection software as orange peaks) are not very consistent. For the GS -120 LIZ™ size standard, there should be nine peaks that represent 15, 20, 25, 35, 50, 62, 80, 110, and 120 base-pair fragments. It is thought that the irreproducibility of the nine peaks occurs because deionized formamide was not used. It is recommended by Applied Biosystems that formamide used for the SNaPshot™ reaction be deionized and aliquoted into screw-top vials and placed in the freezer prior to use. This is suggested because the formamide forms ions that have an effect that decreases the signal strength of the fluorescent dyes during capillary electrophoresis. Although the size standard peaks were not ideal, the overall results were not affected. Note that the size standard reveals

that the peak locations of all donors were consistent and that they were between 20 and 25 bp in length (i.e., between the second and third black and white dashed peaks). This ensures that the reaction worked well and that the ddNTP incorporation in the electrophoregram represents the peak of interest because the primer with extended ddNTP is 22 bp in length. Also, since the size standard peaks present in the electrophoregrams of the no-template control and of the formamide-only control are so large (data not shown), it is assumed that the background noise level of the capillary electrophoresis was not considerable. This is important because it shows that the fluorescent signal peaks were high enough despite the fact that the formamide used was not deionized. In addition, changing the type of polymer used and changing the run conditions did not affect the samples negatively. These results illustrate the flexibility of the genotyping method as a whole.

Pyrosequencing™ is an innovative technology, utilizing an enzyme-substrate reaction to produce visible light for each dNTP incorporation, and except for preparation of the product for analysis, the instrument does all the work. The PSQ96™ is created for high-throughput analysis and even calls the genotypes of all the samples being analyzed based on the theoretical histograms the instrument creates with respect to the sequence being analyzed. In this study, the resulting pyrograms™ (Fig. 2b) seem representative of the theoretical histograms (Fig. 2a) to the observing scientist, but for most attempts, the PSQ96™ could not call the genotypes of the 15 donors correctly with regularity. It became obvious after examining the controls (Fig. 2c) that there was considerable background that the instrument could not make sense of.

Theoretically, the pyrogram™ of a homozygous G donor (Fig. 2b) should look like the histogram for the homozygous G donor (Fig. 2a) produced by the computer. As previously mentioned, the sequence to be analyzed was G/AGGAACCCATAA, where G/A is the SNP site. In Fig. 2a, since the Y-axis represents the number of nucleotides added and the X-axis represents the specific dNTP added over time, it is evident that for a homozygous G donor, three dGTPs should be incorporated first (one for the SNP site and two following the SNP site), then two dATPs should be incorporated, then three dCTPs, then one dATP, then one dTTP, and finally two dATPs should be incorporated in the reaction. The heights of the bars for each dNTP incorporated reflect these proportions of nucleotides added (3G:2A:3C:1A:1T:2A). Note that the instrument dispenses one dCTP before and after the SNP site so that the SNP site is set off from the rest of the sequence for ease of visibility. The resulting peaks in the pyrogram of the homozygous G donor (Fig. 2b) were seemingly similar in proportion to the bars of the theoretical histogram in Fig. 2a, but it is clear that there was a minor incorporation of dATP prior to the dGTP incorporation (arrow in Fig. 2b). It is possible that the PSQ96™ recognized the dATP incorporation and could not call the donor a homozygous G since there should be no dATPs incorporated. Similarly, the theoretical histograms of the homozygous A donor, with an incorporation scheme of 1A:2G:2A:3C:1A:1T:2A, and of the heterozygote G/A donor, with an incorporation scheme of 1/2A:21/2G:2A:3C:1A:1T:2A, were not accurately represented by the resulting pyrograms either (data not shown). For both instances, it is evident that the height of the first A peak was very high. Again, it is believed that the PSQ96™ could not call the genotypes of these donors correctly because of the extraneous peak for the dATP incorporation.

It is recommended by Pyrosequencing AB that controls be run to assess any background-level interaction that could interfere with the reaction. It is a considerable concern because Pyrosequencing™ is a reaction that adds substrate and enzyme that can incorporate dispensed dNTPs into any template.

Because strands may hybridize even if the sequence of each is not identical, there is the possibility of unwanted secondary structures forming that can serve as templates for the reaction in addition to the primary template of concern. Based on the control reactions run, it is obvious that secondary structures did form because the background level is considerably high.

The template-only control revealed no incorporations since the baseline was relatively flat, which indicated that there were no secondary structures formed with respect to the template folding up on itself (data not shown). Both runs of the sequencing primer alone and of the biotinylated primer alone revealed that dNTPs were incorporated, since minor peaks were evident when dNTPs were added to the reaction (data not shown). Because a template is required in order for dNTPs to be incorporated and because these primer controls were run without any donor template, these resulting pyrograms indicate that each primer either folded up on itself or formed primer-dimers to reveal a template suitable for dNTP incorporation. (Fig. 2c) indicates that the biotinylated primer and the sequencing primer together contributed considerable interaction since the signal intensity is even higher than that of the runs of any of the donors. Because the PSQ96™ could not call the bases correctly for the majority of the donors, it is suspected that there were leftover primers that did not anneal to the template strand and instead annealed to each other to some extent to present interactions considerable enough to affect the analysis.

Based on the results from the controls, many attempts were made to decrease the chance of considerable background so that the PSQ96™ could call the genotypes, but nothing was successful. For one set of runs, less sequencing primer was used and pyrograms of a single donor template combined with a range of varying amounts of sequencing primer were compared. There was no considerable change in results and it was concluded that 1µL of sequencing primer was ideal. In another set of runs, more template was used with the hopes that increasing the template would maximize the primer-template interactions and therefore minimize the primer-primer interactions. Using 1µL of sequencing primer, a range of the amount of a single donor's template used was compared. Again, there was no considerable change in results, and it was concluded that 15µL of template were appropriate. A set of donors was run through the PCR using less biotinylated primer, but the PSQ96™ still could not call the genotypes correctly. The cooling time for annealing the sequencing primer was increased to 20 minutes for another set of donors, but again, there was no considerable change in the results.

The difficulties encountered during the Pyrosequencing™ analysis were discouraging because it became obvious that a lot of planning was required in order to have the PSQ96™ work properly. It also made the SNaPshot™ ddNTP Primer Extension Kit look very attractive to the average scientist looking for useful genotyping methods. Since SNaPshot™ could work consistently and repeatedly with the same SNP site used in the Pyrosequencing™ assay, there was no question as to which one is better. This study clearly questions the robustness of Pyrosequencing™, especially since there is always a chance of primer-primer interactions and other secondary formations. For high-throughput purposes, this study revealed that SNaPshot™ is a good investment, but both have their limitations. Table 2 presents a list of some of the advantages and disadvantages of both techniques based on this study. It should be noted that the disadvantages of SNaPshot™ are not difficult to overcome thanks to the products offered by Applied Biosystems.

Table 2. Side-by-side comparison of the SNaPshot and Pyrosequencing techniques.

	SNaPshot™	Pyrosequencing™
Pros	Single NTP incorporation	96 well high-throughput format
	Dye-specific labeling	Minimal sample handling
	Reproducible results	PSQ96™ run time ~10 minutes
Cons	Extensive sample handling	Primer optimization critical
	Time-consuming purification steps	Analysis dependent on quantitative signal
	ABI Prism 310 run time ~1 day	Incorporation of multiple bases

For instance, in this study, QIAquick™ spin columns were used to purify the initial PCR product, but it is optional to use shrimp alkaline phosphatase (SAP) instead. Using SAP is simpler and avoids some of the extensive sample handling encountered using SNaPshot™. Also, the ABI Prism® 310 is not an instrument created for the highest throughput analysis, but the ABI Prism 3700 is and runs similarly to the 310. ABI Prism offers software to accompany the GeneScan® software program, called Genotyper®, which calls the genotypes of representative peaks as well, which would be helpful if time spent viewing results is a concern.

Many people believe that pharmacogenomics constitutes the strategic plan required for achieving certainty regarding target selection, compound selection, and clinical trial performance (Pettipher and Holford 2000). If genotyping an individual SNP site is the first step in the realization of personalizing medicine, then optimizing clinical trials better to characterize drug interactions is the next step. For instance, knowing which SNPs are present in the patient population allows researchers to select better drug candidates. Selecting better drug candidates in turn reduces the risk of trial failure. A reduced risk in trial failure means that there are more data available for the purpose of compiling information on the relationships between SNPs and drug interactions. More available data for compilation can significantly speed the results of a clinical trial, shortening the time needed for a useful drug to reach the public. While this chain of events will constitute an enormous breakthrough in public health, scientists are only just beginning the research necessary to achieve it.

Pharmacogenomics holds much promise, but to achieve the dream of scientists and doctors to tailor medications to patients' genetic make-up will require enormous amounts of research and time. Genetic polymorphisms, such as SNPs, that exist in DNA are numerous and with so many to characterize within the human genome, large-scale genotyping is crucial to the identification of the genetic make-ups that underlie individual variations in drug responses (Shi, 2001). It is important to understand that the overall pharmacological effects of medications are determined by the interplay of several genes encoding proteins involved in multiple pathways of drug metabolism, disposition, and effects—not just by a monogenic trait (Evans and Relling 1999). This further emphasizes the magnitude of the task at hand and the value of high-throughput analysis.

The SNaPshot™ ddNTP Primer Extension Kit and Pyrosequencing™ technology are only two of many possible techniques employed by scientists to identify SNPs. Both utilize primer extension methodology and allele-specific nucleotide incorporation—two very popular SNP genotyping methods. SNaPshot™ and Pyrosequencing™ may not be the most ideal for ultra-high-throughput analysis (for which there are better existing methods), but both prove useful for in-house genotyping analysis at pharmaceutical companies evaluating the effect of their own compounds on patients. Although it was concluded from this study that SNaPshot™ was a more robust genotyping method, it should be noted that Pyrosequencing™ was also a useful genotyping method. This study shows that a scientist must be open but critical of the type of genotyping method he or she utilizes. The scientist should, above all, be aware that the success of pharmacogenomics depends on user-friendly technologies that can detect polymorphisms rapidly, accurately, and cost-effectively on a large-scale basis.

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On a Flawed Sample Size Formula in the Hazardous Materials Laboratory User's Manual

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Abstract

The Hazardous Materials Laboratory, located in Berkeley, California, has published a User's Manual to help instruct its employees. This lab is responsible for testing the ground, water, and air for high concentrations of contaminants, and the employees rely on this manual to assist them in the testing process. However, one of the formulas used in the manual is flawed. This formula is designed to calculate the sample size needed to make an accurate measure of contamination. Yet, a problem occurs in the laboratory's formula because it uses a denominator containing a random variable. This random variable will inevitably take on different values, which will produce erratic results and possibly incorrect numbers for sample size. Such erratic results are depicted in this paper in computer simulations and graphs produced using the statistical analysis package SAS. In addition, SAS was used to compare the behaviors of the standard sample-size formula and the formula used in the California Hazardous Materials Laboratory. To go beyond simulation, the probability density functions involved in both the laboratory's formula and the proven one were analyzed mathematically, showing the profound difference between the flawed equation and the standard one.

Introduction

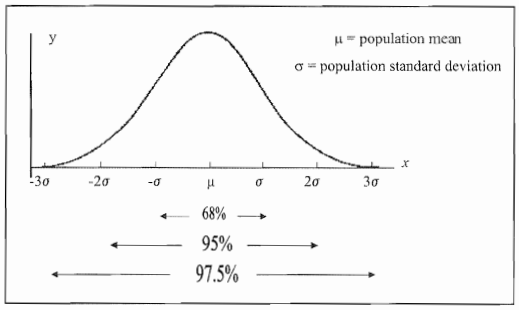
Mathematics and statistics are essential to the formation of accurate data collections, analyses, and conclusions. The Hazardous Materials Laboratory in Berkeley, California, for example, uses such tools for these purposes. The lab is part of the California Department of Toxic Substance Control, and its functions include testing water, ground, and air samples for levels of toxicity. To conduct these tests, the laboratory has published a User's Manual to provide instructional documentation for its employees. Not surprisingly, the processes used for calculating levels of contamination must be precise and reliable, so the Hazardous Materials Laboratory relies on statistical distributions and equations for the testing of field samples.

This manual contains several formulas that are used for different types of analyses. Upon further examination of the manual, however, it was found that the specific formula used for sample size, $n_{odd} = \frac{t^2 s^2}{(RT - \bar{x})^2}$, is flawed. This formula is used to find the sample size needed to make an accurate measure of contamination. However, the flaw lies within the denominator of this formula because it contains a random variable, namely $\bar{x}$. This random variable can be represented by different values, which can sometimes produce erratic and possibly wrong numbers for sample size.

In order to see where this flawed formula originated, some information about the statistical distribution used may be helpful. In this User's Manual, the lab relies on a model of the normal curve as a basis for its analyses and possible contaminant clean-up recommendations. An example of a typical

normal curve used by the laboratory is depicted here.

Fig. 1: A normal curve with mean μ and standard deviation σ. The curve shows the percentage of data contained from one point to another.



In this curve the mean, or average, is represented by μ. The standard deviation, or σ, is represented by the distance between each vertical mark on the x-axis. This normal distribution demonstrates that for all samples tested, the largest percentage of all the results falls near the average.

Let $X_1, X_2, ..., X_k$ be a simple random sample from a Normal (μ, σ) population, and let $\bar{x} = \frac{1}{n}\sum_{i=1}^{n} x_i$, where n is the sample size and $\bar{x}$ is the mean of the sample.

Lemma 1. $\bar{x}$ is Normal $\left(\mu, \frac{\sigma}{\sqrt{n}}\right)$.
For example,

$$95\% \cong P\left[-z \le \frac{\bar{x}-\mu}{\sigma/\sqrt{n}} \le z\right], \quad z = 1.96 \approx 2.$$

Application. How large a sample do we need so that with a 95% chance, $|\bar{x}-\mu| \le m$? Here, m is the margin of error that we can tolerate.

Solution.

$$95\% \cong P\left[-z \le \frac{\bar{x}-\mu}{\sigma/\sqrt{n}} \le z\right], \quad z = 1.96 \approx 2.$$

$$= P\left[\frac{-z\sigma}{\sqrt{n}} \le \bar{x}-\mu \le \frac{z\sigma}{\sqrt{n}}\right]$$

So, $m = z\frac{\sigma}{\sqrt{n}}$, and $n = \frac{z^2\sigma^2}{m^2}$.

In practice, we do not know σ, so we need a preliminary sample $\{x_1, x_2, ..., x_{n_0}\}$ to calculate standard deviation s, where

$$s = \sqrt{\frac{1}{n_0}\sum_{i=1}^{n_0}\left(x_i - \bar{x}\right)^2}.$$

Usually the preliminary sample size is small, and $\frac{\bar{x}-\mu}{s/\sqrt{n_0}}$ has a *t*-distribution with degrees of freedom, denoted *df*, equal to n_0-1. Here, a *t*-curve is similar to a *z*-curve, but the *t*-curve has a larger spread. Thus, the standard equation for sample size *n*, is

$$n_{\text{standard}} = \frac{t^2 s^2}{m^2},$$

where *t* is a constant derived from the *t*-curve and selected by the Hazardous Materials Laboratory according to the lab's desired accuracy in the sample size.

In the Hazardous Materials Laboratory's User's Manual, the denominator in the formula for sample size is different:

$$n_{odd} = \frac{t^2 s^2}{\left(RT - \bar{x}\right)^2},$$

where *RT* is the Regulatory Threshold, which is the value that represents the limit of tolerable contamination levels. This value is not to be exceeded in contamination levels for the sample area to be considered safe.

The user's manual that is being discussed, the 11th edition published in 1999, is the most current version. In fact, the document uses this formula for finding sample sizes in three separate places in the text. It also uses a similar equation, $n_{odd-2} = \frac{t^2 s^2}{\left(\bar{X} - \bar{Y}\right)^2}$, for a two-population comparison. Though we did not study this formula, we believe that this one is also flawed for the same reason: the denominator contains random variables, which by definition are subject to change values.

To demonstrate the erratic results in the Hazardous Materials Laboratory's formula, we would like to incorporate one specific example for n_{odd} in the manual in which *RT* = 100, *k* = the preliminary sample size = 5, $\bar{x}$ = 95, s = 8, and t = 1.533 for 80%

probability (instead of 95%). Therefore,

$$n_{odd} = \frac{(1.533)^2(8)^2}{(100-95)^2} \cong 6.016 \approx 6.$$

However, recall that $\bar{x}$ is a random variable. If $\bar{x}$ is too close to the value of *RT*, then the denominator will be a very small number. This will result in the sample size being quite large. In SAS, simulations performed using this n_{odd} formula found numbers for sample size sometimes to be as large as 248, 573, 3156, and even 31,697. By contrast, SAS simulations of $n_{standard}$ calculated sample size usually to be about 3-9 samples, and sometimes being as large as 15-20 samples.

Fig. 2.0: SAS simulation that produced a vertical bar graph of values for sample size nst.

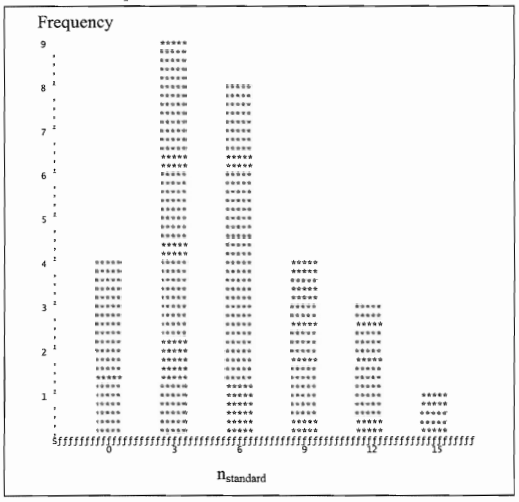


Fig. 2.1: SAS simulation that produced a vertical bar graph of values for sample size nodd. Some of these values reach as high as 3,156 and 31.697 samples.

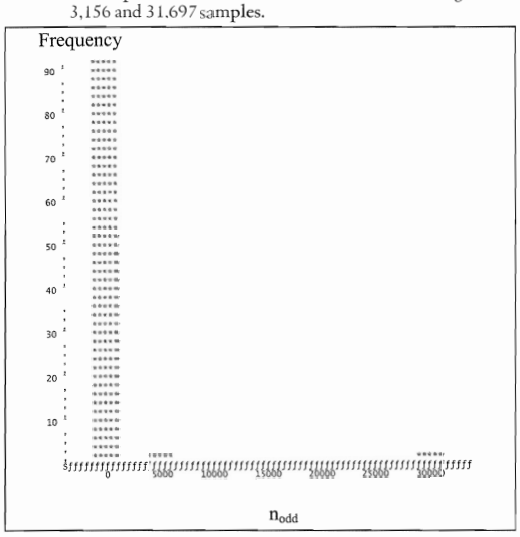


Fig. 2.2: SAS simulation that produced a vertical bar graph of values for sample size n_{odd}. In order to get a more precise look at the values for n_{odd}, all values above sample size 500 were truncated.

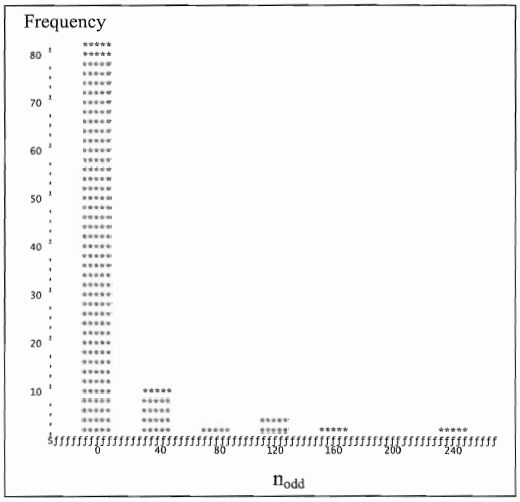
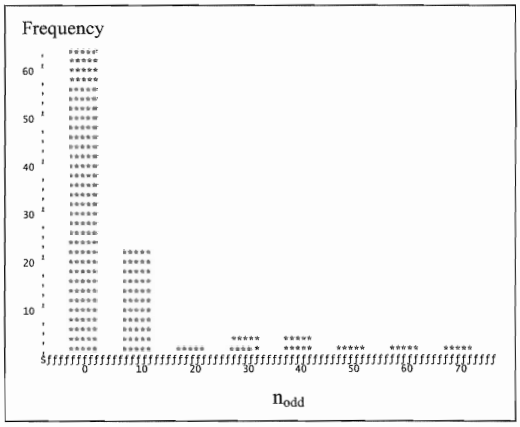


Fig. 2.3: SAS simulation that produced a vertical bar graph of values for sample size n_{odd}. In order to make an even closer examination of the sample size numbers generated, all values above 100 were truncated.



In this project, we also tried to investigate the mathematical properties of $n_{standard}$ and n_{odd}. Let's first focus on the standard formula for sample size.

Definition 1. If $Z_1, Z_2, \ldots, Z_{n_0}$ are independent random variables with a Normal (μ, σ) distribution, then $z_1^2 + z_2^2 + \ldots + z_{n_0}^2$ is called a $\bar{x}$ random variable with degrees of freedom $= n_0$.

We can then modify this definition of a x^2 random variable to help us in our specific case.

Lemma 2. $\sum_{i=1}^{n_0}\left(\frac{x_i-\bar{x}}{\sigma}\right)^2$ has a χ^2 distribution with degrees of freedom $=n_0-1$.

Recall, . $s=\sqrt{\frac{1}{n_0-1}\sum_{i=1}^{n_0}\left(x_i-\bar{x}\right)^2}$

Therefore, $s^2=\frac{1}{n_0-1}\sum_{i=1}^{n_0}\left(x_i-\bar{x}\right)^2$,

and $\sum_{i=1}^{n_0}\left(\frac{x_i-\bar{x}}{\sigma}\right)^2=\frac{(n_0-1)s^2}{\sigma^2}$.

This shows us that $s^2=c\chi^2$ and the degrees of freedom $=n_0-1$, where c is a constant.

Next, we can express $n_{standard}$ as a product of a χ^2 and a constant.

$$n_{st}=\frac{t^2s^2}{m^2}=\left(\frac{t^2}{m^2}\right)\left(\frac{\sigma^2}{n_0-1}\right)\left(\frac{(n_0-1)s^2}{\sigma^2}\right)=\left(\frac{t^2\sigma^2}{m^2(n_0-1)}\right)\cdot\chi^2$$

Example. From the Hazardous Materials Laboratory User's Manual, we extracted values such that $t=1.533$, $m=5$, and $\sigma=8$ to yield

$$n_{st}=\frac{(1.533)^2(8)^2}{(5)^2(4)}\chi^2=1.5\chi^2 .$$

Now, let's focus on the Hazardous Materials Laboratory's equation, $n_{odd}=\frac{t^2s^2}{\left(100-\bar{x}\right)^2}$.

Definition 2. If Y is Normal (μ,σ), then $\left(\frac{Y}{\sigma}\right)^2$ is a non-central χ^2, with degrees of freedom = 1, and non-central parameter $=\lambda=\frac{\mu^2}{2\sigma^2}$. If $\mu=0$, then $\lambda=0$, and $\left(\frac{Y}{\sigma}\right)^2$ is an ordinary χ^2 with degrees of freedom = 1.

Example. Again from the Hazardous Materials Laboratory's example, $\mu=95$, hence $\left(100-\bar{x}\right)\approx N\left(5,\frac{\sigma}{\sqrt{n_0}}\right)$,

and $\left(\frac{100-\bar{x}}{\sigma/\sqrt{n}}\right)^2$ is χ^2, degree of freedom = 1,

and non-central parameter $=\lambda=$

$$\frac{\mu^2}{2\sigma^2/n}=\frac{125}{128}\cong .977.$$

Now to begin showing precisely where the flaw in the lab's equation lies, we will use proven statistical rules and distributions, in addition to some calculus.

Lemma 3. s^2 and $\bar{x}$ are independent.

Definition 3. Let U_1 be χ^2, $df=n_1$, $\lambda_1>0$, and let U_2 be χ^2, $df=n_2$, $\lambda_2=0$.

If U_1 and U_2 are independent, then $F=\frac{U_1/n_1}{U_2/n_2}$ has an F-distribution with degrees of freedom $=(n_1, n_2)$, and non-central parameter λ_1.

Remark. $n_{odd}=c\cdot\frac{U_2/n_2}{U_1/n_1}\neq$ traditional non-central F.

Let's examine the mathematical formulation for n_{odd}, which does not have a traditional non-central F-distribution. In a traditional distribution, a non-central χ^2 is used for the numerator, and then a central χ^2 is used for the denominator. However, in this case, the F-distribution has a non-central χ^2 in the denominator, and a central χ^2 in the numerator.

Lemma 4. The probability density function of a Non-Central Chi-Square random variable is

$$\chi^2(u:n;\lambda)=\sum_{j=0}^{\infty}\left(\frac{e^{-\lambda}\lambda^j}{j!}\right)\left(\frac{u^{(n+2j-2)/2}\cdot e^{-u/2}}{\Gamma\left(\frac{n+2j}{2}\right)\cdot 2^{(2j+n)/2}}\right)$$

for $u>0$.

If $\lambda=0$, then the Chi-Square distribution becomes centralized, and for which the probability density function is given by

$$f_{U_1}(u_1)=\frac{u_1^{(n_1-2)/2}\cdot e^{-u_1/2}}{\Gamma\left(\frac{n_1}{2}\right)\cdot 2^{n_1/2}}.$$

When $\lambda>0$, we have a non-central Chi-Square distribution given by

$$f_{U_2}(u_2)=\sum_{j=0}^{\infty}\left(\frac{e^{-\lambda}\lambda^j\cdot u_2^{(n_2+2j-2)/2}\cdot e^{-u_2/2}}{j!\,\Gamma\left(\frac{n_2+2j}{2}\right)\cdot 2^{(2j+n_2)/2}}\right).$$

The graphs of these functions are shown below.

Fig.3.0: A central Chi-Square distribution.

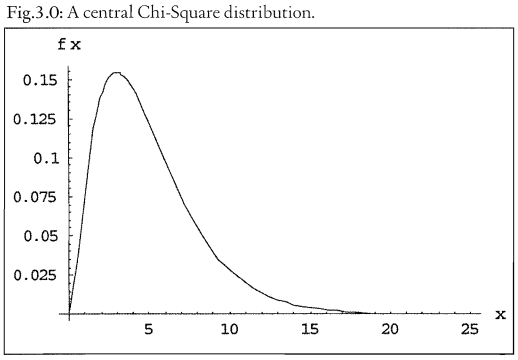


Fig.3.1: A non-central Chi-Square distribution.

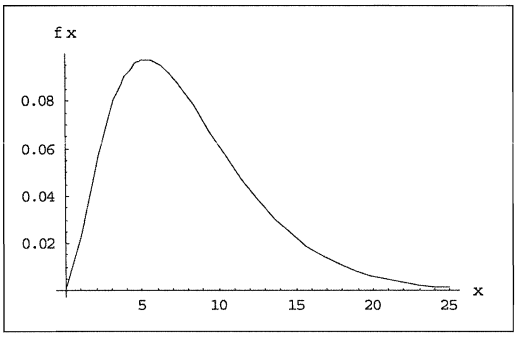
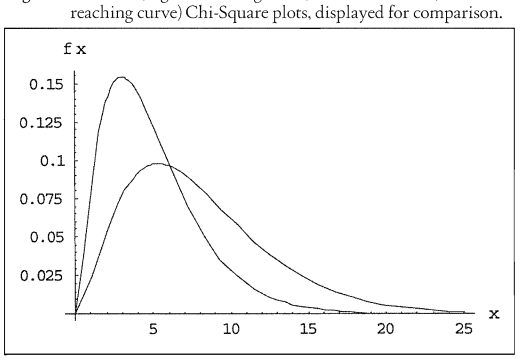


Fig. 3.2: A central (higher-reaching curve) and non-central (lower-reaching curve) Chi-Square plots, displayed for comparison.



Theorem 1.

Let $w = \dfrac{\chi^2(\lambda_1 = 0, df = n_1)/n_1}{\chi^2(\lambda_2 > 0, df = n_2)/n_2}$, and $f_W(w) =$ probability density function of w.

Then $$f_W(w) = \sum_{j=0}^{\infty}\left(\frac{e^{-\lambda}\lambda^j \cdot \left(\frac{n_1}{n_2}\right)^{n_1/2} \Gamma\left(\frac{n_1+n_2+2j}{2}\right) w^{(n_1-2)/2}}{j!\left(1+\frac{n_1 w}{n}\right)^{(n_1+n_2+2j)/2} \Gamma\left(\frac{n_1}{2}\right)\cdot\Gamma\left(\frac{2j+n_2}{2}\right)}\right).$$

Proof. Since U_1 and U_2 are independent, their joint Probability Density Functions equal the product of their marginal Probability Density Functions, so by multiplying them together, we obtain the joint density of U_1 and U_2:

$$f_{U_1,U_2}(u_1,u_2) = \frac{u_1^{(n_1-2)/2}\cdot e^{-u_1/2}}{\Gamma\left(\frac{n_1}{2}\right)\cdot 2^{n_1/2}} \cdot \sum_{j=0}^{\infty}\left(\frac{e^{-\lambda}\lambda^j \cdot u_2^{(n_2+2j-2)/2}\cdot e^{-u_2/2}}{j!\,\Gamma\left(\frac{n_2+2j}{2}\right)\cdot 2^{(2j+n_2)/2}}\right)$$

Now we make a transformation from u_1 and u_2 to w and z.

$$w = \frac{u_1/n_1}{u_2/n_2} = \frac{u_1 n_2}{u_2 n_2}, \quad z = u_1$$

Then $f_{W,Z}(w,z) = f_{U_1,U_2}(u_1,u_2)\cdot|J|$, where J is the Jacobian of the transformation. Note that it is easier to find

$$J^{-1} = \begin{vmatrix} \frac{\partial w}{\partial u_1} & \frac{\partial z}{\partial u_1} \\ \frac{\partial w}{\partial u_2} & \frac{\partial z}{\partial u_2} \end{vmatrix} = \frac{u_1 n_1}{u_2^2 n_1} .$$

Hence, $J = \dfrac{u_2^2 n_1}{u_1 n_2} = \dfrac{z n_2}{w^2 n_1}$.

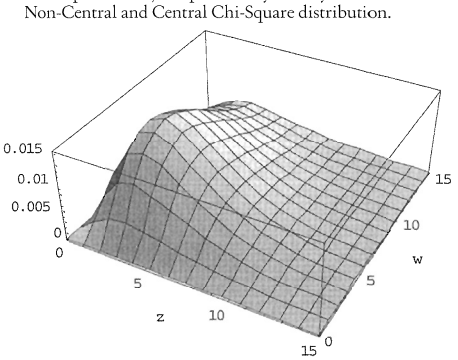
Then by substitution into $f_{U_1,U_2}(u_1,u_2)$, we find that the joint density for w and z is

$$\sum_{j=0}^{\infty} C_j \left(\frac{z}{w}\right)^{(n_2+2j-2)/2} \cdot z^{(n_1-2)/2} \cdot \left(\frac{z}{w^2}\right)\cdot e^{\left(\frac{-n_2 z}{2n_1 w}-\frac{z}{2}\right)},$$

where $$C_j = \frac{e^{-\lambda}\lambda^j \left(\frac{n_2}{n_1}\right)^{(n_2+2j)/2}}{j!\,2^{(n_1+n_2+2j)/2}\Gamma\left(\frac{n_1}{2}\right)\Gamma\left(\frac{2j+n_2}{2}\right)} .$$

The three-dimensional joint density plot is depicted below.

Fig. 4: A 3-D plot of the joint probability density functions of a Non-Central and Central Chi-Square distribution.



Now we integrate with respect to z to find the density for w:

$$f_{II}(w) = \sum_{j=0}^{\infty} \frac{e^{-\lambda}\lambda^j \left(\frac{n_2}{n_1}\right)^{(n_2+2j)/2} \Gamma\left(\frac{n_1+n_2+2j}{2}\right)}{j!\,2^{(n_2-n_1+2j)/2}\cdot\Gamma\left(\frac{n_1}{2}\right)\Gamma\left(\frac{2j+n_2}{2}\right)\cdot w^{(n_2+2j-2)/2}\left(\frac{n_2}{2n_1 w}+\frac{1}{2}\right)^{(n_1+n_2-2j)/2}}.$$

We can then simplify this equation and obtain the density function in Theorem 1.

Lemma 5. If Y = cX, then

$$f_Y(y) = f_X(x)\left|\frac{dx}{dy}\right| = \left|\frac{1}{c}\right| f_X\left(\frac{Y}{c}\right), \text{ where}$$

$$\begin{cases} f_Y(y) = \textit{density of } Y, \\ f_X(x) = \textit{density of } X. \end{cases}$$

Main Theorem.

Let $f_{st}(x)$ = density function of n_{st},

and let $f_{odd}(x)$ = density of n_{odd}.

Then

$$f_{st}(y) = \frac{m^2(n_0-1)\left(\frac{y}{c_1}\right)^{(n_1-2)/2}\cdot e^{-\left(\frac{y}{c_1}\right)/2}}{t^2\sigma^2 \qquad \Gamma\left(\frac{n_1}{2}\right)\cdot 2^{n_1/2}},$$

where $c_1 = \dfrac{t^2\sigma^2}{m^2(n_0-1)}$, and

$$f_{odd}(y) = \frac{1}{n_2 t^2}\sum_{j=0}^{\infty} \frac{e^{-\lambda}\lambda^j \left(\frac{n_1}{n_2}\right)^{n_1/2}\Gamma\left(\frac{n_1+n_2+2j}{2}\right)\cdot\left(\frac{y}{c_2}\right)^{(n_1-2)/2}}{j!\left(1+\frac{n_1 y}{c_2 n_2}\right)^{(n_1+n_2+2j)/2}\Gamma\left(\frac{n_1}{2}\right)\Gamma\left(\frac{2j+n_2}{2}\right)},$$

where $c_2 = n_2 t^2$.

Proof. By Lemma 5, Theorem 1, and Lemma 4.

Example. If $n_O = 5$, then

$$n_{odd} = t_\alpha^2 \cdot \frac{s^2 \cdot 4/\sigma^2}{\left(4/\sigma^2\right)\frac{(100-\bar{x})^2}{\sigma^2/5}\cdot\frac{\sigma^2}{5}}$$

$$\Rightarrow n_{odd} = \frac{5}{4}t_\alpha^2 \cdot \frac{\chi^2(4;\lambda_1=0)}{\chi^2(1;\lambda_2=.977)}\cdot\frac{4}{1}$$

$$n_{odd} = 5t^2 \cdot F(df=(4,1),\lambda_1=0,\lambda_2=.977) = 11.75F.$$

In short, .

$$f_{\text{standard}}(y) = \frac{1}{1.5} f_{\chi^2}\left(\frac{y}{1.5}\right),$$

and $f_{\text{standard}}(y) = \dfrac{1}{1.5} f_{\chi^2}\left(\dfrac{y}{1.5}\right)$, .

For $n = 5, s = 8, t = 1.533$, and $m = 5$, the following graphs resulted.

Fig. 5.0: The plot of $y = f_{standard}$, which is the density function of the sample size using the standard formula.

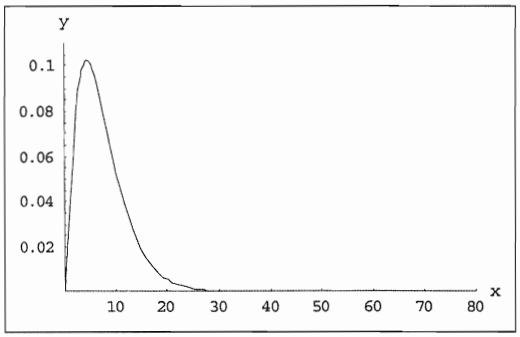


Fig. 5.1: The plot of $y = f_{odd}$, which is the density function of the sample size using the formula from the Hazardous Materials Laboratory

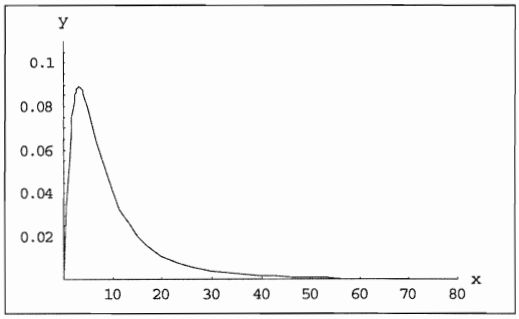


Fig. 5.2: $f_{standard}$ (steeper curve) and fodd (lower curve), displayed for comparison.

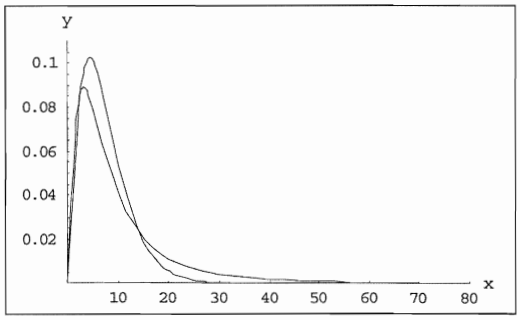


Figure 6: Table of probabilities for $n_{standard}$ and n_{odd}. For $n_{standard}$, the probability of a sample size of 60 or above occurring is virtually 0.

Probability that $n_{standard}$ is...		Probability that n_{odd} is...	
Greater than 20	2.04 %	Greater than 20	13.43 %
Greater than 30	.12 %	Greater than 30	6.47 %
Greater than 40	.0066 %	Greater than 40	3.65 %
Greater than 60	0	Greater than 60	1.54 %
Greater than 100	0	Greater than 100	.48 %
Greater than 200	0	Greater than 200	.093 %

From Figure 6, the probability density curves of $f_{standard}$ and f_{odd} look similar, but the right tail probabilities are indeed very different. For example, $P[n_{standard} > 40] = 0.0066\% \cong 0$, while

$P[n_{odd} > 40] \cong 3.65\%$, $P[n_{odd} > 100] \cong 0.5\%$,

and $P[n_{odd} > 200] \cong 0.1\%$.

CONCLUDING REMARKS

The way that we approached the testing of the manual's flawed equation is not the only way to investigate this problem. The standard sample size formula, $n_{\text{standard}} = \frac{t^2 s^2}{m^2}$, is used in the interval estimation of μ. In the California Hazardous Materials Laboratory case, one may want to consider

$H_o : \mu \geq 100$. *Reject* $H_o \Leftrightarrow \bar{x} \geq c$

to control the probabilities of Type I and Type II errors in the determination of the sample size. This concept just demonstrates another way to examine the Hazardous Materials Laboratory's formula and how it should be adjusted.

Mathematics and statistics have many practical applications, such as this case involving the Hazardous Materials Laboratory User's Manual. Not only is it essential to use mathematics in these applications, but it is also necessary to use correct and precise calculations. The Hazardous Materials Laboratory uses formulas that are erratic and require change to make them dependable and employable. In particular, we showed that the equation the laboratory uses for sample size produces some very strange, impractical, and potentially costly numbers. To be cost-efficient and more accurate in their testing, the laboratory needs to adjust the denominator of their equation for sample size from a varying quantity to a stabilized, predetermined margin of error. This margin of error will rid the testing of inaccurate results. It will allow scientists conducting the test to know how much contamination is allowable at a site without solely relying on the average toxicity of preliminary samples. Furthermore, a fixed margin of error would tie the Hazardous Materials Laboratory's equation to an already proven mathematical theorem for computing sample size. The Hazardous Materials Laboratory should alter its sample size formula to save money and to obtain better results.

Conference Proceedings

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

Jacqueline Dioh-Eko
The College of New Jersey Graduate Programs in Education, Johannesburg, South Africa (Ruth J. Palmer, Faculty Adviser)

Creating a Classroom Culture of Caring, Responsibility, and Self-Motivated Learning in the Middle-Level Grades at the American School of Douala, Cameroon
Presented at the Association for International Schools in Africa (AISA) Southern Africa Teachers' Conference, Johannesburg, South Africa, October 10-13, 2002

The purpose of this ethnographic study was to document and analyse the process of establishing and maintaining a culture of respect, caring, responsibility, self-discipline, and active learning. More specifically, this study focused on the teacher-student collaborative process of designing rules that acknowledged the classroom as a place for constructing knowledge and establishing mutual respect. In addition, the study examined the effectiveness of students' goal setting, self-monitoring, and self-evaluation during project learning; in particular, their collaborative involvement, and discipline as communication and problem solving. The participants, middle school students (8) at the American School of Douala, Cameroon, participated in a teacher-designed 14-week social skills intervention block in which students learned the process of working together, rule setting, respect for self and others, and engagement in academic work. Data collected by observation, interviews, checklists, and self-reports were analysed interpretively using descriptive statistics (counts). The results indicated that students' understanding and adoption of basic intrapersonal and interpersonal concepts, and their participation in, and practice of, procedural routines served to create both self-motivated learners and a culture of caring. Similar findings emerged when this study was replicated in one public school with a larger sample (40), in Douala. These results were shared with teachers, parents, and community members who are concerned about the school/classroom learning environment. These results have implications for teacher professional development, student leadership, and school policy in the educational system in Cameroon.

Chinyere Mary Ibe
The College of New Jersey Graduate Programs in Education, Johannesburg, South Africa (Ruth J. Palmer, Faculty Adviser)

The Town Crier and His Communications: Theatre and Reality
Presented at the Association for International Schools in Africa (AISA) West Africa Teachers' Conference, Accra, Ghana, October 19-22, 2002

The town crier is a functionary of the King and/or Council of Elders, who delivers messages to the populace in the towns and rural communities. The study aimed to analyse the activities of the town crier in three communities in Nigeria: Mbieri, an autonomous community of 19 villages; Obudu, an urban

community with 36 villages, and the Ile-Ife community. Another purpose was to evaluate a program using identified communication strategies to improve classroom communications in the International Community School of Abidjan, Côte d'Ivoire. This investigation addressed (a) the historical and social structures that precipitated the emergence of the town crier in rural communities; (b) what the community members and traditional rulers indicated as the distinctive communication strategies and techniques adopted by the town crier; (c) an evaluation of the impact of the town crier in the social development of the communities; and (d) the design of a communicative program based on the strategies and techniques of the town crier for improving teacher-student communication. Data were collected using interviews and observations of ritualised presentations; these were analysed using backward mapping, and triangulating. The findings indicated that the town crier originated in community communication needs; that the town crier originally thought to be male did have a female counterpart who provided services to women; and that the town crier, while adept at incorporating dramatic stances, song, and musical instruments, further embellished his medium by his own creative actions. Additionally, it was established that the town crier was given high status in the community. Since he represented the king, communities compensated him/her with food, lodging, clothes, and goods. These results were incorporated into a series of classroom experiences including cultural information, role-playing, rule-making, and critical thinking for international students. Students and teachers rated their experiences as informative and effective.

Jane Sparks
The College of New Jersey Graduate Programs in Education, Johannesburg, South Africa
(Ruth J. Palmer, Faculty Adviser)

Teacher Study, Inquiry, and Practice: Pathways to Understanding Pre-Kindergarten Students' Developing Understandings About Print Concepts

Presented at the Association for International Schools in Africa (AISA) Southern Africa Teachers' Conference, Mbabane, Swaziland, October 18-21, 2001

A two-part workshop presentation reported the findings of a research study that focused on the knowledge of, and developing understandings about, print concepts of pre-kindergarten students at an international school (Masters' Thesis, July 2001). The first session introduced the processes of teacher study, inquiry, and practice as pathways to a focused area of a teacher's interest. The second session reported the findings of an investigation of pre-kindergarteners' knowledge and understanding of print concepts across the school year.

Jane Sparks
The College of New Jersey Graduate Programs in Education, Johannesburg, South Africa
(Ruth J. Palmer, Faculty Adviser)

Pre-Kindergarten Students' Awareness of Print: an Ethnographic study across the first year of Formal Schooling at an International School

Presented at the Association for International Schools in Africa (AISA) Southern Africa Teachers' Conference, Mbabane, Swaziland, October 18-21, 2001

This qualitative study investigated the knowledge of, and developing understandings about, print concepts of pre-kindergarten students at the American International School of Johannesburg, South Africa. An ethnographic approach with multiple embedded case studies was used to investigate parent roles and the impact of early experiences. Clay's *Concept about Print Observation Tasks* (1993) was used, taking

into account social, cultural, and linguistic backgrounds. Parent interviews, checklists, researcher field notes, student drawings, and photographs supplied further data. Data from the case studies were analyzed using an interpretational and reflective approach, while the overall ethnographic data were examined using the comparative method of analysis. The results suggested that: (a) students had developing and varied print understandings, depending upon prior experiences; (b) all parents believed their role was important in facilitating early literacy; (c) with some adjustments, the assessment tool was appropriate for pre-kindergarten students. The extension intervention study investigated (1) parents' further involvement with their children's developing literacy after participating in a series of workshops related to print awareness; and (2) kindergarteners' perceptions of fourth graders' modelling of reading and writing in a teacher-designed service learning project. Parents participated fully in all sessions and reported their increased knowledge of how to help their children; both the fourth grade models and the pre-kindergarten students have established friendship bonds based on their learning.

Henry F. Fradella, Lauren O'Neill, and Adam Fogarty
The College of New Jersey
(Henry F. Fradella, Faculty Sponsor)

The Impact of Daubert on Forensic Science
Presented at the Academy of Criminal Justice Sciences, Boston, MA, March 5-8, 2003

With its 1993 decision in Daubert v. Merrill Dow Pharmaceuticals, Inc., the United States Supreme Court altered the landscape for the admissibility of scientific evidence in federal courts. In the years that followed, Daubert was extended to all types of expert testimony. Daubert has had a profound impact on many types of forensic evidence, especially on the forensic sciences. Using both quantitative and qualitative content analysis, this study examines federal judicial opinions applying Daubert to various forensic scientific techniques, such as fingerprinting, polygraphing, and voice print analysis from the time Daubert was decided by the Supreme Court through 2002. A typology of the ways in which Daubert has been applied in the forensic sphere is presented, and the policy implications for forensic science are explored.

Timothy Duva and Henry F. Fradella
The College of New Jersey
(Henry F. Fradella, Faculty Sponsor)

Judicial Views of the Social Science Researcher's "Black Arts"
Presented at the Academy of Criminal Justice Sciences, Boston, MA, March 5-8, 2003

Socio-legal literature, from the writings of the legal realists of the early 20th century to modern critical legal theorists, is replete with denunciations of legal formalism in judicial decision-making. Some of this literature advanced the law's understanding of itself, contributing, in part, to the acceptance of social science findings as substantive evidence in constitutional fact-finding, as illustrated by Brown v. Board of Education. But in the 1980s and 1990s, judges became increasingly hostile to social science research, a fact best exemplified by McCleskey v. Kemp. In an attempt to explain this shift, a content analysis was conducted of published federal judicial decisions in which social science research was offered as evidence. Based upon both quantitative and qualitative comparisons between favorable and unfavorable judicial treatment of social science research, this paper posits that the modern shift of the judiciary away from social science research is caused, in part, by the social sciences' shift away from Karl Popper's views of science, especially those that are manifest in social constructionism and cultural relativism.

J. E. Burgents and D. L. Lovett
The College of New Jersey
(D. L. Lovett, Faculty Sponsor)

Is the increase in Na^+, K^+-ATPase activity observed during hyperosmoregulation in the blue crab Callinectes sapidus *due to stimulation of translation?*

Presented at the Annual Meeting of the Society of Integrative and Comparative Biology, Anaheim, CA, January 2-6, 2002

Estuarine crabs, such as the blue crab *Callinectes sapidus*, hyperosmoregulates in diluted seawater through transport of ions across the gill epithelium by the enzyme Na^+, K^+-ATPase (ATPase). It has been well documented that the relative activity of ATPase in gills is higher in crabs acclimated to low salinity than in crabs acclimated to high salinity. In previous studies, we have shown that ATPase activity in gill homogenates increases significantly by 4 days after transfer to diluted seawater and reaches a maximum between 6 and 8 days. By the time the crab has acclimated to low salinity (approximately 18 days after transfer) the activity has decreased slightly from this maximum. This increase in activity during acclimation to low salinity may be caused by synthesis of new enzyme or activation or deinhibition of existing enzyme. Using immunological techniques to quantify the amount of α5-subunit of ATPase present, we determined that the amount of ATPase in gill tissue changes in a pattern that is reflective of the pattern observed for change in ATPase activity. This trend was observed using both the total amount of protein in the homogenate and the amount of actin in the homogenate to control for variations in homogenation or dilution of samples. Thus, the amount of ATPase protein present does appear to change during acclimation. We currently are attempting to measure the relative amount of mRNA coding for the α-subunit of ATPase to determine whether significant change in mRNA expression occurs during acclimation to diluted seawater.

C. A. Tanner, T. M. Ricart, D. W. Borst, and D. L. Lovett
The College of New Jersey
(D. L. Lovett, The College of New Jersey and Mt. Desert Island Biology Lab., Salisbury Cove, ME, and D. W. Borst, Illinois State University, Faculty Sponsors)

The effect of osmotic conditions on methyl farnesoate levels in the green crab, Carcinus maenas.

Presented at the Annual Meeting of the Society of Integrative and Comparative Biology, Toronto, ONT, January 4-8, 2003

We have shown previously that stress can increase methyl farnesoate (MF) levels in crustaceans. One type of stress that is particularly effective is exposure to diluted seawater. For example, transfer of green crabs (*Carcinus maenas*) from full-strength seawater (32 ppt) to diluted seawater (5 -15 ppt) causes a rapid and chronic rise in hemolymph levels of MF that are inversely related to decreases in salinity. In the present study we tested whether this increase in MF was due to osmotic or ionic stress by acclimating male crabs in mixtures of seawater and mannitol (added to increase the osmotic but not the ionic concentration of the solution). Hemolymph osmolality was low (548 ± 20 mOsm/kg) (mean ± SE) in diluted seawater (5 ppt; 170 mOsm/kg); hemolymph osmolality was normal (~ 850-950 mOsm/kg) in diluted seawater with mannitol (final osmolality 820 mOsm), isosomotic seawater (27 ppt, 830 mOsm/kg), and 20 ppt seawater with mannitol (final osmolality 985 mOsm/kg); hemolymph osmolality was elevated (1462 ± 6 mOsm/kg) in concentrated seawater (50 ppt; 1490 mOsm/kg). In contrast, levels of MF in the hemolymph were elevated only in animals maintained in diluted seawater (four-fold increase in MF above basal levels) or in diluted seawater with mannitol (three-fold increase), and were normal in the other solutions. Thus, our results indicate that MF levels in the crab rise in response to hypo-ionic conditions, and not in response to hypo-osmotic or to hyper-osmotic conditions. Ion substitution studies currently are being

conducted to determine which specific ion(s) may affect MF levels. (Supported by MDIBL NIA Fellowship to DLL, NIH grant HD37953 to DWB, and NSF REU Site at MDIBL DBI-0139190).

D. L. Lovett, T. M. Ricart, C. A. Tanner, and D. W. Towle
The College of New Jersey
(D. L. Lovett, The College of New Jersey and Mt. Desert Island Biol. Lab., Salisbury Cove, ME, Faculty Sponsor)

Chronic exposure of the blue crab, Callinectes sapidus, *to low salinity stimulates expression of Na^+, K^+-ATPase _-subunit mRNA and protein in gills*

Presented at the Annual Meeting of the Society of Integrative and Comparative Biology, Toronto, ONT, January 4-8, 2003

When estuarine crabs are transferred from high to low salinity, the specific activity of Na+, K+-ATPase (ATPase) in homogenates of posterior gills increases. In the blue crab, *Callinectes sapidus*, there is a slight increase in ATPase activity within 24 hours following transfer, but substantial increase is not observed until 4 days after transfer. Maximal ATPase activity is reached by 8 days following transfer, and then activity decreases slightly by 18 days (when the crab has acclimated fully). Using Western blot analysis, we have shown previously that the amount of ATPase _-subunit protein in gill homogenates changes during acclimation in a pattern that is reflective of that observed for change in ATPase activity. This trend was observed using either total protein or actin to normalize results. To assess whether the increase in protein expression was caused by an increase in gene expression, we now have quantified ATPase _-subunit mRNA from posterior gill homogenates using real-time PCR. When the concentration of ATPase mRNA is normalized using the concentration of actin mRNA in each sample, the same pattern as that observed for acclimation changes in both ATPase activity and _-subunit protein expression is obtained. Although levels of actin mRNA increase two-fold at 24 hours and then decrease, the pattern of ATPase mRNA levels remains similar even when values are not normalized. These results suggest that changes in concentrations of ATPase mRNA in the gill may effect the change in ATPase activity that is observed during acclimation of crabs to low salinity. (Supported by MDIBL NIA Fellowship to DLL, NSF grant DBI-0100394 to DWT, and NSF REU Site at MDIBL DBI-0139190).

Romulo Ochoa, Michael Arief, The College of New Jersey and Joseph H. Simmons University of Arizona
(Romulo Ochoa, Faculty Sponsor)

Computer Simulation Studies of Fracture in Vitreous Silica

Presented at the Materials Research Society Spring Meeting, San Francisco, CA, April 3, 2002

We conducted molecular dynamics computer simulations of fractures in silica glass using the van Beest, Kramer, and van Santen model. Stress is applied by uniaxial strain at different pulling rates. Comparisons with previous fracture simulations of silica that used the Soules force function are presented. We find that in both models stress is relieved by rotation of the $(SiO4)^{-2}$ tetrahedrons, increasing Si-O-Si bonding angles, and causing only small changes in the tetrahedron dimensions and O-Si-O angles.

Jamie Bartletta, Kathryn DeTurk, Lindsay Warren, and John C. Pollock
The College of New Jersey
(John C. Pollock, Faculty Sponsor)

Nationwide Newspaper Coverage of Charter Schools: A Community Structure Approach

Presented at the annual conference of the National Communication Association, Atlanta, GA, November 3, 2001

Charter schools are independently initiated schools that must meet state levels of

proficiency in key academic areas. Proponents of charter schools see them as alternatives to the failing public school systems in their area. Opponents of charter schools believe that attention and funds allocated to charter schools should instead be directed to mending ailing public school systems.

Using the "community structure approach," elaborated in nationwide studies conducted by Pollock and others (1977, 1978, 1994-2001), this study compared hypotheses on different city characteristics and newspaper coverage of charter schools.

A national cross-section sample of 21 newspapers was drawn from the DIALOG newspaper database, sampling all articles 500 words or longer on the topic printed between Jan. 1, 1998, and Jan. 1, 2000. The resulting total of 425 articles was analyzed using content analysis. A single score, Pollock's Media Vector, was calculated for each newspaper to combine prominence given to each article as well as reporting direction (favorable, balanced/neutral, or unfavorable), and the results ranged from -.403 to .298, demonstrating clear national variation.

Pearson correlations confirmed "buffer" and "lifecycle position" hypotheses. Pollock's "buffer hypothesis" expects that the greater the percent of privileged groups in a city, the more favorable the coverage of human rights claims, in this case charter schools. The "lifecycle position" stakeholder hypothesis expects that the higher the proportion of young children in a city, the more favorable the coverage. Pearson correlations revealed several measures of "privilege" linked with favorable Media Vectors: percent in professional/technical occupations ($r = .785$, $p = .000$); median income ($r = .546$, $p = .005$); percent of women in the workforce ($r = .492$, $p = .012$); and percent of households with incomes of $100,000+ ($r = .362$, $p = .053$). Pearson correlations also linked two measures of "lifecycle position" with favorable Media Vectors: percent of households with children 5-7 ($r = .477$, $p = .014$), and percent of households with children 5-17 ($r = -.405$, $p = .034$). Regression analysis further supported the "buffer hypothesis," with professional/technical occupations, median income, and wealth of households cumulatively accounting for approximately 74% of the variance.

Charles Auletta, Adrian Castillo, Susan Haderer, Michael C. Bobal, and John C. Pollock
The College of New Jersey
(John C. Pollock, Faculty Sponsor)

Nationwide Newspaper Coverage of the Death Penalty: A Community Structure Approach
Presented at the annual conference of the National Communication Association, Atlanta, GA, November 1-4, 2001

While some groups support the use of capital punishment as just retribution for heinous crimes, other groups abhor its use as cruel and unusual. This study on capital punishment maps the way newspapers from a national cross-section of cities across the United States vary in coverage of the death penalty. Using a "community structure approach" elaborated by Pollock and others (1977, 1978, 1994-2001), key city characteristics are systematically linked to newspaper reporting on critical issues, in this case capital punishment.

A sample of all newspaper articles on the topic 500 words or more in length, published in a national cross-section of 15 newspapers, was collected from the period January 1, 1997, through November 30, 1999, yielding 300 articles. Content analysis combined the amount of "prominence" given to an article (its placement, headline size, story length, and presence of photographs) and the "direction" of the article into a single score for each newspaper selected: Pollock's Media Vector. Media Vectors ranged from .283 to -.128, showing nationwide variation.

Pearson correlations and multiple stepwise regressions revealed strong relationships between city characteristics and newspaper reporting. Measures of "media access" such

as number of AM radio stations in a city (r =.728; p =.001) and number of cable television stations in a city (r =.494; p =.031) were linked to favorable coverage of the death penalty. Conversely, measures of "vulnerability," violent crime rate in a city (r = -.714; p =.005) and the unemployment rate (r = -.477; p =.036) displayed an unfavorable relationship with coverage of the death penalty. AM radio alone accounted for 52% of the variance in the multiple stepwise regression. When coupled with poverty, 75% of the total variance is explained.

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Comparing Nationwide Newspaper Coverage of FDA Regulation of Tobacco: A Community Structure Approach

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Although the use of tobacco and tobacco products has been described as the single most significant preventable cause of death in the United States, it is still a habit practiced by millions of adults and children. Accordingly, the Food and Drug Administration has attempted to regulate the production and selling of tobacco products. A study was conducted to examine the effect society has on the reporting of this issue, linking city characteristics to media coverage.

Using the community structure approach, elaborated by Pollock and others (1977, 1978, 1994-2001), this study suggests that the structures of communities, certain demographics in particular, are linked systematically to news coverage of critical issues, in this case FDA attempts to regulate tobacco. Using the DIALOG database, a sample of all articles 400 words or more was drawn from newspapers in 15 major cities nationwide between the years 1993 and 2000, yielding 272 articles. Content analysis was conducted combining article "prominence" (placement, headline size, word count, and presence of graphics) and "direction" (favorable, unfavorable, or balanced/neutral) to yield a single score, Pollock's Media Vector, which varied widely throughout the nation, ranging from .246 to -.303.

Pearson correlations and regression analysis revealed two patterns. One can be called a "partisan" stakeholder pattern. The higher the percentage of those voting Democratic in the 1996 presidential election, the more favorable the coverage of FDA regulation of tobacco (r = -.684; p =.002). However, the higher the percentage of voting Republicans in the '96 election, the more unfavorable the coverage of FDA regulation (r = -.622; p = .007). A second pattern can be called a "lifestyle autonomy" pattern. Specifically, the higher the percentage of women in the workforce (r. = -.637; p = .005), or percent with professional/technical occupations in a city (r = -.609; p =. 008), the more unfavorable the coverage of FDA regulation of tobacco or nicotine. The third pattern is an "access" pattern: The higher the percentage of people who have access to cable (r =. 433; p = .054), the more favorable the coverage of FDA regulation. The partisanship and access patterns are consistent with other community structure studies on a Patients' Bill of Rights and Social Security privatization, while the new "lifestyle autonomy" pattern deserves further study.

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Nationwide Newspaper Coverage of Gun Control since Columbine: A Community Structure Approach

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After the attempted assassination of President Reagan, a modern debate surfaced

over the need for further gun control laws. While many bills bogged down in Congress, the debate was losing steam until school shootings occurred at places such as Columbine, Jonesboro, and the Detroit shooting of six-year-old Kayla Rolland by a classmate. While the topic of gun control is so heated as to spark the Million Mom March on Washington, database searches reveal little research attempting to examine gun control as a communication issue. Using the community structure approach developed into multiple nationwide studies by Pollock and others (1977, 1978, 1994-2001), this study proposes that certain demographic characteristics of communities (such as cities) are linked to newspaper reporting on critical issues; in this case, gun control.

A nationwide sample of 21 newspapers was selected from the DIALOG newspaper database. All articles over 300 words printed between January 1999 and November 2000 on gun control legislation were chosen from a national cross-section of 21 newspapers nationwide. The resulting 420 articles were analyzed using a special method of content analysis combining both "prominence scores" and the "direction" of each article. The prominence score was based upon the placement, headline size, article length, and the presence of graphics. Article direction was coded as favorable, unfavorable, or balanced/neutral toward the issue of gun control. These two scores were combined mathematically to yield a Media Vector, ranging from .500 to -.058, demonstrating substantial differences in coverage across the nation.

Pearson correlations, measuring links between city characteristics and coverage of gun control legislation, yielded nine significant findings in three different clusters. The "stakeholder" cluster yielded one significant finding with percent of hunting or shooting frequently linked to negative coverage of gun control ($r = -.374$; $p = .047$). Three findings can be clustered into Pollock's "violated buffer" hypothesis, suggesting that handgun use threatens society physically and in terms of a "cherished way of life" (Pollock, in Frey, Botan, & Kreps, 2000, p. 239). Linked to favorable coverage of gun control are the following city characteristics: percent of four or more years of college ($r = .399$; $p = .037$); percent of professional/technical workers ($r = .388$; $p = .041$), and percent with income over $100,000 ($r = .519$; $p = .008$). Most significant is the "lifecycle position" cluster, in which the percentage of families with children is linked to unfavorable coverage of gun control: percent of single parents ($r = -.538$; $p = .006$); households with children ages 8-10 ($r = -.505$; $p = .010$); 11-12 ($r = -.512$; $p = .009$); 13-15 ($r = -.552$; $p = .005$); and finally, most significantly, households with children ages 16-18 ($r = -.681$; $p = .000$). Since family size and single parenthood correlate strongly with poverty levels, a "vigilante" hypothesis is forwarded, suggesting that those who are by several definitions most vulnerable and lacking in resources or protection may regard gun ownership as an essential component of self-reliance.

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Nationwide Newspaper Coverage of Privacy on the Internet: A Community Structure Approach
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Although e-commerce has simplified individuals' lives with its convenience and accessibility, it has also sparked a heated debate over whether a person's information being transferred over the Internet is a private matter. Proponents of regulation that would protect Internet users believe that by governing the transmission of this data individuals would be safeguarded against such computer "evils" as electronic mass-mailings (spamming), telemarketing, credit card theft, and viruses. On the other hand, opponents trust that the e-commerce companies can regulate

themselves and that the information sent over the World Wide Web should be accessible to all users.

Using the "community structure approach," elaborated in nationwide studies by Pollock and others (1977, 1978, 1994-2001), this study suggests that certain demographic structures of a community are systematically linked to newspaper reporting on critical issues, in this case Internet privacy.

A national cross-section sample of 21 newspapers was selected from the DIALOG newspaper database, and a sample of all articles on the topic over 350 words long in each newspaper was drawn from January 27, 1996, to November 7, 2000. The resulting total of 495 articles was analyzed using content analysis. A single score, Pollock's Media Vector, was calculated combining attention prominence given to each article as well as reporting direction (favorable, balanced/neutral, or unfavorable). Resulting Media Vectors (ranging from .211 to -.137) demonstrated clear variation. Pearson correlations revealed two city characteristics had a significant relationship to newspaper coverage: a measure of "vulnerability" —percent below the poverty line ($r = .377$; $p = .046$) correlated with favorable coverage of Internet regulation; yet a measure of "privilege"—percent in technical/professional occupations ($r = -.372$; $p = .048$), correlated with unfavorable coverage, confirming a "violated buffer" hypothesis: Privilege is associated with unfavorable coverage of threats to a cherished way of life (Pollock in Frey, Botan, & Kreps, 2000, p. 239). Factor analysis of city characteristics revealed that "vulnerability" and "lifecycle position" were noteworthy because regression analysis revealed the characteristics "families with children under 18" and "percent below the poverty line" in a city accounted for nearly 30 percent of the variance in coverage of Internet privacy regulation.

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Adult Crime...Adult Time: The Debate Over Juvenile Sentencing: National Newspaper Coverage of Trying Juveniles as Adults: A Community Structure Approach

Presented to the Applied Communication Division at the annual conference of the National Communication Association, Atlanta, GA, November 1-4, 2001

Those who favor trying juveniles as adults believe the potential of much harsher treatment and sentences will serve as a deterrent, whereas the opposition argues that the primary purpose of the juvenile justice system should be rehabilitation, not retribution. Interestingly enough, a surge in media coverage of crimes by juveniles comes at a time when the juvenile crime rate is actually decreasing. The potential exists, therefore, for a significant public misperception concerning the seriousness and extent of crimes by juveniles. It is therefore reasonable to ask: Is the media's reporting on the issue of juvenile crime skewed in a way that fosters or promotes this misperception?

Using the community structure approach elaborated in nationwide studies by Pollock and colleagues (1977, 1978, 1994-2001), this study suggests that important community characteristics are linked to newspaper reporting on critical issues, in this case trying juveniles as adults. A sample of 25 newspapers from a geographic cross-section of the United States was drawn from the DIALOG newspaper database, including all articles 250 words or longer, printed from January 1, 1996, to December 1, 2000. The resulting 403 articles were content-analyzed to combine the "prominence" given to each article (placement, headline size, article length, and number of graphics/photos) and "direction" (favorable, unfavorable, balanced/neutral), to yield a single score, Pollock's Media Vector (Frey, Botan, & Kreps, 2000, p. 238).

Media Vectors ranged from .409 to -.294, evidence of national variation in reporting on trying juveniles as adults. Pearson correlations revealed significant correlations between Media Vectors and two types of characteristics: stakeholder partisanship and lifecycle position. Regarding political partisanship, percent voting Democratic in the 1996 election correlated with negative coverage of trying juveniles as adults ($r = .539$, $p = .003$), while percent voting Republican correlated positively ($r = .340$, $p = .048$). Regarding lifecycle position, percent retired in a city correlated negatively with trying juveniles as adults ($r = .384$, $p - .029$), while percent of families with children ages 5 to 7 (perhaps those with children at risk from older juveniles or with children not yet at juvenile crime-risk age) correlated positively with the topic. Multiple stepwise regression showed the combination of Democrats, retired persons, and Republicans accounted for a total of 43% of the statistical variance. These results suggest that the issue of trying juveniles as adults is highly partisan, with Democratic voting correlating with negative coverage of trying juveniles as adults and Republican voting correlating with favorable coverage. These correlations suggest that there is a link between certain key demographics in a city and newspaper coverage on issues of public policy and social change.

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Nationwide Newspaper Coverage of School Voucher Initiatives: A Community Structure Approach

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Many legislatures across the country are proposing school voucher programs in order to make the nation's schools better. School voucher plans provide every student with the opportunity to attend the public or private school of his or her choice by providing federal tax dollars in the form of vouchers, which typically range from $2,000 to $4,000 per student per year. Those in support of school vouchers argue that such plans will promote competition among public schools and will allow low-income residents to send their children to schools with stronger academic programs, which also tend to be more expensive. Those opposed to school voucher plans claim money will be siphoned from the public schools, hurting those left behind, or perhaps that voucher programs are unconstitutional, since they allow parents to send their children to private schools with federal tax dollars.

Using the "community structure approach," tested in nationwide studies by Pollock and others (1977, 1978, 1994-2001), this study suggests that certain demographic structures of a community are systematically linked to newspaper reporting on critical issues, in this case, school vouchers. A national cross-section of newspapers from 20 cities was selected from the DIALOG newspaper database and a sample of all articles over 250 words on the topic published between January 1, 1993, and November 1, 2000, was drawn. The resulting total of 378 articles was analyzed using content analysis. A single score, the Pollock Media Vector, was calculated to combine prominence given to each article and reporting direction (favorable, balanced/neutral, or unfavorable). The resulting Media Vectors (ranging from .048 to -.189) displayed national coverage variation. Pearson correlations tested the link between different city characteristics and coverage. One city characteristic had a significant relationship to newspaper coverage: A measure of "access to media" —number of AM radio stations ($r = -.432$; $p = .028$) correlated with negative coverage, supporting hypotheses linking density of AM radio stations with general resistance to social change, consistent with other community structure studies of coverage of capital punishment and a Patients' Bill of Rights.

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Nationwide Newspaper Coverage of Women in Combat: A Community Structure Approach
Presented at the annual conference of the National Communication Association, Atlanta, GA, November 1-4, 2001

Until the last decade, the U. S. military was overwhelmingly a masculine organization. However, with rising interest nationwide in women's equality, some women are demanding that the military update its forces with the enrollment of female officers in combat positions.

Women in combat evokes a number of issues, from chivalric principles to physiological standards. As the armed forces, government, and women's rights groups address this debate, media have the responsibility accurately to report this discourse to the rest of the nation. This study examines varied U. S. newspaper coverage of women in combat in association with selected demographics in 15 cities across the United States, a methodology called "community structure approach." Building on past research using a community structure approach, tested nationwide by Pollock and colleagues (1977, 1978, 1994-2001), expecting a strong correlation between newspaper coverage of high-profile news stories and the social structure and demographics of communities, this study examines variations in media portrayals of women in combat.

A sample of newspaper articles over 500 words long from a national cross-section of 20 cities was drawn from the DIALOG newspaper database, collected from January 1, 1997, to January 1, 2000. A total of 387 articles was coded for prominence (placement, article length, headline size, and presence of photographs) and direction (favorable, unfavorable, or neutral reporting) to yield a single score—the Pollock Media Vector—for each city newspaper. This score was then compared with demographics of the cities served by the newspapers (Frey, Botan, and Kreps, 2000, pp. 238-239).

Using Pearson correlations, one city characteristic emerged as statistically significant in its association with widely varied newspaper reporting on women in combat. Nationwide, family incomes of more than $100,000 are linked strongly to newspaper coverage negatively portraying women's involvement in combat ($r = -.962$; $p = .000$). Multiple stepwise regression analysis further verified that income over $100,000 accounted for 92% of the variance in newspaper coverage. The association between income and negative coverage of women in combat illustrates Pollock's "violated buffer" hypothesis, in which privilege is linked to unfavorable reporting on biological threats or threats to a cherished way of life (Frey, Botan, & Kreps, 2000, p. 239).

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Nationwide Newspaper Coverage of Diet Drugs: A Community Structure Approach
Presented to the Health Communication Division of the International Communication Association, Seoul, South Korea, July 2002

The issue of diet drug usage has become highly controversial throughout the United States. While some Americans, such as the obese and the pharmaceutical companies, believe the benefits of diet drugs substantially outweigh the possible consequences of the side effects, opponents of the drugs argue that these side effects are far more dangerous than believed by the general public.

In this study, primary research was conducted to investigate how newspapers from various cities in the United States reported on the issue of diet drugs. The study compared hypotheses based on different city characteristics and newspaper coverage of diet drugs 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 colleagues (1977, 1978, 1994-2002), suggesting that certain demographic structures of a community are systematically linked to newspaper reporting on critical issues.

A national cross-section collection of 15 newspapers was selected from the DIALOG newspaper database, and a sample was drawn of all articles 150 words or longer published between June 1, 1997, and June 1, 1998, on diet drug use. The resulting total of 233 articles was analyzed using content analysis. A single score, the Media Vector, was calculated combining the "prominence" given to each article and reporting "direction" (favorable, balanced/neutral, unfavorable). The resulting Media Vectors ranged from -.041 to -.858, demonstrating widespread negative nationwide coverage of diet drugs. Pearson correlations and regression analyses were used to test links between different city characteristics and coverage of diet drugs.

Three umbrella hypotheses appear confirmed, two suggesting the presence of health-conscious "stakeholders," the third, a manifestation of media access. Health-conscious "stakeholders" are represented by the number of nutrition centers and percent of city residents between ages 18 and 24, both linked to unfavorable coverage of diet drugs as perhaps a relatively less healthy way of losing weight and promoting health. "Media access" is represented by newspaper circulation size: The greater the newspaper circulation, the less favorable the newspaper coverage of diet drugs, suggesting that the greater the range of newspaper reach in a city, the more likely newspaper audiences (typically well-educated or influential) are to access information on the impact of diet drugs on health. Regression analysis of these characteristics further showed that these three variables accounted for 59 percent of the total variance (with the number of nutrition centers accounting for 32 percent) of newspaper coverage on the topic of diet drugs.

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Responding to the Events of September 11th: The Role of Psychosocial Identity and the Need for Affect

Presented at the meetings of the Society for Research on Identity Formation, New Orleans, LA, April 11, 2002

Responses to the terrorist attacks on September 11 were studied in a sample of college students. At about the one-month anniversary of the attacks, participants completed (a) the September 11 Response Questionnaire, (b) the Extended Objective Measure of Ego Identity Status, and (c) the Need for Affect Scale. The main areas of interest were Emotional Distress (reactions ranging up to post-traumatic stress disorder), Repression- Sensitization, and Anger (including the desire to retaliate). The questionnaires were distributed during group sessions. The approximate length of time of completion was 45 minutes. Participants were given a debriefing form which listed the phone number and office hours of the campus counseling services in case they felt any emotional distress because of the subject matter of the research. There were a total of 148 participants, which included 36 males and 112 females. Overall, the level of emotional distress dropped dramatically from 9/11 to the one-month anniversary, while the level of anger remained constant. Also, the level of sensitization moderated from 9/11 to the one-month anniversary. Identity Achievement was significantly related to higher levels of emotional distress in response to the attacks but lower levels of defensiveness. The opposite pattern was found for Identity Diffusion. Identity Achievement was associated with a significantly higher need for affect in general, while Identity Diffusion was associated with the avoidance of strong affect.

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